DOCUMENT HISTORY

S.E.F
STRATEGIC ENVIRONMENTAL FOCUS

Revision History

Revision No	Revision Date	Author	Reviewer	Summary of Changes	File Name
1	February 2011	Anèl Dannhauser / Milicent Solomons	Mirenda Moremedi / Nico Swart / Leon Boshoff	Technical input	503918 WP 2 BAR 2010.11.25 draft for team review.doc
2	February 2011	Anèl Dannhauser	Milicent Solomons	Integration of technical team comments	503918 WP 2 BAR 2011.02.24 draft for public review.doc

Approval for Release

Name	Title	Signed
M. Solomons	Project Manager	MSolomons

Distribution

Designation	Name	Date
Department of Environmental Affairs	Reggy Nkosi	25 February 2011
Mpumalanga Department of Economic Development, Environment and Tourism	Bheki Mndawe	25 February 2011
Department of Water Affairs	Madi Moloto Stanford Macevele	25 February 2011
Department of Mineral Resources	Sonia Chipu Martha Mkonyane	25 February 2011
General public: Interested and Affected Parties		25 February 2011
Bigen Africa Services	Leon Boshof Dieter Storbeck Nico Swart Rudi West	25 February 2011
Eskom Holdings	Mirenda Moremedi	25 February 2011
SANRAL	Mpati Makoa	25 February 2011
SAHRA	Dumisani Sibayi	25 February 2011

DRAFT BASIC ASSESSMENT REPORT

WORK PACKAGE 2 – N11 BETWEEN HENDRINA AND ERMELO: REHABILITATION OF NATIONAL ROUTE 11 BETWEEN ERMELO AND HENDRINA AND R38 BETWEEN HENDRINA AND THE R542

Department of Environmental Affairs Reference Number: 12/12/20/2078

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SEF Ref. 503918

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

	(For official use only)
File Reference Number:	12/12/20/2078
Application Number:	DEAT/EIA/
Date Received:	

Basic assessment report in terms of the Environmental Impact Assessment Regulations, 2010, promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.

Kindly note that:

1. This **basic assessment report** is a standard report that may be required by a competent authority in terms of the EIA Regulations, 2010 and is meant to streamline applications. Please make sure that it is the report used by the particular competent authority for the activity that is being applied for.

2. The report must be typed within the spaces provided in the form. The size of the spaces provided is not necessarily indicative of the amount of information to be provided. The report is in the form of a table that can extend itself as each space is filled with typing.

3. Where applicable **tick** the boxes that are applicable in the report.

4. An incomplete report may be returned to the applicant for revision.

5. The use of "not applicable" in the report must be done with circumspection because if it is used in respect of material information that is required by the competent authority for assessing the application, it may result in the rejection of the application as provided for in the regulations.

6. This report must be handed in at offices of the relevant competent authority as determined by each authority.

7. No faxed or e-mailed reports will be accepted.

8. The report must be compiled by an independent environmental assessment practitioner.

9. Unless protected by law, all information in the report will become public information on receipt by the competent authority. Any interested and affected party should be provided with the information contained in this report on request, during any stage of the application process.

10. A competent authority may require that for specified types of activities in defined situations only parts of this report need to be completed.

EXECUTIVE SUMMARY

Eskom has embarked on a road repair programme to address the current unsafe conditions on the roads that are currently servicing their power stations (i.e. Camden, Hendrina and Majuba). The relevant roads currently carry a significant load of traffic, specifically heavy vehicles like coal trucks transporting coal to the Eskom power stations. As a result, the road surface has deteriorated, which may lead to unsafe conditions on the road and high vehicle operation costs.

NETGroup Consortium (a coalition of companies consisting of, among others, Bigen Africa Services (Pty) Ltd and Strategic Environmental Focus (Pty) Ltd (SEF)) was appointed by Eskom to undertake the engineering and environmental service components of the project.

The project involves the upgrading and rehabilitation of a section of the R38 and N11 between Hendrina and Ermelo. This road section starts at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo, Mpumalanga Province. Refer to Figure 1 in Appendix A.

The length of road for the total project is 49.83 km for the N11 and 4.88km for the R38 respectively. The current road prism is approximately 13.4m wide. The existing pavement surface is in a poor condition with many patched areas. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The final surfaced road width will be approximately 14.2m and the road prism 16m. The preferred alternative for the proposed road upgrade is a construction method constituted of road widening along the existing alignment to allow half width construction; without limiting traffic flow.

Potential negative impacts anticipated due to the implementation of this alternative includes:

- During the construction phase: noise, visual, possible deterioration in air quality and ecological impacts will occur. Impacts will occur throughout the construction phase but can be mitigated by continuous maintenance, vigilance and rehabilitation during, and after, completion of the construction period.
- During the operational phase: continued visual and minimal noise impacts will occur. Ecological impacts will also occur, should proper mitigation measures not be taken, and the proposed ecological management plan not be implemented.

The specialist reports; i.e. Aquatic Assessment, Wetland Assessment, Fauna and Flora Assessments have been included in Appendix D. The key findings of the specialists' studies are:

- Flora Assessment Findings:

The majority of the N11 road section is situated within the Eastern Highveld Grassland vegetation unit, while a middle portion of the N11 road section is situated within the Soweto Highveld Grassland. Both these vegetation units are under threat and the remaining portions (that are not disturbed), should thus ideally be avoided and conserved.

In terms of the vegetation composition, the areas that will be affected by the road upgrade activities comprise areas of medium and medium to high sensitivity. The higher sensitivity ratings are either as a result of the occurrence of plants of conservation concern, protected plants and/or moist grasslands and riparian areas that have a high ecological function in the landscape.

The road upgrade activities along the N11 from Hendrina to Ermelo are anticipated to impact on the existing road verges which are mostly colonised by typical grassland vegetation and in a secondary / sub climax state. However, the road upgrade will also traverse through moist grasslands and streams which are habitat to protected plant species. Where the upgrade activities occur within the moist grasslands and streams, the mitigation measures must be strictly applied in order to limit destruction to these habitats.

- Fauna Assessment Findings:

Faunal habitats that fell within the shoulder of the road were already heavily disturbed with very little chance of sustaining functional faunal communities. Long grasses and vegetation that are present along fences could, however, provide cover for specifically rodent species that occasionally forages there. The most important habitat types along the road were two water crossings and a number of wetlands that occurred frequently along the road. Specifically, a bird rich pan was noted as being a Highly Sensitive area. Construction activities should be minimised in these areas and caution should be taken to adhere to the proposed mitigation measures.

- Wetland Assessment Findings:

Six different types of wetlands were classified within the study area and were categorised into hydro-geomorphic (HGM) units of which a total of 67 HGM units were delineated. The largest majority of wetlands consisted of valleyhead seepage wetlands with temporary to seasonal zonation, dominated by a graminoid layer containing a rich harbaceuos component.

From a functional perspective, wetlands within the study area serves to improve habitat within, and downstream of, the study area through the provision of various ecosystem services such as streamflow regulation, flood attenuation, groundwater recharge, nitrogen removal, phosphate removal, toxicant removal, particle assimilation and provision of natural resources. Several of the wetlands within the study area provide habitat for a variety of taxa which contain species of conservation concern and are therefore highly valuable from a biodiversity point of view.

The impact assessment identified destruction of wetland habitat and surface water pollution as the two major potential impacts during the construction period while the highest rated potential impact during the operational phase is increased erosion as a result of the higher surface runoff from increased impermeable surface areas. Several existing erosion processes at various localities requires rehabilitation, as it is likely to threaten not only the existing road but the proposed development as well. After completion of the construction phase, a wetland monitoring program must be initiated to ensure that all wetland protection infrastructure and storm-water systems are properly installed and that all affected wetland areas are adequately rehabilitated. The wetland monitoring program should continue during the operational phase in order to identify any new erosion processes that are developing, and timeously initiate cost effective rehabilitation plans.

- Aquatic Assessment Findings:

Based on the results obtained during the assessment of watercourses associated with the proposed upgrading of the N11 between Ermelo and Hendrina, it was concluded that all perennial watercourses were in a seriously impaired state at the time of the field survey. However, this was expected based on the lack of rainfall prior to the field survey and the timing of the survey, the position of the sites within the upper reaches of their catchments and the presence of numerous wetlands feeding the watercourses which would release a steady flow of water into the watercourses, thus not facilitating the formation of complex and diverse habitat structures within the watercourses. Nevertheless, a number of taxa considered to be moderately sensitive to water quality impairment were collected, and a general observation made with regards to the ecological state of the watercourse and its location in relation to urbanised centres.

Additionally, structures were observed to have been established within the watercourse associated with Site C1UNSP-SPITS that included an upstream weir wall and downstream baffles and a gabion mattress. This mitigated the formation of possible erosion features associated with the installation of the culvert, thus preventing degradation of the aquatic ecosystem associated with the structure.

- Public Participation Process:

As per sections 54 to 57 of the EIA Regulations 2010, a detailed public participation process was conducted and the results thereof are included in Appendix E. The main concerns raised by stakeholders included:

- Road responsibility belonging to the South African National Roads Agency Limited (SANRAL), not to the Department of Public Works, Roads and Transport;
- Traffic management during construction;
- Increase in traffic disturbance;
- Pollution prevention during construction;

- Provision of cattle crossings / walkways to safely cross the road;
- Damages to farm fences; and
- Powerline position and relocation of powerlines should the road extend over the servitude.

These issues were considered and discussed with the technical team and incorporated in this assessment process as well as the technical design of the road and associated infrastructure.

- Impact assessment and management:

All impacts throughout the construction and operational phases can be mitigated by following the measures described in the Environmental Management Programme (EMPr) (attached in Appendix F).

Positive impacts anticipated due to the implementation of this alternative includes:

- Social impacts leading to, amongst others, safer road conditions, fewer accidents, better visibility;
- Economic impacts due to improved road conditions and improved delivery times; and
- Less continuous maintenance on the road surface, such as filling potholes, as the design life will be 20 years.

Power generation is a strategic economic asset of the country. Because of its dependency on the supply of coal, of which 35% is transported by road, the economy cannot afford that power generation be jeopardised by irregular coal delivery. Degraded roads is also contributing to increased transport costs of coal, thus causing the production cost of electricity to rise to unaffordable levels. It is therefore essential to ensure that the roads that have already deteriorated to unacceptable poor conditions be upgraded immediately to secure coal supply to the power stations.

SEF believes that the no-go alternative is not a viable option; since the road will remain prevalent with patched tar areas and potholes. This currently results in seepage into the groundwater via these potholes from the road surface and this situation will continue if the roads are not repaired. Cumulative impacts will include an increase in the number of accidents occurring due to bad road conditions and low visibility. The road will also continue to degrade until the surface becomes inoperative. Initially, no direct impact will occur on the surrounding environment. However, should the road conditions continue to deteriorate, it is anticipated that road users will start driving on the gravel or soil shoulders of the road, as is currently the case in other areas in Mpumalanga. This in turn will lead to degraded surrounding veld conditions, and the soil will lose structure and create unsafe conditions to drive on. Moreover, this places all road users in danger and at risk.

An EMPr has been developed and is attached to this report in Appendix F. The EMPr is a legally binding document and therefore all mitigation and management measures proposed must be implemented and enforced.

PROJECT DETAILS

DEA Reference	:	12/12/20/2078
Title	:	Basic Assessment Process - Draft Basic Assessment Report: Work Package 2: Rehabilitation of National Route 11 between Ermelo and Hendrina, Mpumalanga Province
Authors	:	Strategic Environmental Focus (Pty) Ltd
		Project Manager — Milicent Solomons
		Environmental Manager — Anèl Dannhauser
		Public Participation — Jessica de Beer / Bongi Mhlanga
Applicant	:	Eskom Primary Energy Division
Report Status	:	Draft Basic Assessment Report for Public and Authority Review
Submission Date	:	February 2011

When used as a reference this report should be cited as: Strategic Environmental Focus (2011) Draft Basic Assessment Report: Work Package 2 – N11 between Hendrina and Ermelo: Rehabilitation of National Route 11 between Ermelo and Hendrina.

TABLE OF CONTENTS

SECTION A: ACTIVITY INFORMATION

Has a specialist been consulted to assist with the completion of this section? NO√
If YES, please complete the form entitled "Details of specialist and declaration of interest" for appointment of a specialist for each specialist thus appointed:
Any specialist reports must be contained in Appendix D.

1. ACTIVITY DESCRIPTION

Describe the activity, which is being applied for, in detail[1]:

Eskom has embarked on a road repair programme to address the current unsafe conditions on the roads that are currently servicing their power stations (i.e. Camden, Hendrina and Majuba). The relevant roads currently carry a significant load of traffic, specifically heavy vehicles like coal trucks transporting coal to the Eskom power stations. As a result, the road surface has deteriorated, which may lead to unsafe conditions on the road and high vehicle operation costs.

NETGroup Consortium (a coalition of companies consisting of, among others, Bigen Africa Services (Pty) Ltd and Strategic Environmental Focus (Pty) Ltd (SEF)) was appointed by Eskom to undertake the engineering and environmental service components of the project.

The project involves the upgrading and rehabilitation of a section of the R38 and N11 between Hendrina and Ermelo. This road section starts at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo.

The following activities are applied for:
Government Notice Regulation No. 544, 18 June 2010, Listing Notice 1:

Activity 9: The construction of facilities or infrastructure exceeding 1000 metres in length for the bulk transportation of water, sewage or storm water:

i. with an internal diameter of 0.36 meters or more; or
ii. with a peak throughput of 120 litres per second or more,

excluding where:

a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage inside a road reserve; or
b. where such construction will occur within urban areas but further than 32meters from a watercourse, measured from the edge of the watercourse.

Activity 37: The expansion of facilities or infrastructure for the bulk transportation of water, sewage or storm water where –

i. the facility or infrastructure is expanded by more than '1000 meters in length; or
ii. where the throughput capacity of the facility or infrastructure will be increased by 10% or more-

excluding where such expansion:

a. relates to transportation of water, sewage or storm water within a road reserve; or
b. where such expansion will occur within urban areas but further than 32 meters from a watercourse, measured from the edge of the watercourse.

The project involves the cleaning of existing culverts and culvert inlets and outlets, the construction of new inlet and outlet structures in close proximity to existing culverts and the installation of sub-soil drains. Furthermore, rehabilitation procedures such as erosion control measures will be implemented, where required. The need for the latter was reiterated through the findings of the Aquatic and Wetland Assessments (see Appendix D3 for a wetland delineation map). The project will also involve the upgrading of existing lined and unlined side drains. The lengthening and / or limited replacement of the existing pipe culverts, fill drains and downchutes on high fills.

[1] Please note that this description should not be a verbatim repetition of the listed activity as contained in the relevant Government Notice, but should be a brief description of activities to be undertaken as per the project description.

Activity 11: The construction of:

i. canals;
ii. channels;
iii. bridges;
iv. dams;
v. weirs;
vi. bulk storm water outlet structures;
vii. marinas;
viii. jetties exceeding 50 square metres in size;
ix. slipways exceeding 50 square metres in size;
x. buildings exceeding 50 square metres in size; or
xi. infrastructure or structures covering 50 square metres or more

where such construction occurs within a watercourse or within 32 meters of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.

Activity 39 : The expansion of

i. canals;
ii. channels;
iii. bridges;
iv. weirs;
v. bulk storm water outlet structures; marinas;

within a watercourse or within 32 meters of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint but excluding where such expansion occur behind the development setback line.

The project also includes the widening of four bridges. It will also include the widening of existing deck slabs and the construction of new sections and extensions to the existing bridge headwalls and wingwalls. Please refer to the construction method statement included in Appendix C.

The temporary works (scaffolding) to be used to support the bridge extension depends on the scaffolding system of the appointed Contractor; i.e. normally 48mm with vertical members at 900mm spacing will be used. These members will be placed upstream and downstream of the current spans on top of the apron slab or river bed. It is estimated that the total projected width of the supports will not exceed the pier's width and will have little effect on the flow of the water. The purpose of the design of the scaffolding is to avoid impediment of any stormwater flow or any backing-up of flood levels.

If the appointed contractor's proposed temporary works require more vertical members which may result in an impediment, the contractor will be required to erect supports on the soffit of the bridge slab so as not to have any effect on the stormwater discharge. Construction will only commence once the Contractor's Method Statement for the construction of the widening has been approved by the engineers.

Activity 47: The widening of a road by more than 6 meters, or the lengthening of a road by more than 1 kilometer-

i. where the existing reserve is wider than 13.5 meters; or
ii. where no reserve exists, where the existing road is wider than 8 meters.

excluding widening or lengthening occurring inside urban areas.

The length of road for the total project is 49.83 km for the N11 and 4.88km for the R38 respectively. The current road prism is approximately 13.4m wide.. The existing pavement surface is in a poor condition with many patched areas. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The final surfaced road width will be approximately 14.2m and the road prism will be 16m.

Other legislative aspects:

As part of the widening of the bridges, a Water Use License Application (WULA) is being submitted to the Department of Water Affairs (DWA) for their decision-making as activities under Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) is triggered. These activities include abstraction of water, storage of water and the alteration of the bed, banks and characteristics of a watercourse as well as the impedance and diversion of flow in a watercourse. The WULA process runs concurrently with the BA process, but a separate application will be submitted to the DWA.

In order to obtain suitable and sufficient quantities of construction material for the upgrading of the road surface, it is proposed that four borrow-pits be established along the route (please refer to Map 2 in Appendix A). These will require a Mining Permit from the Department of Mineral Resources (DMR) under the Mineral and Petroleum Resource Development Act, 2002 (Act No. 28 of 2002). Although this process runs concurrently with the BA process, a separate application will be submitted to the DMR for their decision-making. It is important to note that the Activity 20 in Listing 1 (Government Notice Regulation 544) of the EIA Regulations, 2010 would apply. However, since the mining activities listed in the aforementioned regulations have not been enacted yet, it has not been included in this application.

2. FEASIBLE AND REASONABLE ALTERNATIVES

"Alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to—

(a) the property on which or location where it is proposed to undertake the activity;
(b) the type of activity to be undertaken;
(c) the design or layout of the activity;
(d) the technology to be used in the activity;
(e) the operational aspects of the activity; and
(f) the option of not implementing the activity.

Describe alternatives that are considered in this application. Alternatives should include a consideration of all possible means by which the purpose and need of the proposed activity could be accomplished in the specific instance taking account of the interest of the applicant in the activity. The no-go alternative must in all cases be included in the assessment phase as the baseline against which the impacts of the other alternatives are assessed. The determination of whether site or activity (including different processes) or both is appropriate needs to be informed by the specific circumstances of the activity and its environment. After receipt of this report the competent authority may also request the applicant to assess additional alternatives that could possibly accomplish the purpose and need of the proposed activity if it is clear that realistic alternatives have not been considered to a reasonable extent.

Project alternatives include the following:

i. <u>Alternative A (preferred alternative): Construction of road widening along existing alignment to allow half width construction without limiting traffic flow.</u>

Alternative A (preferred) would make use of the existing road prism on which the road widening is to be constructed. It is important to note that the expansion of the road will not meet the thresholds as specified in Listing 1 (47) and all construction activities will be within the road reserve. It is anticipated that this construction method will not result in a significant delay in the delivery time of raw material as would be the case in Alternative B. This alternative is also more cost-effective, and as a result has been adopted as the preferred construction method. The road widening will be implemented as follows:

Step 1 Widening of existing shoulder on left hand side (LHS) carriageway to accommodate two-way traffic;
Step 2 Re-construction of right hand side (RHS) carriageway (including construction of Cape Seal with single slurry seal);
Step 3 Re-construction of LHS carriageway including Cape Seal with double slurry seal (following transfer of two-way traffic from LHS to newly constructed RHS carriageway); and
Step 4 Construction of single slurry seal on RHS carriageway.

ii. Alternative B: Half width construction and only one-way traffic can be accommodated on open side. Will require stop/go sections.

Implementing Alternative B would result in a delay of approximately 107 hours in the delivery of the 12,870 tons of coal transported to the power station per day. This alternative is not considered as a viable option; since the delay in the delivery of raw material will have significant economic and financial impacts, not just on Eskom, but on the greater region as well.

iii. Alternative C: Construction of diversion (with an alignment unrelated to the existing roads alignment).

Implementing Alternative C would require the construction of a completely new road in a previously undisturbed area. This option is not regarded as viable as it would entail extensive engineering as well as environmental investigations to determine the most viable route. In addition, the specialist studies have revealed that a number of hydro-geomorphic units are present along the existing route and its proximity. Furthermore, this alternative will have significant financial implications as well as potentially significant biophysical impacts; therefore it was discarded and not further considered in the environmental process. Furthermore, by implication the existing road would remain in its current state; which is not viable.

iv. Alternative D: No Go Alternative

The result of undertaking the No-go Alternative is that the road will remain prevalent with patched tar areas, potholes and the current conditions will result in seepage into the groundwater via these potholes from the road surface. Cumulative impacts will include a growing number of accidents occurring due to bad road conditions and low visibility. The road will also continue to degrade until the surface becomes unusable.

Initially, no direct impact will occur on the surrounding environment, however, should the road conditions continue to worsen, it is anticipated that people will start driving on the gravel or soil shoulders of the road. This in turn will lead to degraded surrounding veld conditions and the soil will lose structure and create unsafe conditions to drive on. Should these conditions continue to escalate; the road will eventually become very dangerous for all motorists.

Paragraphs 3 – 13 below should be completed for each alternative.

3. ACTIVITY POSITION

Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees and decimal minutes. The minutes should have at least three decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection.

List alternative sites, if applicable: N/A

	Latitude (S):		**Longitude (E):**	
Alternative S1[2] (preferred or only site alternative)	°	'	°	'
Alternative S2 (if any)	°	'	°	'
Alternative S3 (if any)	°	'	°	'

In the case of linear activities:

	Latitude (S):		**Longitude (E):**	
Alternative S1 (preferred or only route alternative) - **Refer to Appendix G1**				
• Starting point of the activity	26°	31'22.17"	29°	59'8.35"
• Middle/Additional point of the activity	26°	16'43.33"	29°	51'8.65
• End point of the activity	26°	10'52.82"	29°	40'35.03"
Alternative S2 (if any) **N/A**				
• Starting point of the activity	°	'	°	'
• Middle/Additional point of the activity	°	'	°	'
• End point of the activity	°	'	°	'
Alternative S3 (if any) **N/A**				

[2] "Alternative S.." refer to site alternatives.

- Starting point of the activity
- Middle/Additional point of the activity
- End point of the activity

For route alternatives that are longer than 500m, please provide an addendum with co-ordinates taken every 250 meters along the route for each alternative alignment. Please see Appendix G1.

4. PHYSICAL SIZE OF THE ACTIVITY

Indicate the physical size of the preferred activity/technology as well as alternative activities/technologies (footprints):

Alternative:	Size of the activity:
Alternative A1[3] (preferred activity alternative)	m^2
Alternative A2	m^2
No-go Alternative	m^2

or, for linear activities:

Alternative:	**Length of the activity:**
Alternative A (preferred activity alternative)	54 710.00m
Alternative B	54 710.00m
No-go Alternative	5 4 710.00m

Indicate the size of the alternative sites or servitudes (within which the above footprints will occur):

Alternative:	**Size of the site/servitude:**
Alternative A (preferred activity alternative)	14 m
Alternative B	14 m
No-go Alternative	14 m

5. SITE ACCESS

Does ready access to the site exist?	YES√
If NO, what is the distance over which a new access road will be built	m

Describe the type of access road planned:

The project involves the upgrading and rehabilitation of a section of the R38 and N11 between Hendrina and Ermelo. This road section starts at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo. The existing roads will be used to access the site and no new roads will be constructed.

Include the position of the access road on the site plan and required map, as well as an indication of the road in relation to the site. (**Please refer to the locality map in Annexure A**)

6. SITE OR ROUTE PLAN

A detailed site or route plan(s) must be prepared for each alternative site or alternative activity. It must be attached as Appendix A to this document.

The site or route plans must indicate the following:

6.1 the scale of the plan which must be at least a scale of 1:500;
6.2 the property boundaries and numbers of all the properties within 50 metres of the site;
6.3 the current land use as well as the land use zoning of each of the properties adjoining the site or sites;
6.4 the exact position of each element of the application as well as any other structures on the site;

[3] "Alternative A.." refer to activity, process, technology or other alternatives.

6.5 the position of services, including electricity supply cables (indicate above or underground), water supply pipelines, boreholes, street lights, sewage pipelines, storm water infrastructure and telecommunication infrastructure;
6.6 all trees and shrubs taller than 1.8 metres;
6.7 walls and fencing including details of the height and construction material;
6.8 servitudes indicating the purpose of the servitude;
6.9 sensitive environmental elements within 100 metres of the site or sites including (but not limited thereto):
- rivers;
- the 1:100 year flood line (where available or where it is required by DWA);
- ridges;
- cultural and historical features;
- areas with indigenous vegetation (even if it is degraded or invested with alien species);

6.10 for gentle slopes the 1 metre contour intervals must be indicated on the plan and whenever the slope of the site exceeds 1:10, the 500mm contours must be indicated on the plan; and
6.11 the positions from where photographs of the site were taken.

(Please refer to Appendix A as well as maps attached in Appendix D).

7. SITE PHOTOGRAPHS

Colour photographs from the centre of the site must be taken in at least the eight major compass directions with a description of each photograph. Photographs must be attached under Appendix B to this form. It must be supplemented with additional photographs of relevant features on the site, if applicable **(Please refer to Appendix B)**.

8. FACILITY ILLUSTRATION

A detailed illustration of the activity must be provided at a scale of 1:200 as Appendix C for activities that include structures. The illustrations must be to scale and must represent a realistic image of the planned activity. The illustration must give a representative view of the activity.
(Please refer to Appendix C).

9. ACTIVITY MOTIVATION

9(a) Socio-economic value of the activity

What is the expected capital value of the activity on completion?	R 600 m
What is the expected yearly income that will be generated by or as a result of the activity?	R 20m
Will the activity contribute to service infrastructure?	YES
Is the activity a public amenity?	YES
How many new employment opportunities will be created in the development phase of the activity?	200
What is the expected value of the employment opportunities during the development phase?	R 30m
What percentage of this will accrue to previously disadvantaged individuals?	20%
How many permanent new employment opportunities will be created during the operational phase of the activity?	40
What is the expected current value of the employment opportunities during the first 10 years?	R 14m
What percentage of this will accrue to previously disadvantaged individuals?	80%

9(b) Need and desirability of the activity

Motivate and explain the need and desirability of the activity (including demand for the activity):

NEED: South Africa's fast growing economy and ever increasing demand for electricity has necessitated the construction of new power stations (Kusile and Medupi, amongst others), the return to service of mothballed power stations (Camden, Grootvlei, Komati, and so forth), and the operation of existing power stations beyond their intended lifespan at higher load factors.

The extension of the lives of Eskom's coal-fired power stations is in most cases beyond the contracted duration of the tied collieries whose contracts commence their expiration date as early as 2013. In light of the above, Eskom has commenced investing in various long-term infrastructure projects including; underground coal gasification (UCG), the Waterberg Rail Link, the 68km Ermelo-Majuba Rail Project and the Coal Haulage Road Repair Programme. The latter includes the upgrade and repair of a number of roads located in the Mpumalanga and Gauteng Provinces; including this application.

The Coal Haulage Road Repair Programme is a result of the drastically increased coal tonnages hauled in Mpumalanga; which has now been identified as the Mpumalanga Coal Haulage Road Network.

The increased coal tonnages transported in this area has detrimentally impacted on the condition of the roads and the consequent safety of all road users. This project is an attempt from Eskom, SANRAL and the Mpumalanga Department of Public Works, Roads and Transport (MPWRT) to focus on rehabilitation initiatives to improve and maintain the conditions of these roads. Coal transported on the N11 to various Eskom power stations along this route exceeds 20 000 ton per day.

1.	Was the relevant provincial planning department involved in the application?	YES√	
2.	Does the proposed land use fall within the relevant provincial planning framework?	YES √	
3.	If the answer to questions 1 and / or 2 was NO, please provide further motivation / explanation:		

DESIRABILITY: The proposed road project will provide suitably paved road surfaces free from potholes, patched areas and the potential risks to road users will be decreased. The upgrading of the road surface will also lead to better visibility in certain areas due to the localised horizontal- and vertical realignment of the road. It is anticipated that the upgrading of infrastructure will provide the roads authority (MPWRT) with between 7 and 10 years maintenance free service (with the obvious exception of maintaining the natural vegetation), prior to any substantial maintenance activities, e.g. resealing being required.

1.	Do the proposed land use / development fit the surrounding area?	YES √	
2.	Do the proposed land use / development conform to the relevant structure plans, SDF and planning visions for the area?	YES √	
3.	Will the benefits of the proposed land use / development outweigh the negative impacts of it?	YES √	
4.	If the answer to any of the questions 1-3 was NO, please provide further motivation / explanation:		
5.	Will the proposed land use / development impact on the sense of place?		NO √
6.	Will the proposed land use / development set a precedent?		NO √
7.	Will any person's rights be affected by the proposed land use / development?		NO √
8.	Will the proposed land use / development compromise the "urban edge"?		NO √
9.	If the answer to any of the question 5-8 was YES, please provide further motivation / explanation:		

BENEFITS: The proposed project will provide a suitable paved road surface with a 20 year design life. It will also comprise of minor widening within the road prism and the localised horizontal- and vertical realignment of the road. This will bring the current road to conform to the National Road Standards and will improve the road and safety conditions on this road significantly.		
1.	Will the land use / development have any benefits for society in general?	YES √
2.	**Explain:** • The proposed project will provide a suitable paved road surface with a life span of 20 years. • Expected reduction in road accidents and risk to road users due to improved road conditions. • The current road will be upgraded to conform to the National Road Standards.	
3.	Will the land use / development have any benefits for the local communities where it will be located?	YES √
4.	**Explain:** • The current road surface will be upgraded, potholes fixed and road accidents reduced. • Access for the local communities will be encouraged by the proposed upgrade. • Employment of labourers from local communities will be encouraged and will be specified within the EMPr.	

10. APPLICABLE LEGISLATION, POLICIES AND/OR GUIDELINES

List all legislation, policies and/or guidelines of any sphere of government that are applicable to the application as contemplated in the EIA regulations, if applicable:

Title of legislation, policy or guideline:	Administering authority:	Date
National Environmental Management Act, 1998 (Act No. 107 of 1998)	Department of Environmental Affairs (DEA)	1998
National Water Act, 1998 (Act No. 36 of 1998)	Department of Water Affairs (DWA)	1998
National Heritage Resources Act, 1999 (Act No. 25 of 1999)	South African Heritage Resource Agency (SAHRA)	1999
Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)	Department of Mineral Resources (DMR)	2002
National Environmental Management: Biodiversity Act 20 (Act No. 10 of 2004)	Department of Environmental Affairs (DEA)	2004
Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983);	Department of Environmental Affairs (DEA)	1983
Environment Conservation Act, 1989 (Act No. 73 of 1989);	Department of Environmental Affairs (DEA)	1989
Guideline on Public Participation	Department of Environmental Affairs and Development Planning (DEA&DP)	July 2006
Guideline on Public Participation	Department of Environmental Affairs (DEA)	May 2006
Guideline on Alternatives	Department of Environmental Affairs (DEA)	May 2006
Guideline on Alternatives	Department of Environmental Affairs and Development Planning (DEA&DP)	July 2006
Occupational Health and Safety Act, 1993 (Act No. 85 of 1993	Department of Labour	23 June 1993
National Water Resource Strategy: First Edition.	Department of Water Affairs (DWA)	2004
Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3	Department of Water Affairs (DWA)	2005

11. WASTE, EFFLUENT, EMISSION AND NOISE MANAGEMENT

11(a) Solid waste management

Will the activity produce solid construction waste during the construction/initiation phase?	YES √
If yes, what estimated quantity will be produced per month?	10 m^3

How will the construction solid waste be disposed of (describe)?

All construction rubble will be removed from the site, covered during transport to prevent dust pollution, and disposed off at a registered landfill site.

Where will the construction solid waste be disposed of (describe)?

The solid construction waste and rubble will be disposed off at a registered landfill site that can handle the quantities and type of solid waste produced. The nearest landfill site to the project will be the Ermelo Landfill Site in the Msukaligwa Local Municipality.

Will the activity produce solid waste during its operational phase?	NO √
If yes, what estimated quantity will be produced per month?	m^3

How will the solid waste be disposed of (describe)?

Where will the solid waste be disposed if it does not feed into a municipal waste stream (describe)?

If the solid waste (construction or operational phases) will not be disposed of in a registered landfill site or be taken up in a municipal waste stream, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Can any part of the solid waste be classified as hazardous in terms of the relevant legislation?	NO √

If yes, inform the competent authority and request a change to an application for scoping and EIA.

Is the activity that is being applied for a solid waste handling or treatment facility?	YES	NO

If yes, then the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

11(b) Liquid effluent

Will the activity produce effluent, other than normal sewage, that will be disposed of in a municipal sewage system?		NO √
If yes, what estimated quantity will be produced per month?	m^3	
Will the activity produce any effluent that will be treated and/or disposed of on site?	Yes	NO

If yes, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

Will the activity produce effluent that will be treated and/or disposed of at another facility?			NO √
If yes, provide the particulars of the facility:			
Facility name:			
Contact person:			
Postal address:			
Postal code:			
Telephone:		Cell:	
E-mail:		Fax:	

Describe the measures that will be taken to ensure the optimal reuse or recycling of waste water, if any:

11(c) Emissions into the atmosphere

Will the activity release emissions into the atmosphere?	NO √
If yes, is it controlled by any legislation of any sphere of government?	

If yes, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If no, describe the emissions in terms of type and concentration:

No emissions are anticipated as this project involves the upgrading, broadening and resurfacing of an existing road link. Dust pollution control measures will be put in place to prevent dust emissions by spraying bare areas with water and covering construction material on site as well as vehicles transporting windblown materials to and from the site. These measures will be enforced through the implementation of the EMPr and the appointment of an independent Environmental Control Officer (ECO) during the construction phase.

11(d) Generation of noise

Will the activity generate noise? YES√
If yes, is it controlled by any legislation of any sphere of government? NO √
If yes, the applicant should consult with the competent authority to determine whether it is necessary to change to an application for scoping and EIA.

If no, describe the noise in terms of type and level:

Construction related noise, other than the existing traffic noise, is expected to occur during the construction phase. Construction vehicles and machinery will be the general contributors of noise. The construction team will be prevented from unscheduled activities on bare roads and will keep to the speed limit as such activities will increase the noise levels in the area. Noise is also expected during working hours from the construction workers on site which may impact on the road users.

The noise levels during the operational phase will not differ from the current noise levels.

12. WATER USE

Please indicate the source(s) of water that will be used for the activity by ticking the appropriate box(es)

municipal	water board	Groundwater	river, stream, dam or lake	other	the activity will not use water

If water is to be extracted from groundwater, river, stream, dam, lake or any other natural feature, please indicate
the volume that will be extracted per month: 960 000 litres
Does the activity require a water use permit from the Department of Water Affairs? YES √
If yes, please submit the necessary application to the Department of Water Affairs and attach proof thereof to this application if it has been submitted. **The application will be submitted to the DWA concurrently with the Basic Assessment Report; therefore proof thereof cannot be attached to this document.**

13. ENERGY EFFICIENCY

Describe the design measures, if any, that have been taken to ensure that the activity is energy efficient:

The proposed construction method for the road upgrade will take energy efficiency into account. The preferred construction method as proposed in Alternative A will take the least time to complete and be more energy efficient in the process.

If lights are to be constructed along the road, these will be switched off during the day to save energy.

Describe how alternative energy sources have been taken into account or been built into the design of the activity, if any:

N/A

SECTION B: SITE/AREA/PROPERTY DESCRIPTION

Important notes:

1. For linear activities (such as pipelines) as well as activities that cover very large sites, it may be necessary to complete this section for each part of the site that has a significantly different environment. In such cases please complete copies of Section B and indicate the area, which is covered by each copy No. on the Site Plan.

Section B Copy No. (e.g. A): **1**

2. Paragraphs 1 - 6 below must be completed for each alternative.

3. Has a specialist been consulted to assist with the completion of this section? YES √

If YES, please complete the form entitled "Details of specialist and declaration of interest" for each specialist thus appointed: **(Please refer to Appendix D)**
All specialist reports must be contained in Appendix D. **(Please refer to Appendix D)**.

Property description/physical address:	The project involves the upgrading and rehabilitation of a section of the R38 and N11 between Hendrina and Ermelo. This road section starts at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo.
	(Farm name, portion etc.) Where a large number of properties are involved (e.g. linear activities), please attach a full list to this application.
	Please refer to Appendix G1
	In instances where there is more than one town or district involved, please attach a list of towns or districts to this application.
	Please refer to Appendix G1
Current land-use zoning:	The N11 is a national road (i.e. public road) and the proposed upgrade will occur within the existing road reserve; whereas the surrounding properties have an agricultural land use zoning for the most part, except where the road enters into urban areas of Hendrina.
	In instances where there is more than one current land-use zoning, please attach a list of current land use zonings that also indicate which portions each use pertains to , to this application. **(Please refer to Appendix G1)**
Is a change of land-use or a consent use application required?	NO √
Must a building plan be submitted to the local authority?	NO √

Locality map: An A3 locality map must be attached to the back of this document, as Appendix A. The scale of the locality map must be relevant to the size of the development (at least 1:50 000. For linear activities of more than 25 kilometres, a smaller scale e.g. 1:250 000 can be used. The scale must be indicated on the map.) The map must indicate the following:

- an indication of the project site position as well as the positions of the alternative sites, if any;
- road access from all major roads in the area;
- road names or numbers of all major roads as well as the roads that provide access to the site(s);
- all roads within a 1km radius of the site or alternative sites; and
- a north arrow;
- a legend; and
- locality GPS co-ordinates (Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in degrees and decimal minutes. The minutes should have at least three decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local projection)

(Please refer to Appendix A).

The table below provides a description of the ecological environment as per the specialist studies conducted. For more detail, please refer to **Appendix D.**

Flora:

The road reserve and borrow pits are situated within the Grassland Biome of South Africa. (Rutherford & Westfall, 1994). The Grassland Biome comprises mainly of 'sweet' and 'sour' grasses and plants with perennial underground storage organs, for example bulbs and tubers, while trees are restricted to specialised habitats such as rocky outcrops or kloofs. The Highveld and montane grasslands of Mpumalanga are an important habitat for several threatened plant and animal taxa (Emery *et al.* 2002).

The majority of the N11 road section is situated within the Eastern Highveld Grassland vegetation unit, while a middle portion of the N11 road section is situated within the Soweto Highveld Grassland. Due to urban development and agricultural pressure within the Gauteng and Mpumalanga Provinces, the extent of this vegetation unit is becoming limited and only a small portion of Eastern Highveld Grassland is conserved in statutory reserves such as the Nooitgedacht Dam or in private nature reserves. Almost half of this vegetation type has been transformed by cultivation, plantation, mining and the building of dams, and it is therefore classified as an Endangered vegetation type (Mucina & Rutherford, 2006).

The Soweto Highveld Grassland comprises short to medium-high dense tufted grassland dominated almost entirely by the grass *Themeda triandra* (Red Grass). The Soweto Highveld Grassland is also under pressure from urban development and only a small portion of its original extent is statutorily conserved. The Soweto Highveld Grassland is also classified as an Endangered vegetation unit.

Both these vegetation units are under threat and the remaining portions (that are not disturbed) should thus ideally be avoided and conserved. For this reason, it was necessary to assess the vegetation that will be impacted on by the proposed road upgrade activities. This was to determine whether any Soweto Highveld Grassland or Eastern Highveld Grassland exist where the proposed road upgrade activities will take place, in what state it is (e.g. primary or secondary vegetation and degree of disturbance), as well as habitat for plants species that are protected or of conservation concern. In addition, it should be noted that the Eastern Highveld Grassland and Soweto Highveld Grassland are listed as vulnerable ecosystems by the National Environmental Management: Biodiversity Act 20 (Act No. 10 of 2004).

The Mpumalanga Biodiversity Conservation Plan (MBCP) is a comprehensive environmental inventory and spatial plan developed for the Mpumalanga Province (Lötter & Ferrar, 2006). The proposed road upgrade activities will traverse through large areas classified as having no natural habitat remaining or areas of Least Concern. However, some sections of the N11 do cross through areas that are classified by the MBCP as "Important and necessary" or "Highly Significant". A number of protected plants, as listed in Schedule 11 and 12 of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) were identified and could be impacted upon by the road upgrade activities. These plants are not to be removed, damaged, or destroyed without permit authorisation from the Mpumalanga Department of Economic Development, Environment and Tourism.

Invasive alien plant species tend to invade riparian and seep zones with disastrous impacts on water resources, especially within catchment regions. Invader and weed species must be controlled to prevent further infestation and it is recommended that all individuals of the invader species be removed and eradicated (Henderson, 2001). Weed species that occur on the site is listed in the plant list in Appendix B of Appendix D1.

The road upgrade is proposed to take place within the existing road reserve; which is currently bordered by cultivated land, grassland and in some cases invasive alien trees. The road reserve comprised mainly of grassland vegetation with some alien invader tree species occurring scattered along the road reserve, but mainly adjacent to the road reserve. The reserves were burnt and were mainly used by maintenance- and other vehicles as numerous vehicle tracks were visible along the route.

The proposed road upgrade activities will traverse through large areas classified as having "No natural habitat remaining" or areas of "Least Concern". However, some sections of the N11 does cross through areas that are classified by the MBCP as "Important and necessary" or "Highly Significant". These are areas of natural vegetation that play an important role in meeting biodiversity targets. Their designation as "Important and necessary" seeks to minimise conflict with competing land uses and represents the most efficient selection of areas to meet biodiversity targets (Ferrar & Lötter, 2007). Therefore, the road upgrade activities should be restricted to the existing road reserves in these areas, with no impact on adjacent land.

The vegetation within the road reserve was either disturbed or observed to comprise mainly secondary grassland with riparian areas and wetlands as well as some invasive alien trees scattered along the route. Points were sampled along the route, concentrating mainly on areas where the vegetation was least disturbed, moist- and riparian areas. The road reserve, by its nature, showed signs of disturbance such as regular burning as well as vehicle tracks – especially next to the farm fences, or where vehicles pull over on the side of the road. However, the section of the road that comprised grassland vegetation included an unexpected high diversity of grasses and forbs (Photograph 2). The road reserve seemingly recover quickly from disturbance, probably due to the surrounding grasslands that function as a seed bank that can colonise the road reserves when disturbance takes place.

The majority of the road reserve comprise secondary grassland or sub climax grassland. No plants of conservation concern or protected plants were confirmed to occur within the secondary grassland within the road verges, although it could support at least three protected plant species. It is therefore classified as medium ecological function as this system occurs at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems. In addition, it comprises of intermediate levels of species diversity without any confirmed protected species and are thus of medium conservation importance and ecological sensitivity.

Fauna:

A number of wetlands were present along the proposed road for upgrade that could provide important habitat for a number of faunal, and especially, avifaunal species. Large numbers of Red-Knobbed Koots, Dabchicks, and Yellow-billed ducks occurred at a pan along the route (S 26'11'27.6; E 29'44'37.1), with a variety of other water birds such as African Spoonbill, Greater Crested Grebe and Fulvous Ducks. In addition, species of conservation concern such as Greater and Lesser Flamingos, are highly likely to be encountered here.

A number of smaller wetlands located at various points along the proposed road for upgrade provide habitat for specifically *Tyto capensis* (African Grass Owl) and a potential large number of frog species. Furthermore, mammal species of conservation concern such as *Chrysospalax villosus* (Rough-haired Golden Mole), *Amblysomus septentrionailis* (Highveld Golden Mole), *Mystromys albicaudatus* (White-tailed Mouse) and *Dasmys incomtus* (African Marsh Rat) are known to associate closely with wetland habitats and could potentially occur within the wetlands identified here. Specifically, a great deal of burrows that could possibly be those of the above mentioned

golden moles, were found in a wetland located at S26'21.244; E29'52.795.

There were two river crossings located along the surveyed road that could provide important faunal habitat. Not withstanding the fact that faunal species could reside here, rivers and streams act as important migration and dispersal corridors for a number of species e.g. *Aonyx capensis* (African Clawless Otter). Construction activities around these areas could thus interrupt such movements and influence the dynamics of populations that occur in the area. Furthermore, Swallows and Swifts breed under bridges during summer and could be influenced by construction activities.

Faunal habitat along the surveyed road was in most instances highly disturbed and provided little or no shelter for faunal species. It is thus highly unlikely that any faunal species would be resident in this area. However, long grass cover along some fences next to the road provides cover for a number of rodent species, which in turn acts as a food source for raptors in the area. Raptors recorded perching on telephone poles along the road during the survey included: Elanus caeruleus (Black-shouldered Kite), Buteo vulpinus (Steppe Buzzard) and Milvus parasitus (Yellow-billed Kite). A number of owl species are also expected to forage along the road at night. These species hunt opportunistically and construction activities are unlikely to have any long term effect on their occurrence. Clumps of Eucalyptus trees (location S26'10.796; E29'40.669) could also provide nesting habitat for a number of bird species.

The ecological importance and sensitivity of the road reserve was rated as Low. Common faunal species occur here opportunistically. Sensitive areas, specifically wetlands and one exceptionally bird-rich pan which were encountered along the road, were classified as *Highly Sensitive* as a result of specialist faunal assemblages that could be encountered here. These areas have a high conservation potential.

Wetlands

According to the National Water Act (Act No. 36 of 1998) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*" Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water. An area which has a high water table just below the surface of the soil is also a wetland, as well as a pan that only contains water for a few weeks during the year.

Six different types of wetland areas were classified within the study area and were categorised into hydro-geomorphic (HGM) units. These include valley bottom wetlands without a channel, floodplains, valley bottom wetlands with a channel, edorheic pans, hillslope seepage wetlands not feeding a watercourse and hillslope seepage wetlands feeding a watercourse. A total of 67 HGM units were delineated and classified within the study area, and are presented graphically in Figure 3, Figure 4 and Figure 5 of the Wetland Report (Annexure D3). Due to the large amount of wetlands delineated along the proposed route, only the verified wetland segments directly adjacent to the route were delineated and mapped. It must however be kept in mind that each of the mapped segments represent a much larger wetland.

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation. Several of the wetlands within the study area provide habitat for a variety of taxa which contain species of conservation concern and are therefore highly valuable from a biodiversity point of view. Further, the vegetation in

and around rivers and drainage lines, play an important role in water catchments, assimilation of phosphates, nitrates and toxins as well as flood attenuation. Quality, quantity and sustainability of water resources are fully dependent on good land management practices within the catchment. All flood lines, riparian zones and wetlands along with corresponding buffer zones must be designated as sensitive. The good state of health of many of the wetlands within the study area further increases the importance of the delineated wetlands.

The four main wetland indicators used during the wetland delineation process included the terrain unit indicator, soil wetness indicator, presence and absence of hydric soils and hydrophytes. A wide variety of hydric soil types and hydrophytes were present within the study area, due to the relatively long linear extent of the study site, and its associated geographical variance.

The impact assessment identified destruction of wetland habitat and surface water pollution as the two major potential impacts during the construction period, while the highest rated potential impact during the operational phase is increased erosion as a result of the higher surface runoff from increased impermeable surface areas. Several specific and general mitigation measures are proposed to mitigate impacts on wetlands. Most important is avoidance of wetland habitat through appropriate road design, e.g. alternate widening on either side of the road to achieve protection of specific HGM units where there are only wetlands located on one side of the road. Where the road supports wetlands of equal importance on both sides of the existing road, the new road footprint should be kept to a minimum and be strictly contained within the existing road reserve. Velocity breaking structures such as baffles should be placed on the downstream side of all culverts and piping. Other erosion interventions such as gabion mattresses and weir walls should also be constructed where erosion potential have been identified. Furthermore, several existing erosion processes at various localities requires rehabilitation as it is likely to threaten not only the existing road but the proposed development as well. After completion of the construction phase, a wetland monitoring program must be initiated that ensure that all wetland protection infrastructure and storm-water systems are properly installed and that all affected wetland areas are adequately rehabilitated. The wetland monitoring program should continue during the operational phase in order to identify any new erosion processes that are developing and initiate cost effective rehabilitation plans timeously.

Aquatic Environment

The study area falls within two water management areas, namely the Upper Vaal Water Management Area (WMA) and the Olifants Water Management Area. The Upper Vaal Water Management Area lies in the eastern interior of South Africa, and is considered to be a pivotal water management area in the country. According to the Department of Water Affairs and Forestry (2004), the sub-management area in which the present study area is located is the Upstream Vaal Dam Sub-management Area. More specifically, the portion of the proposed project that corresponds with the Upper Vaal Water Management Area falls within Quaternary Catchment C11F.

The Olifants Water Management Area corresponds with the South African portion of the Olifants River Catchment (excluding the Letaba River catchment). Diverse economic activities are associated with the Olifants Water Management Area, and range from mining and metallurgic industries to irrigation, dry land and subsistence agriculture, and ecotourism. According to the Department of Water Affairs and Forestry (2004), the sub-management area in which the present study area is located is the Upper Olifants Sub-management Area. More specifically, the portion of the proposed project that corresponds with the Olifants Water Management Area falls within Quaternary Catchment B12A.

A total of three perennial water courses are associated with the proposed project, namely the Klein

Olifants River (located within the Olifants Water Management Area), and the Klein Xspruit and an additional unnamed watercourse (located in the Upper Vaal Water Management Area). According to Nel *et al.* (2004), the heterogeneity signature of the perennial watercourses associated with the proposed road upgrade are Highveld 2 and Highveld 3, with the conservation status of the signature regarded as being Critically Endangered due to the fact that the river heterogeneity signature has an intact length of less than their conservation target of 10% of total length. In addition, the proposed project is bisected by numerous identified wetlands that comprise mainly of unchannelled valley bottom wetlands and seepages.

Habitat index scores determined according to the Invertebrate Habitat Assessment System (IHAS; MacMillan, 1998) during this aquatic assessment indicated habitat diversity within the study area to be generally poor. This is likely the result of the assessed sites' positions in the catchment, and the fact that many can be regarded as being channelled valley-bottom wetlands which inherently have a poor expression of aquatic habitat types. Another factor that was likely to contribute to the poor habitat scores obtained, particularly sites C1KXSP-KAFFE and B1KOLI-TWEEF (please refer to details in the Aquatic Assessment), was the fact that while pools were present, very little flow was observed within the channels.

The primary index used in the determination of Present Ecological State for the present assessment was the newly developed Marcoinvertebrate Response Assessment Index (MIRAI; Thirion, 2008). Chutter (1998) developed the SASS protocol as an indicator of water quality. It has since become clear that SASS gives an indication of more than mere water quality, but rather a general indication of the present state of the invertebrate community. Following the application of the MIRAI at each site surveyed, it was concluded that all sites can be regarded as seriously impaired. However, the causal factors of the ecological state differed between sites, with the primary driver of sites C1UNSP-ERMEL and C1UNSP-SPITS determined to be water quality impairment, and the primary driver of sites C1KXSP-KAFFE and B1KOLI-TWEEF determined to be lack of flow. A general observation was made that the closer the watercourse to an urban center, the poorer the scores obtained for aquatic macroinvertebrates.

However, this was expected based on the lack of rainfall prior to the field survey and the timing of the survey, the position of the sites within the upper reaches of their catchments and the presence of numerous wetlands feeding the watercourses which would release a steady form of water into the watercourses, thus not facilitating the formation of complex and diverse habitat structures within the watercourses.

Additionally, structures were observed to have been established within the watercourse associated with Site C1UNSP-SPITS that included an upstream weir wall and downstream baffles and a gabion mattress. This mitigated the formation of possible erosion features associated with the installation of the culvert, thus preventing degradation of the aquatic ecosystem associated with the structure. It is strongly recommended that similar structures should be considered at all culverts currently installed and associated specifically with unchanneled valley bottom wetlands. While such structures should not be considered for perennial watercourses associated with the proposed project, the installation of the structures within the perennial watercourse associated with Site C1UNSP-SPITS is not regarded as a negative impact due to the presence of a dam directly below the bridge crossing, which would otherwise prevent the upstream movement of fish species.

1. GRADIENT OF THE SITE

Indicate the general gradient of the site.

Alternative S1:

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Alternative S2 (if any):

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

Alternative S3 (if any):

Flat	1:50 – 1:20	1:20 – 1:15	1:15 – 1:10	1:10 – 1:7,5	1:7,5 – 1:5	Steeper than 1:5

2. LOCATION IN LANDSCAPE

Indicate the landform(s) that best describes the site:

2.1 Ridgeline
2.2 Plateau
2.3 Side slope of hill/mountain
2.4 Closed valley
2.5 Open valley
2.6 Plain
2.7 Undulating plain / low hills √
2.8 Dune
2.9 Seafront

3. GROUNDWATER, SOIL AND GEOLOGICAL STABILITY OF THE SITE

Is the site(s) located on any of the following (tick the appropriate boxes)?

	Alternative S1:		Alternative S2 (if any):		Alternative S3 (if any):	
Shallow water table (less than 1.5m deep)		NO √		NO √		NO √
Dolomite, sinkhole or doline areas		NO √		NO √		NO √
Seasonally wet soils (often close to water bodies)	YES√		YES√		YES √	
Unstable rocky slopes or steep slopes with loose soil		NO √		NO √		NO √
Dispersive soils (soils that dissolve in water)		NO √		NO √		NO √
Soils with high clay content (clay fraction more than 40%)		NO √		NO √		NO √
Any other unstable soil or geological feature		NO √		NO √		NO √
An area sensitive to erosion	YES √		YES √		YES √	

If you are unsure about any of the above or if you are concerned that any of the above aspects may be an issue of concern in the application, an appropriate specialist should be appointed to assist in the completion of this section. (Information in respect of the above will often be available as part of the project information or at the planning sections of local authorities. Where it exists, the 1:50 000 scale Regional Geotechnical Maps prepared by the Council for Geo Science may also be consulted).

4. GROUNDCOVER

Indicate the types of groundcover present on the site:

The location of all identified rare or endangered species or other elements should be accurately indicated on the site plan(s).

Natural veld - good condition[E]	Natural veld with scattered aliens[E]	Natural veld with heavy alien infestation[E]	Veld dominated by alien species[E]	Gardens
Sport field	Cultivated land	Paved surface	Building or other structure	Bare soil

If any of the boxes marked with an "[E] "is ticked, please consult an appropriate specialist to assist in the completion of this section if the environmental assessment practitioner doesn't have the necessary expertise. **Please refer to Appendix D.**

5. LAND USE CHARACTER OF SURROUNDING AREA

Indicate land uses and/or prominent features that does currently occur within a 500m radius of the site and give description of how this influences the application or may be impacted upon by the application:

5.1 Natural area	√
5.2 Low density residential - for most part of the site	√
5.3 Medium density residential	
5.4 High density residential - for small sections of the site in urban areas	√
5.5 Informal residential[A]	
5.6 Retail commercial & warehousing - for small sections of the site in urban areas	√
5.7 Light industrial	
5.8 Medium industrial[AN]	
5.9 Heavy industrial[AN]	
5.10 Power station	√
5.11 Office/consulting room	
5.12 Military or police base/station/compound	
5.13 Spoil heap or slimes dam[A]	
5.14 Quarry, sand or borrow pit	√
5.15 Dam or reservoir	√
5.16 Hospital/medical centre	
5.17 School	
5.18 Tertiary education facility	
5.19 Church	
5.20 Old age home	
5.21 Sewage treatment plant[A]	
5.22 Train station or shunting yard[N]	
5.23 Railway line[N]	√
5.24 Major road (4 lanes or more)[N]	
5.25 Airport[N]	
5.26 Harbour	
5.27 Sport facilities	
5.28 Golf course	
5.29 Polo fields	
5.30 Filling station[H]	
5.31 Landfill or waste treatment site	
5.32 Plantation	
5.33 Agriculture	√
5.34 River, stream or wetland	√
5.35 Nature conservation area	
5.36 Mountain, koppie or ridge	
5.37 Museum	
5.38 Historical building	
5.39 Protected Area	
5.40 Graveyard	
5.41 Archaeological site	
5.42 Other land uses (describe)	

If any of the boxes marked with an "N "are ticked, how will this impact / be impacted upon by the proposed activity?

The N11 road link between Hendrina and Ermelo will be upgraded and widened. Although there are several railway lines, for example the Richards Coal Line – Johannesburg – Richards Bay, located to the south of the site, these will not be impacted upon by the proposed upgrade as it is located too far from the site. The only activity that will potentially affect a railway line, is the widening of the railway bridge located at Estancia approximately 23km north of Ermelo along the N11. The railway bridge will be widened by 2.5m on one side.

If any of the boxes marked with an "An" are ticked, how will this impact / be impacted upon by the proposed activity?

If YES, specify and explain:

If YES, specify:

N/A

If any of the boxes marked with an "H" are ticked, how will this impact / be impacted upon by the proposed activity.

If YES, specify and explain:

If YES, specify:

N/A

6. CULTURAL/HISTORICAL FEATURES

Are there any signs of culturally or historically significant elements, as defined in section 2 of the National Heritage Resources Act, 1999, (Act No. 25 of 1999), including Archaeological or palaeontological sites, on or close (within 20m) to the site?	NO √
If YES, explain: N/A	
If uncertain, conduct a specialist investigation by a recognised specialist in the field to establish whether there is such a feature(s) present on or close to the site.	
Briefly explain the findings of the specialist: N/A	
Will any building or structure older than 60 years be affected in any way?	NO √
Is it necessary to apply for a permit in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999)?	NO √

If yes, please submit or, make sure that the applicant or a specialist submits the necessary application to SAHRA or the relevant provincial heritage agency and attach proof thereof to this application if such application has been made.

SECTION C: PUBLIC PARTICIPATION

1. ADVERTISEMENT

The person conducting a public participation process must take into account any guidelines applicable to public participation as contemplated in section 24J of the Act and must give notice to all potential interested and affected parties of the application which is subjected to public participation by—

(a) fixing a notice board (of a size at least 60cm by 42cm; and must display the required information in lettering and in a format as may be determined by the competent authority) at a place conspicuous to the public at the boundary or on the fence of—
  (i) the site where the activity to which the application relates is or is to be undertaken; and
  (ii) any alternative site mentioned in the application **(Refer to Appendix E)**.

(b) giving written notice to—
  (i) the owner or person in control of that land if the applicant is not the owner or person in control of the land;
  (ii) the occupiers of the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;
  (iii) owners and occupiers of land adjacent to the site where the activity is or is to be undertaken or to any alternative site where the activity is to be undertaken;
  (iv) the municipal councillor of the ward in which the site or alternative site is situated and any organisation of ratepayers that represent the community in the area;
  (v) the municipality which has jurisdiction in the area;
  (vi) any organ of state having jurisdiction in respect of any aspect of the activity; and
  (vii) any other party as required by the competent authority **(Refer to Appendix E)**.

(c) placing an advertisement in—
  (i) one local newspaper; or
  (ii) any official *Gazette* that is published specifically for the purpose of providing public notice of applications or other submissions made in terms of these Regulations **(Refer to Appendix E)**.

(d) placing an advertisement in at least one provincial newspaper or national newspaper, if the activity has or may have an impact that extends beyond the boundaries of the metropolitan or local municipality in which it is or will be undertaken: Provided that this paragraph need not be complied with if an advertisement has been placed in an official *Gazette* referred to in subregulation 54(c)(ii); and

(e) using reasonable alternative methods, as agreed to by the competent authority, in those instances where a person is desiring of but unable to participate in the process due to—
  (i) illiteracy;
  (ii) disability; or
  (iii) any other disadvantage.

2. CONTENT OF ADVERTISEMENTS AND NOTICES

A notice board, advertisement or notices must:

(a) indicate the details of the application which is subjected to public participation; and

(b) state—
  (i) That the application has been submitted to the competent authority in terms of these Regulations, as the case may be;
  (ii) Whether basic assessment or scoping procedures are being applied to the application, in the case of an application for environmental authorisation;
  (iii) The nature and location of the activity to which the application relates;
  (iv) Where further information on the application or activity can be obtained; and
  (iv) The manner in which and the person to whom representations in respect of the application may be made.

3. PLACEMENT OF ADVERTISEMENTS AND NOTICES

Where the proposed activity may have impacts that extend beyond the municipal area where it is located, a notice must be placed in at least one provincial newspaper or national newspaper, indicating that an application will be submitted to the competent authority in terms of these regulations, the nature and location of the activity, where further information on the proposed activity can be obtained and the manner in which representations in respect of the application can be made, unless a notice has been placed in any *Gazette* that is published specifically for the purpose of providing notice to the public of applications made in terms of the EIA regulations **(Refer to Appendix E)**.

Advertisements and notices must make provision for all alternatives.

4. DETERMINATION OF APPROPRIATE MEASURES

The practitioner must ensure that the public participation is adequate and must determine whether a public meeting or any other additional measure is appropriate or not based on the particular nature of each case. Special attention should be given to the involvement of local community structures such as Ward Committees, ratepayers associations and traditional authorities where appropriate. Please note that public concerns that emerge at a later stage that should have been addressed may cause the competent authority to withdraw any authorisation it may have issued if it becomes apparent that the public participation process was inadequate.

5. COMMENTS AND RESPONSE REPORT

The practitioner must record all comments and respond to each comment of the public before the application is submitted. The comments and responses must be captured in a comments and response report as prescribed in the EIA regulations and be attached to this application. The comments and response report must be attached under Appendix E. **(Refer to Appendix E)**.

6. AUTHORITY PARTICIPATION

Please note that a complete list of all organs of state and or any other applicable authority with their contact details must be appended to the basic assessment report or scoping report, whichever is applicable.

Authorities are key interested and affected parties in each application and no decision on any application will be made before the relevant local authority is provided with the opportunity to give input.

List of authorities informed:

Local & District Municipalities

- Govan Mbeki Local Municipality
- Pixley Ka Seme Local Municipality
- Msukaligwa Local Municipality
- Steve Tshwete Local Municipality
- Msukaligwa Local Municipality
- Hendrina Local Municipality
- Gert Sibande District Municipality
- Nkangala District Municipality

State Departments

- Mpumalanga Department of Economic Development, Environment and Tourism
- Department of Water Affairs
- Department of Mineral Resources
- Mpumalanga Department of Public Works, Roads and Transport
- Mpumalanga Department of Health
- Department of Agriculture
- Mpumalanga Commission of Restitution of Land Rights
- South African National Roads Agency Limited (SANRAL)

List of authorities from whom comments have been received:

- Mpumalanga Department of Public Works, Roads and Transport
- Govan Mbeki Local Municipality

7. CONSULTATION WITH OTHER STAKEHOLDERS

Note that, for linear activities, or where deviation from the public participation requirements may be appropriate, the person conducting the public participation process may deviate from the requirements of that subregulation to the extent and in the manner as may be agreed to by the competent authority.

Proof of any such agreement must be provided, where applicable.

Has any comment been received from stakeholders? YES√

If "YES", briefly describe the feedback below (also attach copies of any correspondence to and from the stakeholders to this application):

A full comments and response report is attached in Appendix E, however main issues included:

- Road responsibility belonging to SANRAL, not to the Department of Public Works, Roads and Transport
- Traffic management during construction
- Pollution prevention during construction
- Provision of cattle crossings / walkways to safely cross the road
- Increase in traffic disturbance
- Powerline position and relocation of powerlines should the road extend over the servitude

SECTION D: IMPACT ASSESSMENT

The assessment of impacts must adhere to the minimum requirements in the EIA Regulations, 2010, and should take applicable official guidelines into account. The issues raised by interested and affected parties should also be addressed in the assessment of impacts.

1. ISSUES RAISED BY INTERESTED AND AFFECTED PARTIES

List the main issues raised by interested and affected parties.

- Road responsibility belonging to SANRAL, not to the Department of Public Works, Roads and Transport
- Traffic management during construction
- Increase in traffic disturbance
- Pollution prevention during construction
- Provision of cattle crossings / walkways to safely cross the road
- Damages to farm fences
- Powerline position and relocation of powerlines should the road extend over the servitude

Response from the practitioner to the issues raised by the interested and affected parties (A full response must be given in the Comments and Response Report that must be attached to this report as Annexure E):

Traffic Control:

- It is proposed that the road be upgraded in phases; although, different options are being investigated.

Pollution prevention:

- General waste will be managed in a sustainable way by making use of recycling, which will ensure that the site is kept neat and tidy. No other waste will be produced as the material will be used as road construction material.

Visual impacts:

- Will be reduced where possible by providing sufficient containers on site;
- Potential to pollute soils, water resources and natural habitats will be minimised by ensuring that there are no visible or measurable signs of pollution on the environment (soils, ground and surface water); and
- Disposal of rubble and refuse in an appropriate manner with no rubble and refuse lying on site.

Cattle crossings:

- The road engineers are in the process of considering the possibility of including cattle crossings in the design.

Traffic disturbance:

- The road upgrade is proposed to be in phases so as to cause the minimum disturbance possible.

Damages to farm fences:

- No fences will be removed or damaged without prior consultation with the landowner.

The Draft Basic Assessment Report is currently available for public review. All comments received during the public review period will be included in the Final Basic Assessment Report and the updated Comments and Response Report. Such comments will be considered before submitting the final report to the Competent Authority for the Authority Review.

2. IMPACTS THAT MAY RESULT FROM THE PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL, DECOMMISSIONING AND CLOSURE PHASES AS WELL AS PROPOSED MANAGEMENT OF IDENTIFIED IMPACTS AND PROPOSED MITIGATION MEASURES

List the potential direct, indirect and cumulative property/activity/design/technology/operational alternative related impacts (as appropriate) that are likely to occur as a result of the planning and design phase, construction phase, operational phase, decommissioning and closure phase**, including impacts relating to the choice of site/activity/technology alternatives as well as the mitigation measures that may eliminate or reduce the potential impacts listed.

Please note that due to the nature of this proposed road upgrade only construction and operational phases are applicable and thus discussed below. The decommissioning and closure phases are not applicable and have thus not been included as decommissioning is not anticipated for this project.

CONSTRUCTION PHASE: ALTERNATIVES A (PREFERRED ALTERNATIVE) & B

Impacts	Mitigation measures
DIRECT IMPACTS:	
Visual Impacts: Visual impacts include, but are not limited to the following: • Visibility of the construction camps, vehicles, material stockpiles, construction signs, and so forth. • Smoke pollution from ill maintained trucks. • Dust clouds during very dry periods. • Increased activity over and above normal traffic. • Flood lights providing illumination for the construction site. Status: Negative Extent: Site Duration: Short term Intensity: Medium Probability: Likely Weighing Factor: Medium Significance: Low to Medium Significance with mitigation: Low	• During construction, all materials and stockpiles will be covered with tarps to prevent erosion, as well as dust arising from it, and to mitigate the visibility thereof. Trucks will undergo regular maintenance as and when necessary. • Dust suppression measures including spraying of water, will be undertaken regularly. • No mitigation measures can be undertaken for the increased visibility of construction vehicles and the additional activity. However, such activities will be kept to normal daytime working hours as far as possible to prevent the impact of floodlights and other sights during resting hours. Construction vehicles will, however, be left in the construction camps next to the roads during off times such as at night and over weekends.
Noise Impacts Increased noise impacts are expected to occur along the road; which is expected to affect residents in the area, especially in the urban areas where the road enters Ermelo and Hendrina. The noise will also affect the travellers on the road. Status: Negative Extent: Regional Duration: Long term Intensity: High Probability: Definite Weighing Factor: High Significance: Medium High Significance with mitigation: Medium	• Construct noise barriers between the road and the residential boundaries, where possible. • Construction activities should be kept to normal working hours.
Air Quality Impacts Anticipated impacts on the air quality are the following: • Increased dust levels. • Smoke pollution from ill maintained machinery and vehicles. Status: Negative Extent: Regional Duration: Long term Intensity: High Probability: Definite Weighing Factor: High Significance: Medium High Significance with mitigation: Medium	• Trucks will undergo regular maintenance as and when necessary. • Dust suppression measures such as the spraying of water, will be undertaken regularly under the supervision of the ECO.

Impacts	Mitigation measures
Soil Impacts Impacts on soil include the following: • Soil contamination due to potential spillages. • Soil erosion due to construction activities. • Degradation of soil structure and function due to exposure of topsoil, incorrectly stockpiled topsoil and lack of vegetation on stockpiles. These impacts are expected to be limited to the soil directly surrounding the site and should not extend to the agricultural and other soils located further from the site. Status: Negative Extent: Site Duration: Short to medium Intensity: Medium Probability: Highly likely Weighing Factor: Medium to high Significance: Medium Significance with mitigation: Low to medium	• Construction equipment should be well maintained to prevent any form of leakage. • Where oil spillages have occurred, contaminated soil must be cleaned and soil be properly reinstated under the supervision of the ECO. • Institute and implement wind and water erosion-control measures. • As the construction activities will remain within the road reserve, no vegetation clearance of surrounding vegetation should occur. • Topsoil should be neatly stacked and stored to prevent loss.
Water Resource Impacts Anticipated impacts on water resources includes the following: • Water quality deterioration due to the incidental presence of waste material or construction material. • Impact on the habitat provided within the water resource for fauna, flora and aquatic life. • Sedimentation due to exposed topsoil stockpiles and uncovered roadsides. • Erosion of river banks. Status: Negative Extent: Regional Duration: Medium term Intensity: Medium Probability: Likely Weighing Factor: High Significance: Medium to high Significance with mitigation: Low	• No sewage or raw water may enter any surface water or storm water system. • Temporary chemical toilet facilities should be used and appropriately maintained. These facilities must be located outside the 1:100 year floodline of any watercourse. • Install appropriate erosion control measures such as the implementation of silt curtains and planting grasses on any exposed soil, to ensure that runoff entering and leaving the site is minimised. • No soil should be discarded into the storm water system or drainage lines. • No construction rubble, if any, or any other sanitary water to be dumped into the storm water system.
Floral Impacts Impacts on surrounding flora includes: • Destruction of the natural habitat and changes to soil structure through negligent activities. Status: Negative Extent: Site Duration: Short - medium term Intensity: Medium Probability: Definite Confidence: High Significance: Medium to High Significance with mitigation: Low to Medium • Exposure of the site to erosion by means of the removal of surface vegetation.	• Sufficient care must be taken during the construction phase to ensure that areas outside of the development footprint are not disturbed through trampling. • Plan construction activities to limit unnecessarily prolonged exposure of stripped areas and stockpiles. Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area. • Prior to any construction, borrowing and quarrying activities, the entire available topsoil layer must be stripped and stockpiled separately from overburden (subsoil and rocky material). • In the absence of a recognisable topsoil

Impacts		Mitigation measures
Status	Negative	layer, strip the upper most 300mm of soil. • Strip and stockpile herbaceous vegetation, overlying grass and other fine organic matter along with the topsoil. • Do not strip topsoil when it is wet. • Store stripped topsoil in an approved location and in an approved manner for later reuse in the rehabilitation process. • Stockpile topsoil stripped from different sites separately, as reapplication during rehabilitation must preferably be site specific. Do not mix topsoil obtained from different sites. • Make use of existing roads and tracks where feasible, rather than creating new routes through vegetated areas. • Avoid routes through drainage lines and riparian zones wherever possible. Where access through drainage lines and riparian zones is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. Avoid roads that follow drainage lines within the floodplain. • Runoff from roads must be managed to avoid erosion and pollution problems. • Regularly remove topsoil (and other material) accumulated in side drains of roadways to keep these open and functional. • Clear up any gravel or cement spillage on roads. • Slight deviations of alignment must be permitted, so as to avoid plant populations of conservation concern. • Where the threatened and protected plants are deemed to be under threat from the construction activity, the plants should be removed by a suitably qualified specialist and replanted as part of vegetation rehabilitation after the construction (Note, these plants may only be removed with the permission of the local authority). In addition the following is recommended (DEAF, 2005): – Aloes and bulbous plants may be transplanted at any time of the year, although the winter months are preferred. – Minimise disturbance of the soil and the remaining roots in the rootball during the lifting, moving and or transportation of all species. – Wrap the rootball in Hessian or in plastic sheeting to retain the soil and to keep the rootball moist.
Extent	Site	
Duration	Medium term	
Intensity	Medium	
Probability	Probable	
Confidence	High	
Significance	High - Medium	
Significance with mitigation	Low - Medium	
• Destruction of the Threatened and Protected Plant Species by means of habitat removal and possible damages during removal. Furthermore, the suitable habitat for plants that has the potential to occur could also be destroyed, limiting the changes of persistence of the plant species in the area.		
Status	Negative	
Extent	Site	
Duration	Medium term	
Intensity	Medium	
Probability	Probable	
Confidence	Medium	
Significance	Medium	
Significance with mitigation	Low	

<table>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td></td><td>
– Plant aloes and bulbs in similar soil conditions and to the same depth as in their original position.
– Water aloes and bulbs once directly after transplanting to settle the soil.
• All threatened and protected plants must be cordoned off (permeable fencing) as no-go areas during the construction period.
• Establish and maintain fire breaks around the work sites as veld fires in the wrong season can cause loss of species and soil erosion.
• An ecologically sound, storm water management plan must be implemented during construction.
• Remove only the vegetation where essential for upgrading activities to continue and do not allow any disturbance to the adjoining natural vegetation cover.
• Construction workers may not tamper or remove the adjoining natural vegetation and neither may anyone collect seed from the plants without permission from the local authority.
• An Ecological Management Plan must be compiled by a suitably qualified ecologist and must:
– Ensure the persistence of the plants of conservation concern along the road during and post construction (monitor for at least one growing season after construction is complete).
– Minimise artificial edge effects (e.g. water runoff from the road upgrade activities and application of chemicals).
– Results to be reported back to the DEA during and after construction (at least one growing season).
• An ECO must be appointed to oversee mitigation measures during the construction and will be responsible for the monitoring and auditing of contractor's compliance with the conditions of the Ecological Management Plan.
</td></tr>
<tr><td>
<u>Faunal Impacts</u>
Impacts on surrounding fauna includes:
• Destruction of faunal habitat along, and adjacent to the road, by means of long lasting effects from road construction.
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Duration</td><td>Medium</td></tr>
<tr><td>Intensity</td><td>High</td></tr>
</table>
</td><td>
• Conduct a final walkthrough of the route prior to commencement of construction activities to ensure absence of species listed as conservation concern.
• Install drains and interceptors to minimise the flow of storm water into sensitive areas adjacent the road.
• All labourers to remain inside construction footprint.
</td></tr>
</table>

Impacts	Mitigation measures

Probability	Definite
Confidence	High
Significance	High
Significance with mitigation	High

- Increased faunal mortality from road construction.

Status	Negative
Extent	Local
Duration	Short term
Intensity	Medium
Probability	High
Confidence	High
Significance	High
Significance with mitigation	Medium

- No animals may be snared, captured or wilfully damaged or killed.
- Use wire mesh on the roadsides to stabilise the ecosystem through reduced soil erosion, minimised landslides and controlled sedimentations into streams and wetlands adjacent the road.
- Removal of rubble, litter, refuse, temporary infrastructure extensions subsequent to construction and rehabilitation.
- Rehabilitation of disturbed areas and communities after construction activities by implementing an ecological restoration plan.
- Re-create habitats, such as sensitive wetland and riparian habitats that might have been destroyed during the construction processes e.g. planting of indigenous grasses or trees on the shoulder of the road.

Wetland Impacts

Impacts on surrounding wetlands include:

- Destruction of wetland habitat: Footprint of new road could infringe or destroy wetland habitat and associated biota through removal of hydrophytic vegetation and or hydric soils.

Status	Negative
Extent	Regional
Duration	Permanent
Intensity	High
Probability	Probable
Confidence	High
Significance	High
Significance with mitigation	Low to Medium

- Surface water pollution by means of hydrocarbon spillages, improperly stockpiled construction materials, litter and a lack of toilet facilities causing sewage spills.

Status	Negative
Extent	Regional
Duration	Short term
Intensity	Low
Probability	Probable
Confidence	High
Significance	Low
Significance with mitigation	Low

- Alternate widening on either side of the road to achieve protection of specific hydrogeomorphic (HGM) units, especially where there are only wetlands located on one side of the road.
- Where the road supports wetlands of equal importance on both sides of the existing road (e.g. HGM 36 & 38), the road footprint should be kept to a minimum and strictly stay within the existing road reserve. Refer to Figure 8 in Appendix D3.
- Re-vegetation of disturbed areas must be undertaken with site indigenous species and in accordance with the instructions issued by the ECO. Refer to the Wetland Assessment in Appendix D3 for a list of recommended species.
- After completion of the construction phase, a wetland monitoring program must be initiated that ensure that all wetland protection infrastructure and storm-water systems are properly installed and that all affected wetland areas are adequately rehabilitated.
- Avoid construction activities in wetlands at all cost through proper demarcation and appropriate environmental awareness training. The Contractor has a responsibility to inform all staff of the need to be vigilant against any practice that will have a harmful effect on wetlands. This information shall form part of the Environmental Education Programme to be effected by the Contractor, including the following:

<table>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td></td><td>– No construction shall take place in areas of high sensitivity i.e. "NO-GO Areas". All no-go areas must be demarcated with red tape under guidance of the ECO.
– Infilling, excavation, drainage and hardened surfaces (including buildings and asphalt) should not occur in any of the wetland zones (i.e. permanent, seasonal or temporary), or within 30m of a wetland. This 30m buffer zone should be extended in areas where slope in combination with rainfall will potentially provide conditions for the transportation and deposition of materials within wetland areas.
– Should constructing be contained to non-wetland areas, caution must be taken to ensure building materials are not dumped or stored within the delineated wetland buffer zone of 30m.
– Stormwater outflows should not enter directly into a wetland. The velocity of water that may reach wetlands should be slowed before it is intercepted by virgin soils using a siltation and erosion control structure. The plans and specification for this structure should be forwarded to the relevant stakeholders such as Working for Wetlands and local municipalities.
– Emergency plans must be in place in case of spillages into wetland systems.
• For more mitigation measures related to wetlands, refer to the EMPr attached in Appendix F3.</td></tr>
<tr><td><u>Aquatic Impacts</u>
Impacts on the aquatic environment includes:
• Increased sediment input due to reshaping of river banks and construction within the river channel.
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Short term</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Probability</td><td>Probable</td></tr>
<tr><td>Confidence</td><td>High</td></tr>
<tr><td>Significance</td><td>Lo</td></tr>
<tr><td>Significance with mitigation</td><td>Low</td></tr>
</table>
• Obstruction of migratory aquatic fauna through construction of the bridges and within the river channel.
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Duration</td><td>Short term</td></tr>
</table></td><td>• Erect silt curtains on the downslope sides of all construction areas in close proximity to water resources, including wetlands.
• The temporary storage of topsoil, inert spoil, fill, and so forth should be above the 20 year floodline or at least 20m from the top of the bank of any drainage lines, whichever is the maximum or as agreed with the ECO.
• To prevent erosion of material that is stockpiled for long periods, the material must be retained in a bermed area.
• Mulch, roughen or sterile grass seeding can be used on any batter or topsoil stockpile that is to be maintained for longer than 28 days.
• Construct an earth bank around the</td></tr>
</table>

Impacts		Mitigation measures
Intensity	Low	upslope portion of any stockpiles in order to redirect runoff and prevent scouring of stockpiles. • Erect a silt fence around any stockpiles in order to trap sediment and prevent stockpile sediment loss. • Stockpiles should not be higher than 2m to avoid compaction, and single handling is recommended. • Dust suppression is necessary for stockpiles older than a month – with either water or a biodegradable chemical binding agent. • While no key migratory aquatic species are likely to be present within the watercourses associated with the proposed project, a precautionary approach should still be applied. As such, ensure that no barriers to the migration of aquatic biota are created when conducting work at the bridge site, and if possible, conduct the proposed activities during times when biota are not likely to utilise migratory routes (i.e. during winter). • For more mitigation measures related to aquatics, refer to the EMP attached in Appendix F4.
Probability	Unlikely	
Confidence	High	
Significance	Low	
Significance with mitigation	Low	
• Surface water pollution by means of flooding of the construction area, the construction vehicles and the construction camp.		
Status	Negative	
Extent	Regional	
Duration	Short term	
Intensity	Low	
Probability	Probable	
Confidence	High	
Significance	Low	
Significance with mitigation	Low	
Heritage Impacts Heritage impacts include: • Findings and destruction of potential human remains or historical artefacts that may be unearthed. No historical buildings will be affected by the upgrade of the road; since the construction activities will be limited to the road reserve.		All finds of human remains or historical artefacts should be left untouched when discovered. The police should be notified if human remains are discovered. Notify the South African Heritage Resources Agency (SAHRA) when any heritage resource or artefact is discovered or unearthed during the construction phase.
Status	Negative	
Extent	Site	
Duration	Permanent	
Intensity	Medium	
Probability	Unlikely	
Weighing Factor	Medium	
Significance	Medium	
Significance with mitigation	Low	
Social Impacts Social impacts include: • Impacts on the surrounding landowners and other affected parties such as people living in the surrounding communities and towns as well as people driving along the road everyday. These people may experience negative feelings due to the noise, dust and nuisance that the construction activities may cause.		• Comments from the potentially affected parties have been obtained in the initial commenting period and have been addressed as part of the comments and response report. Further issues and comments will be obtained by means of placing this report for public comment. • Implement a dust minimisation strategy that will reduce the impact of atmospheric pollution. • Construction related activities should be limited to work days (Monday to Saturday, daylight hours) and the impact on traffic patterns should be mitigated by
Status	Negative	
Extent	Site	
Duration	Short term	
Intensity	High	

Impacts		Mitigation measures
Probability	Highly Likely	instating traffic off-peak times. • Traffic calming measures should be put in place to minimise traffic noise. • Adequate monitoring of the biophysical impacts should occur in order to address any unnecessary inconveniences to stakeholders. Further impacts can be mitigated by implementing the mitigation measures as provided for above.
Weighing Factor	Medium	
Significance	Medium	
Significance with mitigation	Low	
<u>Management of construction camps (noise, visual, air quality and social impacts)</u> Ill conducted management of construction camps may lead to the following impacts occurring: • Spillage of chemicals and hydrocarbons. • Other pollution such as litter, rubble and construction waste. • Uncontrolled dust. • Fires. • Detrimental ecological impacts. • Uncontrolled waste dumping and windblown waste.		• All incidences of spillage of chemicals or other pollution to be reported on, and addressed immediately, and where an independent or specialist company is used, the local authority should be informed. • Fires are not permitted on site. • Dust suppression should be undertaken regularly. • Erect silt curtains on the downslope sides of all construction areas in close proximity to water resources, including wetlands. • Avoid construction activities in wetlands at all cost through proper demarcation and appropriate environmental awareness training. • Implement stockpile control measures such as height restrictions, vegetating of stockpiles and dust suppression. • All labourers to remain inside construction footprint. • Remove rubble, litter, refuse and temporary infrastructure extensions subsequent to construction and rehabilitation. • During rehabilitation, re-vegetate disturbed areas and ensure re-establishment of faunal habitats. • Manage runoff from roads to avoid erosion and pollution problems. • Clear up any gravel or cement spillage on roads. • Establish and maintain fire breaks around the work sites as veld fires in the wrong season can cause loss of species and soil erosion. • Construction workers may not tamper or remove the adjoining natural vegetation and neither may anyone collect seed from the plants without permission from the local authority. • An ECO must monitor and audit the construction camps for compliance.
• Status	Negative	
Extent	Site	
Duration	Short term	
Intensity	Medium	
Probability	Likely	
Weighing Factor	Medium	
Significance	Low to Medium	
Significance with mitigation	Low	

<table>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td><u>Waste management (soil, water resources and social impacts)</u>
Inadequate waste management can lead to the following impacts occurring during construction:
• Contamination of soil.
• Infiltration of pollutants to water resources.
• Litter being blown away by the wind thereby affecting the sense of place, farm and wild animals (health hazard) and polluting the water resources and ecological features.

The following impact status is expected:
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Duration</td><td>Short term</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Probability</td><td>Likely</td></tr>
<tr><td>Weighing Factor</td><td>Low</td></tr>
<tr><td>Significance</td><td>Medium</td></tr>
<tr><td>Significance with mitigation</td><td>Low</td></tr>
</table></td><td>• Littering on site and the surrounding areas is prohibited.
• Clearly marked litterbins must be provided on site.
• All bins must be regularly cleaned of all litter.
• The contractor must install and maintain mobile chemical toilets at the work site.</td></tr>
<tr><td><u>Construction rehabilitation</u>
Rehabilitation on completion of construction is expected to have the following impacts:
• Removal of all noise, visual, air quality and ecological direct impacts.
• During rehabilitation, the relevant machinery may have impacts as described in this section until such time as rehabilitation of the surrounding areas is complete and all vehicles and materials are removed.

<table>
<tr><td>Status</td><td>Positive</td></tr>
<tr><td>Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Short term</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Probability</td><td>Definite</td></tr>
<tr><td>Weighing Factor</td><td>Medium</td></tr>
<tr><td>Significance</td><td>Low to medium</td></tr>
<tr><td>Significance with mitigation</td><td>Low</td></tr>
</table></td><td>After the completion of the construction activities along the N11 between Hendrina and Ermelo, the area should be restored, as a minimum, to its original state. This includes landscaping activities along the route.</td></tr>
<tr><td>INDIRECT IMPACTS:
It is not expected that any indirect negative impacts will occur due to the upgrading of the road.

It is however, expected that the upgrading of the road will have a positive impact for all commuters on the road upon completion.</td><td>No mitigation necessary.</td></tr>
<tr><td>CUMULATIVE IMPACTS:
Construction activities on other road sections in close proximity to this project may cause additional traffic disturbances and disruptions. Nuisance effects due to various road upgrading projects can be expected.</td><td>No mitigation measures other than the ones listed above can be undertaken for such cumulative impacts.</td></tr>
</table>

CONSTRUCTION PHASE: NO-GO ALTERNATIVE

Impacts	Mitigation measures
Should the project not be approved, no construction activities will occur. Therefore there will be no resulting environmental impact during this phase. It should, however, be noted that should the project not be approved and construction not occur, the condition of the road will continue to deteriorate and lead to an increased number of accidents and other health and safety impacts. The road repair programme is a strategic project; which should it fail to be implemented will significantly impact on the delivery of coal to the power plants and thereby impacting on the ability of the power station to generate sufficient quantities of electricity. Non-implementation may also lead to coal trucks driving on alternative routes and thereby degrading such roads in the process. This in turn may lead to residents in the area and other road users experiencing increased safety risks, higher operating cost on their private vehicles and associated problems on the degraded roads.	No mitigation measures can be provided for this alternative.

OPERATIONAL PHASE: ALTERNATIVES A (PREFERRED ALTERNATIVE) & B

Impacts	Mitigation measures
DIRECT IMPACTS:	
Visual Impacts: Visual impacts during the operation phase includes: • The anticipated increased number of vehicles on the road. • Badly maintained road reserves (e.g. invasive vegetation and litter). • Maintenance crews working in the road reserve.	• Ensure that areas along the proposed N11 road upgrade are always kept clean. • Supply enough signage along the route thereby informing the public of illegal littering.

Status	Negative
Extent	Site
Duration	Permanent
Intensity	Low
Probability	Definite
Weighing Factor	Low
Significance	Low
Significance with mitigation	Low

Floral Impacts • Possible increase in exotic vegetation: Alien invasive species can spread into disturbed soils.	• Sufficient care must be taken during routine maintenance to ensure that areas outside of the development footprint will not be disturbed through trampling. • The introduction of alien plant species should be avoided at all times through routine maintenance activities. • Compile and implement an alien invasive monitoring plan to prevent the colonisation and spread of alien invasive plant species. • Remove alien invasive plants in planned phases (e.g. starting upstream and working on light infestations first) and maintain control via regular follow-ups. • Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. • Follow manufacturers' instruction when using chemical methods, especially in terms of quantities, time of application and so forth. • Ensure that only properly trained people handle and make use of chemicals. • Dispose of the eradicated plant material at an approved solid waste disposal site. If no toxic sprays or persistent poisons were used during eradication, then the wood may be sold or donated. • Rehabilitate all identified areas as soon as practically possible, utilising specified methods and species. • Only indigenous plant species

Status	Negative
Extent	Site
Duration	Medium term
Intensity	Medium
Probability	Probable
Confidence	Medium
Significance	Medium
Significance with mitigation	Low

<table>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td></td><td>naturally occurring in the area should be used during the rehabilitation of the areas affected by the construction activities.
• All overburden and spoil shall be left in a configuration which is in accordance with accepted conservation practices and which is suitable for the proposed subsequent use of the land.
• Control the type of material imported to ensure that soil contamination does not occur and bury coarse material incapable of supporting vegetation beneath the finer material.
• Grassing must be undertaken by a suitably qualified Contractor, making use of the appropriate equipment via sodding or hydroseeding.
• Hydroseeding with a winter mix will only be required where regrassing is urgent, and cannot wait for the summer.
• Planting and re-planting of plants removed prior to commencement of the road upgrade should preferably be done during the rainy season.
• Allow for a maintenance period of one year following practical completion, unless otherwise specified.
• Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
• Bare areas that show no specified vegetation growth after three months of the rehabilitation work are to be spread with additional topsoil, ripped to a depth of 100mm and re-planted, re-sodded, re-hand sown or re-hydroseeded.
• Once the site is reclaimed, any fences where they exist, shall be removed to permit re-vegetation.</td></tr>
<tr><td></td><td></td></tr>
<tr><td><u>Faunal Impacts</u>
Impacts on the fauna during this phase includes:
• Destruction of faunal habitats: faunal habitats present along the road could be negatively affected or even destroyed by construction activities associated with the road.
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Duration</td><td>Medium term</td></tr>
<tr><td>Intensity</td><td>Medium</td></tr>
<tr><td>Probability</td><td>Probable</td></tr>
<tr><td>Confidence</td><td>High</td></tr>
</table>
</td><td>• Install underpasses or tunnels underneath the road, specifically where watercourses cross the road. This will act as important movement corridors for a number of faunal species, including amphibians and may lessen the fragmentation effect of roads and therefore the faunal distributions associated with them.
• Construction of fences is good practice to minimise the number of larger faunal species (wild and</td></tr>
</table>

Impacts	Mitigation measures

Significance	High
Significance with mitigation	Medium

- Increased mortality from collisions with vehicles for most terrestrial species. Amphibians may be especially vulnerable to road kill because their life histories often involve migration between wetland habitats and individuals are inconspicuous and slow moving.

Status	Negative
Extent	Local
Duration	Short term
Intensity	High
Probability	Medium
Confidence	Medium
Significance	Medium
Significance with mitigation	Low

- Modification of animal behaviour: The presence and construction of a road may modify an animal's behaviour either positively or negatively. For instance: Raptors may change their home ranges to forage along roads as there are more prey species present. Conversely animals that are attracted to modified habitats alongside roads can suffer high rates of mortalities and could result in population sinks.

Status	Negative
Extent	Local
Duration	Long term
Intensity	Medium
Probability	Medium
Confidence	Medium
Significance	Medium
Significance with mitigation	Medium

domestic) impacted on by road collisions.

- Rehabilitation of disturbed areas and communities after construction activities by implementing an ecological restoration plan.

Wetland Impacts

- Increased erosion due to road widening and therefore increase in impermeable surfaces.
- There is an associated increase in flow velocities and erosion potential within affected wetland habitats.
- Runoff from the road surface may enter into the associated watercourse and wetlands, resulting in an unnaturally high catchment runoff, wetland scouring and increased flooding of downstream areas.

Status	Negative
Extent	Regional
Duration	Permanent
Intensity	Medium
Probability	Possible
Confidence	Medium
Significance	High
Significance with mitigation	Low

- Should any work be conducted on the culverts present, box culverts are to be used as it will allow for better connectivity.
- The base of the box culverts should be at least 1m below the bed of the river channel so as to prevent the formation of plunge pools on the downstream side of the bridge.
- The bed of the river channel should be rehabilitated to the correct height following culvert installation.
- An ecologically-sensitive stormwater management plan should be developed that does not allow concentrated stormwater to enter into a wetland or watercourse directly, but instead makes use of flow diffusers and retention areas (such as artificial wetland areas, swales, baffles and gabion structures). There is a need for between one and four such structures

Impacts	Mitigation measures
	for each of the 67 identified wetlands within the study area. • The area east of the road located between HGM 2 and HGM 6. Headgully erosion is moving northwards scouring away wetland habitat and is likely to threaten the integrity of the road (especially with increased runoff velocities). It is recommended that appropriate gabion structures are designed and installed in the appropriate localities in order to halt the current erosion processes and re-establish the wetlands water table to pre-disturbance levels. • HGM 21, west of the existing road have been exposed to several anthropogenic disturbances including concentrated flow from two pipes which have caused plunge pool formation and gully erosion in several sections downstream. Appropriate rehabilitation initiatives should be designed and implemented including velocity breaking structures such as baffles, alien vegetation removal and restoration initiatives of the affected seepage wetland areas. • HGM 31 and 32 has been degraded through gully erosion east and west of the existing road which itself are being affected by erosion processes. The worst affected section is on the western side of the road where a plunge pool have formed with subsequent gully erosion downstream. A weir wall should be constructed upstream of the road which will stabilise erosion processes within the wetland. The downstream area with plunge pool and gully should be rehabilitated and flow velocity dissipating structures introduced to prevent reoccurrences of the problem. • HGM 29 and HGM 30 achieved a high functional score during the field assessment and are therefore especially sensitive. This largely unchannelled valleybottom system have been impacted by the existing road through channel development as a result of concentrated flow. Appropriate rehabilitation initiatives should be designed and implemented including velocity breaking structures such as baffles, widening the release platform on the downstream side as well as plugging the eroding channel.

<table>
<tr><th>Impacts</th><th>Mitigation measures</th></tr>
<tr><td>
<u>Aquatic Impacts</u>
Impacts on the aquatic life in the study area will be impacted as follows:
• Increased erosion by means of increased surface runoff.
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Permanent</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Probability</td><td>Possible</td></tr>
<tr><td>Confidence</td><td>Medium</td></tr>
<tr><td>Significance</td><td>Medium</td></tr>
<tr><td>Significance with mitigation</td><td>Low</td></tr>
</table>
• Obstruction of migratory aquatic fauna due to incorrect culvert structure.
<table>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Extent</td><td>Regional</td></tr>
<tr><td>Duration</td><td>Permanent</td></tr>
<tr><td>Intensity</td><td>Low</td></tr>
<tr><td>Probability</td><td>Possible</td></tr>
<tr><td>Confidence</td><td>High</td></tr>
<tr><td>Significance</td><td>Medium</td></tr>
<tr><td>Significance with mitigation</td><td>Low</td></tr>
</table>
</td><td>
• Should any work be conducted on the culverts present, box culverts are to be used.
• The base of the box culverts should be at least 1m below the bed of the river channel so as to prevent the formation of plunge pools on the downstream side of the bridge.
• The bed of the river channel should be rehabilitated to the correct height following culvert installation.
• An ecologically-sensitive stormwater management plan should be developed that does not allow concentrated stormwater to enter into the watercourse, but instead makes use of flow diffusers and retention areas.
</td></tr>
<tr><td>
INDIRECT IMPACTS:
Indirect impacts due to the upgrade of the road anticipated to occur during the operational phase includes:
• <u>Noise:</u> An increased number of commuters will lead to a more constant noise level. It is not anticipated that the noise levels will increase. It is not expected that the noise levels will impact many people as most of the road passes by rural areas where the communities live relatively far from the road.
• <u>Social:</u> The road will be in a better condition than before leading to less accidents and a safer environment.
• <u>Social:</u> Due to increased traffic, farmers moving cattle across the road may be involved in more accidents than before.
</td><td>
• <u>Noise</u>: Berms can be placed next to the road. However as the road reserve needs to be free for maintenance, the berms will have to be placed on farm properties. As this is not a viable option and the noise is unlikely to significantly affect anyone, it is proposed that this impact remain unmitigated.
• <u>Social</u>: The safer road conditions are positive and thus do not need to be mitigated.
• <u>Social:</u> Affected farmers may be able to use existing culverts to transport cattle from one side of the road to the other. This will be determined in the engineering designs.
</td></tr>
<tr><td>
CUMULATIVE IMPACTS:
No cumulative impacts are expected to occur in the operational phase as a result of road upgrade activities.
</td><td>
No mitigation necessary.
</td></tr>
</table>

OPERATIONAL PHASE: NO-GO ALTERNATIVE

Impacts	Mitigation measures
DIRECT IMPACTS: The anticipated impacts of the no-go alternative comprises of not upgrading the existing road. The road will remain prevalent with patched tar areas, potholes and result in seepage into the groundwater via these potholes from the road surface. Should the road conditions continue to worsen, it is anticipated that people will start driving on the gravel or soil shoulders of the road. In turn, this will lead to an increased risk to the road users as the bad quality of the road may lead to dangerous situations.	
INDIRECT IMPACTS: Driving on the gravel shoulders will in turn lead to degraded surrounding veld conditions. The soil will also lose structure and create unsafe conditions to drive on. Unsafe driving conditions will continue as the road continues to deteriorate. This in turn may lead to an increase in road accidents.	Although Eskom is considering alternative options like the coal to rail link, this will not reduce or eliminate the need for the proposed upgrade.
CUMULATIVE IMPACTS: Should the above conditions continue to escalate, the road will eventually become very dangerous for all motorists. An increase in number of accidents occurring due to bad road conditions and low visibility is anticipated. The road will also continue to degrade until the surface becomes unusable. Similar to the no-go alternative in the construction phase, should the project not be implemented it will significantly impact on the delivery of coal to the power station and thereby impact on the ability of the power station to generate sufficient quantities of electricity. Non-implementation may also lead to coal trucks driving on alternative routes and thereby degrading such roads in the process. This in turn may lead to residents in the area and other road users experiencing problems on the degraded roads.	

3. ENVIRONMENTAL IMPACT STATEMENT

Taking the assessment of potential impacts into account, please provide an environmental impact statement that summarises the impact that the proposed activity and its alternatives may have on the environment after the management and mitigation of impacts have been taken into account, with specific reference to types of impact, duration of impacts, likelihood of potential impacts actually occurring and the significance of impacts.

Alternative A (preferred alternative)

This is the preferred alternative. Negative impacts anticipated due to the implementation of this alternative includes:

- During construction, noise, visual, possible air quality and ecological impacts will occur. Impacts will occur throughout the construction phase but can be mitigated by continuous monitoring, maintenance, vigilance and rehabilitation upon completion of the construction period.
- During the operational phase, continued visual impacts will occur. Ecological impacts will also occur should proper mitigation measures not be taken and the ecological management plan not be implemented.

All impacts throughout the construction and operational phases can be mitigated by following the measures described in the EMPr (attached in Appendix F).

Positive impact anticipated due to the implementation of this alternative includes:

- Social impacts leading to safer road conditions, less accidents, better visibility, and so forth.
- Less continuous maintenance on the road surface such as filling potholes, as the design life will be 20 years.
- Power generation is a strategic economic asset of the country. Because of its dependency on the supply of coal, of which 35% is transported by road, the economy cannot afford that the power generation be jeopardised by irregular coal delivery. Roads that are in a deteriorating state is also contributing to increased transport costs of coal, thus causing the production cost of electricity to rise to unaffordable levels. It is therefore essential to ensure that the roads that have already deteriorated to unacceptable poor conditions be upgraded immediately to secure coal supply to the power stations.

Alternative B

The impacts for Alternative B (half width construction limiting traffic flow) will have the same impacts as Alternative A, however the period over which the impacts will extend will be greater as longer delays will be affected.

No-go alternative (compulsory)

The result of undertaking the No-go Alternative is not upgrading the existing road. The road will remain prevalent with patched tar areas, potholes and result in seepage into the groundwater via these potholes from the road surface. Cumulative impacts will include a growing number of accidents occurring due to bad road conditions, low visibility and so forth. The road will also continue to degrade until the surface becomes unusable.

Initially, no direct impact will occur on the surrounding environment, however, should the road conditions continue to worsen, people will start driving on the gravel or soil shoulders of the road. This in turn will lead to degraded surrounding veld conditions. The soil will also lose structure and create unsafe conditions to drive on. Should these continue to escalate; the road will eventually become very dangerous for all motorists.

As this project is of strategic importance, should it not be implemented, it will significantly impact on the delivery of coal to the power stations and thereby impact on the ability of the power stations to generate sufficient quantities of electricity.

Non-implementation may also lead to coal trucks driving on alternative routes and thereby degrading such roads in the process. This in turn may lead to residents in the area and other road users experiencing problems on the degraded roads.

SECTION E: RECOMMENDATION OF PRACTITIONER

Is the information contained in this report and the documentation attached hereto sufficient to make a decision in respect of the activity applied for (in the view of the environmental assessment practitioner)? YES √

If "NO", indicate the aspects that should be assessed further as part of a Scoping and EIA process before a decision can be made (list the aspects that require further assessment):

If "YES", please list any recommended conditions, including mitigation measures that should be considered for inclusion in any authorisation that may be granted by the competent authority in respect of the application:

The construction and operation of the N11 between Hendrina and Ermelo should be implemented according to an EMPr to adequately mitigate and manage the identified impacts.

Design and Construction Phase:
The following mitigation and management measures should be implemented during the construction phase in order to minimise potential environmental impacts:

- Construction activities should, where possible, be limited to between 06:00 and 18:00 (in terms of the requirements of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).
- Responsible construction practices must be adopted and aimed at containing the construction activities to specifically demarcated areas, thereby limiting the removal of natural vegetation to the minimum.
- A Water Use License should be applied for in terms of the National Water Act, 1998 (Act No. 36 of 1998).
- No wetland areas should be disturbed and construction materials should not be allowed to enter any river systems, as this will affect the water quality and aquatic biodiversity.
- In terms of the borrow pits, a Mining License has to be obtained before they can be used. This must be obtained from the Department of Mineral Resource (DMR).
- Construction vehicles should use existing roads and not create new roads where natural vegetation may be destroyed.
- Clear signage and notices should be erected around the construction site or along the site, to warn motorists as this may be a risk in terms of safety.
- An ecological management plan should be developed and implemented throughout the construction phase.

Operation Phase:
The following mitigation and management measures should be implemented during the operation phase in order to minimise potential environmental impacts:

- The N11 Road should be routinely monitored and road maintenance takes place.
- Appropriate signage and warnings should be in place to provide motorists with warning of these activities during construction.
- No illegal dumping of domestic waste or any other waste will be allowed alongside the road.
- Use existing roads and stay within the road reserve during routine maintenance practises.
- The ecological management plan should be implemented throughout the construction phase.

Is an EMPr attached? YES √

The EMPr must be attached as Appendix F.

For more details on mitigation and management measures to be implemented throughout the construction and operation phases, please refer to Appendix F.

SECTION F: APPENDIXES

The following appendixes must be attached as appropriate:

Appendix A: Site plan(s)

Appendix B: Photographs

Appendix C: Facility illustration(s) & Design Drawings with Method Statement

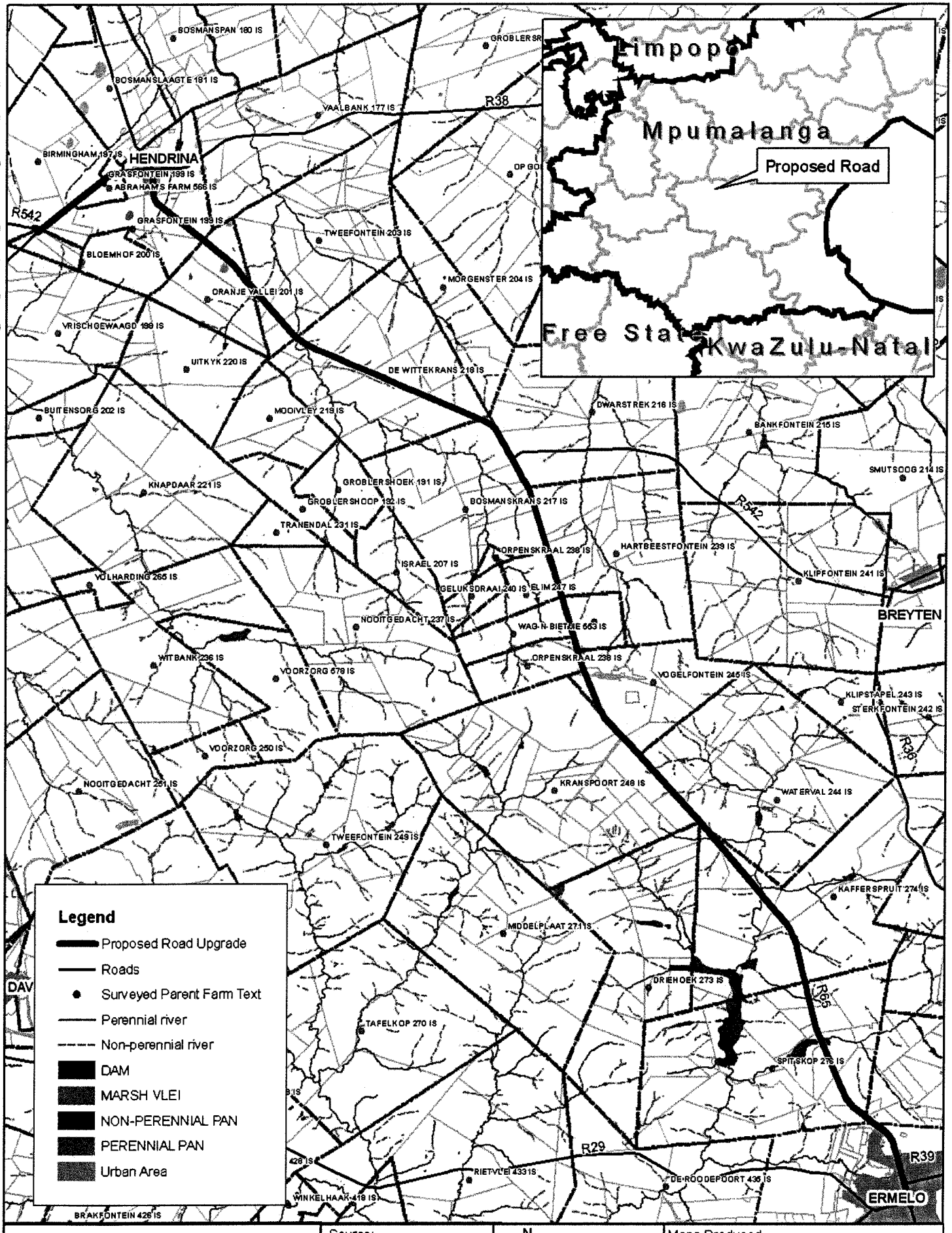
Appendix D: Specialist reports

Appendix E: Comments and responses report

Appendix F: Environmental Management Programme (EMPr)

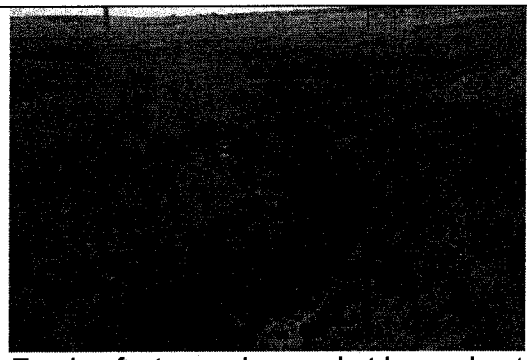
Appendix G: Other information

Appendix A: Site plan(s)

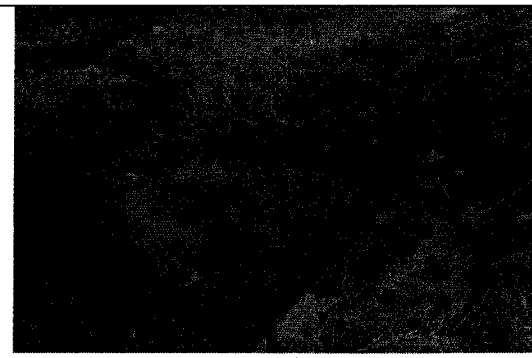


503918 WP2: N11	Source: Cadastral: MBCP 2007 Roads: CDSM	N 1:185,000	Maps Produced By: S.E.F
LOCALITY MAP		2 1 0 2 km	Date: Nov 2010

Appendix B: Photographs



Erosion features observed at box culvert crossings, showing (A) headcut erosion upstream of culverts

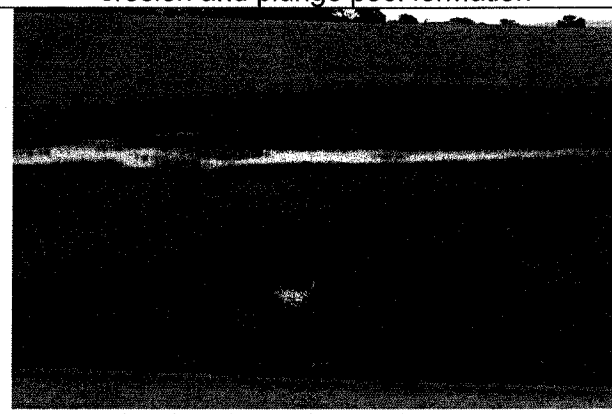


Erosion and plunge pool formation downstream of culverts

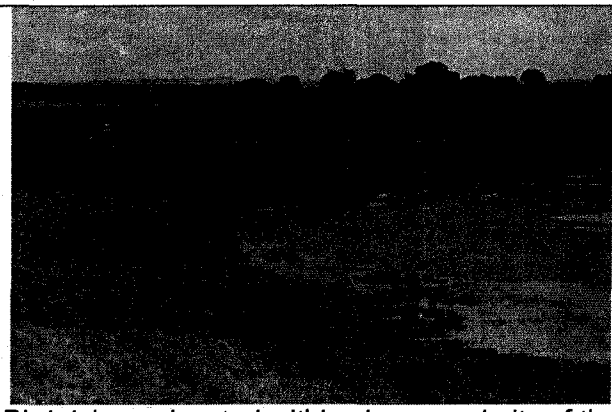
Installation of a weir wall at Site C1UNSP-SPITS upstream of the bridge crossing to prevent headcut erosion

Installation of baffle structures and gabion mattress at Site C1UNSP-SPITS downstream of the bridge crossing to prevent downstream erosion and plunge pool formation

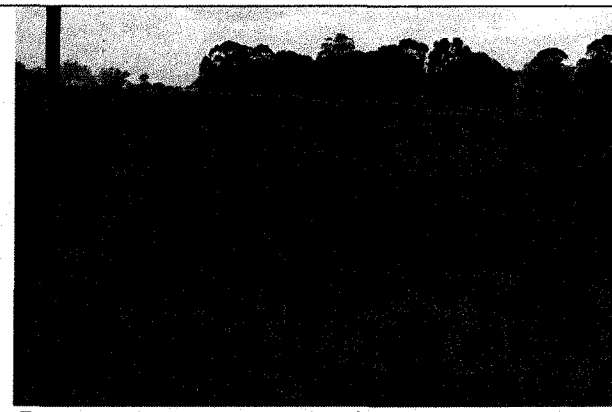
Ferric hydroxide precipitate present at bridge crossings associated with seepage and unchannelled valley bottom wetlands



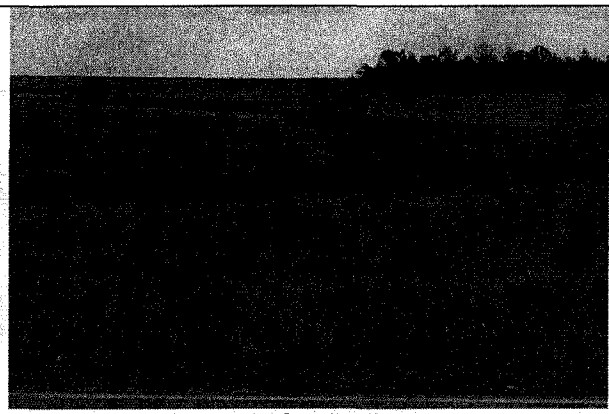
Example of wetlands found along the survey road



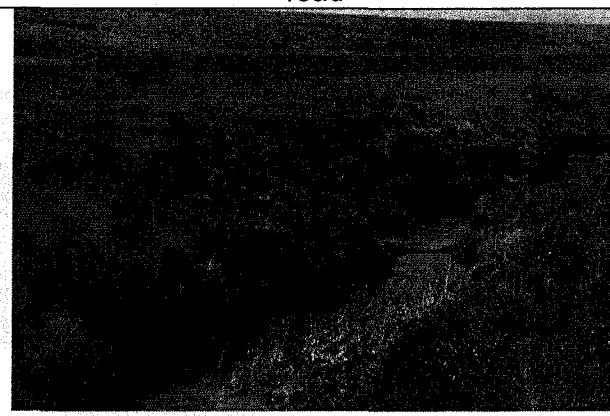
Bird rich pan located within close proximity of the road



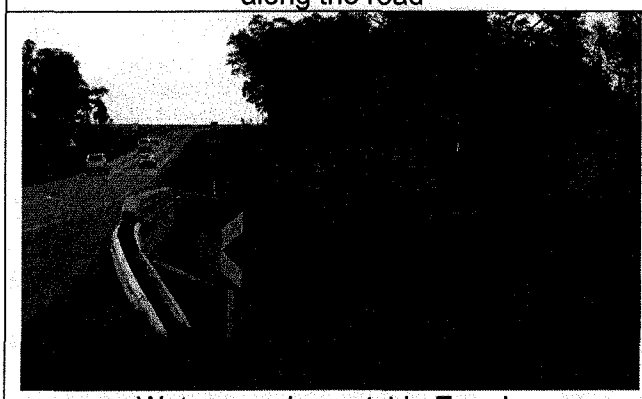
Burrows found in a wetland along the surveyed road



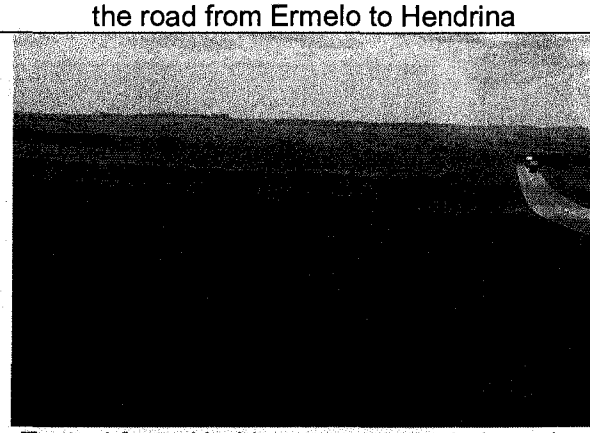
Prime example of African Grass Owl habitat along the road



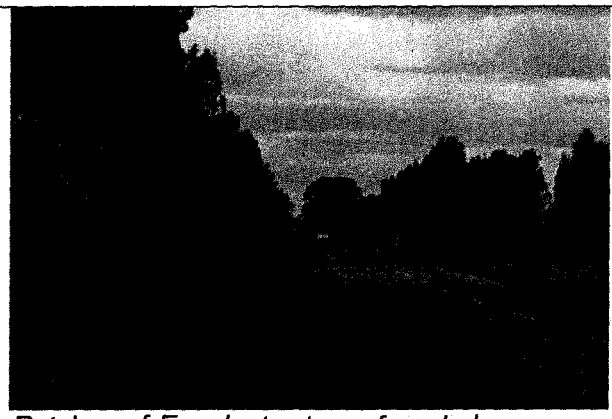
Perennial stream that flows under a bridge on the road from Ermelo to Hendrina



Water crossing outside Ermelo



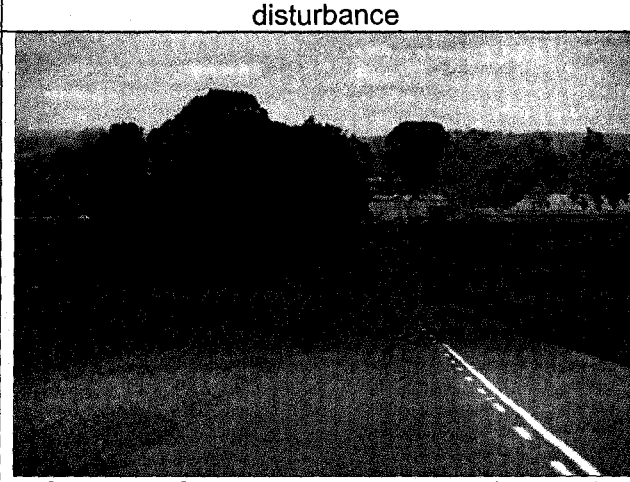
Typical faunal habitat encountered along the surveyed road



Patches of *Eucalyptus* trees found along some places along the road

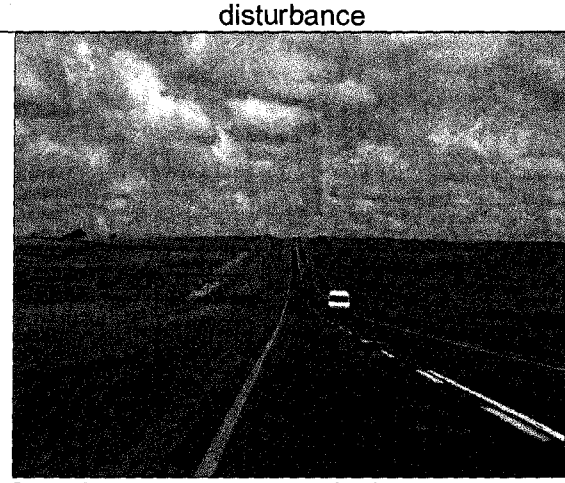
Portions of the road showing high levels of disturbance

Portions of the road showing high levels of disturbance

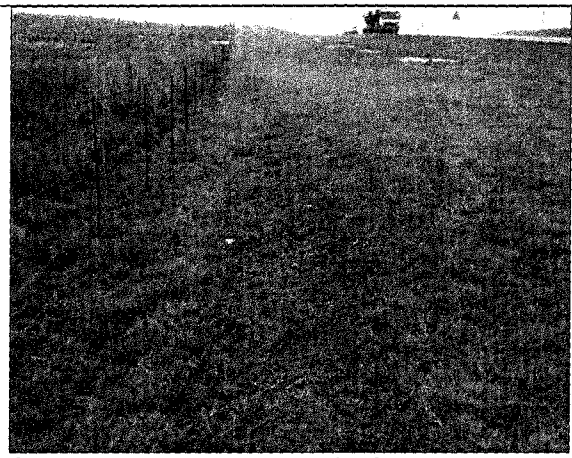


Portions of the road showing lower levels of disturbance

Portions of the road showing lower levels of disturbance



Grassland vegetation within the road reserve



Grassland vegetation within the road reserve

River crossing

Typaha capensis colonised moist areas at road culverts

Appendix C: Facility illustration(s)

Not Applicable - linear existing road with no additional structures

Appendix D: Specialist reports

Appendix D1: Vegetation Assessment Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/2078
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Work Package 2 – N11 between Hendrina and Ermelo: Rehabilitation of National Route 11 between Ermelo and Hendrina

Specialist:	Antoinette Eyssell		
Contact person:	Byron Grant		
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Professional affiliation(s) (if any)	Registered with the South African Council for Natural Scientific Professions (SACNASP) as Candidate in the field of Ecology (Reg. no 100040/08)		

Project Consultant:	Strategic Environmental Focus		
Contact person:	Milicent Solomons		
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Telephone:	012 349 1307	Fax:	012 349 1229
E-mail:	Milicent@sefsa.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Antoinette Evssell** , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of 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 have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form 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 the specialist:

Strategic Environmental Focus

Name of company (if applicable):

18/01/2011

Date:

ROAD UPGRADE AND ASSOCIATED BORROW PITS: N11 BETWEEN ERMELO AND HENDRINA WORK PACKAGE 2

Vegetation Assessment

SEF Reference No. 503928

Prepared for:

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Prepared by:

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S.E.F

STRATEGIC ENVIRONMENTAL FOCUS

January 2011

Declaration of Independence by Ecologist

I, **Antoinette Eyssell,** in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Antoinette Eyssell (Cand Sci Nat)
Terrestrial Ecologist
SACNASP Reg. No. 100040/08

Date

EXECUTIVE SUMMARY

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed by Bigen Africa (Part of the Netgroup Consortium) to conduct a Basic Assessment (BA) process for the proposed upgrade of a section of the N11 road between Hendrina and Ermelo as well as a small portion of the R38 westward from Hendrina to the R542 turnoff. The upgrade is deemed necessary as the existing pavement surface is in a poor condition with many areas having been patched. The length of the total project is 55.69km of single carriageway road. The final formation is approximately 14.0m wide.

The project also includes the widening of four bridges (including a bridge over a spruit and the Klein Olifants River). In order to obtain sufficient material for the upgrading of the road surface, it is proposed that four borrow-pits should be established along the route (three along the N11 and one adjacent to the R38 west of Hendrina). The proposed borrow pits are situated in close proximity to the road and spaced along the length thereof. The proposed road upgrade activities falls within the following quarter degree squares 2629BA, 2629BB and 2629BD.

As part of the BA process, an ecological study of the natural environment was required to inform the proposed road upgrade as well as the associated borrow pits. This report represents the vegetation assessment and should be read in conjunction with the other ecological specialist reports or opinions pertaining to the proposed road upgrade and borrow pits.

This report presents the findings obtained following an assessment of the study area that was conducted during the week of 23rd-27th of November 2010. A major limitation to the reports was that the exact size and character of the borrow pits were not known at the time of the field survey and therefore the general area around given Geographic Positioning System (GPS) coordinates was surveyed.

The study area is situated within the Grassland Biome which is divided into smaller units known as vegetation units. The majority of the N11 road section, as well as borrow pits (BP) 2, 3 and 4 are situated within the Eastern Highveld Grassland vegetation unit, while borrow pit 1 and a middle portion of the N11 road section, is situated within the Soweto Highveld Grassland. Both these vegetation units are under threat and the remaining portions (that are not disturbed) should thus ideally be avoided and conserved. Therefore, the vegetation that will be impacted upon by the proposed road upgrade activities was assessed in order to determine whether any Soweto Highveld Grassland or Eastern Highveld Grassland exist where the road upgrade activities is proposed, what the state is thereof (e.g. primary or secondary vegetation and degree of disturbance), as well as habitat for plants species that are protected or of conservation concern. In addition the Eastern Highveld Grassland and Soweto Highveld Grassland is listed as vulnerable ecosystems by the National Environmental Management: Biodiversity Act 20 (Act No. 10 of 2004).

In terms of the vegetation composition, the areas that will be affected by the road upgrade activities comprise areas of low and medium to high sensitivity. The higher sensitivity ratings are either as a result of the occurrence of plants of conservation concern, protected plants and/or moist grasslands and riparian areas that have a high ecological function in the landscape.

The road upgrade activities along the N11 from Hendrina to Ermelo are proposed to impact on the existing road reserves which are mostly colonised by typical grassland vegetation and in a secondary to sub-climax state. However, the route will also traverse trough moist grasslands and streams which are habitat to protected plant species. Where the upgrade activities occur within the moist grasslands and streams, the mitigation measures must be strictly applied in order to limit destruction to these habitats.

Borrow pit 1 and 2 are situated within medium sensitivities, whereas Borrow pit 3 is rated as being of medium to high ecological sensitivity due to its proximity to the Klein Olifants, as well as the occurrence of moist grasslands (wetlands) –. BP4 comprised of disturbed vegetation and is classified as medium to low sensitivity.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

1. INTRODUCTION

1.1 Project Description

Strategic Environmental Focus (Pty) Ltd (SEF) was appointed by Bigen Africa (Part of the Netgroup Consortium) to conduct a Basic Assessment (BA) process for the proposed upgrade of a section of the N11 road between Hendrina and Ermelo as well as a small portion of the R38 westward from Hendrina to the R542 turnoff. The upgrade is deemed necessary as the existing pavement surface is in a poor condition with many areas having been patched. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The length of the total project is 55.69km of single carriageway road. The final formation is approximately 14.0m wide.

The project also includes the widening of four bridges (including a bridge over a spruit and the Klein Olifants River). In order to obtain sufficient material for the upgrading of the road surface, it is proposed that four borrow pits should be established along the route (three along the N11 and one adjacent to the R38 west of Hendrina).

As part of the BA process, an ecological study of the natural environment was required to inform the proposed road upgrade as well as the associated borrow pits. This report represents the vegetation assessment and should be read in conjunction with the other ecological specialist reports or opinions pertaining to the proposed road upgrade and borrow pits.

1.2 Terms of Reference

The terms of reference for this assessment were as follows:

Literature review

- Gain an understanding of the ecological sensitivities within the planning area and supplement this information with the Mpumalanga Biodiversity Conservation Plan (MBCP) (Ferrar & Lötter, 2007);
- Determine the regional vegetation that is expected to occur along the N11 road section to be upgraded as well as the four borrow pits;

Field investigation

- Undertake a vegetation survey to assess the actual vegetation and sensitivities that occurs along the N11 road between Hendrina and Ermelo as well as the four borrow pits required for the upgrade;
- Conduct a survey to assess the occurrence or potential occurrence of conservation important plant species along the N11 road section to be upgraded as well as the four borrow pits; and

Recommendation and mitigation

- To provide recommendations and mitigation measures to limit the identified impacts that the proposed road upgrade and the four borrow pits required will have on the identified vegetation.

1.3 Assumptions and Limitations

This report presents the findings obtained following an assessment of the study area. The field survey was conducted during the week of 23rd-27th of November 2010.

1. The exact size and character of the borrow pits were not known at the time of the field survey and therefore the general area around given GPS coordinates were surveyed.
2. In order to obtain a comprehensive understanding of the dynamics of the biota on the site, including species of conservation concern, on a specific site, studies should include the following:

    - Investigations through the different seasons of the year;
    - Investigations over a number of years; and
    - Extensive sampling of the area.

In addition, according to the Mpumalanga Minimum Requirements for Biodiversity Assessment (Mpumalanga Tourism and Parks Agency, 2008):

> *"A floristic (plant) survey must be conducted during the growing season of all species that may potentially occur (this may require more than one season's survey in order to identify flowering species) with two (2) visits undertaken (November & February). Visits during other seasons will be determined by the flowering and fruiting times of species that do not occur during the summer."*

However, this assessment comprised of only a single site visit that was undertaken during the growing period of plants which are mainly from October to April in the summer rainfall region. The road upgrade proposes to utilize the exiting road reserve that was already impacted upon by the building and preceding road upgrades. Also, borrow pits were mainly proposed adjacent to existing borrow pits where some disturbances are expected to already have occurred.

Therefore, this vegetation assessment should be sufficient to highlight and map potential sensitivities along the N11 road section between Hendrina and Ermelo and the required borrow pits, as well as the occurrence or possible occurrence of plants species that are of conservation concern or provincially protected plant species. The resulting sensitivity map(s) is a valuable tool informing the upgrade and use of borrow pits, as well as by advising on the integration or avoidance of the sensitive vegetation where applicable.

1.4 Methodology

1.4.1 Road reserve: Hendrina-Ermelo

The vegetation assessment and sampling along the N11 road section between Hendrina and Ermelo were mainly focussed on areas where intact vegetation was expected with emphasis on riparian areas, wetlands and other potential habitats for plants of conservation concern. Transects were walked within sampling areas along the road section to be upgraded in order to determine the plant species that occur within the road reserve. Primary vegetation as well as riparian vegetation and wetlands which are protected by national legislation, are classified as being of high ecological sensitivity. The study methodology is set out in Appendix A.

1.4.2 Borrow pits

The estimated sites for the borrow pits were surveyed. Satellite images (Google-Earth, 2010) were used to pre-determine relatively homogeneous units within the study area. These units were ground-truthed during the survey by walking transects and concentrating on moving through environmental gradients in order to identify species and communities. This was continued until few to no new species were encountered. In addition, the cover abundance of plant species within sample plots where determined according to the Braun-Blanquet cover abundance scale. Primary vegetation as well as riparian vegetation and wetlands which are protected by national legislation, are classified as being of high ecological sensitivity. The study methodology is set out in Appendix A.

For each road upgrade activity the following are discussed:

- Regional vegetation (Mucina and Rutherford, 2006),
- Locality of the activity in relation to the Mpumalanga Biodiversity Conservation Plan (MBCP),
- Listed ecosystems;
- Results of the field survey including plants of conservation concern, protected plants and alien invasive plants that occur or could occur; and
- Concluded ecological sensitivity.

1.5 List of Abbreviations

Table 1 lists the abbreviations used in this report.

Table 1 Abbreviations used in the report

Abbreviation	Description
BP	Borrow Pit
EMP	Environmental Management Plan
MBCP	Mpumalanga Biodiversity Conservation Plan
MDEDET	Mpumalanga Department of Economic Development, Environment and Tourism
POSA	Plants of Southern Africa
QDS	Quarter degree square

2. Description of the Environment

2.1 Locality

The section of the N11 proposed to be upgraded connects the towns of Hendrina and Ermelo in the Mpumalanga Province. The length of the road upgrade is 55.69km of single carriageway road, while the existing width is approximately 14.0m (Figure 1). The borrow pits are situated in close proximity to the road and spaced along the length thereof (Figure 1). The proposed road upgrade activities falls within the following quarter degree squares (QDS) 2629BA, 2629BB and 2629BD.

2.2 Biophysical description

2.2.1 Climate

The area receives summer rainfall that varies between 650mm and 750 mm per year. The winters are dry with frost. The average midday temperatures for Ermelo range from 15.8°C in June to 24.1°C in January. The region is the coldest during June when the mercury drops to 0.2°C on average during the night (SA Explorer, 2010).

2.2.2 Regional Vegetation

The road reserve and borrow pits is situated within the Grassland Biome of South Africa (Rutherford & Westfall, 1994). High summer rainfall characteristic of the Grassland Biome combined with dry winters with night frost and marked diurnal temperature variations are unfavourable to tree growth. The Grassland Biome therefore comprises mainly of 'sweet' and 'sour' grasses and plants with perennial underground storage organs, for example bulbs and tubers, while trees are restricted to specialised habitats such as rocky outcrops or kloofs. The majority of Rare and Threatened plant species in the summer rainfall regions of South Africa are restricted to high-rainfall grasslands, making this the biome in most urgent need of conservation. It is not generally acknowledged that the majority of plant species in grasslands are non-grassy herbs (forbs), most of which are perennial plants with large underground storage structures. The highveld and montane grasslands of Mpumalanga are an important habitat for several threatened plant and animal taxa (Emery *et al.* 2002).

The Grassland Biome can be divided into smaller units known as vegetation units. The majority of the N11 road section, as well as borrow pits 2, 3 and 4 are situated within the Eastern Highveld Grassland vegetation unit, while borrow pit 1 and a middle portion of the N11 road section, is situated within the Soweto Highveld Grassland (Mucina & Rutherford, 2006; Figure 2).

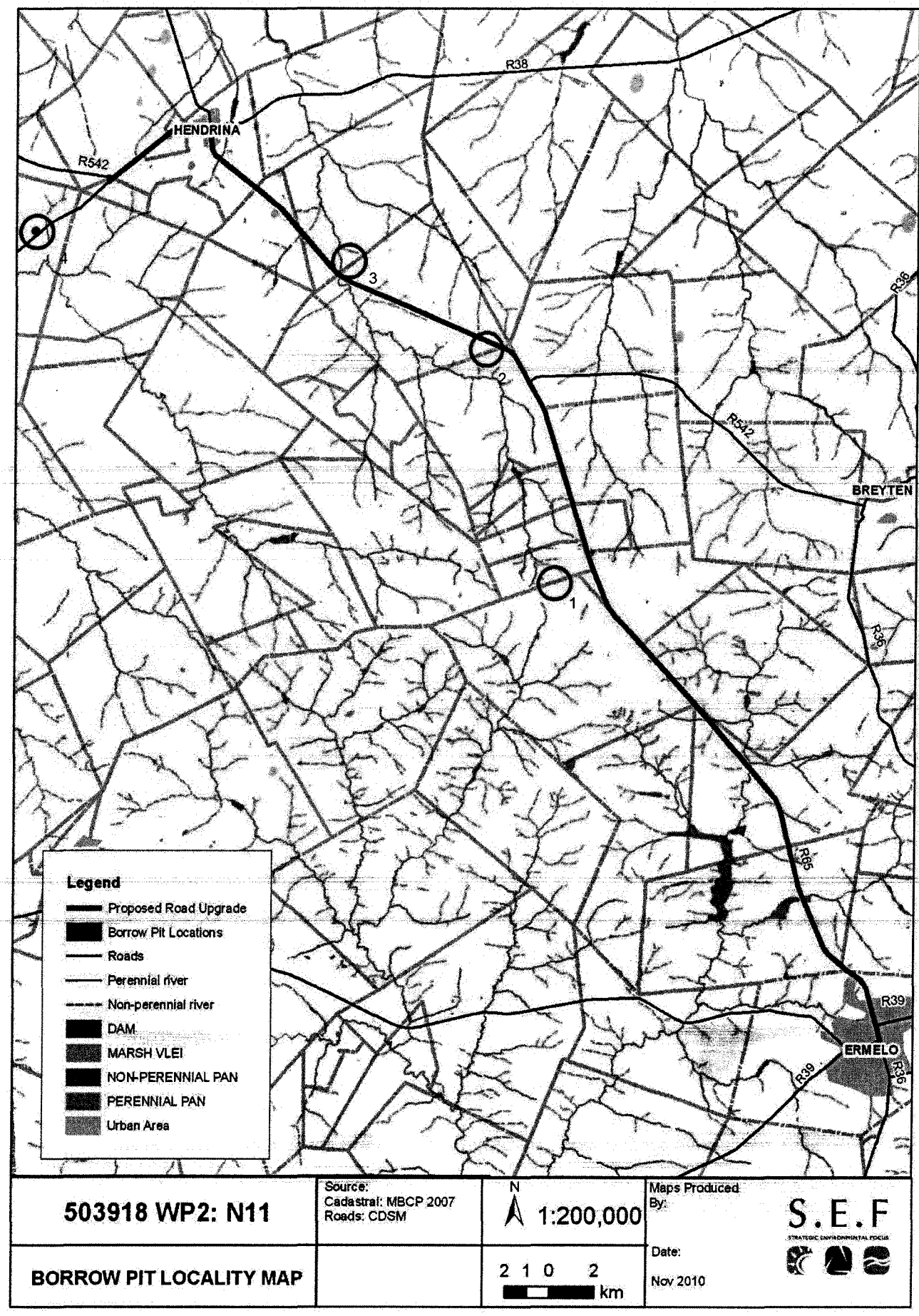


Figure 1: Locality of the Study Site

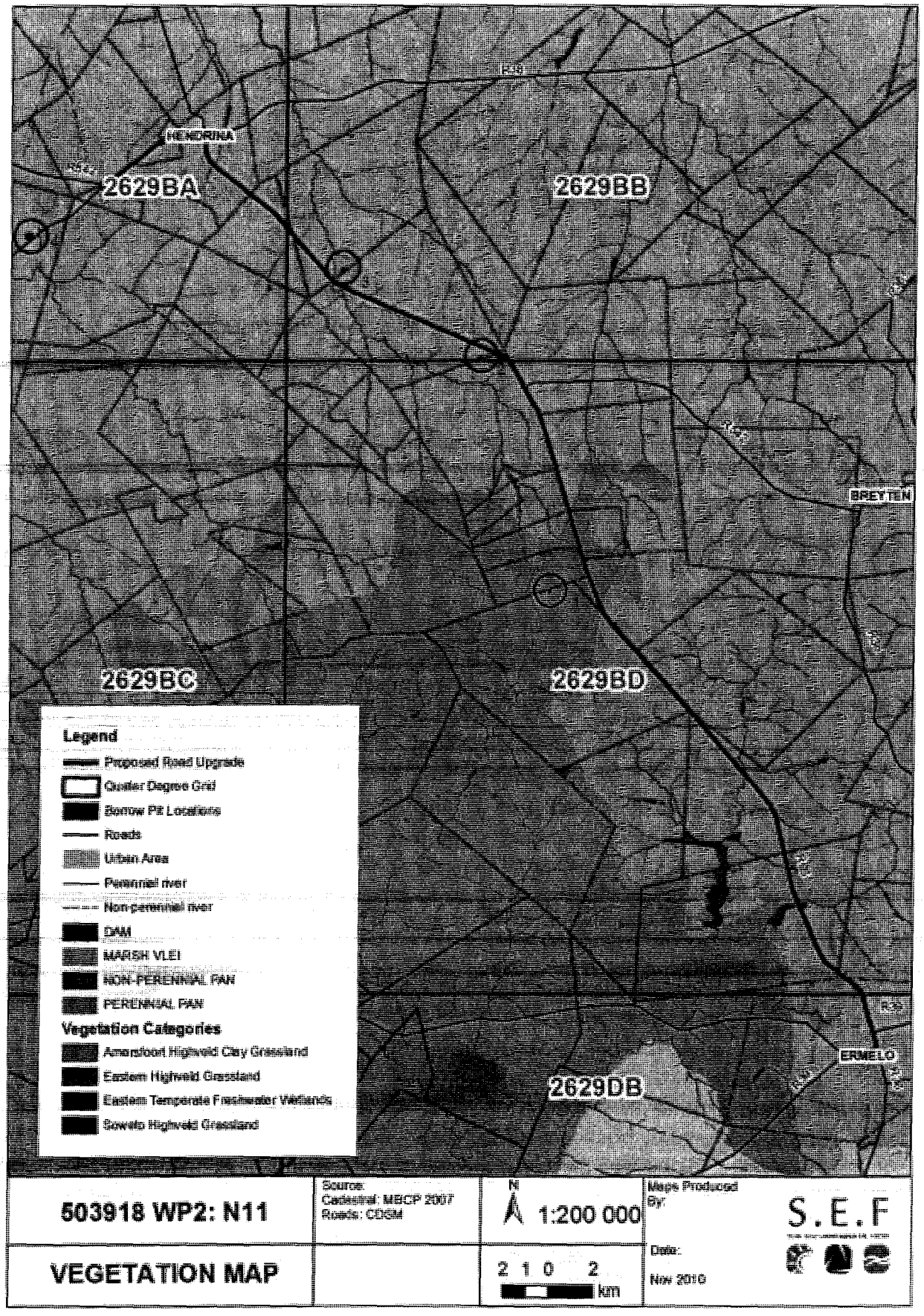


Figure 2: Regional vegetation (Mucina & Rutherford, 2006)

Eastern Highveld Grassland
Eastern Highveld Grassland occurs in the Gauteng and Mpumalanga Provinces. The species composition of this grassland unit comprises highveld grasses such as *Themeda triandra* (Red Grass), *Aristida congesta*, *Digitaria* species as well as *Tristachya leucothrix* and *T. rehmanni* (Mucina & Rutherford, 2006). The landscape usually includes undulating plains that support short, dense grassland, scattered rocky outcrops with sour grasses and tree species such as *Acacia caffra* (Sweet Thorn), *Celtis africana* (White Stinkwood) *and Diospyros lycioides* subsp. *lycioides* (Blue Bush).

Due to urban development and agricultural pressure within Gauteng and Mpumalanga, the extent of this vegetation unit is becoming limited. Only a small portion of Eastern Highveld Grassland is conserved in statutory reserves like the Nooitgedacht Dam or in private reserves. Almost half of this vegetation type has been transformed by cultivation, plantation, mining and the building of dams and it is therefore classified as an Endangered vegetation type (Mucina & Rutherford, 2006). Activities within these vegetation types should be considered according to the potential impact the development could have on the conservation of this sensitive vegetation types.

Soweto Highveld Grassland
Soweto Highveld Grassland occurs mainly within the Mpumalanga and Gauteng Provinces, with a limited distribution in the Free State and North West Provinces. This grassland unit comprises short to medium-high dense tufted grassland dominated almost entirely by the grass *Themeda triandra* (Red Grass). Other grasses include *Elionorus muticus* (Copper Wire Grass), *Heteropogon contortus* (Spear Grass) and *Tristahya leucothrix* (Hairy Trident Grass). A high diversity of forbs (herbaceous plants other than grasses) also occurs within this grassland unit, some of which are of conservation concern. The Soweto Highveld Grassland is also under pressure from urban development and only a small portion of its original extent is statutorily conserved. Soweto Highveld Grassland is also classified as an Endangered vegetation unit.

Both vegetation units are thus under threat and the remaining portions (that are not disturbed) should thus ideally be avoided and conserved. Therefore, the vegetation that will be impacted upon by the proposed road upgrade activities was assessed in order to determine whether any Soweto Highveld Grassland or Eastern Highveld Grassland exist where the road upgrade activities is proposed, what the state is thereof (e.g. primary or secondary vegetation and degree of disturbance), as well as habitat for plants species that are protected or of conservation concern.

2.2.3 Associated Water Courses

The section of the N11 that are proposed to be upgraded will cross the perennial Klein Olifants River, the Klein Xspruit and an additional unnamed watercourse as well as non perennial streams, while the relevant portion of the R38 crosses a non perennial stream (Chief Directorate: Surveys & Mapping, 1996).

3. MPUMALANGA BIODIVERSITY CONSERVATION PLAN

The Mpumalanga Biodiversity Conservation Plan (MBCP) is a comprehensive environmental inventory and spatial plan developed for the Mpumalanga Province (Lötter & Ferrar, 2006). The MBCP maps the distribution of the Province's known biodiversity into six terrestrial categories which were ranked according to ecological and biodiversity importance and their contribution to meeting the quantitative targets set for each biodiversity feature. The MBCP is intended to guide conservation and land-use decisions in support of sustainable development and includes land-use planning guidelines to guide planning and development within each of the biodiversity conservation categories throughout the Province. In each category, there are different land uses and development consequences (Lötter & Ferrar, 2006).

The following terrestrial ecosystems are defined by the MBCP:

1. Areas with no natural habitat remaining (areas with development options);
2. Areas of least concern with development options;
3. Important and necessary ecosystems (protection needed);
4. Ecological Corridors;
5. Highly Significant; and
6. Irreplaceable ecosystems.

The proposed road upgrade activities will traverse through large areas classified as having "No Natural Habitat Remaining" or areas of "Least Concern". However, some sections of the N11 do cross through areas that are classified by the MBCP as "Important and Necessary" or "Highly Significant" (Figure 3).

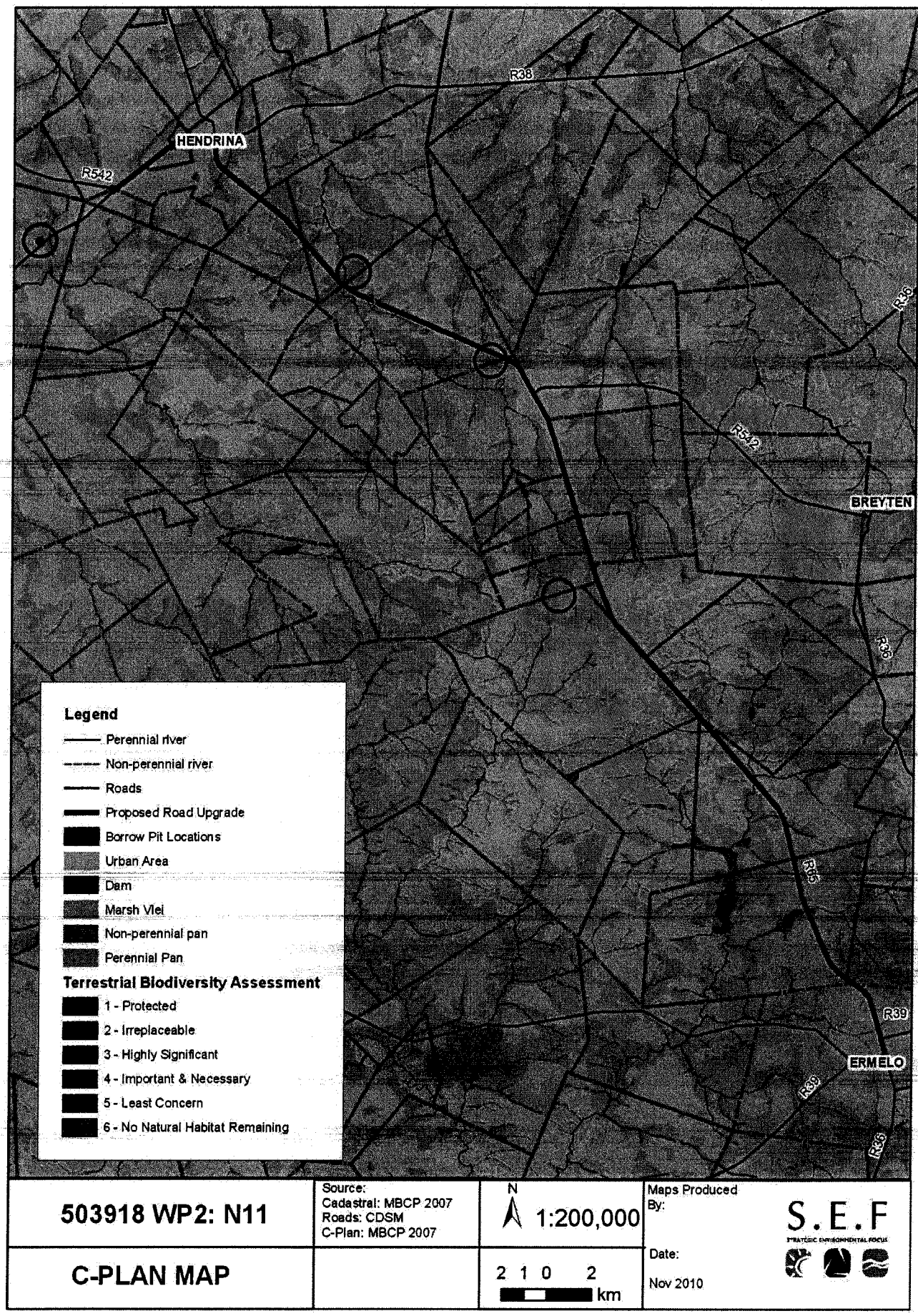


Figure 3: Study areas in relation to the Mpumalanga Biodiversity Conservation Plan

4. LISTED ECOSYSTEMS

The South African National Environmental Management: Biodiversity Act (Act 10 of 2004) provides for the listing of threatened or protected ecosystems. These ecosystems are grouped into Critically Endangered, Endangered, Vulnerable and Protected ecosystems. The purpose of listing ecosystems is primarily to reduce the rate of ecosystem and species extinction, including the prevention of further degradation and loss of structure, function and composition of threatened ecosystems.

The draft national list of threatened ecosystems (Government Gazette No 32689, 6 November 2009) lists both the Soweto Highveld Grassland and the Eastern Highveld Grassland as Vulnerable ecosystems based on the irreversible loss of natural habitat (Criterion A1). The remaining natural habitat of this ecosystem is approximately 60% of its original area.

5. PLANTS OF CONSERVATION CONCERN, PROTECTED PLANTS AND ALIEN INVASIVE SPECIES

5.1 Plants of Conservation Concern

Plants of conservation concern (*previously termed Red Data plants*) are those plants that are important for South Africa's conservation decision making processes and include all plants that are assessed to be Threatened, Extinct in the wild, Data deficient, Near threatened, Critically rare, Rare and Declining (Raimondo *et al*, 2009). The bulk of these plant species are nationally protected by the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) and should be conserved *in situ.*

Rare and threatened plant species in grasslands are mostly small, very localised, and visible for only a few weeks in the year when they flower (Ferrar & Lötter, 2007). Therefore, a single survey may not be adequate to identify these species and this report relied on distribution data and the identification of suitable habitat for these species where the road upgrade activities are proposed. The occurrence or possible occurrence of these plants is discussed under the vegetation results (Section 7 and 8).

5.2 Protected Plants

The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) list a number of plants in Schedule 11 and 12 that are protected within the Province. These plants are not to be removed, damaged, or destroyed without permit authorisation from Mpumalanga Department of Economic Development, Environment and Tourism. A number of protected plants were identified and could be impacted upon by the road upgrade activities. The occurrence of the plants is discussed in Section 7 and 8.

5.3 Alien Invasive Plants

Declared weeds and invaders have the tendency to dominate or replace the canopy or herbaceous layer, thereby transforming the structure, composition and function of natural ecosystems. Therefore, it is important that all these transformers (as defined above) be controlled and eradicated by means of an eradication and monitoring programme – especially as disturbances due to the road upgrade activities could result in invasion of disturbed soils by these invasive species. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species (Henderson, 2001).

The amended Regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) identifies three categories of problem plants:

- Category 1 plants may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish, plant, maintain, propagate or sell/import any category 1 plant species;
- Category 2 plants are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled; and
- Category 3 plants are ornamentally used plants and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30m of a 1:50 year flood line and must be prevented from spreading.

Invasive alien plant species tend to invade riparian and seep zones with disastrous impacts on water resources, especially within catchments regions. Invader and weed species must be controlled to prevent further infestation and it is recommended that all individuals of the invader species be removed and eradicated (Henderson, 2001). Weed species that occur on the site is listed in plant list in Appendix B.

6. CONSERVATION IMPORTANCE OF THE SITES IMPACTED ON BY THE PROPOSED ACTIVITIES

Based on the findings of the study and the following criteria, sensitive habitat or areas of conservation importance are classified based on:

Ecological Function: The ecological function describes the intactness of the structure and function of an ecosystem in terms of the relationship between plant and animal assemblages and the surrounding abiotic environment. It also refers to the degree of ecological connectivity between systems within a landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

High – Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems that are considered important for the maintenance of ecosystem integrity. Most of these systems represent late succession ecosystems with high connectivity with other important ecological systems.

Medium – These systems occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems.

Low – Degraded and highly disturbed systems with little ecological function.

Conservation Importance: The conservation importance of the site gives an indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation. The criteria are defined as follows:

High –Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. These areas should be protected.
Medium – Ecosystems with intermediate levels of species diversity without any threatened species.

Low – Areas with little or no conservation potential and usually species poor (most species are usually exotic).

7. RESULTS: ROAD RESERVE

7.1 Land Use

The road upgrade is proposed to take place within the existing road reserve. The road reserve was bordered by cultivated land, grassland and in some cases invasive alien trees. The reserve comprised mainly of grassland vegetation with some alien invader tree species occurring scattered along the reserve, but mainly adjacent to the reserve. The reserves were burnt and were mainly used by maintenance- and other vehicles as numerous vehicle tracks were visible along the route.

7.2 Mpumalanga Biodiversity Conservation Plan

The proposed road upgrade activities will traverse through large areas classified as having "No Natural Habitat Remaining" or areas of "Least Concern". However, some sections of the N11 do cross through areas that are classified by the MBCP as "Important and Necessary" or "Highly Significant" (Figure 3).

Areas with no natural habitat remaining have already lost most of their biodiversity and consequently its ecological functioning. In the remnants of natural habitat that occur between cultivated lands and along river lines and ridges, residual biodiversity features and ecological processes do survive. However, these disconnected remnants are biologically impoverished, highly vulnerable to damage and have limited likelihood of being able to persist. The more transformed a landscape becomes, the more value is placed on these remnants of natural habitat (Ferrar & Lötter, 2007). While areas with no natural habitat remaining are preferred sites for development; localised sensitivities such as the occurrence of protected plants should be taken into account.

Areas of "Least Concern" contribute least to reaching biodiversity targets. However, they have significant environmental, aesthetic and social values and should not be viewed as wastelands or carte-blanche development zones (Lötter & Ferrar, 2006). At the broad scale, these areas and those where natural habitat has been lost serve as preferred sites for all forms of development, although local sensitivities must be taken into account.

The road upgrade activities will traverse through small portions classified by the MBCP as "Important and Necessary", as well as a portion of "Highly Significant". These are areas of natural vegetation that play an important role in meeting biodiversity targets. Their designation as important and necessary seeks to minimise conflict with competing land uses and represents the most efficient selection of areas to meet biodiversity targets (Ferrar & Lötter, 2007). Therefore, the road upgrade activities should be restricted to the existing road reserves in these areas, with no impact on adjacent land.

7.3 Vegetation

The vegetation within the road reserve was either disturbed or observed to comprise mainly secondary grassland with riparian areas and wetlands as well as some

invasive alien trees scattered along the route (Photograph 1). Points were sampled along the route, concentrating mainly on areas where the vegetation was least disturbed as well as moist and riparian areas (Figure 4). The road reserve, by its nature, showed signs of disturbance such as regular burning as well as vehicle tracks, especially next to the farm fences or where vehicles stop on the side of the road. Most disturbances were noted at sample point 92 – 94, along the R542 westward from Hendrina and the outskirts of Ermelo (Photograph 1; Figure 4).

Photograph 1: Portions along the road reserve showing a) a high level of disturbance and b) lower levels of disturbance

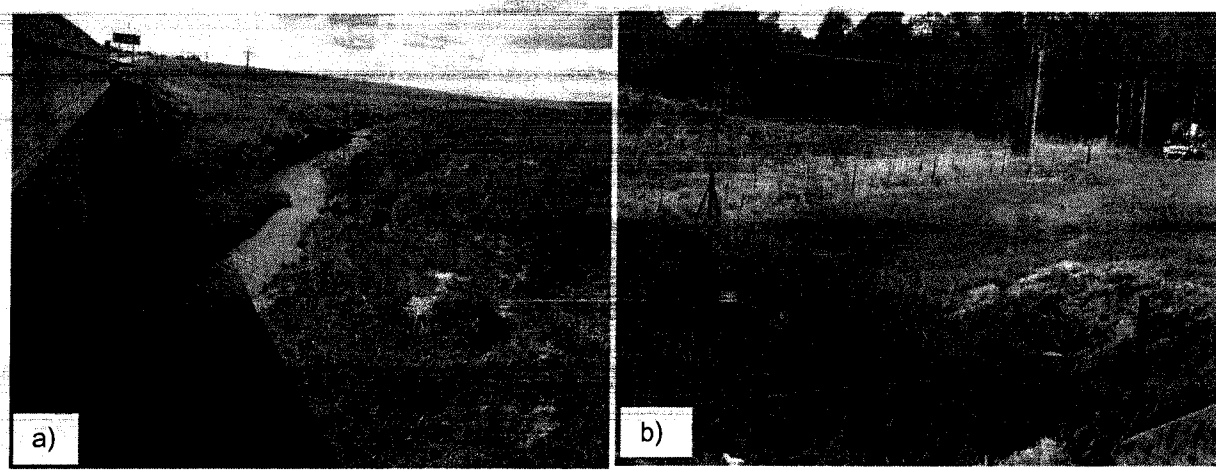
The grassland vegetation included an unexpected high diversity of grasses and forbs (Photograph 2). The road reserve seemingly recovered quickly from disturbance, probably due to the surrounding grasslands that function as a seed bank that can colonise the road reserves when disturbance takes place.

The grass layer included, but was not limited to, *Aristida congesta* (Spreading Three-awn), *Cynodon dactylon* (Couch Grass), *Eragrostis curvula* (Weeping Love Grass), *Eragrostis lehmanniana* (Knietjiesgras), *Eragrostis cilianensis* (Stink Love Grass) and *Melinis repens* (Natal Red Top). The forb species mostly encountered within the road reserve were *Crepsis hypochoeridea*, *Helichrysum rugulosum, Euryops transvaalensis, Hibiscus microcarpus, Plantago lanceolata* (Narrow-leaved Ribwort), *Nemesia fructisans* (Wildeleubekkie), *Berkeya setifera* (Rasperdisseldoring), *Pelargonium luridum* and *Sphenostylis angustifolia* (Wild Sweet Pea). Rainwater

collected in portions where the road reserve slopes downward from the road and provides habitat to the moisture loving grass *Setaria pallida-fusca* (Garden Bristle Grass) and the forb *Haplocarpa scaposa* (Tonteldoosbossie). Where the road reserve is higher than the road (slope upwards), the rocky soil included plants such as *Hypoxis rigidula* and *Ipomoea crassipes* (Leafy-flowered Ipomoea). Additional plant species that were identified within the road reserve are listed in Appendix B.

Photograph 2: Grassland vegetation within the road reserve

Moist grasslands or wetlands (SEF, 2011) were also encountered within the road reserves, many of which corresponded to the non-perennial streams indicated in Figure 2. These moist areas were mostly in a natural state. However, some disturbed wetland areas were noted along the R38 road from Hendrina westward to the R542 turnoff, as well as on the outskirts of the town of Ermelo (point 92; Figure 4). The disturbed wetland areas included weedy species such as *Pennisetum clandestinum* (Kikuyu Grass), *Eucalyptus* species (Blue Gums), *Paspalum urvillei* (Vasey Grass) as well as the indigenous reed *Typha capensis* (Bulrush) (Photograph 3).



Photograph 3: a) River crossing and (b) *Typaha capensis* colonised moist areas at road culverts

A large wetland area, north of Ermelo (point 97-99; Figure 3) provided suitable habitat for plants of conservation concern (Photograph 4). The protected *Kniphofia*

porphyrantha (Dwarf Red-hot Poker), as well as the protected *Zanthedeshia albomaculata* (Arrow-leaved Arum) were identified here.

Photograph 4: Wetland area with a) the protected *Kniphofia porphyrantha* and b) *Zanthedeschia albomaculata*

Additional wetland systems were identified closer to Ermelo and although these areas were in close proximity to informal housing, taxi ranks and other disturbances, numerous herbaceous species were identified here, including the protected orchid *Eulophia clavicornis*.

7.3.1 Plants of conservation concern

The riparian areas and wetlands along the route provided suitable habitat for *Crinum bulbispermum* (Orange River Lily) and a small population was identified at point 95 (Figure 4). This specie was assessed as Declining (Raimondo *et al*, 2009). Although this taxon has not reached the threshold of concern, it should still be conserved *in situ* and the disturbance to its habitat limited.

Although not identified at sampling points, the Declining *Boophane disticha* (Poison Bulb) is highly likely to occur within the road reserves. In addition, the Vulnerable

Nerine platypetala could occur in the moist grasslands along the road. *Nerine platypetala* flowers in autumn and therefore could be present on the site although not noticeable due to the lack of flowers at the time of this field survey. The Environmental Management Plan (EMP) for the road upgrade activities must make provision for the relocation of these plants where they occur within the footprint of upgrading activities. Please note that this will require a permit from the MDEDET. Appendix C lists additional plant species of conservation concern known to occur in the area and could thus potentially occur here.

7.3.2 Protected Plants

Table 2 lists the plant species protected by the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) that were identified within the road reserve. These plants were identified adjacent to the road reserve and could thus be impacted on by the road upgrading activities. In addition, some plants that were not identified, but have a high possibility of occurring within the road reserve are also listed (Table 2).

Table 2: Protected plants that occur or are likely to occur within the road reserve

Protected species	Occurrence	Typical habitat
Crinum species	Confirmed: (point 95) *Crinum bulbispermum*	Near rivers, streams and seasonal pans
Kniphofia species	Confirmed: (point 99) *Kniphofia porphyrantha*	Wetland and marshy areas
Zanthedeschia species	Confirmed: (point 98 and 99) *Zanthedeschia albomaculata*	Wetland and marshy areas
Eulophia clavicornis	Confirmed	Moist grasslands close to Ermelo
Boophane disticha	Probable	Grassland
Eucomis species	Probable	Grassland and moist grassland/wetlands
Gladiolus species	Probable	Grassland
Habenaria species	Probable	Moist grasslands

7.3.3 Alien Invasive Plants

Two declared invasive tree species (Category 2) were identified adjacent to the road reserves namely *Eucalyptus camaldulensis* (Red River Gum) and *Acacia mearsnii* (Black Wattle). In addition, the Category 3 invasive weed *Argimonia ordorata* (Argimony) was identified in wetlands areas close to Ermelo. No additional significant alien invasive plant infestation was noted within the road reserves, other than weedy species that have become naturalised. The EMP for the road upgrade activities should include an alien invasive monitoring plan to prevent invasive species to colonise disturbed soils during and after the activities.

7.4 Ecological Sensitivity

Secondary grasslands

The majority of the road reserve comprise secondary grassland or sub-climax grassland. No plants of conservation concern or protected plants were confirmed to occur within the secondary grassland within the road reserves, although the secondary grassland could support at least three protected plant species. It therefore classified as medium ecological function as this system occurs at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems. In addition, it comprises of intermediate levels of species diversity without any confirmed protected species and are thus of medium conservation importance and ecological sensitivity (Figure 5).

Moist grasslands and wetlands

However, the proposed upgrade of the road will impact on streams and wetlands along the N11 route between Hendrina and Ermelo. Other than its obvious hydrological function, the stream banks and wetland areas also support protected plants or provided suitable habitat for such species. These areas are concluded to be of high ecological function with a high degree of connectivity with other ecological systems. In addition, it provides suitable habitat for a number of protected species and should be conserved and impacts mitigated to limit any detrimental effects n this habitat.

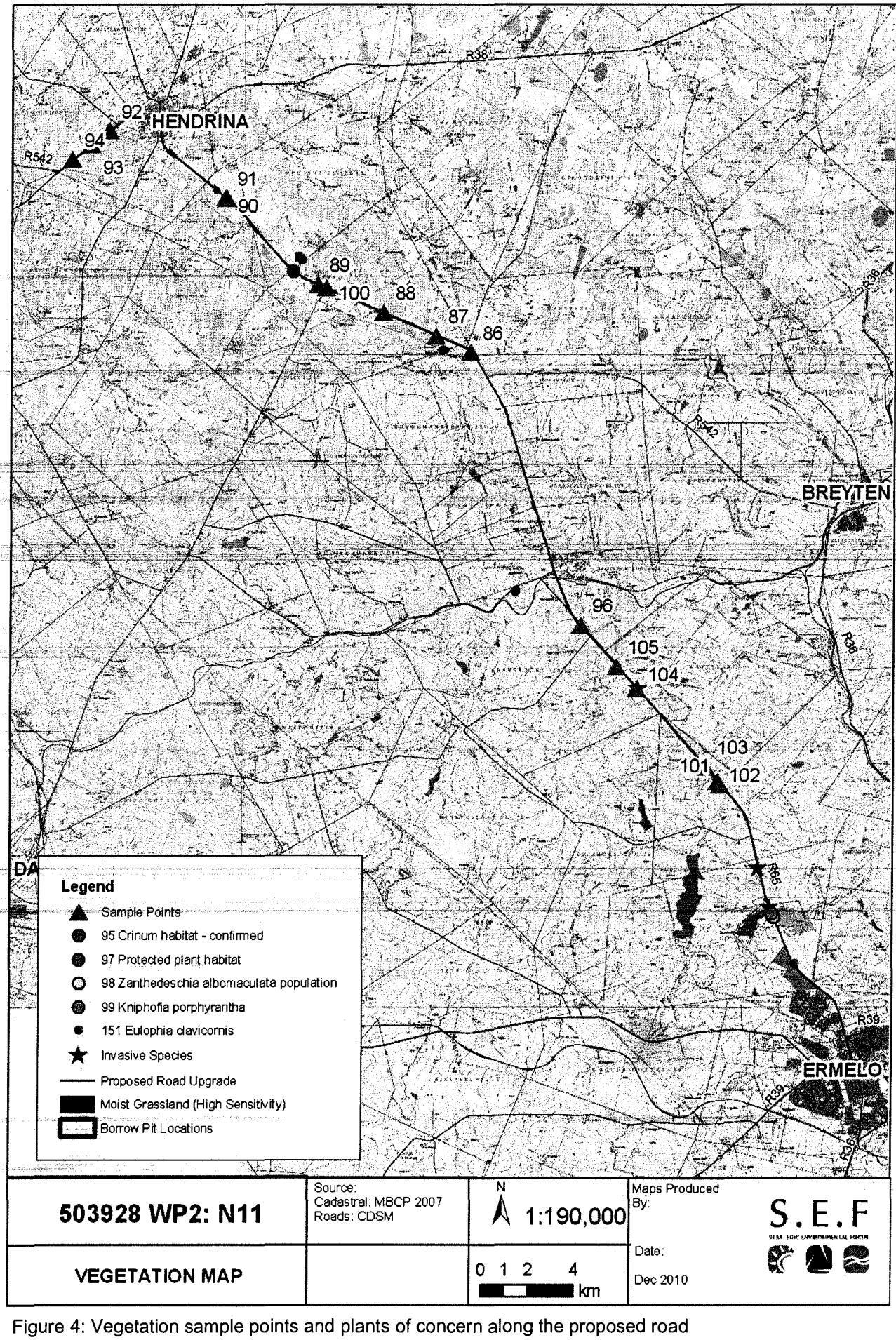


Figure 4: Vegetation sample points and plants of concern along the proposed road

8. RESULTS: BORROW PITS

8.1 Borrow Pit 1

Borrow pit 1 (BP1) is situated approximately 25 km north of Ermelo and west of the N11. The borrow pit falls within the QDS 2629BD with a GPS coordinate: 26°20'25.35"S; 29°51'17.94"E. The regional vegetation that should be present at BP1 is the Soweto Highveld Grassland (Figure 2). According to the MBCP, the borrow pit is situated within areas classified as "No Natural Habitat Remaining" and "Least Concern" (Figure 3).

BP1 is situated on a small hill sloping downward towards a drainage line. The eastern boundary of BP1 consisted of a cultivated field and the northern boundary comprised a dirt road, while the borrow pit footprint comprised mainly disturbed grassland (Photograph 5). Due to the westward slope towards the drainage line, it was estimated that impacts caused by BP1, such as erosion, could extend downward towards the drainage line and the vegetation growing there. Therefore, sampling points also included the land west of BP1 as this area comprised natural grassland.

Photograph 5: Vegetation at BP1 with disturbed grass (left side of fence) and cultivated field (right)

The eastern portion of this site was disturbed, probably due to ploughing activities on and/or adjacent to this portion of the site. The disturbed area was dominated by *Eragrostis curvula* (Weeping Love Grass), some *Pennisetum clandestinum* (Kikuyu Grass) and *Cyperus esculentus* which is a troublesome weed in pasture and cultivated land. In addition, the weedy *Tagetes minuata* (Khaki Weed) and *Solanum rigescens* were also identified in patches on the site.

However, the northern boundary of the site as well as the western portion and down the slope towards the drainage line included higher species diversity with grasses such as *Elionorus muticus* (Copper Wire Grass), *Harplochloa flax* (Caterpillar Grass), *Heteropogon contortus* (Spear Grass), *Themeda triandra* (Red Grass) and *Tristachya leucothrix* (Hairy Trident Grass). This grassland was intensely grazed as evident by the presence of *Hermannia depressa* (Creeping Hermannia) and *Seripheum plumosum* (Bankrupt Bush) (van Wyk & Malan, 1997). The forbs species included the

Declining *Boophane disticha* (Poison Bulb), the Protected *Aloe ecklonis* (section 8.1.1 and 8.1.2) as well as *Hypoxis rigidula*, *Erythrina zeyherii* (Ploegbreker), *Hermannia transvaalensis, Becium obovatum* and *Commelina africana.* Moist grassland patches were also evident where grasses such as *Eragrostis capensis* and *Setaria sphacelata* (Common Bristle Grass) as well as forbs such as *Diclis reptans* and *Helichrysum aereonitenss* (Golden Everlasting) were observed. Additional plant species that were identified to be associated with BP1 are listed in Appendix B.

8.1.1 Plants of conservation concern

The Declining plant, *Boophane disticha* (Poison bulb) was identified within the footprint of BP1. The Environmental Management Plan (EMP) should therefore incorporate a search and rescue operation whereby the plants are relocated to suitable habitat prior to the commencement of activities. In addition, the EMP should monitor the survival of this plant during and after the activities.

Two individuals of the Declining *Eucomis autumnalis* (Pineapple Flower) and *Hypoxis hemerocallidea* (Potato Flower) were identified within the drainage line directly west of BP1. The Environmental Management Plan (EMP) should ensure that the borrow pit activities do not impact on these plants and make provision to monitor the survival of this plant during and after the activities. Appendix C list additional species of conservation concern known to occur in the area (such as *Nerine platypetala*) and that could thus potentially occur at BP1.

8.1.2 Protected Plants

The Declining *Boophane disticha* (Poison Bulb) as well as *Eucomis autumnalis* (Pineapple Flower) are also protected in terms of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998). In addition, all Aloes naturally occurring in Mpumalanga is also protected (Table 3). The grassland could also provide habitat to the protected genus *Watsonia* and *Gladiolus* which might not have been in flower and thus not noticed at the time of the survey. The (EMP) should therefore incorporate a search and rescue operation prior to the commencement of activities.

Table 3: Protected plants that occur or are likely to occur at BP1

Protected species	Occurrence	Typical habitat
Aloe spp	Confirmed: *Aloe ecklonis*	Grassland and moist grassland
Boophane disticha.	Confirmed	Grassland
Eucomis spp	Confirmed: *Eucomis autumnalis*	Grassland and moist grassland/wetlands
Gladiolus spp	Probable	Grassland
Habenaria spp	Probable	Moist grasslands
Watsonia spp	Probable	Grassland

8.1.3 Alien Invasive Species

No declared invasive plant species was identified on the proposed site for BP1. However, disturbances could lead to the weedy *Pennisetum clandestinum* (Kikuyu Grass) and *Cyperus esculentus* becoming dominant and out-competing the natural vegetation in re-colonising the areas disturbed by the proposed BP1. These species should be eradicated form the proposed borrow pit area and the re-vegetation of the borrow pit monitored to ensure that these species were eradicated completely.

8.1.4 Ecological Sensitivity

The eastern portion of the grassland on site is not in a natural state and disturbances occur at low-medium intensity. Although, there is a degree of connectivity with other ecological systems, the MBCP classified the site as "Least Concern" and "No Natural Habitat Remaining". However, on a local scale, the western portion of BP1 footprint includes sensitivities such as protected plant species (*Boophane disticha* and possible *Gladiolus* and *Watsonia* species). Although these plants can be relocated, the site also plays a role in the hydrology of the area and the BP1 activities is likely to impact on the wetland just west of the BP1 site (See wetland delineation report). Therefore, the site is graded as being of medium ecological function and sensitivity (Figure 5). The site is suitable for use as a borrow pit, providing that mitigation measures as set out in this and other specialist reports are adhered to.

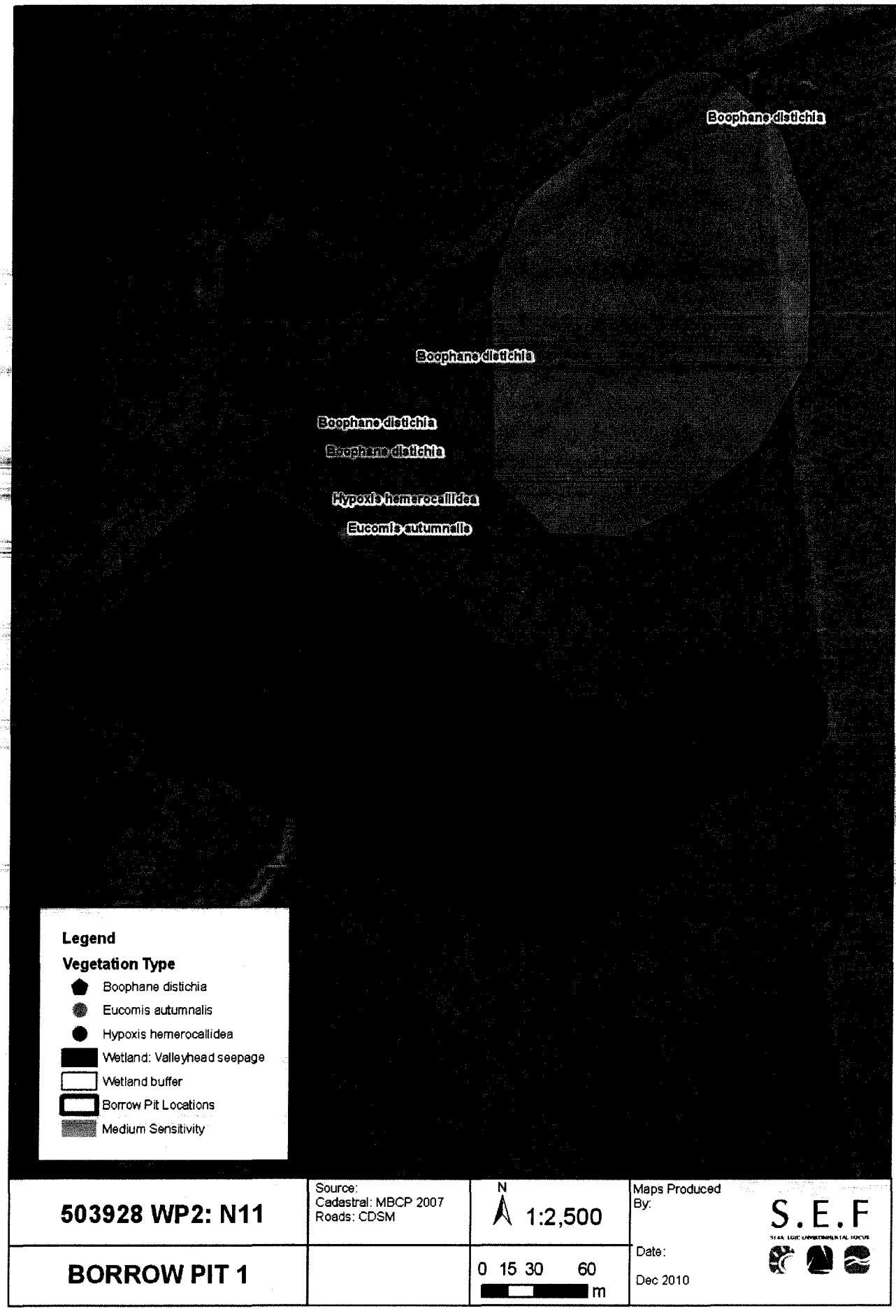
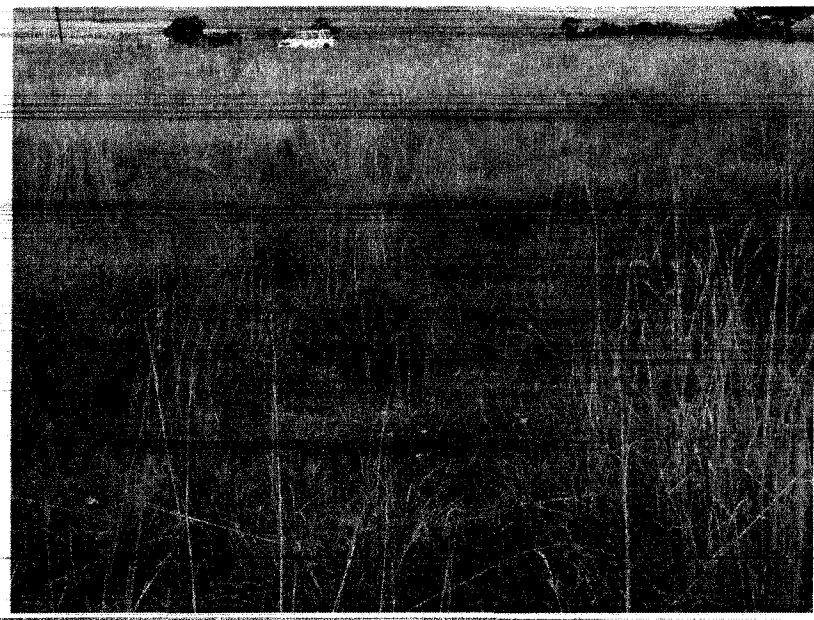


Figure 5: Borrow Pit 1 vegetation sensitivity

8.2 Borrow Pit 2

Borrow pit 2 (BP2) is situated directly adjacent to an existing borrow pit, approximately 40 km north of Ermelo and about 17km south of Hendrina, west of the N11. The borrow pit falls within the QDS 2629BB with a GPS coordinate: 26°14'53.02"S; 29°49'39.27"E. The regional vegetation that BP2 is located in Eastern Highveld Grassland (Figure 2). According to the MBCP, BP2 is situated within an area classified as "Important and Necessary". Therefore, if this borrow pit is approved, it is important that the impact of BP2 is limited to a small area from the existing borrow pit, southwards towards the dirt road.

The vegetation that will be impacted on by the proposed BP2 was mostly in a natural state. Although the grassland showed signs of past grazing, the grass layer at the time of the study was moribund (accumulation of plant material) (Photograph 6). In addition, signs of the previous disturbances related to the existing borrow pit were visible as well as some plough lines east of the borrow pit.



Photograph 6: Grassland vegetation at BP2

The grass layer comprised of typical highveld grasses such as *Themeda triandra* (Red Grass), *Hyparrhenia hirta* (Thatch Grass), *Eragrostis chloromelas* (Curly Leaf) and to a limited degree *Tristachya leucotrhix* (Hairy Trident Grass), *Heteropogon contortus* (Spear Grass) and *Eragrostis capensis* (Heart-seed Love Grass). The forbs included *Berkeya setifera* (Rasperdisseldoring), *Hermannia depressa* (Rooi-opslag), *Gebera viridifolia, Hibiscus aethiopicus, Pelargonium luridum* and the weedy *Plantago major* (Broadleaf Ribwort). Additional species as well as medicinal plants species that were identified are listed in Appendix B.

8.2.1 Plants of conservation concern

At the time of this survey, no plants of conservation concern were identified at BP2. Species known to occur in the area and that could thus potentially occur are listed in

Appendix C.

8.2.2 Protected Plants

No plants protected in terms of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) were identified at the time of the survey. However, the grassland could provide habitat to the protected genus *Watsonia* and *Gladiolus* which might not have been in flower and thus not noticed at the time of the survey. The Environmental Management Plan (EMP) should therefore incorporate a search and rescue operation prior to the commencement of activities.

8.2.3 Alien Invasive Species

The vegetation at BP2 included three invasive plants (Appendix B). All three are classified as Category 1 weeds that should be removed namely *Acacia mearsnii* (Black Wattle), *Cirsium vulgare* (Scotch Thistle) and *Argemone ochroleua* (Mexican Poppy). The EMP should include an alien invasive monitoring plan to prevent the spread of these species into the disturbed soils from where it could spread into adjacent grasslands.

8.2.4 Ecological Sensitivity

The BP2 site is rated by the MBCP as being "Important and Necessary to reach conservation targets within Mpumalanga. Although connected to other natural areas, low to medium intensity disturbance were evident. In addition, no species of conservation concern or protected plant species was identified here, although it could provide suitable habitat to these species. The site is of medium ecological function as well as conservation importance and is thus classified as being of medium ecological sensitivity (Figure 6) and suitable for use as a borrow pit, providing that mitigation measures as set out in this and other specialist reports are adhered to.

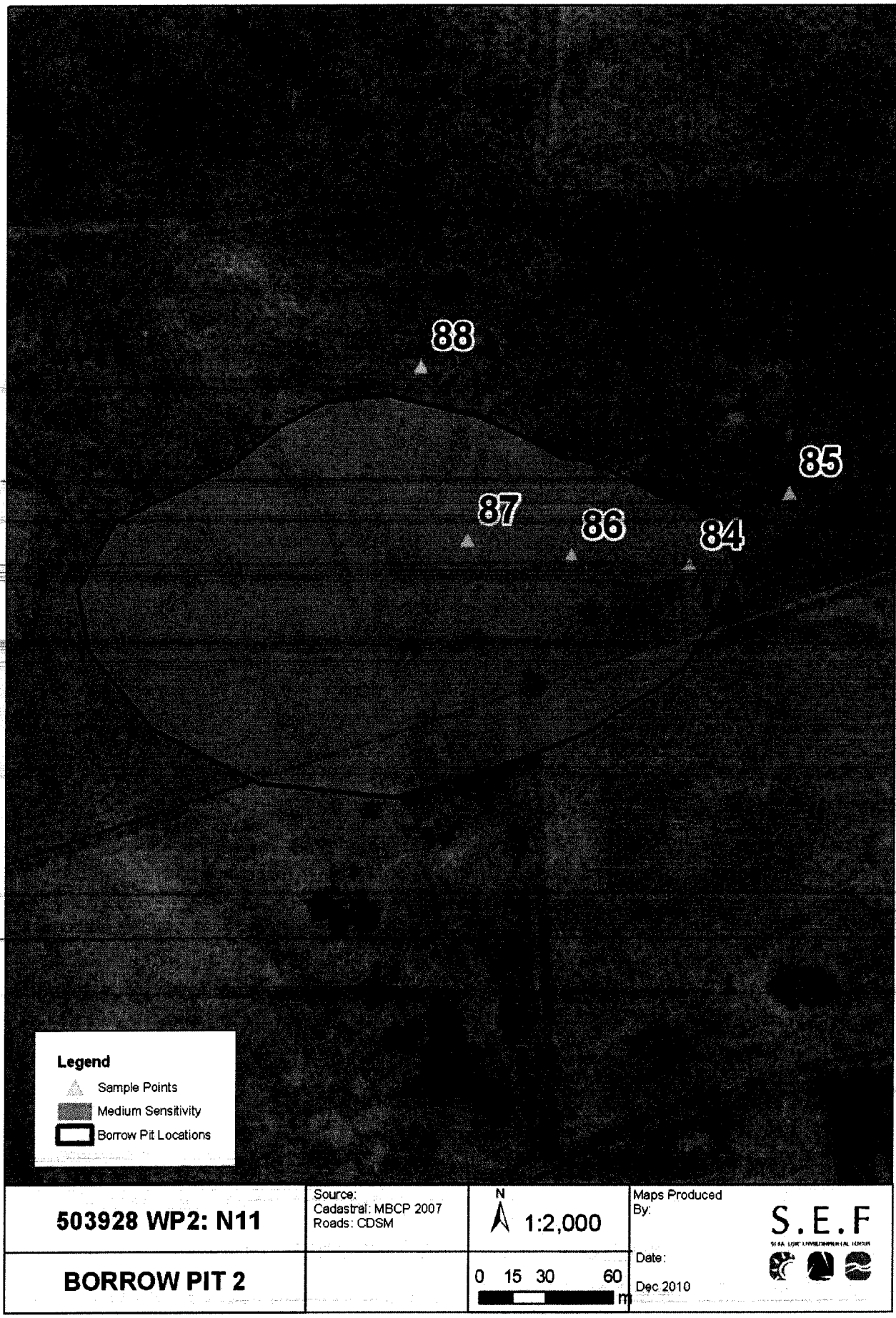
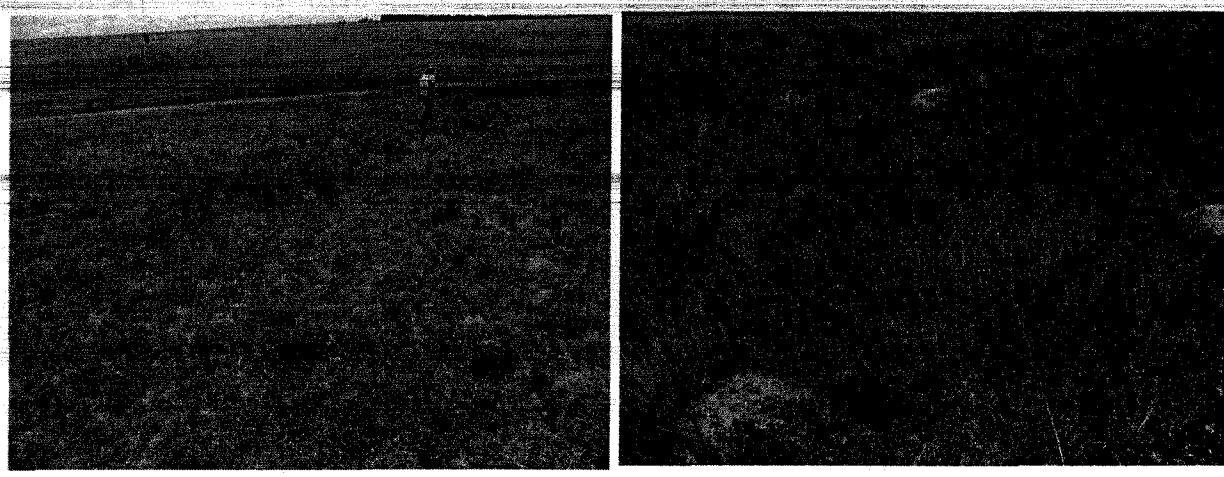


Figure 6: Borrow Pit 2 vegetation sensitivity

8.3 Borrow Pit 3 (BP3)

Borrow pit 3 (BP3) is situated approximately 9 km south east of the town of Hendrina and east of the N11. The borrow pit falls within the QDS 2629B with a GPS coordinate: 26°12'50.42"S; 29°46'18.66"E. The Klein Olifants River flows directly west from BP2. The regional vegetation that BP3 is located in is Eastern Highveld Grassland (Figure 2). According to the MBCP, the footprint of the BP3 is within land classified as "Least concern".

The BP3 site comprised grassland vegetation which was being grazed. The species cover abundance data indicated that dominant species between the sample plots were not similar and a distinction could thus be made between grassland and moist grassland (Photograph 7). The grassland was mainly dominated by *Themeda triandra* (Red Grass) and *Harpochloa falx* (Caterpillar Grass) while moist grassland patches were dominated by a *Cyperus* specie and the forbs *Diclis reptans* and *Helichrysum aerionitens* (Golden Everlasting) which prefers moist areas in grasslands (Van Wyk & Malan, 1997).



Photograph 7: Grassland vegetation at BP3 with moist grassland (right)

Portions of the grassland vegetation showed signs of severe grazing with a low basel cover and plants such as *Delosperma cf ashtonii* and a patchy occurrence of *Solanum incanum* (Bitter Apple). Additional species as well as medicinal plants that were observed are listed in Appendix B.

8.3.1 Plants of Conservation Concern

At the time of this field survey, no plants of conservation concern were identified within the footprint or immediate surroundings of BP 3.

8.3.2 Protected Plants

Only one plant that is protected in terms of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) was identified on the site namely the fern *Cheilanthus cf hirta*. However, the grassland could provide habitat to specimens of the protected genus *Watsonia* and *Gladiolus* which might not have been in flower and thus not

noticed at the time of the survey. The (EMP) should therefore incorporate a search and rescue operation during the flowering time of these species (November to March) prior to the commencement of activities.

8.3.3 Alien and Invasive Plants

No declared invasive plants were identified at the proposed site for BP3.

8.3.4 Ecological Sensitivity

Although this borrow pit is proposed in an area classified as "Least Concern" in the MBCP, the site comprise natural grassland with some degree of grazing pressure and disturbance. Although no protected plants other than the fern *Chellanthus cf hirta* were identified during the field survey, the site contains moist grassland indicative of a wetland system. The moist grassland has a low inherent resistance or resilience towards disturbance factors and is considered important for the maintenance of ecosystem integrity. Due to the proximity of the Klein Olifants River, the grassland is connected with other important ecological systems. This site is considered to be of medium to high ecological sensitivity (Figure 7) and should the borrow pit continue on this site, the mitigation measures in this as well as the other specialist report should be strictly adhered to.

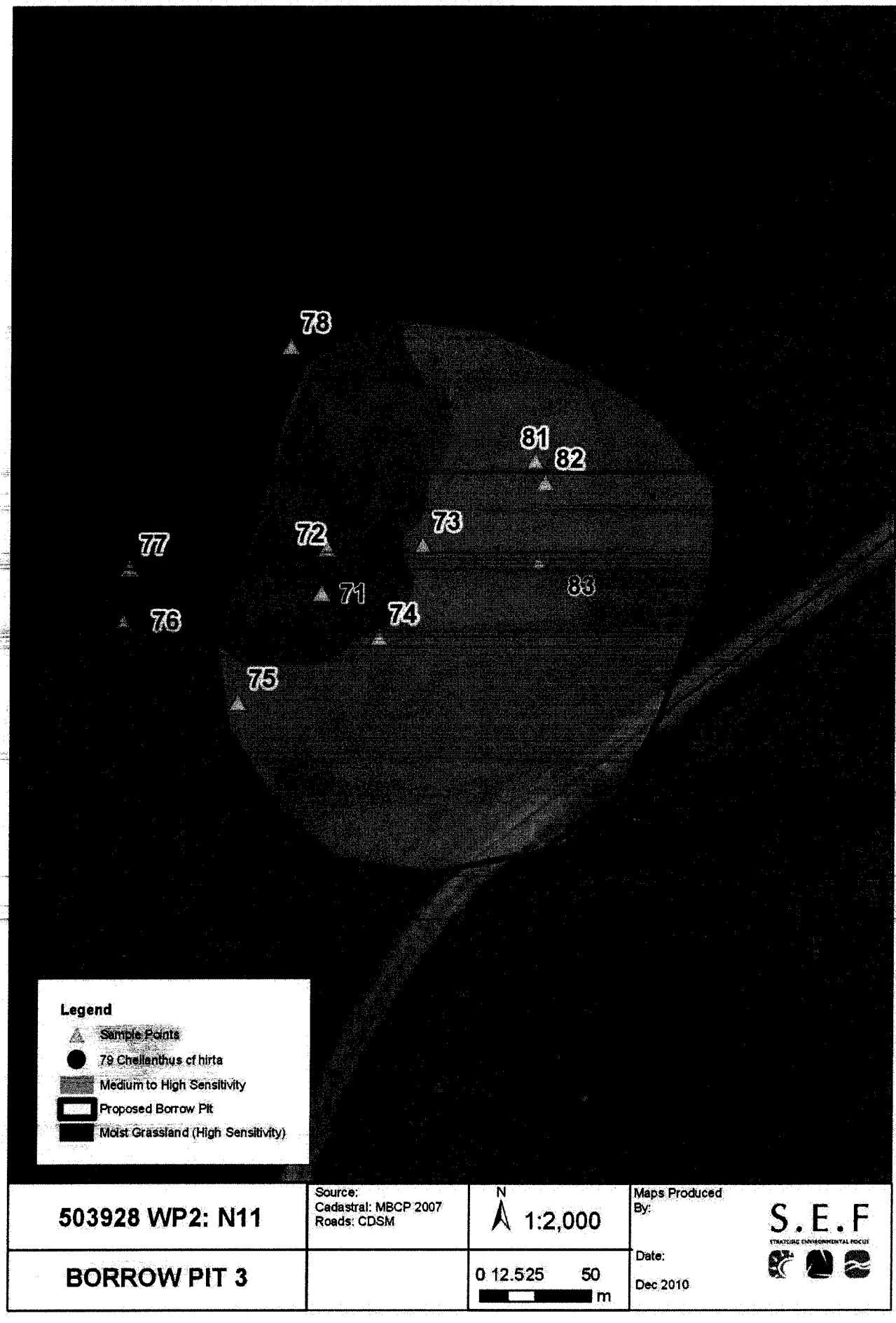


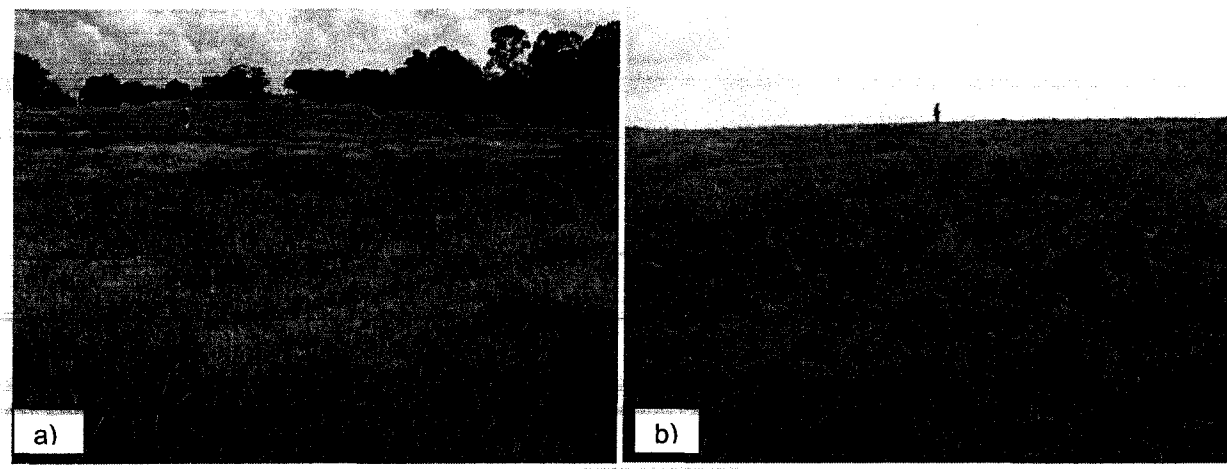
Figure 7: Borrow Pit 3 vegetation and sensitivity

8.4 Borrow Pit 4 (BP4)

Borrow pit 4 (BP4) is situated approximately 8 km west of the town of Hendrina on the R38. The borrow pit falls within the QDS 2629BA with a GPS coordinate: 26°12'2.60"S; 29°38'52.31"E. BP3 is located in the regional vegetation, Eastern Highveld Grassland (Figure 2). According to the MBCP, the footprint of the BP4 is within land classified as "Least Concern". The area was historically ploughed although probably abandoned due to the possible high moisture content in the soil.

The BP4 site comprised of moist grassland towards the eastern portion of the proposed area with a high occurrence of the moisture loving grass *Setaria sphacelata* (Common Bristle Grass) and included sedges such as *Fimbristylis complanata* and *Cyperus* species. In addition, the weedy *Centella asiatica* (Marsh Pennywort) were also identified within the moist grassland. Additional forbs included *Helichrysum aerionitens* (Golden Everlasting) which prefers moist areas in grasslands (Van Wyk & Malan, 1997).

The western portion comprised grassland vegetation which showed signs of some disturbances such as ploughing. The grass layer included *Eragrostis curvula*, *Hyparrhenia hirta* (Thatch Grass) and *Setaria sphacelata* (Common Bristle Grass) along with weedy forbs such as *Datura stromonium, Plantago major* (Large Leaf Ribwort) and *Verbena bonariensis* (Photograph 8). Additional species as well as medicinal plants that were observed are listed in Appendix B.



Photograph 8: a) Moist grassland vegetation and b) grassland at BP4

8.4.1 Plants of Conservation Concern

At the time of this filed survey, no plants of conservation concern were identified within the footprint or immediate surroundings of BP4. Nonetheless, the site does provide suitable habitat for the Vulnerable *Nerine platypetala* (Appendix C). Therefore, prior to excavation at the borrow pit, the site must be surveyed within the flowering period of this plant (autumn) to determine its presence on the site.

8.4.2 Protected Plants

No plants protected in terms of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) were identified on the site at the time of this field survey. However, the site does provide suitable habitat to the protected *Nerine platypetala* and *Nerine gracilis.* The EMP should therefore incorporate a search and rescue operation during the flowering time of this specie (February to March) prior to the commencement of activities.

8.4.3 Alien and Invasive Plants

No declared invasive plants were identified at the proposed site for BP4.

8.4.4 Ecological Sensitivity

This borrow pit is proposed in an area classified as "Least concern" in the MBCP and due to the historic disturbances on the site, the vegetation was found to be of medium to low sensitivity.

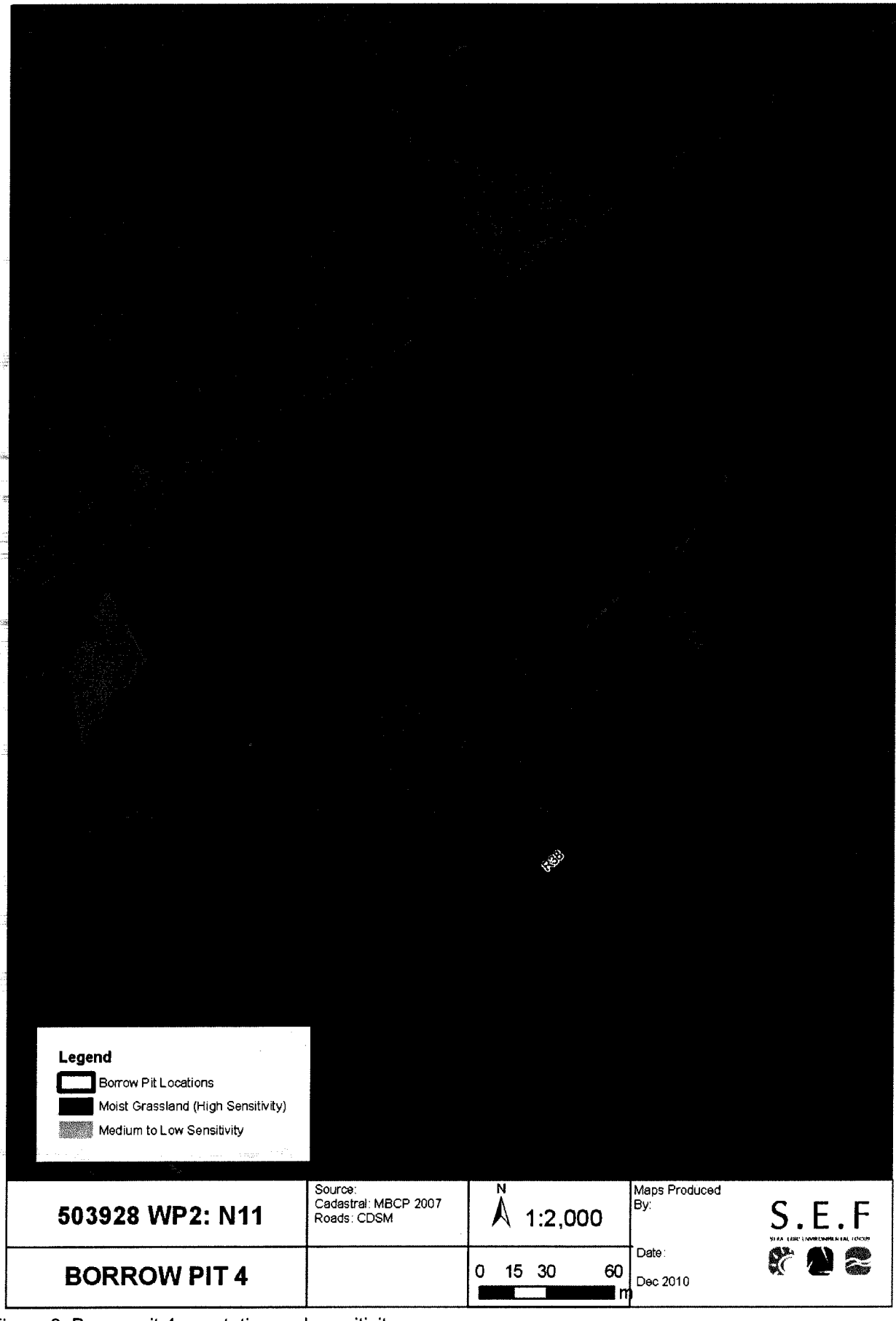


Figure 8: Borrow pit 4 vegetation and sensitivity

9. IMPACT ASSESSMENT AND MITIGATION

Any development in a natural system will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the study was therefore to identify and assess the significance of the impacts likely to arise during the road upgrade activities and borrow pits and provide a short description of the mitigation required so as to limit the impact of the proposed development on the natural environment.

9.1 Assessment Criteria

The environmental impacts are assessed with mitigation measures (WMM) and without mitigation measures (WOMM) and the results presented in impact tables which summarise the assessment. Mitigation and management actions are also recommended with the aim of enhancing positive impacts and minimising negative impacts.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction and operation phase. The criteria against which these activities were assessed are discussed below.

9.1.1 Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

9.1.2 Extent of the Impact

A description of whether the impact will be local (extending only as far as the servitude), limited to the study area and its immediate surroundings, regional, or on a national scale.

9.1.3 Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

9.1.4 Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

9.1.5 Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

9.1.6 Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

9.2 Impact Assessment

The possible impacts of the proposed road upgrade on road reserves and borrow pit vegetation, as well as surrounding areas are divided into two phases of activities: Construction phase and Operational phase of the proposed road upgrade activities. Table 4 and Table 5 list a summary of the possible risks that could occur within the two phases.

Table 4: Potential Impacts during the Construction Phase of the proposed road upgrade activities.

Possible Risks	Source(s) of the Risk	Site(s) to be affected
Destruction of natural habitat and changes to soil structure	Construction workers and – activities; Borrow pits	Grasslands, moist grasslands and riparian areas.
Exposure of the sites to erosion	Construction activity	All sites
Destruction of plants of conservation concern as well as protected plant species	Construction workers and – activities; Borrow pits	Localities of plants confirmed to occur as well as suitable habitat for plants that has the potential to occur

Table 5: Potential impacts during the Operational Phase of the proposed development

Possible Risks	Source of the Risk	Site to be affected
Possible increase in exotic vegetation	Alien invasive plants spreading to disturbed soils	All sites
Deterioration of the natural vegetation and the subsequent loss of the ecological function of the vegetation (e.g. soil and water retention)	Un-rehabilitated borrow pits that become invaded by weedy plant species	Grassland and moist grasslands at borrow pit sites

9.2.1 Construction Phase

9.2.1a Destruction of Natural Habitat

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOMM	WMM	
Destruction of natural habitat and changes to soil structure	Grasslands, moist grasslands and riparian areas.	Road reserves and borrow pits as well as access roads	**Road reserves:** Short term **Borrow pits:** Medium term	**Road reserves:** Medium to low **Borrow pits:** Medium	Definite	**Road reserve** Medium to High **Borrow pits:** Medium to low	**Road reserve** Medium to Low **Borrow pits:** Low	High

Description of Impact

The proposed road upgrade will require the removal of mainly secondary grassland vegetation from the road reserves, whereas the borrow pit vegetation range from secondary to primary grassland that will be removed. In addition, both the road reserves and some borrow pits will involve the removal or alteration of moist grassland vegetation. The primary grassland and moist grasslands are of high ecological sensitivity as they are habitat to plants of conservation concern and any negligent activities could impact on the habitat and thus future persistence of these plant species

Mitigation Measure

Topsoil and vegetation (road reserves and borrow pits)

- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- Ahead of all construction and borrowing, strip the available topsoil layer and stockpile for later use in rehabilitation (adapted from: DWAF, 2005).
- In the absence of a recognizable topsoil layer, strip the upper most 300mm of soil (DWAF, 2005).
- Strip and stockpile herbaceous vegetation, overlying grass and other fine organic matter along with the topsoil.
- Do not strip topsoil when it is wet as compaction could occur.
- Store stripped topsoil in an approved location and in an approved manner for later reuse in the rehabilitation process.
- Make use of existing roads and tracks where feasible, rather than creating new routes through vegetated areas.
- Avoid routes through drainage lines and riparian zones wherever possible. Where access through drainage lines and riparian zones is unavoidable, only one road is permitted, constructed perpendicular to the drainage line. Avoid roads that follow drainage lines within the floodplain.

Where the road upgrade will cross highly sensitive areas the following mitigation measures are applicable:

- The mitigation measures as set out by the wetland and aquatic assessment reports (SEF, 2011; SEF, 2010) should strictly be adhered to.
- Runoff from roads must be managed to avoid erosion and pollution problems.
- Regularly remove topsoil (and other material) accumulated in side drains of roadways to keep these open and functional (DWAF, 2005).
- Clear up any gravel or cement spillage on roads.
- Slight deviations of alignment must be permitted, so as to avoid plant populations of conservation concern (DWAF, 2005).
- Where the plants of conservation concern and protected plants are deemed to be under threat from the construction activity, the plants should be removed by a suitably qualified specialist and replanted as part of vegetation rehabilitation after the construction (**Note, these plants may only be removed with the permission of the local authority, MDEDET**).
- All threatened and protected plants that occur in close proximity to the proposed activities, although not directly impacted upon by the proposed activities (e.g. not within the borrow pit or access road foot prints) must be cordoned off (permeable fencing) as no-go areas during the construction period.

9.2.1b Exposure of the site to erosion

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOMM	WMM	
Exposure of the whole site to erosion	Road verges and borrow pit sites	Site	Medium term	Medium	Probable	High (in moist grasslands) Medium elsewhere	Medium to Low	High

Description of Impact

The removal of the surface vegetation will cause exposed soil conditions where rainfall and high winds can cause mechanical erosion.

Mitigation Measure

- Establish and maintain fire breaks around the Work Sites as veld fires in the wrong season can cause loss of species and subsequent soil erosion where vegetation was destroyed;
- An ecologically sound, storm water management plan must be implemented during construction; and
- Remove only the vegetation where essential for upgrading activities to continue and do not allow any disturbance to the adjoining natural vegetation cover.

9.2.1c Destruction of the Threatened and Protected Plant Species

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOMM	WMM	
Destruction of threatened and protected plants	Rocky Grassland	Site and surrounds	Short term	High	Probable	High	Medium	High

Description of Impact

The road upgrade activities will affect the habitat of plants of conservation concern and protected plant species. In addition, the plants could become damaged or removed during construction. Furthermore, the suitable habitat for plants that has the potential to occur could also be destroyed, limiting the changes of persistence of the plant species in the area.

Mitigation Measure

- Construction workers may not tamper or remove these plants and neither may anyone collect seed from the plants without permission from the local authority (MDEDET).
- All threatened and protected plants that occur in close proximity to the proposed activities, although not directly impacted upon by the proposed activities (e.g. not within the borrow pit or access road foot prints) must be cordoned off (permeable fencing) as no-go areas during the construction period. This is mainly relevant to the road reserve close to Ermelo where two Protected plant species were identified, and the grasslands around the borrow pits.
- Where the plants of conservation concern and protected plants are deemed to be under threat from the construction activity, the plants should be removed by a suitably qualified specialist and replanted as part of vegetation rehabilitation after the construction (**Note, these plants may only be removed with the permission of the local authority**). In addition the following is recommended (DEAF, 2005):
    1. Aloes and bulbous plants may be transplanted at any time of the year, although the winter months are preferred.
    2. Minimise disturbance of the soil and the remaining roots in the rootball during the lifting, moving and or transportation of all species.
    3. Wrap the rootball in Hessian or in plastic sheeting to retain the soil and to keep the rootball moist.
    4. Plant aloes and bulbs in similar soil conditions and to the same depth as in their original position. and
    5. Water aloes and bulbs once directly after transplanting to settle the soil.
- Establish and maintain fire breaks around the Work Sites to prevent veld fires as burning in the wrong season could have detrimental effects these plant species. Like deciduous trees, the energy from bulb leaves are relocated to the

bulb during the late autumn and the leaves die back. The energy stored within the bulb during winter is essential for new growth and flowering early in spring when rainfall is still low. Thus, if the leaves are burnt during summer, it could influence the bulbs ability to store energy during winter and subsequently affect new growth in spring and the plants future survival.

- An Ecological Management Plan must be compiled by a suitably qualified ecologist and must:
  - Ensure the persistence of the Plants of conservation concern along the road during and post construction (monitor for at least one growing season after construction is complete);
  - Minimise artificial edge effects (e.g. water runoff from the road upgrade activities and application of chemicals);
  - Result in a report back to the Department on during and after construction (at least one growing season).
- An Environmental Control Officer must be appointed to oversee mitigation measures during the construction and will be responsible for the monitoring and auditing of contractor's compliance with the conditions of the Ecological Management Plan.

9.2.2 Operational Phase

9.2.2a Possible increase in exotic vegetation

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOMM	WMM	
Possible increase in exotic vegetation	Areas affected by the road upgrade activities	All sites	Medium term	Medium	Probable	Medium	Low	Medium

Description of Impact

Alien invasive plants species that occur in the area could spread into disturbed soils where they will out-compete indigenous vegetation and could eventually form dominant stands.

Mitigation Measure

- Compile and implement an alien invasive monitoring plan to prevent the colonisation and spread of alien invasive plant species.
- Remove alien invasive plants in planned phases (e.g. working on light infestations first) and maintain control via regular follow ups.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge.
- Follow manufacturers instruction when using chemical methods, especially in terms of quantities, time of application etc.
- Ensure that only properly trained people handle and make use of chemicals.

- Dispose of the eradicated plant material at an approved solid waste disposal site. If no toxic sprays or persistent poisons were used during eradication, then the wood may be sold or donated.
- Rehabilitate all identified areas as soon as practically possible, utilising specified methods and species.
- In addition, only indigenous plant species naturally occurring in the area should used during the rehabilitation of the areas affected by the construction activities.

9.2.2b Deterioration of the natural vegetation and subsequent loss of the vegetation

Impact	Site	Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
						WOMM	WMM	
Large volumes of water that could wash away soil and vegetation	Whole site	Site and surroundings	Short to medium term	High	Probably	High	Medium	High

Description of Impact

Un-rehabilitated borrow pits could become invaded by weedy plant species. In addition, the lack of rehabilitation could lead to the deterioration of the natural vegetation and the subsequent loss of the ecological function of the vegetation such as soil and water retention.

Mitigation Measure

- After the use of the borrow pit, the land must be cleared of rubbish and all parts of the land shall be left in a condition as close as possible to that prior to use.
- Ensure that work does not take place haphazardly, but according to a fixed plan, from one area to the other (Figure 9; Figure 10 and Figure 11).
- Avoid stripping material to bedrock. This limits rehabilitation potential for these areas. Leave a thin layer of bedrock where possible.
- Minimise the flow of any surface water or floodwater into borrow areas. Where necessary protect borrow areas by an earth berm or sandbag system to deflect clean surface runoff away from the excavations.
- Allow for the natural free drainage of borrow areas. All borrow areas must be drained unless otherwise specified (DAWF, 2005).
- Ideally, no stockpiling should take place at the extraction point: material must be loaded directly from the screens onto trucks and transported to the construction site.
- Plan the location of dump sites within the borrow area taking into account the progression of borrow activities and the potential for rehabilitation (Figure 9).

- Control the type of material imported to ensure that soil contamination does not occur and bury coarse material incapable of supporting vegetation beneath the finer material.
- Backfill inert rubble in layers of not more than 1m, level and compact. Proceed in this manner until the level of backfilling has been reached and then cover the site with a layer of fine overburden at least 500mm thick, followed by a layer of topsoil at least 200mm thick (Figure 10; Figure 11)
- No residue or substance which causes or is likely to cause pollution of a water resource may be placed in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation.
- Topsoil stripped from the surface shall be used for final cover to recontoured slopes where practicable. Non usable material including overburden, screenings and rocks, should be placed in the pit bottom and covered with the previously stripped topsoil.
- Grassing must be undertaken by a suitably qualified Contractor, making use of the appropriate equipment via sodding or hydroseeding (Hydroseeding entails adding a specified seed mix to a slurry containing water and other approved materials to enhance plant growth potential. This mixture is applied by means of a spraying device onto the prepared ground areas to be seeded).
- Hydroseeding with a winter mix will only be specified where re-grassing is urgent, and cannot wait for the summer.
- Planting and re-planting of plants removed prior to commencement of the borrow pit/road upgrade should preferably be done during the rainy season.
- Allow for a maintenance period of one year following practical completion, unless otherwise specified.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Delay the re-introduction of stock to all rehabilitation areas until an acceptable level of re-vegetation has been reached. Fencing may be used, or the area may be covered by branches.
- Bare areas that show no specified vegetation growth after three months of the Rehabilitation Work are to be spread with additional topsoil, ripped to a depth of 100mm and re-planted, re-sodded, re-hand sown or re-hydroseeded.
- Once the site is reclaimed any fences where they exist shall be removed to permit re-vegetation.

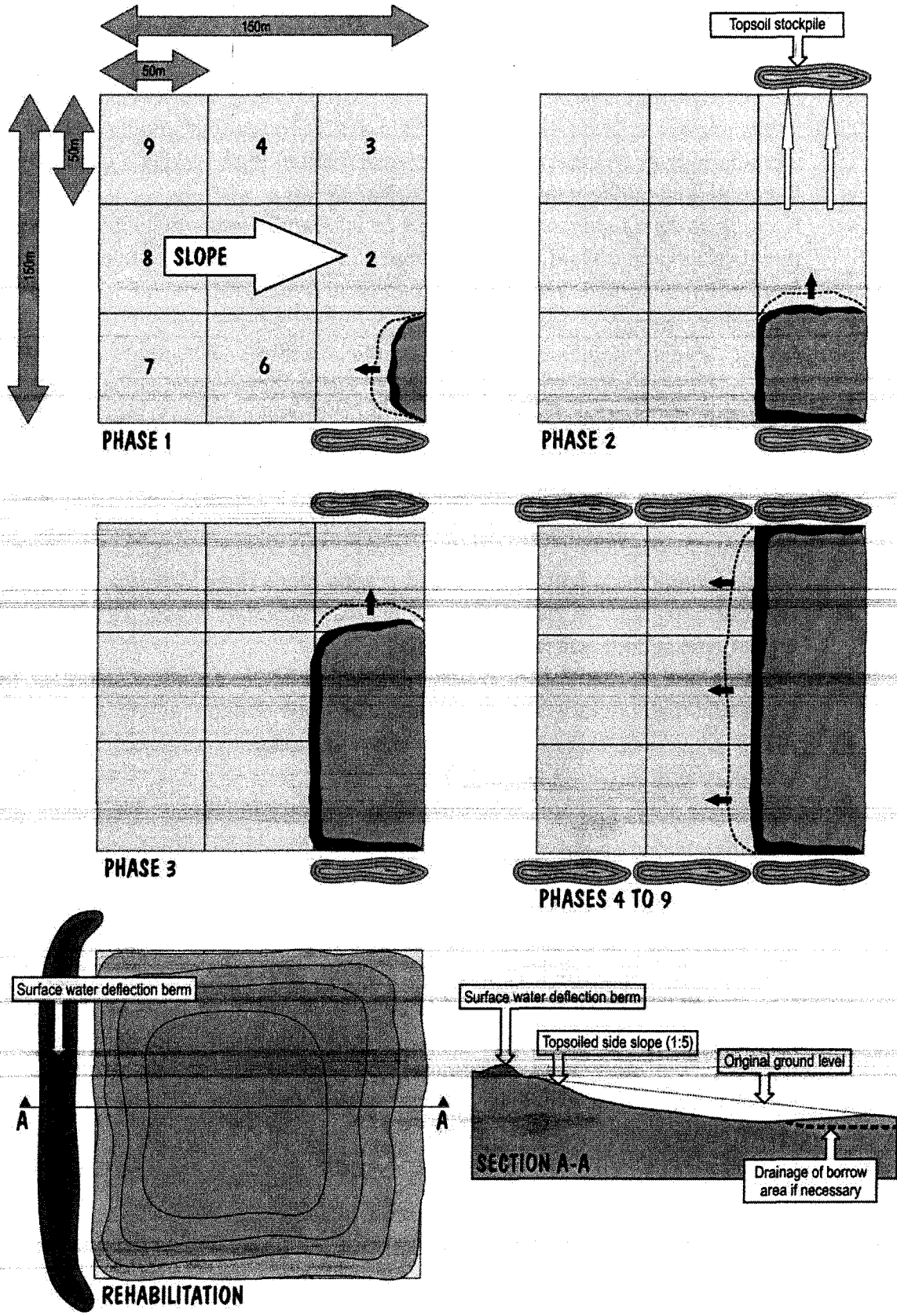


Figure 9: An example of incremental development of a borrow pit (DWAF, 2005)

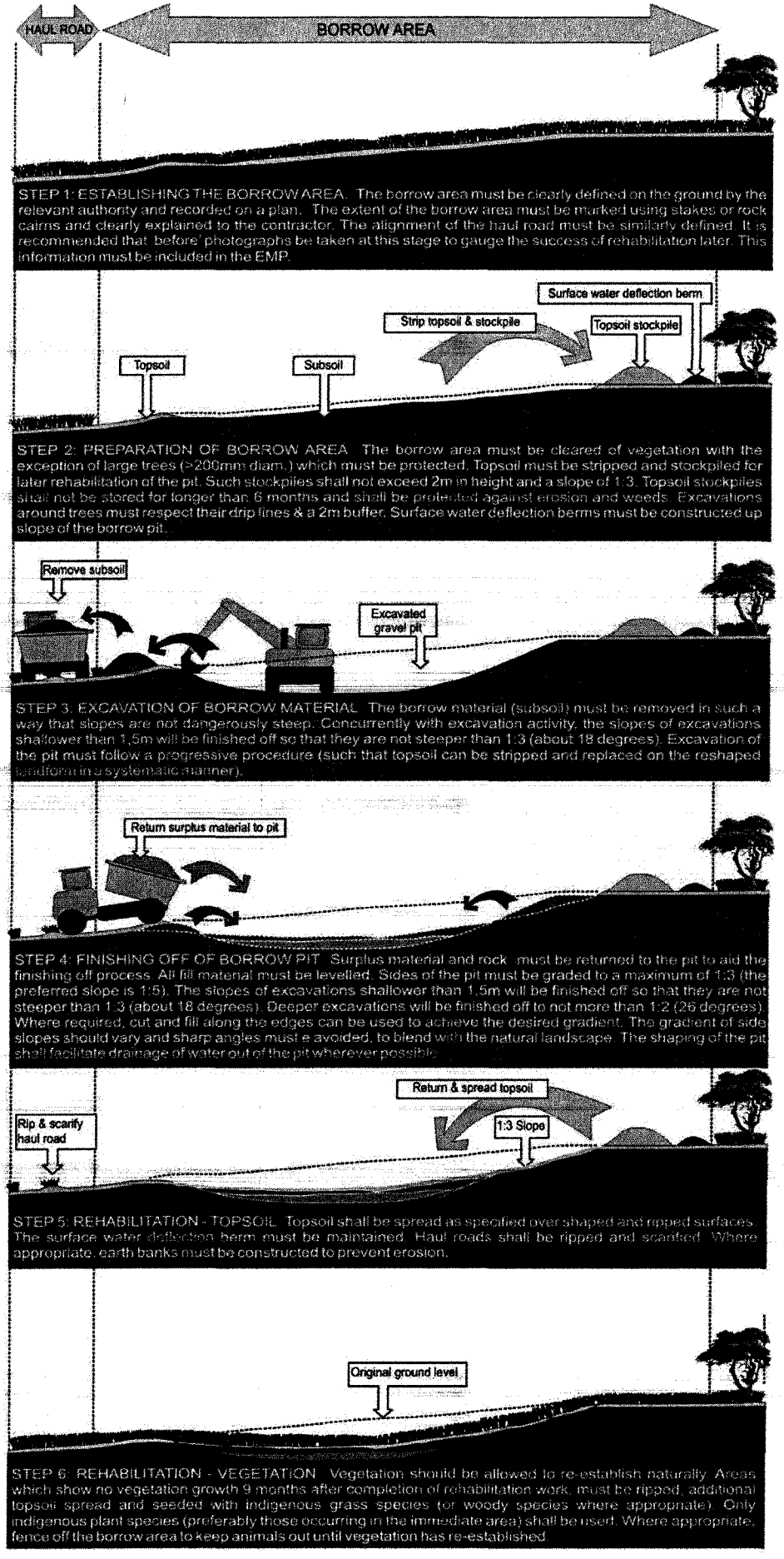


Figure 10: Typical lifecycle of a borrow pit operation showing a fully rehabilitated site at the end of works (DWAF, 2005)

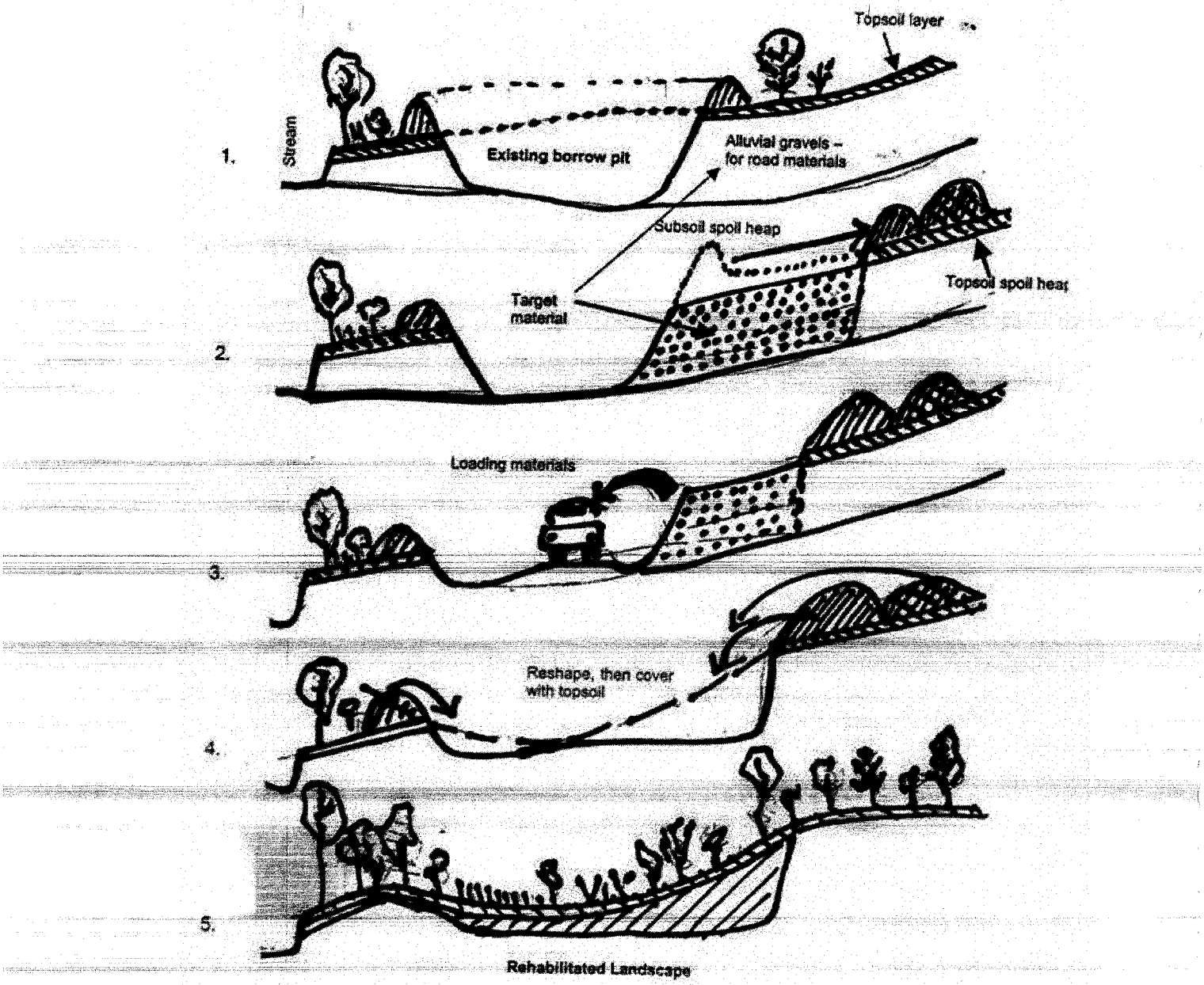


Figure 11: An example of borrow pit rehabilitation

10. CONCLUSION AND RECOMMENDATIONS

In terms of the vegetation composition, the areas that will be affected by the road upgrade activities comprise areas of low and medium to high sensitivity. The higher sensitivity ratings are either as a result of the occurrence of plants of conservation concern, protected plants and/or moist grasslands and riparian areas that have a high ecological function in the landscape.

The road upgrade activities along the N11 from Hendrina to Ermelo are proposed to impact on the existing road reserves which are mostly colonised by typical grassland vegetation and in a secondary to sub-climax state. However, the route will also

traverse trough moist grasslands and streams which are habitat to protected plant species. Where the upgrade activities occur within the moist grasslands and streams, the mitigation measures must be strictly applied in order to limit destruction to these habitats.

Borrow pit 1 and 2 are situated within medium sensitivities, whereas Borrow pit 3 is rated as being of medium to high ecological sensitivity due to its proximity to the Klein Olifants, as well as the occurrence of moist grasslands (wetlands) –. BP4 comprised of disturbed vegetation and is classified as medium to low sensitivity. However, the borrow pit activities should refrain from impacting on the wetland area that stretches eastward from the site.

11. REFERENCES

Barbour, M.G., Burk, J.H. & Pitts, W.D. (1987): *Terres-trial Plant Ecology*, 2nd edn. Benjamin/Cummings,Menlo Park.

Braun-Blanquet, J. (1932): Plant Sociology: The Study of Plant Communitites. English Translation of Plantzensoziologie (translated by Fuller, G.D. and H.S. Conard), McGraw-Hill. New York.

Chief Directorate: Surveys & Mapping (1996): Hydrology. Cape Town: CDSM.

Department of Water Affairs and Forestry, (2005): Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3

Emery. A. J., Lotter. M. Williamson. S.D. (2002): Determining the conservation value of land in Mpumalanga. DWAF (Department of Water Affairs)/DFID (Department for International Development) Strategic Environmental Assessment. Department: Water Affairs and Forestry, Republic of South Africa.

Ferrar, A.A. & Lötter, M.C. (2007): Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit.

Government Gazette No 32689, (2009): Draft National List of Threatened Ecosystems in terms of the National Environmental Management Act, 2004 (Act 10 of 2004). Department of Environmental Affairs Notice 1477 of 2009 in Government Gazette No 32689, 6 November 2009.

Henderson, L., (2001): Alien Weeds and Invasive Plants. A complete guide to declared weeds and invaders in South Africa. Plant Protection Research Institute Handbook No. 12. Agricultural Research Council, South Africa.

Lotter, M.C., Ferrar, A.A., (2006): Mpumalanga Biodiversity Conservation Plan Map. Mpumalanga Parks and Tourism Agency, Nelspruit.

Mpumalanga Tourism and Parks Agency (MTPA), (2008): Requirements for assessing and mitigating environmental impacts of development applications.

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. South African National Biodiversity Institute*, Pretoria.

Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. & Manyama P.A., (eds) (2009): Red List of South African plants 2009. *Strelitzea* 25, South African National Biodiversity Institute.

Rutherford, M. C. & Westfall, R. H. (1994): *Biomes of Southern Africa: an objective categorisation.* National Botanical Institute, Pretoria.

Satellite Application Centre, (2000): Land cover 1:50 000. Pretoria: SAC. Obtained via the ARC-ISCW.

Strategic Environmental Focus, (2010): Proposed Rehabilitation of Roads Between Ermelo and Hendrina (Work Package 2) Aquatic Assessment December 2010. (Project code: 503928 and 503803)

Strategic Environmental Focus, (2011): Proposed Rehabilitation of the N11 Between Ermelo and Hendrina (Work Package 2) Wetland Assessment January 2011 (Project code: 503928 and 503803)

Van Oudtshoorn, F. (2002): *A Guide to Grasses of Southern Africa.* Briza Publications.

Van Wyk, B and Smith G. (2005): Guide to the Aloes of South Africa. Briza Publications, Pretoria.

Van Wyk, B. and Malan, S. (1997): *Field Guide to the Wild Flowers of the Highveld.* Struik Publishers. Cape Town.

Internet references:

Google Earth (2010): http://www.earth.google.com (Accessed 03/12/2010)

Plants of Southern Africa, (2010): (http://posa.sanbi.org) (Accessed from 30 November 2010 to 13 December 2010)

SA Explorer (2010). http://www.saexplorer.co.za/south-africa/climate/amersfoort_climate.asp (Accessed on 01/12/2010)

12. GLOSSARY OF TERMS

Alien species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Climax community	The presumed en point of successional sequence; a community that has reached a steady state, the most mature and fully developed vegetation that an ecosystem can achieve under the prevailing conditions. It is reached after a sequence of changes in the ecosystem, known as succession. Once climax vegetation develops, the changes are at a minimum and the vegetation is in dynamic equilibrium with its environment. Very few places show a true climax because physical environments are constantly changing so that ecosystems are always seeking to adjust to the new conditions through the process of succession.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Conservation concern (Plants of..)	A plant taxon is of conservation concern when it is considered to be threatened, or close to becoming threatened with extinction and therefore classified as Critically Endangered, Endangered, Vulnerable or Near Threatened .
Conservation status	An indicator of the likelihood of that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future

Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible
Edge effect	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future
Endemic	Naturally only found in a particular and usually restricted geographic area or region
Exotic species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Fauna	The animal life of a region.
Flora	The plant life of a region.
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas
Mitigation	The implementation of practical measures to reduce adverse impacts
Protected Plant	According to the Transvaal Nature Conservation Ordinance of 1983 (No 12 of 1983), no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities
Red Data	A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions

Species diversity	A measure of the number and relative abundance of species
Species richness	The number of species in an area or habitat
Vegetation Unit	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels, and appear similar in vegetation structure and especially floristic composition".
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future
Vulnerable ecosystem	Ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems

13. APPENDICES

Appendix A	Methodology
Appendix B:	Plants species identified
Appendix C:	Threatened plant species that occur and potentially occur on the site

APPENDIX A: METHODOLOGY

A1. Desktop analysis and literature review

The description of the regional vegetation relied on literature from Mucina & Rutherford (2006). Plant names follow Van Wyk & Van Wyk (1997), Van Wyk & Malan (1997), Pooley (1998), Henderson (2001) and Van Oudtshoorn (2002).

Information regarding plant species of conservation concern that occur within the quarter degree square that the proposed activities are situated within, were obtained from the Mpumalanga Parks and Tourism Agency (MPTA) database. In addition, the Red List of Southern African Plants (Raimondo, *et al*, 2009) was also consulted in order to determine the possibility of any additional species that could potentially occur.

A2. Field survey

N11 Road reserve between Hendrina and Ermelo

The vegetation assessment and sampling along the N11 road section between Hendrina and Ermelo were mainly focussed on areas where intact vegetation was expected with emphasis on riparian areas, wetlands and other potential habitats for plants of conservation concern. Transects were walked within sampling areas along the road section to be upgraded in order to determine the plant species that occur within the road reserve. Transects were walked within the perceived habitat types on the site, concentrating on moving through environmental gradients encountered within the habitat type in order to identify species and communities. This was continued until few to no new species were encountered. Habitat and potential habitat for plants of conservation concern were mapped. Any additional information on any other feature thought to have ecological significance within the site, such as fauna or evidence of fauna, soil type, altitude, erosion, rocky cover, alien/exotic/invasive plants as well as the presence of plant species of conservation concern and/or their habitat was also recorded.

Borrow pits

The proposed sites for the borrow pits as well as a buffer area of approximately 50m were surveyed. Satellite images (Google-Earth, 2010) were used to pre-determine relatively homogeneous units within the study area. These units were sampled during the survey (Figure 1) by walking transects and concentrating on moving through environmental gradients in order to identify species and communities. This was continued until few to no new species were encountered. In addition, the cover abundance of plant species within sample plots was recorded according to the Braun-Blanquet cover abundance scale (Brown & Bezuidenhout, 2000). An area that best represented the community was located and the minimal area for sampling was determined (the smallest area within which the species of the community were adequately represented). The minimal area was determined by a species-area curve and concluded on 8m x 8m.

A species-area curve was compiled by placing larger and larger plots on the ground in such a way that each larger plot encompassed all the smaller ones, an arrangement called nested plots (Barbour *et al*, 1987; Figure 2). As each larger plot was located, a list of additional species encountered was created. A point of 'diminishing return' was reached, beyond which increasing the plot area results in the addition of only a few more species. The point on the curve where the slope most rapidly approaches the horizontal is called the minimal area (Figure 2). Because this definition of minimal area is subjective, some define it instead as that area which contains some standard fraction of the total flora of a stand, for example, 95%. The most recently proposed solution is to plot the similarity between plots as plot size increases. Minimal area is thought by some ecologists to be an important community trait that is just as characteristic of a community type as the species that make it up.

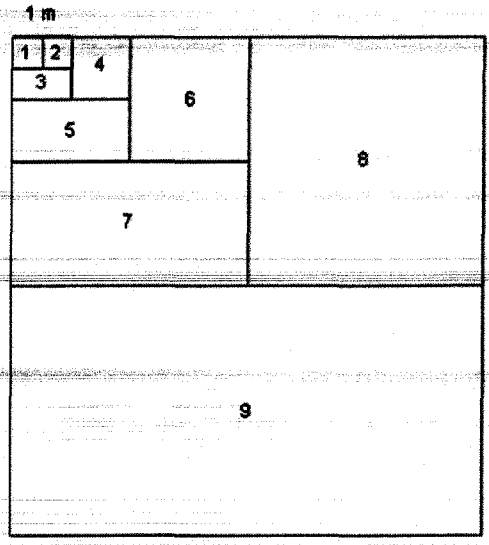


Figure 2: A system of nested plots for determining minimal area (Mueller-Dombois & Ellenberg, 1974).

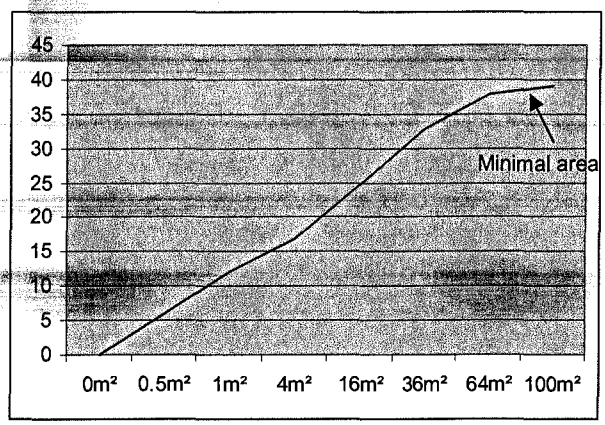


Figure 3: Species-area curve for the study area

Cover was placed in one of seven categories by a visual estimate (Table 1). Braun-Blanquet and others recognise that plant cover is very heterogeneous from point to point and from time to time even within a small stand. The range of percentage points within each class allows for each observer's deviance from the correct cover percentage.

Table 1: Braun-Blanquet Cover classes (Mueller-Dombois & Ellenberg, 1974).

Class	Range of cover (%)	Mean
5	75-100	87.5
4	50-75	62.5
3	25-50	37.5
2b	13-25	19
2a	6-12	9
1	1-5	2.5
□	<1	0.1
R	<<1	*

* Individuals occurring only once; cover ignored and assumed to be insignificant.

APPENDIX B: PLANTS IDENTIFIED ON THE SITE

Plants in **RED** = Threatened or Declining

(P) Protected species **(EN)** Endangered **(D)** Declining **(M)** Used medicinally

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
Herbaceous plants							
Acalypha punctata	Sticky Brooms and Brushes	Grassland	X	X			
Ajuga ophrydis **(M)**		Grassland, often in colonies		X		X	
Albuca specie		Moist vlei's in grassland		X			
Aloe ecklonis **(M)**	Ecklon's Aloe	Grassland		X			
Amaranthus hybridus	Pigweed	Weed in disturbed places		X			
Anthericum cooperi		Grassland.				X	
Asclepias gibba **(M)**	Humped Turret-flower	Grassland		X			
Asclepias multicaulis	Doily Cartwheel	Grassland, on river banks				X	
Becium obovatum subsp *obovatum* **(M)**		Grassland		X		X	
Berkheya setifera **(M)**	Rasperdisseldoring	Grassland, usually in large colonies.	X		X		
Boophane disticha* **(P) (D) (M)**	**Poison Bulb**	**Grassland, often in rocky places**		**X**			
Centella asiatica **(M)**	Marsh Pennywort	Marshes, vlei's.					X
Cephalaria zeyheriana		Grassland and swampy areas	X		X	X	
Cheilanthus cf. hirta **(P)**	Lip Fern	Between rocks				X	
Cheilanthus specie		Rocky grassland				X	
Chironia pupurascens subsp. *humuilis*	Bitterwortel	Damp or marhy areas often n colonies				X	
Comelina africana var *krebsiana* **(M)**		Grassland		X		X	
Crassula capitella subsp nodulosa		Grassland				X	
Crepsis hypochoeridea		Widespread in Grasslands.	X		X	X	X

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
***Crinum bulbispernum* (P) (D) (M)**	**Orange River Lily**	**Moist soils, usually along rivers and vleis**	**X**				
Delosperma cf ashtonii		Grassland				X	
Diclis reptans		Grassland, moist places along vleis and along streams		X		X	
Dipcadi viride	Grootslymuinte	Grassland, often in vleis		X			
Erythrina zeyherii	Ploegbreker	Grassland, sometimes clay soils	X	X	X		
Eucomis autumnalis (P) (D) (M)*	**Pineapple Flower**	**Damp grassland**		**X**			
Eulophia clavicornis	(Grassland orchid)	Grassland	X				
Euphorbia striata	Milk Grass	Infrequently scattered in grassland, often in seepage lines	X		X		
Euryops gilfillanii		Open or rocky grassland			X		
Euryops transvaalensis		Rocky places, a weed in overgrazed areas.	X	X	X	X	
Erytrhina zeyheri	Ploegbreker	Grassland, frequently in moist vlei's with clay soils	X	X			
Gazania krebsiana	Botterblom	Grassland	X		X		
Gerbera viridifolia subsp *viridifolia*		Grassland		X	X		
Habenaria chlorotica		Marshy grassland	X				
Haplocarpa scaposa **(M)**	Tonteldoosbossie	Grassland, often in moist places	X				
Helichrysum aereonitens **(M)**	Golden everlasting	Sandy areas, frequently in disturbed areas		X		X	
Helichrysum pillosellum **(M)**		Grassland, often in vlei's		X			
Helichrysum rugulosum **(M)**		Grassland, summit of ridges	X		X		
Hermannia depressa	Creeping Hermannia	Grassland, in trampled areas		X	X	X	
Hermannia transvaalensis		Grassland		X		X	
Hibiscus aethiopicus		Grassland			X		
Hibiscus microcarpus		Grassland and disturbed places	X				

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
Hibiscus pusillus		Grassland, usually in stony places and sandy soil				X	
Hypoxis argentea **(M)**	Small Yellow Star-Flower	Grassland		X			
Hypoxis hemerocallidea* **(D) (M)**	**Star Flower**	**Grassland**		**X**			
*Hypoxis rigidula**(M)	Kaffirtulp	Bushveld - mainly Pretoria region	X	X	X		
Indigofera sanguinea		Grassland				X	
Ipomoea crassipes **(M)**	Leafy-flowered Ipomoea	Grassland	X	X			
Justica anagalloides		Grassland			X	X	
Kniphofia porphyrantha* **(P) (M)**	**Dwarf Red-hot Poker**	**Damp grassland and marshy areas**	**X**				
Ledebouria ovatifolia **(M)**		Grassland.		X		X	
Ledebouria sp				X			
Lessertia stricta		Grassland, rocky or damp areas	X			X	
Limosella maior		Grassland			X	X	
Monopsis decipiens **(M)**	(Also known as Lobelia)	Grassland, often in seasonally moist places.				X	
Nemesia fructicans	Wildeleeubekkie	Grassland, rocky places	X		X	X	
Oxalis obliquifolia **(M)**	Sorrel	Grassland, often in moist places		X			
Pelargonium luridum **(M)**		Grassland, often in moist places.	X		X		
Pellaea calomelanos **(P)**	Hard Fern	Grassland.				X	
Pentanissia prunelloides **(M)**	Broad-leaved Pentanissia	Exotic weed invading moist areas.(Naturalized).				X	
Plantago lanceolata **(M)**	Narrow-leaved Plantain	Introduced weed, usually in disturbed places.	X				X
Polygala amatymbica	Dwarf Polygala	Common in grassland, often in damp places				X	
Scabiosa columbaria **(M)**	Wild Scabiosa	Grassland, moist places and around rocky outcrops.			X		

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
Sebaea leiostyla		Grassland, usually in moist vlei's	X				X
Selago densiflora		Grassland and bushveld	X		X	X	
*Senecio (cf) discordregeanus**		Grassland				X	
Senecio erubescens		Grassland, often in moist places			X	X	
Senecio scitus		Grassland	X				
Seripheum plumosum	Bankruptbush	Grassland and Bushveld, often in disturbed areas.		X	X	X	
Silene (cf) burchelii	Gunpowder plant	Along streams, often in water.			X		
Solanum incanum	Bitter Apple	Grassland				X	
Solanum panduriforme **(M)**	Poison Apple	Disturbed places, often under trees (probably an indigenous specie)				X	
Solanum rigescens	Wildelemoentjie	Grassland		X			
Sphenostylis angustifolia **(M)**	Wild Sweetpea	Grassland, particularly rocky places	X				
Thunbergia atriplicifolia	Natal Primrose	Grassland, used medicinally					
Tolpis capensis		Grassland, often in disturbed places				X	X
Trachyandra asperata **(M)**		Grassland, usually rocky or marshy places		X		X	
Trachyandra saltii		Grassland, often in rocky places		X		X	
Tragopogon dubius	Yellow Goat's Beard	Weed in disturbed places	X				
*Verbena bonariensis**	Wild Verbena	Exotic weed invading moist areas.(Naturalised).	X				X
Vernonia galpinii		Grassland				X	
Vernonia oligocephala **(M)**	Bitterbossie	Bushveld, often weed in disturbed places				X	
Wahlenbergia caledonica		Grassland, rocky or seasonally moist places				X	
Zanthedeschia albomaculata **(M)**	Arrow-leaved Arum	Marshy areas or grassy mountainsides	X				

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
Total number of herbaceous species identified = 82			**27**	**30**	**22**	**40**	**6**
GRASSES							
Agrostis eriantha	Large Panicle Agrostis	Often occur in damp areas on basalt	X			X	X
Aristida congesta subsp barbicollis	Spreading Three-awn	Disturbed areas such as fallow lands and road reserves	X				
Aristida junciformis	Gongoni Three-awn	Grows in most soil types, often in moist soils	X		X		X
Bromus catharticus	Rescue Grass	Weed in disturbed places, particularly in moist areas and along streams	X				
Cymbopogon validus	Giant Turpentine Grass	Open veld in moist soils.		X		X	X
Cynodon dactylon	Couch grass	Most soils, usually in disturbed areas	X			X	
Digitaria ternata	Black Seed Finger Grass	Disturbed places, particularly where water accumulates.	X		X	X	
Elionorus muticus	Copper grass / Wire Grass	Common in overgrazed veld, sour grassland	X	X	X	X	
Eragrostis capensis	Heart-seed Love Grass	Disturbed areas often in vlei-areas	X	X	X		
Eragrostis chloromelas	Curly Leaf	Rocky slopes, mostly in open grassland		X	X		X
Eragrostis cilianensis	Stink Love Grass	Disturbed areas, usually where water accumulates	X				
Eragrostis curvula	Weeping Love Grass	Mostly occurs in disturbed areas	X	X	X		X
Eragrostis lehmanni	Lehmann's Grass	Sandy soil, mostly in disturbed land.	X				
Eragrostis plana	Tough Love Grass	Disturbed areas, mostly in moist patches	X			X	X
Eragrostis racemosa	Narrow Heart Love Grass	Various habitats, mostly sandy or				X	

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
		rocky moist soils					
Harpochloa falx	Caterpillar Grass	Rocky slopes, well drained soil.		X		X	
Heteropogon contortus	Spear Grass	Rocky, sloped land and common on disturbed road reserves		X	X	X	
Hyparrhenia hirta	Common Thatching Grass	Well drained, rocky soil in open grassland and disturbed areas	X	X	X		X
Hyperrhenia tamba	Blue Thatching Grass	Road reserves and where water accumulates, alos next to rivers	X		X	X	
Leersia hexandra	Rice Grass	Grows in or near permanent water, often forming dense stands.	X				
Melinis repens	Natal Red Top	Disturbed grassland	X				
Miscanthus junceus	Wireleaf Daba Grass	Riverbanks and vlei's, often in standing water.	X				
Paspalum notatum	Bahia Grass	An exotic grass growing in disturbed moist areas. Often in town and cities.	X				
Paspalum urvillei	Vasey Grass	Moist areas such as marshes, vlei's and river banks,	X				
*Pennisetum clandestinum**	Kikuyu	Disturbed, moist areas.	X				
Rendlia altera	Mahem's Crest	Sour grassland, shallow soil against slopes.				X	
Setaria pallida-fuscua	Garden Bristle Grass	Disturbed areas e.g. next to roads and where rainwater collect	X		X		X
Setaria sphacelata var. torta	Creeping Bristle Grass	Well drained soils, mostly in disurbed areas.	X	X			X
Setaria nigrostis		Bushveld, disturbed sandy soils	X		X	X	
Themedia triandra	Red Grass	Undisturbed or disturbed open grassland	X	X	X	X	
Tristachya leucothrix	Hairy Trident Grass	Commonly found in overgrazed veld and marshy areas		X	X	X	

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
Total number of grasses identified = 33			**24**	**11**	**13**	**13**	**11**
SEDGES							
Cyperus esculentus **(M)**		Weedy exotic in marshy areas	X	X			X
Cyperus obtusifolius var obtsifolius		Grassland				X	
Cyperus rupestrs var rupestris		Moist or marshy places in grassland	X			X	
Fimbristylis complanata		Moist grassland	X				X
Schoenoplectus corymbosus/paludicola		Marshy grassland, forming stands.	X				X
Typha capensis **(M)**	Bulrush	Grows in marshy areas and along watercourses.	X				
Mariscus solidus		Along watercourses, in fringing grasslands	X				X
Mariscus congestus		Grassland, moist or marshy places	X				
Total number of sedges identified = 8			**7**	**1**	**0**	**2**	**4**
INVADERS / WEEDS							
Acacia mearnsii	Black Wattle	Invader			X		
Argemone ochroleua	Mexican Poppy	Declared Weed			X		
Argimonia ordorata **(M)**	Agrimony	Moist grassland and disturbed places.	X				
Bidens pilosa	Khaki Bush/ Blackjack	Widespread weed.		X			
Cirsium vulgare	Scotch Thistle	Weed			X		
Datura stramonium **(M)**	Thorn-apple						X
Eucalyptes specie **(M)**	Bluegum	Declared invader, Category 2	X				

Specie name	Common Name	Relevant Notes	Road Servitude	BP 1	BP 2	BP 3	BP 4
		(Henderson, 2001).					
Pennisetum clandestinum	Kikuju Grass	Proposed declared invader.	X	X			
Plantago major **(M)**	Broadleaved Ribwort	Weed in moist areas, used medicinally.	X		X		X
Rumex acetosella subsp. *angiocarpus*	Sheep Sorrel				X		
Solanum incanum		Grassland, usually in moist areas.				X	
Oenothera rosea	Rose Evening Primrose	Weed in disturbed places					X
Oenothera tetraptera	White evening Primrose	Weed					X
Total number of weeds identified = 13			**4**	**2**	**5**	**1**	**4**
Total species per vegetation community:			**62**	**44**	**49**	**56**	**25**

APPENDIX C: PLANTS OF CONSERVATION CONCERN KNOWN TO OCCUR WITHIN THE AREA AND WITH A POSSIBILITY TO OCCUR ON SITES IMPACTED BY THE PROPOSED ROAD UPGRADE.

Plant species	Conservation Status	Occurrence	Additional typical habitat where is could occur (Raimondo *et al*, 2009)
Boophane disticha.	Declining	Confirmed at BP1	Grassland
Crinum bulbispermum	Declining	Confirmed: (point 95)	Near rivers, streams and seasonal pans
Eucomis autmunalis	Declining	Confirmed west of BP1	Grassland and moist grassland/wetlands
Alepidea longecilliata	Endangered within Mpumalanga Province Least Concern elsewhere	*Not identified*	
Aspidoglossum xanthosphaerum	Vulnerable	*Not identified, however it is highly likely that the plant could occur at marshy grasslands along the N11 and BP1 and BP3* *Known to occur within the quarter degree 2629BA*	Montane grasslands, marshy sites
Eulophia parvilabris	Least Concern, however very rare	*Not identified* *Known to occur within the quarter degree 2629BA*	Grassland marshy areas
Gladiolus robertsoniae	Near Threatened	*Not identified* *Known to occur within the quarter degree 2629BA*	Moist grassland on rocky sites, mostly dolerite outcrops.
Hesperantha rupestris	Data deficient	*Not identified, although probable occurrence at BP3* *Known to occur within the quarter degree 2629BA*	Moist grassland
Khadia carolinensis	Vulnerable	*Not identified* *Known to occur within the quarter degree 2629BA*	Well drained sandy loam soils, among rocky outcrops, or at the edge of sandstone sheets, highveld grassland

Plant species	Conservation Status	Occurrence	Additional typical habitat where is could occur (Raimondo *et al*, 2009)
Nerine platypetala	Vulnerable	*Not identified Flowers in autumn**	Montane grassland, margins of permanently moist vlei's and riverbanks
Nerine gracilis	Near Threatened	*Not identified Flowers February to March*. Known to occur within the quarter degree 2629BA*	Moist grassland between Bethal and Carolina

*Field survey (November) did not coincide with flowering

Appendix D2: Faunal Assessment Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/2078
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Work Package 2 – N11 between Hendrina and Ermelo: Rehabilitation of National Route 11 between Ermelo and Hendrina

Specialist:	Pieter Olivier		
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Professional affiliation(s) (if any)	South African Council for Natural Scientific Professions (membership pending) Birdlife South-Africa		

Project Consultant:	Strategic Environmental Focus		
Contact person:	Milicent Solomons		
Postal address:	PO Box 74785 Lynnwood Ridge Pretoria		
Postal code:	0040	Cell:	
Telephone:	012 349 1307	Fax:	012 349 1229
E-mail:	Milicent@sefsa.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Pieter Olivier , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of 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 have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form 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 the specialist:

Strategic Environmental Focus

Name of company (if applicable):

24/02/2011

Date:

ROAD UPGRADE AND ASSOCIATED BORROW PITS: N11 BETWEEN ERMELO AND HENDRINA WORKPACKAGE 2 FAUNAL ASSESSMENT

SEF Reference No. 503928

Prepared for:

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S.E.F
STRATEGIC ENVIRONMENTAL FOCUS

December 2010/January 2011

Declaration of Independence

I, **PIETER OLIVIER**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

_____ _____

Pieter Olivier Date
Ecologist
SACNASP Reg. No. Pending

EXECUTIVE SUMMARY

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed by Bigen Africa (Part of the Netgroup Consortium) to conduct a Basic Assessment (BA) process for the proposed upgrade of a section of the N11 road between Hendrina and Ermelo as well as a small potion of the R38 westward from Hendrina to the R542 turnoff. The upgrade is deemed necessary as the existing pavement surface is in a poor condition with many areas having been patched. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The length of the total project is 55.69km of single carriageway road. The existing formation is approximately 14.0m wide. The project also includes the widening of four bridges (including a bridge over a spruit and the Klein Olifants River). In order to obtain enough material for the upgrading of the road surface, it is proposed that four borrow-pits should be established along the route.

The study was carried out to determine regional faunal assemblages that are expected to occur along the N11 road section to be upgraded as well as the three borrow pits and focused specifically on the occurrence of species of conservation concern.

The ecological sensitivity of the study sites associated with the proposed borrow pits One, Two, Three and Four was rated as Medium, Medium-Low, Medium and Medium-Low respectively. No faunal species of conservation concern were encountered during the survey, but there was a moderate to moderately-high probability that some species could occur here periodically. The ecological rehabilitation of borrow pits do have the potential to provide cover and additional habitat for faunal species that occur on the study site as well as providing suitable habitat for other faunal species that would not necessarily occur on the study site. The mitigation measures as proposed in this report should thus be adhered to in order to minimize the effect of mining on faunal species that occurs here.

Faunal habitats that fell within the road reserve were heavily disturbed with very little chance of sustaining functional faunal communities. Long grasses and vegetation that are present along fences that could, however provide cover for specifically rodent species that forages here occasionally. The most important habitat types along the road were two water crossings and a number of wetlands that occurred frequently along the road. Specifically, a bird-rich pan (S 26°11'27.6 E 29°44'37.1) was noted as being a *Highly Sensitive* area. Construction activities should be minimized in these areas and caution should be taken to adhere to mitigation measures as set out in this report.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

1. INTRODUCTION

1.1 Project Description

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed by Bigen Africa (Part of the Netgroup Consortium) to conduct a Basic Assessment (BA) process for the proposed upgrade of a section of the N11 road between Hendrina and Ermelo as well as a small potion of the R38 westward from Hendrina to the R542 turnoff. The upgrade is deemed necessary as the existing pavement surface is in a poor condition with many areas having been patched. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The length of the total project is 55.69km of single carriageway road. The existing formation is approximately 14.0m wide.

The project also includes the widening of four bridges (including a bridge over a spruit and the Klein Olifants River). In order to obtain enough material for the upgrading of the road surface, it is proposed that four borrow-pits should be established along the route.

As part of the BA process, an ecological study of the natural environment was required to inform the proposed road upgrade as well as the associated borrow pits. This report represents the faunal assessment and should be read in conjunction with the other ecological specialist reports or opinions pertaining to the proposed road upgrade and borrow pits.

1.2 Terms of Reference

Literature review

- Gain an understanding of the ecological sensitivities within the planning area and supplement this information with the Mpumalanga Biodiversity Conservation Plan (MBCP) (Ferrar & Lötter, 2007);
- Determine the regional faunal assemblages that are expected to occur along the N11 road section to be upgraded as well as the four borrow pits;

Field investigation

- Undertake a faunal survey to assess the occurrence of faunal species with specific reference to species of conservation concern along the R38 and R542 road between Hendrina, Ermelo and Bethal as well as the four borrow pits required for the upgrade; and
- Conduct a survey to identify possible sensitive faunal habitat that could be occupied by species of conservation concern.

Recommendation and mitigation

- To provide recommendation and mitigation measures to limit the identified impacts that the proposed road upgrade and the four borrow pits required will have on the identified faunal species.

1.3 Assumptions and Limitations

This report presents the findings obtained following an assessment of the study area. The field survey was conducted during the week of 23-27th of November 2010. In order to obtain a comprehensive understanding of the dynamics of the biota on the site, including species of conservation concern, on a specific site, studies should include the following:

- Investigations through the different seasons of the year;
- Investigations over a number of years; and
- Extensive sampling of the area.

This assessment comprised of only a single site visit during November 2010. Most faunal species reach a peak in their activity patterns during this time of the year. A full faunal survey was carried out to determine species richness that met the Mpumalanga Minimum Requirements for Biodiversity Assessment (Mpumalanga Tourism and Parks Agency, 2008):

Therefore, this faunal assessment should be sufficient to highlight and map potential sensitivities along the N11 road section that forms Work Package 2 and the required borrow pits, as well as the occurrence or possible occurrence of species that are of conservation concern or provincially protected species. The resulting sensitivity map(s) is a valuable tool informing the upgrade and use of borrow pits, as well as by advising on the integration or avoidance of sensitive species where applicable.

1.4 List of Abbreviations

Table 1 lists the abbreviations used in this report.

Table 1: Abbreviations used in the report

Abbreviation	Description
QDS	Quarter Degree Grid Square

2. Description of the Environment

2.1 Location

The study area is located between the towns of Ermelo and Hendrina in Mpumalanga Province. Specifically, the study area is associated with the N11 national road, starting at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo (Figure 1).

2.2 Biophysical description

2.2.1 Climate

The area receives summer rainfall that varies between 650 and 750 mm per year. The winters are dry with frost. The average midday temperatures for Ermelo range from 15.8°C in June to 24.1°C in January. The region is the coldest during June when the mercury drops to 0.2°C on average during the night (SA Explorer, 2010).

2.2.2 Regional Vegetation

The road reserve and borrow pits is situated within the Grassland Biome of South Africa (Rutherford & Westfall, 1994).

The Grassland Biome can be divided into smaller units known as vegetation units. The majority of the N11 road section, as well as borrow pits two, three and four are situated within Eastern Highveld Grassland, while borrow pit one and a middle portion of the N11 road section, is situated within Soweto Highveld Grassland (Mucina and Rutherford, 2006; Figure 2).

The Grassland Biome is home to several animal species including 15 (or 45%) of South Africa's endemic mammal species, 10 globally threatened bird species, 52 of the 122 Important Bird Areas in South Africa, and some endemic fish species. Of the 195 reptile species endemic to South Africa, 22% are found in the biome, whilst one-third of the 107 threatened South African butterfly species occur in the grasslands. Some of the species of conservation concern that are found here include: *Anthropoides paradiseus* (Blue Crane), *Hirundo atrocaerulea* (Blue Swallow), *Ourebia ourebia* (Oribi) and *Geronticus calvus* (Southern Bald Ibis).

2.2.3 Associated Water Courses

The study area falls within two water management areas, namely the Olifants Water Management Area and the Upper Vaal Water Management Area. The Upper Vaal Water Management Area lies in the eastern interior of South Africa, and is considered to be a pivotal water management area in the country. According to the Department of Water Affairs and Forestry (2004), the sub-management area in which the present study area is located is the Upstream Vaal Dam sub-management area. More specifically, the portion of the proposed project that corresponds with the Upper Vaal Water Management Area falls within Quaternary Catchment C11F.

A total of three perennial water courses are associated with the proposed project, namely the Klein Olifants River (located within the Olifants Water Management Area), and the Klein Xspruit and an additional unnamed watercourse (located in the Upper Vaal Water Management Area).

In addition, the proposed project is bisected by numerous wetlands identified to comprise mainly unchannelled valley bottom wetlands and seepages.

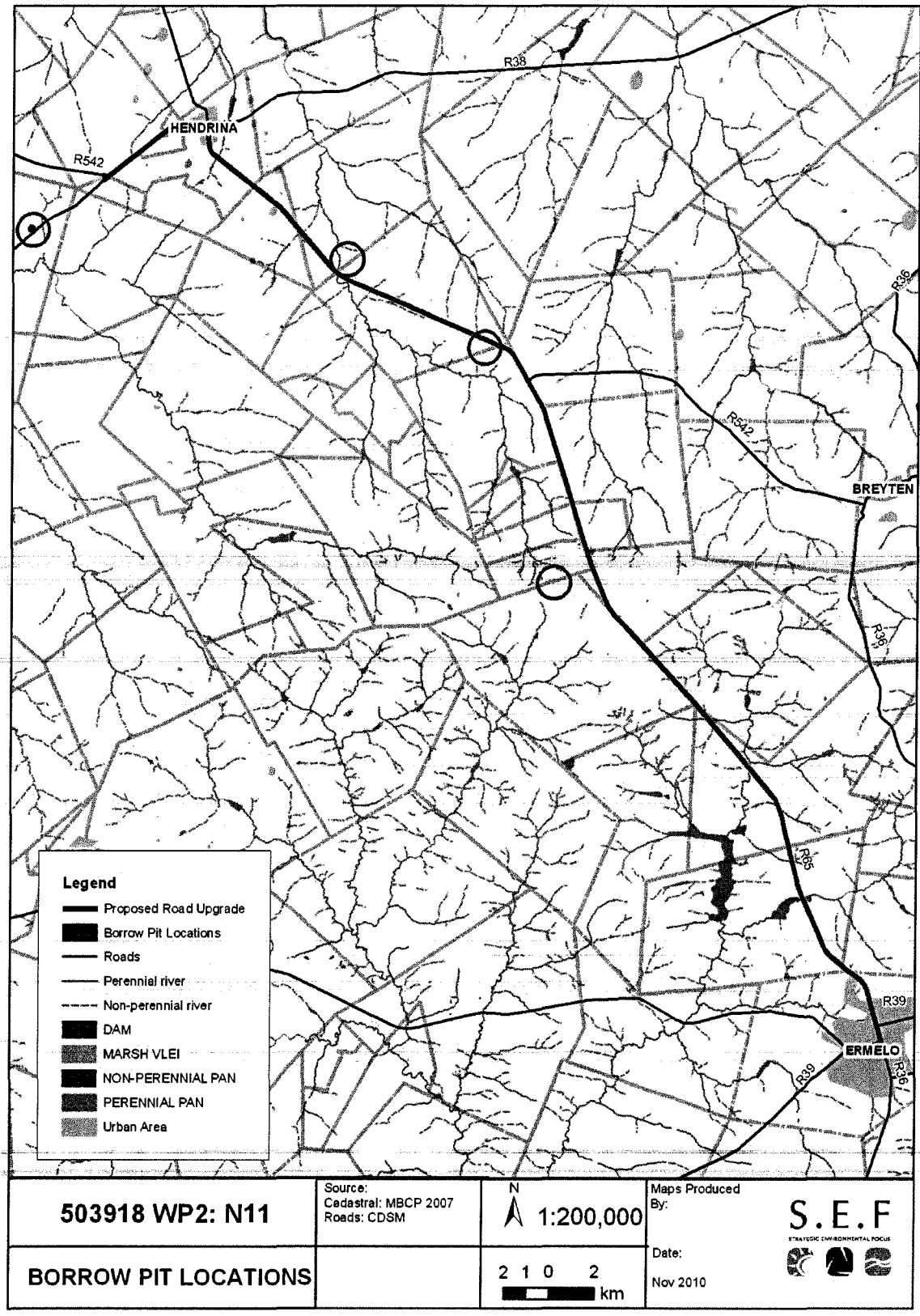


Figure 1: Location of the study area

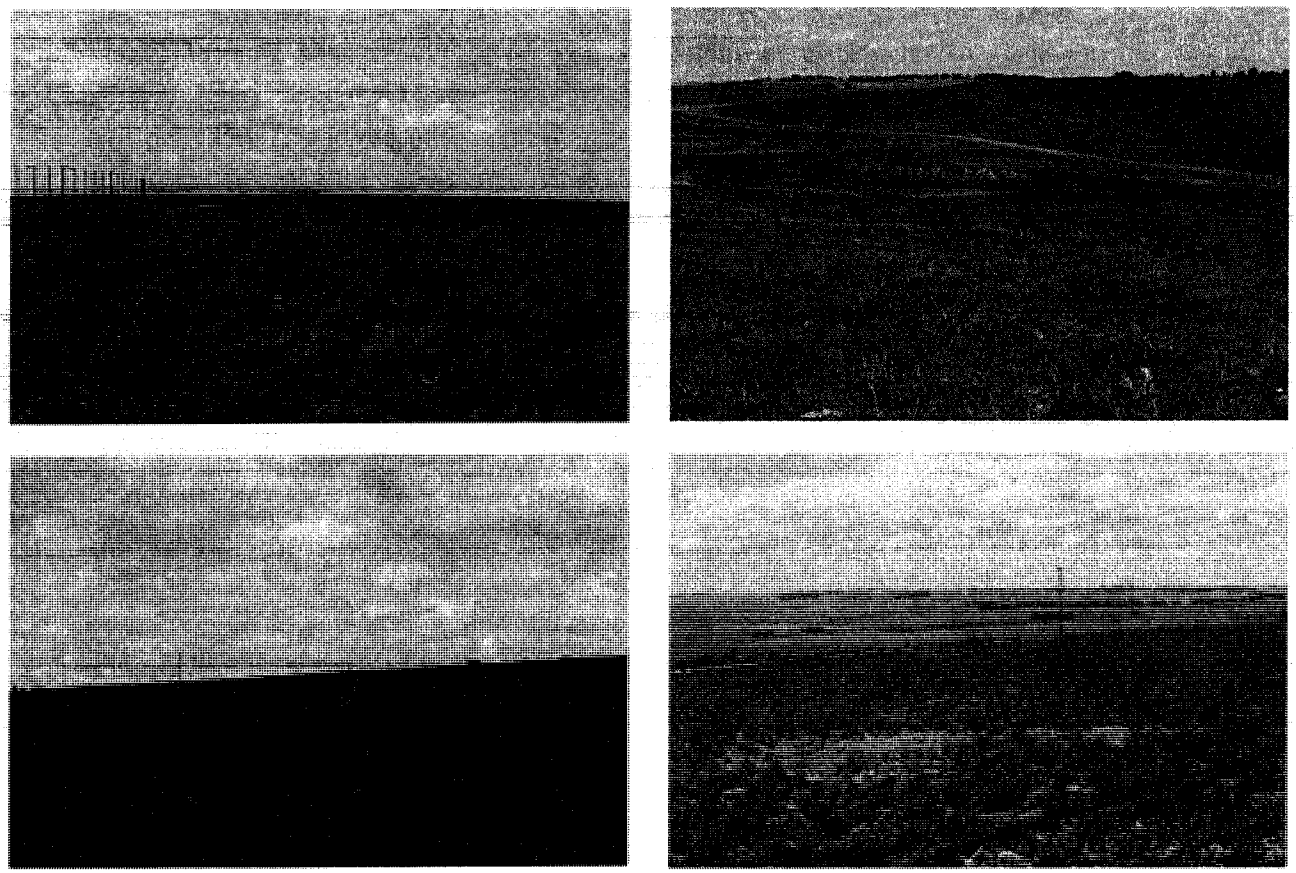
3. RESULTS

3.1 Faunal assemblages associated with proposed borrow pits

3.1.1 Borrow pit 1 – (S26˚20.433; E29˚51.309)

3.1.1.a Faunal habitat types

The study site was surrounded by maize fields in the east, and agricultural fields in the north, south and west (Photographs 1). The study site was comprised of homogenous grassland habitat that included recently burnt and grazed grassland interspersed with rocks (Photograph 1c). An old borrow pit was located west of the study site with a drainage line flowing into it (Photograph 1b).



Photograph 1: (a) Recently ploughed maize fields (b) abandoned borrow pit filled with rainwater (c) homogenous grassland interspersed with rocks (d) and agricultural field surrounding the study site.

3.1.1.b Birds

A total of 191 bird species have been recorded in the quarter degree square (QDS) of the study site (South African Bird Atlas Project 2010) including 13 species of conservation concern (One *Endangered*, Four *Vulnerable*, Eight *Near-Threatened*). Only five bird species were recorded on the study site during the field survey namely: *Hirundo rustica* (Barn Swallow), *Saxicola torquatus* (African Stonechat), *Pternistes swainsonii* (Swainson's Spurfowl), *Streptopelia semitorquata* (Cape Turtle Dove) and

Vanellus coronatus (Crowned Lapwing). *Plegadis falcinellus* (Glossy Ibis) and *Fulica cristata* (Red-knobbed Koot) were present in the old borrow pit adjacent the study site. The lack of more heterogeneous habitat and the relatively small size of the study site most likely resulted in the small number of bird species encountered here.

The probabilities for other species occurring on the study site were as follows:

- 56 species had a high probability of occurring on the study site;
- 16 species had a moderate to high probability of occurring on the study site;
- 42 species had a moderate probability of occurring on the study site including two species of conservation concern, namely: *Eupodotis caerulescens* (Blue Korhaan) and *Spizocorys fringillaris* (Botha's Lark);
- 22 species had a moderate to low probability of occurring on the study site including six species of conservation concern, namely: *Sagitarius serpentis* (Secretarybird), *Falco biarmicus* (Lanner Falcon), *Falco naumanni* (Lesser Kestrel), *Anthropoides paradiseus* (Blue Crane), *Glareola nordmanni* (Black-winged Pranticole) and *Tyto capensis* (African Grass Owl);
- 55 species had a low probability of occurring on the study site including five species of conservation concern, namely: *Phoenicopterus rubber* (Greater Flamingo), *Phoenicopterus minor* (Lesser Flamingo), *Geronticus calvus* (Southern Bald Ibis), *Alcedo semitorquata* (Half-collard Kingfisher) and *Aquila ayresii* (Ayres Hawk Eagle).

Please refer to Appendix B for the complete list of bird species that could potentially occur on the study site.

3.1.1.c Mammals

A total of 46 mammal species are expected to occur within the QDS where the study site is located (Friedmann & Daly, 2004), four of which were species of conservation concern. *Sylvicapra grimmia* (Grey Duiker) was the only mammal species confirmed during the field survey. The probabilities of other species occurring on the study site were as follows:

- 17 species had a high probability of occurring on site including one species of conservation concern, namely: *Felis serval* (Serval);
- 14 species had a moderate to high probability of occurring on the study site.
- Five species had a moderate probability of occurring on the study site including three species of conservation concern, namely: *Amblysomus robustus* (Robust Golden Mole), *Amblysomous septentrionalis* (Highveld Golden Mole) and *Ourebia ourebia* (Oribi);
- Five species had a moderate to low probability of occurring on the study site including two species of conservation concern, namely: *Mystromys albicaudatus* (White-tailed Rat) and *Crocidura maquassiensis* (Maquassie Musk Shrew).
- Three species had a low probability of occurring on the study site.

Please refer to Appendix C for the comprehensive list of mammal species that could potentially occur on the study site.

3.1.1.d Reptiles

A total of 15 reptile species could potentially occur on the study site (Appendix D). None of these were species of conservation concern. During the survey *Mabuya variegata variegate* (Variegated Skink) were encountered on the rocks interspersed on the study site. The secretive nature of reptiles makes it difficult to locate and identify species occurring in an area in a relative short space of time. However, a habitat assessment suggests that five of the 15 expected species have a high to moderate-high probability of occurring within the area.

3.1.1.e Amphibians

The small drainage line was the only suitable habitat for amphibians on the study site. Rainwater that accumulated in the old borrow pit adjacent to the study site could also provide some suitable amphibian habitat. Nonetheless, 11 amphibian species have been recorded in the QDS where the study site is located (Appendix E). Of these, none were of conservation concern.

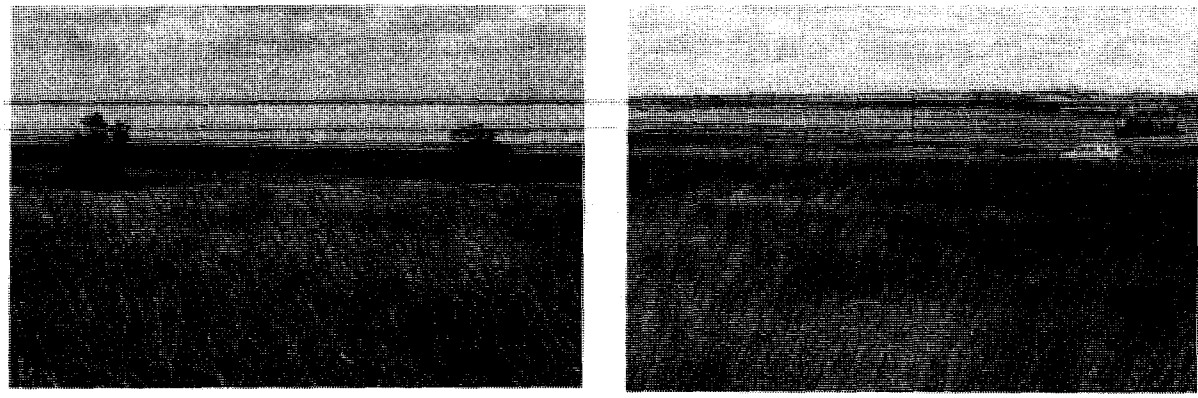
3.1.1.5 Invertebrates

Two butterfly species are known to occur in the QDS where the study site is located (South African Butterfly Assessment, 2010) namely: *Stygionympha vigilans* (Western Hillside Brown) and *Stygionympha wichgrafi* (Wichgraf's Hillside Brown). Both of these are classified as *Least Concern*.

3.1.2 Borrow pit 2 (S26˚14.916; E29˚49.644)

3.1.2.1 Faunal habitat types

The study site was comprised of relatively dense, long grass that has been grazed in the past (Photograph 1a). This was the only faunal habitat present along with small damp depressions that have formed as a result of rainwater accumulating in the adjacent abandoned borrow pit (Photograph 1b).



Photograph: (a) Previously grazed grassland on the study site and (b) damp depressions that formed in the abandoned borrow pit.

3.1.2.a Birds

A total of 150 bird species have been recorded in the QDS of the study site (South African Bird Atlas, 2010) including nine species of conservation concern (One *Endangered*, Three *Vulnerable*, Five *Near-Threatened*). Four species were recorded on the study site: *Anthus cinnamomeus* (African Grassveld Pipit), *Cisticola juncidis* (Ziiting Cisticola), *Euplectes progne* (Long-tailed Widowbird) and *Ploceus velatus* (Southern Masked Weaver). The relative homogenous nature of the study site as a result of past disturbances most likely resulted in the small number of species encountered here.

The probabilities of other species occurring on the study site were as follows:

- 32 species had a high probability of occurring on the study site;
- 34 species had a moderate to high probability of occurring on the study site;
- 26 species had a moderate probability of occurring on the study site including four species of conservation concern, namely: *Sagitarius serpentis* (Secretarybird), *Neotis denhami* (Denham's Bustard), *Eupodotis caerulescens* (Blue Korhaan) and *Spizocorys fringillaris* (Botha's Lark);
- 13 species had a moderate to low probability of occurring on the study site including two species of conservation concern, namely: *Balearica regulorum* Grey-crowned Crane and *Glareola nordmanni* (Black-winged Pranticole); and
- 44 species had a low probability of occurring on the study site including three species of conservation concern, namely: *Phoenicopterus rubber* (Greater Flamingo), *Phoenicopterus minor* (Lesser Flamingo), and *Geronticus calvus* (Southern Bald Ibis).

Please refer to Appendix B for the complete list of bird species that could potentially occur on the study site.

3.1.2.b Mammals

A total of 51 mammal species are expected to occur within the QDS where the study site is located. Four of these were species of conservation concern. No mammal species were encountered during the field survey.

The probabilities of other species occurring on the study site were as follows:

- 19 species had a high probability of occurring on site including one species of conservation concern, namely: *Felis serval* (Serval);
- 16 species had a moderate to high probability of occurring on the study site;
- Six species had a moderate probability of occurring on the study site including two species of conservation concern namely: *Ourebia ourebia* (Oribi) and *Atelerix frontalis* (South African Hedgehog;
- Five species had a moderate to low probability of occurring on the study site (including three species of conservation concern namely *Mystromys albicaudatus* (White-tailed Rat), *Amblysomus robustus* (Robust Golden Mole), *Amblysomous septentrionalis* (Highveld Golden Mole); and
- Four species had a low probability of occurring on the study site.

Please refer to Appendix C for the comprehensive list of mammal species that could potentially occur on the study site.

3.1.2.c Reptiles

A total of 13 reptile species have been recorded in the QDS and could potentially occur on the study site (Appendix D). No species of conservation concern were expected to occur on the study site. The lack of cover (e.g. rocks or trees) and the homogenous nature of the study site made it unlikely that a wide variety of reptiles would occur here.

3.1.2.d Amphibians

Rainwater that accumulated in the old borrow pit adjacent to the study site provided the only suitable amphibian habitat. During the field survey *Amietophrysus gutturalis* (Guttural Toad) was encountered. In addition 12 other amphibian species have been recorded in the QDS where the study site is located and could potentially also occur on the study site (Appendix E), of which none were of conservation concern.

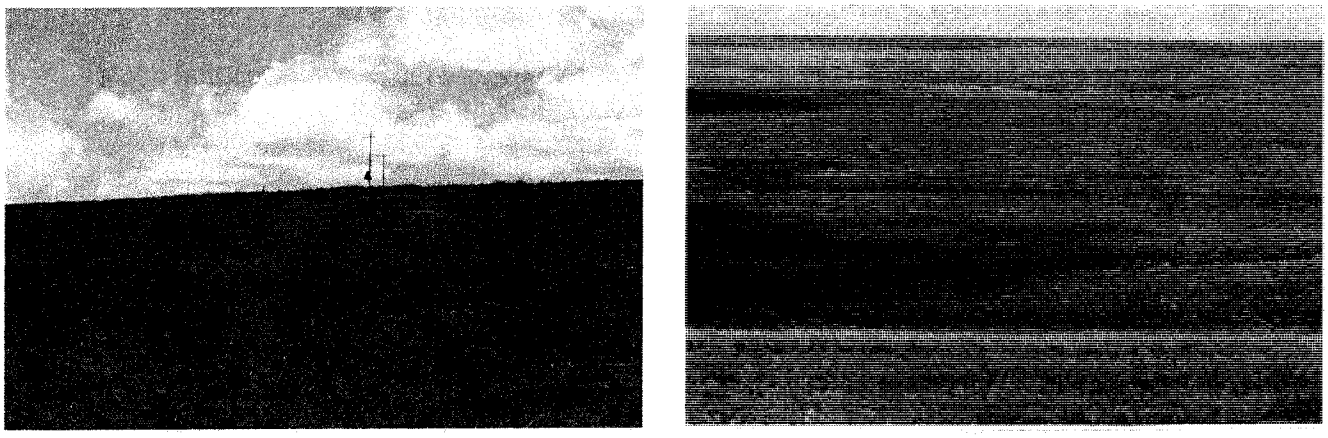
3.1.2.e Invertebrates

Unfortunately there were no data available on butterfly distribution in the QDS where the study site is located (South African Butterfly Assessment, 2010). No invertebrate species were encountered during the field survey.

3.1.3 Borrow pit 3 (S26˚12.838; E29˚46.312)

3.1.3.a Faunal habitat types

The study site was mostly comprised of homogenous short grazed grassland. On the western side of the study site, the Klein Olifants River was present that could provide additional faunal habitat. Along the river, grass was denser and longer which could potentially provide cover and habitat for a number of faunal species. Even though no species were encountered during the field survey, faunal species that do reside here could use the study site for foraging or dispersal as the river could be functioning as a potential movement corridor.



Photograph 3: Homogenous short grazed grassland present on the study site (a) and small, non perennial stream on the western border of the study site (b).

3.1.3.b Birds

A total of 150 bird species have been recorded in the QDS of the study site (South African Bird Atlas, 2010) including nine species of conservation concern (One *Endangered*, Three *Vulnerable*, Five *Near-Threatened*). Six species were recorded on the study site during the survey: *Hirundo rustica* Barn Swallow, *Riparia cincta* (Banded Martin), *Vanellus coronatus* (Crowned Lapwing), *Vanellus senegallus* (Wattled Lapwing), *Euplectes orix* (Red Bishop) and *Euplectes progne* (Long-tailed Widowbird). The open, small area and homogenous state of the study site as well as the agricultural activities on the surrounding areas most likely resulted in the small number of bird species recorded here.

The probabilities of other species occurring on the study site were as follows:

- 40 species had a high probability of occurring on site.
- 36 species have a moderate to high probability of occurring on the study site including two species of conservation concern namely: *Sagitarius serpentis* (Secretarybird) and *Spizocorys fringillaris* (Botha's Lark);
- 24 species have a moderate probability of occurring on the study site including two species of conservation concern namely: *Neotis denhami* (Denham's Bustard), *Eupodotis caerulescens* (Blue Korhaan);
- 10 species have a moderate to low probability of occurring on the study site (including two species of conservation concern namely: *Balearica regulorum* Grey-crowned Crane and *Glareola nordmanni* (Black-winged Pranticole); and
- 39 species have a low probability of occurring on the study site (including 3 species of conservation concern namely: *Phoenicopterus rubber* (Greater Flamingo), *Phoenicopterus minor* (Lesser Flamingo), and *Geronticus calvus* (Southern Bald Ibis).

Please refer to Appendix B for the complete list of bird species that could potentially occur on the study site.

3.1.3.c Mammals

A total of 51 mammal species are expected to occur within the QDS where the study site is located. Four of these were species of conservation concern. No mammal species were encountered during the field survey. However, burrows that indicated the presence of *Hystrix africaeaustralis* (Porcupine) and *Pedetes capensis* (Springhare) were found on the study site.

The probabilities of other species occurring on the study site were as follows:

- 19 species had a high probability of occurring on site including one species of conservation concern, namely: *Felis serval* (Serval);
- 16 species had a moderate to high probability of occurring on the study site;
- Six species had a moderate probability of occurring on the study site including three species of conservation concern, namely: *Ourebia ourebia* (Oribi) and *Amblysomus robustus* (Robust Golden Mole), *Amblysomous septentrionalis* (Highveld Golden Mole);
- Five species had a moderate to low probability of occurring on the study site including one species of conservation concern, namely: *Mystromys albicaudatus* (White-tailed Rat); and
- Four species had a low probability of occurring on the study site.

Please refer to Appendix C for the complete list of mammal species that could potentially occur on the study site.

3.1.3.d Reptiles

A total of 13 reptile species have been recorded in the QDS and could potentially occur on the study site. No species of conservation concern are expected to occur here. The lack of cover, rocks or termite mounds on the study site made it unlikely that most of the reptiles listed in Appendix D would occur on the study site.

3.1.2.e Amphibians

Amphibian species are only expected to occur within close proximity of the non perennial stream in the west of the south of the study site. Impacts associated with the proposed borrow pits could affect amphibians living in close vicinity of the study site. For instance, possible erosion caused by construction activities may impact on the stream and subsequently alter amphibian habitats.

A total of 12 amphibian species have been recorded in the QDS where the study site is located and could potentially also occur in the vicinity of the study site (Appendix E) none of which were of conservation concern.

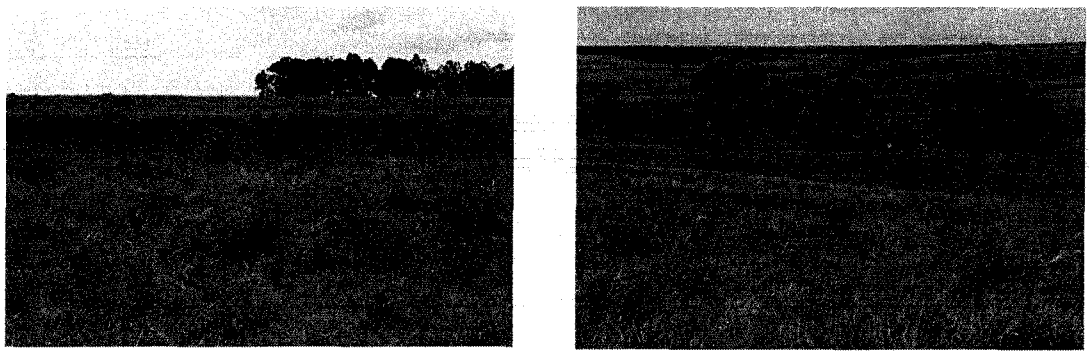
3.1.2.f Invertebrates

Unfortunately there are no data available on butterfly distribution in the QDS where the study site is located (South African Butterfly Assessment, 2010). No invertebrate species were encountered during the field survey.

3.1.4 Borrow pit 4 (S26°12.838; E29°46.312)

3.1.3.a Faunal habitat types

The study site was mostly comprised of disturbed grazed grassland. However, on the north-eastern side of the study site a small spruit was present that could also provide additional faunal habitat.



Photograph 4: Homogenous short grazed grassland present on the study site (a) and small, non perennial stream and Willow trees on the north-eastern border of the study site (b).

3.1.3.b Birds

A total of 150 bird species have been recorded in the QDS of the study site (South African Bird Atlas) including nine species of conservation concern (One *Endangered*, Three *Vulnerable*, Five *Near-Threatened*). Five species were recorded on the study site during the survey namely: *Riparia cincta* (Banded Martin), *Vanellus coronatus* (Crowned Lapwing), *Euplectes orix* (Red Bishop), *Euplectes progne* (Long-tailed Widowbird) and *Megaceryle maximus* (Giant Kingfisher). The disturbed nature, small size and lack of diversity of habitats on the study site as well as the agricultural activities on the surrounding areas most likely resulted in the small number of bird species recorded here.

The probabilities of other species occurring on the study site were as follows:

- 40 species had a high probability of occurring on site.
- 36 species have a moderate to high probability of occurring on the study site including one species of conservation concern, namely: *Spizocorys fringillaris* (Botha's Lark).
- 24 species have a moderate probability of occurring on the study site including two species of conservation concern, namely: *Neotis denhami* (Denham's Bustard), *Eupodotis caerulescens* (Blue Korhaan);
- 10 species have a moderate to low probability of occurring on the study site (including two species of conservation concern, namely: *Balearica regulorum* Grey-crowned Crane and *Glareola nordmanni* (Black-winged Pranticole); and
- 39 species have a low probability of occurring on the study site (including 3 species of conservation concern, namely: *Phoenicopterus rubber* (Greater

Flamingo), *Phoenicopterus minor* (Lesser Flamingo), and *Geronticus calvus* (Southern Bald Ibis).

Please refer to Appendix B for a detailed list of bird species that could potentially occur on the study site.

3.1.3.c Mammals

A total of 51 mammal species are expected to occur within the QDS where the study site is located. Four of these were species of conservation concern. No mammal species were encountered during the field survey. However, burrows were found within damp depressions on the study site which suggest the occurrence of rodent species.

Photograph 5: An example of a rodent burrow found on the study site of Borrow pit 4.

The probabilities of other species occurring on the study site were as follows:

- 19 species had a high probability of occurring on site including one species of conservation concern, namely: *Felis serval* (Serval);
- 16 species had a moderate to high probability of occurring on the study site.
- Six species had a moderate probability of occurring on the study site including three species of conservation concern, namely: *Ourebia ourebia* (Oribi) and *Amblysomus robustus* (Robust Golden Mole), *Amblysomous septentrionalis* (Highveld Golden Mole);
- Five species had a moderate to low probability of occurring on the study site including one species of conservation concern, namely: *Mystromys albicaudatus* (White-tailed Rat); and
- Four species had a low probability of occurring on the study site.

Please refer to Appendix C for the complete list of mammal species that could potentially occur on the study site.

3.1.3.d Reptiles

A total of 13 reptile species have been recorded in the QDS and could potentially occur on the study site. However, no species of conservation concern are expected to occur here. The lack of cover, rocks or termite mounds on the study site made it unlikely that most of the reptiles listed in Appendix D would occur on the study site.

3.1.2.e Amphibians

Amphibian species are only expected to occur within close proximity of the non-perennial stream in the west of the south of the study site. No amphibian species are expected to occur on the study site, however individuals could potentially disperse across the area.

A total of 12 amphibian species have been recorded in the QDS where the study site is located and could potentially also occur in the vicinity of the study site (Appendix E) of which none were of conservation concern.

3.1.2.5 Invertebrates

Unfortunately there were no data available on butterfly distribution in the QDS where the study site is located (South African Butterfly Assessment, 2010). No invertebrate species were encountered during the field survey.

3.2 Faunal habitats along the road

3.2.1 Wetlands

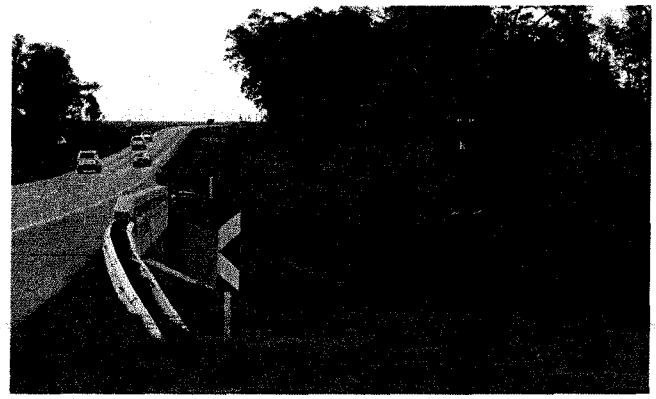
A number of wetlands were present along the road that could provide important habitat for a number of faunal, and especially bird, species. For a more detailed description on the wetlands present here please refer to the SEF (2010). The most important of these from a faunal perspective were a pan located at (S 26˚11'27.6 E 29˚44'37.1). Large numbers of *Fulica cristata* (Red-Knobbed Koot), *Tachybaptus ruficollis* (Little Grebe), and *Anas undulate* (Yellow-billed duck) occurred here along with a variety of other water birds such as *Platalea alba* (African Spoonbill), *Podiceps cristatus* (Greater Crested Grebe) and *Dendrocygna bicolour* (Fulvous Duck) (Photograph 3b). In addition, species of conservation concern such as *Phoenicopterus roseus* (Greater Flamingo) and Phoenicopterus minor (Lesser Flamingo) are highly likely to be encountered here.

A number of smaller wetlands located at various points along the road provide habitat for specifically *Tyto capensis* (African Grass Owl) and a potential large number of frog species (Photograph 3). In addition, mammal species of conservation concern such as *Chrysospalax villosus* (Rough-haired Golden Mole), *Amblysomus septentrionailis* (Highveld Golden Mole), *Mystromys albicaudatus* (White-tailed Mouse) and *Dasmys incomtus* (African Marsh Rat) are known to associate closely with wetland habitats and could potentially occur within the wetlands identified here. Specifically, a great deal of burrows that could possibly be those of the above mentioned golden moles or the common *Gerbilliscus brantsii* (Highveld Gerbil) were found in a wetland located at S26'21.244; E29'52.795.

Photograph 6: Example of wetlands found along the survey road (a) bird rich pan located within close proximity of the road (b) burrows found in a wetland along the surveyed road and (c) prime example of African Grass Owl habitat along the road (d).

3.2.2 River crossings

There were three river crossings along the surveyed road that could provide important faunal habitat. Not withstanding the fact that faunal species could reside here, rivers and streams act as important migration and dispersal corridors for a number of species e.g. *Aonyx capensis* (African Clawless Otter). Construction activities here could thus interrupt such movements and influence the dynamics of populations that occur in the area. Furthermore, *Hirundo spp.* (Swallows) breed under bridges here during summer and would be influenced by construction activities.

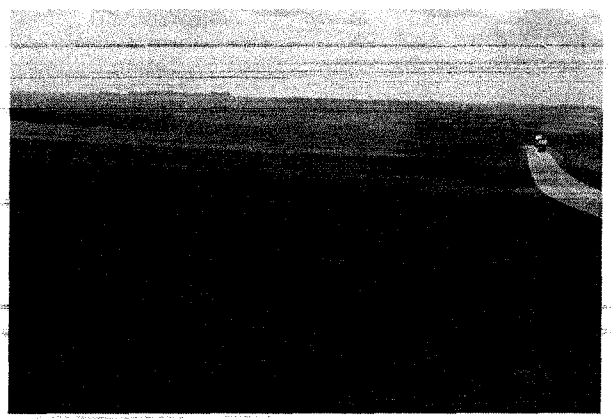



Photograph 7: (a) Perennial stream that flows under a bridge on the road from Ermelo to Hendrina and (b) water crossing outside Ermelo.

3.2.2 *Other faunal habitats*

Faunal habitat along the surveyed road was in most instances highly disturbed and provided little or no shelter for faunal species (Photograph 5). It is thus highly unlikely that any faunal species would be resident here. However, long grass cover along some fences next to the road provides cover for a number of rodent species which in turn acts as a food source for raptors in the area. Raptors recorded perching on telephone poles along the road during the survey included: *Elanus caeruleus* (Black-shouldered Kite), *Buteo vulpinus* (Steppe Buzzard) and *Milvus parasitus* (Yellow-billed Kite). A number of owl species are also expected to forage along the road at night. These species hunt here opportunistically and construction activities are unlikely to have any long term effect on their occurrence.

Clumps of *Eucalyptus* trees (location S26'10.796; E29'40.669) could also provide nesting habitat for a number of bird species (Photograph 5).




Photograph 8a &b: Typical faunal habitat encountered along the surveyed road (a) Patches of *Eucalyptus* trees found along some places along the road (b).

3.5 Ecological Importance and Sensitivity

The ecological sensitivity rating was based on the ecological function and conservation importance of a particular area. The relative ecological function (e.g. connectivity & presence of wetland systems) of an area was based upon the inherent function of the system or portion of land. For example, highly sensitive or dynamic systems will be those systems contributing to ecosystem service (e.g. wetlands) or the total preservation of biodiversity. Secondly, it relates to the degree of ecological connectivity between systems within a landscape matrix. Systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

On the other hand, ecological conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened species and species (or ecosystems) protected by legislation. Based on the findings of the study and the following criteria, sensitive habitat or areas of conservation importance were classified based on:

Ecological Function: The ecological function describes the intactness of the structure and function of an ecosystem in terms of the relationship between plant and animal assemblages and the surrounding abiotic environment. It also refers to the degree of ecological connectivity between systems within a landscape. Therefore, systems with a high degree of landscape connectivity among each other are perceived to be more sensitive.

High – Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems that are considered important for the maintenance of ecosystem integrity. Most of these systems represent late succession ecosystems with high connectivity with other important ecological systems.

Medium – These systems occur at disturbances of low-medium intensity and representative of secondary succession stages with some degree of connectivity with other ecological systems.

Low – Degraded and highly disturbed systems with little ecological function.

Conservation Importance: The conservation importance of the site gives an indication of the necessity to conserve areas based on factors such as the importance of the site on a national and/or provincial scale and on the ecological state of the area (degraded or pristine). This is determined by the presence of a high diversity, rare or endemic species and areas that are protected by legislation. The criteria are defined as follows:

High –Ecosystems with high species diversity and usually provide suitable habitat for a number of threatened species. These areas should be protected.

Medium – Ecosystems with intermediate levels of species diversity without any threatened species.

Low – Areas with little or no conservation potential and usually species poor (most species are usually exotic).

3.5.1 Borrow Pit 1

The ecological importance and sensitivity of the area was rated *Medium*. This is as a result of the grazed and recently burnt state of the grassland here. In addition previous mining of a now abandoned borrow pit was also noted. However, ecological succession processes has resulted in suitable habitat being present within and around the abandoned borrow pit. For instance, animal signs found during the survey suggest that a number of common faunal species do occur here. In addition the borrow pit provide habitat for amphibians occurring in the area.

3.5.2 Borrow Pit 2

The ecological importance and sensitivity of the area was rated *Medium-Low*. No faunal species of conservation concern had a high probability of occurring on the study site. The study site does however provide habitat for a number of common faunal species that will be impacted on by the proposed borrow pit mining.

3.5.3 Borrow Pit 3

The ecological importance and sensitivity of the area was rated *Medium*. The proximity of the Klein Olifants River and its surrounding habitat to the proposed mining site was the main reason for the medium sensitivity rating. The rest of the study area was comprised of relatively homogenous grazed grassland that provided habitat for only common faunal species. No species of conservation concern were expected to occur on the study site.

3.5.4 Borrow Pit 4

The ecological importance and sensitivity of the area was rated as *Medium-Low*, while no faunal species of conservation concern were expected to occur, however the non perennial watercourse on the north western part of the study site could provide habitat for some common faunal species, especially amphibians.

3.5.4 Road Survey

The ecological importance and sensitivity of the road reserve was rated as *Low* as common faunal species occur here opportunistically. Sensitive areas, specifically wetlands and an exceptionally bird-rich pan were encountered along the road and were classified as *Highly Sensitive* as a result of specialist faunal assemblages that may be associated with these areas. Furthermore, these areas have a high conservation potential.

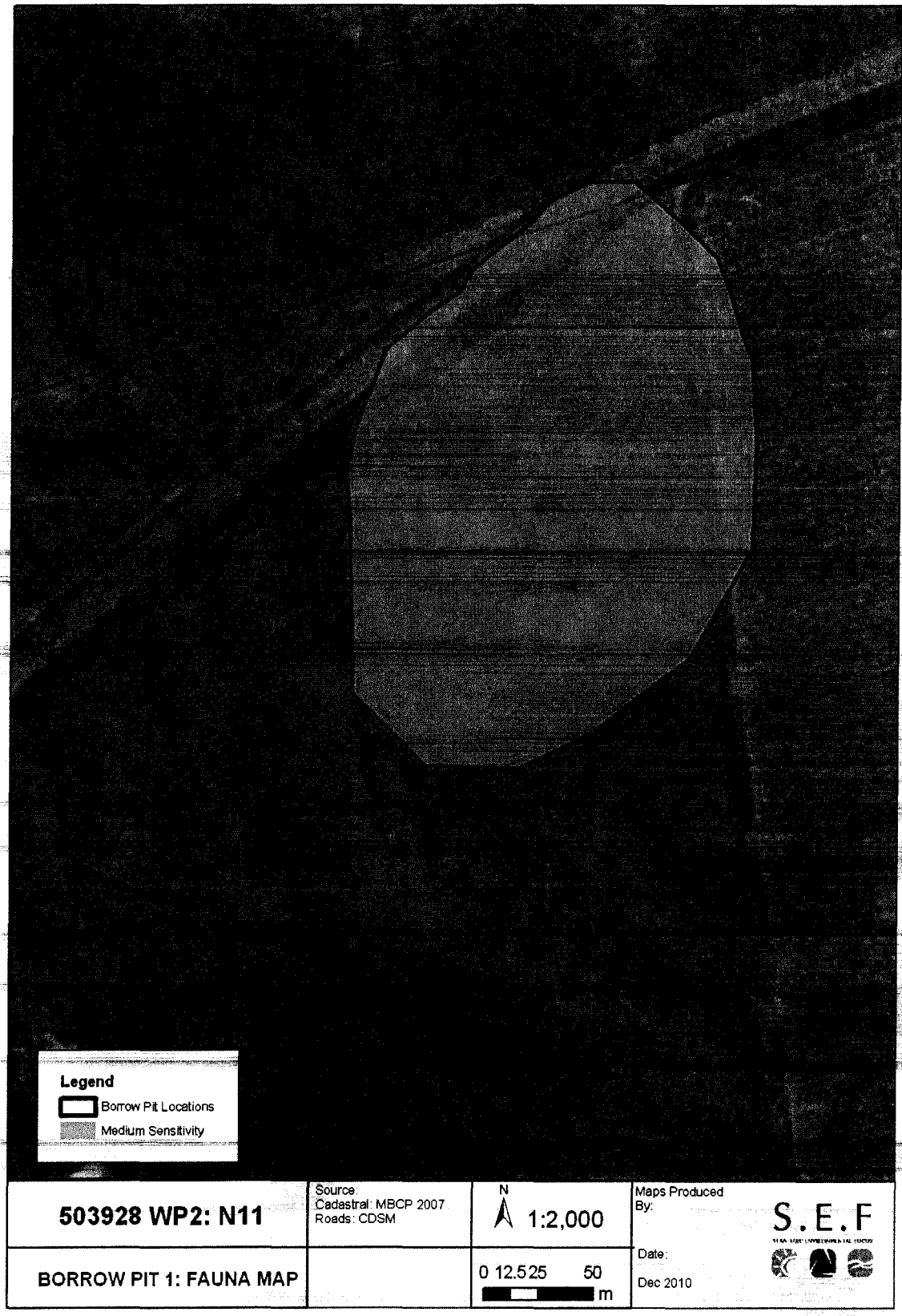


Figure 2: Ecological Sensitivity Map for Borrow pit 1.

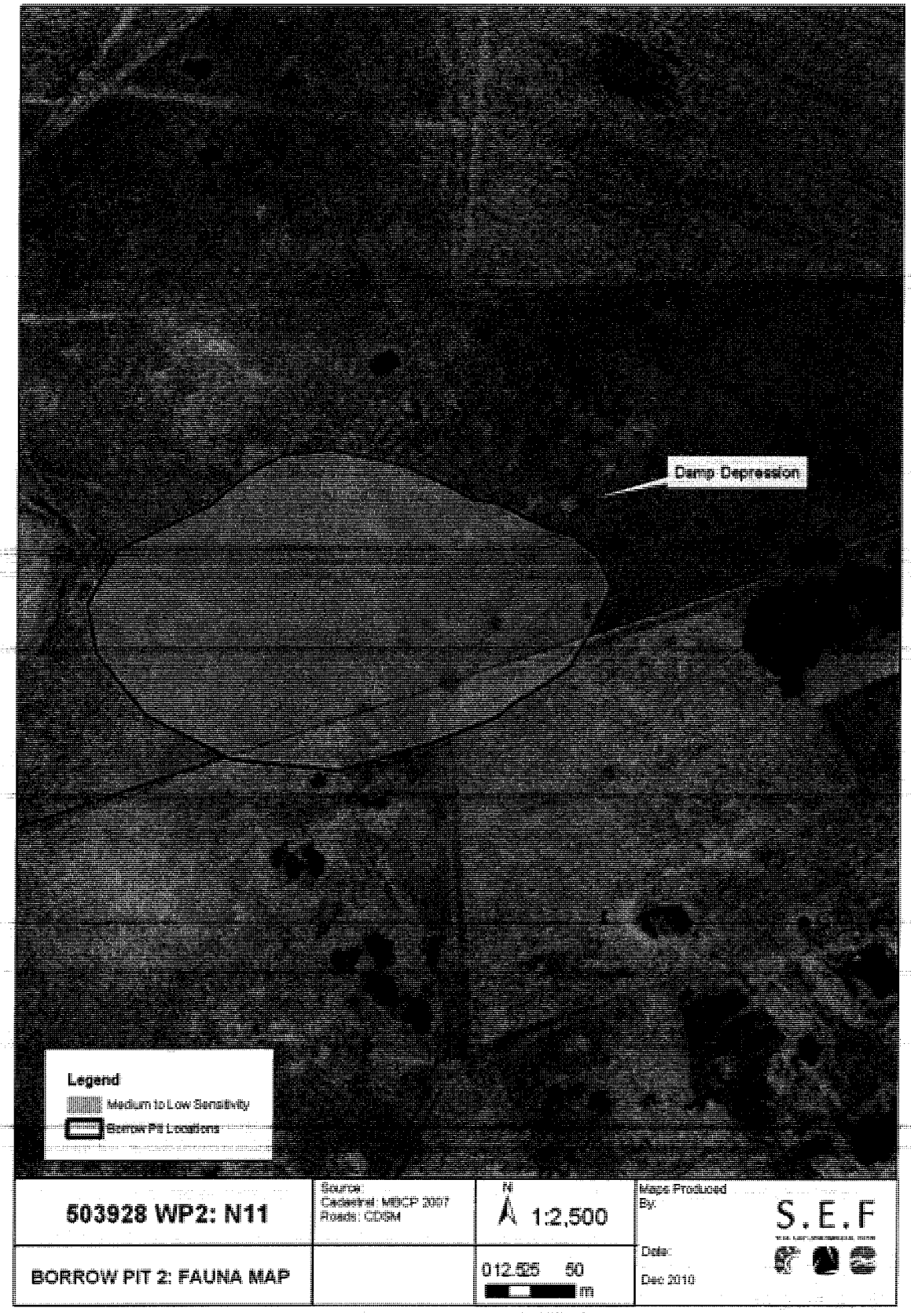


Figure 3: Ecological Sensitivity Map for Borrow pit 2.

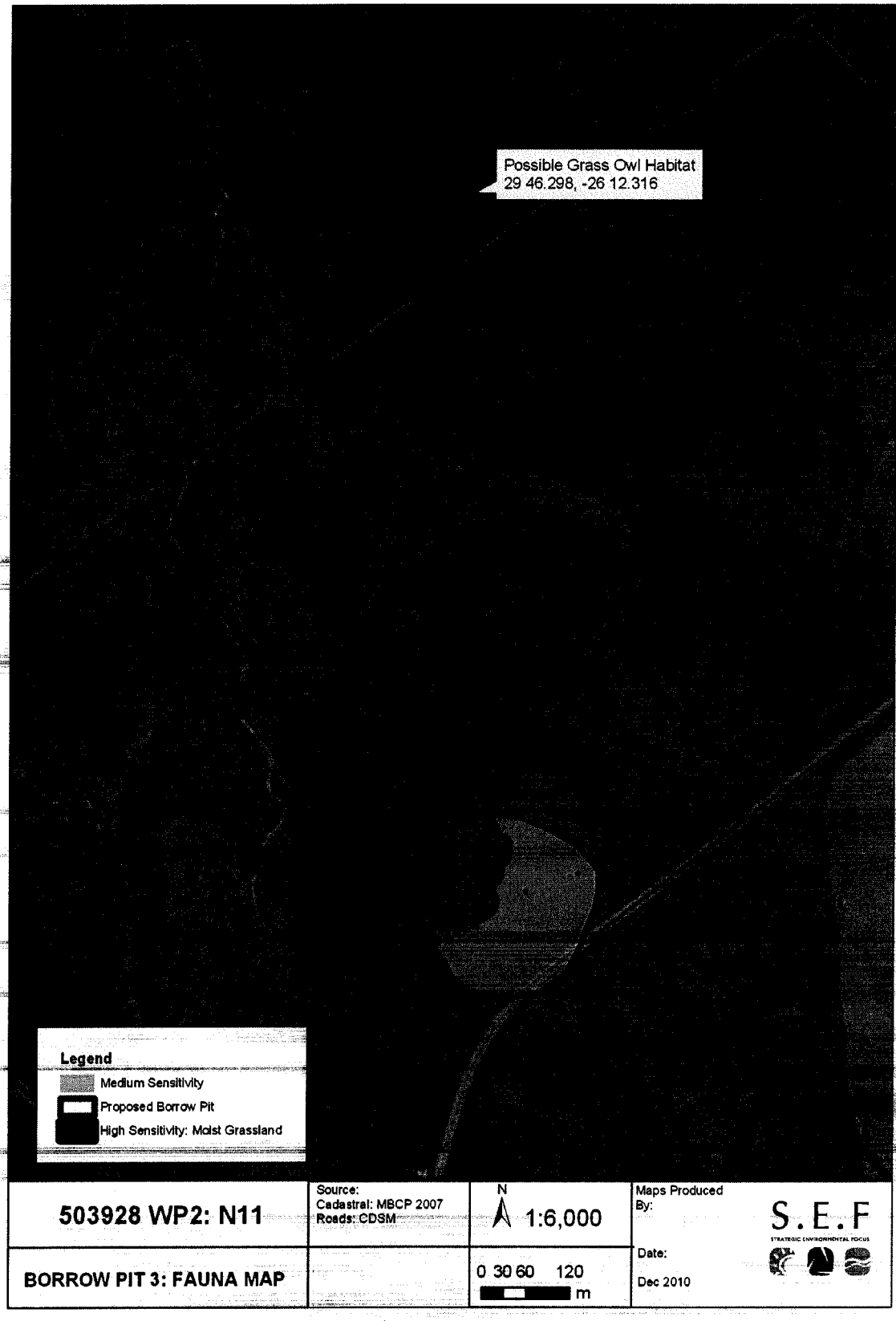


Figure 4: Ecological Sensitivity Map for Borrow pit 3.

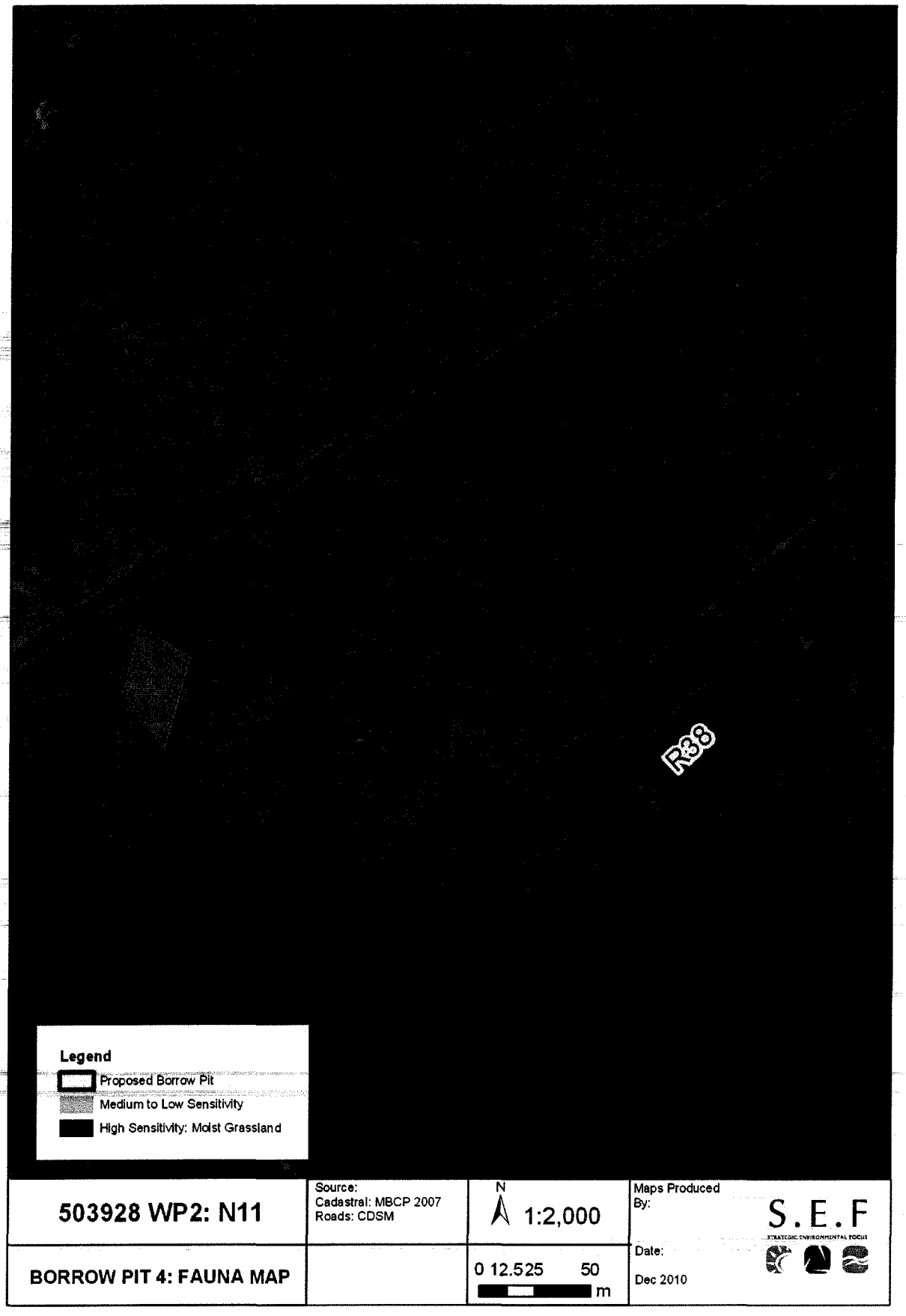


Figure 5: Ecological Sensitivity Map for Borrow pit 4.

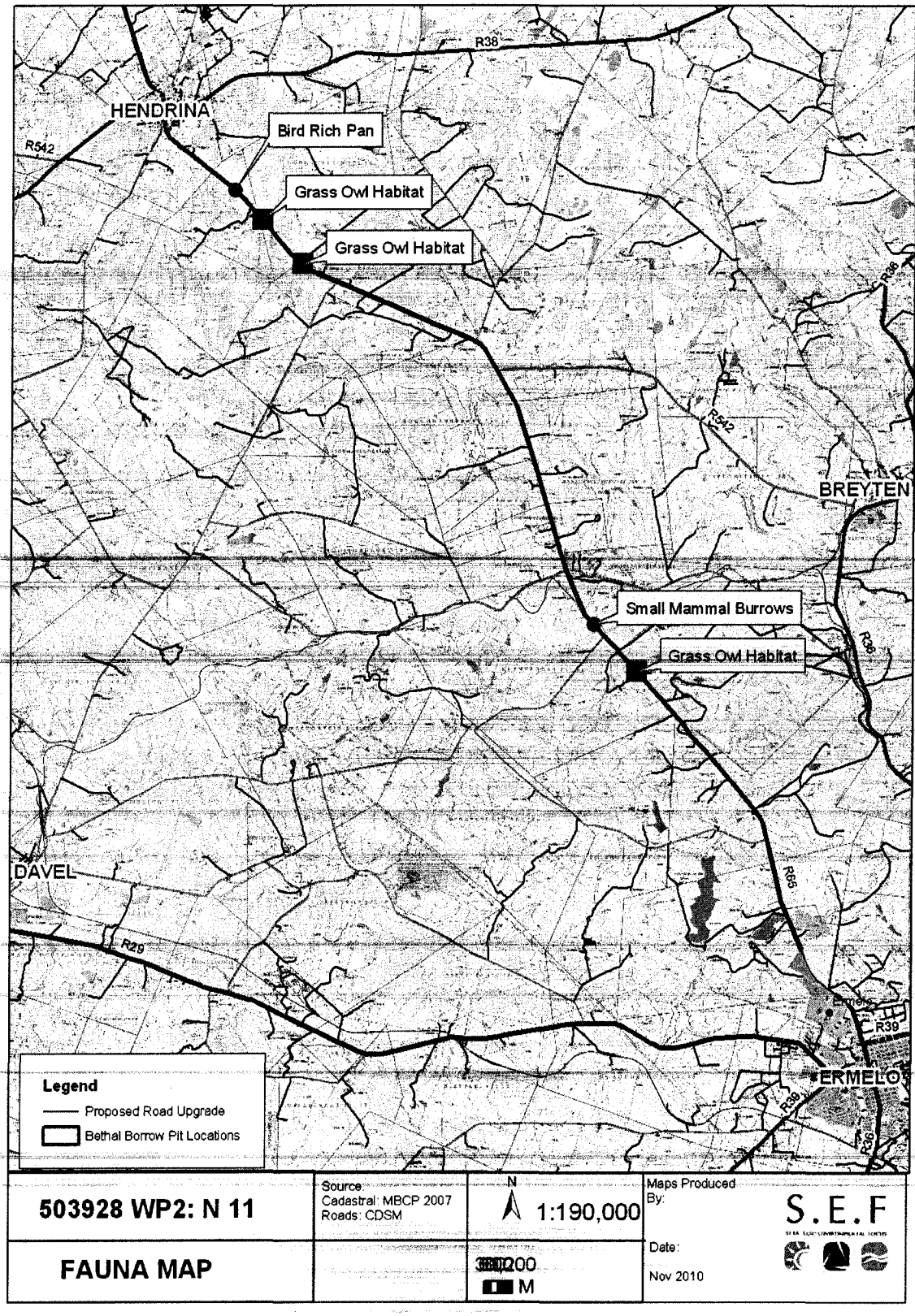


Figure 6: Faunal habitats encountered along the surveyed road.

4. IMPACT ASSESSMENT AND MITIGATION

Any development in a natural system will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the project was therefore to identify and assess the significance of the impacts likely to arise during the construction and the operational phases of the project, and provide a short description of the mitigation required so as to limit the impact of the proposed development on the natural environment. Possible impacts associated with the proposed development and their sources are provided in (Borrow pits) and Table 3 (Road Upgrade).

4.1 Assessment Criteria

The environmental impacts are assessed with mitigation measures (WMM) and without mitigation measures (WOMM) and the results presented in impact tables which summarise the assessment. Mitigation and management actions are also recommended with the aim of enhancing positive impacts and minimising negative impacts.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction and operation phase. The criteria against which these activities were assessed are discussed below.

4.1.1 Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

4.1.2 Extent of the Impact

A description of whether the impact will be local (extending only as far as the servitude), limited to the study area and its immediate surroundings, regional, or on a national scale.

4.1.3 Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

4.1.4 Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

4.1.5 Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

4.1.6 Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

4.2 Impact Assessment – Borrow Pit Mining

Due to the nature of borrow pit mining, most of the existing natural habitat will be destroyed even if mitigation measures are implemented. These activities will inevitably alter or destroy the habitat of most fauna species resulting in the lack of suitable habitat on the mining site. The noise from construction vehicles and related activities could disturb and therefore deter fauna from the study site and adjacent areas which could lead to a decline in species number and/or eradication of the faunal species concerned. Fragmentation of the landscape is expected which could also lead to a possible reduction in suitable migratory routes and dispersal patterns of fauna. Furthermore, poaching incidence could increase as a result of people occupying the site.

Table 2: Possible impacts associated with borrow pit mining.

Possible impact	Source of impact
Destruction of Faunal Habitat	Surface/soil disturbances during mining
Fragmentation of Faunal Habitat	Surface/soil disturbances during mining
Impacts on Surrounding Habitat and Species	Construction of roads as well as dust and noise associated with mining activities
Erosion of Faunal Habitat	Surface disturbances during mining
Increase in Environmental Degradation	Occurrence of accidental fires, health and sanitation concerns
Faunal Interactions with Structures and Personnel	Poaching/trapping/illegal hunting

4.2.1 Borrow Pit Mining

4.2.1.a Destruction and Fragmentation of Faunal Habitats

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Short	High	Definite	High	Medium	High

Description of Impact

The nature of borrow pit mining makes it inevitable that faunal habitats will be destroyed. The habitat will become unsuitable for faunal occupation and may impact on the dynamics of some populations. Furthermore, the resultant fragmentation may impact on the population dynamics of faunal species occurring in the surrounding area as they may use the study site for dispersal or foraging events.

Mitigation Measures

- No development should take place within the areas zoned as high sensitivity (please refer to Ecological Sensitivity Maps in this report);
- If possible, mining should commence in winter when nests and breeding pairs are least likely to be encountered and faunal diversity is at its lowest;
- No animal may under any circumstances be handled, removed or be interfered with;
- Should faunal species of conservation concern or any other species need to be removed from the study area, a faunal capture and relocation plan should be developed and implemented by a faunal specialist approved by Mpumalanga Conservation (MTPA). This is important for the planning and execution of all animal relocation activities so that animals are not introduced into areas where population stress is already being felt; and
- The slope of the borrow pits should not be steeper than 1(V):3(H). This will prevent faunal species being trapped within the pit created by the borrow pit mining processes (the rationale is that the new slopes must mimic the natural slopes and topography);
- Ensure that no concrete rubble is present within the top 1.5m of any embankment.
- Shape all disturbed areas to blend in with the surrounding landscape;
- Ensure that the study site is kept clean, tidy and free of rubbish that would attract animals; and
- Compile and implement an environmental monitoring programme, the aim of which should be preventing mining related impacts, ensuring long-term success of rehabilitation and prevention of environmental degradation.

4.2.1.b Impacts on Surrounding Habitats and Species

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Short-term	Low	High	Medium	Low	High

Description of Impact

Most faunal species are sensitive to disturbances and are unlikely to occupy habitats that are affected by mining activities. Faunal species occurring in adjacent areas might also be negatively affected. For instance the construction of new roads to utilize the mining site as well as dust and noise associated with mining activities could negatively impact on faunal species that occur within the surrounding areas but should be negligible in the long-run.

Mitigation Measure

- Demarcate the mining area in order to control movement of personnel and vehicles as well as providing boundaries for construction sites in order to limit dilution or spread of peripheral impacts;
- Make use of existing roads and tracks where feasible, rather than creating new routes;
- If additional access routes are planned, sensitive areas as set out in this report should be avoided;
- Ensure that adequate vehicle turning areas are allowed for;
- No off-road driving outside of demarcated areas is permitted;
- Plan for dust suppression as a result of traffic along roads;
- Runoff from roads must be managed to avoid erosion and pollution problems; and
- After closure, roads should be obliterated while vegetation should be re-established.

4.2.1.c Erosion of Faunal Habitat

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Medium	Medium	Probable	Medium	Low	Medium

Description of Impact

The removal of the surface vegetation will cause exposed soil conditions where rainfall and high winds can cause mechanical erosion. Soils can be washed into nearby streams and can therefore have an affect on faunal species and habitats in the greater area.

Mitigation Measures

- Where possible, limit mining activities to dry periods in order to curb occurrence/augmentation of erosion;
- Implement an ecologically-sound, storm water management plan during mining;
- Remove only the vegetation where mining will take place and limit any other disturbance to the natural vegetation cover; and
- Ensure surface restoration and resloping in order to prevent erosion, taking account of local contours, drainage lines and landscaping;

4.2.1.d Increase in Environmental Degradation

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Medium	Medium	Probable	High	Low	Medium

Description of Impact

Environmental degradation is the process where the natural environment of an area is degenerated to such an extent that the general health and biodiversity of an area is subjected to drastic reduction. This could be attributed to a variety of human activities such as: health and sanitation activities, storage of hazardous materials, use of pesticides, frequent and unnatural fires ext.

Mitigation Measure

- Ensure off-site storage of hazardous materials, chemicals, fuels, oils, etc. in order to prevent accidental spillage, contamination or pollution;

- Provide temporary on-site sanitation, litter and waste management and hazardous materials management facilities;
- Removal of dismantled structures, rubble, litter, refuse, temporary infrastructures, sanitation equipment, etc. subsequent to construction and rehabilitation; and
- Prevent open fires, provide demarcated fire-safe zones, facilities and fire control measures.

4.2.1.e Faunal Interactions with Structures and Personnel

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Medium	Medium	Probable	Medium	Low	Medium

Description of Impact

The most important negative faunal interactions that could be associated with mining personnel are poaching, trapping and hunting of faunal species. This is especially important where species of conservation concern are involved.

Mitigation Measure

- No wild animal may under any circumstance be hunted, snared, captured, injured or killed. This includes animals perceived to be vermin;
- Regularly undertake checks of the surrounding vegetation, in fences and along game paths to ensure that no traps have been set. Remove and dispose of any snares or traps found on or adjacent to the site;
- Have problem animals and vermin removed by an appropriate organization or authority (i.e. such as the Parks Board, the SPCA or a registered exterminator);
- No wild animal may be fed on site; and
- Compile an education programme for all contractors and subcontractors and workers to ensure compliance to all aspects of the EMP as well as educating personnel in the safe and proper conduct within areas of natural habitat.

4.3 Impact Assessment – Road Upgrade

Roads have diverse and systemic effects on many aspects of terrestrial and aquatic ecosystems. The ecological effects of roads can resonate substantial distances from the road in terrestrial ecosystems, creating habitat fragmentation and ensuing fragmentation through support of human exploitative activities. Since the current study involves the upgrading of an existing road, these effects are expected to be less than what would have been the case if a new road was constructed. Nonetheless these impacts and their associated mitigation measures are discussed below.

Table 3: Possible impacts as a result of proposed road upgrade.

Possible impact	Source of impact
Destruction of Faunal Habitat Along and Adjacent Road	Construction activities
Increased Faunal Mortality from Road Construction	Construction activities
Increased Mortality from Collision with Vehicles	Operation of the road
Modification of Animal Behaviour	Widening of the road

4.2.2 Road construction and operation

4.2.2.a Destruction of Faunal Habitats

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Medium	Medium	Probable	Low	Low	High

Description of Impact

A road transforms the physical conditions on and adjacent to it, therefore creating edge effects with consequences that extent beyond the time of the road's construction. Therefore, faunal habitats present along the road could be negatively affected or even destroyed by construction activities associated with the road. During the assessment no important faunal habitats were encountered in the zone where the proposed widening of the road will take place. However, sensitive faunal habitats, specifically wetland and riparian, were identified along the road that may be affected by the widening of bridges and by the construction of new culverts and inlets.

Mitigation Measure

- Use wire mesh on the roadsides to stabilize the ecosystem through reduced soil erosion, minimized landslides and controlled sedimentations into streams and wetlands adjacent the road;
- Rehabilitation of disturbed areas and communities after construction activities by implementing an ecological restoration plan;

- Re-create habitat that might have been destroyed during the construction processes e.g. planting of indigenous grasses or trees on the shoulder of the road; and

- Removal of rubble, litter, refuse, temporary infrastructure ext. subsequent to construction and rehabilitation.

4.2.2.b Increased Mortality from Road Construction

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Short-term	High	Medium	Low	Low	Medium

Description of Impact

Road construction kills any sessile or slow moving organism in the path of the road. Construction may also injure organisms adjacent to the path of construction.

Mitigation Measures

- Use wire mesh on the roadsides to stabilize the ecosystem through reduced soil erosion, minimized landslides and controlled sedimentations into streams and wetlands adjacent the road;

- Install drains and interceptors to minimize the flow of storm water into sensitive areas adjacent the road that could also act as movement corridors for faunal species; and

- Conduct a final walkthrough prior to commencement of construction activities to ensure absence of species listed as conservation concern.

4.2.2.c Increased Mortality from Collisions with Vehicles

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Long-Term	Medium	Medium	Low	Low	Medium

Description of Impact

Most terrestrial animal species that occur in the vicinity of roads suffer mortalities as a result of collision with vehicles. Amphibians may be especially vulnerable to road kill because their life histories often involve migration between wetland habitats and individuals are inconspicuous and slow moving.

Mitigation Measures

- Install underpasses or tunnels underneath the road, specifically where watercourses cross the road. This will act as important movement corridors for a number of faunal species, including amphibians; and
- Construction of fences/good practise so as to minimize the number of larger faunal species impacted on by road collisions.

4.2.2.d Modification of Animal Behaviour

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Local	Long-Term	Medium	Medium	Medium	Low	Medium

Description of Impact

The presence and construction of a road may modify an animal's behaviour either positively or negatively. For instance: Raptors may change their home ranges to forage along roads as there are more prey species present. Conversely animals that are attracted to modified habitats alongside roads can suffer high rates of mortalities and could result in population sinks.

Mitigation Measures

- Install underpasses or tunnels underneath the road, specifically where watercourses cross the road. This will act as important movement corridors for a number of faunal species and may lessen the fragmentation affect of roads and therefore the faunal distributions associated with them; and
- Rehabilitation of disturbed areas and communities after construction activities by implementing an ecological restoration plan.

5. CONCLUSION AND RECOMMENDATION

The ecological sensitivity of the study sites associated with the proposed borrow pits One, Two, Three and Four was rated as Medium, Medium-Low, Medium and Medium Low respectively. No faunal species of conservation concern were encountered during the survey, but there are a moderate to moderately-high probability that some species could occur here periodically. The ecological rehabilitation of borrow pits do have the potential to provide cover and additional habitat for faunal species that occur on the study site as well as providing suitable habitat for other faunal species that would not necessarily occur on the study site. The mitigation measures as proposed in this report should thus be adhered to, to minimize the effect of mining on

faunal species that occurs here.

Faunal habitats that fell within the road reserve were heavily disturbed with very little chance of sustaining functional faunal communities. Long grasses and vegetation that are present along fences that could, however provide cover for specifically rodent species that forages here occasionally. The most important habitat types along the road were two water crossings and a number of wetlands that occurred frequently along the road. Specifically, a bird-rich pan (S 26°11'27.6 E 29°44'37.1) was noted as being a *Highly Sensitive* area. Construction activities should be minimized in these areas and caution should be taken to adhere to mitigation measures as set out in this report.

REFERENCES

Acocks, J. P. H. (1988): Veld types of South Africa. *Memoirs of the Botanical Survey of South Africa* 57: 1-146.

Barnes, K.N. (2000) The Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa.

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

Du Preez, L. & Carruthers, V. (2009) A complete guide to the frogs of southern Africa. Struik Nature, Cape Town, S.A.

Ferrar, A.A. & Lötter, M.C. (2007): Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga Tourism & Parks Agency, Nelspruit.

Friedmann, Y. & Daly, B, (editors) (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.

Henning, G.A., Terblanche, R.F. & Ball, J.B. (2009). South African Red Data Book: butterflies. SANBI Biodiversity Series 13. Pp. 158. South African National Biodiversity Institute, Pretoria.

Hockey P.A.R., Dean, W.R.J & Ryan, P.G. (2007) Roberts Birds of southern Africa. 7th Edition, John Voelcker Bird Book Fund.

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

Mpumalanga Tourism and Parks Agency: Requirements for assessing and mitigating environmental impacts of development applications.

Sinclair, I. & Hockey (2005) The larger illustrated guide to birds of southern Africa. Struik Publishers, Cape Town.

Skinner, J.D. & Chimimba, C.T. (2005) The mammals of the southern African sub-region. Cambridge, UK.

Internet references:

Google Earth (2010): http://www.earth.google.com (Accessed 01/11/2010)

SABAP (2010): South African Bird Atlas Project 1 & 2 : http://sabap2.adu.org.za (Accessed 10/11/2010)

South African Reptile Conservation Assessment (2010): www.sarca.org (Accessed 10/11/2010).

South African Butterfly Conservation Assessment (2010): http://sabca.adu.org.za/

GLOSSARY OF TERMS

Alien species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Biodiversity	Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems
Biome	A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.
Buffer zone	A collar of land that filters edge effects.
Climax community	The presumed en point of successional sequence; a community that has reached a steady state, the most mature and fully developed vegetation that an ecosystem can achieve under the prevailing conditions. It is reached after a sequence of changes in the ecosystem, known as succession. Once climax vegetation develops, the changes are at a minimum and the vegetation is in dynamic equilibrium with its environment. Very few places show a true climax because physical environments are constantly changing so that ecosystems are always seeking to adjust to the new conditions through the process of succession.
Conservation	The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.
Conservation concern (Plants of..)	A plant taxon is of conservation concern when it is considered to be threatened, or close to becoming threatened with extinction and therefore classified as Critically Endangered, Endangered, Vulnerable or Near Threatened .
Conservation status	An indicator of the likelihood of that species remaining extant either in the present day or the near future. Many factors are taken into account when assessing the conservation status of a species: not simply the number remaining, but the overall increase or decrease in the population over time, breeding success rates, known threats, and so on.
Community	Assemblage of populations living in a prescribed area or physical habitat, inhabiting some common environment.
Critically Endangered	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future
Ecosystem	Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space
Ecological Corridors	Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any

	obstructions where other solutions are not feasible
Edge effect	Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution
Endangered	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future
Endemic	Naturally only found in a particular and usually restricted geographic area or region
Exotic species	Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity
Fauna	The animal life of a region.
Flora	The plant life of a region.
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas
Mitigation	The implementation of practical measures to reduce adverse impacts
Protected Plant	According to the Transvaal Nature Conservation Ordinance of 1983 (No 12 of 1983), no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities
Red Data	A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions
Species diversity	A measure of the number and relative abundance of species
Species richness	The number of species in an area or habitat
Vegetation Unit	A complex of plant communities ecologically and historically (both in spatial and temporal terms) occupying habitat complexes at the landscape scale. Mucina and Rutherford (2006) state: "Our vegetation units are the obvious vegetation complexes that share some general ecological properties such as position on major ecological gradients and nutrient levels, and appear similar in vegetation structure and especially

	floristic composition".
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future

Appendices

Appendix A: Methodology

Appendix B: Bird species that could potentially occur on the study sites.

Appendix C: Mammal species that could potentially occur on the study sites

Appendix D: Reptile species that could potentially occur on the study sites

Appendix E: Amphibian species that could potentially occur on the study sites

APPENDIX A: METHODOLOGY

1.1 Desktop Survey

1.1.1 Avifauna

A comprehensive list of species occurring in the area was compiled using electronic databases (SABAP 1 & SABAP 2) and information from unpublished reports and newsletters. The study area falls within the quarter degree grid square 2528CC. Species of conservation concern that have been recorded or that could potentially occur here were noted and their habitat requirements were determined by consulting the relevant literature. Knowledge of the species habitat requirements was then used in conjunction with Google Earth mapping programs to establish whether and where suitable habitats for these species exist. It was also determined whether the specific habitat is of adequate quality and quantity to sustain the species or a viable sub-population on the study site.

The probability of birds occupying the study area was then estimated for all observed and expected species according to the following:

- High probability of occurrence - >50% chance of occurrence;
- Medium probability of occurrence - 10 - 50% chance of occurrence; and
- Low probability of occurrence - <10% chance of occurrence;

1.1.2 Mammals and Herpetofauna

The presence of suitable habitat (a habitat assessment) was used to determine the probability of occurrence of mammal, reptile and amphibian species through various field guides and atlases. This was based on their respective geographical area of occupancy and habitat suitability. High probability of occurrence would be applicable to a species with an area of occupancy within the geographic locality of the study site as well as the presence of suitable habitat occurring on the study site. Medium probability of occurrence refers to species whose area of occupancy is marginal to the study site or its habitat is found to be within the surroundings of the study area. Lastly, a low probability of occurrence will indicate that the species' occupy an area surrounding the study area and that unsuitable habitat exists on site.

2.1 Field Surveys

During the initiation of the survey period, specific areas of habitat structure were selected and surveyed for specific taxonomic groups according to the methodology described below.

2.2.1 Avifauna

Bird species were identified and verified using Sinclair & Hockey (2005). Identifications were supplemented using other means such as calls, feathers, roosting sites and nests. Bird names follow Hockey *et al.*, (2007).

2.2.2 Mammals

Random transect walks were done whereby mammal species were identified [using Stuart & Stuart (2001) and Skinner & Chimimba (2005)] by visual sightings as well as by means of spoor, droppings and roosting sights. Only diurnal searches were carried out.

2.2.3 Reptiles & Amphibians

Possible burrows or reptile habitats (rocks and stumps) were inspected for inhabitants. A small number of old abandoned termite mounds were opened at random to determine the presence of Striped Harlequin Snakes. Reptiles were identified using Branch (1998). Suitable amphibian habitat was identified and then investigated for signs of amphibian species occupying the habitat.

2.2.4 Invertebrates

Random searches were carried out to determine the presence of invertebrate species of conservation concern on the study site.

APPENDIX B: Bird species that could potentially occur on the study site based on records from the South African Bird Atlas Project 1&2 and a habitat assessment conducted during the survey. (Conservation Status: CR – Critically Endangered, E – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concern).

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
6	*Podiceps cristatus*	Great Crested Grebe	LC	Low	Low	Low	Low
8	*Tachybaptus ruficollis*	Little Grebe	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
55	*Phalacrocorax lucidus*	White-breasted Cormorant	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
58	*Phalacrocorax africanus*	Reed Cormorant	LC	Moderate	Moderate	Moderate	Moderate
60	*Anhinga rufa*	African Darter	LC	Low	Low	Low	Low
62	*Ardea cinerea*	Grey Heron	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
63	*Ardea melanocephala*	Black-headed Heron	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
64	*Ardea goliath*	Goliath Heron	LC	Low	Low	Low	Low
65	*Ardea purpurea*	Purple Heron	LC	Low	Low	Low	Low
66	*Egretta alba*	Great Egret	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
67	*Egretta garzetta*	Little Egret	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
68	*Egretta intermedia*	Yellow-billed Egret	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
69	*Egretta ardesiaca*	Black Heron	LC	Low	Low	Low	Low
71	*Bubulcus ibis*	Cattle Egret	LC	High	High	High	High
72	*Ardeola ralloides*	Squacco Heron	LC	Low	Low	Low	Low
76	*Nycticorax nycticorax*	Black-crowned Night Heron	LC	Low	Low	Low	Low
78	*Ixobrychus minutes*	Little Bittern	LC	Low	Low	Low	Low
81	*Scopus umbretta*	Hamerkop	LC	Moderate	Moderate	Moderate	Moderate
83	*Ciconia ciconia*	White Stork	LC	Moderate	Moderate	Moderate	Moderate
84	*Ciconia nigra*	Black Stork	VU	Moderate	Moderate	Moderate	Moderate
90	*Mycteria ibis*	Yellow-billed Stork	VU	Moderate	Moderate	Moderate	Moderate
91	*Threskiornis aethiopicus*	African Sacred Ibis	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
92	*Geronticus calvus*	Southern Bald Ibis	LC	Low	Low	Low	Low
93	*Plegadis falcinellus*	Glossy Ibis	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
94	*Bostrychia hagedash*	Hadeda Ibis	LC	High	High	High	High
95	*Platalea alba*	African Spoonbill	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
96	*Phoenicopterus rubber*	Greater Flamingo	LC	Low	Low	Low	Low
97	*Phoenicopterus minor*	Lesser Flamingo	LC	Low	Low	Low	Low
99	*Dendrocygna viduata*	White-faced Duck	LC	Low	Low	Low	Low
100	*Dendrocygna bicolour*	Fulvous Duck	LC	Low	Low	Low	Low
101	*Thalassornis leuconotus*	White-backed Duck	LC	Low	Low	Low	Low
102	*Alopochen aegyptiacus*	Egyptian Goose	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
104	*Anas undulate*	Yellow-billed Duck	LC	High	High	High	High
105	*Anas sparsa*	African Black Duck	LC	Low	Low	Low	Low
106	*Anas capensis*	Cape Teal	LC	Low	Low	Low	Low
107	*Anas hottentota*	Hottentot Teal	LC	Low	Low	Low	Low
108	*Anas erythrorhyncha*	Red-billed Teal	LC	Low	Low	Low	Low
112	*Anas smithii*	Cape Shoveler	LC	Low	Low	Low	Low
113	*Netta erythrophthalma*	Southern Pochard	LC	Low	Low	Low	Low
116	*Plectropterus gambensis*	Spur-winged Goose	LC	High	High	High	High
117	*Oxyura maccoa*	Maccoa Duck	LC	Low	Low	Low	Low
118	*Sagittarius serpentarius*	Secretarybird	NT	Moderate	Moderate	Moderate	Moderate
127	*Elanus caeruleus*	Black-shouldered Kite	LC	High	High	High	High
149	*Buteo vulpinus*	Steppe Buzzard	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
152	*Buteo rufofuscus*	Jackal Buzzard	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
172	*Falco biarmicus*	Lanner Falcon	VU	Moderate	Moderate	Moderate	Moderate
173	*Falco subbuteo*	Eurasian Hobby	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
180	*Falco amurensis*	Amur Falcon	LC	High	High	High	High

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
179	*Falco amurensis*	Amur Falcon	LC	High	High	High	High
181	*Falco rupicolis*	Rock Kestrel	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
182	*Falco rupicoloides*	Greater Kestrel	LC	Moderate	Moderate	Moderate	Moderate
183	*Falco naumanni*	Lesser Kestrel	NT	Moderate	Moderate	Moderate	Moderate
193	*Scleroptila levaillantoides*	Orange River Francolin	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
199	*Pternistis swainsonii*	Swainson's Spurfowl	LC	High	High	High	High
200	*Coturnix coturnix*	Common Quail	LC	High	High	High	High
203	*Numida meleagris*	Helmeted Guineafowl	LC	High	High	High	High
208	*Anthropoides paradiseus*	Blue Crane	VU	Moderate	Moderate	Moderate	Moderate
223	*Porphyrio madagascariensis*	African Purple Swamphen	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
226	*Gallinula chloropus*	Common Moorhen	LC	Moderate	Moderate	Moderate	Moderate
228	*Fulica cristata*	Red-knobbed Coot	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
234	*Eupodotis caerulescens*	Blue Korhaan	VU	Moderate	Moderate	Moderate	Moderate
242	*Rostratula benghalensis*	Greater Painted Snipe	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
248	*Charadrius pecuarius*	Kittlitz's Plover	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
249	*Charadrius tricollaris*	Three-banded Plover	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
255	*Vanellus coronatus*	Crowned Lapwing	LC	High	High	High	High
258	*Vanellus armatus*	Blacksmith Lapwing	LC	High	High	High	High
260	*Vanellus senegallus*	African Wattled Lapwing	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
264	*Actitis hypoleucos*	Common Sandpiper	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
266	*Tringa glareola*	Wood Sandpiper	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
269	*Tringa stagnatilis*	Marsh Sandpiper	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
270	*Tringa nebularia*	Common Greenshank	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
272	*Calidris ferruginea*	Curlew Sandpiper	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
274	*Calidris minuta*	Little Stint	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
284	*Philomachus pugnax*	Ruff	LC	Low	Low	Low	Low

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
286	*Gallinago nigripennis*	African Snipe	LC	Low	Low	Low	Low
294	*Recurvirostra avosetta*	Pied Avocet	LC	Low	Low	Low	Low
295	*Himantopus himantopus*	Black-winged Stilt	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
297	*Burhinus capensis*	Spotted Thick-knee	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
300	*Cursorius temminckii*	Temminck's Courser	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
305	*Glareola nordmanni*	Black-winged Prantincole	NT	Moderate	Moderate	Moderate	Moderate
315	*Larus cirrocephalus*	Grey-headed Gull	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
339	*Chlidonias leucopterus*	White-winged Tern	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
348	*Columba livia*	Rock Dove	LC	Moderate	Moderate	Moderate	Moderate
349	*Columba guinea*	Speckled Pigeon	LC	Moderate	Moderate	Moderate	Moderate
352	*Streptopelia semitorquata*	Red-eyed Dove	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
354	*Streptopelia capicola*	Cape Turtle-Dove	LC	High	High	High	High
355	*Streptopelia senegalensis*	Laughing Dove	LC	High	High	High	High
356	*Oena capensis*	Namaqua Dove	LC	Moderate	Moderate	Moderate	Moderate
377	*Cuculus solitarius*	Red-chested Cuckoo	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
386	*Chrysococcyx caprius*	Diderick Cuckoo	LC	High	High	High	High
392	*Tyto alba*	Barn Owl	LC	High	High	High	High
393	*Tyto capensis*	African Grass Owl	VU	Moderate-Low	Low	Low	Moderate
395	*Asio capensis*	Marsh Owl	LC	High	High	High	High
401	*Bubo africanus*	Spotted Eagle-Owl	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
412	*Apus barbatus*	African Black Swift	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
415	*Apus caffer*	White-rumped Swift	LC	Moderate	Moderate	Moderate	Moderate
417	*Apus affinis*	Little Swift	LC	Moderate	Moderate	Moderate	Moderate
421	*Cypsiurus parvus*	African Palm-Swift	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
424	*Colius striatus*	Speckled Mousebird	LC	Moderate	Moderate	Moderate	Moderate
428	*Ceryle rudis*	Pied Kingfisher	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
429	*Megaceryle maximus*	Giant Kingfisher	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
430	*Alcedo semitorquata*	Half-collard Kingfisher	NT	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
431	*Alcedo cristata*	Malachite Kingfisher	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
446	*Coracias garrulous*	European Roller	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
451	*Upupa Africana*	African Hoopoe	LC	Moderate	Moderate	Moderate	Moderate
452	*Phoeniculus purpureus*	Green Wood-Hoopoe	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
464	*Lybius torquatus*	Black-collared Barbet	LC	Moderate	Moderate	Moderate	Moderate
465	*Tricholaema leucomelas*	Acacia Pied Barbet	LC	Moderate	Moderate	Moderate	Moderate
473	*Trachyphonus vaillantii*	Crested Barbet	LC	Moderate	Moderate	Moderate	Moderate
489	*Jynx ruficollis*	Red-throated Wryneck	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
494	*Mirafra Africana*	Rufous-naped Lark	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
506	*Chersomanes albofasciata*	Spike-heeled Lark	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
507	*Calandrella cinerea*	Red-capped Lark	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
518	*Hirundo rustica*	Barn Swallow	LC	High	High	High	High
520	*Hirundo albigularis*	White-throated Swallow	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
526	*Hirundo cucullata*	Greater Striped Swallow	LC	High	High	High	High
528	*Hirundo spilodera*	South African Cliff-Swallow	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
529	*Hirundo fuligula*	Rock Martin	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
530	*Delichon urbicum*	Common House Martin	LC	High	High	High	High
533	*Riparia paludicola*	Brown-throated Martin	LC	High	High	High	High
534	*Riparia cincta*	Banded Martin	LC	High	High	High	High
541	*Dicrurus adsimilis*	Fork-tailed Drongo	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
545	*Oriolus larvatus*	Black-headed Oriole	LC	Moderate	Moderate	Moderate	Moderate
548	*Corvus albus*	Pied Crow	LC	High	High	High	High
568	*Pycnonotus tricolour*	Dark-capped Bulbul	LC	High	High	High	High
577	*Turdus olivaceus*	Olive Thrush	LC	Moderate	Moderate	Moderate	Moderate

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
586	*Oenanthe monticola*	Mountain Chat	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
587	*Oenanthe pileata*	Capped Wheatear	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
595	*Myrmecocichla formicivora*	Ant-eating Chat	LC	High	High	High	High
596	*Saxicola torquatus*	African Stonechat	LC	High	High	High	High
601	*Cossypha caffra*	Cape Robin-Chat	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
631	*Acrocephalus baeticatus*	African Reed Warbler	LC	Low	Low	Low	Low
634	*Acrocephalus schoenobaenus*	Sedge Warbler	LC	Low	Low	Low	Low
635	*Acrocephalus gracilirostris*	Lesser Swamp-Warbler	LC	Low	Low	Low	Low
638	*Bradypterus baboecala*	Little Rush-Warbler	LC	Low	Low	Low	Low
643	*Phylloscopus trochilus*	Willow Warbler	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
664	*Cisticola juncidis*	Zitting Cisticola	LC	High	High	High	High
666	*Cisticola textrix*	Cloud Cisticola	LC	High	High	High	High
667	*Cisticola ayresii*	Wing-snapping Cisticola	LC	High	High	High	High
668	*Cisticola cinnamomeus*	Pale-crowned Cisticola	LC	High	High	High	High
670	*Cisticola lais*	Wailing Cisticola	LC	High	High	High	High
677	*Cisticola tinniens*	Levaillant's Cisticola	LC	High	High	High	High
681	*Cisticola fulvicapilla*	Neddicky	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
683	*Prinia subflava*	Tawny-flanked Prinia	LC	High	High	High	High
685	*Prinia flavicans*	Black-chested Prinia	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
698	*Sigelus silens*	Fiscal Flycatcher	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
706	*Stenostira scita*	Fairy Flycatcher	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
713	*Motacilla capensis*	Cape Wagtail	LC	High	High	High	High
716	*Anthus cinnamomeus*	African Pipit	LC	High	High	High	High
719	*Anthus vaalensis*	Buffy Pipit	LC	High	High	High	High
727	*Macronyx capensis*	Cape Longclaw	LC	High	High	High	High
732	*Lanius collaris*	Common Fiscal	LC	High	High	High	High

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
736	*Laniarius ferrugineus*	Southern Boubou	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
746	*Telophorus zeylonus*	Bokmakierie	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
758	*Acridotheres tristis*	Common Myna	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
759	*Spreo bicolour*	Pied Starling	LC	High	High	High	High
769	*Onychognathus morio*	Red-winged Starling	LC	Moderate	Moderate	Moderate	Moderate
775	*Nectarinia famosa*	Malachite Sunbird	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
796	*Zosterops virens*	Cape White-eye	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
801	*Passer domesticus*	House Sparrow	LC	High	High	High	High
803	*Passer melanurus*	Cape Sparrow	LC	High	High	High	High
804	*Passer diffuses*	Southern Grey-headed Sparrow	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
811	*Ploceus cucullatus*	Village Weaver	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
813	*Ploceus capensis*	Cape Weaver	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
814	*Ploceus velatus*	Southern Masked-Weaver	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
821	*Quelea quelea*	Red-billed Quelea	LC	High	High	High	High
824	*Euplectes orix*	Southern Red Bishop	LC	High	High	High	High
826	*Euplectes afer*	Yellow-crowned Bishop	LC	High	High	High	High
828	*Euplectes axillaries*	Fan-tailed Widowbird	LC	High	High	High	High
829	*Euplectes albonotatus*	White-winged Widowbird	LC	High	High	High	High
831	*Euplectes ardens*	Red-collard Widowbird	LC	High	High	High	High
832	*Euplectes progne*	Long-tailed Widowbird	LC	High	High	High	High
846	*Estrilda astrild*	Common Waxbill	LC	High	High	High	High
852	*Ortygospiza atricollis*	African Quailfinch	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
854	*Sporaeginthus subflavus*	Orange-breasted Waxbill	LC	Moderate	Moderate	Moderate	Moderate
856	*Amadina erythrocephala*	Red-headed Finch	LC	Moderate	Moderate	Moderate	Moderate
860	*Vidua macroura*	Pin-tailed Whydah	LC	High	High	High	High
869	*Crithagra mozambicus*	Yellow-fronted Canary	LC	High	High	High	High

Reference Number	Scientific Name	Common Name	Status	Probability of Occurrence: BP 1	Probability of Occurrence: BP 2	Probability of Occurrence: BP 3	Probability of Occurrence: BP 4
870	*Crithagra atrogularis*	Black-throated Canary	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
872	*Serinus canicollis*	Cape Canary	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
881	*Crithagra gularis*	Streaky-headed Seedeater	LC	Moderate	Moderate	Moderate	Moderate
884	*Emberiza flaviventris*	Golden-breasted Bunting	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
885	*Emberiza capensis*	Cape Bunting	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
886	*Emberiza tahapisi*	Cinnamon-breasted Bunting	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
888	*Milvus parasitus*	Yellow-billed Kite	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
889	*Milvus migrans*	Black Kite	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
891	*Anas platyrhynchos*	Mallard	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low

APPENDIX C: Mammal species that could potentially occur on the study site based on the Red Data Book of the Mammals of South Africa (Friedmann & Daly 2004) and a habitat assessment conducted during the survey.

Common Name	Scientific Name	Status	Probability of Occurrence BP 1	Probability of Occurrence BP 2	Probability of Occurrence BP 3	Probability of Occurrence BP 4
MACROSCELIDEA						
Short-snouted Elephant-shrew	*Elephantulus brachyrhynchus*	Data deficient	Moderate	Moderate	Moderate	Moderate
Aardvark	*Orycteropus afer*	Least concern	Moderate	Moderate	Moderate-High	Moderate-High
LAGAMORPHA						
Cape Hare/Desert Hare	*Lepus capensis*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Scrub Hare	*Lepus saxatilis*	Least Concern	High	High	High	High
INSECTIVORA						
Robust Golden Mole	*Amblysomus robustus*	Endangered	Moderate	Moderate	Moderate	Moderate
Highveld Golden Mole	*Amblysomus septentrionalis*	Near Threatened	Moderate	Moderate	Moderate	Moderate
Reddish-grey Musk Shrew	*Crocidura cyanea*	Data Deficient	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Greater Musk Shrew	*Crocidura flavescens*	Data Deficient	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Tiny Musk Shrew	*Crocidura fuscomurina*	Data Deficient	High	High	High	High

Common Name	Scientific Name	Status	Probability of Occurrence BP 1	Probability of Occurrence BP 2	Probability of Occurrence BP 3	Probability of Occurrence BP 4
Lesser Red Musk Shrew	*Crocidura hirta*	Data Deficient	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Maquassie Musk Shrew	*Crocidura maquassiensis*	Vulnerable	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
Greater Dwarf Shrew	*Suncus lixus*	Data Deficient	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Lesser Dwarf Shrew	*Suncus varilla*	Data Deficient	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
RODENTIA						
Tete Veld Rat	*Aethomys ineptus*	Least Concern	Low	Low	Low	Low
Namaqua Rock Mouse	*Aethomys namaquensis*	Least Concern	Low	Low	Low	Low
Common Mole-rat	*Cryptomys hottentotus*	Least Concern	High	High	High	High
Grey Climbing Mouse	*Dendromus melanotis*	Least Concern	Moderate	Moderate	Moderate	Moderate
Brant's Climbing Mouse	*Dendromus mesomelas*	Least Concern	Moderate-High	Moderate-High	High	High
Chesnut Climbing Mouse	*Dendromus mystacalis*	Least Concern	Moderate-High	Moderate	High	High
Cape Mole-rat	*Georychus capensis*	Least Concern	High	High	High	High
Porcupine	*Hystrix africaeaustralis*	Least Concern	High	High	High	High
Single-striped Mouse	*Lemniscomys rosalia*	Data deficient	High	High	High	High

Common Name	Scientific Name	Status	Probability of Occurrence BP 1	Probability of Occurrence BP 2	Probability of Occurrence BP 3	Probability of Occurrence BP 4
Multimammate Mouse	*Mastomys coucha*	Least Concern	High	High	High	High
Pygmy Mouse	*Mus minutoides*	Least Concern	High	High	High	High
White-tailed Rat	*Mystromys albicaudatus*	Endangered	Moderate	Moderate	Moderate	Moderate
Angoni Vlei Rat	*Otomys angoniensis*	Least Concern	Moderate	Moderate	Moderate-High	Moderate-High
Springhare	*Pedetes capensis*	Least Concern	High	High	High	High
Striped Mouse	*Rhabdomys pumilio*	Least Concern	High	High	High	High
Pouched Mouse	*Saccostomus campestris*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Krebs' Fat Mouse	*Steatomys krebsii*	Least Concern	High	High	High	High
Fat Mouse	*Steatomys pratensis*	Least Concern	Moderate	Moderate	Moderate	Moderate
Highveld Gerbil	*Tatera brantsii*	Least Concern	High	High	High	High
Greater Cane Rat	*Thryonomys swinderianus*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
CARNIVORA						
Water Mongoose	*Atilax paludinosus*	Least Concern	Low	Low	Low	Low
Black-backed Jackal	*Canis mesomelas*	Least Concern	High	High	High	High

Common Name	Scientific Name	Status	Probability of Occurrence BP 1	Probability of Occurrence BP 2	Probability of Occurrence BP 3	Probability of Occurrence BP 4
Caracal	*Caracal caracal*	Least Concern	High	High	High	High
African Civet	*Civettictis civetta*	Least Concern	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
Yellow Mongoose	*Cynictis penicillata*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Black-footed Cat	*Felis nigripes*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
African Wild Cat	*Felis silvestris*	Least Concern	High	High	High	High
Small Grey Mongoose	*Galerella pulverulenta*	Least Concern	Moderate	Moderate	Moderate	Moderate
Slender Mongoose	*Galerella sanguinea*	Least Concern	High	High	High	High
Small-spotted Genet	*Genetta genetta*	Least Concern	High	High	High	High
Large-spotted Genet	*Genetta tigrina*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
White-tailed Mongoose	*Ichneumia albicauda*	Least Concern	Low	Low	Low	Low
Striped Polecat	*Ictonyx striatus*	Least Concern	Moderate	Moderate	Moderate	Moderate
Serval	*Leptailurus serval*	Near Threatened	High	High	High	High
African Weasel	*Poecilogale albinucha*	Data Deficient	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Suricate	*Suricata`suricatta*	Least Concern	High	High	High	High

Common Name	Scientific Name	Status	Probability of Occurrence BP 1	Probability of Occurrence BP 2	Probability of Occurrence BP 3	Probability of Occurrence BP 4
Cape Fox	*Vulpes chama*	Least Concern	Moderate-High	Moderate-High	Moderate-High	Moderate-High
ARTIOTACTYLA						
Blesbok	*Damaliscus pygargus*	Least Concern	High	High	High	High
Oribi	*Ourebia ourebia*	Endangered	Moderate-High	Moderate	Moderate-Low	Moderate-High
Grey Rhebok	*Pelea capreolus*	Least Concern	Moderate	Moderate	Moderate-High	Moderate-High
Bushpig	*Potamochoerus porcus koiropotamus*	Least Concern	Moderate-High	Moderate-Low	Moderate	Moderate
Steenbok	*Raphicerus campestris*	Least Concern	High	High	High	High
Common Duiker	*Sylvicapra grimmia*	Least Concern	High	High	High	High

Appendix D: Reptile species that could potentially occur on the study site (information from the South African Reptile Conservation Assessment: www.sarca.org).

Family	Species name	Common Name	Conservation Status	Probability of Occurrence BP 1	Probability of Occurrence BP 2	Probability of Occurrence BP 3	Probability of Occurrence BP 4
Agamidae	*Agama aculeate distanti*	Distant's Ground Agama	Not Evaluated	Low	Low	Moderate	Low
Agamidae	*Agama atra*	Southern Rock Agama	Not Evaluated	Low	-	Moderate	Low
Atractaspididae	Aparallactus capensis	Black-headed Centipede-eater	Not Evaluated	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Atractaspididae	*Aparallactus capensis*	Cape Centipede-eater	Not Evaluated	Moderate – High	Moderate-High	-	-
Atractaspididae	*Homoroselaps lacteus*	Spotted Harlequin Snake	Near-Threatened	Moderate	Moderate-Low	-	Moderate-Low
Colubridae	Crotaphopeltis hotamboeia	Red-lipped Snake	Not Evaluated	-	Moderate	Moderate	Moderate
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	Not Evaluated	Moderate	Moderate-High	Moderate	Moderate
Colubridae	*Lycodonomorphus rufulus*	Brown Water Snake	Not Evaluated	Moderate – Low	-	-	-
Colubridae	*Psammophis crucifer*	Cross-marked Grass Snake	Not Evaluated	Moderate - High	-	-	-
Colubridae	*Psammophylax rhombeatus rhombeatus*	Spotted Grass Snake	Not Evaluated	Moderate – High	Moderate-Low	Moderate	Moderate
Colubridae	*Pseudaspis cana*	Mole Snake	Not Evaluated	Moderate – High	Moderate-High	Moderate-High	Moderate-High
Cordylidae	*Pseudocordylus melanotus melanotus*	Common Crag Lizard	Not Evaluated	Moderate	Moderate-High	Moderate-High	Moderate
Elapidae	*Hemachatus haemachatus*	Rinkhals	Not Evaluated	Moderate – High	Moderate	Moderate	Moderate

Leptotyphlopidae	*Leptotyphlops scutifrons conjunctus*	Eastern Cape Thread Snake	Not listed	Moderate	Moderate-High	Moderate	Moderate
Scincidae	Trachylepis punctatissima	Speckled Rock Skink	Not Evaluated	-	Moderate	Moderate-Low	Moderate-Low
Scincidae	*Trachylepis capensis*	Cape Skink	Not Evaluated	Moderate	-	-	
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake	Not Evaluated	Moderate	-	-	-
Viperidae	Causus rhombeatus	Rhombic Night Adder	Not Evaluated	-	Moderate-Low	Moderate	Moderate

Appendix E: Amphibian species that could potentially occur on the study site (information from Minter *et al.* 2004). (Conservation Status: CR – Critically Endangered, E – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concern).

Name	Scientific Name	Status	Probability of occurrence BP 1	Probability of occurrence BP 2	Probability of occurrence BP 3	Probability of occurrence BP 4
Common River Frog	*Amietia angolensis*	LC	Low	Moderate	Low	Low
Cape River Frog	*Amietia fuscigula*	LC	Low	Moderate-High	Low	Low
Guttural Toad	*Amietophrynus gutturalis*	LC	High	Moderate-High	High	High
Raucous Toad	*Amietophrynus rangeri*	LC	Moderate-Low	Moderate-Low	Moderate-Low	Moderate-Low
Boettger's Caco	*Cacosternum boettgeri*	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-High
Bubbling Kassina	*Kassina senegalensis*	LC	Moderate-High	Moderate	Moderate-High	Moderate-High
Striped Grass Frog	*Ptychadena porosissima*	LC	Moderate	Moderate-Low	Moderate	-
Rattling Frog	*Semnodactylus wealii*	LC	Moderate	Moderate-High	Moderate	Moderate
Striped Stream Frog	*Strongylopus fasciatus*	LC	Moderate-Low	Moderate-High	Moderate-Low	Moderate
Tremolo Sand Frog	*Tomopterna cryptotis*	LC	Moderate-High	Moderate-High	Moderate-High	Moderate-Low
Common Platanna	*Xenopus laevis*	LC	Moderate-Low	Moderate-Low	-	Moderate-High
Clicking Stream Frog	*Strongylopus grayii*	LC	-	Moderate-Low	Moderate-Low	Moderate
Natal Sand Frog	*Tomopterna natalensis*	LC	-	Moderate	Moderate	Moderate-High
Tandy's Sand Frog	*Tomopterna tandyi*	LC	-	Moderate-High	Moderate-High	Moderate-High

Appendix D3: Wetland Assessment Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/2078
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Work Package 2 – N11 between Hendrina and Ermelo: Rehabilitation of National Route 11 between Ermelo and Hendrina

Specialist:	Willem Lubbe		
Contact person:	Willem Lubbe		
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E-mail:	willem@sefsa.co.za		
Professional affiliation(s) (if any)	Registered with the South African Council for Natural Scientific Professions (SACNASP) as Candidate in the field of Ecology (Reg. No. 100064/08)		

Project Consultant:	Strategic Environmental Focus		
Contact person:	Milicent Solomons		
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Postal code:	0040	Cell:	
Telephone:	012 349 1307	Fax:	012 349 1229
E-mail:	Milicent@sefsa.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, **Willem Lubbe** , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of 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 have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form 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 the specialist:

Strategic Environmental Focus

Name of company (if applicable):

24/02/2011

Date:

PROPOSED REHABILITATION OF THE N11 BETWEEN ERMELO AND HENDRINA (WORK PACKAGE 2)

Wetland Assessment

SEF Reference No.: 503928

Prepared for:

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S.E.F
STRATEGIC ENVIRONMENTAL FOCUS

January 2011

EXECUTIVE SUMMARY

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed by Bigen Africa (Part of the Netgroup Consortium) to conduct a Basic Assessment (BA) process for the proposed upgrade of a section of the N11 road between Hendrina and Ermelo as well as a small potion of the R38 westward from Hendrina to the R542 turnoff. The upgrade is deemed necessary as the existing pavement surface is in a poor condition with many areas having been patched. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The length of the total project is 55.69km of single carriageway road. The existing formation is approximately 14.0m wide. The project also includes the widening of four bridges (including a bridge over a spruit and the Klein Olifants River). In order to obtain enough material for the upgrading of the road surface, it is proposed that four borrow-pits should be established along the route.

As part of the BA process, an ecological study of the natural environment was required to inform the proposed road upgrade as well as the associated borrow pits. This report represents the wetland assessment and should be read in conjunction with the other ecological specialist reports or opinions pertaining to the proposed road upgrade and borrow pits.

The four main wetland indicators used during the wetland delineation process included the terrain unit indicator, soil wetness indicator, presence and absence of hydric soils and hydrophytes. A wide variety of hydric soil types and hydrophytes were present within the study area due to the relatively long linear extent of the study site and its associated geographical variance.

Six different types of wetlands were classified within the study area and were categorised into hydro-geomorphic (HGM) units. These include valley bottom wetlands without a channel, floodplains, valley bottom wetlands with a channel, edorheic pans, hillslope seepage wetlands not feeding a watercourse and hillslope seepage wetlands feeding a watercourse. A total of 67 hydro-geomorphic units were delineated and classified within the study area. The majority of wetlands consisted of valleyhead seepage wetlands with temporary to seasonal zonation, dominated by a graminoid layer containing a rich harbaceuos component.

From a functional perspective, wetlands within the study area serve to improve habitat within and downstream of the study area through the provision of various ecosystem services such as streamflow regulation, flood attenuation, groundwater recharge, nitrogen removal, phosphate removal, toxicant removal, particle assimilation and provision of natural resources. Several of the wetlands within the study area provide

habitat for a variety of taxa which contain species of conservation concern and are therefore highly valuable from a biodiversity point of view.

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation. Authoritative legislation that lists impacts and activities on wetlands that requires authorisation include the:

- Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983);
- Environment Conservation Act, 1989 (Act No. 73 of 1989);
- National Water Act, 1998 (Act No. 36 of 1998) [NWA];
- National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended [NEMA]; and
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

The impact assessment identified destruction of wetland habitat and surface water pollution as the two major potential impacts during the construction period while the highest rated potential impact during the operational phase is increased erosion as a result of the higher surface runoff from increased impermeable surface areas. Several specific and general mitigation measures are proposed to mitigate impacts on wetlands. Most important is avoidance of wetland habitat through appropriate road design, e.g. alternate widening on either side of the road to achieve protection of specific hydro-geomorphic units where there are only wetlands located on one side of the road. Where the road supports wetlands of equal importance on both sides of the existing road, the new road footprint should be kept to a minimum and be strictly contained within the existing road reserve. Velocity breaking structures such as baffles should be placed on the downstream side of all culverts and piping. Other erosion interventions such as gabion mattresses and weir walls should also be constructed where erosion potential have been identified. Further, several existing erosion processes at various localities require rehabilitation as it is likely to threaten not only the existing road but the proposed development as well. After completion of the construction phase, a wetland monitoring program must be initiated that ensure that all wetland protection infrastructure and storm-water systems are properly installed and that all affected wetland areas are adequately rehabilitated. The wetland monitoring program should continue during the operational phase in order to identify any new erosion processes that are developing and initiate cost effective rehabilitation plans timeously.

Declaration of Independence by Ecologist

I, **Willem Lubbe,** in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Willem Lubbe (Cand. Sci. Nat.)
Ecologist
SACNASP Reg. No. 100064/08

Date

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PHOTOGRAPHS

1. INTRODUCTION

With South Africa being a contracting party to the Ramsar Convention on Wetlands, the South African government has taken a keen interest in the conservation, sustainable utilisation and rehabilitation of wetlands in South Africa. This aspect is also reflected in various pieces of legislation controlling development in and around wetlands and other water resources, of which the most prominent may be the National Water Act, Act 36 of 1998. As South Africa is an arid country, with a mean annual rainfall of only 450mm in relation to the world average of 860mm (DWAF, 2003), water resources and the protection thereof becomes critical to ensure their sustainable utilisation. Wetlands perform various important functions related to water quality, flood attenuation, stream flow augmentation, erosion control, biodiversity, harvesting of natural resources, and others, highlighting their importance as an irreplaceable habitat type. Determining the location and extend of existing wetlands, as well as evaluating the full scope of their ecosystem services, form an essential part in striving towards sustainable development and protection of water resources.

1.1 Project Description

Strategic Environmental Focus (Pty) Ltd. (SEF) was appointed by Bigen Africa (Part of the Netgroup Consortium) to conduct a Basic Assessment (BA) process for the proposed upgrade of a section of the N11 road between Hendrina and Ermelo as well as a small potion of the R38 westward from Hendrina to the R542 turnoff. The upgrade is deemed necessary as the existing pavement surface is in a poor condition with many areas having been patched. The project aims to provide a suitable pavement for a 20 year design life as well as minor widening of the road prism and localized horizontal and vertical realignment of the road to bring it up to current national road standards. The length of the total project is 55.69km of single carriageway road. The existing formation is approximately 14.0m wide.

The project also includes the widening of four bridges (including a bridge over a spruit and the Klein Olifants River). In order to obtain enough material for the upgrading of the road surface, it is proposed that four borrow-pits should be established along the route.

As part of the BA process, an ecological study of the natural environment was required to inform the proposed road upgrade as well as the associated borrow pits. This report represents the wetland assessment and should be read in conjunction with the other ecological specialist reports or opinions pertaining to the proposed road upgrade and borrow pits.

1.2 Terms of Reference

As part of the study, it was necessary to determine the environmental impacts associated with the implementation of this project to ultimately determine the

feasibility thereof. The purpose of this wetland study was to delineate the wetlands and assess their sensitivity. This entailed the following:

- To describe wetlands and their functionality within the study boundary; and
- To recommend suitable buffer zones, rehabilitation initiatives and mitigation measures for different wetland habitats in order to minimise negative impacts of the proposed development.

This report presents the findings obtained following a desktop assessment, literature review and field work within the designated study area.

1.3 Assumptions and Limitations

In order to obtain definitive data regarding the biodiversity, hydrology and functioning of particular wetlands, studies should ideally be conducted over a number of seasons and over a number of years. However, cost implications and time constraints prevent such long-term studies, and reliance was placed on information gained during field surveys conducted during a single season, desktop information for the area, information obtained from provincial conservation authorities and similar organisations, as well as professional judgement and experience gained during similar assessments.

Due to the large extend of the study area involved, poor weather conditions a times, as well as historic impacts on wetlands, small seepage wetlands could have been overseen during the field survey as a result of their cryptic nature. However, such seepages are likely to be highly disturbed as a result of cultivation practices in the region and are therefore likely to retain minimal functionality.

The exact size and character of the borrow sites were not known at the time of the field survey and therefore the general area around given GPS coordinates were surveyed.

1.4 Methodology

Field surveys were undertaken during November 2010. The wetland delineation was based on the legislatively required methodology as described by DWAF (2005). For a more comprehensive study approach and specific methodologies employed during the current study, see Appendix A.

2. BACKGROUND INFORMATION

2.1 Locality

The section of the N11 proposed to be upgraded connects the towns of Hendrina and Ermelo in the Mpumalanga Province. The length of the road upgrade is 55.69km of single carriageway road, while the existing width is approximately 14.0m (Figure 1). The borrow pits are situated in close proximity to the road and spaced along the length thereof (Figure 1). The proposed road upgrade activities falls within the following quarter degree squares (QDS): 2629BA, 2629BB and 2629BD.

2.2 Biophysical description

Climate

The area receives summer rainfall that varies between 650 and 750 mm per year. The winters are dry with frost. The average midday temperatures for Ermelo range from 15.8°C in June to 24.1°C in January. The region is the coldest during June when the mercury drops to 0.2°C on average during the night (SAExplorer, 2010).

Regional Vegetation

The road reserve and borrow pits are situated within the Grassland Biome of South Africa. (Rutherford & Westfall, 1994). High summer rainfall characteristic of the Grassland Biome combined with dry winters with night frost and marked diurnal temperature variations are unfavourable to tree growth. The Grassland Biome therefore comprises mainly of 'sweet' and 'sour' grasses and plants with perennial underground storage organs, for example bulbs and tubers, while trees are restricted to specialised habitats such as rocky outcrops or kloofs. The majority of Rare and Threatened plant species in the summer rainfall regions of South Africa are restricted to high-rainfall grasslands, making this the biome in most urgent need of conservation. It is not generally acknowledged that the majority of plant species in grasslands are non-grassy herbs (forbs), most of which are perennial plants with large underground storage structures. The highveld and montane grasslands of Mpumalanga are an important habitat for several threatened plant and animal taxa (Emery *et al.* 2002).

The Grassland Biome can be divided into smaller units known as vegetation units. The majority of the N11 road section, as well as borrow pit 2 and borrow pit 3 are situated within the Eastern Highveld Grassland vegetation unit, while borrow pit 1 and a middle portion of the N11 road section, is situated within the Soweto Highveld Grassland (Mucina & Rutherford, 2006).

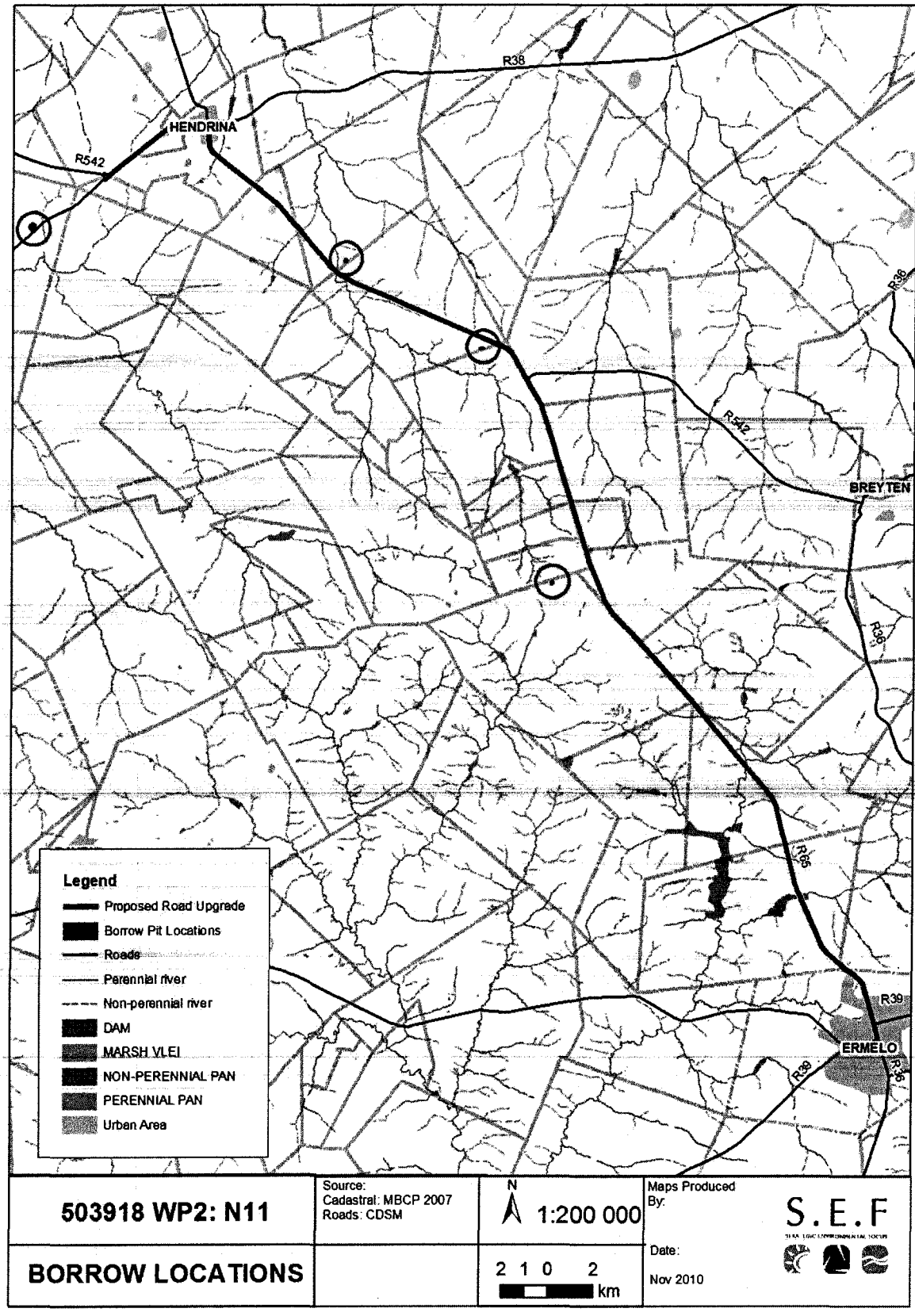


Figure 1: Locality of the Study Site

Eastern Highveld Grassland

Eastern Highveld Grassland occurs in the Gauteng and Mpumalanga Provinces. The species composition of this grassland unit comprises highveld grasses such as *Themeda triandra* (Red Grass), *Aristida congesta*, *Digitaria* species as well as *Tristachya leucothrix* and *T rehmanni* (Mucina & Rutherford, 2006). The landscape usually includes undulating plains that support short, dense grassland, scattered rocky outcrops with sour grasses and tree species such as *Acacia caffra* (Sweet Thorn), *Celtis africana* (White Stinkwood) *and Diospyros lycioides subsp lycioides* (Blue Bush) (Mucina & Rutherford, 2006).

Due to urban development and agricultural pressure within Gauteng and Mpumalanga, the extent of this vegetation unit is becoming limited. Only a small portion of Eastern Highveld Grassland is conserved in statutory reserves like the Nooitgedacht Dam or in private reserves. Almost half of this vegetation type has been transformed by cultivation, plantation, mining and the building of dams and it is therefore classified as an Endangered vegetation type (Mucina & Rutherford, 2006). Development within these vegetation types should be considered according to the potential impact the development could have on the conservation of this sensitive vegetation types.

Soweto Highveld Grassland

Soweto Highveld Grassland occurs mainly within the Mpumalanga and Gauteng Provinces, with a limited distribution in the Free State and North West Provinces. This grassland unit comprise short to medium-high dense tufted grassland dominated almost entirely by the grass *Themeda triandra* (Red Grass). Other grasses include *Elionorus muticus* (Copper Wire Grass), *Heteropogon contortus* (Spear Grass) and *Tristahya leucothrix* (Hairy Trident Grass). A high diversity of forbs (herbaceous plants other than grasses) also occurs within this grassland unit, some of which are of conservation concern.The Soweto Highveld Grassland is also under pressure from urban development and only a small portion of its original extent is statutorily conserved. Soweto Highveld Grassland is also classified as an Endangered Vegetation unit (Mucina and Rutherford, 2006).

Both vegetation units are thus under threat and the remaining portions (that are not disturbed) should thus ideally be avoided and conserved.

Associated Water Courses

The section of the N11 that are proposed to be upgraded will cross the perennial Klein Olifants River, other perennial rivers as well as non perennial streams, while the relevant portion of the R38 crosses a non perennial stream (Chief Directorate: Surveys & Mapping, 1996).

3. RESULTS

3.1 Wetland soils

According to DWAF (2005), the permanent zone of a wetland will always have either Champagne, Katspruit, Willowbrook or Rensburg soil forms present, as defined by the Soil Classification Working Group (1991). The seasonal and temporary zones of the wetlands will have one or more of the following soil forms present (signs of wetness incorporated at the form level): Kroonstad, Longlands, Wasbank, Lamotte, Estcourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu. Alternatively, the seasonal and temporary zones will have one or more of the following soil forms present (signs of wetness incorporated at the family level): Inhoek, Tsitsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa, Dundee (DWAF, 2005).

For an area to be considered a wetland, redoximorphic features must be present within the upper 500 mm of the soil profile (Collins, 2005). Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of iron and manganese oxides that occur when soils are saturated for sufficiently long periods of time to become anaerobic. Only once soils within 50cm of the surface display these redoximorphic features can the soils be considered to be hydric (wetland) soils. Redoximorphic features typically occur in three types (Collins, 2005):

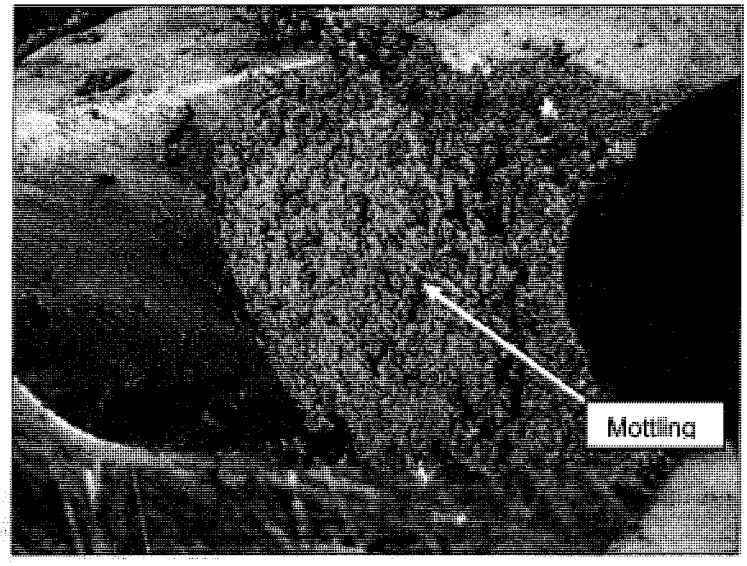
- **A reduced matrix** - i.e. an *in situ* low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by "grey" colours of the soil matrix.
- **Redox depletions** - the "grey" (low chroma) bodies within the soil where Fe- Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.
- **Redox concentrations** - Accumulation of iron and manganese oxides (also called mottles),. These can occur as:
    - Concretions - harder, regular shaped bodies;
    - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours; and,
      Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

According to the DWAF (2005), soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence due to

the fact that soil wetness indicators (redoximorphic features) remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 500mm of the soil profile alone is sufficient to identify the soil as being hydric (a wetland soil), or non-hydric (non-wetland soil) (Collins, 2005).

A wide variety of hydric soil types were present within the study area due to the relatively large extent of the study area and its associated geographical variance. The more clayey soils such as Katspruit and Kroonstad were characteristic of the valley bottom wetlands (Photograph 1), while the more sandy soils such as Avalon, Pinedene and Westleigh were associated with hillslope seepage wetlands (Photograph 2). Numerous areas associated with vigorous plant growth, particularly seepage areas, also displayed a dark organic layer at ground surface (Photograph 3). The build up of organic carbon content in topsoil was indicative of water preventing breakdown of organic matter, as would typically occur within a wetland.

Photograph 1: Soils with prolonged periods of saturation displaying a reduced matrix, as indicated by the grey colouration. Note the vigorous growth of plant material within the permanent zone of wetness, background.



Photograph 2: Soils with prolonged periods of saturation displaying mottling within a seasonal zone of a hillslope seepage.

Photograph 3: Dark organic built up at ground surface due to extended periods of saturation

3.2 Wetland Vegetation

According to DWAF (2005), vegetation is regarded as a key component to be used in the delineation procedure for wetlands. Vegetation also forms a central part of the wetland definition in the National Water Act, Act 36 of 1998. Using vegetation as a primary wetland indicator however, requires undisturbed conditions (DWAF, 2005). A cautionary approach must be taken as vegetation alone cannot be used to delineate a wetland, as several species, while common in wetlands, can occur extensively outside of wetlands. When examining plants within a wetland, a distinction between hydrophilic (vegetation adapted to life in saturated conditions) and upland species must be kept in mind. There is typically a well-defined 'wetness' gradient that occurs from the centre of a wetland to its edge that is characterized by a change in species composition between hydrophilic plants that dominate within the wetland to upland species that dominate on the edges of, and outside of the wetland (DWAF, 2003). It is important to identify the vegetative indicators which determine the three wetness zones (temporary, seasonal and permanent) which characterize wetlands. Each zone is characterized by different plant species which are uniquely suited to the soil wetness within that zone.

The largest majority of wetlands consisted of valleyhead seepage wetlands with temporary zonation and dominated by a graminoid layer which is complimented by a rich harbaceuos component. Graminoids within the valleyhead seepages included *Setaria spacelata, Eragrostis capensis, Fuirenia hirsute, Eragrostis plana, Isolepis setacea, Kyllinga pulchella, Pycreus macranthus Imperata cylindrica* and *Aristida junciformis*, while the herbaceous component included species such as *Helichrysum aureionitens, Gazania krebsiana, Ornithogalum tenuifolium* subsp. *Tenuifolium, Justicia adhatodea, Infigofera oxytropis* and several species of conservation importance including *Kniphofia porphyrantha, Zanthedeshia albomaculata, Crinum* and *Gladiolus* spp. (SEF, 2010)

The dominant species associated with the permanent zone of wetlands (mostly valley bottom wetlands) within the study site was the obligatory wetland species *Leersia hexandra, Phragmites australis* and *Typha capensis. Agrosits lachnanta,* an obligatory wetland species was present in all three wetland zones but flourished more abundantly in the seasonal and temporary zones. Other species associated with wetlands within the study area included the graminoids *Hyparrhenia tamba, Andropogon eucomus, Eragrostis plana, Miscanthus junceus, Paspalum dilatatum, Sporobulus africanus, Tristachya leucothrix, Cynodon dactylon, Paspalum notatum, P. urvillei, Pennisetum clandestinum, Verbena brasiliensis* and *Oenothera rosea.* Other herbaceous plants also associated with wetlands included *Albuca* sp., *Alysicarpus rugosus* subsp. *rugosus, Aponogeton junceus, Argyrolobium tuberosum, Berkeya radula, Cephalaria zeyheriana, Chironia pupurascens* subsp. *Humuilis, Conyza anthemoides, Dipcadi viride, Helichrysum pillosellum, Lessertia stricta, Nerine* sp., *Sebaea leiostyla, Habenaria*

chlorotica as well as protected species such as *Eulophia welwitshii* , *E. ovalis* subsp. *ovalis* and *E. clavicornis,* photograph 4. Sedges present within the study area, often dominating more towards areas of prolonged saturation within seasonal seeps included *Cyperus rupestrs* var. *rupestris, Mariscus congestus and Schoenoplectus corymbosus cf. paludicola, Cyperus difformis, Cyperus laevigatus, Cyperus marginatus, Fimbristylis complanata, Isolepis costata, Isolepis setacea, Kyllinga pulchella, Pycreus macranthus, Pycreus nitidus, Pycreus rehmannianus.*

. Photograph 4: *Eulophia clavicornis* situated within a valleyhead seepage wetland adjacent to N11 within the study area

3.3 Delineated Wetland Areas

According to the National Water Act (Act no 36 of 1998) a wetland is defined as, "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*" Wetlands typically occur on the interface between aquatic and terrestrial habitats and therefore display a gradient of wetness – from permanent, to seasonal, to temporary zones of wetness - which is represented in their plant species composition, as well as their soil characteristics. It is important to take cognisance of the fact that not all wetlands have visible surface water. An area which has a high water table just below the surface of the soil is also a wetland, as well as a pan that only contains water for a few weeks during the year.

Hydrophytes and hydric soils are subsequently used as the two main wetland indicators. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. The soil form indicator examines soil forms,

as defined by the Soil Classification Working Group. Typically soil forms associated with prolonged and frequent saturation by water, where present, is an indicator of wetland occurrence (DWAF, 2005). The Soil Classification Working Group (1991) has identified various soil types that typically occur within the different zones typically found within a wetland, i.e. a permanent, seasonal and temporary zone. Terrain unit refers to the terrain unit in which the wetland is found. Wetlands can occur across all terrain units from the crest to valley bottom. Many wetlands occur within valley bottoms, but wetlands are not exclusively found within depressions. Terrain unit is a useful indicator in assessing the hydro-geomorphic form of the wetland.

In practice all four indicators should be used in any wetland assessment / delineation exercise, the presence of redoximorphic features being most important, with the other indicators being confirmatory. An understanding of the hydrological processes active within the area is also considered important when undertaking a wetland assessment. Indicators should be 'combined' to determine whether an area is a wetland and to delineate the boundary of a wetland. According to the DWAF (2005), the more wetland indicators that are present, the higher the confidence of the delineation. In assessing whether an area is a wetland, the boundary of a wetland or a non- wetland area should be considered to be the point where indicators are no longer present.

Six different types of wetland areas were classified within the study area and were categorised into hydro-geomorphic (HGM) units. These include valley bottom wetlands without a channel, floodplains, valley bottom wetlands with a channel, edorheic pans, hillslope seepage wetlands not feeding a watercourse and hillslope seepage wetlands feeding a watercourse. A total of 67 Hydro-geomorphic units were delineated and classified within the study area, and are presented graphically in Figure 3, Figure 4 and Figure 5. Due to the large amount of wetlands delineated along the proposed route, only the verified wetland segments directly adjacent to the route were delineated and mapped. It must however be kept in mind that each of the mapped segments represent a much larger wetland as illustrated in figure 2.

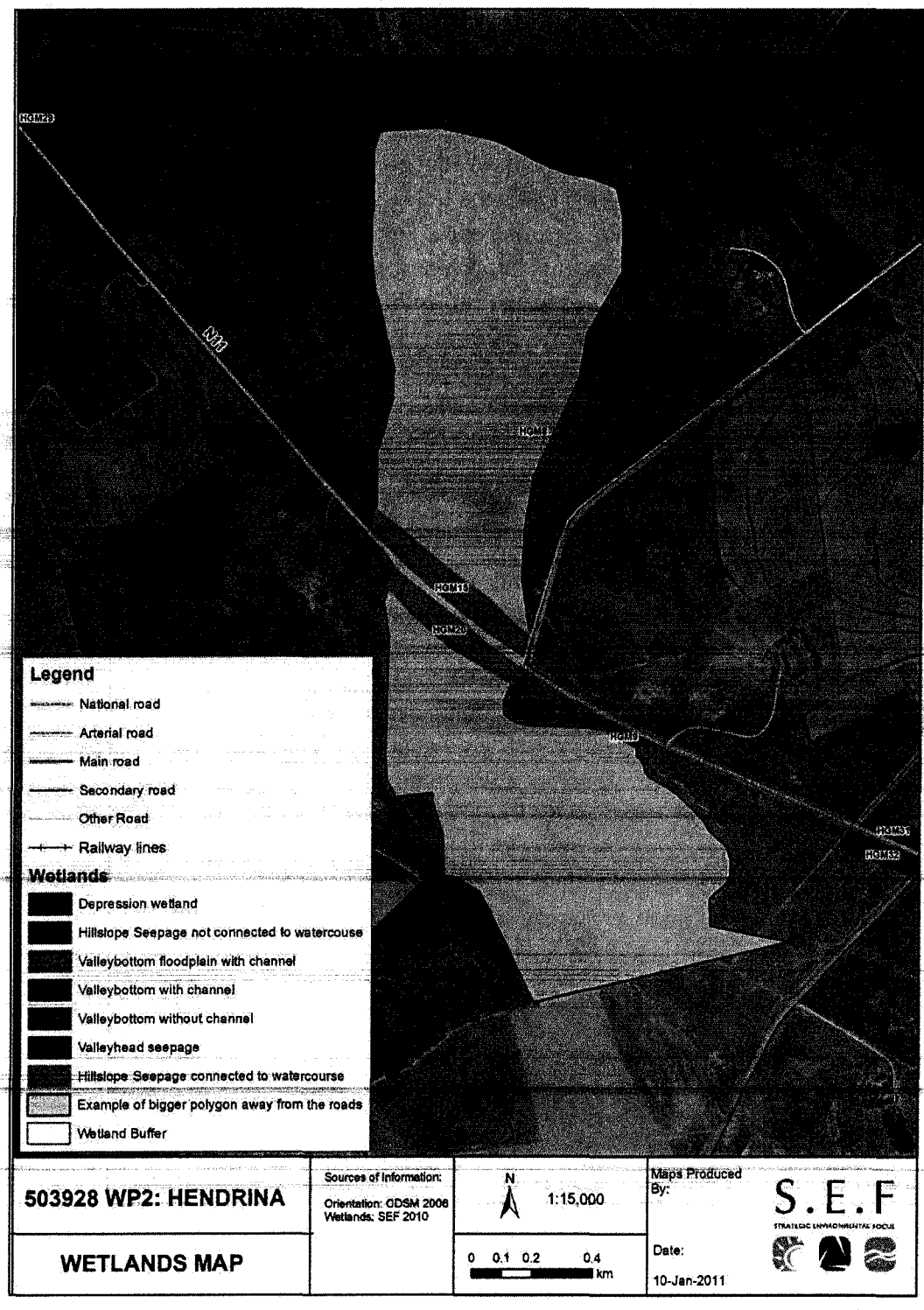


Figure 2: Map indicating highlighted wetlands segments directly adjacent to exisiting road in relation to larger wetland extend.

HGM units encompass three key elements (Kotze *et al*, 2005):

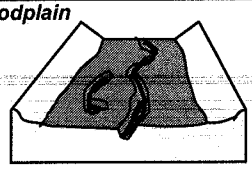
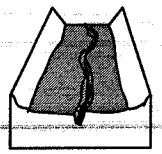
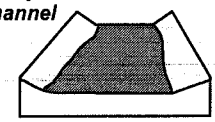
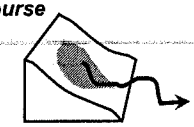
(1) Geomorphic setting. This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);

(2) Water source. There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and

(3) Hydrodynamics, which refers to how water moves through the wetland.

Table 1 describes the characteristics that form the basis for the classification of the HGM units in the study area.

Table 1: Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa (adapted from Kotze *et al*, 2005)

Hydro-geomorphic types	Description	Source of water maintaining the wetland[1]	
		Surface	Sub-surface
Floodplain 	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 	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 	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.	***	*/ ***
Hillslope seepage feeding a watercourse 	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 not feeding a watercourse 	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 (includes Pans) 	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.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source:

*	Contribution usually small
***	Contribution usually large
*/ ***	Contribution may be small or important depending on the local circumstances

Wetland

Several wetlands were also identified within the vicinity of proposed borrowpit areas, Figure 6, 7 & 8

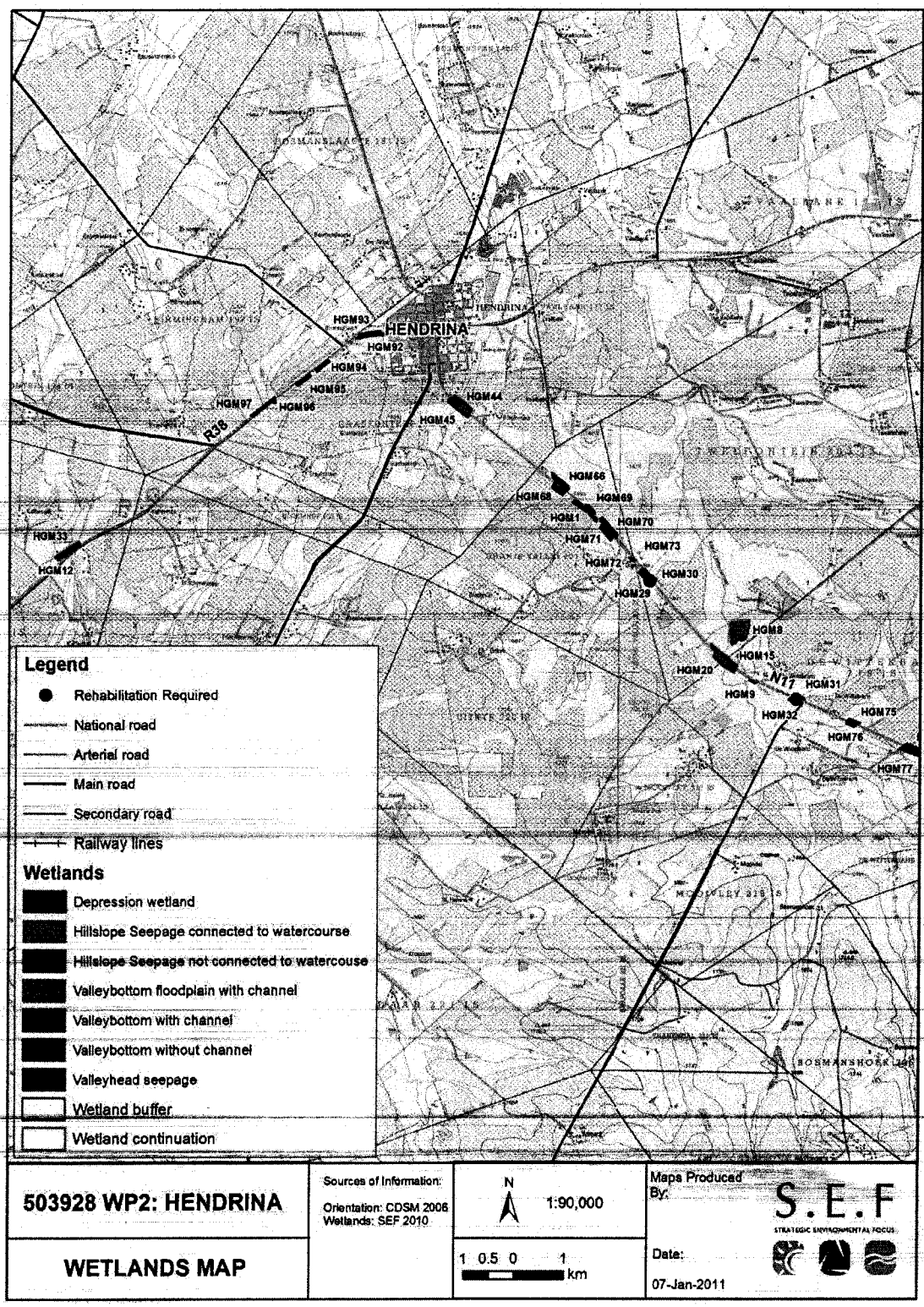


Figure 3: Verified Hydro-geomorphic units in the study area

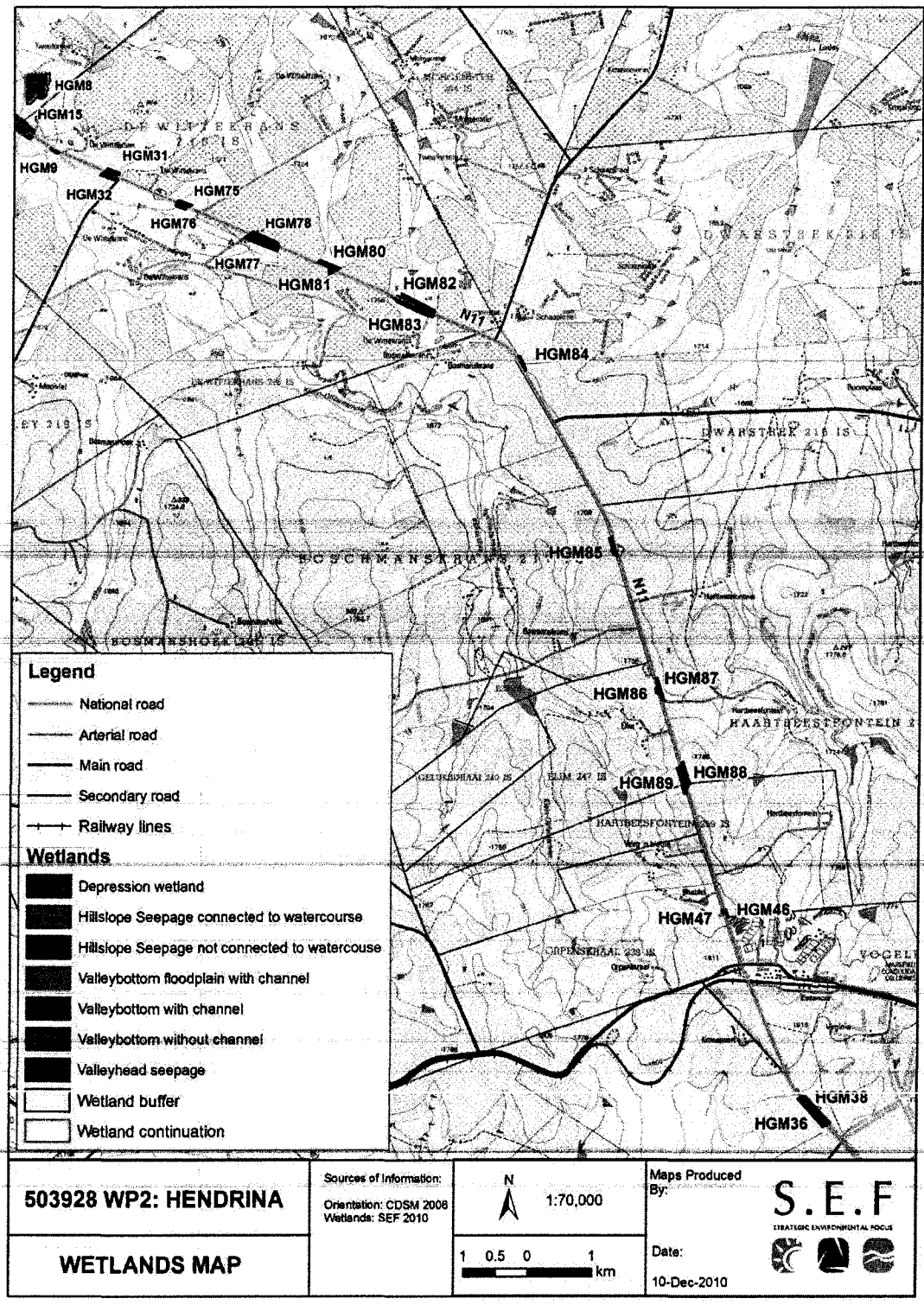


Figure 4: Verified Hydro-geomorphic units in the study area

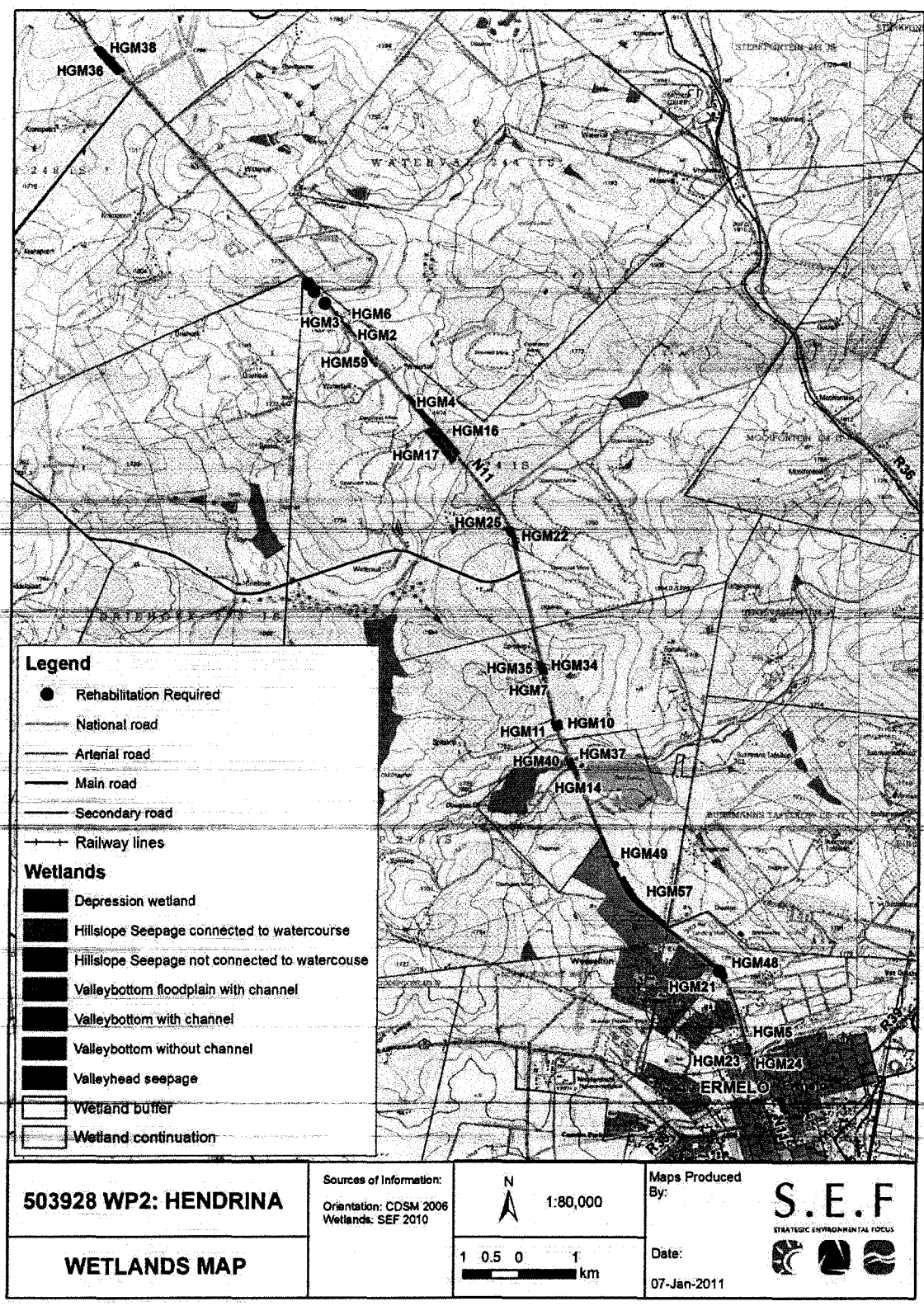


Figure 5: Verified Hydro-geomorphic units in the study area

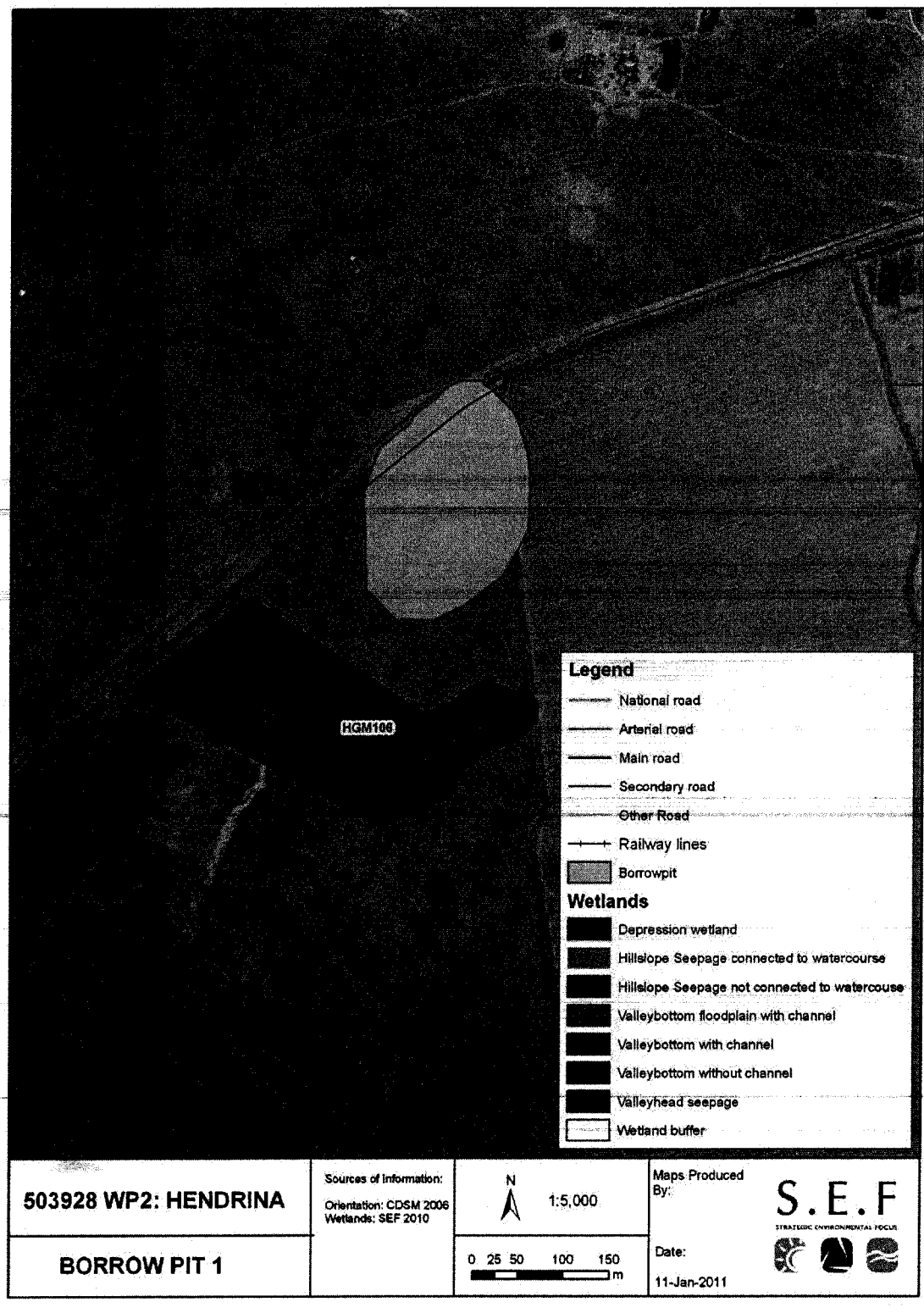


Figure 6: Verified Hydro-geomorphic units in the study area at borrow pit 1.

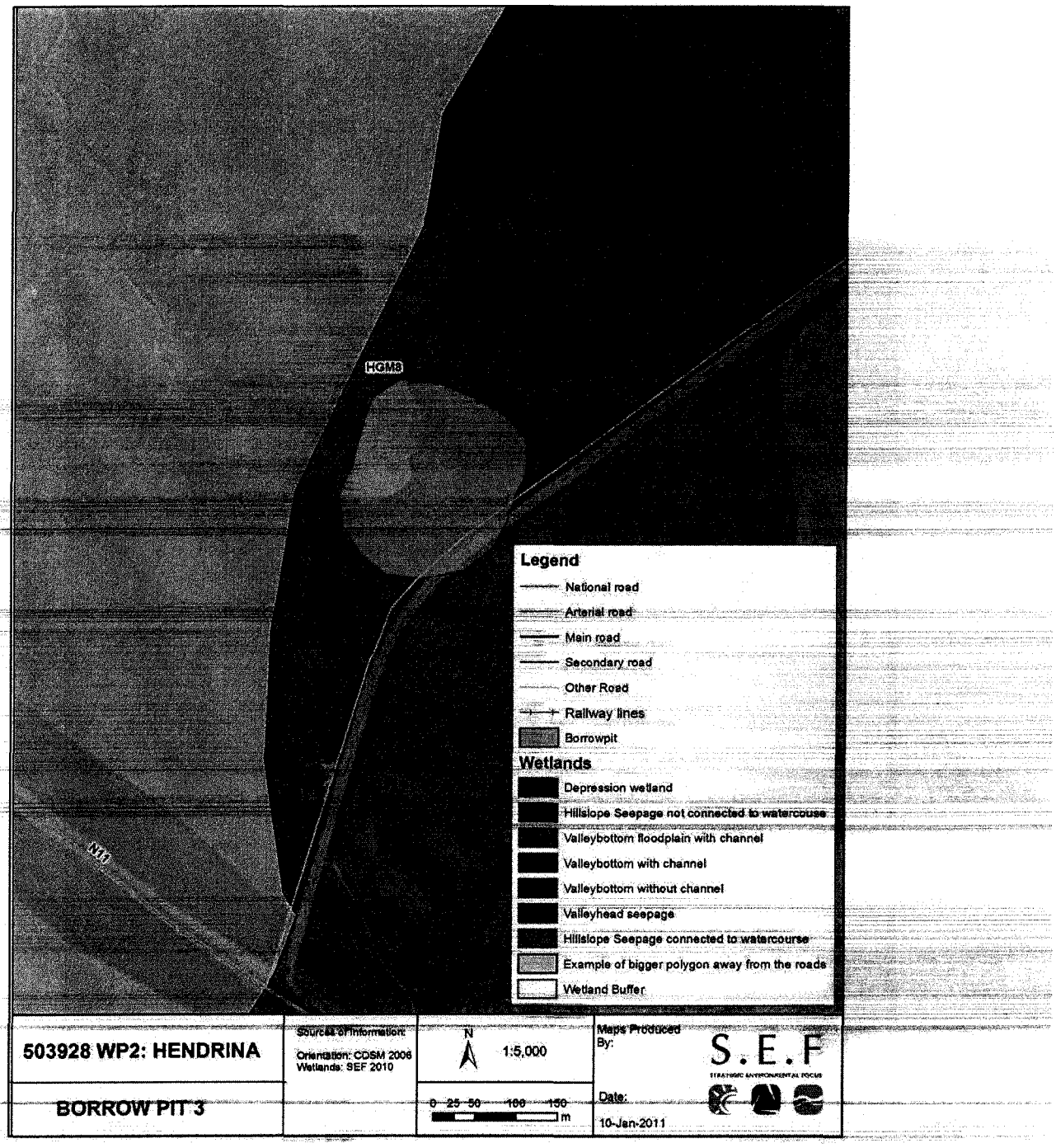


Figure 7: Verified Hydro-geomorphic units in the study area at borrow pit 3.

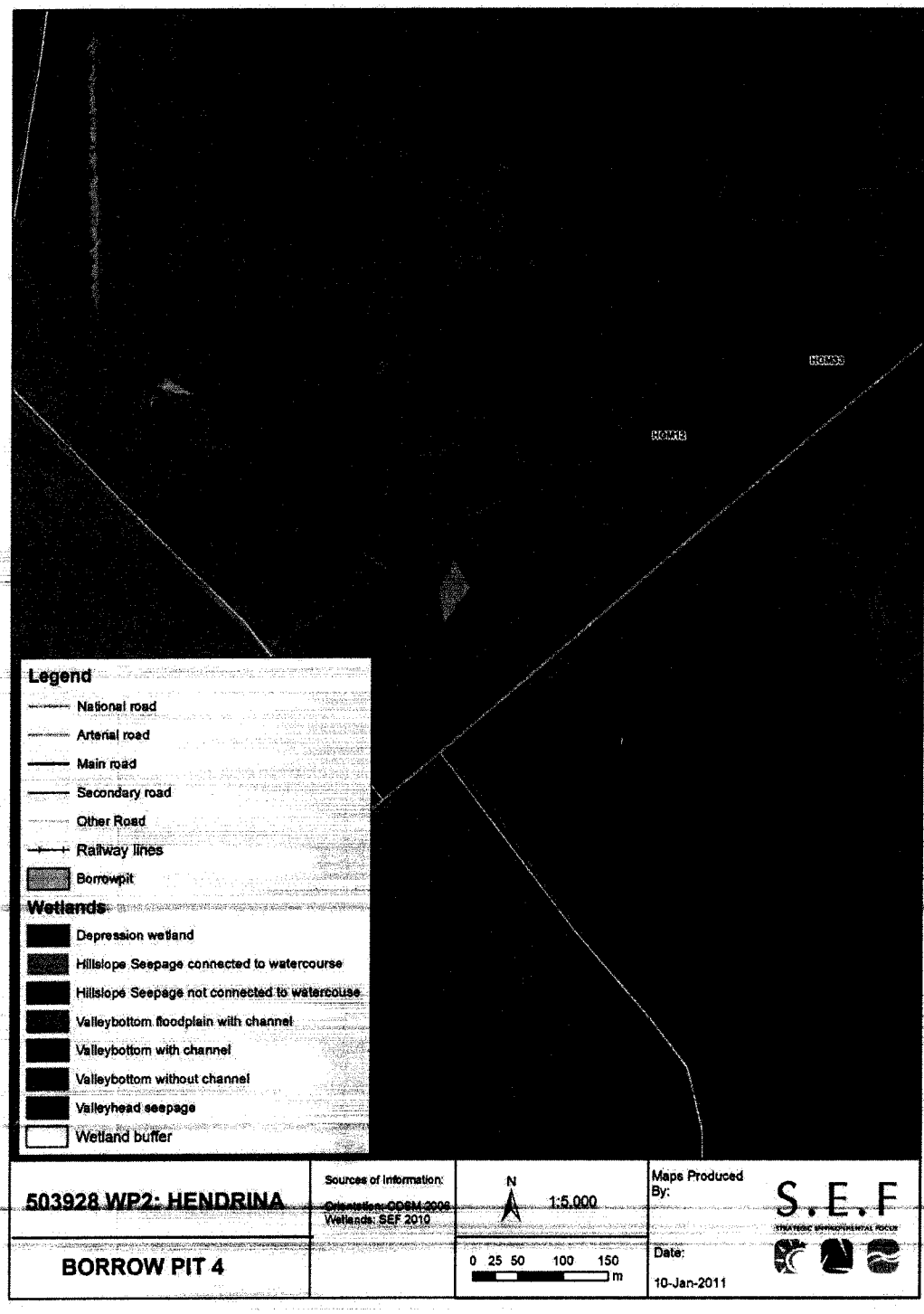


Figure 8: Verified Hydro-geomorphic units in the study area at borrow pit 4.

4. FUNCTIONAL ASSESSMENT

Wetlands within the study area serves to improve habitat within and downstream of the study area through the provision of various ecosystem services (Table 2).

Table 2: Potential wetland services and functions in study area

Function	Aspect
Water balance	Streamflow regulation
	Flood attenuation
	Groundwater recharge
Water purification	Nitrogen removal
	Phosphate removal
	Toxicant removal
	Water quality
Sediment trapping	Particle assimilation
Harvesting of natural resources	Reeds, Hunting, etc.
Livestock usage	Water for livestock
	Grazing for livestock
Crop farming	Irrigation

Hydro-geomorphic units are inherently associated with hydrological characteristics related to their form, structure and particularly because of their position in the landscape. This, together with the biotic and abiotic character (or biophysical environment) of wetlands in the study area, means that these wetlands are able to contribute better to some ecosystem services than to others (Kotze *et al.* 2005) (Table 3).

Table 3 Preliminary rating of the hydrological benefits likely to be provided by a wetland given its particular hydro-geomorphic type

WETLAND HYDRO-GEOMORPHIC TYPE	HYDROLOGICAL BENEFITS POTENTIALLY PROVIDED BY THE WETLAND							
	Flood attenuation		Stream flow regulation	Erosion control	Enhancement of water quality			
	Early wet season	Late wet season			Sediment trapping	Phos-phates	Nitrates	Toxicants[2]
Floodplain	++	+	0	++	++	++	+	+
Valley bottom - channelled	+	0	0	++	+	+	+	+
Valley bottom - unchannelled	+	+	+?	++	++	+	+	++
Hillslope seepage feeding a stream channel	+	0	+	++	0	0	++	++
Hillslope seepage not feeding a stream	+	0	0	++	0	0	++	+
Pan/ Depression	+	+	0	0	0	0	+	+

[2]Toxicants are taken to include heavy metals and biocides

Rating: 0 Benefit unlikely to be provided to any significant extent
+ Benefit likely to be present at least to some degree
++ Benefit very likely to be present (and often supplied to a high level)

Functional values are discussed according to grouped hydro geomorphic types in the following section.

4.1 Floodplains

Using Wet-EcoServices (Kotze *et al,* 2005), benefit graphs were constructed which illustrate the typical functional assessment results for floodplains within the study area (Figure 9). A score value for a specific wetland function indicates the level to which the related HGM unit can perform the function. Score values are typically calculated as a combination of the effectiveness and the opportunity of a specific HGM unit to perform a particular function.

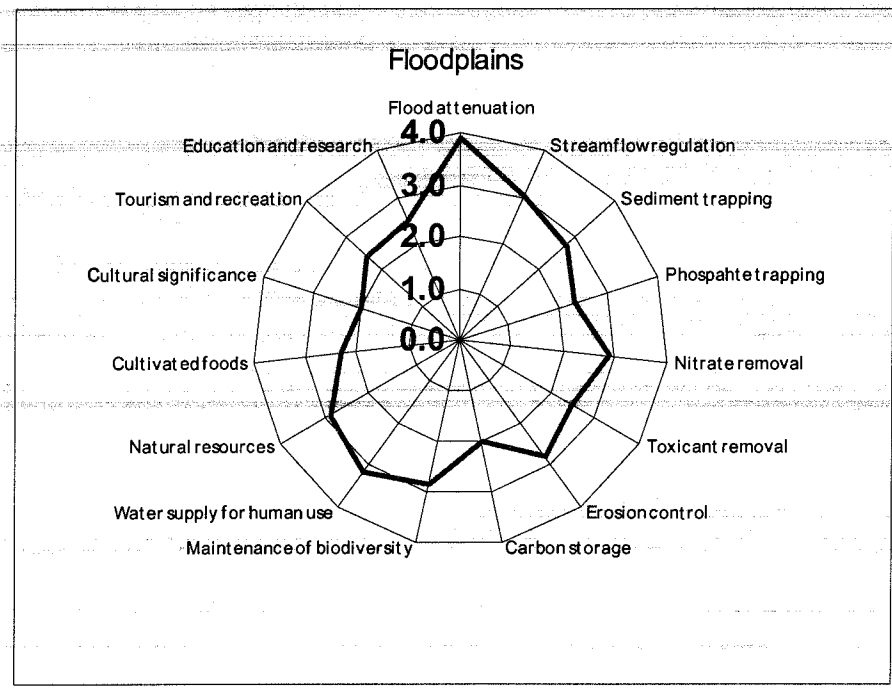


Figure 9: Wetland ecosystem services scores provided for floodplains.

According to Kotze *et al* (2005), floodplains generally receive most of their water during high flow events when waters overtop the streambanks. As per the ecosystem benefit graph, floodplains in the study area are considered to be important for flood attenuation because of the nature of the vegetation and the topographic setting that they occupy. Flood attenuation is likely to be high early in the season until the floodplain soils are saturated (see McCartney *et al.,* 1998; McCartney, 2000) and the oxbows and other depressions are filled. In the late season, the flood attenuation capacity is usually

reduced. Nevertheless, even in the late season it is still likely to be carried out to some extent, particularly in drier years (Kotze *et al.* 2005).

Floodplains dominated by clayey soils are generally unlikely to contribute significantly to stream flow regulation and groundwater recharge due to water loss through evapotranspiration (Kotze *et al.* 2005). However, floodplains with course sediments, could contribute significantly to streamflow and groundwater recharge.

Kotze *et al* (2005) further states that in general, once the flood overtops the river banks, the velocity of flow decreases laterally, permitting the deposition of particles within the floodplain landscape. Phosphorous and any toxicants bound to trapped sediments is therefore likely to be effectively retained on the floodplains, and this is a key mechanism through which wetlands trap phosphates (Boto and Patrick, 1979; Hemond and Benoit, 1988). Generally the inundation period in floodplains is short but in the oxbow depression portions of the floodplain inundation is more prolonged and some of the deposited phosphates may be released as a consequence of change in redox potential, given that phosphorus is held more tightly to soil particles under oxidized conditions than under reduced conditions (Cronk and Siobhan Fennessy, 2001; Keddy, 2002).

Nitrogen removal via nitrification/denitrification is likely to occur but are likely to be limited due to short residence times during flood events (which limits contact between the bulk of the water and the sediments) and due to the generally limited sub-surface water movement within the wetland (Kotze *et al.* 2005). Furthermore, the concentration of nutrients in flood waters entering the floodplain is often low due to dilution effects. However, the behaviour of nitrogen in oxbows and depressions is likely to be similar to that in pans, with cycling between dissolved and organic forms and with some removal from the water through denitrification (Kotze *et al.* 2005).

The most evident resource use within floodplains of the study area were its likely use for grazing, especially for winter grazing when the moisture content of the floodplain is expected to be higher than the surrounding terrestrial environment.

Floodplains play an important role in the maintenance of biodiversity, as several species from various taxa are dependant on wetlands for breeding and feeding purposes. Floodplains, often in conjuction with other wetlands also provide important ecological corridors for the species to receive genetic diversity from other populations (Palmer *et al*, 2002).

4.2 *Hillslope seepage wetlands feeding a watercourse (Including valleyhead seepages)*

Figure 10 presents a graphic representation of the functional attributes of the hillslope seepage wetlands feeding a watercourse.

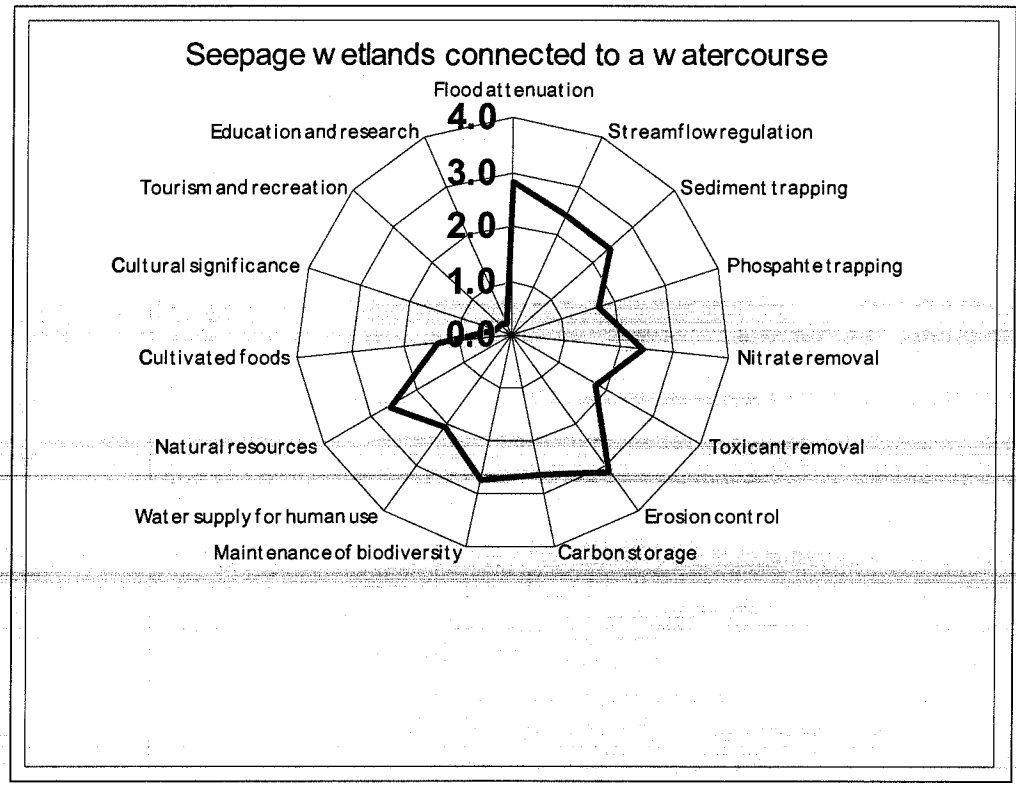


Figure 10: Wetland ecosystem services scores provided by seepage wetlands feeding a watercourse.

According to Kotze *et al* (2005), these systems are normally associated with groundwater discharges, although flows through them may be supplemented by surface water contributions. These wetlands are expected to contribute to some surface flow attenuation early in the season until the soils are saturated, after which their contribution to flood attenuation is likely to be limited (WRP, 1993; McCartney *et al.*, 1998; McCartney, 2000). The accumulation of organic matter and fine sediments in the wetland soils results in the wetland slowing down the sub-surface movement of water down the slope. This "plugging effect" increases the storage capacity of the slope above the wetland, and prolongs the contribution of water to the stream system during low flow periods. For some seepage wetlands this contribution may continue into the dry season, but for many others it is confined mainly to the wet season (Kotze *et al,* 2005). According to Thompson and Goes (1997), these types of systems could replenish and recharge groundwater systems when water percolates through the topsoil to the underlying aquifer. Batchelor (2007) states that seepage wetlands represent an important

indicator of water retained in the landscape. This plays a role in maintaining a mosaic of vegetation patterns across the landscape as well as species richness associated with the footprint of the seepage wetland itself. From a hydrological perspective, the seepage wetlands reflect the extended and diffused release of water which would otherwise, in the worst case scenario, runoff the landscape in defined high energy, short duration flows (Batchelor, 2007).

Kotze *et al* (2005) further states that seepage wetlands are commonly considered to supply a number of water quality enhancement benefits, such as removing excess nutrients and inorganic pollutants produced by agriculture (e.g. maize production) (Rogers *et al*, 1985; Gren, 1995; Ewel, 1997; Postel and Carpenter, 1997). Seepages generally would be expected to have a relatively high nitrogen removal potential. Nitrogen and specifically nitrate removal could be expected as the groundwater emerges through low redox potential zones within the wetland soils, with the wetland plants contributing to the necessary supply of organic carbon (Kotze *et al,* 2005). Particularly effective removal has been recorded of nitrates from diffuse sub-surface flow, as characterized by hillslope seepages (Muscutt *et al.*, 1993; Kotze *et al*, 2005).

The most evident resource use within seepages of the study area are for grazing, especially for winter grazing when the moisture content of the floodplain is expected to be higher than the surrounding terrestrial environment. Many of the temporary seepages have been ploughed in the past for Maize production.

The valleyhead seepage wetlands are important custodians of biodiversity for various taxa including protected species and species of conservation concern such as *Crinum bulbispermumm, Crinum bulbispermum, Eucomis* sp. *and Gladiolus* sp.

4.3 Valley bottom wetlands without a channel

Ecosystem services provided by valley bottom wetlands without a channel are graphically displayed in Figure 11.

As evident from the Figure 11, these wetlands perform various important functions and achieved high scores for maintenance of biodiversity, water supply, stream flow regulation, sediment trapping, toxicant and nitrate removal. During precipitation events, this type of wetland's stream channel input is spread diffusely across the wetland, even in low flows, resulting in extensive areas of the wetland remaining permanently saturated and tending to have high levels of soil organic matter (Kotze *et al,* 2005). Nitrate and toxicant removal is consequently expected to be higher than in floodplains owing to the greater contact of the wetland with runoff waters, particularly if there is a significant groundwater contribution to the wetland.

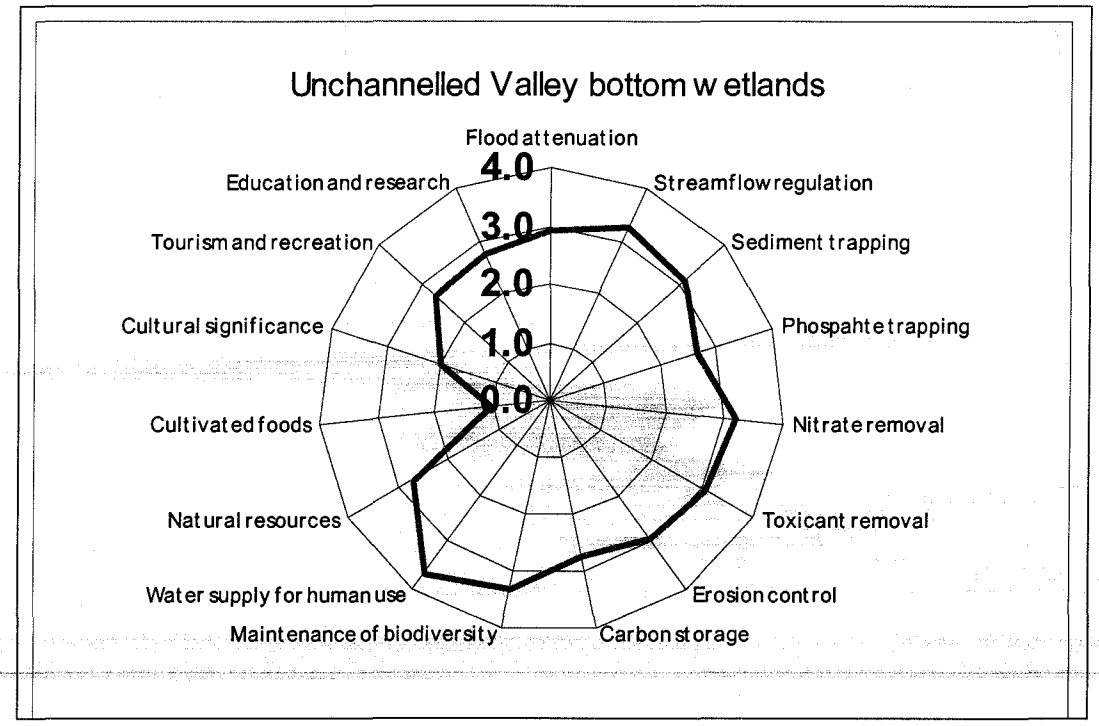


Figure 11: Wetland ecosystem services scores provided Valley bottom wetlands without a channel.

Typically within the study area, farm-dams have been constructed within the valley bottom wetlands for water retention of various uses. The areas surrounding the dams and parts of the dams which contain shallow water promote sunlight penetration, contributing to the photodegradation of certain toxicants. However, phosphate retention levels tend to be lower than in floodplains because a certain amount of phosphate may be re-mobilized under prolonged anaerobic conditions (Kotze *et al,* 2005). In addition, the nitrate removal potential would generally not be as high as in seepage slopes because sub-surface water movement through the wetlands (where the greatest levels of nitrate removal generally take place associated with high organic matter levels and low dissolved oxygen levels) occurs to a lesser degree owing to the generally finer, less permeable soils and lower gradients. However, where sub-surface water inputs are high, nitrate removal levels in unchannelled valley bottoms may be similar to hillslope seepage wetlands (Kotze *et al,* 2005).

These systems are important for their maintenance of biodiversity through provision of habitat and corridor provision for animals, for example, breeding habitat for the vulnerable *Tyto capensis* (African Grass Owl) as well as protected plant species such as *Eulophia* spp. and Crinum sp..

4.4 Valley bottom wetlands with a channel

Ecosystem services provided by valley bottom wetlands with a channel are graphically displayed in Figure 12.

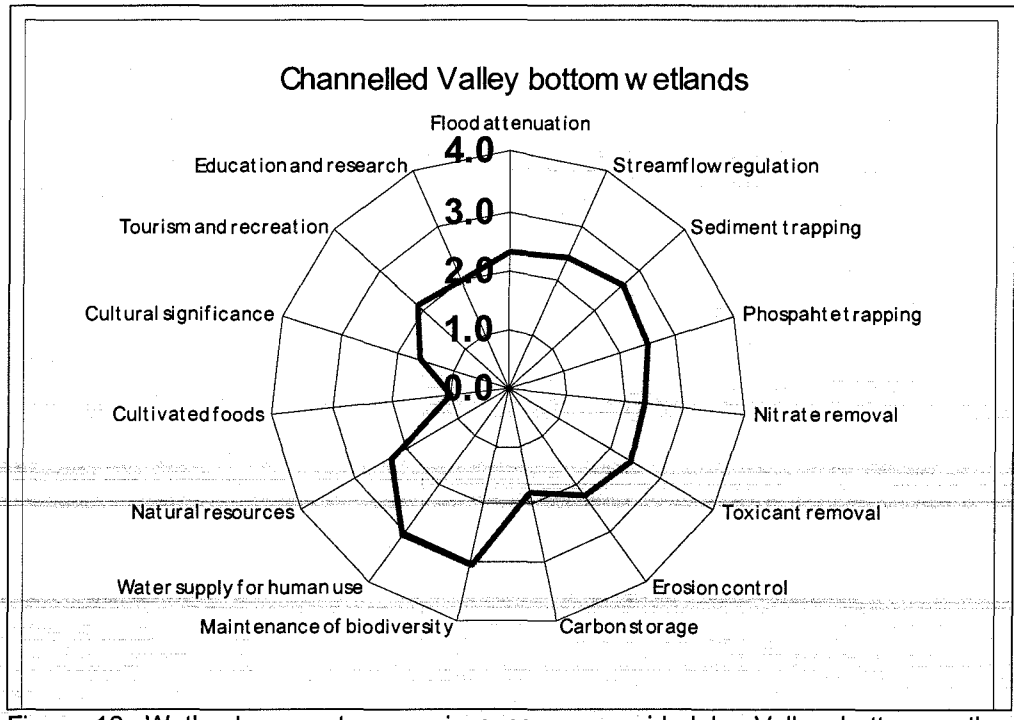


Figure 12: Wetland ecosystem services scores provided by Valley bottom wetlands with a channel.

Channelled valley bottom wetlands resemble floodplains. However, they are characterized by less active deposition of sediment and an absence of oxbows and other floodplain features such as natural levees and meander scrolls. They tend to be narrower and have somewhat steeper gradients and the contribution from lateral groundwater input relative to the main stream channel is generally greater (Kotze *et al,* 2005). According to Kotze *et al* (2005), from a functional point of view they tend to contribute less towards flood attenuation and sediment trapping, but would supply these benefits to a certain extent. Some nitrate and toxicant removal potential would be expected, particularly from the water being delivered from the adjacent hillslopes (Exigent, 2006)

Ecosystem services scores for this type of wetland were not as high as compared to valley bottom wetlands without a channel (Figure 12). This could partially be contributed to the fact that several of these channelled systems most likely originated from head-cut erosion processes through anthropogenic disturbances within unchannelled systems. Channelled valley bottom wetlands are still however very important in terms of maintenance of biodiversity.

4.5 Hillslope seepage wetlands not feeding a watercourse

Figure 13 presents the wetland ecosystem services provided by Hillslope seepage wetlands not connected to a watercourse.

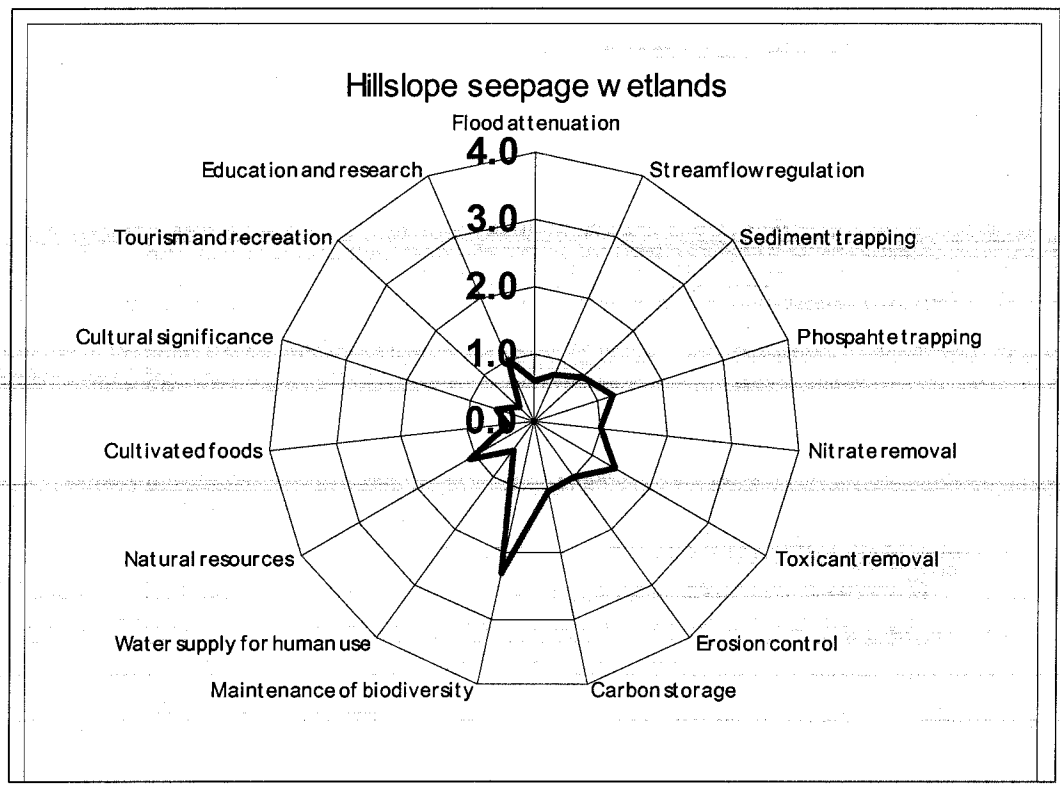


Figure 13: Wetland ecosystem services scores provided by hillslope seepage wetlands not connected to a watercourse.

This wetland type closely resembles the previous type in terms of sources of water and functioning. The key difference, however, is that these systems tend to have a lower degree of wetness which make little direct contribution to streamflow regulation as they are not directly connected to a watercourse. Some of these settings do, however, contribute via sub-surface water flow (Kotze *et al*, 2005). These types of seepages also represented a very small surface area of wetlands within the study area and therefore these systems scored lower in terms of ecosystem services than connected hillslope seepage wetland.

4.6 Endorheic Pans

Wetland ecosystem services provided by Endorheic pans are presented graphically in Figure 14.

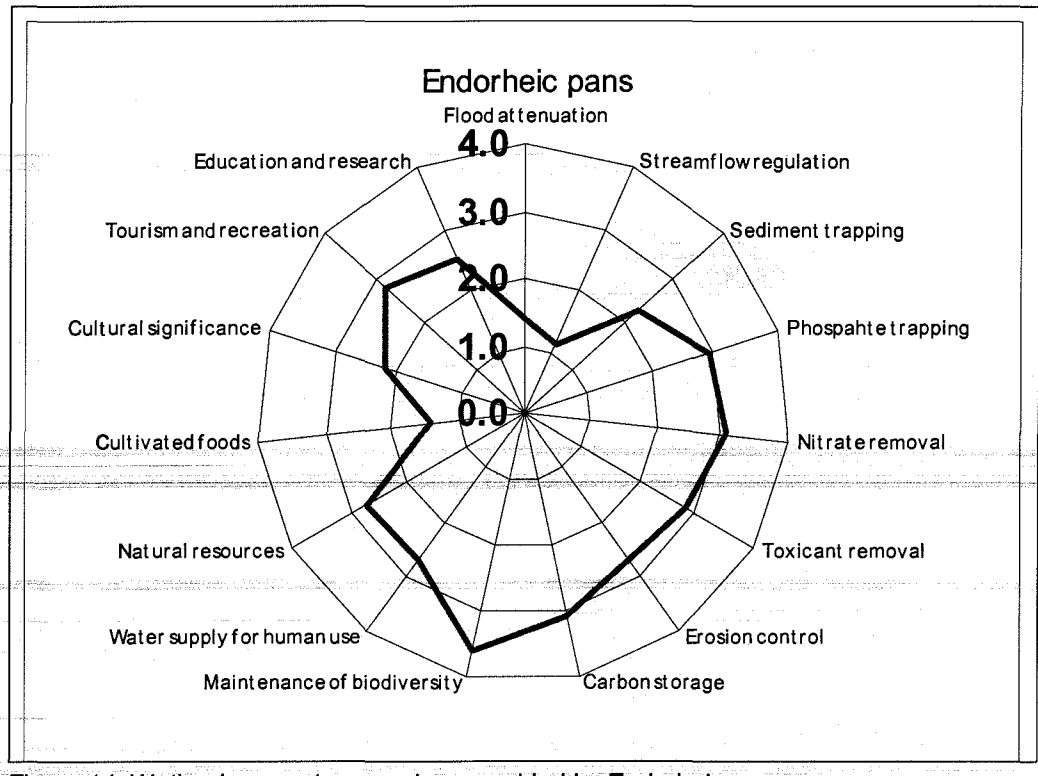


Figure 14: Wetland ecosystem services provided by Endorheic pans.

Depressions can receive both surface and groundwater flows, which accumulate in the depression owing to a generally impervious underlying layer which prevents the water draining away (Goudie and Thomas, 1985; Marshal and Harmse, 1992; Kotze *et al,* 2005). The relative contributions of these different water sources may vary considerably amongst different depressions. The opportunity for attenuating floods is limited by the position of pans in the landscape, which is generally isolated from stream channels. However, they do capture runoff because of their inward draining nature, and thus they reduce the volume of surface water that would otherwise reach the stream system and contribute to stormflows. This inward draining nature, together with their generally impermeable underlying layer, however, also means that pans are unlikely to play a significant role in streamflow regulation, although in the Highveld there appear to be some exceptions to this (Kotze *et al,* 2005). While pans are generally isolated, there is some evidence to suggest that some pans on the Highveld are "leaky", meaning that some of the water that collects in the pans leaks through the pan floor into the underlying substrata (Marneweck and Batchelor 2002; Marneweck, 2003). Pans that lie on drainage divides, particularly where the soils are sandy and streams are abundant, may suggest a

possible link to flow regulation. Whether or not this actually is the case within the study area will still need to be determined. In addition, pans are also not considered important locations for sediment trapping, with many pans, in fact, originating from the removal of sediment by wind, thus creating what are referred to as deflation basins (Goudie and Thomas, 1985; Marshal and Harmse, 1992).

According to Kotze *et al* (2005), temporary pans allow for the precipitation of minerals, including phosphate minerals due to the concentrating effects of evaporation. Nitrogen cycling is likely to be important with some losses due to denitrification, and volatilization in the case of high pH's. Water quality in pans is influenced by the pedology, geology, and local climate (Allan *et al*, 1995). These factors in turn, also influence the response of these systems to nutrient inputs. In pans that dry out completely at some stage or another (non-perennial pans), some of the accumulated salts and nutrients (such as organic nitrogen, and various phosphate and sulphate salts) can be transported out of system by wind and be deposited on the surrounding slopes. Those remaining may dissolve again when waters enter the system again as the pan fills after rainfall events.

According to Exigent (2006), the most important wetland type for bird distribution is likely to be pans. Pans provide a great variety of habitat types including open saline water and fresh water, as well as different saturation zones (temporary, seasonal and permanent). Most water bird species are opportunistic and the diversity of species utilizing pans are high (Barnes, 1998; Barnes, 2000; Palmer *et al*, 2002).

5. Ecological Importance & Sensitivity

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation. Several of the wetlands within the study area provide habitat for a variety of taxa which contain species of conservation concern and are therefore highly valuable from a biodiversity point of view. Further, the vegetation in and around rivers and drainage lines play an important role in water catchments, assimilation of phosphates, nitrates and toxins as well as flood attenuation. Quality, quantity and sustainability of water resources are fully dependent on good land management practices within the catchment. All flood lines, riparian zones and wetlands along with corresponding buffer zones must be designated as sensitive. The good state of health of many of the wetlands within the study area further increases the importance of the delineated wetlands.

6. IMPACT ASSESSMENT AND MITIGATION

Any development in a natural system will impact on the surrounding environment, usually in a negative way. The purpose of this phase of the project was therefore to identify and assess the significance of the impacts likely to arise during the construction and the operational phases of the project, and provide a short description of the mitigation required so as to limit the impact of the proposed development on the natural environment.

6.1 Assessment Criteria

The environmental impacts are assessed with mitigation measures (WMM) and without mitigation measures (WOMM) and the results presented in impact tables which summarise the assessment. Mitigation and management actions are also recommended with the aim of enhancing positive impacts and minimising negative impacts.

In order to assess these impacts, the proposed development has been divided into two project phases, namely the construction and operation phase. The criteria against which these activities were assessed are discussed below.

6.1.1 Nature of the Impact

This is an appraisal of the type of effect the project would have on the environment. This description includes what would be affected and how and whether the impact is expected to be positive or negative.

6.1.2 Extent of the Impact

A description of whether the impact will be local (extending only as far as the servitude), limited to the study area and its immediate surroundings, regional, or on a national scale.

6.1.3 Duration of the Impact

This provides an indication of whether the lifespan of the impact would be short term (0-5 years), medium term (6-10 years), long term (>10 years) or permanent.

6.1.4 Intensity

This indicates the degree to which the impact would change the conditions or quality of the environment. This was qualified as low, medium or high.

6.1.5 Probability of Occurrence

This describes the probability of the impact actually occurring. This is rated as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

6.1.6 Degree of Confidence

This describes the degree of confidence for the predicted impact based on the available information and level of knowledge and expertise. It has been divided into low, medium or high.

6.2 Impact Assessment

Possible impacts associated with the proposed project and their sources are provided in Table 4 (Construction phase) and Table 5 (Operational phase). The reader is to note that the impacts listed below pertain to wetlands assessed, and do not reflect impacts on the perennial watercourses observed to be associated with the proposed project. For a detailed account of impacts associated with the perennial watercourses, the reader is referred to the Aquatic Impact Assessment conducted in conjunction with the Wetland Impact Assessment.

Table 4: Possible impacts arising during construction phase

Possible impact	Source of impact
Destruction of wetland habitat	Reshaping and construction activities of road within wetland habitat
Surface water pollution	Flooding of construction area; construction vehicles; construction camp within wetland habitat or wetland cathcments

Table 5: Possible impacts arising during operational phase

Possible impact	Source of impact
Increased erosion	Increased surface runoff & canalisation of flow

6.2.1 Construction Phase

6.2.1.a Destruction of wetland habitat through road widening and borrow pit activities

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Permanent	High	Probable	High	Med - Low	High

Description of Impact

Footprint of new road could infringe or destroy wetland habitat and associated biota through removal of hydrophytic vegetation and or hydric soils.

Specific Mitigation Measures

- Alternate widening on either side of the road to achieve protection of specific HGM units, especially where there are only wetlands located on one side of the road. The location of the following wetlands allows for widening on the opposite side of the road and should be addressed in the detailed design:

  HGM 97, HGM 95, HGM 94, HGM 72, HGM 9, HGM 80, HGM 85, HGM 87, HGM 59, HGM 4, HGM 22, HGM 49 and HGM 57.

- Where the road supports wetlands of equal importance on both sides of the existing road (e.g. HGM 36 & 38), the road footprint should be kept to a minimum and strictly stay within the existing road reserve;

- Re-vegetation of disturbed areas must be undertaken with site indigenous species and in accordance with the instructions issued by the Environmental Control Officer (ECO). The following species should be utilised in each of the different wetland zones for rehabilitation:

  Temporary seeps: *Aristida junciformis; Conyza ulmifolia; Eriocaulon dregei; Fingerhuthia sesleriiformis; Gunnera perpensa; Helichrysum mundii; Imperata cylindrica; Miscanthus capensis; Miscanthus junceus; Paspalum scrobiculatum; Pennisetum macrourum; Pennisetum sphacelatum; Phragmites mauritianus; Ranunculus meyeri; Ranunculus multifidus* and *Setaria sphacelata.*

Seasonal seeps: *Andropogon appendiculatus; Arundinella nepalensis; Carex acutiformis; Carex cognata; Cladium mariscus; Cyperus digitatus; Cyperus latifolius; Cyperus longus; Eriocaulon dregei; Fimbristylis complanata; Fimbristylis dichotoma; Fingerhuthia sesleriiformis; Gunnera perpensa; Helichrysum mundii; Isolepis costata; Juncus dregeanus; Juncus exsertus; Juncus oxycarpus; Juncus punctorius; Kniphofia linearifolia; Limosella longiflora; Ludwigia palustris; Paspalum scrobiculatum; Pennisetum macrourum; Phragmites mauritianus; Pycreus mundii; Pycreus nitidus; Ranunculus meyeri; Ranunculus multifidus; Sacciolepis chevalieri; Schoenoplectus decipiens; Scleria welwitschii; Setaria sphacelata; Xyris capensis and Xyris congensis.*

Permanent zone: *Arundinella nepalensis; Carex acutiformis; Carex cognata; Cladium mariscus; Cyperus digitatus; Cyperus latifolius; Fimbristylis dichotoma; Gunnera perpensa; Isolepis costata; Juncus dregeanus; Juncus exsertus; Juncus oxycarpus; Juncus punctorius; Kniphofia linearifolia; Limosella longiflora; Ludwigia palustris; Phragmites australis; Pycreus mundii; Pycreus nitidus; Ranunculus meyeri; Ranunculus multifidus; Sacciolepis chevalieri; Schoenoplectus decipiens and Scleria welwitschii.*

- The establishment and use of Borrowpit areas are not permitted within wetland areas or within wetland bufferzone areas. The borrowpit areas should also not impact on the hydrology of wetland areas through increased run-off or dissication of geo-hydrological pathways feeding the wetlands. Effective rehabilitation of the borrowpit areas must be implemented as soon as they are finished

- After completion of the construction phase, a wetland monitoring program must be initiated that ensure that all wetland protection infrastructure and storm-water systems are properly installed and that all affected wetland areas are adequately rehabilitated.

General Mitigation Measures

- Avoid construction activities in wetlands at all cost through proper demarcation and appropriate environmental awareness training. The Contractor has a responsibility to inform all staff of the need to be vigilant against any practice that will have a harmful effect on wetlands. This

information shall form part of the Environmental Education Programme to be effected by the Contractor.

- No construction shall take place in areas of high sensitivity i.e. "no-go Areas". All no-go areas must be demarcated with red tape under guidance of the ECO.
- Any proclaimed weed or alien species that germinates during the contract period shall be cleared by hand before flowering.
- Infilling, excavation, drainage and hardened surfaces (including buildings and asphalt) should not occur in any of the wetland zones (i.e. permanent, seasonal or temporary), or within 30m of a wetland. This 30m buffer zone should be extended in areas where slope in combination with rainfall will potentially provide conditions for the transportation and deposition of materials within wetland areas.
- Caution must be taken to ensure building materials are not dumped or stored within the delineated wetland buffer zone of 30m.
- The design of drainage systems must ensure there is no contamination, eutrophication or increased erosion of the wetland areas. Drainage systems should be maintained regularly in order to minimize the runoff of harmful chemical substances into the wetland areas.
- The construction of surface stormwater drainage systems during the construction phase must be done in a manner that would protect the quality and quantity of the downstream system. The use of swales, which could then be grassed for the operational phase, is recommended as the swales would attenuate run-off water.
- Stormwater outflows should not enter directly into a wetland. The velocity of water that may reach wetlands should be slowed before it is intercepted by virgin soils using a siltation and erosion control structure. The plans and specification for this structure should be forwarded to the relevant stakeholders such as Working for Wetlands and local municipalities.
- It should be ensured that the road has minimal affect on the flow of water through the wetland (e.g. by using a bridge or box culverts rather than pipes, photograph 5). During construction, disturbance to the wetlands at, and adjacent to, the road crossing site should be minimised.

- Imported fill material should be monitored during and after construction for the presence of any alien species. Any such species should be removed immediately.

- Emergency plans must be in place in case of spillages into wetland systems.

- All stockpiles must be protected from erosion, stored on flat areas where run-off will be minimized, and be surrounded by bunds. Stockpiles should also only be stored for the minimum amount of time necessary.

- Erosion control of all banks must take place so as to reduce erosion and sedimentation into river channels or wetland areas.

- Silt traps and culverts should be regularly maintained and cleared so as to ensure effective drainage.

- Weather forecasts from the South African Weather Bureau of up to three days in advance must be monitored on a daily basis to avoid exposing soil or building works or materials during a storm event and appropriate action must be taken in advance to protect construction works should a storm event be forecasted.

- Littering and contamination of water sources during construction must be mitigated by effective construction camp management

- All construction materials including fuels and oil should be stored in a demarcated area that is contained within a bunded impermeable surface to avoid spread of any contamination (outside of wetlands or wetland buffer zones)

- Cement and plaster should only be mixed within mixing trays. Washing and cleaning of equipment should also be done within a bermed area, in order to trap any cement or plaster and avoid excessive soil erosion. These sites must be rehabilitated prior to commencing the operational phase.

6.2.1.b Surface water pollution

Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Short	Low	Probable	Low	Low	High

Description of Impact

Hydrocarbons-based fuels or lubricants spilled from construction vehicles, construction materials that are not properly stockpiled, and litter deposited by construction workers may be washed into wetlands and surface water bodies. Should appropriate toilet facilities not be provided for construction workers at the construction crew camps, the potential exists for surface water resources and surrounds to be contaminated by raw sewage. While it is acknowledged that the impacts associated with the proposed activities will be negligible, every effort should still be taken so as to limit additional contributions.

Mitigation Measure

- Construction vehicles are to be maintained in good working order, to reduce the probability of leakage of fuels and lubricants;
- A walled concrete platform, dedicated store with adequate flooring or bermed area should be used to accommodate chemicals such as fuel, oil, paint, herbicide and insecticides, as appropriate, in well-ventilated areas;
- Storage of potentially hazardous materials should be above any 100-year flood line, or as agreed with the ECO. These materials include fuel, oil, cement, bitumen etc.;
- Sufficient care must be taken when handling these materials to prevent pollution;
- Surface water draining off contaminated areas containing oil and petrol would need to be channelled towards a sump which will separate these chemicals and oils;
- Oil residue shall be treated with oil absorbent such as Drizit or similar and this material removed to an approved waste site;
- Concrete, if used, is to be mixed on mixing trays only, not on exposed soil;
- Concrete and tar shall be mixed only in areas which have been specially demarcated for this purpose;

- All concrete and tar that is spilled outside these areas shall be promptly removed by the Contractor and taken to an approved dumpsite;
- After all the concrete / tar mixing is complete all waste concrete / tar shall be removed from the batching area and disposed of at an approved dumpsite;
- Storm water shall not be allowed to flow through the batching area. Cement sediment shall be removed from time to time and disposed of in a manner as instructed by the Consulting Engineer;
- All construction materials liable to spillage are to be stored in appropriate structures with impermeable flooring;
- Portable septic toilets are to be provided and maintained for construction crews. Maintenance must include their removal without sewage spillage;
- Portable septic toilets are to be located outside of the 1-100year floodline;
- Under no circumstances may ablutions occur outside of the provided facilities;
- At all times care should be taken not to contaminate surface water resources;
- No uncontrolled discharges from the construction crew camps to any surface water resources shall be permitted. Any discharge points need to be approved by the relevant authority;
- In the case of pollution of any surface or groundwater, the Regional Representative of the Department of Water Affairs (DWA) must be informed immediately;
- Where construction in close proximity to sewer lines is unavoidable then excavations must be done by hand while at all times ensuring that the soil beneath the sewer lines is not destabilised;
- Store all litter carefully so it cannot be washed or blown into any of the water courses within the study area;
- Provide bins for construction workers and staff at appropriate locations, particularly where food is consumed;
- The construction site should be cleaned daily and litter removed;
- Conduct ongoing staff awareness programs so as to reinforce the need to avoid littering; and

- Backfill must be compacted to form a stabilised and durable blanket; and the current load above the sewer lines must at no time be exceeded.

6.2.2 Operational Phase

6.2.2 Increased erosion

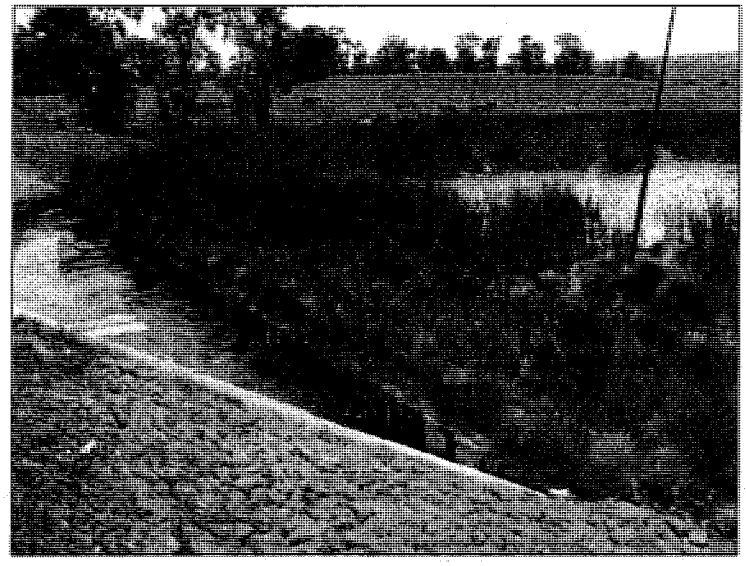
Extent	Duration	Intensity	Probability of occurrence	Significance		Confidence
				WOMM	WMM	
Regional	Permanent	Medium	Possible	High	Low	Medium

Description of Impact

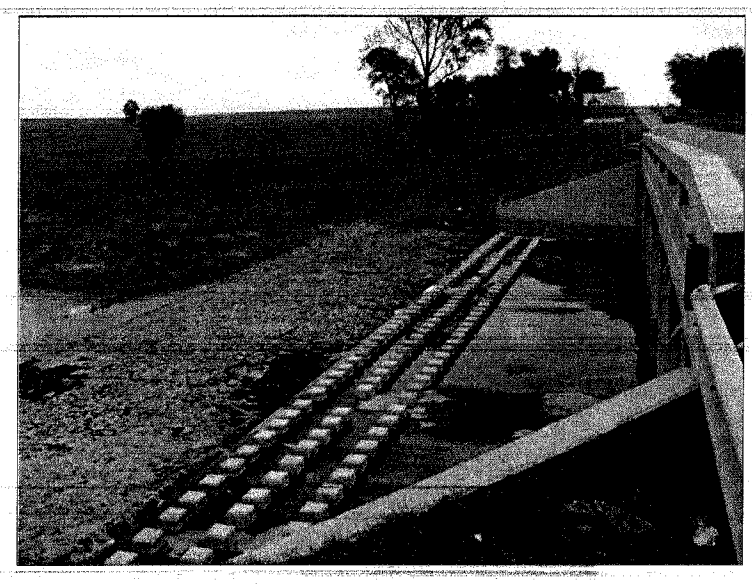
Due to road widening and therefore increase in impermeable surfaces, there is an associated increase in flow velocities and erosion potential within affected wetland habitats. Runoff from the road surface may enter into the associated watercourse and wetlands, resulting in an unnaturally high catchment runoff, wetland scouring and increased flooding of downstream areas. Increased runoff could potentially also affect existing erosion processes within catchments to such an extent that the newly constructed road itself is threatened in the medium to long term. Additionally, the incorrect choice of culvert structure may concentrate the water flow, and result in downstream erosion. Finally, the establishment of a culvert with a base higher than that of the associated watercourse will result in the formation of a plunge pool, which may undercut the culvert on the downstream side, eventually leading to a collapse of the culvert structure.

Mitigation Measures

- Velocity breaking structures such as baffles should be placed on the downstream side of all culverts and piping. Other erosion interventions such as gabion mattresses should also be constructed where erosion potential have been identified, photo 5 and 6.



Photograph 5: Installation of a weir wall upstream of a bridge crossing to prevent headcut erosion.



Photograph 6: Installation of baffle structures and gabion mattress downstream of a bridge crossing to prevent downstream erosion and plunge pool formation.

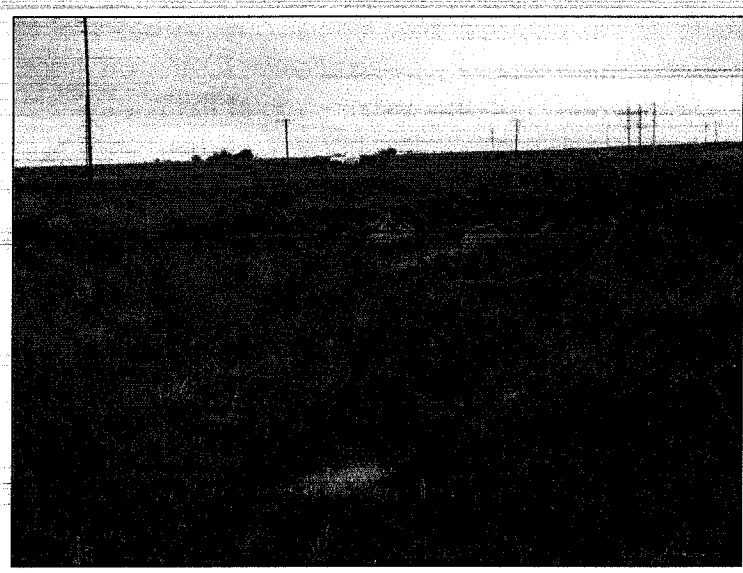
- Should any work be conducted on the culverts present, box culverts are to be used;
- The base of the box culverts should be at least 1m below the bed of the river channel so as to prevent the formation of plunge pools on the downstream side of the bridge;

- The bed of the river channel should be rehabilitated to the correct height following culvert installation; and

- An ecologically-sensitive stormwater management plan should be developed that does not allow concentrated stormwater to enter into a wetland or watercourse directly, but instead makes use of flow diffusers and retention areas (such as artificial wetland areas, swales, baffles and gabion structures). There is a need for between one and four such structures for each of the 67 identified wetlands within the study area.

- Areas in need of rehabilitation intervention include:

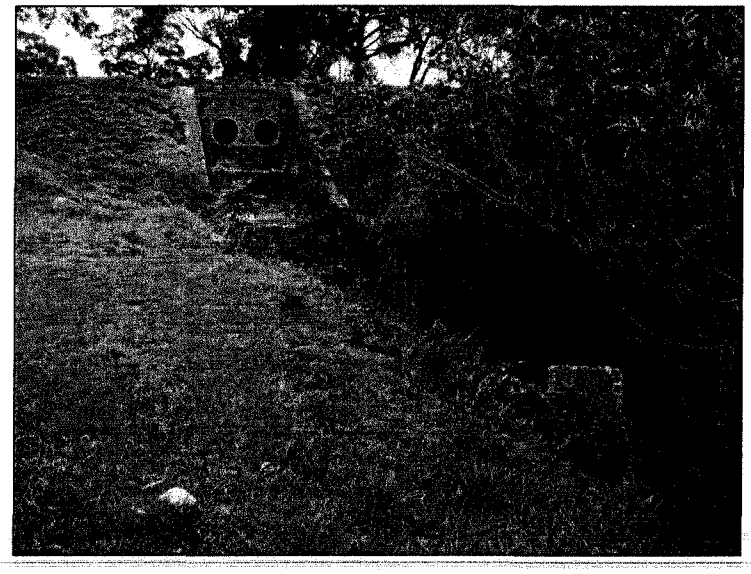
- The area east of the road located between HGM 2 and HGM 6. Headgully erosion is moving northwards scouring away wetland habitat and are likely to threaten the integrity of the road (especially with increased runoff velocities), Photo 7. It is recommended that appropriate gabion structures are designed and installed in the appropriate localities in order to halt the current erosion processes and re-establish the wetlands water table to pre-disturbance levels.



Photograph 7: One of several head gully erosion channels creeping towards the road.

- HGM 21, west of the existing road have been exposed to several anthropogenic disturbances including concentrated flow from two pipes which have caused plunge pool formation and gully erosion in several sections downstream, photo 8. Appropriate rehabilitation initiatives should be designed and implemented including velocity breaking structures such

as baffles, alien vegetation removal and restoration initiatives of the affected seepage wetland areas.

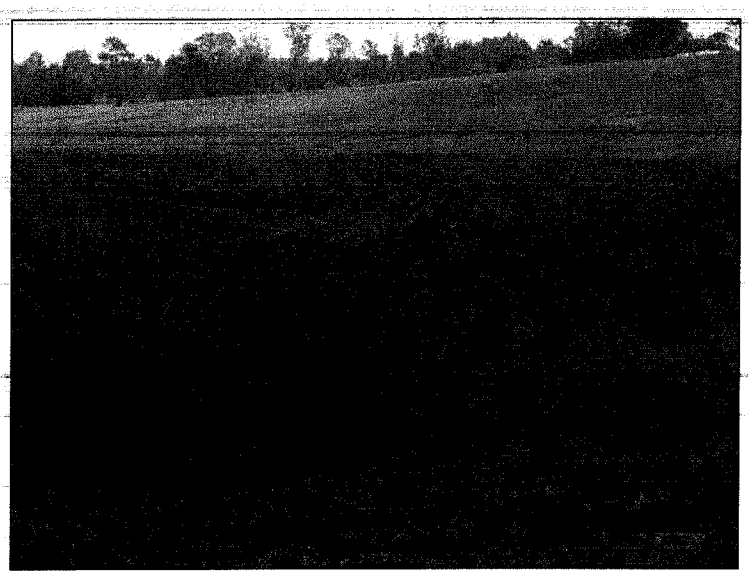


Photograph 8: Existing infrastructure which have concentrated water flow and resulted in erosion processes within HGM 21

- HGM 31 and 32 has been degraded through gully erosion east and west of the existing road which itself are being affected by erosion processes. The worst affected section is on the western side of the road where a plunge pool have formed with subsequent gully erosion downstream, photo 9. A weir wall as depicted in photo 4 should be constructed upstream of the road which will stabilise erosion processes within the wetland. The downstream area with plunge pool and gully should be rehabilitated and flow velocity dissipating structures introduced to prevent reoccurrences of the problem.

Photograph 9: Plunge pool with gully erosion in valleybottom wetland (HGM 32).

- HGM 29 and HGM 30 achieved a high functional score during the field assessment and are therefore especially sensitive. This largely unchannelled valleybottom system, photo 10, have been impacted by the existing road through channel development as a result of concentrated flow, photo 11. Appropriate rehabilitation initiatives should be designed and implemented including velocity breaking structures such as baffles, widening the release platform on the downstream side as well as plugging the eroding channel.



Photograph 10: Unchanneled valleybottom, upstream of the existing road.

Photograph 11: Channel development taking place as a result of concentrated flow, downstream of the existing road.

7 CONCLUSION

Six different types of wetlands were classified within the study area and were categorised into hydro-geomorphic (HGM) units. These include valley bottom wetlands without a channel, floodplains, valley bottom wetlands with a channel, edorheic pans, hillslope seepage wetlands not feeding a watercourse and hillslope seepage wetlands feeding a watercourse. A total of 67 Hydro-geomorphic units were delineated and classified within the study area. The largest majority of wetlands consisted of valleyhead seepage wetlands with temporary to seasonal zonation, dominated by a graminoid layer containing a rich harbaceuos component.

From a functional perspective, wetlands within the study area serves to improve habitat within and downstream of the study area through the provision of various ecosystem services such as movement corridors, streamflow regulation, flood attenuation, groundwater recharge, nitrogen removal, phosphate removal, toxicant removal, particle assimilation and provision of natural resources. Several of the wetlands within the study area provide habitat for a variety of taxa which contain species of conservation concern and are therefore highly valuable from a biodiversity point of view.

All wetlands, rivers, their flood zones and their riparian areas are protected by law and no development is allowed to negatively impact on rivers and river vegetation.

The impact assessment identified destruction of wetland habitat and surface water pollution as the two major potential impacts during the construction period while the highest rated potential impact during the operational phase is increased erosion as a result of the higher surface runoff from increased impermeable surface areas and channelisation of flow. Several specific and general mitigation measures are proposed to mitigate impacts on wetlands. Most important is avoidance of wetland habitat through appropriate road design, e.g. alternate widening on either side of the road to achieve protection of specific hydro-geomorphic units where there are only wetlands located on one side of the road. Where the road supports wetlands of equal importance on both sides of the existing road, the new road footprint should be kept to a minimum and be strictly contained within the existing road reserve. Velocity breaking structures such as baffles should be placed on the downstream side of all culverts and piping. Other erosion interventions such as gabion mattresses and weir walls should also be constructed where erosion potential have been identified. Further, several existing erosion processes at various localities requires rehabilitation as it is likely to threaten not only the existing road but the proposed development as well. After completion of the construction phase, a wetland monitoring program must be initiated that ensure that all wetland protection infrastructure and storm-water systems are properly installed and that all affected wetland areas are adequately rehabilitated. The wetland monitoring program

should continue during the operational phase in order to identify any new erosion processes that are developing and initiate cost effective rehabilitation plans timeously.

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8. GLOSSARY

Alien species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity.

Biodiversity Biodiversity is the variability among living organisms from all sources including inter alia terrestrial, marine and other aquatic ecosystems and ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Biome A major biotic unit consisting of plant and animal communities having similarities in form and environmental conditions, but not including the abiotic portion of the environment.

Buffer zone A collar of land that filters edge effects.

Conservation The management of the biosphere so that it may yield the greatest sustainable benefit to present generation while maintaining its potential to meet the needs and aspirations of future generations. The wise use of natural resources to prevent loss of ecosystems function and integrity.

Critically Endangered A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.

Ecosystem Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space.

Ecological Corridors Corridors are roadways of natural habitat providing connectivity of various patches of native habitats along or through which faunal species may travel without any obstructions where other solutions are not feasible.

Edge effect Inappropriate influences from surrounding activities, which physically degrade habitat, endanger resident biota and reduce the functional size of remnant fragments including, for example, the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution.

Endangered A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.

Exotic species Plant taxa in a given area, whose presence there, is due to the intentional or accidental introduction as a result of human activity

Fauna The animal life of a region.

Flora	The plant life of a region.
Forb	A herbaceous plant other than grasses.
Habitat	Type of environment in which plants and animals live.
Indigenous	Any species of plant, shrub or tree that occurs naturally in South Africa.
Invasive species	Naturalised alien plants that have the ability to reproduce, often in large numbers. Aggressive invaders can spread and invade large areas.
Karoid	Dwarf xerophytic woody shrublets and succulents.
Outlier	An observation that is numerically distant from the rest of the data
Primary vegetation	Vegetation state before any disturbances such as cultivation, overgrazing or soil removal
Protected plant	According to the Transvaal Nature Conservation Ordinance of 1983 (No 12 of 1983), no one is allowed to sell, buy, transport, or remove this plant without a permit from the responsible authority.
Threatened	Species that have naturally small populations, and species which have been reduced to small (often unsustainable) population by man's activities.
Red data	A list of species, fauna and flora that require environmental protection. Based on the IUCN definitions.
Species diversity	A measure of the number and relative abundance of species.
Species richness	The number of species in an area or habitat.
Vulnerable	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.

8. REFERENCES

Allan DG, Seaman, M. and Kaletja, B, (1995). The endorheic pans of South Africa. In: Cowan, G.I. (ed.), *Wetlands of South Africa.* Department of Environmental Affairs and Tourism, Pretoria, South Africa, pp. 75-101.

Barnes, K.N. (1998). The important bird areas of southern Africa. BirdLife South Africa, Johannesburg.

Barnes, K.N. (2000). The ESKOM Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg

Batchelor, A. (2007). Wetland Baseline Assessment: Modderfontein. *Wetland Consulting services.* Ref 286/2007.

Boto, K G, and Patrick, W H, 1979. Role of wetlands in removal of suspended sediments. In: GREESON P E, CLARK J R, and CLARK J L, (eds.) *Wetland functions and values: the state of our understanding.* American Water Resources Association, Minneapolis, Minnesota.

Chief Directorate: Surveys & Mapping (1996): Hydrology. Cape Town: CDSM

Collins, N.B. (2005). Wetlands: The basics and some more. *Free State Department of Tourism, Environment and Economic Affairs.*

Cronk, J K, and Siobhan Fennessy, M, 2001. *Wetland Plants: Biology and Ecology.* Lewis Publishers.

Department of Water Affairs and Forestry (2003) National Water Resource Strategy (Final draft). *Department of Water affairs and Forestry.* Pretoria. South Africa.

Department of Water Affairs and Forestry. (2005) A practical field procedure for identification and delineation of wetlands and riparian areas. *Department of Water affairs and Forestry.* Pretoria. South Africa.

Ewel C, (1997). Water quality improvement by wetlands In: DAILY G. (Ed.) *Nature's Services: Societal Dependence on Natural Ecosystems,* Island Press: Washington DC.

Exigent Engineering Consultants (2006). Upper Olifants River Catchment Wetlands Inventory for Mpumalanga and Gauteng Provinces.

Goudie A S, and Thomas S G, (1985). Pans in southern Africa with particular reference to South Africa and Zimbabwe. *Zeitschrift fur Geomorphologie* NF 29: 1-19.

Gren I, (1995). 'The value of investing in wetlands for nitrogen abatement', *European Review of Agricultural Economics* 22: 157-172.

Hemond, H F, and Benoit, J, (1988). Cumulative impacts on water quality functions of wetlands. *Enviornmental Management* 12: 639-653.

Kotze, D.C., Marneweck G.C., Bachelor, A.L., Lyndley, D.S. & Collins, N.B. (2005). Wet-EcoServices. South African National Botanical Institute. Pretoria. South Africa.

Marneweck G C, and Batchelor A L, (2002). Wetland classification, mapping and inventory. In: PALMER R W, TURPIE J, MARNEWECK G C, and BATCHELOR A L. *Ecological and economic evaluation of wetlands in the upper Olifants River Catchment, South Africa.* WRC Report No. 1162/1/02. Water Research Commission, Pretoria.

Marneweck, G C, (2003). *Wetland baseline and impact assessment: Elders strip and underground mine.* Report for Oryx Environmental and Anglo Coal. Wetland Consulting Services, Report No 88/2002.

Marshall T R, and Harmse J T, (1992). A review of the origin and propogation of pans. *SA Geographer* 19: 9-21.

McCarntey, M P, (2000). The influence of a headwater wetland on downstream river flows in sub-Saharan Africa. In: Land-Water Linkages in Rural Watersheds Electronic Workshop. *18 September – 27 Ocober.* Food and Agriculture Organization of the United Nations, Rome, Italy.

McCartney, M P, Neal, C, and Neal, M, (1998). Use of deuterium to understand runoff generation in a headwater catchment containing a dambo. *Hydrol. Earth Syst. Sci. 5: 65-76*

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

Muscutt, A. D., Harris G L, Bailey S W, and Davies D B, (1993). Buffer zones to improve water quality: a review of their potential use in UK agriculture. *Agriculture, Ecosystems and Environment* 45: 59-77.

Palmer, R.W., Turpie, J., Marneweck, G.C. & Batchelor, A.L. (2002). Ecological and economic evaluation of wetlands in the Upper Olifants River catchment, South Africa. WRC Report no. 1162/1/02.

Postel, S. and Carpenter, S. (1997). Freshwater ecosystem services In: Daily G (Ed.) *Nature's Services: Societal Dependence on Natural Ecosystems*, Island Press: Washington DC.

Rogers F E, Rogers K H and Buzer J S. (1985). Wetlands for wastewater treatment: with special reference to municipal wastewaters. WITS University Press, Johannesburg.

Rutherford, M. C. & Westfall, R. H. (1994): *Biomes of Southern Africa: an objective categorisation.* National Botanical Institute, Pretoria.

Soil Classification Working Group (1991). Soil classification. A taxonomic system for South Africa, Mem. agric. nat. Resour. S. Afr. No. 15. Dept. Agric. Dev., Pretoria.

Strategic Environmental Focus, (2010a): Work package 2. Road Upgrade of a section of the N11 Vegetation Assessment. (Project code: 503928 and 503918)

Thompson N, Marneweck G, Bell S, Kotze D, Muller J, Cox D, and Clark R. (2002). A methodology proposed for a South African national wetland inventory. Division of Water, Environment and Forest Technology, CSIR, Pretoria

WRP, (1993). Wetland groundwater processes. WRP Technical Note HY-EV-2.2.

Internet references:

SA Explorer (2010). http://www.saexplorer.co.za/south-africa/climate/amersfoort_climate.asp (Accessed on 01/12/2010)

Appendix A

Methodology

The report incorporated a desktop study, as well as field surveys, with site visits conducted during October and November 2010. Additional data sources that were incorporated into the investigation for further reliability included:

- Google Earth images;
- 1:50 000 cadastral maps; and
- ortho-rectified aerial photographs.

Identified wetland areas were marked digitally using GIS (changes in vegetation composition within wetlands as compared to surrounding non-wetland vegetation show up as a different hue on the orthophotos, thus allowing the identification of wetland areas). These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field surveys.

The wetland delineation methodology used was the same as the one set out by the Department of Water affairs and Forestry (DWAF, 2005) document *"A Practical field procedure for the identification and delineation of wetlands and riparian areas"*.

The (DWAF, 2005) guide makes use of indirect indicators of prolonged saturation by water, namely wetland plants (hydrophytes) and (hydromorphic) soils. The presence of these two indicators is indicative of an area that has sufficient saturation to classify the area as a wetland. Hydrophytes were recorded during the site visit and hydromorphic soils in the top 0.5 m of the profile were identified by taking cored soil samples with a bucket soil auger and Dutch clay auger (photographs of the soils were taken). Each auger point was marked with a handheld Global Positioning System (GPS) device. All cored samples were analysed for signs of wetness that indicate wetland associated conditions.. Areas denuded of primary vegetation often corresponded to areas that have been tilled, making vegetation and soil profiles poor wetland indicators.

The methodology *"Wet-EcoServices"* (Kotze *et al,* 2005) was adapted and used to assess the different benefit values of the wetland units. An adapted level two assessment, including a desktop study and a field assessment were preformed to determine the wetland functional benefits between the different hydro-geomorphological types within the study area. Due to time constraints it was not possible to determine functional scores for each hydro-geomorhic unit but were calculated for typical hydro-geomorhic units found within the study area. Other documents and guidelines used are referenced accordingly. During the field survey, all possible wetlands and drainage lines identified from maps and aerial photos were visited on foot. Where feasible, cross sections were taken to determine the state and boundaries of the wetlands.

Following the field survey, the data was submitted to a GIS program for compilation of the map sets. Subsequently the field survey and desktop survey data were combined within a single project report.

Appendix D4: Aquatic Assessment Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20/2078
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Work Package 2 – N11 between Hendrina and Ermelo: Rehabilitation of National Route 11 between Ermelo and Hendrina

Specialist:	Byron Grant		
Contact person:	Byron Grant		
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E-mail:	byron@sefsa.co.za		
Professional affiliation(s) (if any)	South African Council for Natural Scientific Professions (SACNASP)		

Project Consultant:	Strategic Environmental Focus		
Contact person:	Milicent Solomons		
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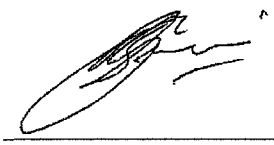
4.2 The specialist appointed in terms of the Regulations_

I, Byron Grant , declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of 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 have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form 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 the specialist:

Strategic Environmental Focus

Name of company (if applicable):

20/01/2011

Date:

PROPOSED REHABILITATION OF THE N11 BETWEEN ERMELO AND HENDRINA (WORK PACKAGE 2)

Aquatic Assessment

SEF Reference No.: 503928

Prepared for:

Eskom Primary Energy Division

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S.E.F

STRATEGIC ENVIRONMENTAL FOCUS

December 2010

Declaration of Independence

I, **BYRON GRANT**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability;
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field; and
- Undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study for which I am registered.

Byron Grant *Pr. Sci. Nat.*
Senior Natural Scientist
SACNASP Reg. No. 400275/08

Date

EXECUTIVE SUMMARY

Eskom proposes to upgrade the R38 and N11 between Ermelo and Hendrina, which starts at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo. The upgrade will provide a suitable pavement and minor widening of the road to bring it up to current national road standards. The length of the total project is 55.69 km and 6 km of single carriageway road.

Strategic Environmental Focus (Pty) Ltd, as independent environmental practitioners, was appointed by Eskom to facilitate the environmental process for the above project. As several activities associated with the proposed project are likely to require a water use licence according to Section 21 of the National Water Act, 1998 (Act No. 36 of 1998), an aquatic assessment was required.

Based on the results obtained during the assessment of watercourses associated with the proposed upgrading of the N11 between Ermelo and Hendrina, it was concluded that all perennial watercourses were in a seriously impaired state at the time of the field survey. However, this was expected based on the lack of rainfall prior to the field survey and the timing of the survey, the position of the sites within the upper reaches of their catchments and the presence of numerous wetlands feeding the watercourses which would release a steady flow of water into the watercourses, thus not facilitating the formation of complex and diverse habitat structures within the watercourses. Nevertheless, a number of taxa considered to be moderately sensitive to water quality impairment were collected, and a general observation made with regards to the ecological state of the watercourse and its location in relation to urbanised centres.

Additionally, structures were observed to have been established within the watercourse associated with Site C1UNSP-SPITS that included an upstream weir wall and downstream baffles and a gabion mattress. This mitigated the formation of possible erosion features associated with the installation of the culvert, thus preventing degradation of the aquatic ecosystem associated with the structure. It is strongly recommended that similar structures should be considered at all culverts currently installed and associated specifically with unchannelled valley bottom wetlands. While such structures should not be considered for perennial watercourses associated with the proposed project, the installation of the structures within the perennial watercourse associated with Site C1UNSP-SPITS is not regarded as a negative impact due to the presence of a dam directly below the bridge crossing that would otherwise prevent the upstream movement of fish species.

It is recommended that all borrow pits be located outside the 1-100year floodlines of any watercourse, including wetlands. These floodlines are essential for maintaining faunal movement corridors and providing a buffer against adjacent impacts. It is further recommended that once the location of satellite camps and all associated areas outside of the road reserve have been identified and confirmed, an opinion regarding the

impacts on possible associated watercourses and the development of mitigation measures to minimise the impacts is required.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

South Africa's river systems are generally in a poorer state than its terrestrial ecosystems, reflecting the fact that South Africa is a water-scarce country. Quality, quantity and sustainability of the country's water resources are fully dependant on good land management practices within catchments. The fate of our natural water resources therefore lies on the integrated approach to managing water and land in order to achieve ecological and socio-economic sustainability.

1.1 Project Description

Eskom proposes to upgrade the R38 and N11 between Ermelo and Hendrina, which starts at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo. The upgrade will provide a suitable pavement and minor widening of the road to bring it up to current national road standards. The length of the total project is 55.69 km and 6 km of single carriageway road.

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1.2 Terms of Reference

The terms of reference for the current study were as follows:

- Provide a description of the watercourse/s associated with the proposed road upgrade;
- Determine possible impacts associated with the proposed development; and
- Identify mitigation measures to limit impacts on the associated aquatic resources.

This report presents the findings obtained following an assessment of the aquatic ecosystem associated with the site of the proposed development. The field survey was conducted on the 18th of November 2010.

1.3 Assumptions and Limitations

In order to obtain a thorough understanding of the ecology of a watercourse, studies should be conducted over a number of seasons in order to determine seasonal differences and to account for factors such as fish migration. However, due to the time constraints associated with the Environmental Impact Assessment, such seasonal studies could not be conducted.

Nevertheless, results obtained during the present assessment are deemed sufficient and accurate for the purpose of the application. Furthermore, the location of satellite camps and other associated areas besides those occurring within the road reserve were not assessed due to a lack of definitive information. As a result, the impact of such areas on the associated watercourses could not be investigated. This report therefore does not take these into account, and an additional opinion is required once the location of such areas has been defined.

2. DESCRIPTION OF THE ENVIRONMENT

2.1 Location

The study area is located between the towns of Ermelo and Hendrina in the Mpumalanga Province. Specifically, the study area is associated with the N11 national road, starting at the intersection of the R38 and the R542 to the intersection of Beukes and Church Street in Hendrina and ends at the intersection of the N11 and Fourie Street (N17) in Ermelo (Figure 1).

2.2 Biophysical Description

2.2.1 Climate

The study area falls within the Highveld Ecoregion, and more specifically within the Level 2 ecoregion 11.05 and to a lesser extent in the north within Level 2 ecoregion 11.02. The ecoregions are characterised by an altitude of 1300 to 1900 meters above mean sea level, and a mean annual precipitation of 500mm to 800mm which falls predominantly within early to mid summer. Mean annual temperatures range from 12°C to 18°C, with the mean daily maximum temperatures in February ranging from 20°C to 26°C, and mean daily maximum temperatures in July ranging from 12°C to 20°C (Kleynhans *et al*, 2007).

2.2.2 Regional Vegetation

According to Mucina and Rutherford (2006), the vegetation unit associated with the proposed road upgrade is Eastern Highveld Grassland.

2.2.3 Associated Water Courses

The study area falls within two water management areas, namely the Upper Vaal Water Management Area (WMA) and the Olifants Water Management Area.

The Upper Vaal Water Management Area lies in the eastern interior of South Africa, and is considered to be a pivotal water management area in the country. According to the Department of Water Affairs and Forestry (2004), the sub-management area in which the present study area is located is the Upstream Vaal Dam Sub-management Area. More specifically, the portion of the proposed project that corresponds with the Upper Vaal Water Management Area falls within Quaternary Catchment C11F.

The Olifants Water Management Area corresponds with the South African portion of the Olifants River Catchment (excluding the Letaba River catchment). Diverse economic activities are associated with the Olifants Water Management Area, and

range from mining and metallurgic industries to irrigation, dry land and subsistence agriculture, and ecotourism. According to the Department of Water Affairs and Forestry (2004), the sub-management area in which the present study area is located is the Upper Olifants sub-management area. More specifically, the portion of the proposed project that corresponds with the Olifants Water Management Area falls within Quaternary Catchment B12A.

A total of three perennial water courses are associated with the proposed project, namely the Klein Olifants River (located within the Olifants Water Management Area), and the Klein Xspruit and an additional unnamed watercourse (located in the Upper Vaal Water Management Area). According to Nel *et al.* (2004), the heterogeneity signature of the perennial watercourses associated with the proposed road upgrade are Highveld 2 and Highveld 3, with the conservation status of the signature regarded as being Critically Endangered due to the fact that the river heterogeneity signature has an intact length of less than their conservation target of 10% of total length. In addition, the proposed project is bisected by numerous wetlands identified to comprise mainly of unchannelled valley bottom wetlands and seepages.

2.3 Selection of Sampling Sites

For the purpose of the present study, sampling sites were selected on the basis of stream type (perennial watercourse vs. wetland).

Co-ordinates of the selected sampling sites were determined using a Garmin global positioning device (GPS) and are listed in Table 1, and presented graphically in Figure 1. Photographs of the selected sampling sites are provided in Appendix 2. Site names follow Dallas (2005). Additional properties associated with the surveyed watercourses within the study area are presented in Table 2.

Table 1: Description of sampling site

Site Name	Co-ordinates	Altitude	Description
C1UNSP-ERMEL	S 26° 30' 39.2" E 29° 58' 57.5"	1714m	Site located within a channeled valley-bottom wetland within the town of Ermelo
C1UNSP-SPITS	S 26° 27' 54.8" E 29° 57' 15.1"	1715m	Site located on an unnamed perennial watercourse on the farm Spitskop 276IS downstream of the Ermelo Golf Course
C1KXSP-KAFFE	S 26° 24'50.7" E 29° 55' 58.1"	1699m	Site is located on the Klein Xspruit on the farm Kafferspruit 275IS
B1KOLI-TWEEF	S 26° 13' 06.4" E 29° 46' 07.7"	1665m	Site is located on the Klein Olifants River on the farm Tweefontein 203IS

Table 2: Properties of the surveyed watercourses associated with Work Package 2

Site Name	C1UNSP-ERMEL	C1UNSP-SPITS	C1KXSP-KAFFE	B1KOLI-TWEEF
Map Reference	2629DB	2629BD	2629BD	2629BB
Political Region	Mpumalanga	Mpumalanga	Mpumalanga	Mpumalanga
Vegetation Type	Eastern Highveld Grassland	Eastern Highveld Grassland	Eastern Highveld Grassland	Eastern Highveld Grassland
Water Management Area	8. Upper Vaal	8. Upper Vaal	8. Upper Vaal	4. Olifants
Level 1 Ecoregion	11. Highveld	11. Highveld	11. Highveld	11. Highveld
Level 2 Ecoregion	11.05	11.05	11.05	11.02
Geomorphic Province	Northwestern Highveld	Northwestern Highveld	Northwestern Highveld	Northeastern Highveld
Secondary Catchment	C1	C1	C1	B1
Quaternary Catchment	C11F	C11F	C11F	B12A
Slope Class	n/a	Not specified	Lower Foothills	Lower Foothills
Watercourse	Channelled Valley Bottom Wetland within Ermelo	Unnamed Watercourse at Ermelo Golf Couse	Klein Xspruit	Klein Olifants
Stream Type	Wetland	Perennial	Perennial	Perennial
River Heterogeneity Signature	n/a	n/a	Highveld 3	Highveld 2
Conservation Status	n/a	n/a	Critically Endangered	Critically Endangered
Freshwater Ecoregion	Southern Temperate Highveld	Southern Temperate Highveld	Southern Temperate Highveld	Southern Temperate Highveld
National Freshwater Ecosystem Priority Areas Category	Upstream Management Catchment	Upstream Management Catchment	Upstream Management Catchment	Negative
Fish Priority Area	Negative	Negative	Negative	Negative
MBCP Aquatic Biodiversity	Ecosystem Maintenance	Ecosystem Maintenance	Ecosystem Maintenance	Ecosystem Maintenance

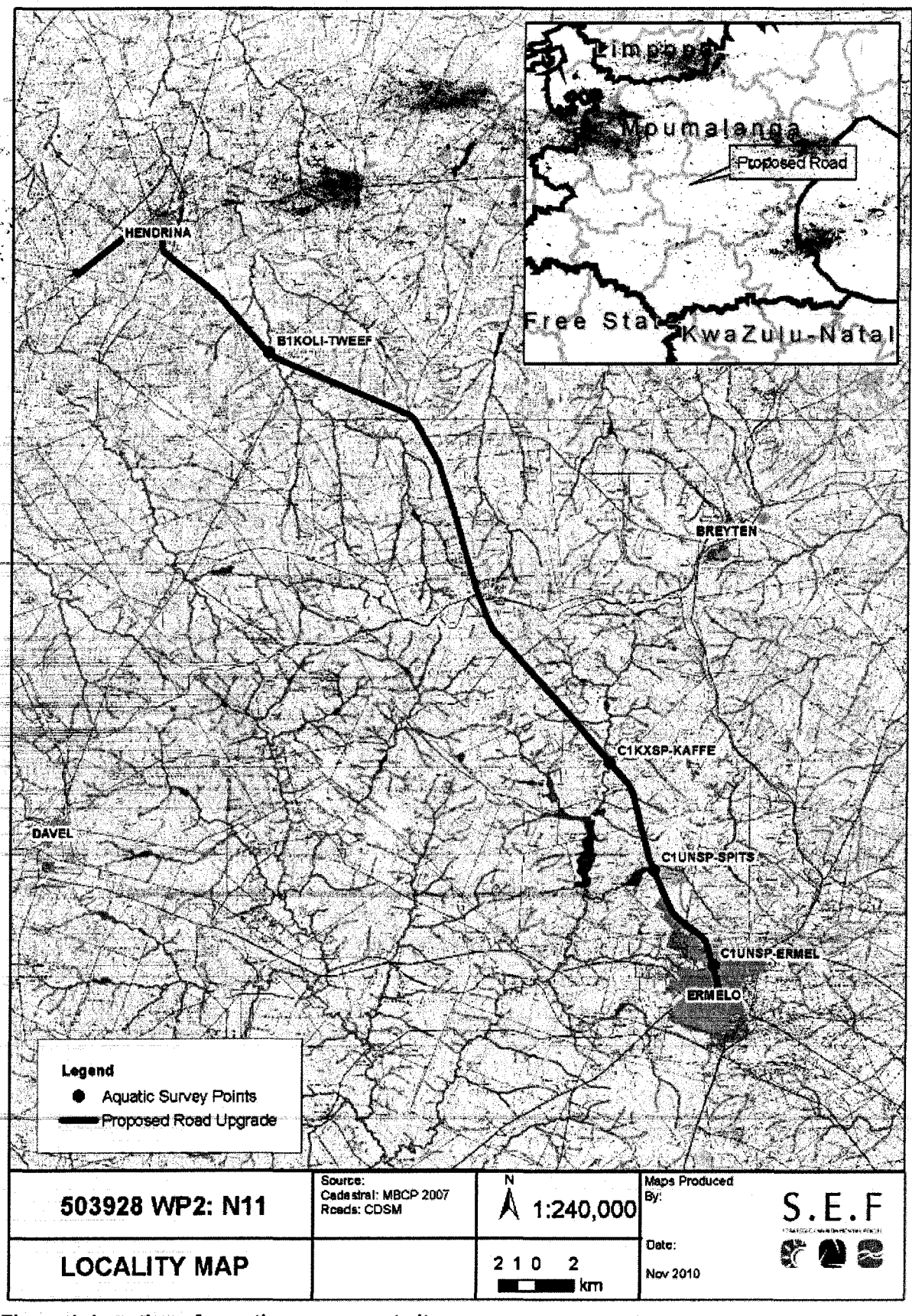

Figure 1: Location of aquatic assessment sites

3. RESULTS

3.1 Surrounding Land Use

Much of the surrounding land use within the study area was determined to consist of open fields, with the exception of areas closer to the urbanised Ermelo and Hendrina. In contrast to the adjacent Witbank Dam catchment, little maize agriculture as well as mining operations were determined to be present during the current assessment.

3.2 Aquatic Habitat

Habitat index scores determined according to the Invertebrate Habitat Assessment System (IHAS; MacMillan, 1998) during the current assessment indicated habitat diversity within the study area to be generally poor (Table 3). This is likely the result of the sites' positions in the catchment, and the fact that many can be regarded as being channelled valley-bottom wetlands which inherently have a poor expression of aquatic habitat types. Another factor that was likely to contribute to the poor habitat scores obtained, particularly sites C1KXSP-KAFFE and B1KOLI-TWEEF was the fact that while pools were present, very little flow was observed within the channels.

Table 3: IHAS values obtained during the present assessment

	IHAS Value	Description
C1UNSP-ERMEL	32	Poor
C1UNSP-SPITS	32	Poor
C1KXSP-KAFFE	41	Poor
B1KOLI-TWEEF	53	Poor

The Invertebrate Habitat Assessment System (IHAS, Version 2.2), developed by McMillan (1998), has routinely been used in conjunction with the South African Scoring System (SASS) as a measure for the variability in the amount and quantity of aquatic macroinvertebrate biotopes available for sampling. However, according to a recent study conducted within the Mpumalanga and Western Cape regions, the IHAS method does not produce reliable scores with regard to the suitability of habitat at sampling sites for aquatic macroinvertebrates (Ollis *et al*, 2006). Furthermore, the performance of the IHAS seems to vary between geomorphologic zones and between biotope groups (Ollis *et al*, 2006). More testing of the IHAS method is required before any final conclusion can be made regarding the accuracy of the index. Interpretation of the IHAS index should therefore be conducted with caution. Nevertheless, the IHAS still serves as a basis from which to compare sites on a temporal scale and assess changes in the availability of aquatic biotopes present at a particular site.

3.3 Aquatic Biota

3.3.1 Aquatic Macroinvertebrates

A total of 30 aquatic macroinvertebrate taxa were collected during the current assessment, ranging from 12 taxa to 17 taxa per site (Table 4). SASS5 (South African Scoring System version 5) values obtained for the surveyed sites ranged from 52 at Site C1UNSP-ERMEL to 86 at Site C1KXSP-KAFFE, resulting in the Average Score Per Taxon (ASPT) values ranging from 4.33 to 5.06 (Table 4). In the process, a number of aquatic macroinvertebrate taxa regarded as being moderately sensitive were sampled, and included Atyidae (Freshwater Shrimps), Hydracarina (Water Mites), Lestidae (Emerald Damselflies), Aeshnidae (Emperor and Hawker Dragonflies), Naucoridae (Creeping Water Bugs) and Dixidae (Meniscus Midge).

Table 4: Aquatic macroinvertebrate data obtained during the present assessment

	SASS5 Score	No. of Taxa	ASPT*
C1UNSP-ERMEL	52	12	4.33
C1UNSP-SPITS	62	14	4.43
C1KXSP-KAFFE	86	17	5.06
B1KOLI-TWEEF	66	14	4.71

*Average Score Per Taxon

3.3.1.a Present Ecological State

The primary index used in the determination of Present Ecological State for the present assessment was the newly developed Marcoinvertebrate Response Assessment Index (MIRAI; Thirion, 2008). Chutter (1998) developed the SASS protocol as an indicator of water quality. It has since become clear that SASS gives an indication of more than mere water quality, but rather a general indication of the present state of the invertebrate community. Because SASS was developed for application in the broad synoptic assessment required for the River Health Programme, it does not have a particularly strong cause-effect basis. The aim of the MIRAI, on the other hand, is to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community (assemblage) from the reference condition (Thirion, 2008). This does not preclude the calculation of SASS scores should they be required. However, the recent tendency is to use the MIRAI even for River Health Programme purposes, and it is now the preferred approach (Thirion, 2008).

Following the application of the MIRAI at each site surveyed, it was concluded that all sites can be regarded as seriously impaired (Table 5). However, the causal factors of the ecological state differed between sites, with the primary driver of sites C1UNSP-ERMEL and C1UNSP-SPITS determined to be water quality impairment, and the primary driver of sites C1KXSP-KAFFE and B1KOLI-TWEEF determined to be lack of flow. A general observation was made that the closer the watercourse to an urban center, the poorer the scores obtained for aquatic macroinvertebrates.

Table 5: MIRAI values and Present Ecological State (PES) Classes obtained during the present assessment

	MIRAI %	PES Class
C1UNSP-ERMEL	27.57	E
C1UNSP-SPITS	32.29	E
C1KXSP-KAFFE	37.50	E
B1KOLI-TWEEF	32.03	E

3.3.2 Ichthyofauna

According to Kleynhans *et al.* (2008) and professional judgement, a total of nine fish species are likely to be associated with the surveyed watercourses (Table 6). Of these, three species are regarded as alien and do not naturally occur within South Africa. None of the species likely to occur are considered to be of conservation importance, and all are considered to be commonly occurring species. It should be noted that while several key migratory species such as *Labeo capensis* (Orange River Labeo), *Labeobarbus aeneus* (Vaal Orange Smallmouth Yellowfish) and *Labeobarbus polylepis* (Bushveld Smallscale Yellowfish) are likely to occur according to Kleynhans *et al.* (2008), the size of the watercourses and their position in their respective catchments was not considered to be suitable to support populations of these species.

Table 6: Fish species likely to be associated with surveyed watercourses

Scientific Name	Common Name
Barbus anoplus	Chubbyhead Barb
Barbus neefi	Sidespot Barb
Barbus paludinosus	Straightfin Barb
Clarias gariepinus	Sharptooth Catfish
Pseudocrenilabrus philander	Southern Mouthbrooder
Tilapia sparrmanii	Banded Tilapia
*Cyprinus carpio**	Carp
*Gambusia affinis**	Mosquitofish
*Micropterus salmoides**	Largemouth Bass

* alien species

During the current field survey, only two fish species were collected within the Klein Olifants River associated with the area, namely *Barbus anoplus* (Chubbyhead Barb) and *Barbus neefi* (Sidespot Barb).

Barbus anoplus (Chubbyhead Barb; Figure 2) prefers cool waters, occurring in a wide variety of habitats from small streams to large rivers and lakes (Skelton, 2001). This fish species breeds during summer when rivers are swollen after rain. *Barbus anoplus* reaches sexual maturity in one year, and feeds on insects, zooplankton,