PROPOSED REHABILITATION OF THE KALKSPRUIT BRIDGE, EMALAHLENI LOCAL MUNICIPALITY, MPUMALANGA PROVINCE

DEDET Reference No: 17/2/3/N-190

DRAFT BASIC ASSESSMENT REPORT

PREPARED BY:

NEMAI CONSULTING

MAY 2013

ENVIRONMENTAL AND SOCIAL CONSULTANTS

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TITLE & APPROVAL PAGE

Project name:	***Proposed Rehabilitation of the Kalkspruit Bridge, Emalahleni Local Municipality, Mpumalanga Province***
Report Title:	***Draft Basic Assessment Report - Proposed Rehabilitation of the Kalkspruit Bridge, Emalahleni Local Municipality, Mpumalanga Province***
Authors:	***M. Chetty***
Status of report:	***Draft***
Date of issue:	***May 2013***
Department of Environmental Affairs project reference number:	***Ref: 17/2/3N-190***

Prepared by Nemai Consulting
for the Nkangala District Municipality.

Consultants: Nemai Consulting
Approved for Consultants by:

M. Chetty

V. Brueton

Approved for the Nkangala District Municipality by:

the dedet

Department:
Economic Development, Environment and Tourism
MPUMALANGA PROVINCIAL GOVERNMENT

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.

(For applicant / EAP to complete)

File Reference Number:	
Project Title:	
Name of Responsible Official:	

(For official use only)

NEAS Reference Number:	
Date Received:	

Kindly note that:

1. Required information 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. Tables can be extended as each space is filled with typing.

2. Where applicable **black out** the boxes that are not applicable in the form.

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

4. 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.

5. All reports (draft and final) must be submitted to the Department at the address of the relevant **DISTRICT OFFICE** given below or by delivery thereof to the relevant **DISTRICT OFFICE**. Should the reports not be submitted at the relevant district office, they will not be considered.

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

7. One copy of the draft version of this report must be submitted to the relevant district office. The case officer may request more than one copy in certain circumstances.

8. **Copies of the draft report must be submitted to the relevant State Departments / Organs of State for comment.** In order to give effect to Regulation 56(7), proof of submission/delivery of the draft documents to the State Departments / Organs of State must be attached to the draft version of this report.

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.

9. All specialist reports must be appended to this document, and all specialists must complete a declaration of independence, which is obtainable from the Department.

DEPARTMENTAL DETAILS

HEAD OFFICE (18 Jones Street, Nelpruit)	EHLANZENI DISTRICT (50 Murray Street, Nelspruit)	NKANGALA DISTRICT (Pavilion Centre, Cnr Botha & Northey Streets, Witbank)	GERT SIBANDE DISTRICT (13 De Jager Street, Ermelo)
Attention: Directorate: Environmental Impact Management Private Bag X 11215 Nelspruit, 1200 Queries should be directed to the Directorate: Environmental Impact Management at: Tel: (013) 759 4000 Fax (013) 759 4165	Attention: Directorate: Environmental Impact Management Private Bag X 11215 Nelspruit, 1200 Queries should be directed to the Directorate: Environmental Impact Management at: Tel: 0824068831 Fax: Email: nvmdhluli@mpg.gov.za	Attention: Directorate: Environmental Impact Management P. O. Box 7255 Witbank, 1035 Queries should be directed to the Directorate: Environmental Impact Management at: Tel: 0136902595/6901358/0766441707 Fax: Email:dtswai@wit.mpu.gov.za	Attention: Directorate: Environmental Impact Management P. O. Box 2777 Ermelo, 2351 Queries should be directed to the Directorate: Environmental Impact Management at: Tel: 0178192828/9 0178114815 0798419582 Fax: E mail:stmarabane@mpg.gov.za

Applications to be sent direct to district office

SECTION A: BACKGROUND INFORMATION

Project applicant:	Nkangala District Municipality		
Trading name (if any):	Not Applicable		
Contact person:	Lucky Msoki		
Physical address:	2A Church Street Middleburg 1050		
Postal address:	PO Box 437 Middelburg		
Postal code:	1050	**Cell:**	078 728 3115
Telephone:	013 249 2029	**Fax:**	086 216 6781
E-mail:	N/A		

Environmental Assessment Practitioner:	Nemai Consulting		
Contact person:	Manogrie Chetty		
Postal address:	PO Box 1673 Sunninghill		
Postal code:	2157	**Cell:**	084 401 1512
Telephone:	031 266 3884	**Fax:**	031 266 5287
E-mail:	manogriec@nemai.co.za		
Qualifications:	BSc Hons Biological Sciences		
Professional affiliations (if any):	N/A		

SECTION B: DETAILED DESCRIPTION OF THE PROPOSED ACTIVITY

Describe the activity, which is being applied for, in detail. The description must include the size of the proposed activity (or in the case of linear activities, the length) and the size of the area that will be transformed by the activity.

The Ngangala District Municipality together with the Emalahleni Local Municipality are proposing to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank, Mpumalanga Province. The rehabilitation of the Kalkspruit Bridge forms part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilization as well as the demolition and re-construction of the aforementioned bridge.

Plates 1 and 2 below indicate the existing status of the Kalkspruit Bridge.

Figure 1: Existing undermined bridge structure

Figure 2: Excessive illegal dumping at Kalkspruit Bridge

The demolition and reconstruction of the Kalkspruit Bridge project and associated activities will entail the following activities:

- Removal of accumulated silt and sediment built up at the Kalkspruit Bridge;
- Removal of vegetation growing in the stream due to siltation;
- Installation of±200m of gabions and reno mattresses for erosion protection along the embankments;
- Demolition and Re-construction of the Bridge on the Kalkspruit; and
- Guard Railing and Balustrade protection.

The length of the bridge will be approximately 20m and the width of the bridge will be approximately 7.2m (this includes 5m road plus 1.1m sidewalks on either side of the road).

Construction will comprise of a cast-insitu reinforced concrete base, reinforced concrete walls, reinforced concrete roof slab and parapet walls. Abutment walls upstream and downstream of the culvert barrel will also be reinforced concrete construction. Gravel fill material will be placed on top of the roof slab to construct the road surface and to ensure a smooth vertical alignment for road users.

Approximately 30m of road will be constructed on either approach side of the bridge to tie in. This road will be raised slightly, since the culverts will be higher than the ones currently in place. The road will be 5m wide, with sidewalks of 1.1m on either side. The road layers will be constituted as follows: (from the bottom up)150mm compacted insitu material (G7), 150mm subbase (G5), 150mm base course material (G2), 30mm asphalt layer.

The bridge has been deemed as being structurally unstable and undermined and therefore the upgrade of the bridge is also driven by the current safety risk that the bridge poses. The upgrade of the Kalkspruit Bridge will ultimately result in preserving the integrity of the structure and will ensure a safe means of crossing the stream for vehicles and pedestrians.
The bridge will service local communities facilitating safer and easier vehicular and pedestrian movement.

The proposed development will restore access into and out of the area and will improve service delivery to the area.

There are no alternate sites as the proposed development comprises of the construction of a bridge to replace the existing damaged structure. The rehabilitation of the Kalkspruit Bridge forms part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilization as well as the demolition and re-construction of the aforementioned bridge.

Various design alternatives have been considered for the proposed bridge and these alternatives are presented in this Basic Assessment Report.

OPTION 1: CONSTRUCTION OF A BOX CULVERT

Box culverts will be used for this option, a slab will then be cast over the culvert structure.

OPTION 2: CAST IN-INSITU BRIDGE
For this alternative, the bridge piers will be cast down to the bedrock, the bridge deck will then be cast over the piers.

'NO GO' ALTERNATIVE
The 'No Go' alternative means that the proposed development will not take place and the area will retain its status quo. This means that the bridge will not be constructed and the vehicular and pedestrian access will not be improved. Local communities will continue, pedestrians and vehicles would continue to be at risk while trying to traverse the stream and potential injury and drowning incidents may occur. The existing structure will continue to deteriorate posing a danger to humans and the environment.

SECTION C: PROPERTY/SITE DESCRIPTION

Provide a full description of the preferred site alternative (farm name and number, portion number, registration division, erf number etc.):

The bridge structure and therefore development footprint falls within the confines of the existing road reserve, as the bridge is an extension of a road providing access across the river.

Indicate the position of the activity using the latitude and longitude of the centre point of the preferred site alternative. 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. The position of alternative sites must be indicated in Section B of this document.

Latitude (S):		Longitude (E):	
25°	52'29.87"	29°	11'19.15"

In the case of linear activities:

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

Latitude (S):		Longitude (E):	
°	'	°	'
°	'	°	'
°	'	°	'

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 an appendix to this document.

The site or route plans must be at least A3 and must include the following:

6.1 a reference no / layout plan no., date, and a legend / land use table
6.2 the scale of the plan which must be at least a scale of 1:2000;
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;
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 indigenous trees taller than 1.8 metres and all vegetation of conservation concern (protected, endemic and/or red data species);
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):
- watercourses and wetlands;
- the 1:100 year flood line;
- ridges;
- cultural and historical features;

6.9 10 metre contour intervals

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 as an appendix to this form**.**

FACILITY ILLUSTRATION
A detailed illustration of the activity must be provided at a scale of 1:200 as an appendix 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.

SECTION D: BASIC ASSESSMENT REPORT

Prepare a basic assessment report that complies with Regulation 22 of the Environmental Impact Assessment Regulations, 2010. The basic assessment report must be attached to this form and must contain all the information that is necessary for the competent authority to consider the application and to reach a decision contemplated in Regulation 25, and must include:

		(Checklist for official use only)
1.	A description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.	
2.	An identification of all legislation and guidelines that have been considered in the preparation of the basic assessment report.	
3.	Details of the public participation process conducted in terms of Regulation 21(2)(a) in connection with the application, including – (i) the steps that were taken to notify potentially interested and affected parties of the proposed application; (ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given; (iii) a list of all persons, organisations and organs of state that were registered in terms of regulation **55** as interested and affected parties in relation to the application; and (iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues;	
4.	A description of the need and desirability of the proposed activity;	
5.	A description of any identified alternatives to the proposed activity that are feasible and reasonable, including the advantages and disadvantages that the proposed activity or alternatives will have on the environment and on the community that may be affected by the activity;	
6.	A description and assessment of the significance of any environmental impacts, including— (i) cumulative impacts, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the activity; (ii) the nature of the impact; (iii) the extent and duration of the impact; (iv) the probability of the impact occurring; (v) the degree to which the impact can be reversed; (vi) the degree to which the impact may cause irreplaceable loss of resources; and (vii) the degree to which the impact can be mitigated;	
7.	Any environmental management and mitigation measures proposed by the EAP;	
8.	Any inputs and recommendations made by specialists to the extent that may be necessary;	
9.	A draft environmental management programme containing the aspects contemplated in regulation **33**;	
10.	A description of any assumptions, uncertainties and gaps in knowledge;	
11.	A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation	
12.	Any representations, and comments received in connection with the application or the basic assessment report;	
13.	The minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants;	
14.	Any responses by the EAP to those representations, comments and views;	
15.	Any specific information required by the competent authority; and	
16.	Any other matters required in terms of sections 24(4)(a) and (b) of the Act.	

The basic assessment report must take into account -

(a) any relevant guidelines; and

(b) any departmental policies, environmental management instruments and other decision making instruments that have been developed or adopted by the competent authority in respect of the kind of activity which is the subject of the application.

* In terms of Regulation 22(4), the EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in subregulation 22(2)(h), exist.

Have reasonable and feasible alternatives been identified, described and assessed?	YES	NO

If NO, the motivation and investigation required in terms of Regulation 22(4) must be attached as an Appendix to this document		

SECTION E: CONSULTATION WITH OTHER STATE DEPARTMENTS

Provide a list of all State Departments / Organs of State that have been consulted and registered as interested and affected parties, and to whom draft reports have been submitted for comment. **Proof of submission / delivery of the draft report to all State Department / Organs of State must be attached to this document.**

Department:	Department of Agriculture, Forestry and Fisheries		
Contact person:	Ms. Nelisiwe Sithole		
Postal address:	Private Bag X11219, Nelspruit 1		
Postal code:	1200	**Cell:**	N/A
Telephone:	013 766 6020	**Fax:**	013 766 8429
E-mail:	okmosome@mpg.gov.za		

Department:	Department of Public Works		
Contact person:	Mr. Matthew Mohlasedei		
Postal address:	Private Bag X 11310 Nelspruit		
Postal code:	1200	**Cell:**	N/A
Telephone:	013 766 6554	**Fax:**	013 766 8449
E-mail:	kmohlasedei@mpg.gov.za		

Department:	Department of Water Affairs		
Contact person:	Valerie Du Plessis		
Postal address:	Private Bag X447, Pretoria,		
Postal code:	0001	**Cell:**	082 809 2155
Telephone:	012 336 7500	**Fax:**	012 336 6608
E-mail:	duplessisv@dea.gov.za		

Department:	Mpumalanga Department of Minerals and Energy		
Contact person:	Martha Mokonyane		
Postal address:	Private Bag X7279, EMALAHLENI,		
Postal code:	1035	**Cell:**	082 447 2400
Telephone:	013 653 0500	**Fax:**	013 656 3288
E-mail:	martha.mokonyane@dmr.gov.za		

Department:	Mpumalanga Department of Water Affairs		
Contact person:	Mr F Guma		
Postal address:	Private Bag X11259, Nelspruit,		
Postal code:	1200	**Cell:**	N/A
Telephone:	013 759 7310	**Fax:**	013 759 7525
E-mail:	gumaF@dwa.gov.za		

Department:	Nkangala District Municipality		
Contact person:	E.K. Tshabalala		
Postal address:	P. O Box 437 Middelburg		
Postal code:	1050	**Cell:**	N/A
Telephone:	013 249 2006	**Fax:**	N/A
E-mail:	nkosinm@nkangaladm.org.za		

Department:	South African Heritage Resources Agency (SAHRA)		
Contact person:	Phillip Hine		
Postal address:	P.O. Box 4637, CAPE TOWN,		
Postal code:	8000	**Cell:**	083 289 6888
Telephone:	021 462 4502	**Fax:**	021 462 4509
E-mail:	phine@sahra.org.za		

Department:	South African National Biodiversity Institute (SANBI)		
Contact person:	Andre Beetge		
Postal address:	P.O Box 722, Cranspoort,		
Postal code:	1080	**Cell:**	084 240 22 64
Telephone:		**Fax:**	086 544 5953
E-mail:	a.beetge@sanbi.org.za		

Department:	WESSA- Northern Regions		
Contact person:	Lemson Betha		
Postal address:	P.O. box 435 Ferndale,		
Postal code:	2160	**Cell:**	N/A
Telephone:	011 462 5663	**Fax:**	N/A
E-mail:	lbetha@wessanorth.co.za		

Department:	Cogta		
Contact person:	Erica van Jaarsveld		
Postal address:	Building 4, no 7 Government Bolevard, Riverside park extension 2, Nelspruit.		
Postal code:	1200	**Cell:**	N/A
Telephone:	084 799 5921	**Fax:**	N/A
E-mail:	Erica@mpg.gov.za		

Department:	Department of Culture, Sports and Recreation (DCSR)		
Contact person:	V Gana		
Postal address:	P/Bag x 11316, Nelspruit		
Postal code:	1200	**Cell:**	072 296 3984
Telephone:	013 766 8018	**Fax:**	013 766 55 75
E-mail:	vgana@mpg.gov.za		

Department:	Emalahleni Local Municipality		
Contact person:	Priscilla Senyane		
Postal address:			
Postal code:		**Cell:**	083 320 7429
Telephone:	013 653 5626	**Fax:**	
E-mail:	health2@webmail.co.za		

Department:	Mpumalanga Economic Growth Agency (MEGA)		
Contact person:	Thobile Motha		
Postal address:	'29 Cnr lukin and botha street, witbank,		
Postal code:	1035	**Cell:**	N/A
Telephone:	013 656 3231	**Fax:**	013 656 32 31
E-mail:	Thobile.motha@mega.gov.za		

Department:	Mpumalanga Tourism and Parks Agency (MPTA)		
Contact person:	Frans Krige		
Postal address:	P.O Box 1250, Groblersdal		
Postal code:	0470	**Cell:**	084 232 2902
Telephone:	013 254 0279	**Fax:**	N/A
E-mail:	franskrige@telkomsa.net/ frans@mpta.co.za		

Department:	Department of Agriculture - Provincial		
Contact person:	Jan venter		
Postal address:	N/A		
Postal code:	N/A	**Cell:**	0826537611
Telephone:	N/A	**Fax:**	N/A
E-mail:	jv16@telkomsa.net		

SECTION E: APPENDICES

The following appendices must be attached to the basic assessment report as appropriate:

Site plan(s)

Photographs

Facility illustration(s)

Specialist reports

Comments and responses report

Other information

Contents

Figures

Tables

Appendices

EXECUTIVE SUMMARY

Introduction

The Nkangala District Municipality together with the Emalahleni Local Municipality proposes to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank. The rehabilitation of this bridge form part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilisation as well as the demolition and re-construction of the aforementioned bridge.

The Kalkspruit bridge has been deemed as being structurally unstable and undermined and therefore the upgrade of the bridge is also driven by the current safety risk that the bridge poses. The upgrade of the Kalkspruit Bridge will ultimately result in preserving the integrity of the structure and will ensure a safe means of crossing the stream for vehicles and pedestrians.

Nemai Consulting has been appointed by HMP Africa Consultants on behalf of the Emalahleni Local Municipality to undertake the requisite Environmental Authorisation Process for the rehabilitation of the Kalkspruit Bridge. The proposed development triggers activities listed in Government Notices No. R 544 and hence requires a basic assessment study as per the August 2010 Environmental Impact Assessment (EIA) Regulations promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

Project Description

The Ngangala District Municipality together with the Emalahleni Local Municipality is proposing to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank (Figure 1).

The demolition and reconstruction of the Kalkspruit Bridge project and associated activities will include the following:

- Removal of accumulated silt and sediment built up at the bridge;
- Lining the embankment with gabions and reno mattresses; and
- Guard Railing and Balustrade protection.

The rehabilitation will also include Amorflex lining as indicated in the figure 2. ArmorFlex is a flexible, interlocking matrix of cellular concrete blocks of uniform size, shape, and weight used for hard armor erosion control. The lining allows full vegetation for the entire system to meet regulation demands and provide an aesthetic solution.[1]

[1] http://www.conteches.com/Products/Erosion-Control/Hard-Armor/ArmorFlex.aspx

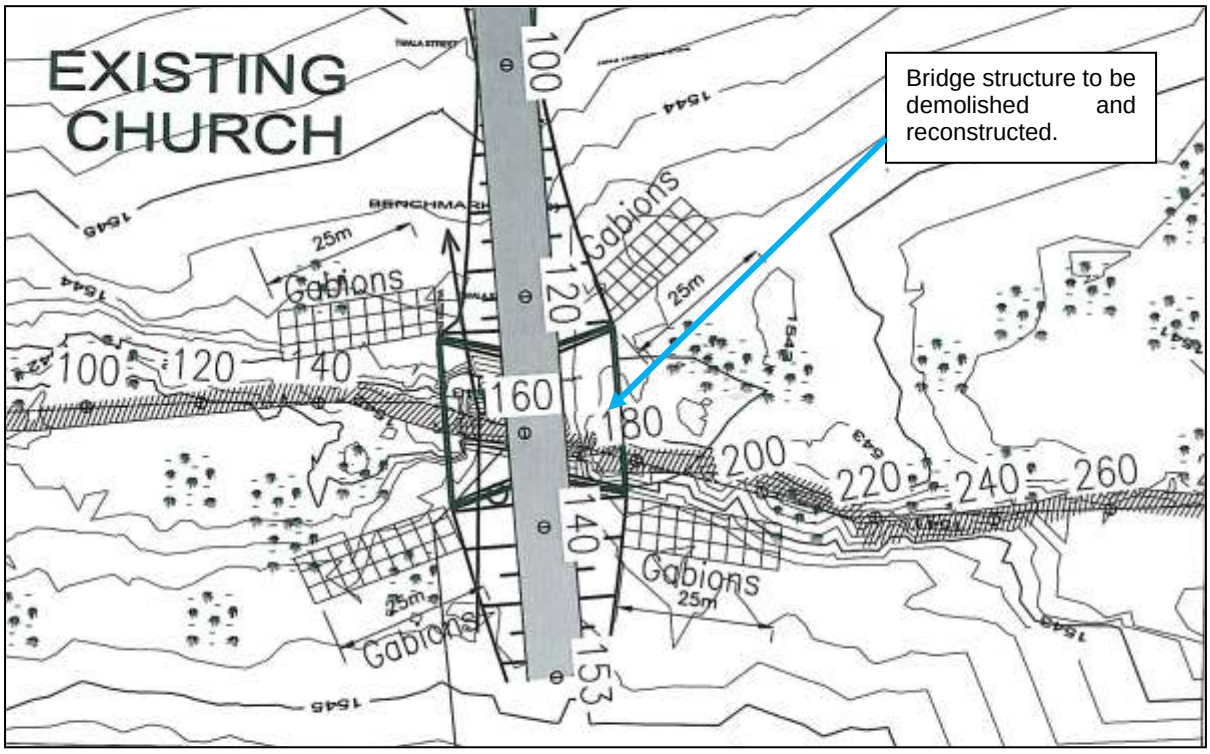


Figure 1: Design map illustrating the bridge and gabion structures

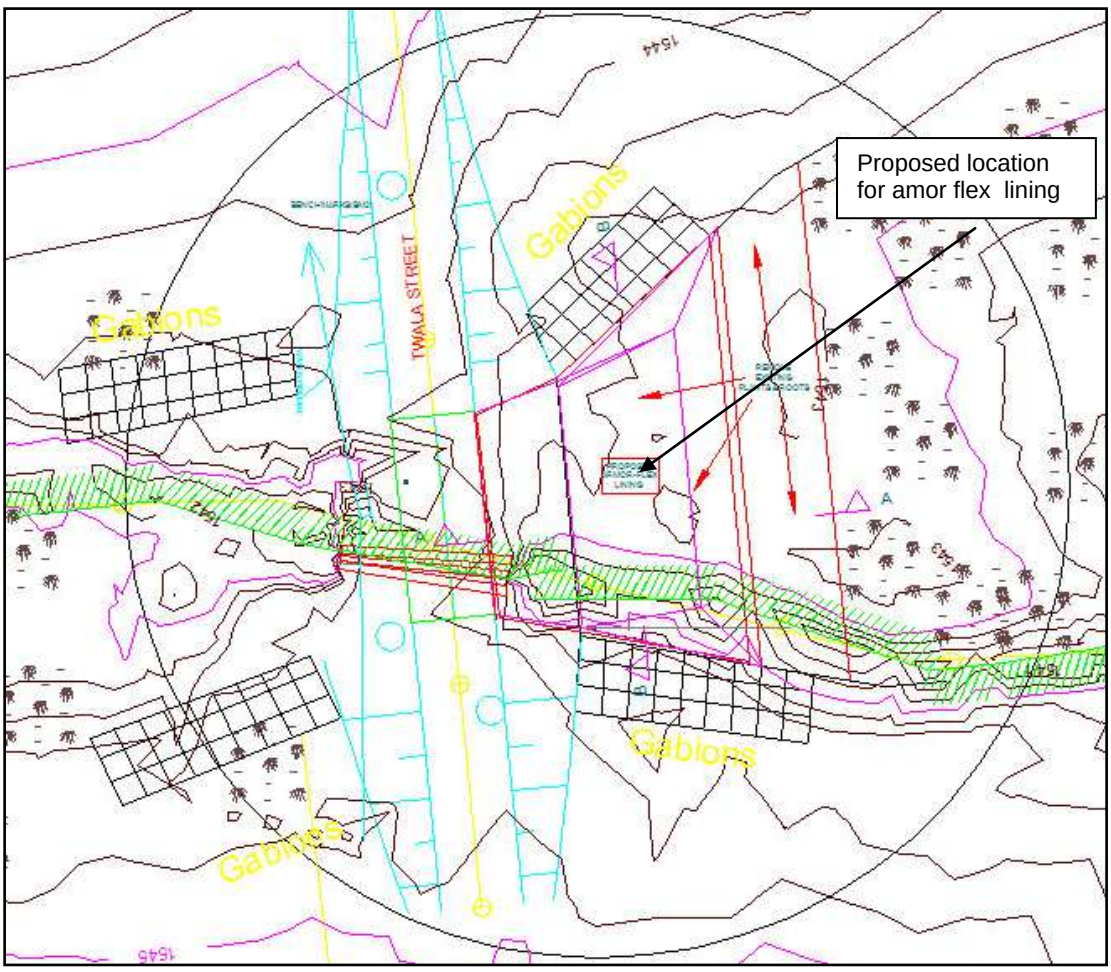


Figure 2: Design map illustrating the bridge and gabion structures as well as location of amor flex lining

Legislation

The process for seeking authorisation is undertaken in accordance with the Environmental Impact Assessment (EIA) Regulations (GNR 543 and 544of 18 June 2010), promulgated in terms of Chapter 5 of NEMA. The EIA decision-making authority is the Mpumalanga Department of Economic Development, Environment and Tourism (DEDET). Other authorities such as Department of Water Affairs and Local Government will comment on this document in an advisory capacity. The environmental assessment for proposed project will be conducted as a Basic Assessment (BA) process.

The key objectives of this BA process include the following:

- Carry out relevant specialist studies;
- Conduct public participation;
- Assess receiving environment;
- Undertake quantitative assessment of significant environmental impacts and identify concomitant mitigation measures;
- Evaluate alternatives through a comparative analysis; and
- Compile EIA Report in accordance with the requirements stipulated in GN No. R543 of 18 June 2010 regulation 32(2). Refer to **Chapter 1** for the document's composition, in terms of the regulatory requirements.

The main purpose of the report is the following:

- To describe the need for the project;
- To explain the environmental legal framework governing the project;
- To explain the Environmental Impact Assessment (EIA) – Basic Assessment Process;
- To present the assumptions and limitations associated with the EIA;
- To describe how the proposed project will be executed during the project life-cycle;
- To provide a description of the receiving environment that could be affected by the proposed project;
- To provide a summary of the specialist studies conducted as part of the EIA;
- To assess the significant impacts associated with the project;
- To conduct a comparative analysis of the proposed;
- To describe the public participation process that was undertaken to date, as part of the EIA phase; and
- To draw conclusions regarding the EIA – BA Process and to make recommendations for decision-making.

In addition, the draft Basic Assessment report provides an opportunity for I&APs to review and comment on the findings of the Specialist Studies undertaken. These comments will be taken into account in the final BAR which will be submitted to DEDET.

Alternatives

A site alternative has not been considered as the existing bridge structure needs to be upgraded. Two design alternative options are therefore considered as part of this application:

Alternative 1: This alternative will involve the upgrading of the bridge and culvert structures. A box culvert design will be used for this alternative (see figure below):

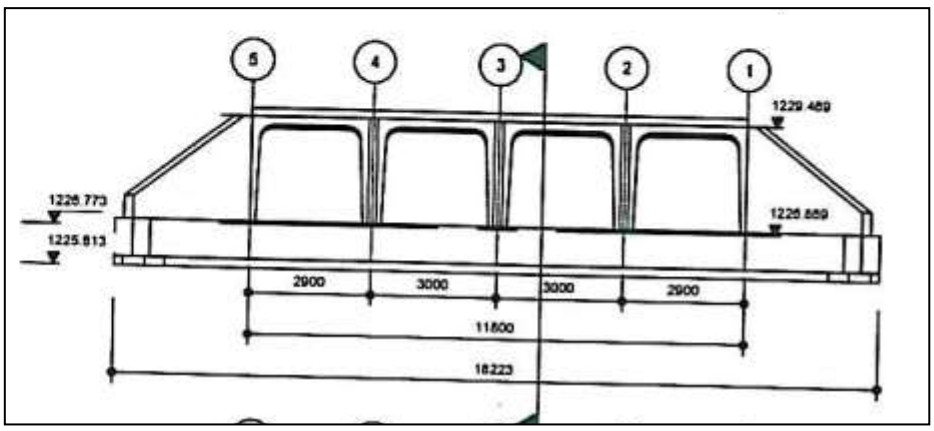


Figure 3: Design of the box culvert alternative

The structure will consist of 4 box culverts, the wing walls and other associated structures. Lining the embankment with gabions and reno mattresses and guard railing and balustrade protection will also be implemented. All accumulated silt and sediment will also be removed to allow for the watercourse to flow freely. The box culvert design is preferable as this design can cope with large flow situation where headroom is limited because the height of box culverts can be reduced. Secondly, for some difficult site conditions, e.g. excavation of structure in rock, for the same equivalent cross-sectional area, the width of box culverts can be designed to be smaller and this enhances smaller amount of excavation and backfilling[2].

Alternative 2: This alternative will differ from the first alternative in that instead of box culvert design, a cast in-situ bridge will be constructed. For this alternative, the piers will be cast down to bedrock. A slab will then be placed over the piers to form the bridge deck.

'NO GO' ALTERNATIVE

The 'No Go' alternative means that the proposed development will not take place and the area will retain its status quo. This means that the bridge will not be constructed and the vehicular and pedestrian access will not be improved. Local communities will continue, pedestrians and vehicles would continue to be at risk while trying to traverse the stream and potential injury and drowning incidents may occur. The existing structure will continue to deteriorate posing a danger to humans and the environment.

Public Participation

[2] http://www.engineeringcivil.com/what-are-the-differences-in-applications-between-pipe-culverts-and-box-culverts.html

- A database of I&APs, which contained authorities, stakeholders, landowners and members of the general public, was prepared for the project (Appendix 6).
- Notification of the BA Process was delivered to all members of the I&AP database via fax, email or by hand on the 06 March 2013 (see attached notice – Appendix 6).
- Newspaper advertisement was placed in the following newspaper:
    - The Witbank Newspaper – 22 March 2013

  The newspaper advertisement had details of the proposed project, contact details of the Environmental Assessment practitioner and an invitation for any interested or affected party to comment or register as an I&AP for the proposed project.
- A Background Information Document with a response form was provided to I&APs (see Appendix 6).
- Onsite notices of regulated size, regarding the commencement of the EIA process were placed at strategic points on the 06 March 2013.
- Copies of the draft BA Report will be placed at the following locations to provide I&APs with the opportunity to review and comment on the draft BA report. A 30 day review period (from 22 May 2013 to 22 June 2013) was granted.

Copy No.	Location	Address	Telephone Number
1	Nkonjane CS - Primary school	5043 Willie Ackerman Drive, Lynnville	013 696 2296
2	Emalahleni / Lynville Library	28 Hofmeyer Street, Emalahleni 1033	

Distribution of BAR

Copies of the Draft BAR will be distributed to the following authorities:

- Department of Economic Development, Environment and Tourism (DEDET);
- Department of Water Affairs (DWA);
- Mpumalanga Department of Water Affairs;
- Mpumalanga Parks and Tourism Agency (MTPA);
- Mpumalanga Department of Agriculture Forestry and Fisheries (DAFF);
- Mpumalanga Department of Mineral Resources (DMR);
- Department of Agriculture, Rural Development and Land Administration (DARDLA);
- South African Heritage Resource Agency (SAHRA);
- Mpumalanga Provincial Heritage Resource Agency;
- South African National Biodiversity Institute.
- Emahleni Local Municipality; and
- Nkangala District Municipality.

Best Practicable Environmental Option

Based on the recommendations of the specialists and the comparison of the impacts associated with the various alternatives, Alternative 1 is considered to be the preferred alternative.

Environmental Impact Statement

Based on the recommendations of the specialists and the impact assessment associated with the various site alternatives, the following alternative is considered to be the Best Practicable Environmental Option (BPEO):

- **Alternative 1** – This option is considered to be the preferred alternative as this design is more suited to accommodate the increased flow of water associated with this watercourse. The risk of flooding decreases with this alternative as a result. The method of construction for this alternative is much quicker. The potential impacts on the environment can be mitigated and therefore the potential impacts are least significant.

With the selection of the BPEO for the proposed upgrade and rehabilitation of the Kalkspruit Bridge; the adoption of the mitigation measures included in the BAR and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impact associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

Key Recommendations / Opinion of the EAP

Based on the findings of the impact assessment and the specialist studies, **alternative 1** is supported as the preferred option.

All recommendations made by the specialists must be adhered to.

Conditions for Authorisation

- Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation by an Independent Environmental Control Officer (ECO) is crucial to ensure compliance with the stipulated management measures of the BAR.
- All relevant recommendations made by the specialists relating to the preferred site alternative must be adhered to in terms of geotechnical and wetland issues.
- Areas affected by construction activities need to be suitably stabilised. A stormwater control plan must be implemented manage stormwater and prevent erosion.
- The construction camp area needs to be identified prior to commencement of construction activities. The camp must be adequately fenced and secure at all times.
- All relevant permits must be obtained prior to the commencement of construction activities or as deemed necessary.

AMENDMENTS PAGE

Date	Nature of Amendment	Amendment No.	Signature
May 2013	Draft Copy for Public Review	0	
	Final Copy for Public Review	1	

1. DOCUMENT ROADMAP

The Basic Assessment (BA) Report for the proposed rehabilitation of the Kalkspruit Bridge, in Emalahleni, Mpumalanga aims to satisfy all requirements stipulated in GN.R. 543. of 18 June 2010 (EIA Regulations, 2010). To this end, the following table provides the composition of the draft BA report together with the requirements from the aforementioned legislation.

Table 1: Document Roadmap

CORRELATION WITH GN No. R. 543 (EIA REGULATIONS)				
Chapter	title	Section	Description	Included
1	Document Roadmap			✓
2.1	Project Background and Motivation			✓
4	Basic Assessment Process			✓
3	Legislation and Guidelines considered	22(e)	An identification of all legislation and guidelines that have been considered in the preparation of the basic assessment report.	✓
5	Assumptions and Limitations	22(m)	A description of any assumptions, uncertainties and gaps in knowledge.	✓
2.2	Need & Desirability	22(g)	A description of the need and desirability of the proposed activity.	✓
6	Environmental Assessment Practitioner	22(a)	Details of the EAP who prepared the report; and the expertise of the EAP to carry out basic assessment procedures.	✓
12	Public Participation	22(f)	Details of the public participation process conducted in terms of regulation **21**(2)(a) in connection with the application, including— (i) the steps that were taken to notify potentially interested and affected parties of the proposed application; (ii) proof that notice boards, advertisements and notices notifying potentially interested and affected parties of the proposed application have been displayed, placed or given; (iii) a list of all persons, organisations and organs of state that were registered in terms of regulation **55** as interested and affected parties in relation to the application; and (iv) a summary of the issues raised by interested and affected parties, the date of receipt of and the response of the EAP to those issues;	✓
7	Project Location	22(c)	A description and a map of the property on which the activity is to be undertaken and the location of the activity on the property, or, if it is— (i) a linear activity, a description of the route of the activity; or (ii) an ocean-based activity, the coordinates within which the activity is to be undertaken.	✓
8	Project Description	22(b)	A description of the proposed activity.	✓
10	Profile of the Receiving Environment	22(d)	A description of the environment that may be affected by the proposed activity and the manner in	✓

			which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity.	
9	Alternatives	22(h)	A description of any identified alternatives to the proposed activity that are feasible and reasonable, including the advantages and disadvantages that the proposed activity or alternatives will have on the environment and on the community that may be affected by the activity.	✓
13	Methodology used to determine significance of Environmental Impacts			✓
11	Summary of Specialist Studies	22(k)	Any inputs and recommendations made by specialists to the extent that may be necessary.	✓
13	Environmental Issues			✓
13	Assessment of Environmental Issues	22(i)	A description and assessment of the significance of any environmental impacts, including— (i) cumulative impacts, that may occur as a result of the undertaking of the activity or identified alternatives or as a result of any construction, erection or decommissioning associated with the undertaking of the activity; (ii) the nature of the impact; (iii) the extent and duration of the impact; (iv) the probability of the impact occurring; (v) the degree to which the impact can be reversed; (vi) the degree to which the impact may cause irreplaceable loss of resources; and (vii) the degree to which the impact can be mitigated;	✓
		22(j)	Any environmental management and mitigation measures proposed by the EAP.	✓
114	Environmental Impact Statement		An environmental impact statement which contains— (i) a summary of the key findings of the environmental impact assessment; and (ii) a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives.	✓
14	Opinion of the Environmental Assessment Practitioner	22(n)	A reasoned opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.	✓
15	References			✓
-		22(r)	Any specific information required by the competent authority.	
-		22(s)	Any other matters required in terms of sections 24(4)(a) and (b) of the Act.	
Appendix 7	Draft Environmental Management Plan	22(l)	A draft environmental management programme containing the aspects contemplated in regulation **33.**	✓
Appendix 6	Comments and Response Report	22(o)	Any representations and comments received in connection with the application or the basic assessment report.	
		22(q)	Any responses by the EAP to those representations, comments and views.	

N/A for Draft Report	Meeting Minutes	22(p)	The minutes of any meetings held by the EAP with interested and affected parties and other role players which record the views of the participants.	
		22(q)	Any responses by the EAP to those representations, comments and views.	
Appendi 5	Specialist Studies report		Copies of any specialist reports and reports on specialised processes complying with regulation 32.	✓

2. PROJECT BACKGROUND AND MOTIVATION

2.1. Background

The Nkangala District Municipality together with the Emalahleni Local Municipality proposes to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank. The rehabilitation of this bridge form part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilisation as well as the demolition and re-construction of the aforementioned bridge.

Nemai Consulting has been appointed by HMP Africa Consultants on behalf of the Emalahleni Local Municipality to undertake the requisite Environmental Authorisation Process for the rehabilitation of the Kalkspruit Bridge. The proposed development triggers activities listed in Government Notices No. R 544 and hence requires a basic assessment study as per the August 2010 Environmental Impact Assessment (EIA) Regulations promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2.2. Need and Desirability

In terms of Regulation 22(2)g of GN No. R543 (18 June 2012), this section discusses the need and desirability of the project. In order to address the need and desirability of the project, the questions raised in the Guideline on Need and Desirability (DEA&DP, 2009) are answered in the table to follow.

Table 2: Need and Desirability of the Project

No.	Question	Response
NEED ('timing')		
1.	Is the land use (associated with the activity being applied for) considered within the timeframe intended by the existing approved Spatial Development Framework (SDF) agreed to by the relevant environmental authority? (i.e. is the proposed development in line with the projects and programmes identified as priorities within the IDP).	The project is to rehabilitate an existing bridge structure and therefore there is no change to the land use.
2.	Should development, or if applicable, expansion of the town/area concerned in terms of this land use (associated with the activity being applied for) occur here at this point in time?	N/A
3.	Does the community/area need the activity and the associated land use concerned (is it a societal priority)? This refers to the strategic as well as local level (e.g. development is a national priority, but within a specific local context it could be inappropriate)	Yes, as the current state of the bridge poses a health and safety risk to community members.

No.	Question	Response
4.	Are the necessary services with appropriate capacity currently available (at the time of application), or must additional capacity be created to cater for the development?	No additional capacity will be required for this development.
5.	Is this development provided for in the infrastructure planning of the municipality, and if not what will the implication be on the infrastructure planning of the municipality (priority and placement of services)?	Yes
6.	Is this project part of a national programme to address an issue of national concern or importance?	No
DESIRABILITY ('placing')		
7.	Is the development the best practicable environmental option (BPEO) for this land/site?	The Kalkspruit bridge is an existing bridge and as such is the best option for this site.
8.	Would the approval of this application compromise the integrity of the existing approved municipal IDP and SDF as agreed to by the relevant authorities?	No, this is an existing bridge.
9.	Would the approval of this application compromise the integrity of the existing environmental management priorities for the area (e.g. as defined in Environmental Management Frameworks), and if so, can it be justified in terms of sustainability considerations?	No, this application is to rehabilitate an existing bridge.
10.	Do location factors favour this land use (associated with the activity applied for) at this place? (this relates to the contextualisation of the proposed land use on this site within its broader context).	The proposal is to rehabilitate an existing bridge.
11.	How will the activity or the land use associated with the activity applied for, impact on sensitive natural and cultural areas (built and rural/natural environment)?	There will be an impact on the wetland areas, however the bridge needs to be upgraded as they do not function efficiently. A Wetland Impact Assessment has been undertaken.
12.	How will the development impact on people's health and wellbeing (e.g. i.t.o. noise, odours, visual character and sense of place, etc)?	Potential impacts during construction phase to be managed through EMP.

No.	Question	Response
13	Will the proposed activity or the land use associated with the activity applied for, result in unacceptable opportunity costs?	No
14	Will the proposed land use result in unacceptable cumulative impacts?	No.

The rehabilitation of this bridge form part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilisation as well as the demolition and re-construction of the aforementioned bridge.

The Kalkspruit bridge has been deemed as being structurally unstable and undermined and therefore the upgrade of the bridge is also driven by the current safety risk that the bridge poses. The upgrade of the Kalkspruit Bridge will ultimately result in preserving the integrity of the structure and will ensure a safe means of crossing the stream for vehicles and pedestrians.

3. LEGISLATION AND GUIDELINES CONSIDERED

3.1. Legislation

The legislation that has possible bearing on the proposed Kalkspruit Bridge Project is captured below.

Note: This list does not attempt to provide an exhaustive explanation, but rather an identification of the most appropriate sections from pertinent legislation.

Table 3: Legislation related to the rehabilitation of the Kalkspruit Bridge

Legislation		Relevance
Constitution of the Republic of South Africa, (no 108 of 1996)		• Chapter 2 – Bill of rights. • Section 24 – Environmental rights
National Environmental Management Act (no. 107 of 1998)		• Section 24 - Environmental Authorization (control of activities which may have detrimental effect on the environment). • Section 28 – Duty of care and remediation of environmental damage • Environmental management Principles
GN R. 544 of 18 June 2010	11	• The proposed project would entail the demolition and reconstructing of a bridge within a watercourse. Furthermore the footprint of the bridge may be increased.
	13	• The development will inherently entail the handling and storage of fuel, oil and chemical storage area. The volumes of these goods are likely to be in excess of 80 but not exceeding 500 cubic metres and thus triggering activity

		13.
	18	• The demolishing and subsequent reconstructing of the bridge structure within the watercourses would result in more than 5cm3 material being deposited into and subsequently removed from the watercourse.
	39	• The proposed project would entail the demolition and reconstructing of a bridge within a watercourse. Furthermore the footprint of the bridge may be increased.
Environmental Conservation Act (No 73 of 1989):		• Environmental Protection and conservation. • Section 25 – Noise regulation • Section 20 – Waste Management
National Environmental Management Air Quality Act (no 39 of 2004)		• Air quality Management. • Section 32 – Dust control. • Section 34 - Noise Control.
National Environmental Management : Biodiversity Act, 2004 (no. 10 of 2004)		• Management and conservation of the country's biodiversity. • Protection of species and ecosystems. •
National Environmental management : Protected Areas Act (No. 57 of 2003)		• Protection and conservation of ecological viable areas representative of South Africa's biological diversity and natural landscapes
Occupation Health and Safety Act (No.25 of 1999)		• Provisions for occupational health and Safety • Authority – Department of Labour.
National Heritage Resource Act (no 25 of 1999)		• Section 38 – the construction of a bridge or similar structure exceeding 50 m in length;
Conservation of Agricultural resource Act (no. 43 of 1983)		• Control measures for erosion. • Control measures for alien and invasive plant species. • Authority – Department of Agriculture.
National Environmental Management : Waste Management Act (59 of 2008)		• Authority – Department of Environmental Affairs
National Environmental Water Act (No. 36 of 1998)		• Authority – Department of Water Affairs • Protection of the water resources

3.2. Guidelines

The following guidelines were considered in the preparation of the Basic Assessment Report:

- MPTA Guidelines
- Guideline 3: General Guide to the Environmental Impact Assessment Regulations, 2005. Integrated Environmental Management Guideline Series (DEAT, 2005a);

- Guideline 4: Public Participation, in support of the EIA Regulations. Integrated Environmental Management Guideline Series (DEAT, 2005);
- Guideline on Need and Desirability, NEMA Environmental Impact Assessment Regulations Guideline and Information Document Series. Department of Environmental Affairs and Development Planning (DEADP, 2009); and
- Assessment of alternatives and impacts (Guideline 5) in support of the EIA Regulations, Department of Environmental Affairs and Tourism, Pretoria (DEAT, 2006).

3.3. Environmental Authorisation Required

From the relevant legislation the following authorization may be required for the proposed facility.

1. Approval required from DEDET for listed activities associated with the project. Basic Assessment conducted under NEMA, in accordance with the EIA Regulations (Government Notice No. R544 of 18 June 2010).
2. Permit to be obtained from South African Heritage Resources Agency (SAHRA) under the National Heritage Resources Act (No. 25 of 1999) if heritage resources are to be impacted on.

3.4. Regional Plans

The following regional plans were considered during the Basic Assessment Process:

- Emalahleni local Municipality integrated development plan 2012/2013.
- Relevant provincial, district and local policies and strategies

4. EIA – BASIC ASSESSMENT PROCESS

4.1. Environmental Assessment Triggers

As noted in **Section 3**, the project entails certain activities that require authorisation in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA).

The EIA – Basic Assessment Process is being undertaken in accordance with the EIA Regulations of 2010 (GN No. R543 of 18 June 2010). **Table 3** lists (amongst others) the associated relevant activities that apply to the proposed project in terms of GN No. R544 of 18 June 2010.

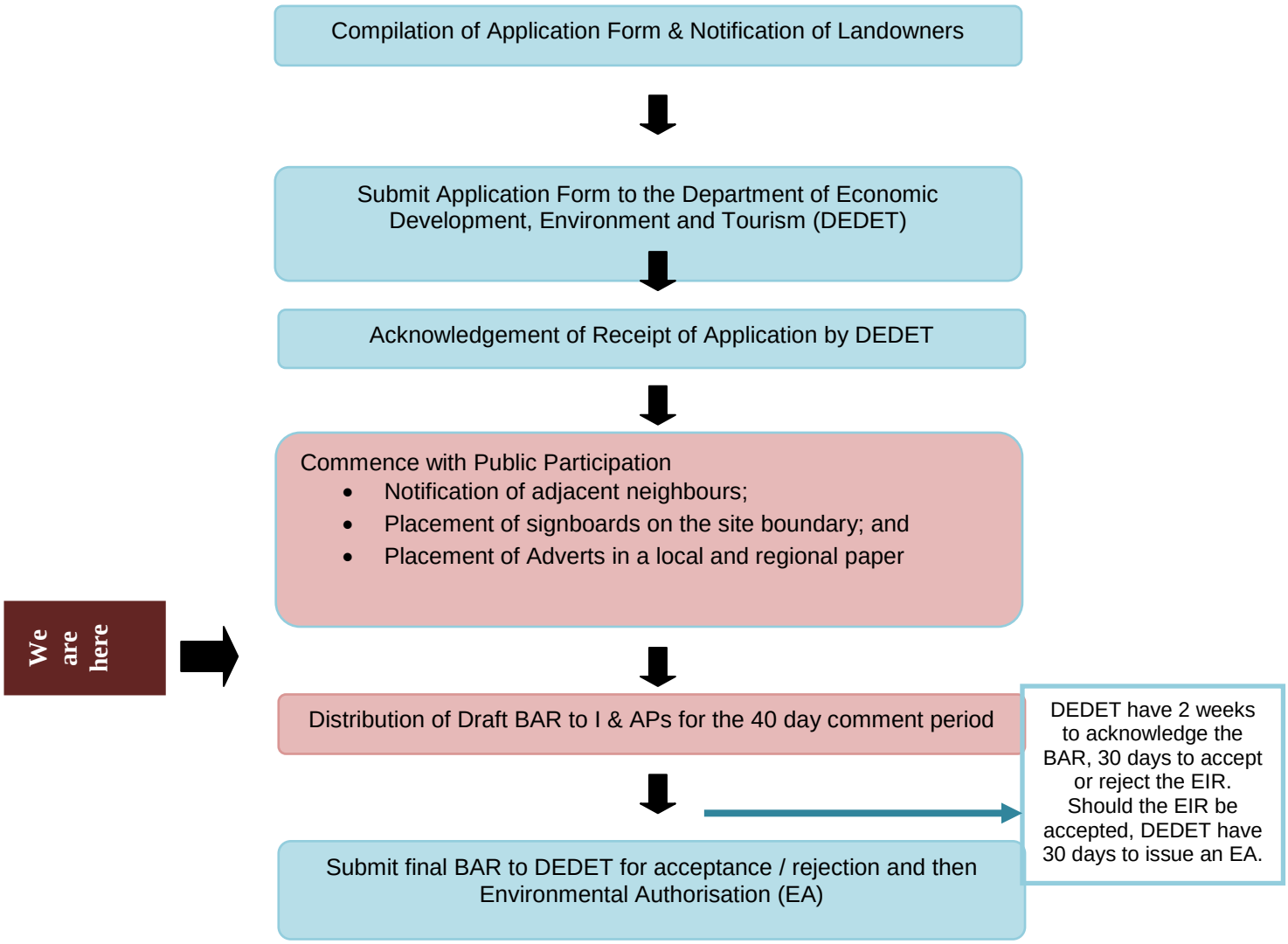
4.2. Environmental Assessment Authorities

The EIA decision-making authority is the Mpumalanga Department of Economic Development, Environment and Tourism (DEDET).

4.2.1. Basic Assessment Process

The Basic Assessment process as set out in EIA Regulations of 2010 (GN No. R543 of 18 June 2010) has commenced. The application form was submitted to DEDET on the 21st August 2012. Acknowledgement of receipt of the application form was provided on the 28th August 2012. The following reference number was then allocated to the project: 17/2/3N-190.

The public participation process then commenced an outline of Basic Assessment Process for the proposed project is provided below:



Once the Environmental Authorisation (EA) has been issued, the applicant / EAP must notify all registered I & APs of the decision and this must be done within 12 days of receipt of the EA and provide them with the details should they wish to appeal the decision as per the EA.

5. ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations accompany the BAR for the proposed upgrade and rehabilitation:

- The EIA process does not make provision for borrow pits. The necessary approval of borrow pits will be required from the Department of Mineral Resources (DMR) in terms of the Minerals and Petroleum Resources Development Act (Act No. 28 of 2002).
- It is assumed that the baseline information scrutinised and used to explain the environmental profile is accurate.
- The locations of camp sites are not known at this stage, and the associated impacts will need to be addressed through suitable mitigation measures in the Environmental Management Programme (EMPr).

6. DETAILS AND EXPERTISE OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER

Nemai Consulting was appointed by Mpumalanga Department of Culture Sports and Recreation as the independent Environmental Assessment Practitioner (EAP) to undertake the environmental assessment for the proposed project.

In accordance with Regulation22 (2) a of GN No. R. 543 of 18 June 2012, this section provides an overview of Nemai Consulting and the company's experience with EIAs, as well as the details and experience of the EAPs that form part of the Scoping and EIA team.

Nemai Consulting is an independent, specialist environmental, social development and Occupational Health and Safety (OHS) consultancy, which was founded in December 1999. The company is directed by a team of experienced and capable environmental engineers, scientists, ecologists, sociologists, economists and analysts. The company has offices in Randburg (Gauteng), Rustenburg (North West Province), and Durban (KwaZulu Natal).

Team members of Nemai Consulting that are involved with the Basic Assessment Process for the proposed upgrade and rehabilitation are captured in **Table 4** below, and their respective Curricula Vitae are contained in to ***Appendix 4***.

Table 4: Basic Assessment Team Members

Name	Qualifications	Experience	Duties
Ms D. Naidoo	• B.Sc Eng (Chem)	17 years	Project Director
Mr C. Chidley	• B.Sc Eng (Civil); • BA (Economics, Philosophy) • MBA	20 years	Quality Reviewer
Ms M. Chetty	• B.Sc Honours Biological Science	4 years	EAP

7. PROJECT LOCATION

Kalkspruit Bridge is located within the Emalahleni Local Municipality and Nkangala District Municipality, Mpumalanga Province (See appendix 1 for Topographical Maps). The bridge is located on Farm Kwaguqa 313 JS (T0JS00000000031300011 and T0JS00000000031300000).

Figure 4: Aerial map showing the location of the Kalkspruit bridge, (a) picture of the existing structure

8. PROJECT DESCRIPTION

The Nkangala District Municipality together with the Emalahleni Local Municipality is proposing to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank.

The demolition and reconstruction of the Kalkspruit Bridge project and associated activities will include the following:

- Removal of accumulated silt and sediment built up at the bridge;
- Lining the embankment with gabions and reno mattresses; and
- Guard Railing and Balustrade protection.

In addition the slope of the channel will be increased on the approach side of the downstream bridge to assist in increasing the velocity of flow. The approach will then be lined with Armorflex for approximately 30m, placed on geotextile material. This will improve the velocity of flow and prevent water weeds growing on the approach side of the channel. The downstream side will then be lined with approximately 10m to allow the flow to pass through (see figure 6 below).

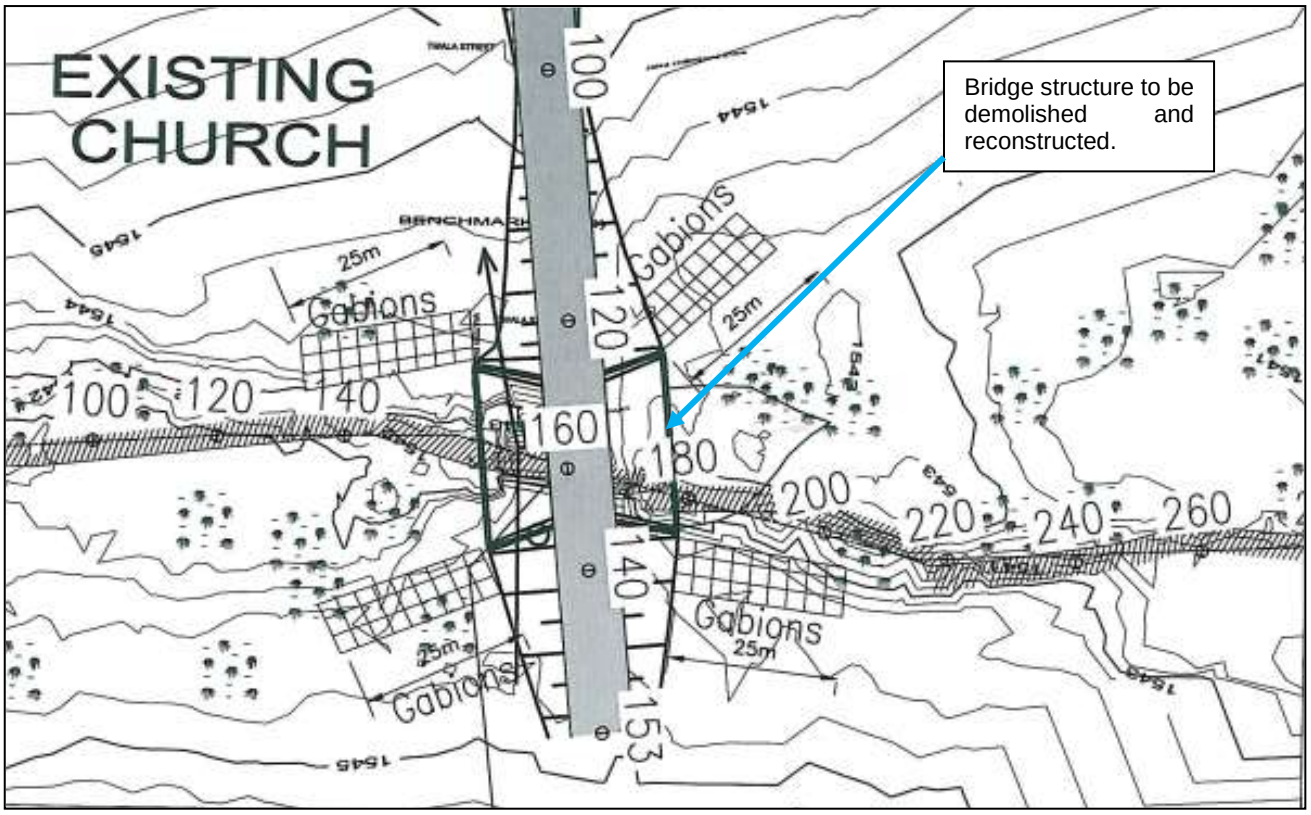


Figure 5: Design map illustrating the bridge and gabion structures

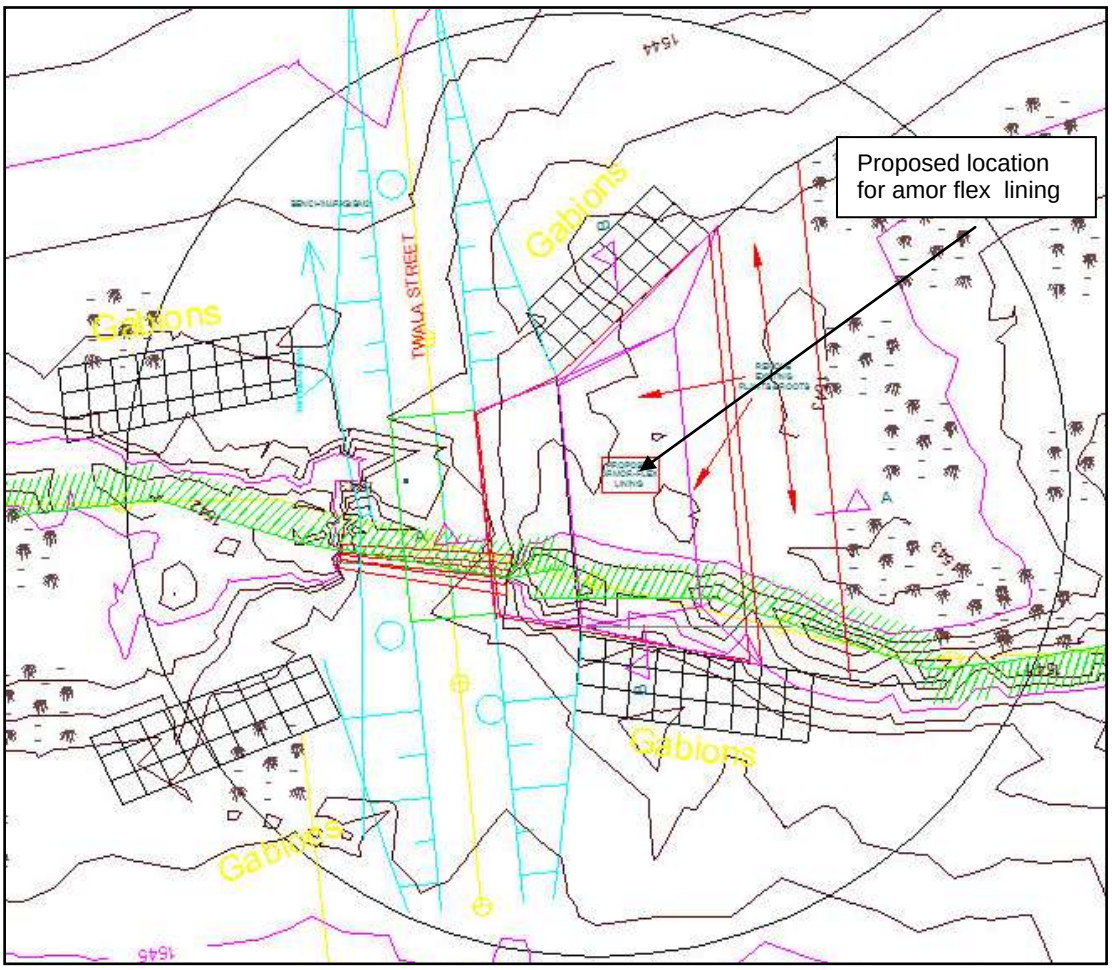


Figure 6: Design map illustrating the bridge and gabion structures as well as location of amor flex lining

9. ANALYSIS OF ALTERNATIVES

In terms of the NEMA EIA Regulations one of the criteria to be taken into account by the competent authority when considering an application is "*any feasible and reasonable alternatives to the activity which is the subject of the application and any feasible and reasonable modifications or changes to the activity that may minimise harm to the environment*". Alternatives are defined in the Regulations as "*different means of meeting the general purpose and requirements of the activity*". It is therefore necessary to provide a description of the need and desirability of the proposed activity and any identified alternatives to the proposed activity that are feasible and reasonable, including the advantages and disadvantages that the proposed activity or alternatives will have on the environment and on the community that may be affected by the activity.

A site alternative has not been considered as the existing bridge structure needs to be upgraded. Two design alternative options are therefore considered as part of this application:

Alternative 1: This alternative will involve the upgrading of the bridge and culvert structures. A box culvert design will be used for this alternative (see figure below):

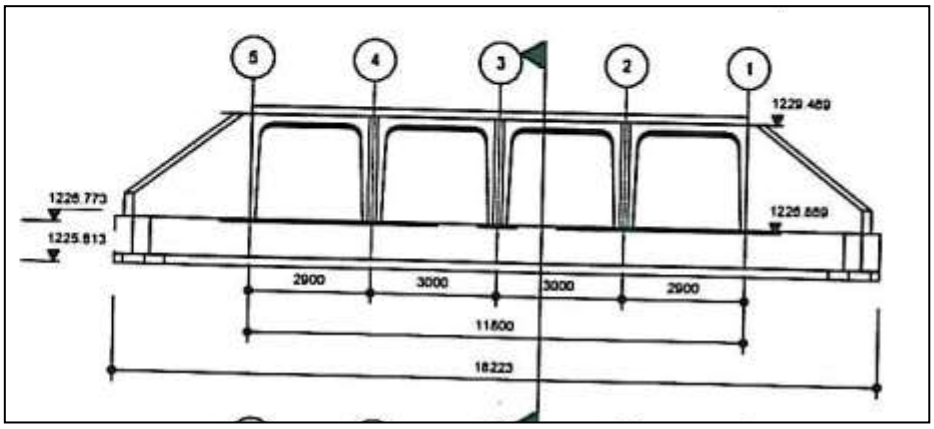


Figure 7: Design of the box culvert alternative

The structure will consist of 4 box culverts, the wing walls and other associated structures. Lining the embankment with gabions and reno mattresses and guard railing and balustrade protection will also be implemented. All accumulated silt and sediment will also be removed to allow for the watercourse to flow freely. The box culvert design is preferable as this design can cope with large flow situation where headroom is limited because the height of box culverts can be reduced. Secondly, for some difficult site conditions, e.g. excavation of structure in rock, for the same equivalent cross-sectional area, the width of box culverts can be designed to be smaller and this enhances smaller amount of excavation and backfilling[3].

Alternative 2: This alternative will differ from the first alternative in that instead of box culvert design, a cast in-situ bridge will be constructed. For this alternative, the piers will be cast down to bedrock. A slab will then be placed over the piers to form the bridge deck.

The following table discusses the advantages of each alternative:

[3] http://www.engineeringcivil.com/what-are-the-differences-in-applications-between-pipe-culverts-and-box-culverts.html

Table 5: Table showing alternative route options and advantages and disadvantages

	Alternative 1	Alternative 2	No-go Option
Advantage	**Environment:** The removal of alien plant species will take place. The rehabilitation will result in a clean up of the area around the bridge surrounding watercourse as the watercourse has silted up. Alternative 1 will have a greater advantage in comparison to alternative 2 as the size of the box culvert will allow for the free flow of water. This will reduce the risk of the watercourse silting up again as it is currently. **Social:** A more efficient access road will be provided to the members of the community as well as other users of this road. The duration of the construction phase is much shorter than alternative 2. **Economic:** There may be potential employment for local member during the construction phase.	**Environment:** The removal of alien plant species will take place. The rehabilitation will result in a clean up of the area around the bridge surrounding watercourse as the watercourse has silted up. **Social:** A more efficient access road will be provided to the members of the community as well as other users of this road. **Economic:** There may be potential employment for local member during the construction phase. This option is slightly cheaper than alternative 1.	**Environment:** There will be no construction related impacts posed by the no-go alternative. **Social:** There will be no social impacts due to construction related activities. **Economic:** There is no advantage from an economic perspective as there will be construction or upgrade of the road.
Disadvantage	**Environment:** There may be increased alien plant growth. **Social:** Disruption of traffic will occur during the construction phase,	**Environment:** The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation	**Environment:** The surface water flow will continue to be impaired due to the size of the existing culverts. This has an

	however these impacts can be mitigated against. **Economic:** This option is slightly more expensive than alternative 2.	encroachment are considered to be higher for the upgrade of the bridge using cast *in situ* options. **Social**: Disruption of traffic will occur during the construction phase, however these impacts can be mitigated against. There will be a greater disruption of traffic flow associated with the construction activities related to this alternative. The duration of the construction period is much longer than alternative 1. **Economic:** There are costs associated with the upgrade, however the costs are less when compared to alternative 1.	effect on wetland functionality. There is a potential for flooding posing an environmental risk as well as a health and safety risk. **Social:** The existing bridge is unstable, which poses a safety risk. Due to the size of the existing culverts, there is a risk of flooding. **Economic:** There will be no job creation with the no-go option. However there will be direct costs associated with the existing road in the short term.

10. DESCRIPTION OF THE RECEIVING ENVIRONMENT

10.1. Socio- Economic Environment

The proposed development site is situated within the Emalahleni Local Municipality (ELM) which forms part of the greater Nkangala District Municipality. The Demographic Overview provided in the Integrated Development Plan (IDP) shows the estimated population size for 2016/17 as 916 757. The estimated population size is based on an annual growth rate of 8.63. At the growth rate of almost 9% per annum. According to the IDP the population would have doubled in 10 years time from the date of the last survey which was done, which coincides with the end of term of the IDP 2012/2013.

The substantial population growth rate has the following implications and requires the following steps to be taken by the Local Municipality:

- Annual budget must be increased by 9% per annum.
- The capacity of the current infra-structure must be doubled.
- Make land available for further development to make provision for increased population numbers.
- EML to meet its current housing backlog and make available a similar amount of housing that is currently available.
- Additional social facilities will be created to cater for the additional communities which will be established.

Measures to address the challenges facing the ELM as listed below will be included in the Local Economic Development strategy:

- Poor mechanisms to measure the contributions by the private sector into surrounding communities
- Poor Recreational Facilities;
- HIV/Aids & Other Communicable Diseases;
- Skills base not responding to Emalahleni Economic Activities;
- Crime linked to Substance Abuse;
- Youth Unemployment;
- Insufficient Programmes towards the upliftment of youth & women;
- Poor quality of matric results; and
- Dependency on grants lack of sustainable livelihoods in poorer communities.

As indicated in the IDP the ELM is under immense pressure to lay the foundation for development by providing high capacity infra-structure to cater for the rapid growth and ensure that it provides skills to ensure that the available labour source caters for all employment levels. There is immense pressure to develop at a faster rate to respond to the population influx into the Municipal area as a result of the economic potential of the municipal area and also sustain the economic viability of the area by creating a dynamic and conducive environment for overall development within the Municipal area.

The proposed upgrade of the bridge will provide a number of opportunities for labourers who reside within the Ward which the development site is located. The generation of employment opportunities will have a direct positive socio-economic impact on these labourers for the duration of construction.

10.2. **Watercourses**

The Kalkspruit Bridge falls within the Highveld Aquatic Ecoregion and the Olifants North Water Management area. The site was also found to be located within the B11k quaternary catchments and within the Kalkspruit River.

The wetland feature (Kalkspruit channel) was identified between Twala Avenue and Botha Street within the township of Kwaguqa in Emalahleni, Mpumalanga Province. This wetland feature was categorised Channelled valley-bottom wetland.

The channelled valley bottom wetland unit has been impacted on and has three main physical modifiers acting upon the wetland system. These physical modifiers are:

- Alien vegetation dominating the stream channel of the wetland feature;
- Illegal dumping of litter and building rubble within the wetland unit ;
- Erosion, incision and siltation (Scientific Aquatic Services, 2012).

Figure 8: (a) litter and illegal dumping in the stream, (b) blocked sewerage drain overflowing into wetland and (c) erosion of stream banks

10.3. Climate

The varied topography of the Mpumalanga Province largely defines the climate of the province. Mpumalanga is divided into two halves, namely the high-lying grassland savannah of the Highveld escarpment and the subtropical Lowveld plains. The proposed development site, which is situated in Emalahleni, lies in the Highveld area of the province. On a broader scale the climate of the province is considered as sub-tropical, with distinct hot summers and mild to cool winters (Mpumalanga SOE, 2003).

The average maximum temperatures in January (summer) peaks at 24°C, while in June the average maximum temperature peaks (winter) at 14.8°C. Accor ding to Statistics South Africa (2002) the average rainfall in the province is 767 mm, with the most rainfall occurring during the summer months.

10.4. Air Quality

The key sources and industries which cause air pollution in the Mpumalanga Province ranges from veldt fires to industrial processes, agriculture, mining activities, power generation, paper and pulp processing, vehicle use and domestic use of fossil fuels. Although the development area falls within a largely residential area, the ambient air quality of the development area can be influenced by regional air movements which, together with local climatic and meteorological conditions are responsible for the distribution of air pollutants both within the province and between neighbouring provinces and countries. Therefore the effect or impact of air pollutants can occur at significant distances from the pollution source, which in turn is determined by the prevalent wind direction.

Electricity use appears greatest in the Nkangala DM. This DM also has the largest population of the four district municipalities. Ambient (outdoor) air quality is generally worse in urban or industrialised areas. The Nkangala District Municipality, within which the development site is located, has the largest population of the four district municipalities and therefore also has the greatest electricity needs in terms of district municipalities. Generally the ambient air quality is generally worse in urban or industrialised areas.

Figure 9: Stream dominated by Typha capensis

10.5. Vegetation

Most of the area within Emalahleni consists of the Eastern Highveld Grassland vegetation type. This vegetation type occurs on slightly to moderately undulating planes, including some low hills and pan depressions. The vegetation is a

short dense grass land dominated by the usual highveld grass composition (*Arsitida, Digitaria, Erafrostsis, Themeda, Tristachya* etc.) with small scattered rocky outcrops with, wiry sour grasses and some woody species. Some 44% transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams.

The Kalkspruit bridge is located in a built up area. The dominant vegetation around the bridge structures is Typha capensis. This indigenous species hinders the water flowing through the stream channel. The site was also found to be dominated by alien vegetation

The following vegetation species was identified on site (Scientific Aquatic Services, 2012):

Table 6: Dominant floral species identified during wetland zone delineation [invader / weed species are indicated with an asterisk (*)].

Terrestrial species	Temporary zone species	Seasonal zone species	Permanent zone species
*Cynodon dactylon	Paspalum urvilli	Cyperus denudatus	Typha capensis
*Pennisetum clandestinum	Hypochaeris radicata	Juncus punctorius	Phragmites australis
Paspalum urvilli	Plantago lanceolata	*Verbena bonariensis	Cyperus denudatus
Sorghum bicolor sp	Brachiaria deflexa	*Salix babylonica	Juncus punctorius
Prunus persica	Capsella bursa pastorsis	*Canna sp.	
Tagetes minuta	Sonchus oleraceus	*Oenothera rosea	
Euphorbia striata			
Hypochaeris radicata			
Argemone ochrdeua sp			
Plantago lanceolata			

10.6. Noise

The development site is situated within a built up area. Given that the bridge will allow vehicles to cross the stream, the most likely sources of noise generated by passing vehicle traffic. The noise levels before and after construction is likely to remain the same, as the source remains unchanged. During the construction phase of the bridge upgrade, elevated noise levels will be generated by the construction activities. The elevated noise levels will however be confined to the construction phase.

10.7. Land Use

The majority of the current land use is residential with a school located to the west of the bridge. The proposed bridge upgrade will have a limited impact on undisturbed/virgin land as it entails the upgrade of an existing structure.

10.8. Heritage Resources

There are no known archaeological or cultural significance known within close proximity to the bridge. It must however be noted that the possibility of archaeological remains or heritage resources being during construction cannot be ruled out. In this event the necessary steps to prevent any damage any archaeological remains or heritage resources found.

10.9. Visual

The proposed bridge upgrade will take place in a largely developed area with existing infrastructure. The activities associated with construction will add on to the existing visual disturbances of the built up/developed area.

10.10. Topography

The site is generally gently sloping towards the river channel and is considered to be gently rolling from the North West and South East of the river channel.

10.11. Geology

The structures are underlain by gneisses and Granites rocks of Bushveld Complex. The soil profile exhibited a thick veneer of transported soils overlying residual granite soils. The granites of this sort are known to be intruded by diabase dykes but from the available data such an intrusion does not appear to be present in this area.

The granites soils derived by the in situ weathering of the bedrock may be either potentially collapsing or potentially expansive depending upon the weathering environment. The weathering environment is controlled by the local microclimate. Where the drainage is good, the feldspar component of granite weather to kaolinitic clays, which may be leached out leaving the quartz particles separated by clay bridges in an open lattice type of structure. This open lattice type structure has a relatively low density and high voids ratio and it is these soils which give rise to collapse settlement. Collapse settlement is a sudden change in volume caused by re-orientation of the soil grain structure. The mechanism is that, although when dry these soils have a high strength, which is derived largely from the strength of the clay bridges, when the moisture content of these soils is increased, the clay bridges lose their initial strength and a re-orientation of the grain structure occurs. The amount of re-orientation is subject to the applied stress.

Where, over time, gneiss soils have poor or impeded drainage and are in contact with water for prolonged periods without adequate infiltration for leaching to take place, potentially expansive soils may be formed through the weathering of the feldspars to smectite group clay minerals. The smectite group clay minerals are ordered so that water may be absorbed between the layers causing a volume change. Soils containing these minerals increase in volume on an increase in moisture content and decrease in volume on a decrease in moisture content. The mechanism responsible for triggering collapse settlement within these soils is a combination of an applied stress and an increase in soil moisture content. In general, there is uniformity in soil horizons across the site both horizontally or vertically.

11. SPECIALIST STUDIES

11.1. Geotechnical Assessment (Mano-Ceph Civils, 2012)

A geotechnical investigation was undertaken by MANO-CEPH Civils in 2012. The following is a summary of the report produced.

A geotechnical study was undertaken to assess the geotechnical engineering issues related to foundation designs, backfill material, excavatability and general constraints with respect to portal culvert/bridge construction works.

A desktop study was done using 1:1 000 000 Geological Map of South Africa and Kingdoms of Swaziland and Lesotho 1997.

In terms of geology, the structures are underlain by gneisses and Granites rocks of Bushveld Complex. Soil profile exhibited a thick veneer of transported soils overlying residual granite soils. The granites of this sort are known to be intruded by diabase dykes but from the available data such intrusion do not appear to be present in this area. In general, there is uniformity in soil horizons across the site both horizontally or vertically.

The field investigations consisted of the excavation of eight (8) test pitsThe test pits were inspected and profiled by an Engineering Geologist using standard terminology proposed by Jenning, Brink and Williams, and further updated by the Geoterminology Workshop 1990. The plan positions of these test pits are shown on the site plan, Figure 1 of the geotechnical report, and the detailed profiles of the individual holes recorded are attached to this report as appendix A of the Geotechnical Report.

The following sections describe the types of foundation and founding levels that should be employed across the site in order to secure an adequate solution.

A. Excavation Issues

Soil profiles and DPSH tests across the site indicate that the top soils were loose to medium dense below to a depth of 4.0m below ground level. The top soils are considered to be compressible and may be excavated by using a conventional light earthmoving equipment to the depth attained in the test pits. However, we have concern about the stability of the excavation in alluvial soils on the culvert site, therefore, we propose, in all cases that the excavated trenches should be cut back in consolidated soils. The degree of cutting should in this case be a matter of experienced judgement taking into account the time over which the excavation is required and danger to the workman.

B. Foundation Solution for the Bridge/ Portal Culvert

The foundation loads of the bridge/culvert are predicted to in the range of 100kN/m2 to 200kN/m2 Soil profiles across the bridge sites indicate medium dense very moist sandy soils with undrained shear strength of less than 20kPa underlying the proposed bridge/culvert.

An assessment of which indicates compressibility and requefaction potential at varying depths. On this basis, it is not considered suitable as a founding stratum in its natural state for structures with settlement sensitivity. Therefore, we recommend that foundations should be placed on soft rock gneiss found at a depth of the range 8.0m to 9.0m below ground level.

DPSH penetration tests carried out on the site gave N value ranging from about 50 to 100 blows per 0.3 metre which reflect very dense horizon at a depth of the range at 7.6m to 9.3m below ground level.

On this basis, the top soil is not considered suitable as a founding stratum in its natural state for structures with settlement sensitivity. Therefore, we recommend that foundations should be placed on soft rock granite found at a depth of the range 7.6m to 9.5m below ground level.

A reinforced cast-in-place concrete base may then be placed on the soft rock gneiss. It would be reasonable to assume that a bearing pressure of 500Kpa could be achieved.

The river water volume and velocity in the river channel on the project sites were seen to be critical, in view of this, dewatering measures need to be planned for. We recommend cofferdams to be constructed across the river channel itself inorder to capture the running water before it reaches culvert sites. The water should then be pumped from the cofferdam across the culvert site back to the river channel or to the nearest existing channel.

The groundwater and leachates produced as a result of infiltration of rain water are presumed to be corrosive against buried concrete and steel. Therefore we recommend that all structures below the ground level as well as cover thicknesses to reinforcing steel should be designed in accordance with the recommendations of Basson (good dense concrete with minimum cement content of 4230kg/m^3 and a cement: water ratio of 2,2).We also consider that there should be a minimum cover of 75mm in all buried concrete.

C. Culvert Approaches

The following procedure should be used for the preparation of the subgrade beneath culvert approaches:

- Strip any vegetated soil and remove all significant root systems.
- Rip the exposed subgrade for a depth of 150mm and compact to 90% of the modified AASHTO maximum dry density at optimum moisture content + or – 1%
- Make up to the required level but provide a minimum of 150mm of a suitable imported material with minimum CBR of 15 at 93% of the modified AASHTO maximum dry density to bridge the unsuitable subgrade.

Then subbase and basecourse layers designed for anticipated load may then be placed on the prepared subgrade. As good practice, paved areas should also be sprayed against termites and vegetation before surfacing.

The pavement was seen to have exhibited distress in the form of extensive alligator, transverse and longitudinal crackings, and deformation in the form of excessive rutting and potholing. Drainage was seen to have prayed a major role towards the exhibited defects. In view of this it is important that drainage should be considered critical during design stage.

It is important to note that these foundation recommendations have based on the ground conditions observed in the test pits and field tests carried out during the field work carried out by ourselves. These ground conditions should be confirmed by inspection of the foundation excavations, which should be carried out by a suitably qualified person. Adequate quality control of earthworks and concrete should be implemented during construction by an independent laboratory.

11.2. Wetland Impact Assessment (Scientific Aquatic Services, 2012)

A wetland Delineation and Functional Impact Assessment was undertaken by Scientific Aquatic Services in October 2012. The following is a summary of the report.

The proposed area to be rehabilitated was assessed during a site visit on the 16th of October 2012. During the site visit the wetland area was delineated and data on the wetland structure and function collected as well as an aquatic assessment was conducted. The area was characterised according to the updated National Wetland Classification System (2009) and several system modifiers were noted. The wetland delineation and aquatic assessment was confined to the wetland and stream channel areas between Twala Avenue and Botha Street. The surrounding area; including the school and grave yard area was however considered as part of the desktop assessment of the area.

The following general conclusions were drawn upon completion of the assessment:

Wetland assessment

- The subject property falls within the *Highveld* Aquatic Ecoregion and the Olifants North Water Management area. The subject property is located within the B11K quaternary catchments and the particular river resource in the area is the Kalkspruit River.
- In terms of Freshwater Ecoservices Priority Areas (FEPA) importance the following key points are highlighted:
    - No FEPA wetlands or flagship rivers were identified within or immediately adjacent to the subject property;
    - No wetland clusters were noted within or near the study area that were important in terms of water supply;
    - No wetlands or rivers were noted near or within the study area that are important in terms of fish sanctuaries;
    - Study area falls within the Olifants management area:
        - Fourteen percent (14%) of the Olifants management area is of FEPA importance;
        - Four percent (4%) of the sub water management area is if FEPA importance;
- This wetland feature was categorised with the use of the *National Wetland Classification System Methodology and described in the table below :*

Level 1: System	**Level 2: Regional Setting**	**Level 3: Landscape unit**	**Level 4: Hydrogeomorphic (HGM) unit**	
HGM Type		**Longitudinal zonation / landform**		
Inland	*Highveld* Ecoregion	Valley floor	Channelled valley-bottom wetland	Lowland River
An ecosystem that has no existing connection to the ocean but which is inundated or saturated with	The subject property falls within the Highveld Ecoregion and the Northern Olifants Water	The typically gently sloping, lowest surface of a valley	Mostly flat wetland area on a valley floor (see valley floor) that is dissected by and typically elevated above a	low-gradient, alluvial fine-bed channels, which may be confined

water, either permanently or periodically.	Management area		well-defined stream channel (see channel). Dominant water inputs to these areas are typically from the channel (when it overtops or	

- The channelled valley bottom wetland unit has been impacted on and has three main physical modifiers acting upon the wetland system. These physical modifiers are:
    - Alien vegetation dominating the stream channel of the wetland feature;
    - Illegal dumping of litter and building rubble within the wetland unit ;
    - Erosion and siltation;
- The wetland has an **moderately low importance** in terms of the eco-services provided to the surrounding area and local community;
- The wetland area Present Ecological State (PES) was calculated and the wetland is **Extensively modified**, as it falls within a Class **E** category;

Aquatic Assessment

Site K1
Water Quality pH 6.72 Conductivity (ms/m) 100.1 Dissolved oxygen (mg/l) 4.71 Temperature (º C) 20.6
Habitat Assessment and Suitability *Invertebrate Habitat Assessment* Class Inadequate IHAS Score 44
Aquatic Macro-invertebrate community assessment Dallas 2007 Class E/F Dickens & Graham 2001 Class F SASS5 Score 6 ASPT Score 3
Current impacts Significant littering.

The general water quality of the aquatic resources in the vicinity of the proposed bridge upgrade may be considered poor. The electrical conductivity (EC) values at the point may be considered highly elevated from

natural conditions, with some impacts as a result of urban runoff and erosion affecting the water quality at this point.

In terms of habitat diversity and structure the stream is generally inadequate for supporting diverse aquatic communities under the current flow conditions.

The SASS5 data indicates that according to the Dickens & Graham (2001) classification system, the aquatic macro-invertebrate community in this section of the Kalkspruit has suffered a critical loss (Class F) in integrity when compared to the reference score for the Highveld Eco-region stream. According to the Dallas (2007) classification system, the K1 site may be classified as a Class E/F (Critically impaired) system. The low flows and the impaired availability of habitat in this system is likely to be the most significant factor in determining the species composition of this system at the present time.

Impact Assessment

Based on the above assessment it is evident that there are 13 possible impacts that may have an effect on the overall wetland and aquatic integrity. The table below summarises the findings indicating the significance of the impacts before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

Summary of Impact Significance

	Impact	Unmanaged	Managed
Alternative 1	IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES	Low	Very Low
Alternative 2	IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES	High	Medium Low
Alternative 1	IMPACT 2: LOSS OF ECOLOGICAL SERVICES	Low	Very Low
Alternative 2	IMPACT 2: LOSS OF ECOLOGICAL SERVICES	High	Medium Low
Alternative 1	IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION	Medium High	Very Low
Alternative 2	IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION	High	Medium Low
Alternative 1	IMPACT 4: IMPACTS DUE TO INUNDATION	Low	Very Low
Alternative 2	IMPACT 4: IMPACTS DUE TO INUNDATION	High	Medium Low
Alternative 1	IMPACT 5: ALIEN VEGETATION ENCROACHMENT	Medium High	Low
Alternative 2	IMPACT 5: ALIEN VEGETATION ENCROACHMENT	Medium High	Low
Alternative 1	IMPACT 6: INEFFECTIVE REHABILITATION	Medium Low	Very Low
Alternative 2	IMPACT 6: INEFFECTIVE REHABILITATION	Medium Low	Very Low
Alternative 1	IMPACT 7: IMPACTS ON INSTREAM FLOW	Medium Low	Very Low
Alternative 2	IMPACT 7: IMPACTS ON INSTREAM FLOW	High	Medium Low
Alternative 1	IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR	Medium Low	Very Low

	AQUATIC SPECIES		
Alternative 2	IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR AQUATIC SPECIES	Medium Low	Low
Alternative 1	IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS	Medium Low	Very Low
Alternative 2	IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS	Medium Low	Very Low
Alternative 1	IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY	Low	Very Low
Alternative 2	IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY	Low	Very Low
Alternative 1	IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY	Medium Low	Very Low
Alternative 2	IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY	Medium Low	Very Low

From the table it is evident that prior to mitigation, most of the impacts on alternative 1 are medium low level impacts. The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation encroachment are considered to be medium high for the upgrade of the bridge using box culverts. If well managed mitigation takes place, the majority of the impacts using the box system, can be reduced to very low level impacts but the impact from alien vegetation encroachment remains low. If the above impacts are managed and adequate measures are implemented during rehabilitation then the impacts become very low and are of a limited severity.

Impacts from alternative 2 are much higher should no mitigation take place. The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation encroachment are considered to be high for the upgrade of the bridge using cast *in situ* options. The impacts from inundation and the risk of alien vegetation encroachment are also considered to be medium high for the upgrade of the bridge using cast *in situ* option. Mitagation measures that are fully implemented can lower the impacts on the overall wetland and aquatic function of the system, but this impacts will still be higher than alternative 1 (box culvert system).

Thus, from the impact assessment it can be concluded that the upgrade of the bridge using box or the cast *in situ* option could have an impact on the wetland characteristics and function. The duration and severity of these impacts will however differ using these alternatives. Depending on the type of infrastructure used and construction activity, the box culverts or the cast *in situ* option could have a higher or lower impact on the wetland feature, respectively. It is recommended in order to minimise the impacts, the box culverts system should be used during the upgrade of the bridge. The box culvert system can be used in the active channel, where it will have less impact on the system in terms of inundation and blockage caused by plant or soil material.

The no-go alternative is not recommended. The current state of the wetland feature is very poor en modified due to alien vegetation encroachment and dumping of waste material by the local residents. If the project no go option is followed and is not rehabilitated the wetland feature or upgrading the bridge, will lead to on-going erosion, sedimentation and incision of the system and lead to further decreases in ecological value and function of the wetland feature from an aquatic and socio-economic aspect.

Sensitivity

After consideration of the findings of the wetland assessment, no buffer is deemed necessary for the wetland feature identified within the subject property. A 32m buffer as defined by DWA guidelines was included for illustrative purposes only. Due to construction activities that will infringe upon the wetland areas, it is crucial that mitigation measures be implemented to minimise the impacts on the wetland system as far as possible. Construction activities occurring within the wetland features requires relevant authorisation according to the National Environmental Management Act (NEMA) 107 of 1998 and Section 21 c and i of the National Water Act 36 of 1998.

From the assessment, some guidelines for the proposed construction activity are recommended. The design and construction should aim to meet the following criteria to ensure the on-going functioning of the wetland system in the vicinity of the proposed infrastructure construction:

- Ensure that all current activities consider the wetland boundaries. No vehicles are to enter or drive through the wetland area unnecessarily;
- Demarcate all wetland boundaries with pegs and danger tape;
- Edge effects of pre-construction and construction activities, including erosion, sedimentation and alien/weed control, need to be strictly managed in wetland areas as well as their associated buffer zones;
- Identify activities, which are causing erosion and incision of any of the wetland feature and mitigate these impacts immediately;
- Adequate erosion control and siltation control measures should be put in place;

- Obtain relevant legislative approval for any activities to be undertaken within the wetland feature to rectify excessive erosion;
- No unnecessary construction activities should be allowed within the riparian zones in line with the requirements of Section 21(c) and (i) of the National Water Act;
- As far, as is practical, implement concurrent rehabilitation processes in order to limit degradation of soil biota;
- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion (where applicable);
- The time in which soils are exposed during construction activities should remain as short as possible;
- Ensure that migratory connectivity for more mobile faunal species is facilitated to allow movement of these species between areas upstream and downstream of the crossing;
- The duration of impacts should be minimised as far as possible by ensuring that the duration of time in which any flow alterations may take place is minimised;
- No dumping of waste or any other materials is allowed within the wetland areas;
- Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction phases;
- If any spills occur, they should be immediately cleaned up;
- No fires should be permitted near the construction area;
- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility;
- Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases;
- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel;
- Throughout the construction and rehabilitation phases stream flow continuity in the system must be maintained;
- The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time;
- All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge;
- Adequate storm water management must be incorporated into the design of the proposed bridge structure in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities, which rely on stream substrates clear of sediment.

- During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10%-15%, berms every 20m should be installed.
    - Where the track has slope greater than 15%, berms every 10m should be installed.
- Throughout the life of the structure, biomonitoring assessments should take place on a quarterly basis to identify any emerging impacts on the aquatic ecology of the system. The monitoring should focus on habitat integrity assessment as well as the assessment of impacts on the aquatic macro-invertebrate and fish communities.

12. PUBLIC PARTICIPATION

The public participation process that was followed for proposed upgrade is governed by GN. R. 543 of 18 June 2010.

The purpose of public participation includes:

1. Providing I&APs with an opportunity to obtain information about the project;
2. Allowing I&APs to present their views, issues and concerns with regard to the project;
3. Granting I&APs an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
4. Enabling the project team to incorporate the needs, concerns and recommendations of I&APs into the project.

12.1. Notification of I & APs

Notification of I&APs was undertaken in the following ways:

- A database of I&APs, which contained authorities, stakeholders, landowners and members of the general public, was prepared for the project (Appendix 6).
- Notification of the BA Process was delivered to all members of the I&AP database via fax, email or by hand on the 06 March 2013 (see attached notice – Appendix 6).
- Newspaper advertisement was placed in the following newspaper:
    - The Witbank Newspaper – 22 March 2013

  The newspaper advertisement had details of the proposed project, contact details of the Environmental Assessment practitioner and an invitation for any interested or affected party to comment or register as an I&AP for the proposed project.
- A Background Information Document with a response form was provided to I&APs (see Appendix 6).
- Onsite notices of regulated size, regarding the commencement of the EIA process were placed at strategic points on the 06 March 2013.
- Copies of the draft BA Report will be placed at the following locations to provide I&APs with the opportunity to review and comment on the draft BA report. A 30 day review period (from 22 May 2013 to 22 June 2013) was granted.

Copy No.	Location	Address	Telephone Number
1	Nkonjane CS - Primary school	5043 Willie Ackerman Drive, Lynnville	013 696 2296
2	Emalahleni / Lynville Library	28 Hofmeyer Street, Emalahleni 1033	

12.2. Distribution of BAR

Copies of the Draft BAR will be distributed to the following authorities:

- Department of Economic Development, Environment and Tourism (DEDET);
- Department of Water Affairs (DWA);

- Mpumalanga Department of Water Affairs;
- Mpumalanga Parks and Tourism Agency (MTPA);
- Mpumalanga Department of Agriculture Forestry and Fisheries (DAFF);
- Mpumalanga Department of Mineral Resources (DMR);
- Department of Agriculture, Rural Development and Land Administration (DARDLA);
- South African Heritage Resource Agency (SAHRA);
- Mpumalanga Provincial Heritage Resource Agency;
- South African National Biodiversity Institute.
- Emahleni Local Municipality; and
- Nkangala District Municipality.

12.3. Summary of Comments and Responses

No comments have been received to date.

13. IMPACT ASSESSMENT AND MITIGATION

13.1. Overview

This section focuses on the pertinent environmental impacts that could potentially be caused by the proposed project during the pre-construction, construction and operation phases of the project.

The impacts to the environmental features are linked to the project activities, which in broad terms relate to the physical infrastructure (emphasis on construction and operation stages). Impacts were identified as follows:

- An appraisal of the project description and the receiving environment;
- Impacts associated with listed activities contained in GN No. R544;
- Issues highlighted by environmental authorities;
- Findings from specialist studies; and
- Comments received during public participation.

13.2. Impacts associated with Listed Activities

As mentioned, the project requires authorisation for certain activities listed in the EIA Regulations (2006), which serves as triggers for the environmental assessment process. The impacts associated with the key listed activities follows (note that list is not exhaustive – refer to complete list under **Table 3**).

The potential impacts linked to the listed activities are then addressed in the subsequent sections.

Table 7: Impacts associated with the key listed activities

GN No.	Activity	Description	Potential Impact Overview
544	**11**	The construction of: (i) canals; (ii) channels; (iii) bridges; (iv) dams; (v) weirs; (vi) bulk storm water outlet structures; (vii) marinas; (viii) jetties exceeding 50 square metres in size; (ix) slipways exceeding 50 square metres in size; (x) buildings exceeding 50 square metres in size; or (xi) infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.	Environmental (i.e. potential impact on wetlands and associated vegetation and fauna) and socio-economic impacts (i.e. potential increase in traffic, potential job creation) associated with the upgrade bridge and culvert structures.
	13	The construction of facilities or infrastructure for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 but not exceeding 500 cubic metres;	
	18	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from (i) a watercourse; (ii) the sea; (iii) the seashore; (iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater- but excluding where such infilling, depositing, dredging, excavation, removal or moving (i) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or (ii) occurs behind the development setback line.	
	39	The expansion of	

GN No.	Activity	Description	Potential Impact Overview
		(i) canals; (ii) channels; (iii) bridges; (iv) weirs; (v) bulk storm water outlet structures; (vi) marinas; within a watercourse or within 32 metres 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 will occur behind the development setback line.	

13.3. Issues raised by Environmental Authorities and I & APs

Any issues raised by authorities and I & APs will be included in the final BAR for review.

13.4. Project Activities and Environmental Aspects

The main project components include the following:

- The upgrade of the Kalkspruit Bridge and culvert structures;
- Removal of accumulated silt and sediment built up at the bridge;
- Lining the embankment with gabions and reno mattresses; and
- Guard Railing and Balustrade protection.

In order to understand the impacts related to the project it is necessary to unpack the activities associated with the project life-cycle, as shown below:

Table 8: Activities associated with the Project Life-Cycle

Pre-construction
Project Activities
• Detailed engineering design
• Detailed geotechnical investigation
• Geophysical investigations
• Survey of the site
• Arrangements with individual landowners and/or land users
• Procurement process for Contractors
Construction
Project Activities
• *On-going consultation with affected parties*

• Vegetation clearance
• Pegging of overall construction footprint
• Site establishment
• Establish construction camp (including material lay-down areas)
• *Construction employment*
• Delivery of construction material
• Storage and handling of material
• Transportation of equipment, materials and personnel
• Topsoil clearance
• Fencing of site camp
• Upgrade and re-alignment of existing road
• Grading of site (where necessary)
• Excavations and Foundation related activities
• Stormwater Drain
• Traffic Control
• Waste Management
• *Wetland rehabilitation*
• *Refuelling*
• *Crossing* inaccessible sites
• *Crossing* sensitive areas
• *Managing construction sites*
• *Reinstatement and rehabilitation*
• *Final road / bridge surface finishes*
• Handing and taking over of the servitude
Operation
Project Activities
• Access arrangements and requirements
• Routine maintenance inspections
• Management of vegetation clearance
• Repair and maintenance works

Environmental aspects are regarded as those components of an organisation's activities, products and services that are likely to interact with the environment. The following environmental aspects have been identified for the proposed project (note that only high-level aspects are provided):

Table 9: Environmental Aspects associated with the upgrade and associated structures

Pre-construction
Environmental Aspects
• Poor construction site planning and layout
• Inaccurate site survey
Construction
Environmental Aspects
• *Lack of environmental awareness creation*
• *Poor consultation with affected parties*
• Indiscriminate site clearing
• Poor site establishment
• Poor management of access and use of access roads
• Poor transportation practices
• Poor fencing arrangements
• Erosion
• Disruptions to existing services
• *Disturbance of topsoil*
• Poor management of excavations
• Inadequate *storage and handling of material*
• Inadequate *storage and handling of hazardous material*
• Lack of equipment maintenance
• Poor management of labour force
• Pollution from ablution facilities
• Inadequate management of construction camp
• Poor waste management practices
• *Wastage of water*
• *Disturbance to landowners*
• Poor management of pollution generation potential
• *Damage to significant flora*
• *Damage to significant fauna*
• *Environmental damage at crossings of* inaccessible sites
• *Environmental damage at crossings of* sensitive areas
• *Disruption of* archaeological and cultural features
• Poor reinstatement and rehabilitation
Operation
Environmental Aspects
• Inadequate management of access, routine maintenance and maintenance works

- Inadequate management of wetlands and associated vegetation

13.5. Significant Environmental Impacts

Environmental impacts are the change to the environment resulting from an environmental aspect, whether desirable or undesirable. Note that it is not the intention of the impact assessment to evaluate all potential environmental impacts associated by the project's environmental aspects, but rather to focus on the potentially **significant** direct and indirect impacts identified. The significant environmental impacts are listed in **Table 20**.

The EMPr strives to provide a comprehensive list of mitigation measures associated with the overall project-related aspects and impacts for the entire project life-cycle (i.e. pre-construction, construction, operation and decommissioning).

The cumulative impacts are discussed in **Sections 13.9**.

Table 10: Significant environmental impacts associated with the project

Construction Phase	
Feature	**Impact**
Topography	• Erosion associated with the upgrade of the bridge and culverts
Surface Water	• Potential contamination of the surface water • Soil erosion resulting in increased sedimentation of the watercourse
Pans and Wetlands	• Damage to wetland habitat • Erosion and sedimentation of the wetland
Geology and Soil	• Erosion of stockpiled soil
Flora	• Excess removal of indigenous vegetation • Damage to sensitive / protected plants • Encroachment of alien vegetation
Fauna	• Disturbance of fauna
Socio-Economic	• Potential job creation for skilled and unskilled labourers from the local community
Archaeological and Cultural Features	• Damage to heritage resources
Infrastructure and Services	• Poor stormwater attenuation resulting damage to surround habitats
Transportation	• Disruption to traffic as a result of construction activities
Visual	• Construction – related activities resulting in negative visual impact
Operational Phase	

Feature	Feature
Surface Water	• Inadequate stormwater management resulting in contamination of the watercourse
Wetlands	• Loss of wetland habitat
Soil	• Erosion on site
Flora	• Encroachment by alien vegetation
Fauna	• Impact on faunal biodiversity • Impact on aquatic species
Socio-economic	• Better access road for residents of the nearby township and other community members
Infrastructure and Services	• Inadequate stormwater management resulting in contamination of the watercourse
Transportation	• Better access road with a walkway for pedestrians
Visual	• Inadequate rehabilitation of the construction footprint
Tourism	• More efficient access road to new sports facility

The findings of the specialists are of particular importance in terms of understanding the impacts of the project and managing the adverse implications of the project life-cycle, as these studies focused on the significant environmental issues identified during the execution of the EIA. As can be seen from the various impact assessments performed by the specialists, there are a host of cross-cutting impacts that are addressed in a number of these studies, with particular reference to the visual, social and economic effects of the proposed upgrade. The mitigation measures proposed by the specialists for these similar types of impacts are not regarded as contradictory, as they are aligned with best practices and principles.

13.6. Impact Assessment Methodology

The impacts and the proposed management thereof are assessed by using the methodology provided below. Where applicable, the impact assessments and significance ratings provided by the respective specialists are included.

In the case of the specialist studies, most of the impact assessment methodologies deviated from the approach to follow. However, the quantitative basis for these specialist evaluations of the impacts to specific environmental features still satisfied the intention of EIA.

For the methodology of the impact assessment, the analysis is conducted on a quantitative basis with regard to the nature, extent, magnitude, duration, probability and significance of the impacts. The following definitions and scoring system apply:

Nature (/Status)
The project could have a positive, negative or neutral impact on the environment.

Extent

- Local - extend to the site and its immediate surroundings.
- Regional - impact on the region but within the province.
- National - impact on an interprovincial scale.
- International - impact outside of South Africa.

Magnitude

Degree to which impact may cause irreplaceable loss of resources.

- Low - natural and social functions and processes are not affected or minimally affected.
- Medium - affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.
- High - natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration

- Short term - 0-5 years.
- Medium term - 5-11 years.
- Long term - impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- Permanent - mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability

1. Almost certain - the event is expected to occur in most circumstances.
2. Likely - the event will probably occur in most circumstances.
3. Moderate - the event should occur at some time.
4. Unlikely - the event could occur at some time.
5. Rare/Remote - the event may occur only in exceptional circumstances.

Significance

Provides an overall impression of an impact's importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-

0 - Impact will not affect the environment. No mitigation necessary.

1- No impact before / after mitigation.

2- Residual impact before / after mitigation.

3- Impact cannot be mitigated.

The following impact methodology was used for the watercourses by the wetland specialist (Specialist Aquatic Services, 2012):

LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function Largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear features affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear features affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Linear features affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Positive/Negative Mitigation Ratings

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Improve current management	Maintain current management
High	101-125	Improve current management	Maintain current management
Medium-high	76-100	Improve current management	Maintain current management
Medium-low	51-75	Maintain current management	Improve current management
Low	26-50	Maintain current management	Improve current management
Very low	1-25	Maintain current management	Improve current management

13.7. Impact Mitigation

Impacts are to be managed by assigning suitable mitigation measures. According to DEAT (2006), the objectives of mitigation are to:

- Find more environmentally sound ways of doing things;
- Enhance the environmental benefits of a proposed activity;
- Avoid, minimise or remedy negative impacts; and
- Ensure that residual negative impacts are within acceptable levels.

Mitigation should strive to abide by the following hierarchy – (1) prevent; (2) reduce; (3) rehabilitate; and/or (4) compensate for the environmental impacts.

Figure 10: Mitigation Hierarchy

The proposed mitigation of the impacts includes specific measures identified by the technical team (including engineering solutions) and environmental specialists, stipulations of environmental authorities and environmental best practices. The mitigation measures that follow in the subsequent sections are not intended to be exhaustive, but rather focus on the significant impacts identified.

The EMPr (refer to ***Appendix 7***) provides a comprehensive list of mitigation measures for the entire project, which extends beyond the impacts evaluated in the body of the BA Report.

	Overview of the EMPr

The scope of the Kalkspruit Bridge EMPr is as follows:

- Establish management objectives during the project life-cycle in order to enhance benefits and minimise adverse environmental impacts;
- Provide targets for management objectives, in terms of desired performance;
- Describe actions required to achieve management objectives;
- Outline institutional structures and roles required to implement the EMPr;
- Provide legislative framework; and
- Description of requirements for record keeping, reporting, review, auditing and updating of the EMPr.

All liability for the implementation of the EMPr (as well as the BA findings and environmental authorisation) lies with the project proponent.

13.8. Impact Assessment

13.8.1. Fauna & Fauna

The bridge is an existing structure and was found in to be in a degraded condition. The vegetation consisted mainly of the indigenous species Typha capensis. The presence of alien

vegetation was also quite evident. There will be aquatic species within the watercourse and this has been addressed under the watercourse impact section. The potential impact on fauna and flora is therefore anticipated to be minimal.

Soil	
Nature of Impact (potential)	**Potential impact on indigenous vegetation and encroachment of alien vegetation**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Extent	Local
Can impact be prevented/ reversed or managed?	Yes
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely

Possible Mitigation measure	• Leave as much of the natural vegetation intact as possible in order to maintain ecological corridors for the movement of species. Make an effort to increase the natural areas around sensitive features such as rivers and wetlands. • In areas where there are nesting sites for birds, vegetation should not be disturbed. • All soils should be stored and managed correctly for rehabilitation to maintain natural habitats for animals. • All alien vegetation must be removed. • Construction activities should be limited to daylight hours, in order to minimise impacts on nocturnal fauna. • Minimise topsoil disturbance as far as possible. • Level and landscape disturbed topsoil areas to facilitate plant succession. • Erosion control measures, such as stone packing, brush packing and reseeding, should be included on disturbed areas. • In disturbed areas, soil conditions must be returned to conditions which can support natural vegetation; • Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases; • All areas affected by construction should be rehabilitated upon completion of the construction phase of the upgrade; and • River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required.
Significance before mitigation	2
Significance after mitigation	2

13.8.2. Watercourses

The rehabilitation and upgrade of the Kalkspruit will have an impact on the watercourse. 11 Possible impacts that may have an effect on the overall wetland and aquatic integrity were identified and discussed in the sections below:

❖ **Impact on wetland areas due to encroachment by construction activities**

The encroachment of infrastructure or construction or operational waste materials into wetland areas could occur and would affect the habitat integrity of these areas.

Impacts on Alternative 1 and 2

Any impact, which occurs (such as edge effects from construction, wetland encroachment, etc.), will be largely specific to the development and rehabilitation area. Impacts for alternative 1 may occur for a short duration of time. Impacts on alternative 2 will be permanent. The impact is highly likely should the mitigation measures not be adhered to. When mitigation measures are implemented, the impact significance of construction in the wetland areas can be reduced to a very low level through a reduction in the severity, duration and scale of the impact.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, this will further decrease the function and ecological state of the wetland feature with regards to further alien encroachment, soil erosion and sedimentation of the wetland feature. The current domestic waste and rubble material dumped within the wetland feature, will further increase and decrease the habitat integrity of the system, downstream.

The following impacts have been identified by the wetland specialist and presented below together with the recommended mitigation measure:

Wetland	
Nature of Impact (potential)	**Impact on wetland areas due to encroachment by construction activities**
Relevant Alternatives and Activities	Site Alternative 1 and 2
Direct, Indirect or cumulative	Direct
Extent	Local
Can impact be prevented/ reversed or managed?	Yes
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	• Ensure that all current activities consider the wetland boundaries. No vehicles are to enter or drive through the wetland area unnecessarily; • Demarcate all wetland boundaries with pegs and danger tape; • Edge effects of pre-construction and construction activities, including erosion, sedimentation and alien/weed control, need to be strictly managed in wetland areas as well as their associated buffer zones. • As far, as is practical, implement concurrent rehabilitation processes in order to limit degradation of soil biota. • No dumping of waste or any other materials is allowed within the wetland areas; and • Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction phases.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site Alternative 1								
Unmanaged	**4**	**2**	**3**	**2**	**2**	**6**	**7**	**42 (Low)**
Managed	**3**	**2**	**2**	**1**	**2**	**5**	**5**	**25 (Very Low)**
Site Alternative 2								
Unmanaged	**5**	**4**	**4**	**4**	**5**	**9**	**13**	**117 (High)**
Managed	**4**	**3**	**3**	**3**	**4**	**7**	**10**	**70 (Medium**

								Low)

❖ **Loss of ecological services**

Impacts on Alternative 1

Impacts on the loss of ecological services are likely to occur during the bridge re-construction and rehabilitation of the wetland area. The receiving environment is of a limited sensitivity. Impacts, which may occur, are likely to affect the local area and the impact is likely to last for a month to a year, depending on the duration of the project and the application of corrects and strict mitigation measures. The bridge re-construction and rehabilitation within the local area has a low impact significance. When mitigation measures are fully implemented, the impact significance of the bridge reconstruction and wetland rehabilitation can be reduced to a very-low level.

Impacts on Alternative 2

Impacts, which will occur, will definitely affect the local area and the impact is likely to last the life of the operation. The cast *in situ* option will have a high impact on the ecological function of the wetland system. Even if mitigation measures are implemented fully, the impact will still be medium-low, compared to the box culvert option to be used, which will be of a short duration and a very low impact should all mitigation measures be implemented fully.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, there will be a further decrease the function and ecological state of the wetland feature with regards to further alien encroachment, soil erosion and sedimentation of the wetland feature. The wetland feature is considered to be of limited sensitivity and by implementing the no-go alternative, will further decrease the sensitivity and ecological function and service to a critically modified system. This will ensure that rehabilitation of the system will be very difficult and will not be able to reinstate the system to a more appropriate ecological management class.

Wetland	
Nature of Impact (potential)	**Loss of ecological services**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• Ensure that effective rehabilitation takes place in order to restore wetland service provision; • Ensure that all activities take the wetland boundaries into account; and • Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction

				phases.				
Management	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Duration of impact**	**Spatial Scale**	**Likelihood**	**Consequence**	**Significance**
Site Alternative 1								
Unmanaged	**3**	**2**	**3**	**2**	**3**	**5**	**8**	**40 (Low)**
Managed	**2**	**2**	**2**	**1**	**2**	**4**	**5**	**20 (Very Low)**
Site Alternative 2								
Unmanaged	**5**	**4**	**4**	**4**	**5**	**9**	**13**	**117 (High)**
Managed	**4**	**3**	3	**3**	**4**	**7**	**10**	**70 (Medium Low)**

❖ **Impacts due to sedimentation, canalisation and erosion**

The aquatic resources in the area can be considered to be highly impacted upon as a result of the effects of sedimentation. Impacts due to additional sedimentation can be significant and have the potential to affect the biodiversity and functioning of the system. With disturbance or the removal of vegetation cover and soils associated with the project, there is a risk of sedimentation of the aquatic resources occurring.

Impacts due to canalisation and erosion can be significant and have the potential to affect the hydrological functioning and biodiversity of the system. Specific risks occur to riparian vegetation, instream habitat and aquatic biota. Disturbances caused by vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Impacts on Alternative 1 and 2

During the pre-construction and construction phase, there will be a disturbance of soils in the area affected by the upgrade of the bridge. Silting up of the aquatic resources within the subject property due to any disturbance of the surface areas may occur, thus impacting on the aquatic resources further downstream. Without mitigation, this impact can be considered to possibly lead to a moderate change in the ecology of the system within a localised area but impacts may occur for a relatively extended period of time. Should these impacts be effectively managed and mitigated, these impacts can be reduced to very low levels.

With the construction, vegetation removal and exposed soils will result in erosion and canalisation of the river systems in the area. Excavations within riparian zones and drainage lines could lead to altered drainage patterns and the removal of vegetation and the disturbance of the soil could lead to erosion and incision of the stream banks. Effects could become significant on a localised scale and if unmitigated impacts could occur in perpetuity. If mitigation measures are adequately implemented, the probability of impact is reduced, and the consequence of the impact becomes significantly lowered.

No-go Alternative

Erosion has occurred within the wetland system especially closer to developed areas and the main road. Due to the alteration and erosion of banks close to Twala Drive, it has caused silt to wash into the wetland system, thus further affecting the aquatic resources. Thus, by following the no-go option will further decrease the aquatic resources of the system and leading to more sedimentation, canalisation and erosion within the system.

Wetland	
Nature of Impact (potential)	**Potential impacts due to sedimentation, canalisation and erosion**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes

Possible Mitigation measure	• The time in which soils are exposed during construction activities should remain as short as possible;
	• Concurrent rehabilitation is to take place as far as possible and footprint areas should be minimised as far as possible;
	• All areas affected by construction should be rehabilitated upon completion of the construction phase;
	• River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required. Steep banks should be stabilised with hessian sheets;
	• Adequate storm water management must be incorporated into the design of the proposed bridge upgrade in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities which rely on stream substrates clear of sediment;
	• During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms:
	  ○ Where the track has slope of less than 2%, berms every 50m should be installed.
	  ○ Where the track slopes between 2% and 10%, berms every 25m should be installed.

	○ Where the track slopes between 10%-15%, berms every 20m should be installed. ○ Where the track has slope greater than 15%, berms every 10m should be installed. • No unnecessary construction activities should be allowed within the riparian zones in line with the requirements of Section 21(c) and (i) of the National Water Act.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site Alternative 1								
Unmanaged	**4**	**3**	**3**	**3**	**3**	**7**	**9**	**63 (Medium-high)**
Managed	**2**	**2**	**2**	**2**	**2**	**4**	**6**	**24 (Very-low)**
Site Alternative 2								
Unmanaged	**5**	**4**	**4**	**4**	**5**	**9**	**13**	**117 (High)**
Managed	**4**	**3**	**3**	**3**	**4**	**7**	**10**	**70 (Medium low)**

❖ **Impacts due to inundation**

The proposed bridge upgrade has the potential to alter bed and bank profiles which in turn can lead to inundation of the riverine systems in the vicinity of the proposed upgrade. Inundation can affect instream habitat conditions, which in turn can affect aquatic biota. Inundation can also affect bankside and riparian vegetation due to the altered soil wetness profiles.

Impacts on Alternative 1 and 2

Any activities or structures impeding flow within the riparian zones could alter bed profiles and by so doing lead to inundation of the areas upstream of the development. The cast in situ option will have a higher impact on the alternation of the bed and bank profiles by roving vegetation and replacing it with a permanent flooring structure. Without any mitigation efforts, any impacts, which occur, will occur within a short distance upstream of the activity or structure and continue for a prolonged period. With mitigatory measures applied the impact can be reduced be minimising the severity of the impact, along with the duration and spatial scale of the impact.

No-go Alternative

The Kalkspruit has already been significantly affected by bank incision, and by implementing this alternative; it will increase the erosion factor.

Wetland	
Nature of Impact (potential)	**Potential impact due to inundation**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel • The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time; • Throughout the construction and operational phases streamflow continuity in the system must be maintained; • During construction all building materials should be kept out of the riparian or wetland zones; • All waste and remaining building materials should be removed from site on completion of the project; • No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones; • All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge; and • The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site Alternative 1								
Unmanaged	**4**	**2**	**3**	**3**	**2**	**6**	**8**	**48 (Low)**
Managed	**2**	**2**	**2**	**2**	**1**	**4**	**5**	**20 (Very-low)**
Site Alternative 2								
Unmanaged	**5**	**4**	**4**	**4**	**5**	**9**	**13**	**117 (High)**
Managed	**4**	**3**	**3**	**3**	**4**	**7**	**10**	**70 (Medium low)**

❖ **Alien vegetation encroachment**

Terrestrial vegetation encroachment is a highly significant problem in disturbed areas and this will need to be mitigated for the life of the proposed upgrade and into the rehabilitation phase.

Impacts on Alternative 1 and 2

Construction activities (whether using box or cast in situ option during the upgrade of the bridge) could lead the removal of natural vegetation and the disturbance of the soil could lead to alien invasive species which are more aggressive in colonising disturbed areas. Effects could become significant on a localised scale and if unmitigated impacts could occur in perpetuity. With mitigation the both the probability and the consequence of the impact can be reduced leading to an overall reduction in the significance of this impact.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, the function and ecological state of the wetland feature is considered likely to continue to degrade especially in terms of further alien encroachment within the subject property and possibly further downstream. if this project is not undertaken future rehabilitation of the system will be more costly and more difficult and it will be very difficult to reinstate the system to a more appropriate ecological management class.

Wetland	
Nature of Impact (potential)	**Potential impact due to alien vegetation encroachment**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• In disturbed areas, soil conditions must be returned to conditions which can support natural vegetation; • Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases; • All areas affected by construction should be rehabilitated upon completion of the construction phase of the upgrade; and • River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required.

Management	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Duration of impact**	**Spatial Scale**	**Likelihood**	**Consequence**	**Significance**
Site Alternative 1								
Unmanaged	**5**	**3**	**4**	**5**	**3**	**8**	**12**	**96 (Medium-high)**
Managed	**3**	**3**	**2**	**3**	**1**	**6**	**6**	**36 (Low)**
Site Alternative 2								

Unmanaged	**5**	**3**	**4**	**5**	**3**	**8**	**12**	**96 (Medium-high)**
Managed	**3**	**3**	**2**	**3**	**1**	**6**	**6**	**36 (Low)**

❖ **Ineffective Rehabilitation**

Ineffective rehabilitation of wetland areas could cause siltation, erosion and changes in the hydrological functioning of these areas. Wetland habitat may remain transformed should proper rehabilitation not take place.

Impacts on Alternative 1 and 2

The impact of improper rehabilitation (whether using box or cast in situ option during the upgrade of the bridge) on the wetland area and bridge reconstruction is possible while the receiving environment has a limited sensitivity. Impacts can have a significant impact on the surrounding ecosystems structure and function. Impacts, which occur due to ineffective rehabilitation, are likely impact the local area and will occur for a short period of time, most likely for a year to one month depending on the length of the project and possibly post closure if rehabilitation measures are ineffective. The bridge upgrade and rehabilitation will have a Low impact. If sufficient rehabilitation measures are implemented (such as effective rehabilitation including structural rehabilitation, wetland functional rehabilitation and biodiversity rehabilitation, with an ecologist forming part of the rehabilitation planning resources), the impact from the bridge design on the wetland can be reduced to very low levels.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, it will lead to a further decrease the function and ecological state of the wetland feature with special mention of further alien encroachment, soil erosion and sedimentation of the wetland feature. The wetland feature is considered to be of Seriously impaired/modified and by implementing the no-go alternative, will further decrease the sensitivity and ecological function and service to a critically modified system. further degradation of the system will mean that effective rehabilitation of the system will be very difficult and it will be very difficult to reinstate the system to a more appropriate ecological management class.

Wetland	
Nature of Impact (potential)	**Potential impact on ineffective rehabilitation**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• Identify activities, which are causing erosion and incision of

	any of the wetland feature and mitigate these impacts immediately. • Obtain relevant legislative approval for any activities to be undertaken within the wetland feature to rectify excessive erosion; and • Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion (where applicable).

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site Alternative 1								
Unmanaged	**3**	**3**	**3**	**3**	**3**	**6**	**9**	**54 (Medium-low)**
Managed	**1**	**2**	**2**	**2**	**1**	**3**	**5**	**15 (Very-Low)**
Site Alternative 2								
Unmanaged	**3**	**3**	**3**	**3**	**3**	**6**	**9**	**54 (Medium-low)**
Managed	**1**	**2**	**2**	**2**	**1**	**3**	**5**	**15 (Very-Low)**

❖ **Impacts on instream flow**

Impacts on instream flow were seen to be characteristic of the aquatic resources in this area.

Impacts on Alternative 1 and 2

The aquatic resources in the area can be considered to be of relatively low sensitivity due to impacts as a result of urbanisation in the area and the probability of impacts on instream flow is considered to be relatively small. However, any impacts on the upper aquatic resources, will impact on the resources in the vicinity of the crossing. Impacts on the cast in situ cast will be higher than the culvert systems Impacts on instream flow have the potential to be permanent on a localised scale and impacts have the potential to have an impact on the receiving aquatic environment. Should effective management and mitigation measures be implemented, all impacts can be reduced to a low level.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, there will be a further decrease in the function and ecological state of the wetland feature over time with special mention of further soil erosion, incision and sedimentation of the wetland feature. The current domestic waste and rubble material dumped within the wetland feature, will further increase and decrease the habitat integrity of the system, downstream.

Wetland

Nature of Impact (potential)	Potential impact on instream flow
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel; • Throughout the construction and rehabilitation phases stream flow continuity in the system must be maintained; • During construction all building materials should be kept out of the riparian or wetland zones; • All waste and remaining building materials should be removed from site on completion of the project; • No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones; • All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream; and • The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site Alternative 1								
Unmanaged	**4**	**2**	**4**	**5**	**2**	**6**	**11**	**66 (Medium-low)**
Managed	**1**	**1**	**1**	**3**	**1**	**2**	**5**	**10 (Very Low)**
Site Alternative 2								
Unmanaged	**5**	**4**	**4**	**4**	**5**	**9**	**13**	**117 (High)**
Managed	**4**	**3**	**3**	**3**	**4**	**7**	**10**	**70 (Medium Low)**

❖ **Impacts on instream habitat and refugia for aquatic species**

Impacts on instream habitat can be significant and has the potential to affect the biodiversity and functioning of the system. The Kalkspruit experiences stress in the low flow season and refugia are important for fish and other aquatic taxa when water levels are low. Any loss of these features could be highly significant in this system on a localised scale. Disturbances

caused by activities within the riparian zone, vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Impacts on Alternative 1 and 2

Loss of instream habitat and refugia as a result of activities during the construction phase of the proposed upgrade has the potential to alter the ecological function and sensitivities of the aquatic resources present. These impacts are likely to be permanent from the cast *in situ* option. Impacts could potentially be permanent if not mitigated. Should adequate mitigation and management measures be implemented, these impacts can be reduced to very low levels, will be of short duration, and will only occur in the immediate vicinity of the bridge crossing.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, a further decrease the function and ecological state of the wetland feature over time is likely to occur with special mention of sedimentation, incision loss of refugia, incision of banks, loss of bankside habitat and cover and scouring, leading to smooth bedrock surfaces.

Wetland	
Nature of Impact (potential)	**Potential impact on instream habitat and refugia for aquatic species**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• The time in which soils are exposed during construction activities should remain as short as possible; • As small an area should be disturbed as possible; • Careful use of stream diversions and coffer dams is deemed essential; • No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel; • During construction all building materials should be kept out of the riparian or wetland zones; • All waste and remaining building materials should be removed from site on completion of the project; • No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones; • The bed profile should be re-instated in such a way as to

	prevent upstream ponding and downstream erosion; and • Adequate erosion control and siltation control measures should be put in place.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site alternative 1								
Unmanaged	**4**	**2**	**3**	**5**	**2**	**6**	**10**	**60 (Medium-low)**
Managed	**1**	**1**	**1**	**2**	**1**	**2**	**4**	**8 (Very Low)**
Site alternative 2								
Unmanaged	**4**	**2**	**3**	**5**	**2**	**6**	**10**	**60 (Medium-low)**
Managed	**1**	**1**	**1**	**2**	**1**	**2**	**4**	**8 (Very Low)**

❖ **Impacts on instream and migratory corridors**

Both aquatic species such as fish as well as species with an affinity for riverine systems such as certain avifaunal species, which may migrate along linear riverine features, may be affected by impacts on the aquatic resources within the area.

Impacts on Alternative 1 and 2

The aquatic resources in the area can be considered to be of relatively low sensitivity due to impacts as a result of urbanisation in the area and the probability of impacts on in-stream flow is considered to be relatively small. Any impacts on migratory connectivity, may impact on the aquatic communities in the vicinity of the crossing. Impacts on instream flow have the potential to be permanent and may affect the fish community on a fairly wide scale. The structures used within the upgrade of the bridge also needs to consider the water flow and migratory corridor of aquatic species, thus these structures must not obstruct the flow of water. Overall, the impact on migratory connectivity prior to mitigation can be considered to be moderately low. Should effective management and mitigation measures be implemented, the risk and impact to migratory species can be reduced to a low level.

No-go Alternative

Should the no-go alternative be implemented, it will lead to the further loss of stream migratory corridors. The condition of the current bridge structure has caused severe sedimentation, and concrete structure to occur within the active channel of the wetland feature. Thus by not upgrading the bridge, and leaving these structure within the active channel, it will lead to a complete loss of aquatic resources within this section of the Kalkspruit.

Wetland	
Nature of Impact (potential)	**Potential impact on instream migratory corridors**

Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel; • The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time; • If at all possible the reconstruction of the bridge should not take place between September and October to prevent impacts on spawning movement; • Throughout the construction and decommissioning phases streamflow continuity in the system must be maintained; • During construction all building materials should be kept out of the riparian or wetland zones; • All waste and remaining building materials should be removed from site on completion of the project; • No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones; • All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge; and • The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site alternative 1								
Unmanaged	**2**	**3**	**3**	**5**	**3**	**5**	**11**	**55 (Medium low)**
Managed	**1**	**3**	**1**	**2**	**1**	**4**	**4**	**16 (Very Low)**
Site alternative 2								
Unmanaged	**2**	**3**	**3**	**5**	**3**	**5**	**11**	**55 (Medium low)**

Managed	**1**	**3**	**1**	**2**	**1**	**4**	**4**	**16 (Very Low)**

❖ **Impacts on taxa sensitive to changes in water quality**

Impacts on instream water quality can be significant and has the potential to affect the biodiversity and functioning of the system. Specific risks occur to taxa, which have an increased sensitivity to water quality changes, with special mention of increased dissolved salt loads as well as changes to the sediment load in the system. Disturbances caused by vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Impacts on Alternative 1 and 2

The river systems in this area support taxa, which are moderately susceptible to changes in water quality. However, water quality in the Kalkspruit was found to be severely impaired as a result of upstream increased urbanisation. Without any mitigation efforts, any impacts, which occur, will occur for some distance downstream of the activity. Prior to mitigation, the impact can be considered to be of limited severity and impact may occur for a few months and affect a fairly localised area. With suitable mitigation, the impact can be reduced through a reduction in the severity of the impact and the extent of the impact leading to a very low level of significance of this impact.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, a further decrease the function and ecological state of the wetland feature over time is likely to occur. The wetland has also been severely impacted on by the dumping of waste material into the wetland area. This poses a serious risk in terms of further degradation in the water quality and in the general sanitation of the area.

Wetland	
Nature of Impact (potential)	**Potential impact on taxa sensitive to changes in water quality**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• The time in which soils are exposed during construction activities should remain as short as possible; • As small an area should be disturbed as possible; • Any exposed soils should be covered and re-vegetated with a suitable grass mix; • No dumping should take place in or near the construction site; • All spills should be immediately cleaned up and treated

	accordingly; • No fires should be permitted on site; • Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility; and • Adequate erosion control and siltation control measures should be put in place.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Site alternative 1								
Unmanaged	**4**	**2**	**2**	**2**	**3**	**6**	**7**	**42 (Low)**
Managed	**2**	**1**	**1**	**2**	**1**	**3**	**4**	**12 (Very Low)**
Site alternative 2								
Unmanaged	**4**	**2**	**2**	**2**	**3**	**6**	**7**	**42 (Low)**
Managed	**2**	**1**	**1**	**2**	**1**	**3**	**4**	**12 (Very Low)**

❖ **Impacts due to increased turbidity**

Impacts on turbidity and water clarity can be significant and has the potential to affect the biodiversity and functioning of the system. Specific risks occur to taxa, which have an increased sensitivity to increased turbidity with special mention of the feeding strategies of some fish species and macro-invertebrates. Disturbances caused by vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Impacts on Alternative 1 and 2

During the pre-construction and construction phase, there will be a disturbance of soils in the area affected by the upgrade of the bridge. Silting up of the aquatic resources within the subject property due to any disturbance of the surface areas may occur, thus impacting on the aquatic resources further downstream. Without mitigation, this impact can be considered to possibly lead to a moderate change in the ecology of the system within a localised area but impacts may occur for a relatively extended period of time. Should these impacts be effectively managed and mitigated, these impacts can be reduced to very low levels.

No-go Alternative

Erosion has occurred within the wetland system especially closer to developed areas and the main road. Due to the alteration and erosion of banks close to Twala Drive, it has caused silt to wash into the wetland system, thus further affecting the aquatic resources. If the no go option is followed further decreases in the aquatic ecological integrity of the system will occur due to increased sedimentation, canalisation and erosion within the system.

Wetland

Nature of Impact (potential)	**Potential impact due to turbidity**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Can impact be prevented/ reversed or managed?	Yes
Possible Mitigation measure	• The time in which soils are exposed during construction activities should remain as short as possible; • Concurrent rehabilitation is to take place as far as possible and footprint areas should be minimised as far as possible; • All areas affected by construction should be rehabilitated upon completion of the construction phase of the development; • River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required. Steep banks should be stabilised with hessian sheets; • Adequate storm water management must be incorporated into the design of the proposed bridge structure in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities which rely on stream substrates clear of sediment; • During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms: o Where the track has slope of less than 2%, berms every 50m should be installed. o Where the track slopes between 2% and 10%, berms every 25m should be installed. o Where the track slopes between 10%-15%, berms every 20m should be installed. o Where the track has slope greater than 15%, berms every 10m should be installed. •

Management	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Duration of impact**	**Spatial Scale**	**Likelihood**	**Consequence**	**Significance**
Site alternative 1								
Unmanaged	**3**	**3**	**3**	**4**	**2**	**6**	**11**	**66 (Medium-low)**
Managed	**2**	**3**	**2**	**2**	**1**	**6**	**4**	**24 (Very Low)**
Site alternative 2								
Unmanaged	**3**	**3**	**3**	**4**	**2**	**6**	**11**	**66 (Medium-low)**
Managed	**2**	**3**	**2**	**2**	**1**	**6**	**4**	**24 (Very Low)**

13.8.3. Soil

Soil erosion could occur following the clearing of vegetation or grading of the site. Construction equipment could potentially lead to soil compaction.

Soil	
Nature of Impact (potential)	**Erosion of exposed soil**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Extent	Local
Can impact be prevented/ reversed or managed?	Yes
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	• No cutting and filling in areas of 4% sideslope and less. • Stabilisation of cleared areas to prevent and control erosion. The method chosen (e.g. watering, planting, retaining structures, commercial anti-erosion compounds) will be selected according to the site specific conditions. • Drainage management should also be implemented to ensure the minimisation of potential erosion on access roads. • Acceptable reinstatement and rehabilitation to prevent erosion during the operation phase. • All mitigation measures made by the geotechnical specialist must be adhered.
Significance before mitigation	2
Significance after mitigation	1

13.8.4. Socio-Economic

The Kalkspruit Bridge is an existing structure and as such the most significant impacts will arise during the construction phase where skilled and unskilled labour will be required. Furthermore the proposed upgrade will result in access to a more stable and safer bridge.

Economic	
Nature of Impact (potential)	Potential job creation as a result of the construction related activities
Relevant Alternatives and	All alternatives

Activities	
Direct, Indirect or cumulative	Direct
Level & duration of impact	Local. Short term – during construction phase
Can impact be prevented/ reversed or managed?	N/A
Possibility of impact before Mitigation	N/A
Possibility of impact after mitigation	N/A
Possible Mitigation measure	No mitigation required as it is a positive impact
Significance before mitigation	3
Significance after mitigation	3

Social	
Nature of Impact (potential)	Provision of a safer bridge and banks
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Level & duration of impact	Local. Short term – during construction phase
Can impact be prevented/ reversed or managed?	N/A
Possibility of impact before Mitigation	N/A
Possibility of impact after mitigation	N/A
Possible Mitigation measure	No mitigation required as it is a positive impact.
Significance before mitigation	3
Significance after mitigation	3

Social	
Nature of Impact (potential)	Increased health and safety risk of flooding due to culvert structure not being able to accommodate such high flows
Relevant Alternatives and Activities	Alternative 2
Direct, Indirect or cumulative	Direct
Level & duration of impact	Long term

Can impact be prevented/ reversed or managed?	The impact cannot be prevented or mitigated
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Likely
Possible Mitigation measure	• Community members must not use this bridge during heavy rains or when a flood is in progress;
Significance before mitigation	3
Significance after mitigation	3

13.8.5. Archaeological and Cultural

The proposed project is not anticipated to have any impacts in terms of cultural or heritage significance as this is an existing bridge structure.

Archaeological and Cultural	
Nature of Impact (potential)	**Potential damage to graves or any items of cultural or heritage significance**
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Extent	Local
Can impact be prevented/ reversed or managed?	Yes
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	Should any graves or artefacts be identified, then all activities must stop and SAHRA must be immediately contacted.
Significance before mitigation	2
Significance after mitigation	1

13.8.6. Transportation

The proposed project is anticipated to have an impact on traffic during the construction phase; however this can be mitigated against by ensuring that mitigation measures are adhered to.

Transportation	
Nature of Impact (potential)	Potential disruption of traffic

Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Level & duration of impact	Local. Short term – during construction phase
Can impact be prevented/ reversed or managed?	Yes the impact can be prevented
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	• Adequate signage must be implemented along the construction route; • Flagmen must be used to control the traffic flow; • All conditions of the EMPr must be adhered to.
Significance before mitigation	2
Significance after mitigation	1

13.8.7. Visual

The proposed project is anticipated to have minimal visual impact. The bridge and culverts are existing structures and as such the only potential impact is anticipated to occur during the construction phase as a result of construction equipment and the camp site.

Visual	
Nature of Impact (potential)	Potential visual impact associated with construction activities and equipment
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Level & duration of impact	Local. Short term – during construction phase
Can impact be prevented/ reversed or managed?	Yes the impact can be mitigated
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	• The construction camp must be fenced to minimise the visual impact; • Disturbance to the site must be kept to a minimum; • Rehabilitation measures must be implemented as soon as construction activities have been completed; • The conditions of the EMPr must be strictly adhered to.
Significance before mitigation	2
Significance after mitigation	1

13.8.8. Infrastructure and Services

All existing services must be identified and clearly demarcated prior to the commencement of any construction activities on site. Should any infrastructure / service be damaged or disrupted, the contractor must ensure that it is immediately repaired. The potential impact on existing services is anticipated to be minimal.

Infrastructure and Services	
Nature of Impact (potential)	Inadequate stormwater management resulting in soil erosion
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Level & duration of impact	Local. Short term – during construction phase
Can impact be prevented/ reversed or managed?	Yes the impact can be prevented
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	A stormwater control plan must be prepared and implemented for the construction and operational phases of the development to ensure that no erosion occurs as a result of the proposed upgrade.
Significance before mitigation	2
Significance after mitigation	1

Infrastructure and Services	
Nature of Impact (potential)	Damage to existing pipelines
Relevant Alternatives and Activities	All alternatives
Direct, Indirect or cumulative	Direct
Level & duration of impact	Local. Short term – during construction phase
Can impact be prevented/ reversed or managed?	Yes the impact can be prevented
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely

Possible Mitigation measure	All pipelines must be clearly identified prior to commencement of construction activities and included on the layout plans / design drawings. Should any of the infrastructure be damaged then it must be immediately replaced at the contractors cost.
Significance before mitigation	2
Significance after mitigation	1

13.8.9. No-go Alternative Impacts

Should the project not go ahead, there will be no impacts as a result of construction activities. The bridge will remain in the same condition and the area will not be rehabilitated. The site will continue to degrade in terms of the vegetation and aquatic habitat. Alien vegetation will be abundant in the site, the watercourse will continue to silt up and sediment will accumulate in the watercourse thereby affecting the water quality and any aquatic species present. Litter and debri will also degrade the quality of the watercourse. The bridge is unsafe and will therefore pose a health and safety risk to members of the community that utilise the bridge. This risk may increase significantly in the event of another flood event.

The potential impacts that arise from the no-go alternative cannot be mitigated against or prevented in any way.

13.9. Cumulative Impacts

What is a "Cumulative Impact"?
According to GN No. R. 385 (2006), ***"cumulative impact"***, in relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.

Cumulative impacts can be identified by combining the potential environmental implications of the project with the impacts of projects that have occurred in the past, are currently occurring, or are proposed in the future within the site and surrounding area.

The following cumulative impacts can be anticipated:

- Increase in the amount of waste sent to the landfill;
- Damage to wetland habitats and water resources;
- Encroachment of alien vegetation;

Cumulative Impacts	
Nature of Impact (potential)	Increase in waste sent to landfill site
Direct, Indirect or cumulative	Cumulative
Level & duration of impact	Long term

Can impact be prevented/ reversed or managed?	Yes the impact can be prevented / mitigated
Possibility of impact before Mitigation	Likely
Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	• Recycling must be undertaken where possible to reduce the amount of waste sent to the landfill site. • Waste must be sent to registered landfills and safe disposal certificates must be retained on site. • All conditions of the EMPr must be adhered to.
Significance before mitigation	2
Significance after mitigation	1
Nature of Impact (potential)	Improvement to wetland functionality
Direct, Indirect or cumulative	Cumulative
Level & duration of impact	Long term
Can impact be prevented/ reversed or managed?	Yes the impact can be prevented / mitigated
Possibility of impact before Mitigation	N/A
Possibility of impact after mitigation	N/A
Possible Mitigation measure	Wetland functionality has been impaired by the existing structure. The proposed development will therefore have a positive impact on the wetland and functionality. All mitigation measures recommended by the wetland specialist must be implemented.
Significance before mitigation	3
Significance after mitigation	3
Nature of Impact (potential)	Encroachment of alien vegetation
Direct, Indirect or cumulative	Cumulative
Level & duration of impact	Long term
Can impact be prevented/ reversed or managed?	Yes the impact can be prevented / mitigated
Possibility of impact before Mitigation	Likely

Possibility of impact after mitigation	Unlikely
Possible Mitigation measure	Rehabilitation measures must be implemented once construction activities are complete to ensure that. Alien vegetation must be controlled during the construction and operational phases. All conditions of the EMPr must be adhered to.
Significance before mitigation	2
Significance after mitigation	1

14. CONCLUSION AND RECOMMENDATIONS

14.1. Environmental Impact Statement

Based on the recommendations of the specialists and the impact assessment associated with the various site alternatives, the following alternative is considered to be the Best Practicable Environmental Option (BPEO):

- **Alternative 1** – This option is considered to be the preferred alternative as this design is more suited to accommodate the increased flow of water associated with this watercourse. The risk of flooding decreases with this alternative as a result. The potential impacts on the environment can be mitigated and therefore the potential impacts are least significant.

With the selection of the BPEO for the proposed upgrade and rehabilitation of the Kalkspruit Bridge; the adoption of the mitigation measures included in the BAR and the dedicated implementation of the EMPr, it is believed that the significant environmental aspects and impact associated with this project can be suitably mitigated. With the aforementioned in mind, it can be concluded that there are no fatal flaws associated with the project and that authorisation can be issued, based on the findings of the specialists and the impact assessment, through the compliance with the identified environmental management provisions.

14.2. Key Recommendations / Opinion of the EAP

Based on the findings of the impact assessment and the specialist studies, **alternative 1** is supported as the preferred option.

All recommendations made by the specialists must be adhered to.

14.3. Conditions for Authorisation

- Diligent compliance monitoring of the EMPr, environmental authorisation and other relevant environmental legislation by an Independent Environmental Control Officer (ECO) is crucial to ensure compliance with the stipulated management measures of the BAR.

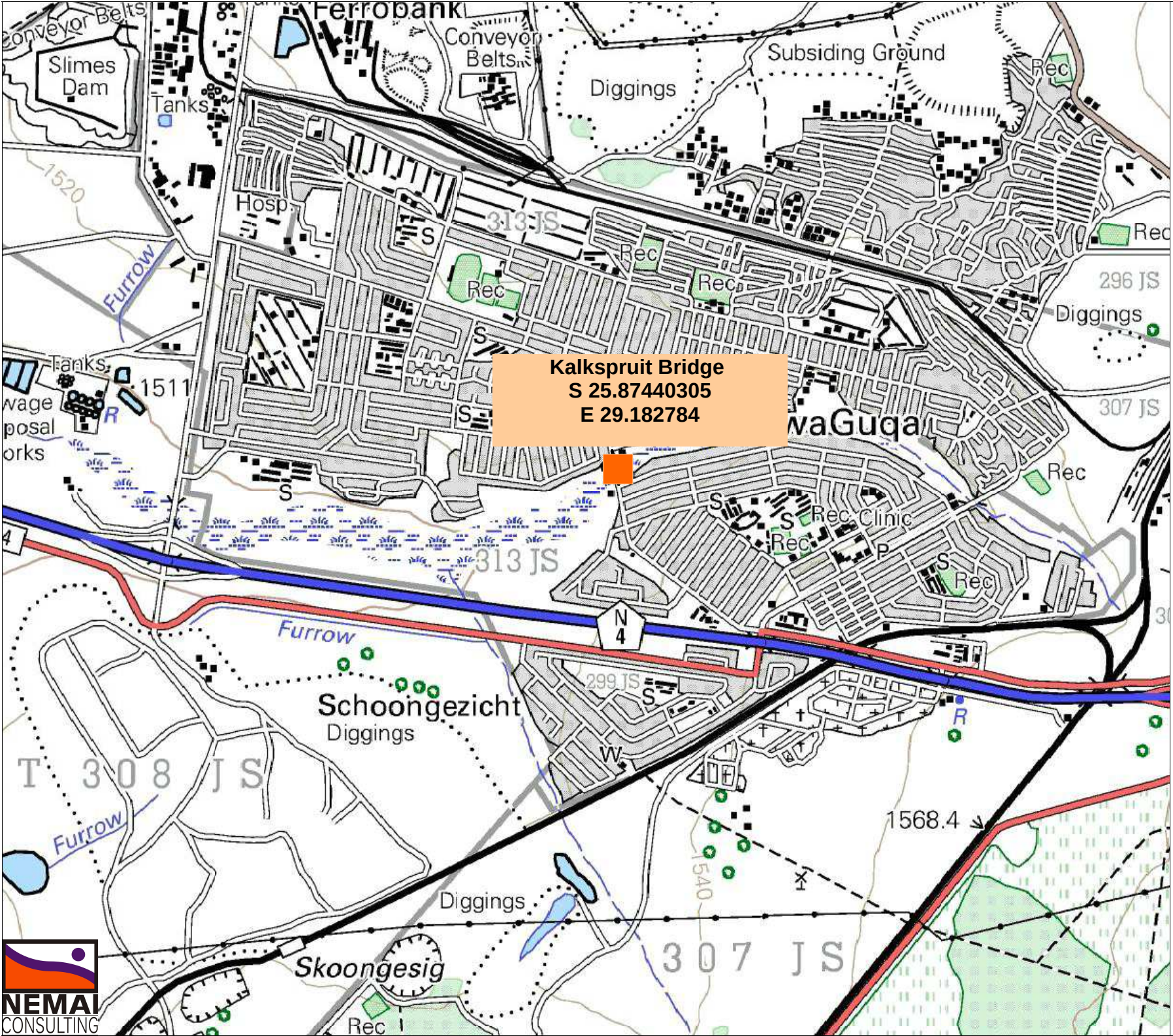
- All relevant recommendations made by the specialists relating to the preferred site alternative must be adhered to in terms of geotechnical and wetland issues.
- Areas affected by construction activities need to be suitably stabilised. A stormwater control plan must be implemented manage stormwater and prevent erosion.
- The construction camp area needs to be identified prior to commencement of construction activities. The camp must be adequately fenced and secure at all times.
- All relevant permits must be obtained prior to the commencement of construction activities or as deemed necessary.

15. REFERENCES

Scientifica Aquatic Services, 2012. Wetland delineation, PES, function and service assessment and aquatic ecological as part of the environmental assessment and authorisation for the proposed rehabilitation of Kalkspruit phase 2, Emalahleni, Mpumalanga Province.

Mano-Ceph Civils, 2012. Nkangala District Municipality geotechnical investigations for the design and construction of a bridge in Kalkspruit in Emalahleni Local Municipality-Mpumalanga.

Appendix 1 : Maps



Project Name:
Proposed Upgrade of the Kalkspruit Bridge, Witbank

Map Name:
Loclity Map

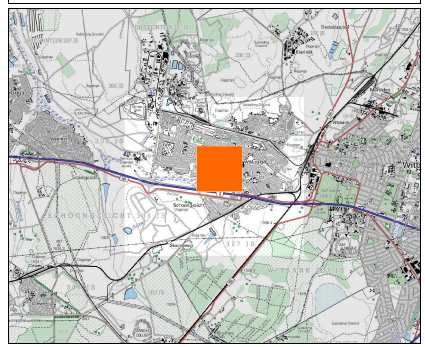
N

Legend

Proposed Project

Bridges

Kalkspruit Bridge

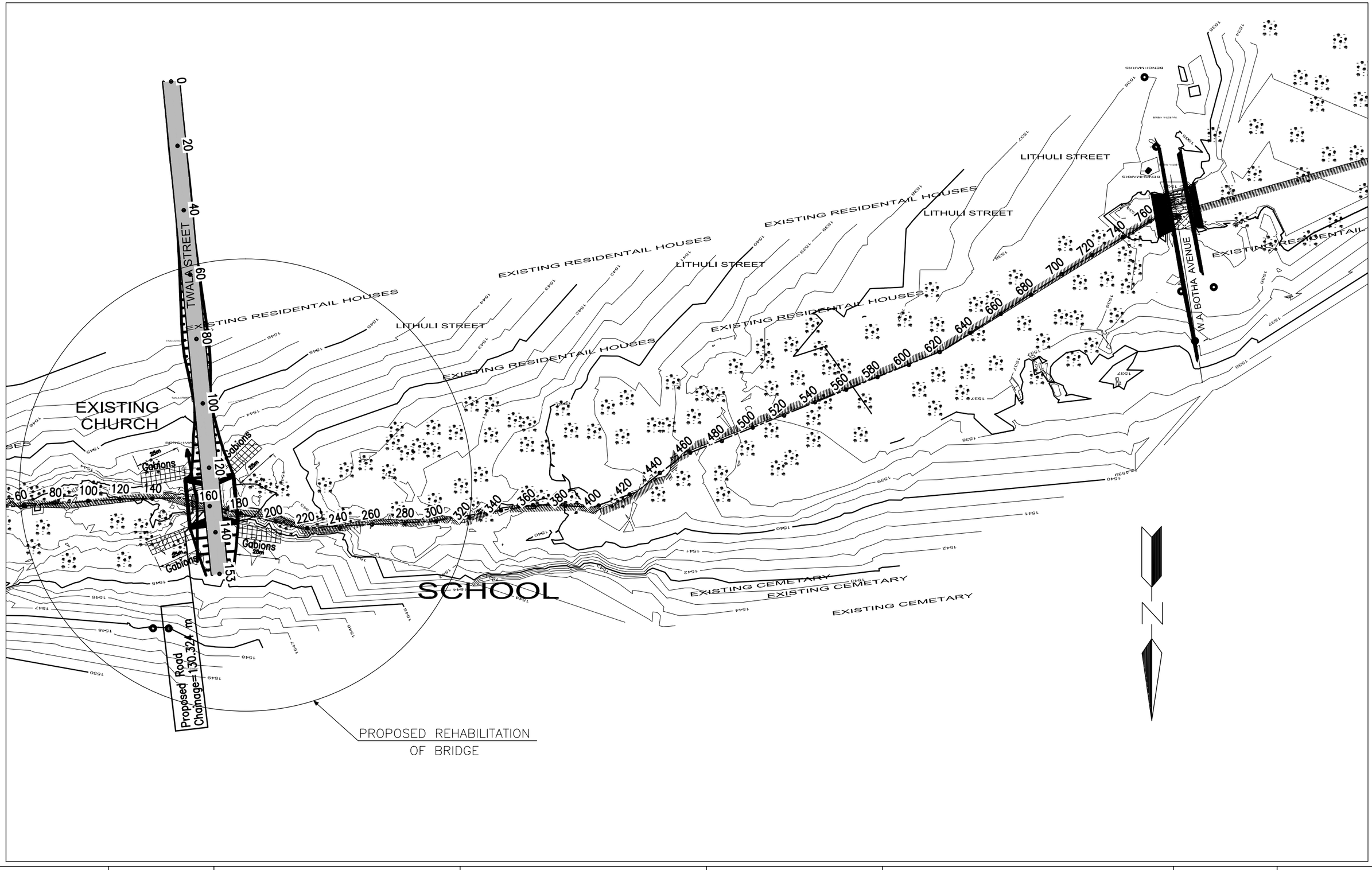


Scale 1:20000

0 300 600 m

NEMAI CONSULTING


Willie Ackermann Dr
Majolani St
Twala Dr
Kalkspruit Bridge
Luthuli St
Mahabane St
Image © 2013 GeoEye
© 2013 AfriGIS (Pty) Ltd.
© 2013 Google
Google earth
Imagery Date: 6/8/2012
2008
25°52'30.33" S 29°11'17.60" E elev 1521 m
Eye alt 1.91 km



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CHECKED BY:	M.Y.					REVISION:	0
DRAWN BY:	S.A.M.			Drawing No: EIA-	GENERAL SITE LAYOUT	SHEET No:	1 OF
CHECKED BY:	M.Y.						

Appendix 2: Photographs

Plate 1 : North View from Bridge

Plate 2 : North East View from Bridge

Plate 3 : East View from Bridge

Plate 4 : South East View From Bridge

Plate 5 : South view from Bridge

Plate 6 : South West view from Bridge

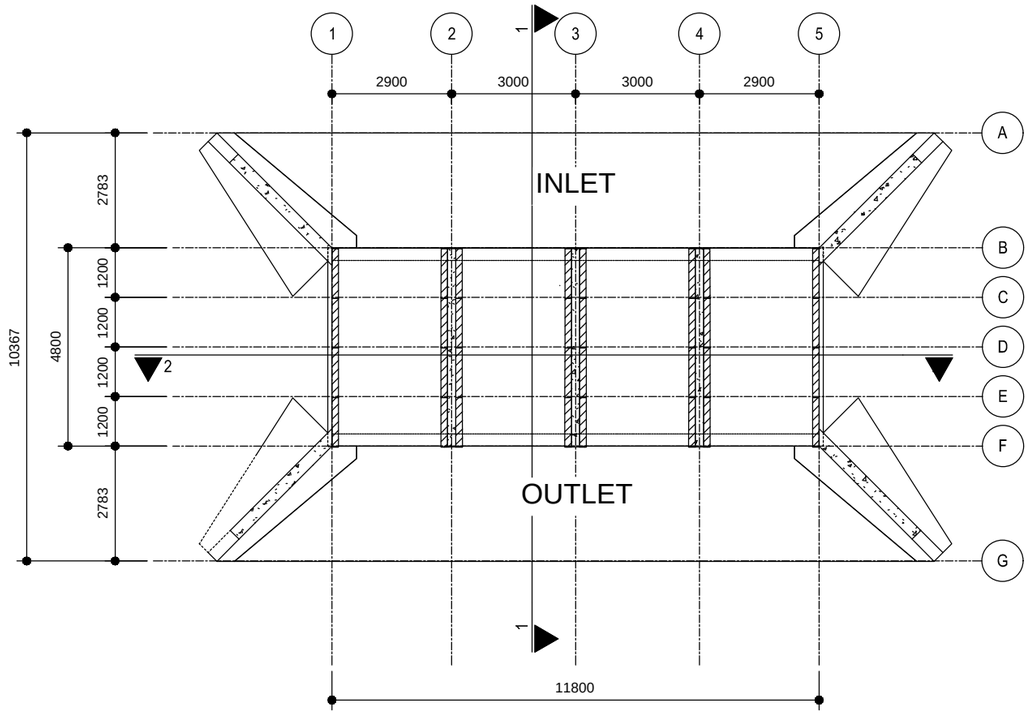
Plate 7 : West View from Bridge

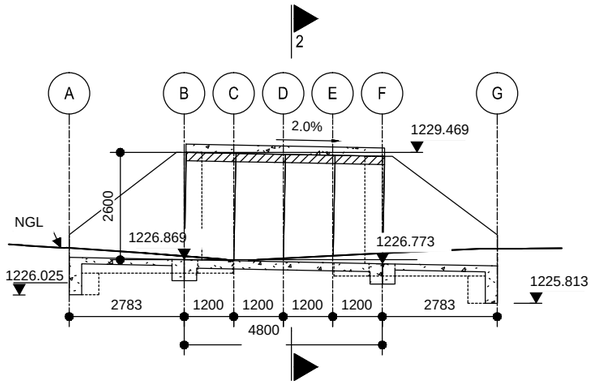
Plate 8 : North West view from the Bridge

Plate 9 : Stream on Western side of Bridge

Plate 10 : Stream on Eastern side of Bridge

Appendix 3: Facility Illustration(s)





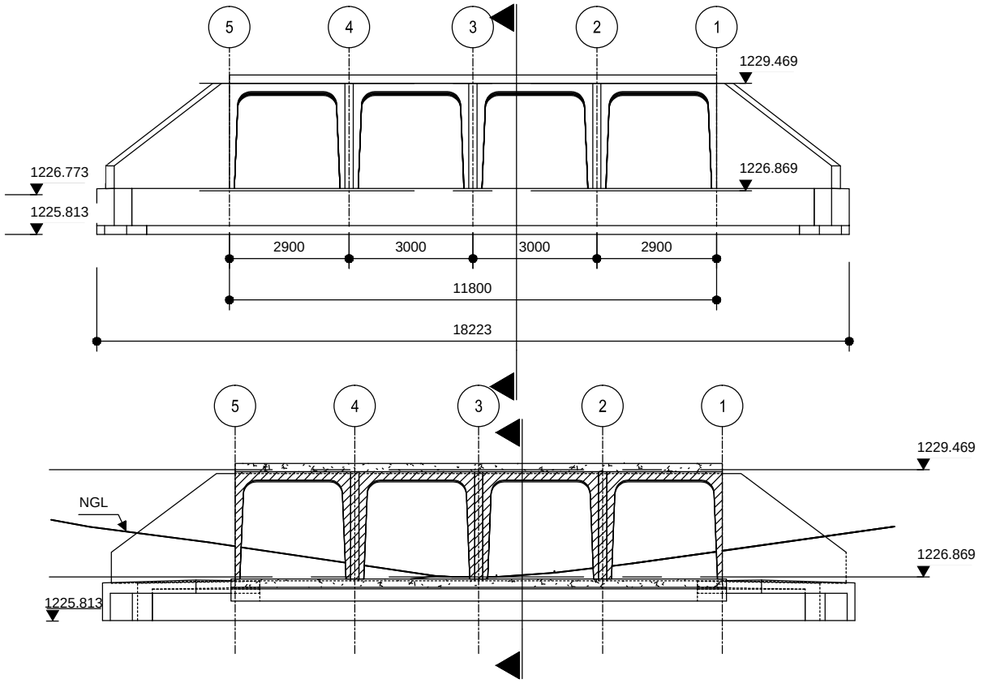
Culvert type
Avengman Culvert 2400x2400 Profile S-Class

Grand total: 16

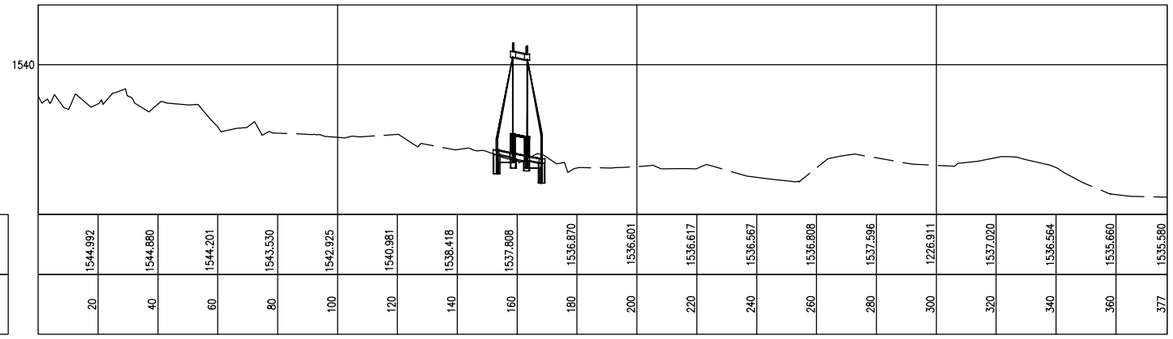
Slabs Schedule	
Description	Volume
Foundation slab	13.68 m³
Cover slab	11.35 m³
Apron Slab Outlet	10.28 m³
Apron Slab Inlet	10.32 m³
Grand total: 4	45.62 m³

Wall Schedule		
Description	Width	Volume
Concrete Wall Between Barrels	200	2.50 m³
Concrete Wall Between Barrels	200	2.50 m³
Concrete Wall Between Barrels	200	2.50 m³
Grand total		7.50 m³

Wing Wall Schedule	
Type	Volume
WING WALL	2.19 m³
WING WALL	2.19 m³
WING WALL	2.06 m³
WING WALL	2.06 m³
Grand total	8.51 m³



DESIGNED BY:	S.A.M.	NKANGALA DISTRICT MUNICIPALITY 2A CHURCH STREET MIDDELBURG 1050 TEL: (013) 249 2028 FAX: (013) 249 2145	HMP AFRICA CONSULTANTS 118, 14TH AVENUE EDENVALE 1610 TEL: (011) 609 8658 FAX: (086) 564 1514	PROJECT No: 6317/12	REHABILITATION OF KALKSPRUIT BRIDGE - PHASE 2	SCALE:	N.T.S
CHECKED BY:	M.Y.					REVISION:	0
DRAWN BY:	S.A.M.			Drawing No: EIA-	BRIDGE DETAILS	SHEET No:	1 OF
CHECKED BY:	M.Y.						

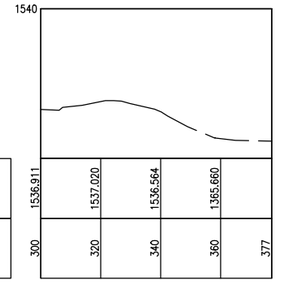


SCALES:
Horizontal 1:1000
Vertical 1:100

DATUM 1535.000

GROUND LEVELS ON CL	1544.992	1544.880	1544.201	1543.530	1542.925	1540.981	1538.418	1537.808	1536.870	1536.601	1536.617	1536.567	1536.808	1537.596	1226.911	1537.020	1536.564	1535.660	1535.580
DISTANCE (m)	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	377

LONGSECTION RIVER CL
FROM 0.000 TO 377.118

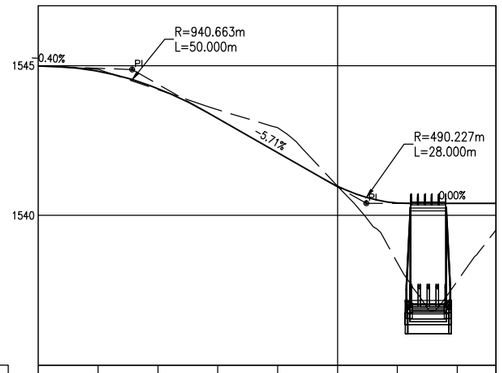


SCALES:
Horizontal 1:1000
Vertical 1:100

DATUM 1535.000

GROUND LEVELS ON CL	1536.911	1537.020	1536.564	1365.660	
DISTANCE (m)	300	320	340	360	377

LONGSECTION RIVER CL
FROM 300.000 TO 377.118



SCALES:
Horizontal 1:1000
Vertical 1:100

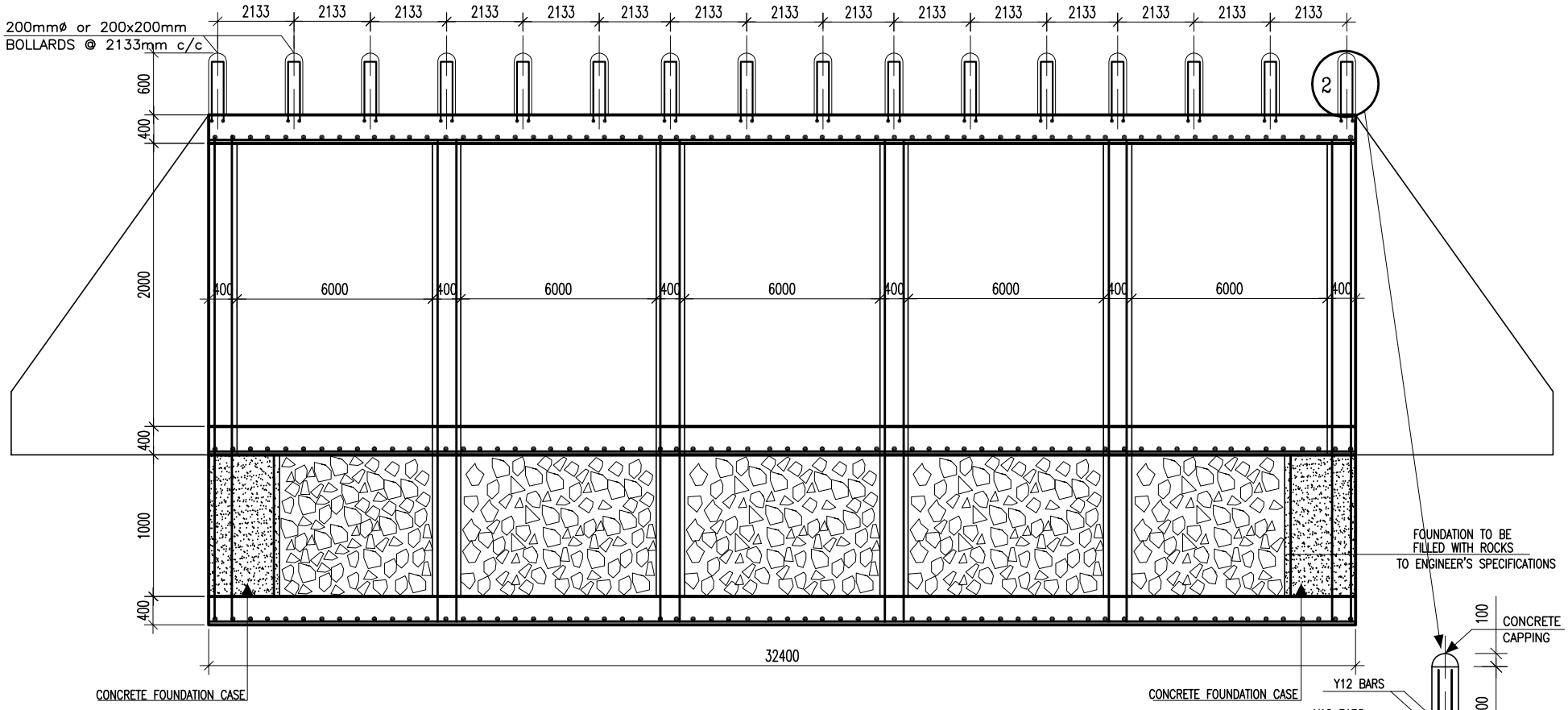
DATUM 1535.000

CUT / FILL	0.000	-0.065	0.035	-0.292	-0.829	-0.009	1.996	2.592	0.887
CENTRE LINE (CL)	1544.992	1544.815	1544.236	1543.238	1542.096	1540.972	1540.414	1540.400	1540.400
GROUND LEVELS ON CL	1544.992	1544.880	1544.201	1543.530	1542.925	1540.981	1538.418	1537.808	1539.513
DISTANCE (m)	0	20	40	60	80	100	120	140	153

LONGSECTION PROPOSED ROAD
FROM 0.000 TO 152.951

DESIGNED BY:	S.A.M.	NKANGALA DISTRICT MUNICIPALITY 2A CHURCH STREET MIDDELBURG 1050 TEL: (013) 249 2028 FAX: (013) 249 2145	HMP AFRICA CONSULTANTS 118, 14TH AVENUE EDENVALE 1610 TEL: (011) 609 8658 FAX: (086) 564 1514	PROJECT No: 6317/12	REHABILITATION OF KALKSPRUIT BRIDGE - PHASE 2	SCALE: N.T.S
CHECKED BY:	M.Y.					REVISION: 0
DRAWN BY:	S.A.M.			Drawing No: EIA-	SECTIONAL DETAILS	SHEET No: 1 OF
CHECKED BY:	M.Y.					

Alternative 2



N.T.S.

SECTION A–A

NOTES:

1. All concrete cover to reinforcement in footings to be 50mm.
2. All reinforced concrete walls and slabs are to be of 19 MPa except if otherwise indicated.
3. All fill to be compacted to a minimum of 95% modified AASHTO density.

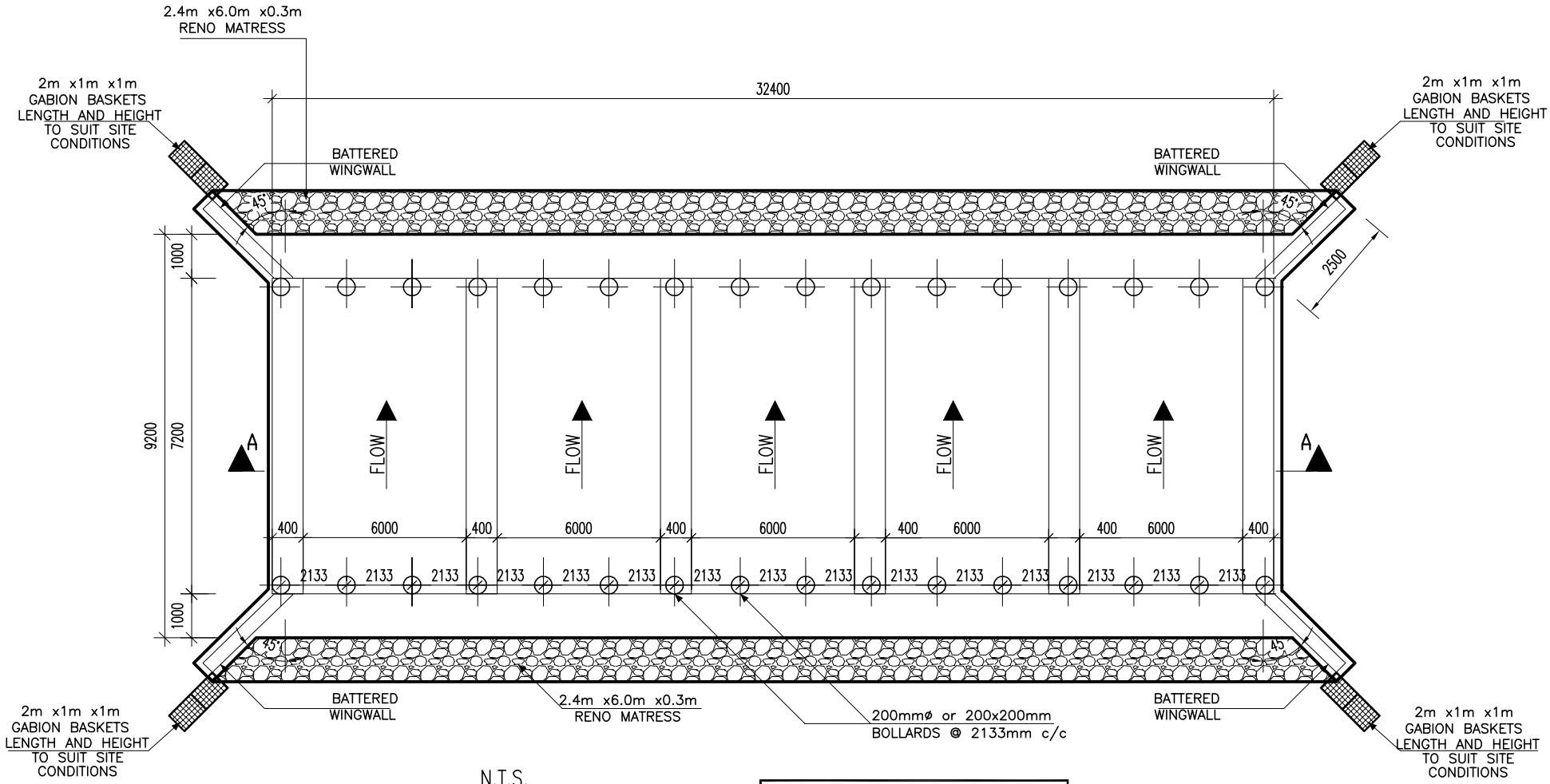
DETAIL '2'
N.T.S.

HMP AFRICA CONSULTANTS

CONSULTING ENGINEERS
PROJECT MANAGERS
DEVELOPMENT CONSULTANTS

118, 14TH AVENUE
EDENVALE, 1610
Tel. (011) 609 8658
Fax.(086) 564 1514
Cell. 082 577-1300

NKANGALA DISTRICT MUNICIPALITY for EMALAHLENI LOCAL MUNICIPALITY	SCALE N.T.S.
	REV. No. 00
REHABILITATION OF KALKSPRUIT PHASE 2 AND BRIDGE ON TWALA	DATE: APRIL 2013
SECTION A–A CAST IN-SITU CONCRETE BRIDGE	DRAWING No. HMPA/TWAL/25



N.T.S.

PLAN–BASE SLAB

NOTES:

1. All concrete cover to reinforcement in footings to be 50mm.
2. All reinforced concrete walls and slabs are to be of 19 MPa except if otherwise indicated.
3. All fill to be compacted to a minimum of 95% modified AASHTO density.

HMP AFRICA CONSULTANTS

CONSULTING ENGINEERS
PROJECT MANAGERS
DEVELOPMENT CONSULTANTS

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EDENVALE
Tel. (011) 609 8658
Fax.(086) 564 1514
Cell. 072 287-0125

NKANGALA DISTRICT MUNICIPALITY for EMALAHLENI LOCAL MUNCIPALITY	SCALE N.T.S.
	REV. No. 00
REHABILITATION OF KALKSPRUIT AND BRIDGE ON TWALA AVENUE	DATE: APRIL 2013
PLAN – BASE SLAB CAST-INSITU CONCRETE BRIDGE	DRAWING No. HMPA/TWAL/24

Appendix 4: EAP CV

Personal Details

Name and Surname	: Manogrie Chetty
Date of birth	: 05 June 1984
Occupation	: Senior Environmental Officer
Qualification	: Bsc (Hons) Biological Sciences
Nationality	: South Africa
Name of Firm	: Nemai Consulting
Years with the firm	: 2 months

EDUCATION AND PROFESSIONAL QUALIFICATIONS

Highest Qualification	Institution	Date
Bsc Biological Sciences	University of Kwa-Zulu Natal	2002-2005
BSc (Hons) Biological Sciences	University of Kwa-Zulu Natal	2006
MSC-CW Environmental Sciences	University of Kwa-Zulu Natal	2008 to Present

RELEVANT EXPERIENCE

- ECO monitoring audits for the eThekwini Municipality Sapref Substation (November 2011 – February 2012).
- ECO monitoring audit and reports for the construction of the FFS Small Depot (December 2008 – June 2009).
- ECO monitoring audit and reports for the Fernleigh housing development (October 2008 – March 2009).
- EMPr for the Rehabilitation of the Ogunjini Water Treatment Plant within the eThekwini Municipality (January 2012).
- EMPr for the Fraser informal settlement proposed sewerage treatment scheme within the eThekwini Municipality (May 2011).
- BAR and EMP for the construction of a taxi holding area in Brookside, PMB (February 2011).
- EIR and EMPr for the reconstruction of the salt rock hotel (May 2012).
- BAR and EMPr for the Tongaat Hulett Developments sewage options for the uMhlatuzana catchment (January 2011).
- EIR, EMPr and the rehabilitation plan for the application submitted to DME for the proposal to continue the mining of gravel by Stockville Quarries (January 2011).
- EIR and EMPr for the Lulubush Wildlife Estate (January 2011).
- Scoping report for the construction of a 2500m^2 processing facility to remove contaminants from waxy oil at FFS (December 2010).
- EIR and EMP for the construction of a petroleum product tank storage facility at FFS Refiners (Pty) Ltd (December 2010).
- Environmental Impact Report (EIR) and Environmental Management Programme (EMPr) for the Burlington extension subsidy housing development (November 2010).
- EMPr for use of the Durban International Old Airport Site as a Vehicle Storage Depot,

Remainder of Durban Airport No 14263 (October 2010).

- Presentation of the NEMA 2010 EIA Regulations for Tongaat Hulett Developments (September 2010).
- BID for the Roseneath Gardens Housing Development (July 2010).
- Preliminary Environmental Assessment Report for the proposed upgrade of low cost housing units in Sim Place, KZN (July 2010).
- EIR and EMP for the proposed construction of a pressure reducing station for the Phoenix area gas supply (May 2010).
- EMP for the rezoning of 34 Old Main Road, Hillcrest, KZN (April 2010).
- Scoping Report for the proposed construction of a pressure reducing station for the Phoenix area gas supply (January 2010).
- Scoping Report for the Burlington extension subsidy housing development (December 2009).
- Scoping Report for the Tshelimnyama Housing Development (October 2009).
- BID for the Ntuzuma – E housing development (October 2009).
- BAR for the construction of a garden refuse transfer station for Ntuzuma A (site 7), KZN (September 2009).
- Feasibility report for the proposed lead recovery process as an upgrade to the existing de-silverising process at the Associated Additives site (September 2009).
- BAR for the construction of a garden refuse transfer station for Umlazi – BB (site 7) and Umlazi – V (site 8), KZN (July 2009).
- BAR for the construction of a torbanite pilot plant at FFS Refiners, PMB (June 2009).
- Environmental Management Plan (EMP) for the rezoning application for 27 Old Main Road, Gillits, KZN (May 2009).
- Scoping Report for the construction of a new lead recycling plant at 245 Lansdowne Road (March 2009).
- Basic Assessment Report (BAR) for the construction of a Heavy Metal Free (HMF) stabilizer plat at the Associated Additives site in Durban (April 2009).

Declaration:

I confirm that the above information is an accurate description of my experience and qualifications.

Manogrie Chetty

Senior Environmental Officer

PERSONAL DATA	CIARAN CHIDLEY
Nationality	South African
Languages	English and Afrikaans
Current Position	Project Manager

EDUCATION AND PROFESSIONAL QUALIFICATIONS

- Registered Professional Engineer with the Engineering Council of South Africa – Reg. no. 980360
- B.Sc (Eng) Civil Engineering – University of the Witwatersrand
- B.A. Economics, Philosophy – University of South Africa
- Master of Business Administration – University of the Witwatersrand
- Certified training as an Occupational Health and Safety Officer.

Frances Baard District Municipality EMF and SEMP	• Specialist contributor for the economic, GIS and development aspects of the Frances Baard Municipality Environmental Management Framework and SEMP. The FBDM is centred around Kimberley in the Northern Cape. The EMF spatially represented and controlled areas for development. This was supported by a Strategic Environmental Management Plan.
Namakwa District Municipality EMF and SEMP	• Project leader for the development of the Namakwa District Municipality Environmental Management Framework. The NDM is the largest District in the country andf is located in the Northern Cape. The EMF spatially represented and controlled areas for development. This was supported by a Strategic Environmental Management Plan.
Hazelmere Dam Raising EIA	• Project leader of the raising of the Hazelmere Dam EIA. The project involved the raising of the dam by 7m to increase the dam yield. The EIA involved the review of various specialist disciplines including flora, fauna, heritage, visual, operational rules and a social impact assessment. Comprehensive public participation was conducted for the project including the conducting of focus groups sessions and open days.
EMF for the Jukskei River Catchment	• Responsible for economic and riverine structure aspects of the EMF. The Jukskei River is the largest river running through the city of Johannesburg and is extensively degraded due to urban development. The EMF recommended measures to be taken to manage the river, both in its riverine health and structure
Empangeni Richards Bay Waste Water Link	• Project leader of the EIA for a new waste water pipeline linking Empangeni's Industrial areas to the Richards Bay Main Outfall. The pipe length was 20 kilometres. The EIA included route review, flora and fauna specialist studies and risk assessment across a road bridge crossing. A public participation campaign was conducted along the route and yielded co-operation with all affected landowners. Was involved in negotiations for crop compensation.

Phokeng to Sun City Road	• Project leader for the widening and re-routing of the main transport link between Rustenburg and Sun City. The road width was doubled along its length and re-routed around the town of Boshoek. The EIA involved extensive consultations with landowners landowners regarding environmental impacts and expropriation processes. The re-routing of the road around Boshoek was highly controversial and necessitated a comprehensive socio-economic study. Additional specialist studies involved flora, fauna and heritage. Applications were also made to DME for permissions to create and use borrow pits.
Gauteng Department of Housing EIAs	• Project leader for all the EIAs conducted for Housing Developments in Tshwane during a three year period. The project involved EIAs for 32 sites and included the conducting and oversight of specialist studies ranging from socio-economic, flora, fauna, heritage, visual impacts, noise impacts and traffic studies. The projects all involved Public Participation and liaison with community structures.
Fairbreeze C Ext Public Participation	• Project leader for the Public Participation campaign for the EIA required for the establishment of a Mineral Sands Mine adjacent to Mtunzini, Kwa-Zulu Natal. The project was controversial and a series of 12 public meetings were necessary for the project. Impacts and mitigations formed an important part of the process and as such close liaison with the various specialists was necessary. In this cae, the specialist studies were geology, geo-hydrology, water resources, avi-fauna, heritage, socio economic, noise, visual, operational rules and traffic.
Fairbreeze C Ext Socio-Economic Study Public Participation	• Conducted the Socio-Economic specialist study for the project. The study presented the socio-economic status quo of the area, generated impacts that the mine would have on the community and suggested mitigation measures. The report was included in the final EIA for the mine.
ERPM Mine Water	• Project leader for a project that identified the various sources of the ground water reporting to the ERPM Mine. The Mine is one of the lowest in a chain of gold mines along the so called Main Reef of the Witwatersrand, As such, mine water from “higher” mines decant though existing mine workings to reach ERPM, a distance of 50 kms. The report demonstrated that water was indeed reporting from other mines and from surface holings considerable distances away from the mine. The report was used to justify the sharing of pumping costs incurred by ERPM to keep their works free of water.

I, undersigned certify that to the best of my knowledge and belief this data correctly describes me, my qualification and my experience.

Signature of Staff Member ***Date: 20 September 2010***

PERSONAL DATA	VANESSA JEAN BRUETON
Company	NEMAI Consulting
Position in firm	Environmental Consultant
Nationality	South African
Languages	English and Afrikaans

EDUCATION AND PROFESSIONAL QUALIFICATIONS

- B.Sc – (Zoology and Archaeology) University of the Witwatersrand
- B.Sc (Hons) (Ecology, Environment and Conservation) – University of the Witwatersrand (With Distinction)
- MSc (Ecology, Environment and Conservation) – University of the Witwatersrand (Awaiting Examination)

RELEVANT EXPERIENCE: ENVIRONMENTAL IMPACT ASSESSMENTS

- Basic Assessment and Waste License Application for the proposed remediation of 600km of asbestos contaminated land on Transnet Properties – Group A (Port Elizabeth to De Aar)
- Basic Assessment and Waste License Application for the proposed High Altitude Training Facility in Mpumalanga
- Basic Assessment for proposed Donkerhoek Resort
- Waste License Application for Sasol Chemical Industries
- Scoping and EIA for Deepening, Lengthening and Widening of Berth 203 to 205, Pier 2, Container Terminal, Port of Durban

RELEVANT EXPERIENCE: ENVIRONMENTAL CONTROL OFFICER

- Environmental Audit of the Mooi Mgeni Transfer Scheme – Phase 2
- Environmental Control Officer – Joe Slovo Low Level Bridge, Modimolle

RELEVANT EXPERIENCE: SOCIAL IMPACT ASSESSMENTS

- Social Impact Assessment for the Nkomati Anthracite Mine, Mpumalanga

RELEVANT EXPERIENCE: ENVIRONMENTAL AUTHORISATION PROJECT MANAGEMENT

- Scoping and Environmental Impact Assessment for the High Altitude Training Centre in Belfast, Mpumalanga
- Basic Assessment for the proposed establishment of a resort on portion 43 of Farm Donkerhoek 312 JQ, North West Province

REVELANT EXPERIENCE: RESEARCH

- Water Research Council Backyard Dwellers report
- Crouch, N.R., Williams. V.L., Edwards, T.J. and Brueton, V.J. 2010. *Drimia cooperi* in Kwa-Zulu Natal and the Ethnomedicinal trade. *Bothalia.* 40(1): 75-78.
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009a. *Boophone disticha*. In:

Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria

- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009b. *Crinum bulbispermum*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009c. *Crinum buphanoides*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009d. *Crinum macowannii*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009d. *Crinum moorei*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009e. *Crinum stuhlmannii*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009f. *Drimia altissima*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009g. *Drimia delagoensis*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009h. *Drimia elata*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009i. *Drimia robusta*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria
- Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M., Ngwenya, A.M., Brueton, V.J. and Mills, L. 2009l. *Urginea epigea*. In: Raimondo, D., von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C.,

Kamundi, D.A. and Manyama, P.A. eds. 2009. Red List of South African Plants 2009. *Strelitzia 25.* South African National Biodiversity Institute, Pretoria

Declaration:
I confirm that the above CV is an accurate description of my experience and qualifications.

Signature of Staff Member

Date: 07 March 2012

Appendix 5: Specialist Reports

WETLAND DELINEATION, PES, FUNCTION AND SERVICE ASSESSMENT AND AQUATIC ECOLOGICAL AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION FOR THE PROPOSED REHABILITATION OF KALKSPRUIT PHASE 2, EMALAHLENI, MPUMALANGA PROVINCE.

Prepared for

Nemai Consulting

April 2013

Prepared by:	**Scientific Aquatic Services**
Report authors	**A Moyles**
	N. Bezuidenhout (Cand.Sci.Nat)
	K. Bremner
	L. Kruger
Report Reviewer	**S. van Staden (Pri.Sci.Nat)**
Report Reference:	**SAS 212226_amended**
Date:	**April 2013**

Scientific Aquatic Services CC
CC Reg No 2003/078943/23
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2007
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Fax: 011 615 6240
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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a wetland delineation, PES and function and aquatic assessment as part of the Rehabilitation of the Kalkspruit stream and wetland area along with the re-construction of the bridge on Twala Drive. The Kalkspruit channel falls between Twala Drive and MA Botha Street within the township of Kwaguqa in Emalahleni, Mpumalanga Province.

The proposed area to be rehabilitated was assessed during a site visit on the 16th of October 2012. During the site visit the wetland area was delineated and data on the wetland structure and function collected as well as an aquatic assessment was conducted. The area was characterised according to the updated National Wetland Classification System (2009) and several system modifiers were noted. The wetland delineation and aquatic assessment was confined to the wetland and stream channel areas between Twala Drive and MA Botha Street. The surrounding area; including the school and grave yard area was however considered as part of the desktop assessment of the area.

The following general conclusions were drawn upon completion of the assessment:

Wetland assessment

- The subject property falls within the *Highveld* Aquatic Ecoregion and the Olifants North Water Management area. The subject property is located within the B11K quaternary catchments and the particular river resource in the area is the Kalkspruit River.
- In terms of Freshwater Ecoservices Priority Areas (FEPA) importance the following key points are highlighted:
    - No FEPA wetlands or flagship rivers were identified within or immediately adjacent to the subject property;
    - No wetland clusters were noted within or near the study area that were important in terms of water supply;
    - No wetlands or rivers were noted near or within the study area that are important in terms of fish sanctuaries;
    - Study area falls within the Olifants management area:
        - Fourteen percent (14%) of the Olifants management area is of FEPA importance;
        - Four percent (4%) of the sub water management area is if FEPA importance;
- This wetland feature was categorised with the use of the *National Wetland Classification System Methodology and described in the table below :*

Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit	
			HGM Type	Longitudinal zonation / landform
Inland	*Highveld* Ecoregion	Valley floor	Channelled valley-bottom wetland	Lowland River
An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	The subject property falls within the Highveld Ecoregion and the Northern Olifants Water Management area	The typically gently sloping, lowest surface of a valley	Mostly flat wetland area on a valley floor (see valley floor) that is dissected by and typically elevated above a well-defined stream channel (see channel). Dominant water inputs to these areas are typically from the channel (when it overtops or from sub-surface discharge) and from adjacent valley-side slopes.	low-gradient, alluvial fine-bed channels, which may be confined

- The channelled valley bottom wetland unit has been impacted on and has three main physical modifiers acting upon the wetland system. These physical modifiers are:
  - Alien vegetation dominating the stream channel of the wetland feature;
  - Illegal dumping of litter and building rubble within the wetland unit ;
  - Erosion and siltation;
- The wetland has an **moderately low importance** in terms of the eco-services provided to the surrounding area and local community;
- The wetland area Present Ecological State (PES) was calculated and the wetland is **Extensively modified**, as it falls within a Class **E** category;

Aquatic Assessment

Site K1	
Water Quality pH 6.72 Conductivity (ms/m) 100.1 Dissolved oxygen (mg/l) 4.71 Temperature (° C) 20.6	
Habitat Assessment and Suitability *Invertebrate Habitat Assessment* Class Inadequate IHAS Score 44	
Aquatic Macro-invertebrate community assessment Dallas 2007 Class E/F Dickens & Graham 2001 Class F SASS5 Score 6 ASPT Score 3	
Current impacts Significant littering.	

The general water quality of the aquatic resources in the vicinity of the proposed bridge upgrade may be considered poor. The electrical conductivity (EC) values at the point may be considered highly elevated from natural conditions, with some impacts as a result of urban runoff and erosion affecting the water quality at this point.

In terms of habitat diversity and structure the stream is generally inadequate for supporting diverse aquatic communities under the current flow conditions.

The SASS5 data indicates that according to the Dickens & Graham (2001) classification system, the aquatic macro-invertebrate community in this section of the Kalkspruit has suffered a critical loss (Class F) in integrity when compared to the reference score for the Highveld Eco-region stream. According to the Dallas (2007) classification system, the K1 site may be classified as a Class E/F (Critically impaired) system. The low flows and the impaired availability of habitat in this system is likely to be the most significant factor in determining the species composition of this system at the present time.

Impact Assessment

Based on the above assessment it is evident that there are 11 possible impacts that may have an effect on the overall wetland and aquatic integrity. The table below summarises the findings indicating the significance of the impacts before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

Summary of impact significance.

Impact	Unmanaged	Managed
IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES	Low	Very Low
IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES	High	Medium Low

Impact	Unmanaged	Managed
IMPACT 2: LOSS OF ECOLOGICAL SERVICES	Low	Very Low
IMPACT 2: LOSS OF ECOLOGICAL SERVICES	High	Medium Low
IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION	Medium High	Very Low
IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION	High	Medium Low
IMPACT 4: IMPACTS DUE TO INUNDATION	Low	Very Low
IMPACT 4: IMPACTS DUE TO INUNDATION	High	Medium Low
IMPACT 5: ALIEN VEGETATION ENCROACHMENT	Medium High	Low
IMPACT 5: ALIEN VEGETATION ENCROACHMENT	Medium High	Low
IMPACT 6: INEFFECTIVE REHABILITATION	Medium Low	Very Low
IMPACT 6: INEFFECTIVE REHABILITATION	Medium Low	Very Low
IMPACT 7: IMPACTS ON INSTREAM FLOW	Medium Low	Very Low
IMPACT 7: IMPACTS ON INSTREAM FLOW	High	Medium Low
IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR AQUATIC SPECIES	Medium Low	Very Low
IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR AQUATIC SPECIES	Medium Low	Low
IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS	Medium Low	Very Low
IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS	Medium Low	Very Low
IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY	Low	Very Low
IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY	Low	Very Low
IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY	Medium Low	Very Low
IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY	Medium Low	Very Low

From the table it is evident that prior to mitigation, most of the impacts on alternative 1 are medium low level impacts. The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation encroachment are considered to be medium high for the upgrade of the bridge using box culverts. If well managed mitigation takes place, the majority of the impacts using the box system, can be reduced to very low level impacts but the impact from alien vegetation encroachment remains low. If the above impacts are managed and adequate measures are implemented during rehabilitation then the impacts become very low and are of a limited severity.

Impacts from alternative 2 are much higher should no mitigation take place. The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation encroachment are considered to be high for the upgrade of the bridge using cast *in situ* options. The impacts from inundation and the risk of alien vegetation encroachment are also considered to be medium high for the upgrade of the bridge using cast *in situ* option. Mitagation measures that are fully implemented can lower the impacts on the overall wetland and aquatic function of the system, but this impacts will still be higher than alternative 1 (box culvert system).

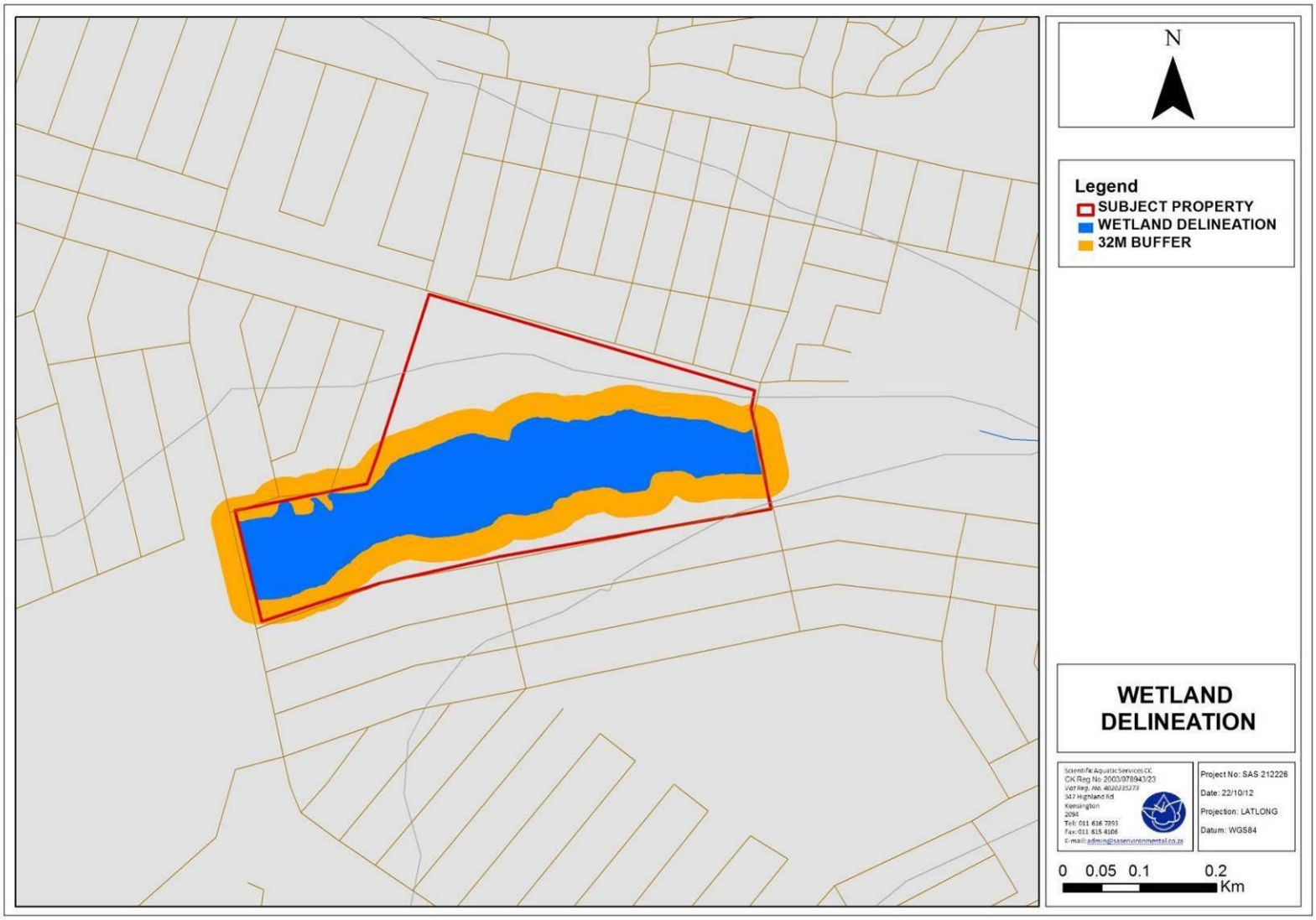
Thus, from the impact assessment it can be concluded that the upgrade of the bridge using box or the cast *in situ* option could have an impact on the wetland characteristics and function. The duration and severity of these impacts will however differ using these alternatives. Depending on the type of infrastructure used and construction activity, the box culverts or the cast *in situ* option could have a higher or lower impact on the wetland feature, respectively.

It is recommended in order to minimise the impacts, the box culverts system should be used during the upgrade of the bridge. The box culvert system can be used in the active channel, where it will have less impact on the system in terms of inundation and blockage caused by plant or soil material.

The no-go alternative is not recommended. The current state of the wetland feature is very poor en modified due to alien vegetation encroachment and dumping of waste material by the local residents. If the project no go option is followed and is not rehabilitated the wetland feature or upgrading the bridge, will lead to on-going erosion, sedimentation and incision of the system and lead to further decreases in ecological value and function of the wetland feature from an aquatic and socio-economic aspect.

Sensitivity

After consideration of the findings of the wetland assessment, no buffer is deemed necessary for the wetland feature identified within the subject property. A 32m buffer as defined by DWA guidelines was included for illustrative purposes only. Due to construction activities that will infringe upon the wetland areas, it is crucial that mitigation measures be implemented to minimise the impacts on the wetland system as far as possible. Construction activities occurring within the wetland features requires relevant authorisation according to the National Environmental Management Act (NEMA) 107 of 1998 and Section 21 c and i of the National Water Act 36 of 1998.



The wetland delineation and associated 32m buffer zone.

From the assessment, some guidelines for the proposed construction activity are recommended. The design and construction should aim to meet the following criteria to ensure the on-going functioning of the wetland system in the vicinity of the proposed infrastructure construction:

- Ensure that all current activities consider the wetland boundaries. No vehicles are to enter or drive through the wetland area unnecessarily;
- Demarcate all wetland boundaries with pegs and danger tape;
- Edge effects of pre-construction and construction activities, including erosion, sedimentation and alien/weed control, need to be strictly managed in wetland areas as well as their associated buffer zones;
- Identify activities, which are causing erosion and incision of any of the wetland feature and mitigate these impacts immediately;
- Adequate erosion control and siltation control measures should be put in place;
- Obtain relevant legislative approval for any activities to be undertaken within the wetland feature to rectify excessive erosion;
- No unnecessary construction activities should be allowed within the riparian zones in line with the requirements of Section 21(c) and (i) of the National Water Act;
- As far, as is practical, implement concurrent rehabilitation processes in order to limit degradation of soil biota;
- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion (where applicable);
- The time in which soils are exposed during construction activities should remain as short as possible;
- Ensure that migratory connectivity for more mobile faunal species is facilitated to allow movement of these species between areas upstream and downstream of the crossing;
- The duration of impacts should be minimised as far as possible by ensuring that the duration of time in which any flow alterations may take place is minimised;
- No dumping of waste or any other materials is allowed within the wetland areas;
- Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction phases;
- If any spills occur, they should be immediately cleaned up;
- No fires should be permitted near the construction area;
- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility;
- Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases;
- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel;
- Throughout the construction and rehabilitation phases stream flow continuity in the system must be maintained;
- The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time;
- All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge;
- Adequate storm water management must be incorporated into the design of the proposed bridge structure in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities, which rely on stream substrates clear of sediment.

- During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10%-15%, berms every 20m should be installed.
    - Where the track has slope greater than 15%, berms every 10m should be installed.

➢ Throughout the life of the structure, biomonitoring assessments should take place on a quarterly basis to identify any emerging impacts on the aquatic ecology of the system. The monitoring should focus on habitat integrity assessment as well as the assessment of impacts on the aquatic macro-invertebrate and fish communities.

Declaration

This report has been prepared according to the requirements of Section 33 (2) of the Environmental Impact Assessments Regulations, 2010 (GNR 543). We (the undersigned) declare the findings of this report free from influence or prejudice.

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Wetland, aquatic and terrestrial ecology

Date: 26/10/2012

Stephen van Staden

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GLOSSARY OF TERMS & ACRONYMS

Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally.
DMEC	Desired Ecological Management Class
DWA	Department of Water Affairs
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region
EC	Electrical conductivity
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological management Class
EAP	Environmental Assessment Practitioner
FEPA	Fresh Water Priority Areas
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectares
HGM	Hydro-geomorphic
IHIA	Intermediate Habitat Integrity Assessment
IHAS	Invertebrate Habitat Assessment System
Indigenous vegetation	Vegetation occurring naturally within a defined area
M	Metres
mm	Millimetres
NEMA	National Environmental Management Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
PES	Present Ecological State
PRECIS	Pretoria Computer Information Systems.
QDS	Quarter degree square
RDM	Resource Directed Measures
REC	Recommended Ecological Category
RHP	River Health Program
Riparian system	Riparian wetlands are recognised as boundaries between the terrestrial and riverine systems
SANBI	South African National Biodiversity Institute
SASS	South African Scoring System

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1 INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a wetland delineation, Present Ecological State (PES), function, and aquatic assessment as part of the rehabilitation of the Kalkspruit stream and wetland area along with the re-construction of the bridge on Twala Drive. The Kalkspruit channel is located between Twala Drive and MA Botha Street within the township of Kwaguqa in Emalahleni, Mpumalanga Province.

The proposed area to be rehabilitated was assessed during a site visit on the 16th of October 2012. During the site visit, the wetland area was delineated and an aquatic assessment was conducted. The wetland area was characterised according to the National Wetland Classification System (2009) and several system modifiers were noted. The wetland delineation and aquatic assessment was confined to the wetland area between Twala Drive and MA Botha Street. The surrounding area; including the school (Itireleng Primary School) and the graveyard area was however considered as part of the desktop assessment of the area.

The purpose of the report is to provide a summary of the wetland delineation, PES and function prior to the proposed construction activities associated with the rehabilitation of the Kalkspruit wetland.

The aquatic assessment included an assessment of the general water quality at the site, a survey of general habitat integrity, habitat conditions for aquatic macro-invertebrates and aquatic macro-invertebrate community integrity. The protocols of applying the indices were strictly adhered to and all work was undertaken or overseen by a South African River Health Program (SA RHP) accredited assessor. The subject property was investigated where the proposed bridge upgrade will be taking place. The co-ordinates for the aquatic assessment within the subject property, is presented in Table 1.

Table 1: Co-ordinates of the aquatic assessment point.

Site	Description	GPS co-ordinates	
		South	East
K1	Representative site in the Kalkspruit stream.	S25°52'29.39"	E29°11'16.82"

An impact assessment on the wetland and aquatic resources of the area to be rehabilitated was performed to determine the significance of the perceived impacts on the receiving wetland and aquatic environment. In addition, mitigatory measures were developed which aim to minimise the impacts, followed by an assessment of the significance of the impacts after mitigation, assuming that they are fully implemented.

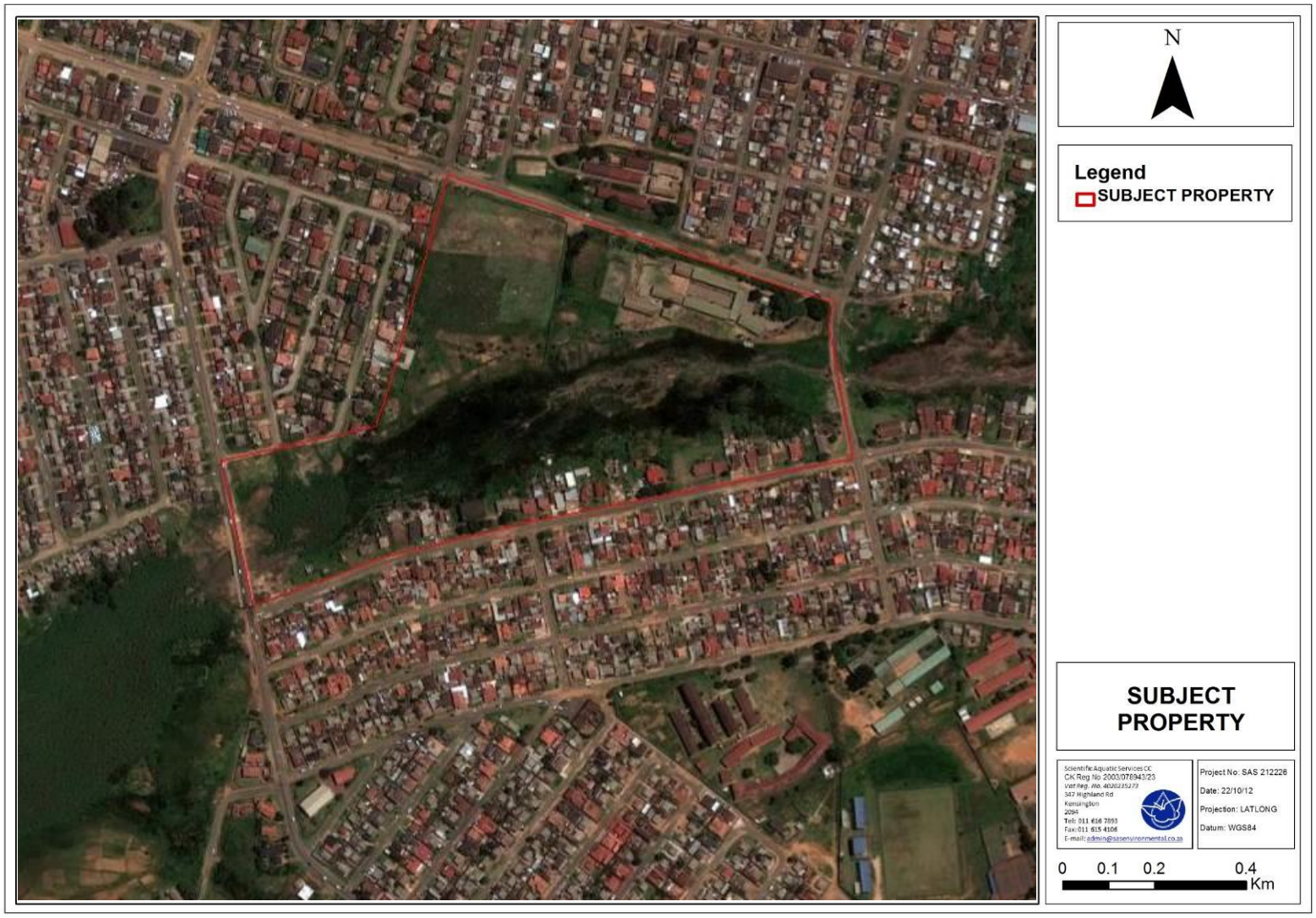

Figure 1: Digital satellite image depicting the location of the proposed subject property in relation to surrounding areas.

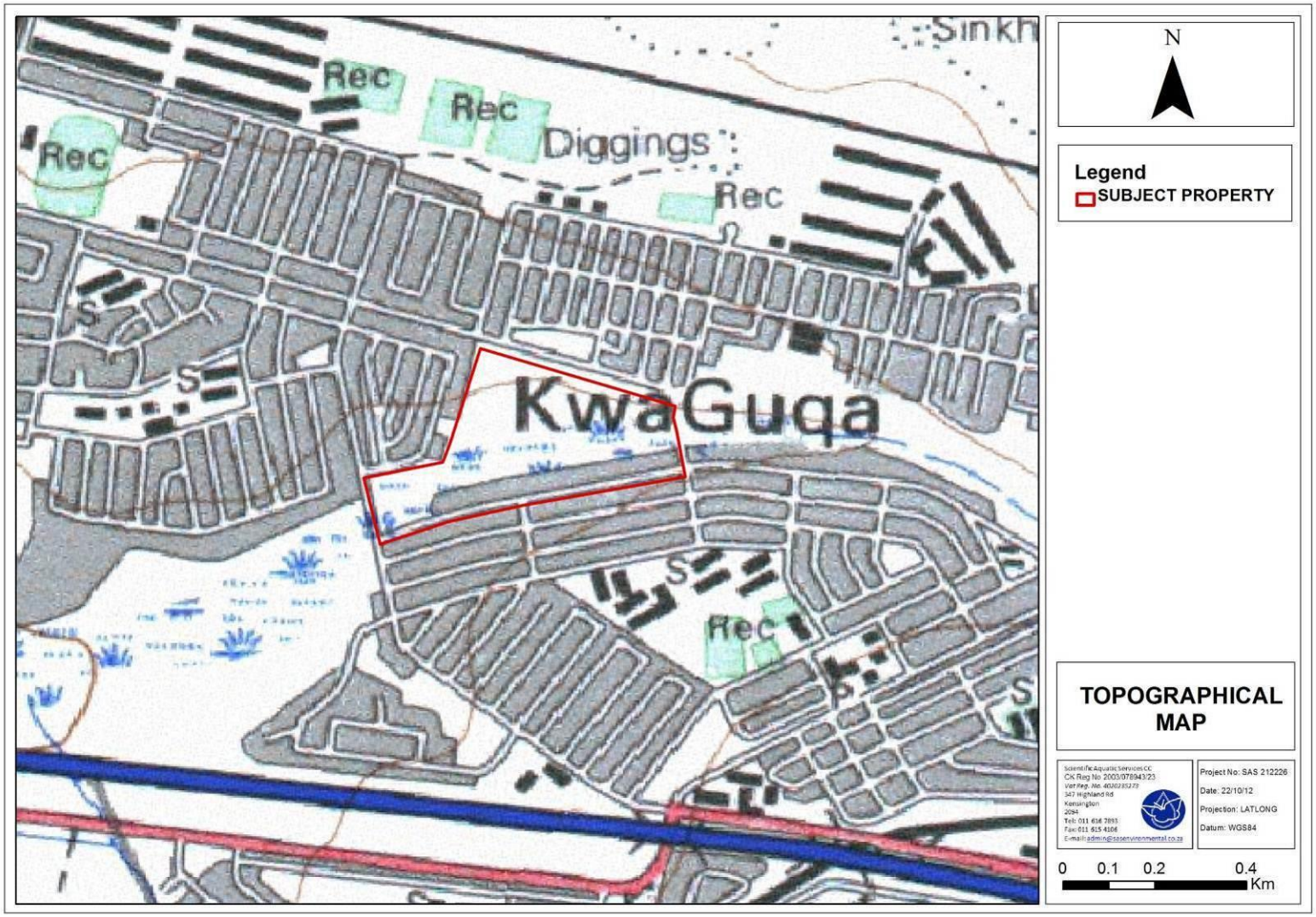

Figure 2: The subject property depicted on a 1:50 000 topographical map in relation to surrounding area.

1.1 Scope

Specific outcomes in terms of this report are as follows:

Wetland delineation

- To define the PES of the wetland system within the subject property;
- To determine the functioning of the system and the environmental and socio-cultural services that the system provide;
- To advocate a Recommended Ecological Category (REC) for the wetland feature;
- To delineate all wetlands or riparian zones within the subject property; and
- To consider impacts on the wetland community due to the proposed re-construction of the bridge on Twala Drive.

Aquatic Assessment

- To define the aquatic Ecological Importance and Sensitivity (EIS) of the aquatic resources within the subject property;
- To define the PES of the aquatic resources within the subject property;
- To define the ecology of the aquatic ecosystems prior to any impact from the proposed development and identify any aspects of particular sensitivity which need to be managed; and
- To assist in developing management and mitigatory measures to minimise the impact on the riverine resources of the subject property.

1.2 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The proposed rehabilitation and bridge re-construction is surrounded by properties where residential development is the dominant land use, leaving some of these areas largely transformed and restricted for access. Therefore, the wetland delineation was confined to the wetland area between Twala Avenue and Botha Street. The surrounding area including the school and graveyard area was however considered as part of the desktop assessment of the area.
- The wetland delineation as presented in this report is regarded as the best estimate of the wetland boundary based on the site conditions present at the time of assessment.
- Due to the scale of the remote imagery used, the accuracy of the handheld GPS unit used reflects a reasonable accuracy of the wetland delineation.

- Should greater mapping accuracy be required, the wetland would need to be pegged in the field and surveyed using conventional survey techniques.
- Wetlands and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to wetland species. Within this transition zone some variation of opinion on the wetland boundary may occur, however if the DWA 2005 method is followed, all assessors should get largely similar results.
- *Reference conditions are unknown:* The composition of aquatic biota in the study area prior to major disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available.
- *Temporal variability:* The data presented in this report are based on a single site visit, undertaken in October 2012. The effects of natural seasonal and long-term variation in the ecological conditions and aquatic biota found in the streams are therefore unknown.
- *Ecological assessment timing:* Aquatic and terrestrial ecosystems are dynamic and complex; it is likely that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling with sampling being undertaken under both low flow and high flow conditions.

1.3 Legislative requirements

National Water Act

- The water act recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved.
- No activity may therefore take place within a watercourse, unless it is authorised by the Department of Water Affairs (DWA).
- Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from DWA in terms of Section 21 (c & i).

National Environmental Management Act

- The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations (No R. 544 and No R. 545) as amended in June 2010, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

2 WETLAND ASSESSMENT METHODOLOGY

2.1 Desktop study

Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. An initial visual on-site assessment of the proposed rehabilitation area was made in order to confirm the assumptions made during consultation of the maps.

2.1.1 Ecoregion

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the study area is located within. This knowledge allows for improved interpretation of data, since reference information and representative species lists are often available on this level of assessment to guide the assessment.

2.1.2 Ecostatus

Studies undertaken by the Institute for Water Quality Studies assessed all quaternary catchments as part of the Resource Directed Measures for Protection of Water Resources. In these assessments, the EIS, Present Ecological Management Class (PEMC) and Desired Ecological Management Class (DEMC) were defined, and serve as a useful guideline in determining the importance and sensitivity of aquatic ecosystems prior to assessment, or as part of a desktop assessment.

Water resources are generally classified according to the degree of modification or level of impairment. The classes used by the SA RHP are presented in the table below and will be used as the basis of classification of the systems in this field, and desktop study.

Table 2: Classification of river health assessment classes in line with the RHP.

Class	Description
A	Unmodified, natural.
B	Largely natural, with few modifications.
C	Moderately modified.
D	Largely modified.
E	Extensively modified.
F	Critically modified.

2.2 National Wetland Classification System

All wetland features encountered within the subject property were assessed using the *National Wetland Classification System (NWCS) for South Africa* (SANBI, 2009). This was done in order to achieve the REC of the wetland feature. The methodology is discussed in the section below.

2.3 Inland systems

For the proposed NWCS, Inland Systems are ***ecosystems that have no existing connection to the ocean***[1] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but ***which are inundated or saturated with water, either permanently or periodically.*** It is important to bear in mind, however, that certain inland Systems may have had an historical connection to the ocean, which in some cases may have been relatively recent.

Levels 1 to 4 of the proposed NWCS for Inland Systems are presented in **Table 3**, on the following Page.

[1] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

Table 3: Proposed classification structure for Inland Systems, up to Level 4

LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT	LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT			
CONNECTIVITY TO OPEN OCEAN	ECOREGION	LANDSCAPE SETTING	*HGM TYPE*	LONGITUDINAL ZONATION/LANDFORM	DRAINAGE OUTFLOW*	DRAINAGE INFLOW*
			A	**B**	**C**	**D**
INLAND	DWAF Level/Ecoregions	SLOPE	Channel (river)	Mountain headwater stream	(not applicable)	(not applicable)
				Mountain stream	(not applicable)	(not applicable)
				Transitional river	(not applicable)	(not applicable)
				Rejuvenated bedrock fall	(not applicable)	(not applicable)
			Hillslope seep	(not applicable)	With ch. Outflow	(not applicable)
					Without ch. Outflow	(not applicable)
			Depression	(not applicable)	Exorheic	With ch. inflow
						Without ch. inflow
					Endorheic	With ch. inflow
						Without ch. inflow
					Dammed	With ch. inflow
						Without ch. inflow
		VALLEY FLOOR	Channel (river)	Mountain stream	(not applicable)	(not applicable)
				Transitional river	(not applicable)	(not applicable)
				Rejuvenated bedrock fall	(not applicable)	(not applicable)
				Upper foothill river	(not applicable)	(not applicable)
				Lover foothill river	(not applicable)	(not applicable)
				Lowland river	(not applicable)	(not applicable)
				Rejuvenated foothill river	(not applicable)	(not applicable)
				Upland floodplain river	(not applicable)	(not applicable)
			Channelled valley-bottom wetland	Valley-bottom depression	(not applicable)	(not applicable)
				Valley-bottom flat	(not applicable)	(not applicable)
			Unchannelled valley-bottom wetland	Valley-bottom depression	(not applicable)	(not applicable)
				Valley-bottom flat	(not applicable)	(not applicable)
			Floodplain wetland	Valley-bottom depression	(not applicable)	(not applicable)
				Valley-bottom flat	(not applicable)	(not applicable)
			Depression	(not applicable)	Exorheic	With ch. inflow
						Without ch. inflow
					Endorheic	With ch. inflow
						Without ch. inflow
					Dammed	With ch. inflow
						Without ch. inflow
			Valleyhead seep	(not applicable)	(not applicable)	(not applicable)
		PLAIN	Channel (river)	Lowland river	(not applicable)	(not applicable)
				Upland floodplain river	(not applicable)	(not applicable)
			Floodplain wetland	Floodplain depression	(not applicable)	(not applicable)
				Floodplain flat	(not applicable)	(not applicable)
			Unchannelled valley-bottom wetland	Valley-bottom depression	(not applicable)	(not applicable)
				Valley-bottom flat	(not applicable)	(not applicable)
			Depression	(not applicable)	Exorheic	With ch. inflow
						Without ch. inflow
					Endorheic	With ch. inflow
						Without ch. inflow
			Flat	(not applicable)	(not applicable)	(not applicable)
		BENCH (HILLTOP/SADDLE/SHELF)	Depression	(not applicable)	Exorheic	With ch. inflow
						Without ch. inflow
					Endorheic	With ch. inflow
						Without ch. inflow
					(not applicable)	(not applicable)
			Flat	(not applicable)	(not applicable)	(not applicable)

Note: 2nd row of Table provides the criterion for distinguishing between wetland units in each column
∗ Ch. = channelled (outflow/inflow).

2.3.1 Level 2: Ecoregions

For Inland Systems, the regional spatial framework that has been included at Level 2 of the proposed NWCS is that of DWA's Level 1 Ecoregions for aquatic ecosystems (after Kleynhans *et al.,* 2005). There are a total of 31 Ecoregions, which have been delineated mainly on the basis of physical/abiotic factors. See Figure below.

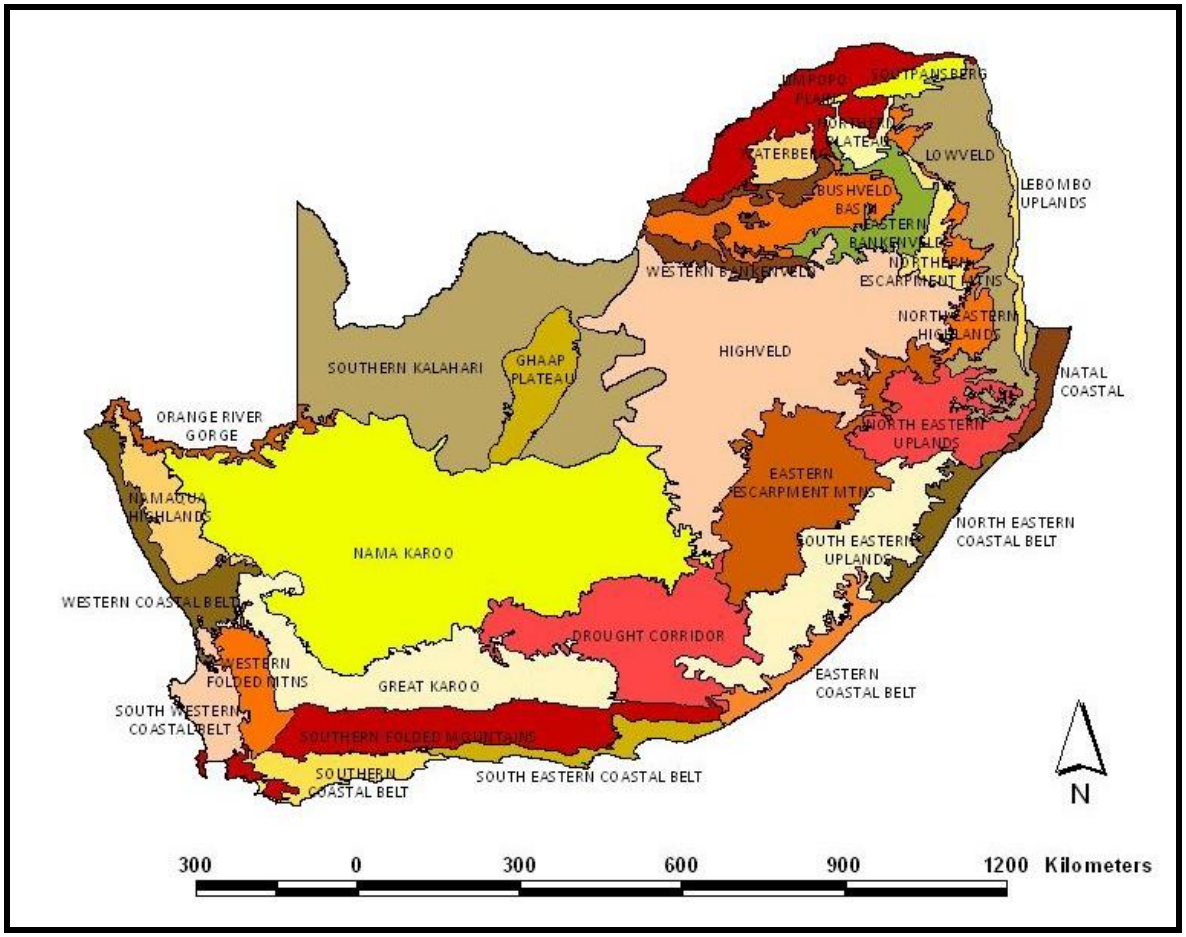

Figure 3: Map of DWAF Level 1 Ecoregions (after Kleynhans *et al.* 2005)

2.3.2 Level 3: Landscape Units

At Level 3 of the proposed NWCS, for Inland Systems, a distinction is made between four Landscape Units (Table 3) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (SANBI, 2009):

- ***Slope*:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley.
- ***Valley floor:*** the typically gently sloping, lowest surface of a valley[2].

[2] Valley: an elongated, relatively narrow region of low land between ranges of mountains, hills, or other high areas (such as sand dunes), often having a river or stream running along the bottom.

- ***Plain:*** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.
- ***Bench (hilltop/saddle/shelf):*** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately permendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

In addition, a schematic diagram of the different landscape settings is shown in the Figure below.

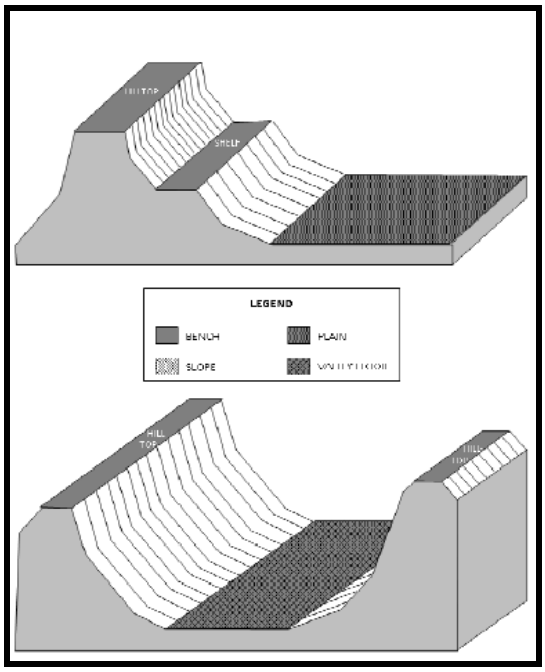

Figure 4: Schematic diagram of the different landscape settings within which an Inland System can occur (Ollis *et al*., 2009).

2.3.3 Level 4: HGM Units

Eight primary HGM Types are recognised for Inland Systems at Level 4A of the proposed NWCS (Table 3), on the basis of hydrology and geomorphology (SANBI, 2009), namely:

- ***Channel (river, including the banks):*** an open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies.
- ***Channelled valley-bottom wetland:*** a mostly flat valley-bottom wetland dissected by and typically elevated above a channel (see channel).

- ***Unchannelled valley-bottom wetland:*** a mostly flat valley-bottom wetland area within a major channel running through it, characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events.
- ***Floodplain wetland:*** the mostly flat or gently sloping wetland area adjacent to and formed by a **Lowland** or **Upland Floodplain** river, and subject to periodic inundation by overtopping of the channel bank.
- ***Depression:*** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- ***Flat:*** a near-level wetland area (i.e. with little or no relief) with little or no gradient, situated on a plain or a bench in terms of landscape setting.
- ***Hillslope seep:*** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope.
- ***Valleyhead seep:*** a gently-sloping, typically concave wetland area located on a valley floor at the head of a drainage line[3], with water inputs mainly from subsurface flow (although there is usually also a convergence of diffuse overland water flow in these areas during and after rainfall events).

The above terms have been used for the primary HGM Units in the proposed NWCS to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produces as part of the Wetland Management Series (Dada *et al.,* 2007), including WET-Health (Macfarlene *et al.,* 2008) and WET-EcoServices (Kotze *et al.,* 2008).

At Level 4B of the proposed classification system, certain of the primary HGM Units can further be divided into sub-categories on the basis of longitudinal geomorphological zonation or localised landform, as follows:

- Channels (including their banks) are divided into six primary longitudinal zones and three zones associated with a rejuvenated longitudinal profile, according to the geomorphological zonation scheme of Rowntree & Wadeson (2000). The sub-categories are *Mountain Headwater Stream, Mountain Stream, Transitional River,*

[3] Valleyhead seeps tend to occur at relatively high altitudes, often in association with an escarpment. This wetland type is, therefore, relatively common in the Lesotho Highlands and the KwaZulu-Natal Drakensberg area (M.Rountree, Fluvius Environmental Consultants, pers.comm.).

Upper Foothill River, Lower Foothill River, and *Lowland River* (i.e. the primary zones); and *Rejuvenated Bedrock Fall, Rejuvenated Foothill River,* and *Upland Floodplain River* (i.e. the zones associated with a rejuvenated long profile).

- Channelled and unchannelled valley-bottom wetlands are divided into '*valley-bottom flats'* and *'valley-bottom depressions'*.
- Floodplain wetlands are divided into *'floodplain depressions'* and *'floodplain flats'*.

Table 4: Characteristics of the different Hydrogeomorphic (HGM) Types included in the proposed National Wetland Classification System (NWCS) (SANBI, 2009).

Primary (Level 4A) HGM Type*	Secondary (Level 4B) HGM Units (Longitudinal Zonation/Landform)	Landscape setting/s	Dominant hydrological characteristics			Dominant hydrodynamics
			Inputs	Throughputs	Outputs	
CHANNEL	Mountain Headwater Stream	Slope	Overland flow from catchment runoff, concentrated surface flow from upstream channels and tributaries, diffuse surface flow from an unchannelled upstream drainage line (i.e. an unchannelled valley-bottom wetland), seepage from adjacent hillslope or valleyhead seeps, and/or groundwater (e.g. via inchannel springs)	Concentrated surface flow	Concentrated surface flow, generally, but can be diffuse surface flow (e.g. where a channelled valley-bottom wetland becomes an unchannelled valley-bottom wetland because of a change in gradient or geological control)	Horizontal: unidirectional
	Mountain Stream	Slope/Valley floor				
	Transitional River	Slope/Valley floor				
	Upper Foothill River	Valley floor				
	Lower Foothill River	Valley floor				
	Lowland River	Valley floor/Plain				
	Rejuvenated Foothill Fall (gorge)	Slope/Valley floor				
	Rejuvenated Foothill River	Slope/Valley floor				
	Upland Floodplain River	Valley floor/Plain (specifically a plateau)				
CHANNELLED VALLEY-BOTTOM WETLAND	Valley-bottom flat	Valley floor	Overland flow from adjacent valley-side slopes, lateral seepage (interflow) from adjacent hillslope seeps, channel overspill during flooding	Diffuse surface flow, temporary containment and storage of water in depressional areas, possible short-lived concentrated flows during flooding events	Diffuse surface flow and interflow into adjacent channel, infiltration and evaporation (particularly from depressional areas)	Horizontal: bidirectional; Limited vertical: bidirectional (mostly in depressions)
	Valley-bottom depression	Valley floor				
UNCHANNELLED VALLEY-BOTTOM WETLAND	Valley-bottom flat	Valley floor/Plain	Concentrated or diffuse surface flow from upstream channels and tributaries; overland flow from adjacent valley-side slopes (if present); lateral seepage from adjacent hillslope seeps (if present); groundwater	Diffuse surface flow, interflow, temporary containment and storage of water in depressional areas, possible short-lived concentrated flows during high-flow events	Diffuse or concentrated surface flow, infiltration and evaporation (particularly from depressional areas)	Horizontal: unidirectional; Limited vertical: bidirectional (mostly in depressions)
	Valley-bottom depression	Valley floor/Plain				

Primary (Level 4A) HGM Type*	Secondary (Level 4B) HGM Units (Longitudinal Zonation/Landform)	Landscape setting/s	Dominant hydrological characteristics			Dominant hydrodynamics
			Inputs	Throughputs	Outputs	
FLOODPLAIN WETLAND	Floodplain flat	Valley floor/Plain	Channel overspill during flooding (predominantly), but there could also be some overland flow from adjacent valley-side slopes (if present) and lateral seepage from adjacent hillslope seeps (if present)	Diffuse surface flow, interflow, temporary containment and storage of water in depressional areas, possible short-lived concentrated flows during flooding events	Diffuse surface flow and interflow into adjacent channel, infiltration and evaporation (particularly from depressional areas)	Horizontal: bidirectional; Limited vertical: bidirectional (mostly in depressions)
	Floodplain depression	Valley floor/Plain				
DEPRESSION (EXHORHEIC, with channelled inflow)	n/a	Slope/Valley floor/Plain/Bench	Precipitation, concentrated and (possibly) diffuse surface flow, interflow, groundwater	Containment and storage of water, slow through-flow	Concentrated surface flow	Horizontal: unidirectional; Vertical: bidirectional
DEPRESSION (EXHORHEIC, without channelled inflow)	n/a	Slope/Valley floor/Plain/Bench	Precipitation, diffuse surface flow, interflow, groundwater	Containment and storage of water, slow through-flow	Concentrated surface flow	Horizontal: unidirectional; Vertical: bidirectional
DEPRESSION (ENDORHEIC, with channelled inflow)	n/a	Slope/Valley floor/Plain/Bench	Precipitation, concentrated and (possibly) diffuse surface flow, interflow, groundwater	Containment and storage of water	Evaporation, infiltration	Vertical: bidirectional
DEPRESSION (ENDORHEIC, without channelled inflow)	n/a	Slope/Valley floor/Plain/Bench	Precipitation, diffuse surface flow, interflow, groundwater	Containment and storage of water	Evaporation, infiltration	Vertical: bidirectional
FLAT	n/a	Plain/Bench	Precipitation, groundwater	Containment of water, some diffuse surface flow and/or interflow	Evaporation, infiltration	Vertical: bidirectional Limited horizontal: multidirectional
HILLSLOPE SEEP (with channelled outflow)	n/a	Slope	Groundwater, precipitation (perched)	Diffuse surface flow, interflow	Concentration surface flow	Horizontal: unidirectional

Primary (Level 4A) HGM Type*	Secondary (Level 4B) HGM Units (Longitudinal Zonation/Landform)	Landscape setting/s	Dominant hydrological characteristics			Dominant hydrodynamics
			Inputs	Throughputs	Outputs	
HILLSLOPE SEEP (without channelled outflow)	n/a	Slope	Groundwater, precipitation (perched)	Diffuse surface flow, interflow	Diffuse surface flow, interflow, evaporation, infiltration	Horizontal: unidirectional
VALLEYHEAD SEEP	n/a	Valley Floor	Groundwater surface flow, interflow	Diffuse surface flow, interflow	Concentration surface flow	Horizontal: unidirectional

* **For completeness, in this list a distinction is also made tween *depressions* and *hillslope seeps* with different *drainage (outflow and inflow)* characteristics, as recorded at Levels 4C and 4D of the proposed NWCS (the drainage criteria are not applicable to other HGM Types).**

2.4 Present Ecological State

All the information gathered above as well as hydrology-, hydraulic/geomorphic-, biological criteria and water quality were then used to assign a PES for the riparian feature. Table 5 below lists the attributes as well as criteria assessed during the PES assessment.

Table 5: Criteria and attributes assessed during the determination of the PES.

Criteria and attributes	
Hydrological	**Hydraulic/ Geomorphic**
Flow modification	Canalisation
Permanent inundation	Topographic Alteration
Water Quality	**Biota**
Water Quality Modification	Terrestrial Encroachment
Sediment load modification	Indigenous Vegetation Removal
	Invasive plant encroachment
	Alien fauna
	Overutilisation of biota

Each of the attributes where given a score according to ecological state observed during the site visit, as well as confidence scores to indicate areas of uncertainty (Table 6).

Table 6: Scoring Guidelines.

Scoring Guidelines		Relative confidence score	
Natural, unmodified	5	Very High	4
Largely natural	4	High	3
Moderately modified	3	Moderate	2
Largely modified	2	Low	1
Seriously modified	1		
Critically modified	0		

A mean score for all attributes was then calculated and the final score was then used in the PES category determination as indicated in the table below:

Table 7: Present Ecological Status Category descriptions[4]

Score	Class	Description
>4	**A**	Unmodified, natural
>3 and <4	**B**	Largely natural, with few modifications
>2 and <3	**C**	Moderately modified
2	**D**	Largely modified
>0 and <2	**E**	Extensively modified
0	**F**	Critically modified

[4]Department of Water Affairs and Forestry, South Africa. *Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999 [Table G2].*

2.5 Reference Conditions

"Reference conditions" refer to the natural un-impacted condition of the riparian feature prior to changes due to human settlement, utilisation of the riparian feature and its resources."[5]To determine, accurate reference conditions the historical geomorphology (terrain unit, landform, substrate type, substrate erodibility, and sediment dynamics), hydrology (water source, saturation zones, extent, period and depth of inundation, flow volumes) and biological attributes (vegetation communities and zonation, faunal communities, occurrence of threatened species) were determined. The reference conditions were then used as a "bench-mark" to determine an appropriate Ecological Management Class (EMC) (DWA - W3, 1999).

2.6 Wetland function assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[6]The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2005). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation
- Stream flow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control
- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

[6]Department of Water Affairs and Forestry, South Africa. *Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999.*

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the riparian system. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the riparian system.

Table 8: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

2.7 Ecological Management Class

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure."[7]

The EMC was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above). Followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired EMC.

A system may receive the same class for the PES, as the EMC if the system is deemed to be in good condition, and therefore must stay in good condition. Otherwise, an appropriate EMC should be assigned in order to prevent any further degradation as well as to enhance the PES of the riparian system.

Table 9: Description of EMC classes.

Score	Description
A	Unmodified, natural
B	Largely natural with few modification
C	Moderately modified
D	Largely modified

2.8 Wetland and Riparian zone delineation

For the purposes of this investigation, a wetland habitat is defined in the National Water Act (1998) as the physical structure and associated vegetation of areas associated with a watercourse. These are commonly characterised by alluvial soils, which are inundated or

[7]Department of Water Affairs and Forestry, South Africa.*Version 1.0 of Resource Directed Measures for Protection of Water Resources 1999*

flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

The wetland and riparian zone delineation took place according to the method presented in the final draft of "*A practical field procedure for identification and delineation of wetlands and riparian areas*" published by the Department of Water Affairs in February 2005. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The presence of water at or near the ground surface;
- Distinctive hydromorphic soils;
- Vegetation adapted to saturated soils and
- The presence of alluvial soils in stream systems.

By observing the evidence of these features, in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWA 2005).

Riparian and wetland zones can be divided into three zones (DWA 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant part of the rainy season and the temporary zone surrounds the seasonal zone and is only saturated for a short period of the year, but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. Thus the object of the wetland delineation was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

3 AQUATIC ASSESSMENT METHODOLOGY

The sections below describe the methodology used to assess the aquatic ecological integrity of the various sites based on water quality, instream and riparian habitat condition and biological impacts and integrity.

3.1 Visual Assessment

The subject property was investigated in order to identify visible impacts on the site, with specific reference to impacts from surrounding activities. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the system, was identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual indications of the conditions at the

time of assessment. Factors which were noted in the site specific visual assessments included the following:

- Stream morphology;
- Instream and riparian habitat diversity;
- Stream continuity;
- Erosion potential;
- Depth flow and substrate characteristics;
- Signs of physical disturbance of the area, and
- Other life forms reliant on aquatic ecosystems.

3.2 Physico Chemical Water Quality Data

On site testing of biota specific water quality variables took place. Parameters measured include pH, electrical conductivity, dissolved oxygen concentration and temperature. The results of on-site biota specific water quality analyses were used to aid in the interpretation of the data obtained by the bio monitoring. Results are discussed against the guideline water quality values for aquatic ecosystems (DWAF 1996 vol. 7) and (OREWRA, 2001).

3.3 Habitat Suitability and Integrity

3.3.1 Habitat for aquatic macro-invertebrates

It is important to assess the habitat of each site, in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the site should be discussed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper; 1999). The Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), should be used for site specific assessments. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site should be scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The instream and riparian zones should be analysed separately, and the final assessment should be made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone are, however, primarily interpreted in terms of the potential impact on the instream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data should be carried out by weighting

each of the criteria according to Kemper (1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the PES of both the in-stream and riparian habitats of the site. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

Table 10: Classification of Present State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Class	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural, with few modifications. A small change in natural habitats and biota may have taken place but the basic ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Extensively modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, basic ecosystem functions have been destroyed and the changes are irreversible.	<20

3.3.2 Habitat for aquatic macro-invertebrates

The Invertebrate Habitat Assessment System (IHAS) was applied according to the protocol of McMillan (1998). This index was used to determine specific habitat suitability for aquatic macro-invertebrates as well as to aid in the interpretation of the results of the South African Scoring System version 5 (SASS5) scores. Scores for the IHAS index were interpreted according to the guidelines of McMillan (1998) as follows:

- <65% inadequate for supporting a diverse aquatic macro-invertebrate community.
- 65%-75% adequate for supporting a diverse aquatic macro-invertebrate community.
- >75% highly suited for supporting a diverse aquatic macro-invertebrate community.

3.4 Aquatic Macro-Invertebrates

Aquatic Macro-invertebrates were sampled using the qualitative kick sampling method called SASS5 (South African Scoring System version 5) (Dickens and Graham, 2001). The SASS5 method has been specifically designed to comply with international accreditation protocols. This method is based on the British Biological Monitoring Working

Party (BMWP) method and has been adapted for South African conditions by Dr. F. M. Chutter. The assessment was undertaken according to the protocol, as defined by Dickens & Graham (2001). All work was undertaken by an accredited SASS5 practitioner.

The SASS5 method was designed to incorporate all available biotypes at a given site and to provide an indication of the integrity of the of the aquatic macro-invertebrate community through recording the presence of various macro-invertebrate families at each site, as well as consideration of abundance of various populations, community diversity and community sensitivity. Each taxon is allocated a score according to its level of tolerance to river health degradation (Dallas, 1997).

This method relies on churning up the substrate with your feet and sweeping a finely meshed SASS net, with a pore size of 1000 micron mounted on a 300 mm square frame, over the churned up area several times. In stony bottomed flowing water biotopes (rapids, riffles, runs, etc.) the net downstream of the assessor and the area immediately upstream of the net is disturbed by kicking the stones over and against each other to dislodge benthic invertebrates. The net was also swept under the edge of marginal and aquatic vegetation to cover from 1-2 meters. Identification of the organisms was made to family level (Thirion *et al*., 1995; Davies & Day, 1998; Dickens & Graham, 2001; Gerber & Gabriel, 2002).

Interpretation of the results of biological monitoring depends, to a certain extent, on interpretation of site-specific conditions (Thirion *et.al*, 1995). In the context of this investigation it would be best not to use SASS5 scores in isolation, but rather in comparison with relevant habitat scores. The reason for this is that some sites have a less desirable habitat or fewer biotopes than others do. In other words, a low SASS5 score is not necessarily regarded as poor in conjunction with a low habitat score. Also, a high SASS5 score, in conjunction with a low habitat score, can be regarded as better than a high SASS5 score in conjunction with a high habitat score. A low SASS5 score, together with a high habitat score, would be indicative of poor conditions. The IHAS Index is valuable in helping to interpret SASS5 scores and the effects of habitat variation on aquatic macro-invertebrate community integrity.

Classification of the system took place by comparing the present community status to Reference conditions, which reflect the best conditions that can be expected in rivers and streams within a specific area and also reflect natural variation over time. SASS and ASPT reference conditions were compared to the reference data for the Highveld Eco-region. The SASS and ASPT reference score, for use in determining the class according

the classification of Dickens and Graham (2001) was defined as a SASS score of 240 and ASPT score of 6.8.

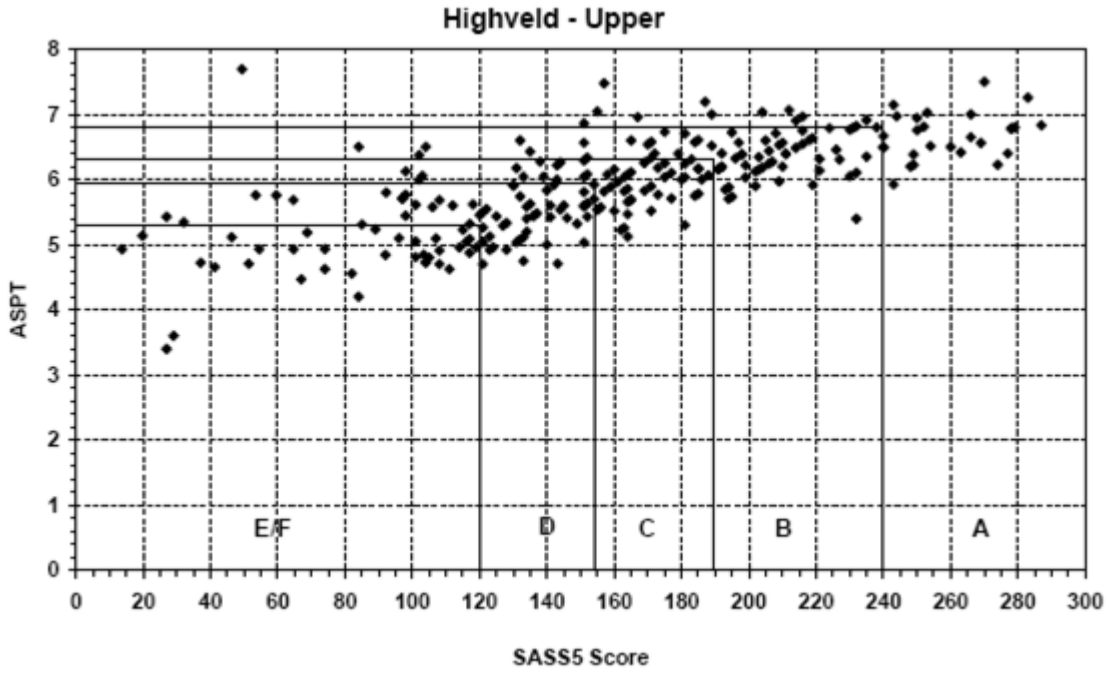

Figure 5: Biological Bands for the Highveld ecoregion, calculated using percentiles.

Table 11: Definition of Present State Classes in terms of SASS scores as presented in Dickens & Graham (2001).

Class	Description	SASS Score%	ASPT%
A	Unimpaired. High diversity of taxa with numerous sensitive taxa.	90-100 80-89	Variable >90
B	Slightly impaired. High diversity of taxa, but with fewer sensitive taxa.	80-89 70-79 70-89	<75 >90 76-90
C	Moderately impaired. Moderate diversity of taxa.	60-79 50-59 50-79	<60 >75 60-75
D	Largely impaired. Mostly tolerant taxa present.	50 – 59 40-49	<60 Variable
E	Severely impaired. Only tolerant taxa present.	20-39	Variable
F	Critically impaired. Very few tolerant taxa present.	0-19	Variable

3.5 Fish community integrity

Whereas macro-invertebrate communities are good indicators of localised conditions in a river over the short-term, fish being relatively long-lived and mobile;

- are good indicators of long-term influences;
- are good indicators of general habitat conditions;
- integrate effects of lower trophic levels and
- are consumed by humans (Uys *et al*., 1996).

The Fish Assemblage Integrity Index (FAII) was applied according to the protocol of Kleynhans (1999). Fish species identified were compared to those expected to be present at the site, which were compiled from a literature survey including Skelton 2007. Fish samples were collected by means of a fixed generator driven electro-fishing device.

Table 12: Definition of Present State Classes in terms of FAII scores according to the protocol of Kleynhans (1999).

Class	Description	Relative FAII score (% of expected)
A	Unmodified, or approximates natural conditions closely.	90-100
B	Largely natural, with few modifications.	80-89
C	Moderately modified. A lower than expected species richness and the presence of most intolerant species.	60-79
D	Largely modified. A clearly lower than expected species richness and absence of intolerant and moderately tolerant species	40-59
E	Seriously modified. A strikingly lower than expected species richness and a general absence of intolerant and moderately intolerant species	20-39
F	Critically modified. An extremely lowered species richness and an absence of intolerant and moderately intolerant species	<20

Table 13: Intolerance ratings for naturally occurring indigenous fish species with natural ranges included in the study area (Kleynhans, 2003; Skelton, 2007).

SPECIES NAME	COMMON NAME	INTOLERANCE RATING	COMMENTS
Barbus anoplus	Chubbyhead barb	2.6	Widespread
Barbus paludinosis	Straightfin Barb	1.8	Widespread
Barbus trimaculatus	Threespot Barb	2.2	Common in many river systems of southern Africa
Barbus unitaeniatus	Longbeard Barb	1.7	Widely distributed in southern Africa
Clarias gariepinus	Sharptooth Catfish	1.2	Most widely distributed fish in Africa.
Labeo cylindricus	Redeye Labeo	3.1	Widespread but unlikely to occur at the site
Labeo molybdinus	Leaden Labeo	3.2	Widespread but unlikely to occur at the site
Labeobarbus polylepis	Smallscale Yellowfish	3.1	Widespread but unlikely to occur at the site
Labeobarbus marequensis	Largescale Yellowfish	2.6	Widespread but unlikely to occur at the site
Micropeterus salmoides	Largemouth Black Bass	2.2	Widespread alien species
Pseudocrenilabrus philander	Southern Mouthborooder	1.3	Widespread
Tilapia sparrmanii	Banded Tilapia	1.3	Widespread

Tolerant: 1-2 moderately tolerant :> 2-3 Moderately Intolerant: >3-4 Intolerant: >4

For the purposes of applying the FAII, species which were considered unlikely to occur at the site due to habitat and cover conditions, flow conditions and due to historic impacts, were excluded from the reference list of fish species for the site. The species highlighted

in grey above indicate the species that were omitted from the expected fish species for the site.

4 Impact Assessment Report

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[8]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.

[8] The definition has been aligned with that used in the ISO 14001 Standard.

- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the table below. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[9].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

[9] Some risks/impacts that have low significance will however still require mitigation

Table 14: Criteria for assessing significance of impacts.

LIKELIHOOD DESCRIPTORS

Probability of impact	RATING
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	RATING
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function Largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear features affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear features affected < 100m	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear features affected < 1000m	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear features affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Linear features affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table 15: Significance rating matrix

LIKELIHOOD (Frequency of activity + Frequency of impact)	CONSEQUENCE (Severity + Spatial Scope + Duration)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table 16: Positive/Negative Mitigation Ratings

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Improve current management	Maintain current management
High	101-125	Improve current management	Maintain current management
Medium-high	76-100	Improve current management	Maintain current management
Medium-low	51-75	Maintain current management	Improve current management
Low	26-50	Maintain current management	Improve current management
Very low	1-25	Maintain current management	Improve current management

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction
  - Construction and;
  - Rehabilitation.

- If applicable, transboundary or global effects were assessed;
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

4.1.1 Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed construction.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[10] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimization, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation.*

4.2 Sensitivity Mapping

All the ecological features of the subject property were considered and sensitive areas were delineated with the use of a Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the proposed development.

4.3 Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues from planning, through construction and rehabilitation to after care and maintenance.

[10] Mitigation measures should address both positive and negative impacts

5 GENERAL IMPORTANCE OF THE STUDY AREA

5.1 Ecoregions

When assessing the ecology of any area (aquatic or terrestrial), it is important to know which ecoregion the subject property is located within. This knowledge allows for improved interpretation of data to be made, since reference information and representative species lists are often available on this level of assessment, which aids in guiding the assessment.

The subject property falls within the *Highveld* Ecoregion and the Olifants north Water Management area. The subject property is located within the B11K quaternary catchments and the particular river resource in the area is the Kalkspruit River (Table 17). Figure 6 below indicates the aquatic ecoregion and quaternary catchments of the subject property.

This database was used as reference for the catchment of concern in order to define the EIS, PEMC and DEMC. The results of the assessment are summarised in the table below.

Table 17: Summary of the ecological status of quaternary catchment B11K based on Kleynhans 1999.

Catchment	Resource	EIS	PESC	DEMC
B11K	Klipspruit	Moderate	CLASS C	C: Moderately Sensitive system

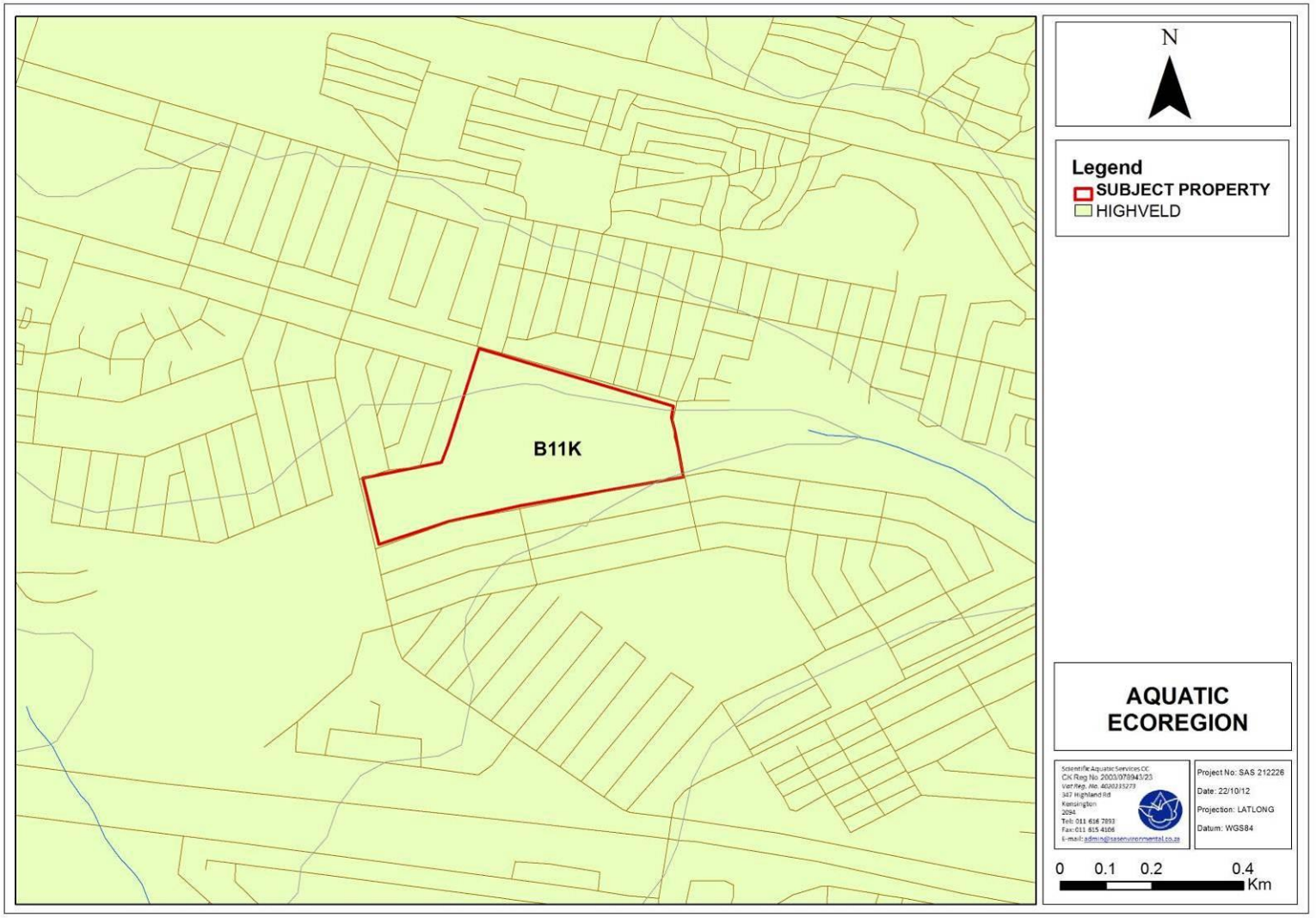

Figure 6: A map of the aquatic ecoregion and quaternary catchment associated with the subject property.

B11K

The points below summarise the impacts on the aquatic resources in B11K quaternary catchment (Kleynhans 1999):

- The aquatic resources within this quaternary catchment have significantly been affected by bed modification due to Precipitates and Oxides.
- High levels of flow modification and very high impacts from inundation have taken place due mining in the area.
- Riparian zones and stream bank conditions are considered to be highly impacted upon.
- A very high impact from the introduction of instream biota is present.
- A moderate impact on water quality is deemed likely due to the mining in the area.

In terms of ecological functions, importance and sensitivity, the following points summarise the conditions in the B11K catchments:

- The riverine systems in this catchment have a moderate diversity of habitat types, increasing their ecological sensitivity and importance.
- The sites have no importance in terms of conservation areas.
- The riverine resources in this system have a moderate intolerance to flow requirements and a moderate sensitivity to flow changes. (*Labeobarbus* sp.)
- The aquatic resources in this catchment have no importance in terms of migration of aquatic species since the catchment it is located at the top of the system.
- The aquatic resources in this catchment are considered to have no importance in terms of rare and endemic species conservation.
- The aquatic resources in this catchment provide moderate amounts of refuge areas for aquatic taxa.
- The riverine resources in this system have a moderate sensitivity to water quality changes.
- The areas are not very unique in terms of Species/Taxon richness.

5.2 General conservation importance of the subject property with regards to wetlands

5.2.1 Freshwater Ecosystem Priority Areas (FEPAs)

The Freshwater Ecosystem Priority Areas (FEPAs)[11] database was consulted to define the aquatic ecology of the wetland systems close to or within the subject property that may be of ecological importance.

- No FEPA wetlands or flagship rivers were identified within or immediately adjacent to the subject property.
- No wetland clusters were noted within or near the study area that were important in terms of water supply.
- No wetlands or rivers were noted near or within the study area that are important in terms of fish sanctuaries.
- Study area falls within the Olifants management area:
    - Fourteen percent (14%) of the Olifants management area is of FEPA importance (Figure 7).
    - Four percent (4%) of the sub water management area is if FEPA importance (Figure 8).

[11] www.bgis.sanbi.org

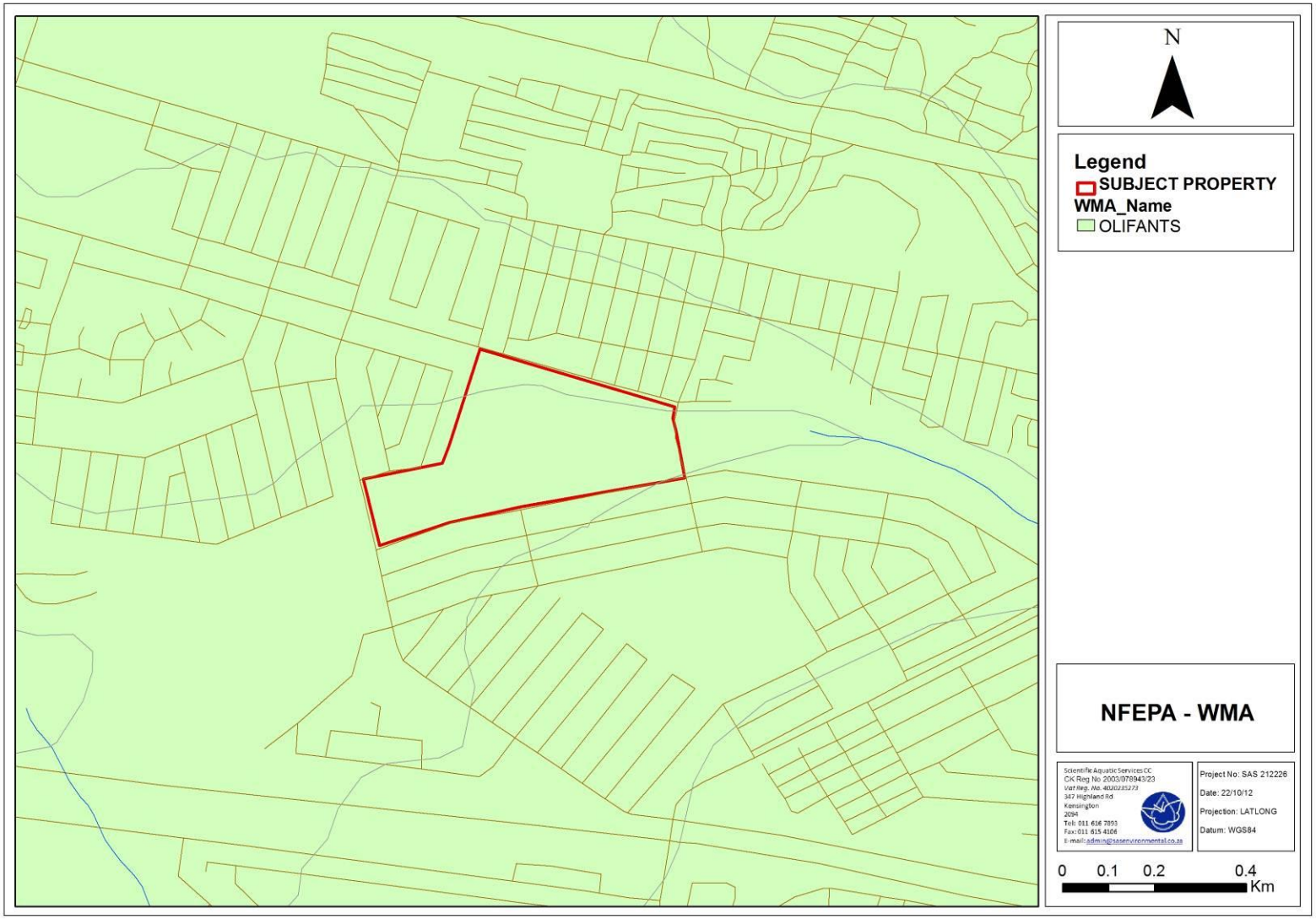

Figure 7: FEPA importance map in relation to Olifants Water Management Area.

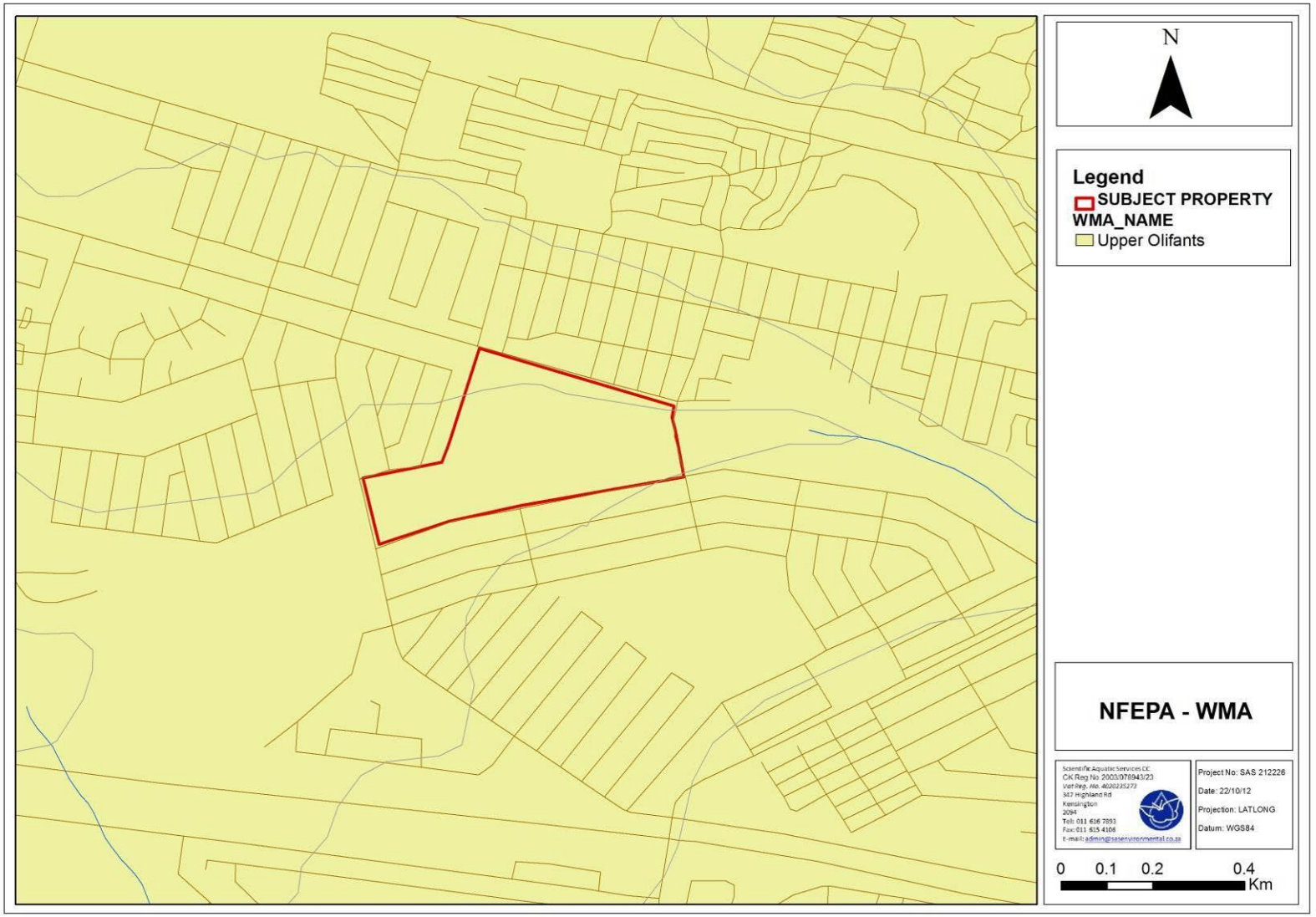

Figure 8: FEPA Importance map in relation to Sub-Water Management Area.

6 WETLAND RESULTS

6.1 Wetland System Characterisation

A wetland feature (Kalkspruit channel) was identified between Twala Drive and MA Botha Street within the township of Kwaguqa in Emalahleni, Mpumalanga Province. This wetland feature was categorised with the use of the *National Wetland Classification System Methodology, as described in Section 2.2*. The results are illustrated in the table below.

Table 18: Wetland categorisation for the wetland feature.

Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) unit	
			HGM Type	Longitudinal zonation / landform
Inland	*Highveld* Ecoregion	Valley floor	Channelled valley-bottom wetland	Lowland River
An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	The subject property falls within the Highveld Ecoregion and the Northern Olifants Water Management area	The typically gently sloping, lowest surface of a valley	Mostly flat wetland area on a valley floor (see valley floor) that is dissected by and typically elevated above a well-defined stream channel (see channel). Dominant water inputs to these areas are typically from the channel (when it overtops or from sub-surface discharge) and from adjacent valley-side slopes.	low-gradient, alluvial fine-bed channels, which may be confined

Figure 9 illustrates the location of the wetland feature within the subject property.

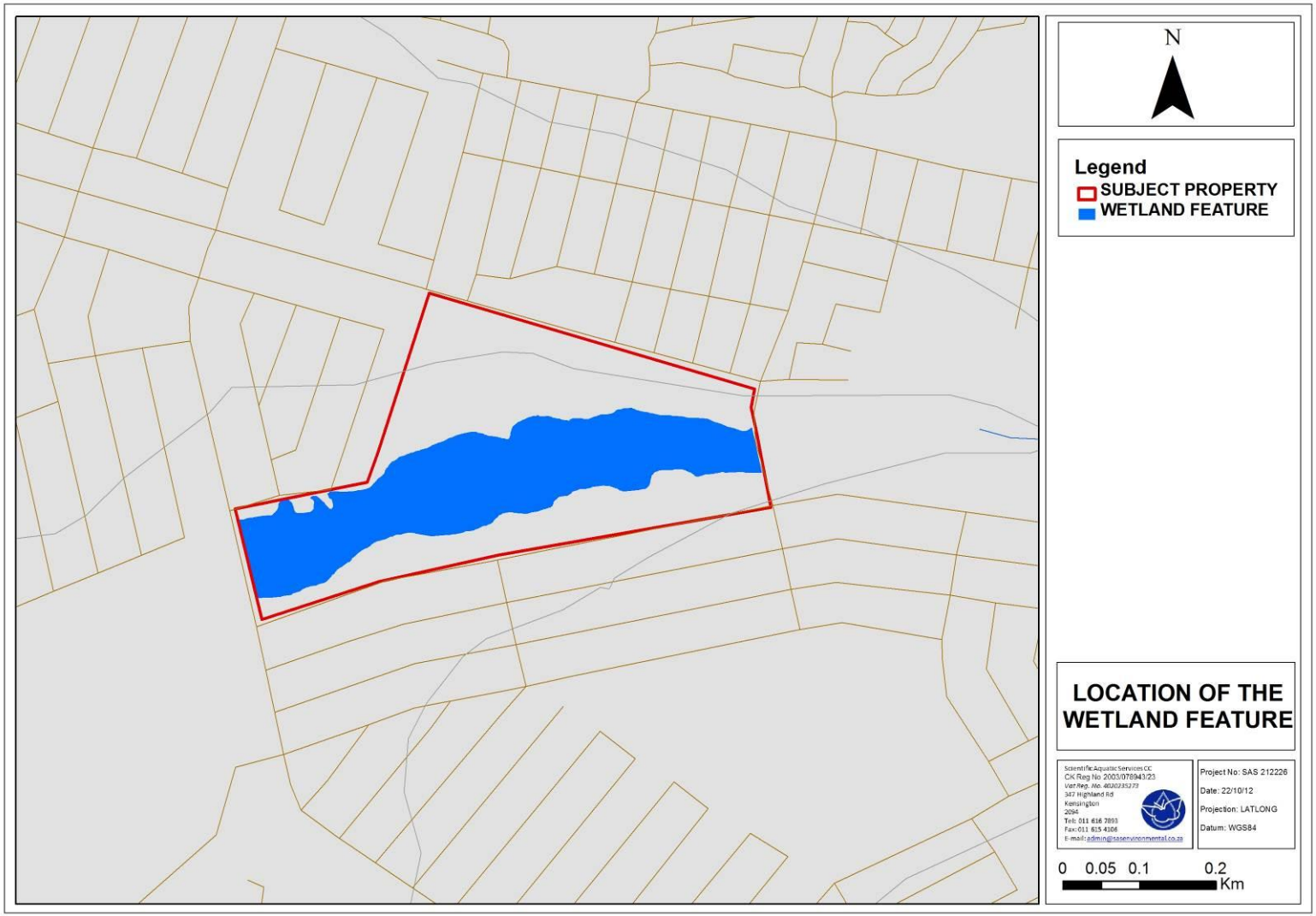

Figure 9: The wetland feature, identified according to the National Wetland Classification System Methodology (SANBI, 2009).

6.1.1 Wetland System Modifiers

The channelled valley bottom wetland unit has been impacted on and has three main physical modifiers acting upon the wetland system. These physical modifiers are:

- Alien vegetation dominating the stream channel of the wetland feature;
- Illegal dumping of litter and building rubble within the wetland unit ;
- Erosion, incision and siltation.

The wetland and active channel area was dominated by *Typha capensis* which has congested much of the channel. This can be attributed to the fact that the wetland has been severely impacted on by erosion and siltation which has formed leading to alteration of the wetlands ecological status. The siltation of the wetland area forms suitable habitat for *Typha capensis* to occur in abundance (Figure 10). This has led to alteration in the vegetation within the channel, and is now dominated by *Typha capensis*. Although *Typha capensis* is an indigenous perennial plant, it can prevent access to streams and channels and become a hindrance to water flowing through the stream channel.

Figure 10: Abundant *Typha capensis* vegetation found within the wetland system.

The wetland has also been severely impacted on by the dumping of waste material into the wetland area. This was mainly closer to the roads on both sides of the wetland. This poses a serious risk in terms of water quality and in the general sanitation of the area. The dumping of building rubble was also noted (Figure 11a).

A blocked sewerage drain system was seen flowing from Luthuli Street into the wetland area. This also contributed to the decrease in water quality and aquatic species found within the wetland system (Figure 11b).

Figure 11: A) Illegal dumping of waste material by the local community and B) the blocked sewerage drain overflowing into the wetland system.

Severe erosion and siltation of the wetland unit area was noted (Figure 12). This has led to several topographic changes within the wetland unit and has resulted in creating a habitat for *Typha capensis* which now dominates most of the wetland unit.

Figure 12: **Erosion and bank failure noted within the wetland system.**

6.2 Wetland Function Assessment

The function and service provision was calculated for the wetland area according to characteristics discussed in Section 2.6. The average score of the wetland is presented in the following table as well as the radar plot in the Figure13 that follows Table19 below.

Table 19: Wetland function and service provision for the subject property.

Ecosystem service	Wetland feature
Flood attenuation	1.20
Stream flow regulation	1.80
Sediment trapping	2.40
Phosphate assimilation	2.50
Nitrate assimilation	2.50
Toxicant assimilation	2.60
Erosion control	1.70
Biodiversity maintenance	0.60
Carbon Storage	1.50
Water Supply	0.50
Harvestable resources	0.50
Cultivated significance	0.00
Tourism and recreation	0.00
Education and resource	0.00
SUM	**17.80**
Average score	**1.27**

The results from the Eco-services assessment; where 15 ecosystem services were assessed; and their outcomes are illustrated in the radar plot. The results show that the wetland has a **moderately low** level of importance in terms of the wetland services and function that it provides. The wetland is important in terms of its indirect benefits, with water quality enhancements being of the greatest benefit. These benefits specifically are Toxicant, Phosphate & Nitrate Assimilation and Sediment trapping also playing an important role. The wetland has some benefit in terms of Stream Flow Regulation and Carbon Storage; while there is a minor benefit related to Flood Attenuation and little benefit to Biodiversity maintenance. Concerning the Direct and social aspects provided by the wetland, the wetland plays a small role in the provision of Cultivated Foods – due to the farming in the wetland area by the local community. The wetland also plays a minor role in Water Supply and Harvestable Resources to the surrounding community; due to the high level of poverty in the area the wetland does provide a source of water to the community although it is of impaired quality, the local community do most likely rely on this as a source for watering their cultivated crops. There is a no benefit in terms of Cultural significance, Tourism and recreation or Education and Resources.

The radar plot below visually illustrates the eco-services provisions for the wetland where 15 wetland services were investigated.

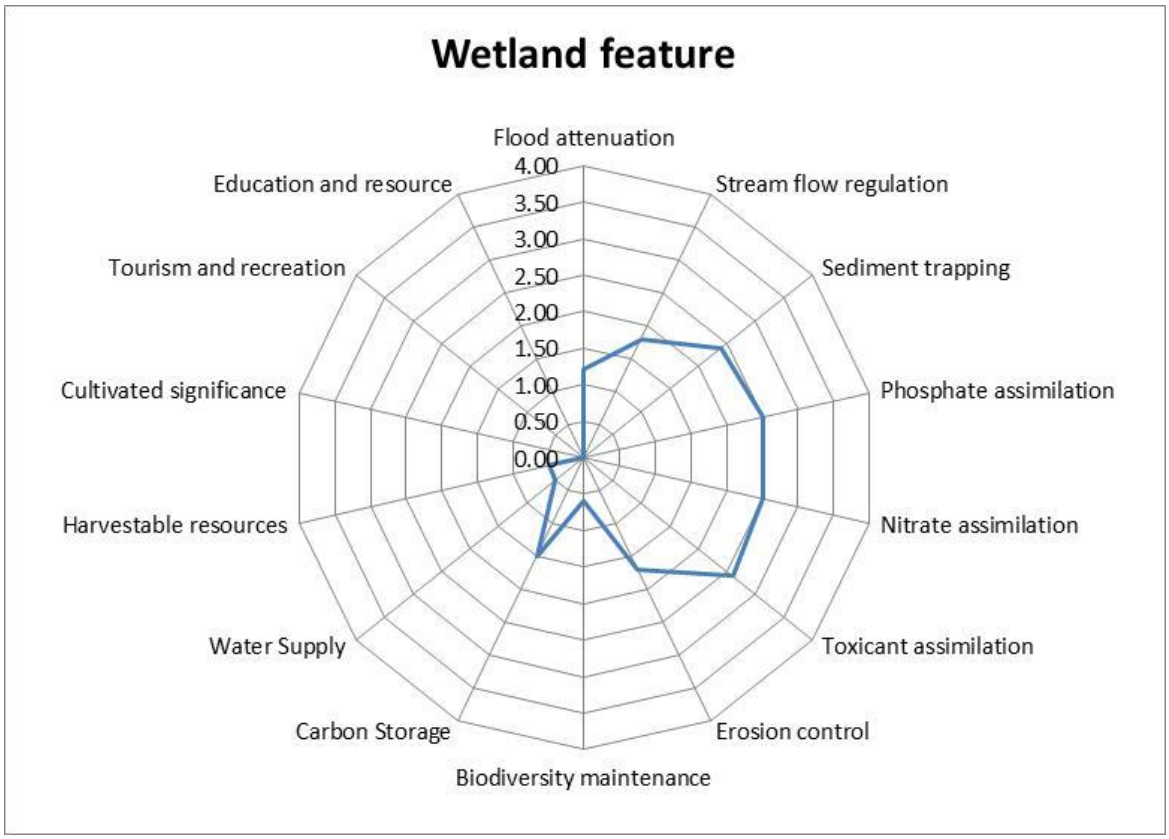

Figure 13: Radar plot of wetland services provided.

6.3 Present Ecological State

The results for the criteria and attributes used for the calculation of the PES are stipulated in the table below.

Table 20: Criteria and Attributes used with the calculation of the PES.

	Channelled Valley Bottom	
Criteria and Attributes	**Score**	**Confidence**
Hydrologic		
Flow modification	2	3
Permanent Inundation	2	2
Water quality		
Water Quality Modification	1	3
Sediment load modification	1	4
Geomorphic		
Canalisation	1	3
Topographic Alteration	2	2
Biota		
Terrestrial Encroachment	2	3
Indigenous Vegetation Removal	2	2
Invasive plant encroachment	2	2
Alien fauna	3	3
Overutilisation of biota	2	2
Total	**20**	
Mean	**1.82**	
Class	**E**	

The Mean Present Ecological State (PES) score obtained for the wetland area was calculated and the wetland is **extensively modified**, as it falls within a class **E** category. This can be attributed to the fact that the wetland has been severely impacted on by erosion and siltation, leading to alteration of the wetlands ecological status. This has led to alteration in the vegetation within the channel. The siltation has provided extra space and has created a habitat for the *Typha* capensis to grow excessively. The current state of the bridge in Twala Drive has led to severe incision of the stream channel downstream of the bridge, which has resulted in increased erosion and change in vegetation structure; due to silting up of the culverts and thus altering the hydrodynamics downstream. The wetland unit has been impacted on by dumping of waste material into the wetlands unit. This poses a health risk and a risk in terms of general sanitation to the local community.

Figure 14: Abundant *Typha capensis* vegetation found within the wetland system.

Dominant flora of the wetland feature

Upon the assessment of the area, the various wetland vegetation components were assessed. Dominant species are typically characterised as either wetland or terrestrial species. The wetland species are then usually further categorised as temporary, seasonal and permanent zone species. It should be noted that due to the time of year the assessment was done some floral species may have been missed; however this was not considered a constraint during the wetland zone verification due to terrain units and soil form used as primary indicators. The characterisation is presented in the table below, including the terrestrial species identified on the subject property.

Table 21: Dominant floral species identified during wetland zone delineation [invader / weed species are indicated with an asterisk (*)].

Terrestrial species	Temporary zone species	Seasonal zone species	Permanent zone species
**Cynodon dactylon*			
**Pennisetum clandestinum*			
Paspalum urvilli	*Paspalum urvilli*	*Cyperus denudatus*	*Typha capensis*
Sorghum bicolor sp	*Hypochaeris radicata*	*Juncus punctorius*	*Phragmites australis*
Prunus persica	*Plantago lanceolata*	**Verbena bonariensis*	*Cyperus denudatus*
Tagetes minuta	*Brachiaria deflexa*	**Salix babylonica*	*Juncus punctorius*
Euphorbia striata	*Capsella bursa pastorsis*	**Canna sp.*	
Hypochaeris radicata	*Sonchus oleraceus*	**Oenothera rosea*	
Argemone ochrdeua sp			
Plantago lanceolata			

6.4 Ecological Management Class (EMC)

The wetland assessment indicates that high levels of transformation have occurred in the wetland. This is evident in all levels of ecology and functionality within the wetland. As the wetland falls in a Class E category and is thus Extensively modified which is an

unacceptable management category. the wetland system therefore has to be managed, improved and maintained as a Class D system. If the Rehabilitation measures and recommendations; which are presented in this report; are adequately followed and correctly implemented, then it is deemed possible to maintain the class D category on a localised scale.

6.5 Wetland delineation and sensitivity mapping

During the assessment, the following temporary zone indicators were used:

- Vegetation was used as the primary indicator for the majority of the wetland temporary zones as this proved to be the most accurate in transformed conditions.
- Terrain units were investigated to aid in identifying areas with wetland characteristics where there was uncertainty on the location of the wetland boundary based on the vegetation characteristics. Terrain units were also used to determine the areas on the subject property where wetlands were most likely to occur.
- For the soil form indicator, the presence of gleyed soils (most of the iron has been leached out of the soil leading to a greyish/greenish/bluish colour) and mottling (created by a fluctuating water table) were investigated to aid in identifying areas with wetland characteristics where no indication of a temporary wetland zone could be identified from the vegetation or landscape characteristics.
- Surface water was also useful during the delineation of the wetland feature with surface water being present throughout the wetland.

After consideration of the findings during the wetland assessment, no buffer is deemed necessary for the wetland feature identified within the subject property. A 32m buffer as requested by DWA guidelines was included for illustrative purposes. Due to construction activities that will infringe upon the wetland areas, it is crucial that mitigation measures be implemented to minimise the impacts on the wetland system as far as possible. Construction activities occurring within the wetland features requires relevant authorisation according to the National Environmental Management Act (NEMA) 107 of 1998 and Section 21 c and i of the National Water Act 36 of 1998.

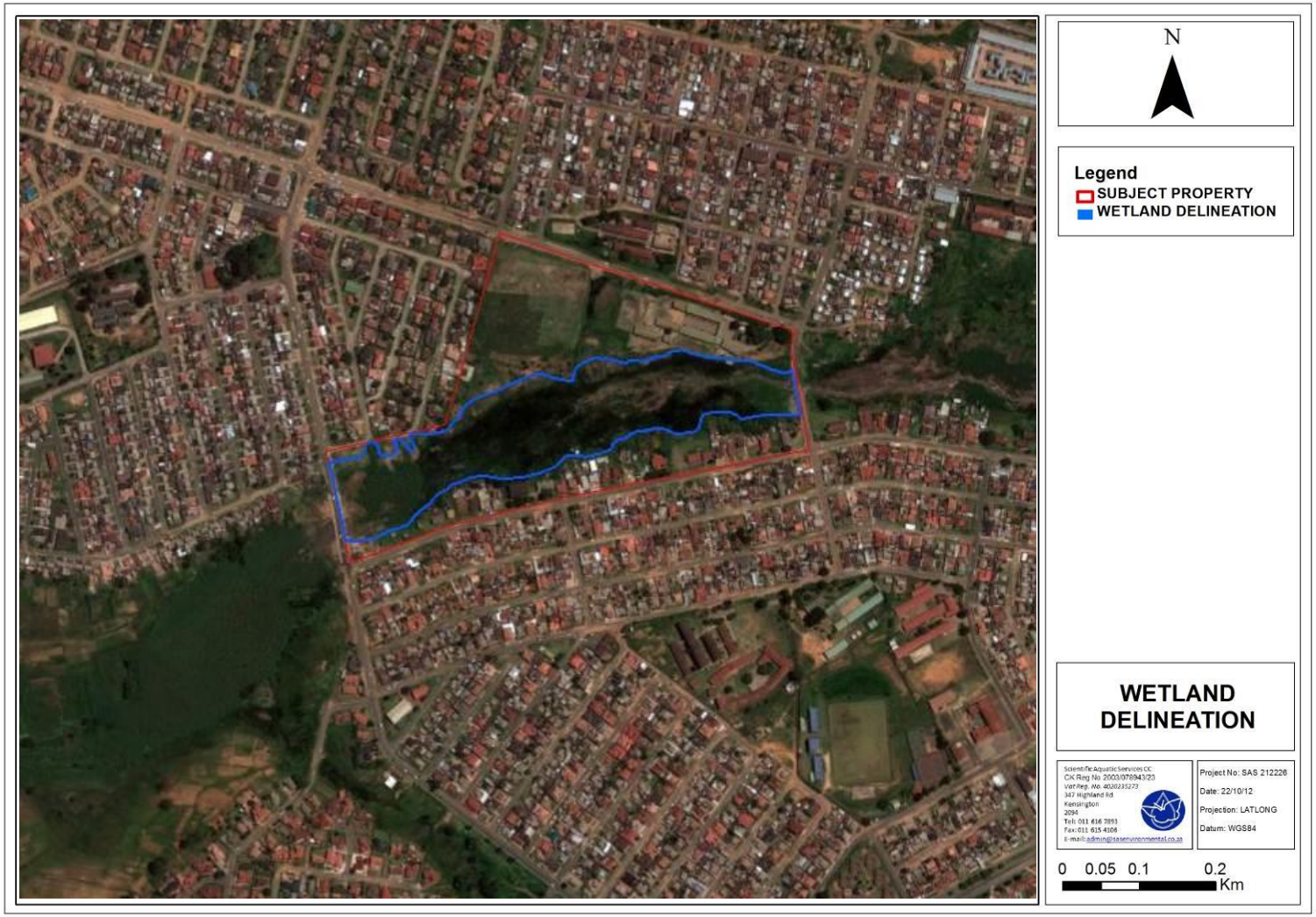

Figure 15: A digital satellite image of the wetland delineation within the subject property.

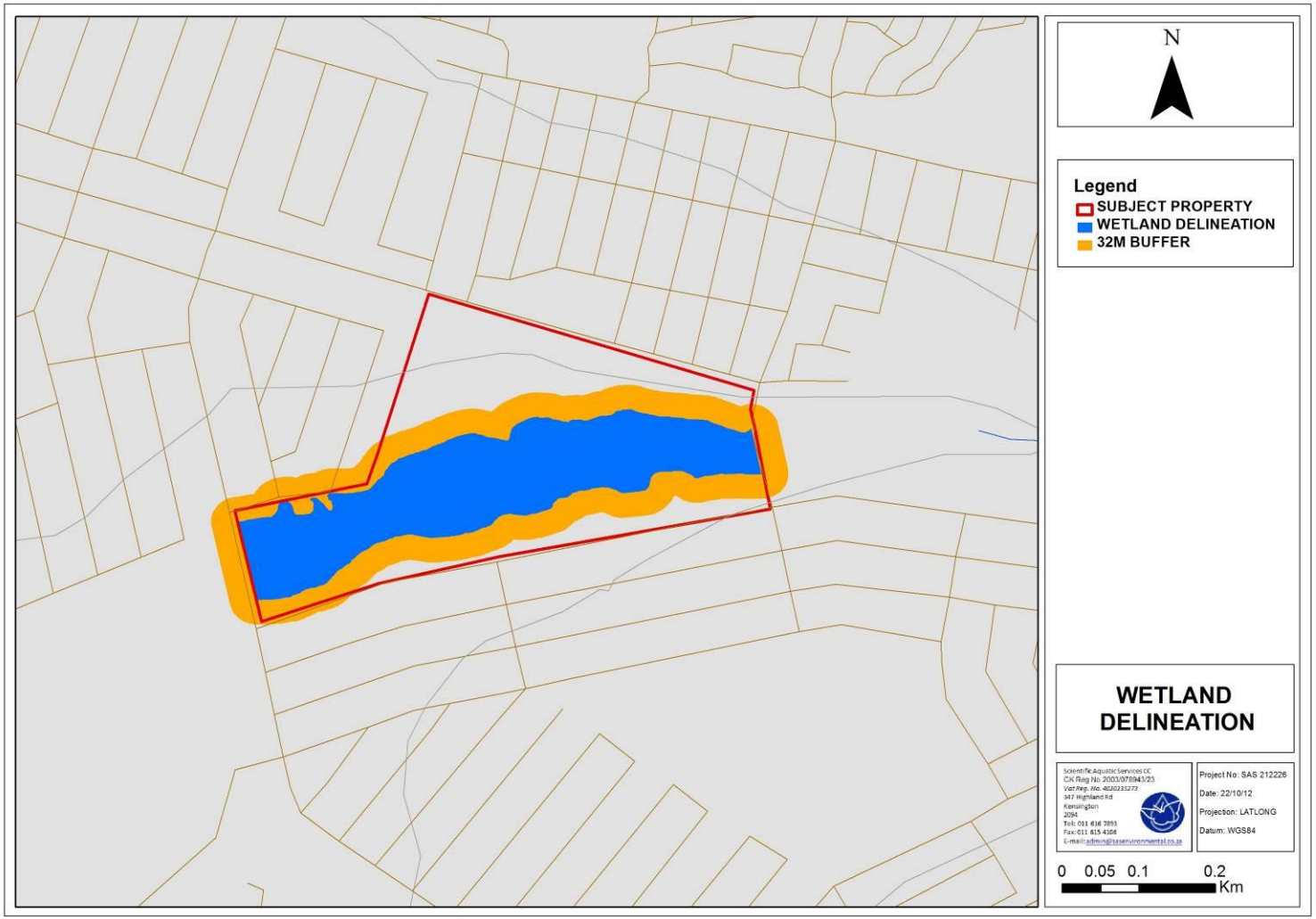

Figure 16: The wetland delineation within the subject property with the associated 32m buffer.

6.6 Aquatic assessment

6.6.1 Visual assessment

A photographic record of the site was made in order to provide a visual record of the condition of the site as observed during the field assessment. The photographs taken are presented below. The table below summarises the observations for the various criteria made during the visual assessment undertaken at this point.

Figure 17: Upstream view of the K1 site.

Figure 18: Downstream view of the K1 site indicating the low flow conditions and sedimentation in the area.

Table 22: Description of the location of the assessment site in the study area.

SITE	K1
Surrounding Features	Located in a residential area where significant anthropogenic activity has occurred. The crossing point is situated in a residential area surrounded by open parks and subsistence farms.
Site significance	Site serves to indicate sensitivity of the habitat in the system at the point of the proposed upgrade as well as the diversity and sensitivity of the aquatic community at this point.
Riparian zone characteristics	The riparian zone at this point is narrow due to significantly incised banks. Bankside vegetation is absent in areas, with vegetation present dominated by reeds and grasses.
Algal presence	No algal proliferation was observed.
Visual indication of and impact on aquatic fauna	Sedimentation and a lack of flow in the system. Some impact from stream erosion and incision is deemed possible. High volumes of solid waste disposal occurring all along the stream.
Depth characteristics	The stream consisted of moderately shallow runs.
Flow condition	The stream consisted of slow flowing runs.
Water clarity	Water was clear at the time of assessment, until sediment is disturbed when water turns black most likely from some sewage input.
Water odour	Odours were evident.
Erosion potential	Potential for erosion is present with the stream having banks with a high gradient and little cover.

6.6.2 Physico-Chemical Water Quality

Table 23 below records the biota specific water quality of the K1 assessment site.

Table 23: Biota specific water quality variables obtained at the assessment site.

SITE	COND MS/M	PH	D.O. mg/l	TEMP ºC
K1	100.1	6.72	4.71	20.6

- The general water quality at this point may be considered poor.
- The electrical conductivity (EC) value may be considered elevated from natural conditions and exceeds the OREWRA requirements for this part of the Olifants River system, with some impact as a result of upstream erosion affecting the water quality at this point.
- pH may be considered natural and is unlikely to limit the diversity and sensitivity of the aquatic communities present. The pH also falls within the TWQR for the OREWRA guidelines.
- Dissolved oxygen values are low and are likely limit the aquatic community to some degree leading to reduced species diversity and reduced community sensitivity;
- Temperature may be considered normal for the time of day and time of year when sampling took place. The temperature also falls within the guidelines for OREWRA.

6.6.3 Intermediate Habitat Integrity Assessment

From the results of the application of the IHIA to the K1 site, some high impacts occurring along this section of the stream were observed. Instream impacts consisted of slight flow, bed modifications, and water quality. Impacts on the riparian zone included impacts as a result of alien encroachment, bank erosion, flow modification, channel modification and water quality. Overall, the site achieved a 42.9% score for instream integrity and a 30.3% score for riparian zone integrity. The site obtained an overall IHIA rating of 36.6%, which indicates extensively modified (Class E) conditions.

Instream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
K1	6	10	17	6	19	8	8	5	6	42.9	D Largely modified
None	Small		Moderate			Large				Serious	Critical

Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
K1	8	18	14	3	15	15	12	8	30.3	E Extensively modified
None	Small		Moderate			Large			Serious	Critical

REACH	*INSTREAM HABITAT*	*RIPARIAN ZONE*	*IHI SCORE*	*CLASS*
K1	42.9	30.3	36.6	E Extensively modified

Figure 19: Integrated Habitat Integrity Assessment.

6.6.4 Habitat Suitability for Aquatic Macro-Invertebrates

The table below presents a summary of the findings of the application of the IHAS index to the site.

Table 24: A summary of the results obtained from the application of the IHAS index to the assessment site

SITE	K1
IHAS score	44
IHAS Adjustment score (illustrative purposes only)	+36
McMillan, 1998 IHAS description	Habitat diversity and structure is inadequate for supporting a diverse aquatic macro-invertebrate community under the current conditions. This is largely due to the lack of flow and adequate habitat in the system at the time of assessment
Stones habitat characteristics	Rocky substrate was absent at this point.
Vegetation habitat characteristics	Marginal vegetation was present at this point. Consisting mainly of grasses.
Other habitat characteristics	Extensive sand and gravel deposits were present, which will provide habitat for suitably adapted organisms.

SITE	K1
IHAS general stream characteristics	The river was relatively narrow with slow flowing runs dominating the site at this point. Bankside vegetation is absent in some areas, however, where present, vegetation was dominated by reeds and grasses.

Habitat diversity and structure at site K1 is currently considered inadequate for supporting a diverse aquatic macro-invertebrate community under the current flow conditions.

6.6.5 Aquatic Macro-invertebrates

The results of the aquatic macro-invertebrate assessment, according to the SASS5 index, are summarised in the tables below. Table 7 indicates the results obtained at the site per biotope sampled. Table 8 summarises the findings of the SASS5 assessment based on the analyses of the data for the site, as well as interpretation of the data obtained.

Table 25: Biotope specific summary of the results obtained from the application of the SASS5 index to the assessment site

PARAMETER	SITE	STONES	VEGETATION	GRAVEL, SAND AND MUD	TOTAL
SASS5 SCORE	K1	0	5	6	6
Number of taxa		0	1	2	2
ASPT		0	5	3	3

Table 26: Summary of the results obtained from the application of the SASS5 index to the assessment site.

TYPE OF RESULT	K1
Biotopes sampled	Marginal vegetation, gravel and sand.
More sensitive macro-invertebrate taxa present	*None*
More sensitive macro-invertebrate taxa absent	*Aeshnidae; Lestidae;; Hydrametridae; Leptophlebiidae; Naucoridae; Gomphidae, Atyidae, Corduliidae, Ancylidae, Hydracarina; Chlorolestidae; Leptoceridae; Elmidae; Caenidae*
Adjusted SASS5 Score	42
SASS5 % of reference score	2.5%
ASPT % of reference score	44.1%
Dickens & Graham (2001) classification	Class F: Critically impaired: fewer families present than expected, due to the loss of most intolerant forms. Extensive loss of basic ecosystem functions has occurred.
Dallas (2007) classification	Class E/F

- The SASS5 data indicates that according to the Dickens & Graham (2001) classification system, the aquatic macro-invertebrate community in this section of the Kalkspruit has

suffered a critical loss (Class F) in integrity when compared to the reference score for the Highveld Eco-region stream.

- According to the Dallas (2007) classification system, the K1 site may be classified as a Class E/F (critically impaired) system.
- The low flows and the limited diversity of habitat in this system, as well as the significantly elevated levels of dissolved salts present in the system at this point are likely to be the most significant factors shaping the species composition of this system at the present time.
- Special care should be taken to prevent any further degradation of the instream habitat flow conditions and water quality as a result of the proposed bridge upgrade.

6.6.6 Fish Community Assessment

The fish community assessment could not be applied due to inadequate flow conditions at the site at the time of the assessment.

7 Impact Assessment

The tables below serve to summarise the significance of potential impacts on the wetland and aquatic integrity of the proposed bridge upgrade site. Each individual impact identified is presented in section 7.1. A summary of all potential construction, operational, rehabilitation and cumulative impacts is provided in Section 7.2.

The impact assessment was divided into three sections where impacts were determined for:

- Alternative 1: Upgrade of the bridge using box culverts;
- Alternative 2: Upgrade of the bridge using cast in situ options; and

Impacts on the No-go alternative (No upgrade or rehabilitation will take place. The site will remain in the existing condition) will be discussed separately under each section. The impact tables were assigned colours for each alternative, which are presented in the table below.

Table 27: The alternatives and associated colour scheme.

Alternative	Colour
Alternative 1: Upgrade of the bridge using box culverts.	
Alternative 2: Upgrade of the bridge using a cast *in situ* option.	

The sections below present the impact assessment according to the method described in Section 4. In addition, it also indicates the required mitigatory measures needed to minimise the impact and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

7.1 Impact Analyses

IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of the proposed upgrade of the bridge	Construction within wetland areas	Increase in alien plant species	Ineffective rehabilitation
Removal of soil and vegetation	Spillage and seepage	Erosion and sedimentation of wetlands	Erosion and sedimentation of wetlands
	Rubble and waste generated through the construction activities dumped within the wetland zone	Concentration of water flow downstream, increasing the flow energy	Encroachment of alien vegetation

Encroachment of infrastructure or construction or operational waste materials into wetland areas could occur and would affect the habitat integrity of these areas.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	4	2	3	2	2	6	7	42 (Low)
Managed	3	2	2	1	2	5	5	25 (Very Low)
Unmanaged	5	4	4	4	5	9	13	117 (High)
Managed	4	3	3	3	4	7	10	70 (Medium Low)

Impacts on Alternative 1 and 2

Any impact, which occurs (such as edge effects from construction, wetland encroachment, etc.), will be largely specific to the development and rehabilitation area. Impacts for alternative 1 may occur for a short duration of time. Impacts on alternative 2 will be permanent. The impact is highly likely should the mitigation measures not be adhered to. When mitigation measures are implemented, the impact significance of construction in the wetland areas can be reduced to a very low level through a reduction in the severity, duration and scale of the impact.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, this will further decrease the function and ecological state of the wetland feature with regards to further alien encroachment, soil erosion and sedimentation of the wetland feature. The current domestic waste and rubble material dumped within the wetland feature, will further increase and decrease the habitat integrity of the system, downstream.

Recommended mitigation measures:

- Ensure that all current activities consider the wetland boundaries. No vehicles are to enter or drive through the wetland area unnecessarily;
- Demarcate all wetland boundaries with pegs and danger tape;
- Edge effects of pre-construction and construction activities, including erosion, sedimentation and alien/weed control, need to be strictly managed in wetland areas as well as their associated buffer zones.
- As far, as is practical, implement concurrent rehabilitation processes in order to limit degradation of soil biota.
- No dumping of waste or any other materials is allowed within the wetland areas; and
- Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction phases.

IMPACT 2: LOSS OF ECOLOGICAL SERVICES

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of the proposed upgrade of the bridge	Construction of the bridge infrastructure in wetland areas.	Erosion and sedimentation of wetlands	Ineffective rehabilitation
Siting of infrastructure	Construction of bridge and access through wetland areas	Degradation of the wetland habitat and function	Erosion and sedimentation of wetlands
Removal of dominant vegetation	Poor construction methods and inappropriate construction techniques	Concentration of water flow downstream, increasing the flow energy	Encroachment of alien vegetation.
Vehicles accessing site through wetland areas	Rubble and waste generated through the construction activities		

Disturbance of the wetland area may lead to a loss of ecological service provision in terms of habitat provision, nutrient trapping, and flood control and water purification among others.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	3	2	3	2	3	5	8	40 (Low)
Managed	2	2	2	1	2	4	5	20 (Very Low)
Unmanaged	5	4	4	4	5	9	13	117 (High)
Managed	4	3	3	3	4	7	10	70 (Medium Low)

Impacts on Alternative 1

Impacts on the loss of ecological services are likely to occur during the bridge re-construction and rehabilitation of the wetland area. The receiving environment is of a limited sensitivity. Impacts, which may occur, are likely to affect the local area and the impact is likely to last for a month to a year, depending on the duration of the project and the application of corrects and strict mitigation measures. The bridge re-construction and rehabilitation within the local area has a low impact significance. When mitigation measures are fully implemented, the impact significance of the bridge reconstruction and wetland rehabilitation can be reduced to a very-low level.

Impacts on Alternative 2

Impacts, which will occur, will definitely affect the local area and the impact is likely to last the life of the operation. The cast *in situ* option will have a high impact on the ecological function of the wetland system. Even if mitigation measures are implemented fully, the impact will still be medium-low, compared to the box culvert option to be used, which will be of a short duration and a very low impact should all mitigation measures be implemented fully.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, there will be a further decrease the function and ecological state of the wetland feature with regards to further alien encroachment, soil erosion and sedimentation of the wetland feature. The wetland feature is considered to be of limited sensitivity and by implementing the no-go alternative, will further decrease the sensitivity and ecological function and service to a critically modified system. This will ensure that rehabilitation of the system will be very difficult and will not be able to reinstate the system to a more appropriate ecological management class.

Recommended mitigation measures:

- Ensure that effective rehabilitation takes place in order to restore wetland service provision;
- Ensure that all activities take the wetland boundaries into account; and
- Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction phases.

IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of the proposed upgrade of the bridge	Disturbance of soils resulting in erosion	Incision and erosion	Disturbance of soils resulting in erosion
Vehicles accessing site through wetland areas	Removal of riparian vegetation	Erosion caused by storm water runoff causing siltation in a downstream direction.	Removal of riparian vegetation
Inadequate planning and design of access roads and coffer dams	Obstacles e.g. rubble and waste generated through the construction activities in the riparian zone obstructing flow and causing a build-up of sediment.	Sediment blockages causing upstream ponding	Inadequate rehabilitation of the area once operational phase is completed leading to on-going erosion and canalisation

The aquatic resources in the area can be considered to be highly impacted upon as a result of the effects of sedimentation. Impacts due to additional sedimentation can be significant and have the potential to affect the biodiversity and functioning of the system. With disturbance or the removal of vegetation cover and soils associated with the project, there is a risk of sedimentation of the aquatic resources occurring.

Impacts due to canalisation and erosion can be significant and have the potential to affect the hydrological functioning and biodiversity of the system. Specific risks occur to riparian vegetation, instream habitat and aquatic biota. Disturbances caused by vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	4	3	3	3	3	7	9	63 (Medium-high)
Managed	2	2	2	2	2	4	6	24 (Very-low)
Unmanaged	5	4	4	4	5	9	13	117 (High)
Managed	4	3	3	3	4	7	10	70 (Medium Low)

Impacts on Alternative 1 and 2

During the pre-construction and construction phase, there will be a disturbance of soils in the area affected by the upgrade of the bridge. Silting up of the aquatic resources within the subject property due to any disturbance of the surface areas may occur, thus impacting on the aquatic resources further downstream. Without mitigation, this impact can be considered to possibly lead to a moderate change in the ecology of the system within a localised area but impacts may occur for a relatively extended period of time. Should these impacts be effectively managed and mitigated, these impacts can be reduced to very low levels.

With the construction, vegetation removal and exposed soils will result in erosion and canalisation of the river systems in the area. Excavations within riparian zones and drainage lines could lead to altered drainage patterns and the removal of vegetation and the disturbance of the soil could lead to erosion and incision of the stream banks. Effects could become significant on a localised scale and if unmitigated impacts could occur in perpetuity. If mitigation measures are adequately implemented, the probability of impact is reduced, and the consequence of the impact becomes significantly lowered.

No-go Alternative

Erosion has occurred within the wetland system especially closer to developed areas and the main road. Due to the alteration and erosion of banks close to Twala Drive, it has caused silt to wash into the wetland system, thus further affecting the aquatic resources. Thus, by following the no-go option will further decrease the aquatic resources of the system and leading to more sedimentation, canalisation and erosion within the system.

Recommended mitigation measures:

- The time in which soils are exposed during construction activities should remain as short as possible;

- Concurrent rehabilitation is to take place as far as possible and footprint areas should be minimised as far as possible;
- All areas affected by construction should be rehabilitated upon completion of the construction phase;
- River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required. Steep banks should be stabilised with hessian sheets;
- Adequate storm water management must be incorporated into the design of the proposed bridge upgrade in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities which rely on stream substrates clear of sediment;
- During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10%-15%, berms every 20m should be installed.
    - Where the track has slope greater than 15%, berms every 10m should be installed.
- No unnecessary construction activities should be allowed within the riparian zones in line with the requirements of Section 21(c) and (i) of the National Water Act.

IMPACT 4: IMPACTS DUE TO INUNDATION

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of the proposed upgrade of the bridge	Ponding upstream of the proposed upgrade due to blockage of bridge infrastructure.	Ponding upstream of the proposed upgrade due blockage of bridge infrastructure	Disturbance of soils resulting in erosion
	Alteration of bed and bank profiles.	Alteration of bed and bank profiles.	Removal of riparian vegetation
	Alteration of instream habitat conditions	Alteration of instream habitat conditions	Inadequate rehabilitation of the area once operational phase is completed leading to on-going inundation

	Alteration of soil wetness profiles	Alteration of soil wetness profiles	

The proposed bridge upgrade has the potential to alter bed and bank profiles which in turn can lead to inundation of the riverine systems in the vicinity of the proposed upgrade. Inundation can affect instream habitat conditions, which in turn can affect aquatic biota. Inundation can also affect bankside and riparian vegetation due to the altered soil wetness profiles.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	4	2	3	3	2	6	8	48 (Low)
Managed	2	2	2	2	1	4	5	20 (Very-low)
Unmanaged	5	4	4	4	5	9	13	117 (High)
Managed	4	3	3	3	4	7	10	70 (Medium Low)

Impacts on Alternative 1 and 2

Any activities or structures impeding flow within the riparian zones could alter bed profiles and by so doing lead to inundation of the areas upstream of the development. The cast in situ option will have a higher impact on the alternation of the bed and bank profiles by roving vegetation and replacing it with a permanent flooring structure. Without any mitigation efforts, any impacts, which occur, will occur within a short distance upstream of the activity or structure and continue for a prolonged period. With mitigatory measures applied the impact can be reduced be minimising the severity of the impact, along with the duration and spatial scale of the impact.

No-go Alternative

The Kalkspruit has already been significantly affected by bank incision, and by implementing this alternative; it will increase the erosion factor.

Recommended mitigation measures:

- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel

- The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time;
- Throughout the construction and operational phases streamflow continuity in the system must be maintained;
- During construction all building materials should be kept out of the riparian or wetland zones;
- All waste and remaining building materials should be removed from site on completion of the project;
- No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones;
- All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge; and
- The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion.

IMPACT 5: ALIEN VEGETATION ENCROACHMENT

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of the proposed upgrade of the bridge	Removal of indigenous vegetation	Encroachment of terrestrial vegetation in the wetland feature	Removal of indigenous vegetation
	Colonisation of disturbed river banks by invasive and opportunistic species	Encroachment and colonising of invasive vegetation species, leading to a loss of natural wetland vegetation	Colonisation of disturbed river banks by invasive and opportunistic species
	Activities where the vegetation is cleared and soil disturbance takes place		Inadequate rehabilitation of the area once operational phase is completed leading to on-going alien vegetation encroachment

Terrestrial vegetation encroachment is a highly significant problem in disturbed areas and this will need to be mitigated for the life of the proposed upgrade and into the rehabilitation phase.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	5	3	4	5	3	8	12	96 (Medium-high)
Managed	3	3	2	3	1	6	6	36 (Low)
Unmanaged	5	3	4	5	3	8	12	96 (Medium-high)
Managed	3	3	2	3	1	6	6	36 (Low)

Impacts on Alternative 1 and 2

Construction activities (whether using box or cast in situ option during the upgrade of the bridge) could lead the removal of natural vegetation and the disturbance of the soil could lead to alien invasive species which are more aggressive in colonising disturbed areas. Effects could become significant on a localised scale and if unmitigated impacts could occur in perpetuity. With mitigation the both the probability and the consequence of the impact can be reduced leading to an overall reduction in the significance of this impact.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, the function and ecological state of the wetland feature is considered likely to continue to degrade especially in terms of further alien encroachment within the subject property and possibly further downstream. if this project is not undertaken future rehabilitation of the system will be more costly and more difficult and it will be very difficult to reinstate the system to a more appropriate ecological management class.

Recommended mitigation measures:

- In disturbed areas, soil conditions must be returned to conditions which can support natural vegetation;
- Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases;
- All areas affected by construction should be rehabilitated upon completion of the construction phase of the upgrade; and
- River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required.

IMPACT 6: INEFFECTIVE REHABILITATION

Pre-Construction	Construction	Operational	Rehabilitation
Failure to develop a comprehensive rehabilitation plan and ensure that sufficient rehabilitation and maintenance budgets are in place to minimise environmental degradation	Failure to correctly rehabilitate areas disturbed during construction	Failure to adequately rehabilitate disturbance throughout the life of the bridge and rehabilitation of wetland	Ineffective rehabilitation
	Ineffective rehabilitation measures where soils are not compacted and inadequate vegetation cover is implemented	Ineffective monitoring and maintenance of rehabilitation during re-construction of bridge and rehabilitation of wetland	Erosion and sedimentation of wetlands
		Rehabilitation using substandard methods and/or using incorrect or invasive vegetation (e.g. using an invasive grass to prevent erosion, instead of a more effective indigenous grass mix.)	Encroachment of alien vegetation
			Ineffective rehabilitation measures where soils are not compacted and inadequate vegetation cover is implemented

Ineffective rehabilitation of wetland areas could cause siltation, erosion and changes in the hydrological functioning of these areas. Wetland habitat may remain transformed should proper rehabilitation not take place.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	3	3	3	3	3	6	9	54 (Medium-low)
Managed	1	2	2	2	1	3	5	15 (Very-Low)
Unmanaged	3	3	3	3	3	6	9	54 (Medium-low)
Managed	1	2	2	2	1	3	5	15 (Very-Low)

Impacts on Alternative 1 and 2

The impact of improper rehabilitation (whether using box or cast in situ option during the upgrade of the bridge) on the wetland area and bridge reconstruction is possible while the receiving environment has a limited sensitivity. Impacts can have a significant impact on the surrounding ecosystems structure and function. Impacts, which occur due to ineffective rehabilitation, are likely impact the local area and will occur for a short period of time, most likely for a year to one month depending on the length of the project and possibly post closure if rehabilitation measures are ineffective. The bridge upgrade and rehabilitation will have a Low impact. If sufficient rehabilitation measures are implemented (such as effective rehabilitation including structural rehabilitation, wetland functional rehabilitation and biodiversity rehabilitation, with an ecologist forming part of the rehabilitation planning resources), the impact from the bridge design on the wetland can be reduced to very low levels.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, it will lead to a further decrease the function and ecological state of the wetland feature with special mention of further alien encroachment, soil erosion and sedimentation of the wetland feature. The wetland feature is considered to be of Seriously impaired/modified and by implementing the no-go alternative, will further decrease the sensitivity and ecological function and service to a critically modified system. further degradation of the system will mean that effective rehabilitation of the system will be very difficult and it will be very difficult to reinstate the system to a more appropriate ecological management class.

Recommended mitigation measures:

- Identify activities, which are causing erosion and incision of any of the wetland feature and mitigate these impacts immediately.
- Obtain relevant legislative approval for any activities to be undertaken within the wetland feature to rectify excessive erosion; and
- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion (where applicable).

IMPACT 7: IMPACTS ON INSTREAM FLOW

Pre-Construction	Construction	Operational	Rehabilitation
Pillars in the active channel.	Vehicles accessing site through wetland areas	Ponding upstream of the proposed bridge upgrade due to loss of stream flow.	Incorrect rehabilitation and reshaping of the stream bed
Inadequate design of proposed bridge upgrade.	Rubble and waste generated through the construction activities dumped in the active channel.		Rubble and waste generated through the construction activities not removed from the active channel.
Inadequate design of temporary access roads and coffer dams	Poor construction methods and inappropriate construction techniques and use of temporary access roads and coffer dams.		Poor operational methods and inappropriate construction techniques.
	Inadequate construction of bridge upgrade leading to impacts throughout the construction and operational phases of the development. Specific mention is made of impacts form the construction of pillars in the active channel.		Inadequate rehabilitation of bridge upgrade leading to impacts beyond the closure phases of the development. Specific mention is made of impacts from the removal of structures in the active channel.

Impacts on instream flow were seen to be characteristic of the aquatic resources in this area.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	4	2	4	5	2	6	11	66 (Medium-low)
Managed	1	1	1	3	1	2	5	10 (Very Low)
Unmanaged	5	4	4	4	5	9	13	117 (High)
Managed	4	3	3	3	4	7	10	70 (Medium Low)

Impacts on Alternative 1 and 2

The aquatic resources in the area can be considered to be of relatively low sensitivity due to impacts as a result of urbanisation in the area and the probability of impacts on instream flow is considered to be relatively small. However, any impacts on the upper aquatic resources, will impact on the resources in the vicinity of the crossing. Impacts on the cast in situ cast will be higher than the culvert systems Impacts on instream flow have the potential to be permanent on a localised scale and impacts have the potential to have an impact on the

receiving aquatic environment. Should effective management and mitigation measures be implemented, all impacts can be reduced to a low level.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, there will be a further decrease in the function and ecological state of the wetland feature over time with special mention of further soil erosion, incision and sedimentation of the wetland feature. The current domestic waste and rubble material dumped within the wetland feature, will further increase and decrease the habitat integrity of the system, downstream.

Recommended mitigation measures:

- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel;
- Throughout the construction and rehabilitation phases stream flow continuity in the system must be maintained;
- During construction all building materials should be kept out of the riparian or wetland zones;
- All waste and remaining building materials should be removed from site on completion of the project;
- No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones;
- All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream; and
- The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion.

IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR AQUATIC SPECIES

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design leading to impacts on instream flow	Vehicles accessing site through wetland areas	Ponding upstream of the bridge due to loss of stream flow.	Incorrect rehabilitation and reshaping of the stream bed
Inadequate design of proposed bridge upgrades leading to localised impacts on	Rubble and waste generated through the construction activities dumped in the active channel.	Support structures leading to erosion which in turn will impact on aquatic refugia	Rubble and waste generated through the construction activities not removed from the

habitat.			active channel.
Inadequate design of temporary access roads and coffer dams leading to a temporary loss of refugia in the local area	Poor construction methods and inappropriate construction techniques and use of temporary access roads and coffer dams. In particular, mention is made of inappropriate designs of coffer dams.		Poor operational methods and inappropriate construction techniques.
	Inadequate construction of bridge upgrade leading to impacts throughout the construction and operational phases of the development. Specific mention is made of impacts form the construction of pillars in the active channel.		Inadequate rehabilitation of proposed road and bridge crossing leading to impacts beyond the closure phases of the development. Specific mention is made of impacts from the removal of structures in the active channel.

Impacts on instream habitat can be significant and has the potential to affect the biodiversity and functioning of the system. The Kalkspruit experiences stress in the low flow season and refugia are important for fish and other aquatic taxa when water levels are low. Any loss of these features could be highly significant in this system on a localised scale. Disturbances caused by activities within the riparian zone, vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	4	2	3	5	2	6	10	60 (Medium-low)
Managed	1	1	1	2	1	2	4	8 (Very Low)
Unmanaged	4	2	3	5	2	6	10	60 (Medium-low)
Managed	1	1	1	2	1	2	4	8 (Very Low)

Impacts on Alternative 1 and 2

Loss of instream habitat and refugia as a result of activities during the construction phase of the proposed upgrade has the potential to alter the ecological function and sensitivities of the aquatic resources present. These impacts are likely to be permanent from the cast *in situ* option. Impacts could potentially be permanent if not mitigated. Should adequate mitigation

and management measures be implemented, these impacts can be reduced to very low levels, will be of short duration, and will only occur in the immediate vicinity of the bridge crossing.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, a further decrease the function and ecological state of the wetland feature over time is likely to occur with special mention of sedimentation, incision loss of refugia, incision of banks, loss of bankside habitat and cover and scouring, leading to smooth bedrock surfaces.

Recommended mitigation measures:

- The time in which soils are exposed during construction activities should remain as short as possible;
- As small an area should be disturbed as possible;
- Careful use of stream diversions and coffer dams is deemed essential;
- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel;
- During construction all building materials should be kept out of the riparian or wetland zones;
- All waste and remaining building materials should be removed from site on completion of the project;
- No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones;
- The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion; and
- Adequate erosion control and siltation control measures should be put in place.

IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design leading to impacts on instream flow	Vehicles accessing site through wetland areas	Altered stream profiles leading to a loss of migratory connectivity in the system	Incorrect rehabilitation and reshaping of the stream bed
Inadequate design of bridge upgrade leading to localised changes in the level of the stream bed	Rubble and waste generated through the construction activities dumped in the active channel.	Support structures leading to erosion which in turn will impact on aquatic refugia and migratory connectivity	Rubble and waste generated through the construction activities not removed from the active channel.

Inadequate design of temporary access roads and coffer dams leading to a temporary loss stream connectivity which will prevent migratory movement	Poor construction methods and inappropriate construction techniques and use of temporary access roads and coffer dams. In particular mention is made of inappropriate designs of coffer dams.		Poor operational methods and inappropriate construction techniques
	Inadequate construction of bridge upgrade leading to impacts throughout the construction and operational phases of the development. Any activity which leads to the alteration of the stream bed profile is considered a significant risk		Inadequate rehabilitation of bridge upgrade leading to impacts beyond the closure phases of the development. Specific mention is made of impacts from the removal of structures in the active channel.

Both aquatic species such as fish as well as species with an affinity for riverine systems such as certain avifaunal species, which may migrate along linear riverine features, may be affected by impacts on the aquatic resources within the area.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	2	3	3	5	3	5	11	55 (Medium low)
Managed	1	3	1	2	1	4	4	16 (Very Low)
Unmanaged	2	3	3	5	3	5	11	55 (Medium low)
Managed	1	3	1	2	1	4	4	16 (Very Low)

Impacts on Alternative 1 and 2

The aquatic resources in the area can be considered to be of relatively low sensitivity due to impacts as a result of urbanisation in the area and the probability of impacts on in-stream flow is considered to be relatively small. Any impacts on migratory connectivity, may impact on the aquatic communities in the vicinity of the crossing. Impacts on instream flow have the potential to be permanent and may affect the fish community on a fairly wide scale. The structures used within the upgrade of the bridge also needs to consider the water flow and migratory corridor of aquatic species, thus these structures must not obstruct the flow of

water. Overall, the impact on migratory connectivity prior to mitigation can be considered to be moderately low. Should effective management and mitigation measures be implemented, the risk and impact to migratory species can be reduced to a low level.

No-go Alternative

Should the no-go alternative be implemented, it will lead to the further loss of stream migratory corridors. The condition of the current bridge structure has caused severe sedimentation, and concrete structure to occur within the active channel of the wetland feature. Thus by not upgrading the bridge, and leaving these structure within the active channel, it will lead to a complete loss of aquatic resources within this section of the Kalkspruit.

Recommended mitigation measures:

- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel;
- The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time;
- If at all possible the reconstruction of the bridge should not take place between September and October to prevent impacts on spawning movement;
- Throughout the construction and decommissioning phases streamflow continuity in the system must be maintained;
- During construction all building materials should be kept out of the riparian or wetland zones;
- All waste and remaining building materials should be removed from site on completion of the project;
- No vehicles should be allowed to indiscriminately drive through the riparian or wetland zones;
- All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge; and
- The bed profile should be re-instated in such a way as to prevent upstream ponding and downstream erosion.

IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of proposed bridge upgrade.	Vegetation clearing and soil disturbance.	Increased urban runoff	Disturbance of soils resulting in erosion.
	Pollution such as litter and any spills (both chemical and organic) may occur during the construction phase.	Inadequately rehabilitated banks and riparian zone	Removal of riparian vegetation.

Impacts on instream water quality can be significant and has the potential to affect the biodiversity and functioning of the system. Specific risks occur to taxa, which have an increased sensitivity to water quality changes, with special mention of increased dissolved salt loads as well as changes to the sediment load in the system. Disturbances caused by vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	4	2	2	2	3	6	7	42 (Low)
Managed	2	1	1	2	1	3	4	12 (Very Low)
Unmanaged	4	2	2	2	3	6	7	42 (Low)
Managed	2	1	1	2	1	3	4	12 (Very Low)

Impacts on Alternative 1 and 2

The river systems in this area support taxa, which are moderately susceptible to changes in water quality. However, water quality in the Kalkspruit was found to be severely impaired as a result of upstream increased urbanisation. Without any mitigation efforts, any impacts, which occur, will occur for some distance downstream of the activity. Prior to mitigation, the impact can be considered to be of limited severity and impact may occur for a few months and affect a fairly localised area. With suitable mitigation, the impact can be reduced through a reduction in the severity of the impact and the extent of the impact leading to a very low level of significance of this impact.

No-go Alternative

Should the re-construction and upgrade of the bridge not take place, a further decrease the function and ecological state of the wetland feature over time is likely to occur. The wetland has also been severely impacted on by the dumping of waste material into the wetland area.

This poses a serious risk in terms of further degradation in the water quality and in the general sanitation of the area.

Recommended mitigation measures:

- The time in which soils are exposed during construction activities should remain as short as possible;
- As small an area should be disturbed as possible;
- Any exposed soils should be covered and re-vegetated with a suitable grass mix;
- No dumping should take place in or near the construction site;
- All spills should be immediately cleaned up and treated accordingly;
- No fires should be permitted on site;
- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility; and
- Adequate erosion control and siltation control measures should be put in place.

IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY

Pre-Construction	Construction	Operational	Rehabilitation
Inadequate design of proposed upgrade.	Disturbance of soils resulting in erosion	Erosion caused by storm water runoff causing siltation in a downstream direction.	Disturbance of soils resulting in erosion
	Removal of riparian vegetation	Obstacles in the riparian zone obstructing flow and causing a build-up of sediment.	Removal of riparian vegetation
	Obstacles in the riparian zone obstructing flow and causing a build-up of sediment.		Obstacles in the riparian zone obstructing flow and causing a build-up of sediment.
			Inadequate rehabilitation of the riparian zone

Impacts on turbidity and water clarity can be significant and has the potential to affect the biodiversity and functioning of the system. Specific risks occur to taxa, which have an increased sensitivity to increased turbidity with special mention of the feeding strategies of some fish species and macro-invertebrates. Disturbances caused by vegetation clearing and soil disturbance are the key activities which could lead to this impact.

Management	Probability of Impact	Sensitivity of receiving environment	Severity	Duration of impact	Spatial Scale	Likelihood	Consequence	Significance
Unmanaged	3	3	3	4	2	6	11	66 (Medium-low)
Managed	2	3	2	2	1	6	4	24 (Very Low)
Unmanaged	3	3	3	4	2	6	11	66 (Medium-low)
Managed	2	3	2	2	1	6	4	24 (Very Low)

Impacts on Alternative 1 and 2

During the pre-construction and construction phase, there will be a disturbance of soils in the area affected by the upgrade of the bridge. Silting up of the aquatic resources within the subject property due to any disturbance of the surface areas may occur, thus impacting on the aquatic resources further downstream. Without mitigation, this impact can be considered to possibly lead to a moderate change in the ecology of the system within a localised area but impacts may occur for a relatively extended period of time. Should these impacts be effectively managed and mitigated, these impacts can be reduced to very low levels.

No-go Alternative

Erosion has occurred within the wetland system especially closer to developed areas and the main road. Due to the alteration and erosion of banks close to Twala Drive, it has caused silt to wash into the wetland system, thus further affecting the aquatic resources. If the no go option is followed further decreases in the aquatic ecological integrity of the system will occur due to increased sedimentation, canalisation and erosion within the system.

Recommended mitigation measures:

- The time in which soils are exposed during construction activities should remain as short as possible;
- Concurrent rehabilitation is to take place as far as possible and footprint areas should be minimised as far as possible;
- All areas affected by construction should be rehabilitated upon completion of the construction phase of the development;
- River banks must be appropriately re-profiled and re-vegetated with indigenous grasses as required. Steep banks should be stabilised with hessian sheets;

- Adequate storm water management must be incorporated into the design of the proposed bridge structure in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities which rely on stream substrates clear of sediment;
    - During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed.
    - Where the track slopes between 2% and 10%, berms every 25m should be installed.
    - Where the track slopes between 10%-15%, berms every 20m should be installed.
    - Where the track has slope greater than 15%, berms every 10m should be installed.

7.2 Impact Assessment Conclusion

Based on the above assessment it is evident that there are 11 possible impacts that may have an effect on the overall wetland and aquatic integrity. The table below summarises the findings indicating the significance of the impacts before mitigation takes place as well as the significance of the impacts if appropriate management and mitigation takes place.

Table 28: Summary of impact significance.

Impact	Unmanaged	Managed
IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES	Low	Very Low
IMPACT 1: IMPACT ON WETLAND AREAS DUE TO ENCROACHMENT BY CONSTRUCTION ACTIVITIES	High	Medium Low
IMPACT 2: LOSS OF ECOLOGICAL SERVICES	Low	Very Low
IMPACT 2: LOSS OF ECOLOGICAL SERVICES	High	Medium Low
IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION	Medium High	Very Low
IMPACT 3: IMPACTS DUE TO SEDIMENTATION, CANALISATION AND EROSION	High	Medium Low
IMPACT 4: IMPACTS DUE TO INUNDATION	Low	Very Low
IMPACT 4: IMPACTS DUE TO INUNDATION	High	Medium Low
IMPACT 5: ALIEN VEGETATION ENCROACHMENT	Medium High	Low
IMPACT 5: ALIEN VEGETATION ENCROACHMENT	Medium High	Low
IMPACT 6: INEFFECTIVE REHABILITATION	Medium Low	Very Low
IMPACT 6: INEFFECTIVE REHABILITATION	Medium Low	Very Low
IMPACT 7: IMPACTS ON INSTREAM FLOW	Medium Low	Very Low
IMPACT 7: IMPACTS ON INSTREAM FLOW	High	Medium Low
IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR AQUATIC SPECIES	Medium Low	Very Low
IMPACT 8: IMPACTS ON INSTREAM HABITAT AND REFUGIA FOR AQUATIC SPECIES	Medium Low	Low
IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS	Medium Low	Very Low
IMPACT 9: IMPACTS ON INSTREAM MIGRATORY CORRIDORS	Medium Low	Very Low
IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY	Low	Very Low
IMPACT 10: IMPACTS ON TAXA SENSITIVE TO CHANGES IN WATER QUALITY	Low	Very Low
IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY	Medium Low	Very Low
IMPACT 11: IMPACTS DUE TO INCREASED TURBIDITY	Medium Low	Very Low

From the table it is evident that prior to mitigation, most of the impacts on alternative 1 are medium low level impacts. The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation encroachment are considered to be medium high for the upgrade of the bridge using box culverts. If well managed mitigation takes place, the majority of the impacts using the box system, can be reduced to very low level impacts but the impact from alien vegetation encroachment remains low. If the above impacts are managed and adequate measures are implemented during rehabilitation then the impacts become very low and are of a limited severity.

Impacts from alternative 2 are much higher should no mitigation take place. The impacts from sedimentation, canalisation and erosion as well as the risk of alien vegetation encroachment are considered to be high for the upgrade of the bridge using cast *in situ* options. The impacts from inundation and the risk of alien vegetation encroachment are also considered to be medium high for the upgrade of the bridge using cast *in situ* option. Mitagation measures that are fully implemented can lower the impacts on the overall wetland and aquatic function of the system, but this impacts will still be higher than alternative 1 (box culvert system).

Thus, from the impact assessment it can be concluded that the upgrade of the bridge using box or the cast *in situ* option could have an impact on the wetland characteristics and function. The duration and severity of these impacts will however differ using these alternatives. Depending on the type of infrastructure used and construction activity, the box culverts or the cast *in situ* option could have a higher or lower impact on the wetland feature, respectively.

It is recommended in order to minimise the impacts, the box culverts system should be used during the upgrade of the bridge. The box culvert system can be used in the active channel, where it will have less impact on the system in terms of inundation and blockage caused by plant or soil material.

The no-go alternative is not recommended. The current state of the wetland feature is very poor en modified due to alien vegetation encroachment and dumping of waste material by the local residents. If the project no go option is followed and is not rehabilitated the wetland feature or upgrading the bridge, will lead to on-going erosion, sedimentation and incision of the system and lead to further decreases in ecological value and function of the wetland feature from an aquatic and socio-economic aspect.

From the assessment, some guidelines for the proposed construction activity are recommended. The design and construction should aim to meet the following criteria to ensure the on-going functioning of the wetland system in the vicinity of the proposed infrastructure construction:

- Ensure that all current activities consider the wetland boundaries. No vehicles are to enter or drive through the wetland area unnecessarily;
- Demarcate all wetland boundaries with pegs and danger tape;
- Edge effects of pre-construction and construction activities, including erosion, sedimentation and alien/weed control, need to be strictly managed in wetland areas as well as their associated buffer zones;
- Identify activities, which are causing erosion and incision of any of the wetland feature and mitigate these impacts immediately;
- Adequate erosion control and siltation control measures should be put in place;
- Obtain relevant legislative approval for any activities to be undertaken within the wetland feature to rectify excessive erosion;
- No unnecessary construction activities should be allowed within the riparian zones in line with the requirements of Section 21(c) and (i) of the National Water Act;
- As far, as is practical, implement concurrent rehabilitation processes in order to limit degradation of soil biota;
- Reseed any areas where earthworks have taken place with indigenous grasses to prevent further erosion (where applicable);
- The time in which soils are exposed during construction activities should remain as short as possible;
- Ensure that migratory connectivity for more mobile faunal and aquatic species is facilitated to allow movement of these species between areas upstream and downstream of the crossing;
- The duration of impacts should be minimised as far as possible by ensuring that the duration of time in which any flow alterations may take place is minimised;
- No dumping of waste or any other materials is allowed within the wetland areas;
- Ensure that construction waste and effluent do not affect the wetland boundaries. Suitable storage and disposal methods should be used during pre-construction and construction phases;
- If any spills occur, they should be immediately cleaned up;
- No fires should be permitted near the construction area;

- Appropriate sanitary facilities must be provided for the duration of the proposed development and all waste removed to an appropriate waste facility;
- Terrestrial invasive removal programs must be maintained throughout the proposed development as well as in the aftercare and maintenance phases;
- No support structures except within the area where the bridge will be upgraded, should be constructed within active stream channel;
- Throughout the construction and rehabilitation phases stream flow continuity in the system must be maintained;
- The use of access roads and coffer dams must be very carefully implemented in order to ensure that stream flow connectivity is maintained at all times and that migratory connectivity is ensured during this time;
- All bridge structures should be wide enough so as to allow for adequate flow (high water volume conditions) in a downstream direction without causing inundation upstream and to prevent the build-up of debris under the bridge;
- Adequate storm water management must be incorporated into the design of the proposed bridge structure in order to prevent erosion and the associated sedimentation of the riparian and instream areas, as these systems have aquatic communities, which rely on stream substrates clear of sediment.
    - During the construction and operational phases of the proposed upgrade, erosion berms should be installed to prevent gully formation and siltation of the riparian resources. The following points should serve to guide the placement of erosion berms:
        - Where the track has slope of less than 2%, berms every 50m should be installed.
        - Where the track slopes between 2% and 10%, berms every 25m should be installed.
        - Where the track slopes between 10%-15%, berms every 20m should be installed.
        - Where the track has slope greater than 15%, berms every 10m should be installed.
- Throughout the life of the structure, biomonitoring assessments should take place on a quarterly basis to identify any emerging impacts on the aquatic ecology of the system. The monitoring should focus on habitat integrity assessment as well as the assessment of impacts on the aquatic macro-invertebrate and fish communities.

8 REFERENCES

Acocks, J.P.H. 1988. Third Edition. Veld Types of South Africa. Memoirs of the Botanical Survey of South Africa No. 57, Botanical Research Institute, RSA.

Bredenkamp, G. and Van Rooyen, N. 1998. 34. Rocky Highveld Grassland – Grassland Biome. In: Low, A. B. and Rebelo, A. G. (eds) (1998) Vegetation of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.

Bromilow, C. 2001. Revised Edition, First Impression. *Problem Plants of South Africa.* Briza Publications, Pretoria, RSA.

Cowardin L.M., Carter V., Golet F.C. and LaRoe E.T. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS-OBS-79-31. US Fish and Wildlife Service, Washington, DC.

Curruthers, V. 2000. *The wildlife of southern Africa***.** Struik, Cape Town.

Dada R., Kotze D., Ellery W. and Uys M. 2007. WET-RoadMap: A Guide to the Wetland Management Series. WRC Report No. TT 321/07. Water Research Commission, Pretoria.

Dallas HF. 2007. The effect of biotope-specific sampling for aquatic macroinvertebrates on reference site classification and the identification of environmental predictors in Mpumalanga, South Africa. African Journal of Aquatic Science 32(2) pp.165-173

Davis, B. and Day, J. 1998. Vanishing waters. University of Cape Town Press, Cape Town, South Africa.

Department of Water Affairs and Forestry (DWAF) 1996. South African water quality guidelines vol. 7, Aquatic ecosystems.

Department of Water Affairs and Forestry (DWAF), South Africa *Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999* [Appendix W3].

Department of Water Affairs and Forestry (DWAF) 2003: Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.

Department of Water Affairs and Forestry (DWAF) 2003. The management of complex waste water discharges, introducing a new approach – Toxicity-based Ecological Hazard Assessment (TEHA). Discussion document, third draft.

Dickens, C. and Graham, M. 2001. South African Scoring System (SASS) version 5. Rapid bio assessment for rivers May 2001.CSIR. http.//www.csir.co.za/rhp/sass.html

Dini, J; Cowan, G and Goodman, P. 1998. Proposed wetland classification system for South Africa. First Draft: DWAF, Version 1.0.

Gerber, A. and Gabriel, M.J.M. 2002. Aquatic Invertebrates of South African Rivers. First Edition. Department of Water Affairs: Pretoria, South Africa.

Henderson, L. 2001. *Alien Weeds and Invasive Plants*. Agricultural Research Council, RSA.

Kleynhans C.J. 1999. *A procedure for the determination of the ecological reserve for the purposes of the national water balance model for South African River*. Institute of Water Quality Studies, Department of Water Affairs & Forestry, Pretoria.

Kleynhans C.J., Thirion C. and Moolman J. 2005. A Level 1 Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2005. WET-EcoServices – A technique for rapidly assessing ecosystem services supplied by wetlands.

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2008. WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands. WRC Report No. TT 339/09. Water Research Commission, Pretoria.

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D., Koopman V., Goodman P. and Goge C. 2008. WET-Health: A technique for rapidly assessing wetland health. WRC Report No. TT 340/08. Water Research Commission, Pretoria.

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

McMillan, P.H. 1998. An integrated habitat assessment system (IHAS v2) for the rapid biological assessment of rivers and streams. A CSIR research project. Number ENV-P-I 98132 for the water resources management programme. CSIR. ii +44 pp

Ollis D.J., Job N., Macfarlane D. and Sieben E.J. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Supplementary Project Report: Application and Testing of Proposed National Wetland Classification System. Prepared for the South African National Biodiversity Institute, Pretoria.

Rowntree K.M. and Wadeson R.A. 2000. An Index of Stream Geomorphology for the Assessment of River Health. Field Manual for Channel Classification and Condition Assessment. NAEBP Report Series No. 13, Institute of Water Quality Studies, Department of Water Affairs and Forestry, Pretoria. Available: http://www.csir.co.za/rhp/reports/reportseries13.html.

SANBI. 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).

Thirion, C, Mocke, A and Woest, R. 1995. Biological Monitoring of Streams and Rivers Using SASS 4: A User Manual. Institute for Water quality Studies, Department of Water Affairs and Forestry. Pretoria. Report No. N0000/REQ/1195

Van Oudtshoorn, F. 2004. Second Edition, Third Print. *Guide to Grasses of South Africa.* Briza Publications, Pretoria, RSA.

Williams W.D. 1985. Biotic adaptations in temporary lentic waters with special reference to those in semiarid and arid regions. *Hydrobiologia 125: 85-110*.

National Water Act 36 of 1998. Section 21(c) and (i).

National Environmental Management Act (NEMA) 107 of 1998

Appendix 1: IHAS score sheets October 2012

INVERTEBRATE HABITAT ASSESSMENT SYSTEM (IHAS)

River Name: KALKSPRUIT
Site Name: K1
Date: 16/10/2012

SAMPLING HABITAT	0	1	2	3	4	5
STONES IN CURRENT (SIC)						
Total length of white water rapids (i.e.: bubbling water) (in meters)	none	0-1	>1-2	>2-3	>3-5	>5
Total length of submerged stones in current (run) (in meters)	none	0-2	>2-5	>5-10	>10	
Number of separate SIC area's kicked (not individual stones)	0	1	2-3	4-5	6+	
Average stone size's kicked (cm's) (gravel is <2, bedrock is >20)	none	<2>20	2-10	11-20	2-20	
Amount of stone surface clear (of algae, sediment, etc) (in %)*	n/a	0-25	26-50	51-75	>75	
PROTOCOL: time spent actually kicking stones (in minutes) (gravel/bedrock = 0 min)	0	<1	>1-2	2	>2-3	>3
(* NOTE: up to 25% of stone is usually embedded in the stream bottom)						
	SIC Score (max 20):			**0**		
VEGETATION	**0**	**1**	**2**	**3**	**4**	**5**
Length of fringing vegetation sampled (river banks) (PROTOCOL - in meters)	none	0-½	>½-1	>1-2	2	>2
Amount of aquatic vegetation sampled (underwater) (in square meters)	none	0-½	>½-1	>1		
Fringing vegetation sampled in: ('still' = pool/still water only; 'run' = run only)	none		run	pool		mix
Type of vegetation (% leafy veg. As opposed to stems/shoots) (aq. Veg. Only = 49%)	none		1-25	26-50	51-75	>75
	Vegetation Score (max 15):				**6**	
OTHER HABITAT/GENERAL	**0**	**1**	**2**	**3**	**4**	**5**
Stones out of current (SOOC) sampled: (PROTOCOL - in square meters)	none	0-½	>½-1	1	>1	
Sand sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	>½-1	1	>1
Mud sampled: (PROTOCOL - in minutes) ('under' = present, but only under stones)	none	under	0-½	½	>½	
Gravel sampled: (PROTOCOL - in minutes) (if all gravel, SIC stone size = <2)**	none	0-½	½	>½**		
Bedrock sampled: ('all' = no SIC, sand, or gravel then SIC stone size = >20)**	none	some			all**	
Algae present: ('1-2m² = algal bed; 'rocks' = on rocks; 'isol' = isolated clumps)***	>2m²	rocks	1-2m²	<1m²	isol	none
Tray identification: (PROTOCOL - using time: 'coor' = correct time)		under		corr		over
(** NOTE: you must still fill in the SIC section)						
	Other Habitat Score (max 20):				**13**	
	HABITAT TOTAL (MAX 55):				**19**	
STREAM CONDITION	**0**	**1**	**2**	**3**	**4**	**5**
PHYSICAL						
River make up: ('pool' = pool/still/dam only; 'run' only; etc)	pool		run	rapid	2mix	3mix
Average width of stream: (in meters)		>10	>5-10	<1	1-2	>2-5
Average depth of stream: (in meters)	>1	1	>½-1	½	<½-¼	<¼
Approximate velocity of stream: ('slow' = <½m/s; 'fast' = >1m/s) (use twig to test)	still	slow	fast	med		mix
Water colour: ('disc' = discoloured with visible colour but still transparent)	silty	opaque		disc		clear
Recent disturbance due to: ('const.' = construction; 'fl/dr' = flood or drought)***	fl/dr	fire	constr	other		none
Bank/riparian vegetation is: ('grass' = includes reeds; 'shrubs' = include trees)	none		grass	shrubs	mix	
Surrounding impacts: ('erosn' = erosion/shear bank; 'farm' = farmland/settlement)***	erosn	farm	trees	other		open
Left bank cover: (rocks and vegetation) (in %)	0-50	51-80	81-95	>95		
Right bank cover: (rocks and vegetation) (in %)	0-50	50-80	81-95	>95		
(*** NOTE: if more than one option, choose the lowest)						
	STREAM CONDITIONS TOTAL (MAX					**25**
	TOTAL IHAS SCORE (%):				**44**	

Appendix 2: SASS5 score sheets October 2012

RIVER HEALTH PROGRAMME - SASS 5 SCORE SHEET

DATE: 16/10/2012	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT	TAXON		S	VG	GSM	TOT
GRID REFERENCE:	**PORIFERA**	5					**HEMIPTERA:**						**DIPTERA:**					
S: '	**COELENTERATA**	1					Belostomatidae*	3					Athericidae	10				
E: '	**TURBELLARIA**	3					Corixidae*	3					Blepharoceridae	15				
SITE CODE: K1	**ANNELIDA:**						Gerridae*	5					Ceratopogonidae	5				
RIVER: KALKSPRUIT	Oligochaeta	1			A	A	Hydrometridae*	6					Chironomidae	2				
SITE DESCRIPTION: D/S BRIDGE	Leeches	3					Naucoridae*	7					Culicidae*	1				
WEATHER CONDITION: HOT CLOUDY	**CRUSTACEA:**						Nepidae*	3					Dixidae*	10				
TEMP: 20.6 ' C	Amphipoda	13					Notonectidae*	3					Empididae	6				
Ph: 6.72	Potamonautidae*	3					Pleidae*	4					Ephydridae	3				
DO: 4.71 mg/l	Atyidae	8					Veliidae/M...veliidae*	5					Muscidae	1				
Cond: 100.1 mS/m	Palaemonidae	10					**MEGALOPTERA:**						Psychodidae	1				
BIOTOPES SAMPLED:	**HYDRACARINA**	8					Cordalidae	8					Simuliidae	5		1	1	A
SIC: TIME: minutes	**PLECOPTERA:**						Sialidae	6					Syrphidae*	1				
SOOC:	Notonemouridae	14					**TRICHOPTERA**						Tabanidae	5				
BEDROCK:	Perlidae	12					Dipseudopsidae	10					Tipulidae	5				
AQUATIC VEG: DOM SP:	**EPHEMEROPTERA**						Ecnomidae	8					**GASTROPODA**					
M VEG IC: DOM SP:	Baetidae 1 sp	4					Hydropsychidae 1 sp	4					Ancylidae	6				
M VEG OOC: DOM SP:	Baetidae 2 sp	6					Hydropsychidae 2 sp	6					Bulininae*	3				
GRAVEL:	Baetidae >2 sp	12					Hydropsychidae >2 sp	12					Hydrobiidae*	3				
SAND:	Caenidae	6					Philopotamidae	10					Lymnaeidae*	3				
MUD:	Ephemeridae	15					Polycentropodidae	12					Physidae*	3				
HAND PICKING/VISUAL OBS:	Heptageniidae	13					Psychomyiidae/Xiphocen.	8					Planorbidae*	3				
FLOW:	Leptophlebiidae	9					**CASED CADDIS:**						Thiaridae*	3				
TURBIDITY:	Oligoneuridae	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
RIPARIAN LAND USE:	Polymitarcyidae	10					Calamoceratidae ST	11					**PELECYPODA**					
	Prosopistomatidae	15					Glossosomatidae SWC	11					Corbiculidae	5				
	Teloganodidae SWC	12					Hydroptilidae	6					Sphaeriidae	3				
	Tricorythidae	9					Hydrosalpingidae SWC	15					Unionidae	6				
	ODONATA:						Lepidostomatidae	10					**SASS SCORE:**		0	5	6	6
DISTURBANCE IN RIVER:	Calopterygidae ST,T	10					Leptoceridae	6					**NO OF TAXA:**		0	1	2	2
	Chlorocyphidae	10					Petrothrincidae SWC	11					**ASPT:**		0.00	5.00	3.00	3.00
	Chlorolestidae	8					Pisuliidae	10					**IHAS:**		44%			
	Coenagrionidae	4					Sericostomatidae SWC	13					**OTHER BIOTA:**					
	Lestidae	8					**COLEOPTERA:**											
SIGNS OF POLLUTION:	Platycnemidae	10					Dytiscidae*	5					**COMMENTS:**					
	Protoneuridae	8					Elmidae/Dryopidae*	8					* = airbreathers					
	Zygoptera juvs.	6					Gyrinidae*	5					SWC = South Western Cape					
	Aeshnidae	8					Halipidae*	5					T = Tropical					
	Corduliidae	8					Helodidae	12					ST = Sub-tropical					
OTHER OBSERVATIONS:	Gomphidae	6					Hydraenidae*	8					S = Stone & rock					
	Libellulidae	4					Hydrophilidae*	5					VG = all vegetation					
	LEPIDOPTERA:						Limnichidae	10					GSM = gravel, sand & mud					
	Pyralidae	12					Psephenidae	10					1=1, A=2-10, B=10-100, C=100-1000, D=>1000					

Appendix 3: IHI score sheets October 2012

		K1	
Water abstraction	14	6	3.36
Flow modification	13	10	5.2
Bed modification	13	17	17.4
Channel modification	13	6	3.12
Water quality modifications	14	19	19.9
Inundation	10	8	3.2
Exotic macrophytes	9	8	2.88
Exotic aquatic fauna	8	5	1.6
Solid waste disposal	2	6	0.48
PROVISIONAL SCORE			**57.1**
INSTREAM SCORE (%)			**42.9**
Indigenous vegetation removal	13	8	4.16
Exotic vegetation encroachment	12	18	16.6
Bank erosion	14	14	12.5
Water abstraction	3	3	0.36
Flow modification	13	15	12.1
Channel modification	11	15	10.2
Water quality modification	12	12	9.72
Inundation	13	8	4.16
INTIAL RIPARIAN SCORE			**69.7**
RIPARIAN SCORE (%)			**30.3**
OVERALL SCORE			**36.6**
CLASS			**E**

MANO-CEPH CIVILS-REP-01-2012: Nkangala District Municipality Geotechnical Investigations for the Design and Construction of a Bridge in Kalkspruit in Emalahleni Local Municipality-Mpumalanga

Table of Contents

1. Introduction

1.1. General

MANO-CEPH CIVILS was commissioned by HMP Consulting Engineers on behalf of Nkangala District Municipality to carry out geotechnical investigations for the design and construction a culvert/bridge and culvert approaches in Kalkspruit Emalahleni Local Municipality in Mpumalanga Province

A list of major structures planned for this project was supplied by HMP Consulting Engineers and is copied herebelow:-

- 1N0 Portal Culvert/Bridge
- Culvert/Bridge Approaches

The objectives and scope of work of this investigation were set out in HMP Consulting Engineers terms of reference, which in general terms required that a study into geotechnical engineering issues related to foundation designs, backfill material, excavatability and general constraints should be assessed with respect to portal culvert/bridge construction works.

The scope for this project is as follows:-

- Complete desk study of the site and its environment and full geological description of the rock and soil units.
- Profile the soil encountered using accepted methods- The method used was that proposed by Jennings, Brink and William in their paper Revised guide to soil profiling for civil engineering purposes in Southern Africa.
- Provide bearing pressures at various relevant depths.
- Provide soil indicators, and CBR's for the roads and foundation designs.
- Report on foundations for the proposed structures and pavements.

1.2. Approaches to undertaking the investigations

A 4-stage sequential process was adopted in undertaking the field and the laboratory investigations as follows:

- Stage 1-Pre Investigation Study
- Stage 2-Site Investigation, Sampling and Field Testing
- Stage 3-Laboratory Testing
- Sage 4-Analysis & Reporting of Test Results

1.3. Information available

At project inception a data search and book review was undertaken in order to obtain information related to the project area. The information sources included the following:-

1:1 000 000 Geological Map of South Africa and Kingdoms of Swaziland and Lesotho 1997

2. Database and Design Parameters

A list of major structures planned for this project was supplied by HMP Consulting Engineers and is copied here below:-

- 1N0 Portal Culvert/Bridge
- Culvert/Bridge Approaches

3. Location

The bridge sites are located in Kalkspruit Phase 2 in Mpumalanga Province . It currently consists of a dilapidated portal culvert. The soils at the surface of the culvert approaches were seen to be light brown in colour. The site is generally gently sloping towards the river channel.

The site is accessed by tar roads.

Topographically, the area could generally be considered to be gently rolling from the North west and South East of the river channel.

4. Overview of Site Geology

The structures are underlain by gneisses and Granites rocks of Bushveld Complex.

Soil profile exhibited a thick veneer of transported soils overlying residual granite soils. The granites of this sort are known to be intruded by diabase dykes but from the available data such intrusion do not appear to be present in this area.

The granites soils derived by the in situ weathering of the bedrock may be either potentially collapsing or potentially expansive depending upon the weathering environment. The weathering environment is controlled by the local microclimate.

Where the drainage is good, the feldspar component of granite weather to kaolinitic clays, which may be leached out leaving the quartz particles separated by clay bridges in an open lattice type of structure. This open lattice type structure has a relatively low density and high voids ratio and it is these soils which give rise to collapse settlement. Collapse settlement is a sudden change in volume caused by re-orientation of the soil grain structure. The mechanism is that, although when dry these soils have a high strength, which is derived largely from the strength of the clay bridges, when the moisture content of these soils is increased, the clay bridges lose their initial strength and a re-orientation of the grain structure occurs. The amount of re-orientation is subject to the applied stress.

Where, over time, gneiss soils have poor or impeded drainage and are in contact with water for prolonged periods without adequate infiltration for leaching to take place, potentially expansive soils may be formed through the weathering of the feldspars to smectite group clay minerals. The smectite group clay minerals are ordered so that water may be absorbed between the layers causing a volume change. Soils containing these minerals increase in volume on an increase in moisture content and decrease in volume on a decrease in moisture content.

The mechanism responsible for triggering collapse settlement within these soils is a combination of an applied stress and an increase in soil moisture content

In general, there is uniformity in soil horizons across the site both horizontally or vertically.

5. Field Investigation

The field investigations consisted of the excavation of eight (8) test pits designated NW1, NW2, NW3, NW4, SE1, SE2, SE3 and SE4 on culvert approaches to a maximum depth of 3.0m or refusal through use of hired TLB JCB 3CX. Performance of four (4) Drop Weight Penetrometer Super Heavy test (DPSH) on either side of the river bank (see site sketch plan attached in Appendix A of this report)

The test pits were inspected and profiled by an Engineering Geologist using standard terminology proposed by Jenning, Brink and Williams, and further updated by the Geoterminology Workshop 1990. The plan positions of these test pits are shown on the site plan, Figure 1, and the detailed profiles of the individual holes recorded are attached to this report as appendix A.

Representative samples of various stratas were taken from the sides of the test pits for laboratory testing.

6. Summary of Soil Profiles

6.1. General

Kalkspruit will have experienced a similar geological history and therefore the soil conditions could be expected to be similar across the sites. This condition makes it impossible to extrapolate soil conditions and hence engineering properties for more than a few metres vertically or horizontary. The underlying bedrock or weathered bedrock soils would probably be relatively consistent in depth, composition and engineering properties across the sites.

Based on the test results conducted on soil samples obtained from the eight (8) test pits that were excavated on the culvert approaches of the bridge, the following generalized profile has been compiled to serve as a guide:-

Alluvial Soil:	The condition of the culvert approaches of the bridge site below to 4.0m+ was seen to be silty SANDs and clayey SANDs of alluvial origin. This horizon extends to depths in excess of 4.0m below ground level.
Bedrock:	No Rock was encountered in the test pits. However, MANO-CEPH CIVILS does not guarantee this description as exact across the entire sites but infers accuracy to the extent that is common in geotechnical.

7. Meteorology and Groundwater

Kalkspruit is located in tropical climate and experiences temperatures ranging from 20° to 35°. The rainy season extend from October to March when rainfall often exceeds 200mm per month. The mean annual precipitation in Witbank is approximately 1000mm. Such intense rainfall often causes flooding and damage to roads and bridges though no reports of floods from the river have been reported by the local inhabitants.

The random intercalation of silty SAND and Clayey SAND horizons encountered on the surface are considered to be cohesionless. This makes it relatively permeable and allows for the rapid drainage of rainwater and horizontal runoff. The underlying residual soil is relatively impermeable forming aquicludes close to the surface, thus forming swamps and shallow perched groundwater conditions within the cohesionless horizon during or after periods of heavy or continuous rain.

Groundwater seepage occurred in test pits NW2, NW3, NW4, SE1, SE2, SE3 and SE4. In view of this, shallow groundwater conditions are likely to occur due to relatively high local water table and worse still during the rainy seasons. Flowing water was seen in the river channel.

8. Field and Laboratory Testing

8.1. Field testing

The field testing consisted of four (4) DPSH tests carried out on the either side of the river bank. (See site sketch plan in appendic A of this report).

The Dynamic Penetrometer Super Heavy (DPSH) probes the bedrock but also measures the soil strength attributes of penetrability and compaction. The instrument is comprised of a metal rods with a hardened steel cone fixed as the striking tip. The cone has an inclination of 30 dec and a basal diameter of 160mm. The study involves driving the 180mm diameter hardened steel cone through the soil with a 63.5kg drop hammer falling through a height of 900mm onto the rods which are in turn connected to a cone.

The results of these tests have been analysed to compare their rates of penetration with the consistencies of the soil. The results of the DPSH tests shows that the consistencies derived from the DPSH tests are generally in agreement with the consistencies described in the test test pits. However, it is important to note that where dry or course grained material occurs the penetration of the DPSH is hampered than normally associated with the consistency category. From the analysis of the data obtained in 4 tests, it was observed that the DPSH did not surpass the 4.5m depth. It was observed that the great majority of testing reached 80 blows or more at a depth between be 1800mm and 2400mm. With one test attaining refusal at a depth of 4.5m.

8.2. Laboratory Testing

8.2.1General

Representative disturbed and undisturbed samples were taken from the sides of test pits for laboratory testing. The following laboratory tests were carried out.

- Particle size distribution by dry sieve analysis
- Atterburg limit determinations
- Natural moisture content
- Moisture density relationship
- California Bearing Ratio

8.2.2 Categorisation of Compaction Tests

The results of these tests showed that the soils were fine to medium grained with a grading modulus of range 1.10 to 1.60 and a maximum dry density at the modified AASHTO compaction effort in the range 1760kg/m³ @ 9.6% to 2115kg/m³@ 8.3%. The CBR values at 90% of modified AASHTO maximum dry density were between 9 and 23 and the soils classified as G8, G7 and G6 material in TRH4 Classification System.

The detailed results of the laboratory tests are attached to this report as Appendix B.

9. Evaluation of Excavation Issues & Foundation Solutions

9.1. General

The following sections describe the types of foundation and founding levels that should be employed across the site in order to secure an adequate solution.

9.2. Excavation Issues

Soil profiles and DPSH tests across the site indicate that the top soils were loose to medium dense below to a depth of 4.0m below ground level. The top soils are considered to be compressible and may be excavated by using a conventional light earthmoving equipment to the depth attained in the test pits. However, we have concern about the stability of the excavation in alluvial soils on the culvert site, therefore, we propose, in all cases that the excavated trenches should be cut back in consolidated soils. The degree of cutting should in this case be a matter of experienced judgement taking into account the time over which the excavation is required and danger to the workman.

9.3. Foundation Solution for the Bridge/ Portal Culvert

The foundation loads of the bridge/culvert are predicted to in the range of 100kN/m^2 to 200kN/m^2

Soil profiles across the bridge sites indicate medium dense very moist sandy soils with undrained shear strength of less than 20kPa underlying the proposed bridge/culvert. An assessment of which indicates compressibility and requefaction potential at varying depths. On this basis, it is not considered suitable as a founding stratum in its natural state for structures with settlement sensitivity. Therefore, we recommend that foundations should be placed on soft rock gneiss found at a depth of the range 8.0m to 9.0m below ground level.

DPSH penetration tests carried out on the site gave N value ranging from about 50 to 100 blows per 0.3 metre which reflect very dense horizon at a depth of the range at 7.6m to 9.3m below ground level.

On this basis, the top soil is not considered suitable as a founding stratum in its natural state for structures with settlement sensitivity. Therefore, we recommend that foundations should be placed on soft rock granite found at a depth of the range 7.6m to 9.5m below ground level.

A reinforced cast-in-place concrete base may then be placed on the soft rock gneiss. It would be reasonable to assume that a bearing pressure of 500Kpa could be achieved.

The river water volume and velocity in the river channel on the project sites were seen to be critical, in view of this, dewatering measures need to be planned for. We recommend cofferdams to be constructed across the river channel itself inorder to capture the running water before it reaches culvert sites. The water should then be pumped from the cofferdam across the culvert site back to the river channel or to the nearest existing channel.

The groundwater and leachates produced as a result of infiltration of rain water are presumed to be corrosive against buried concrete and steel. Therefore we recommend that all structures below the ground level as well as cover thicknesses to reinforcing steel should be designed in accordance with the recommendations of Basson (good dense concrete with minimum cement content of 4230kg/m³ and a cement: water ratio of 2,2).We also consider that there should be a minimum cover of 75mm in all buried concrete.

9.4 Culvert Approaches

The following procedure should be used for the preparation of the subgrade beneath culvert approaches:

i. Strip any vegetated soil and remove all significant root systems.

ii. Rip the exposed subgrade for a depth of 150mm and compact to 90% of the modified AASHTO maximum dry density at optimum moisture content + or – 1%

iii. Make up to the required level but provide a minimum of 150mm of a suitable imported material with minimum CBR of 15 at 93% of the modified AASHTO maximum dry density to bridge the unsuitable subgrade.

Then subbase and basecourse layers designed for anticipated load may then be placed on the prepared subgrade. As good practice, paved areas should also be sprayed against termites and vegetation before surfacing.

The pavement was seen to have exhibited distress in the form of extensive alligator, transverse and longitudinal crackings, and deformation in the form of excessive rutting and potholing. Drainage was seen to have prayed a major role towards the exhibited defects. In view of this it is important that drainage should be considered critical during design stage.

It is important to note that these foundation recommendations have based on the ground conditions observed in the test pits and field tests carried out during the field work carried out by ourselves. These ground conditions should be confirmed by inspection of the foundation excavations, which should be carried out by a suitably qualified person. Adequate quality control of earthworks and concrete should be implemented during construction by an independent laboratory.

10. References

10.1 Jennings JE and Knight KA (1975). A guide to construction on or with materials exhibiting additional settlement due to collapse of grain structure Proceedings 6th Regional Conference for Africa Sm and FE Durban 1975.

10.2 Jennings, Brink and Williams (1973). Revised Guide to Soil Profiling for Civil Engineering Purposes in South Africa. The Civil Engineer in South Africa, January 1973.

10.3 Basson JJ (1989). Deterioration of Concrete in Aggressive Waters-Measuring aggressiveness and taking countermeasures Portland Cement Institute.

10.4 Knight K (1995). A Guide to Practical Geotechnical Engineering in Southern Africa, July1995.

10.5 Geotechnical Investigation Report, Kanye Infrastructure Development Stage 2 Works, Botswana. Masetlaoka Scott Wilson, October 2007.

10.6 Geology Map of South Africa and kingdoms of Swaziland and Lesotho. 1:1 000 000.

11. Appendix A-Test Pit Profiles and Site Sketch Plan

12. Appendix B – Test Results

13. Appendix C: Photo Album

Appendix 6: Public Participation

Background Information Document (BID)

Proposed Rehabilitation of the Kalkspruit Bridge, Witbank

BACKGROUND INFORMATION DOCUMENT

Mpumalanga Department Economic Development, Environmental and Tourism Ref No: 17/2/3N - 190

Contact : Manogrie Chetty
or Rivani Maharaj
Nemai Consulting
Tel: (031) 266 3884
Fax: 031 266 5287;

Email: manogriec@nemai.co.za
Email : rivanim@nemai.co.za
Postal Address: PO Box 1673
Sunninghill
2157

PURPOSE OF BACKGROUND INFORMATION DOCUMENT (BID)

The purpose of this document is as follows:

1. It serves to provide an overview of the proposed project.
2. It provides an outline of the Basic Assessment (BA) process; and
3. It grants the opportunity to be registered as Interested and Affected Parties (I&APs).
4. It serves as notification of the review of the draft Basic Assessment Report

The purpose of the BA process is to identify and evaluate potential impacts and to recommend measures to mitigate negative impacts, and enhance positive impacts.

BACKGROUND AND INTRODUCTION

The Ngangala District Municipality together with the Emalahleni Local Municipality is proposing to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank.

Nemai Consulting was appointed as the independent Environmental Assessment Practitioner (EAP) to complete all requisite environmental processes and seek environmental authorisation, on behalf of the applicant.

PROJECT LOCATION

The Kalkspruit Bridge is situated between Twala Avenue and Botha Street, Witbank, Mpumalanga, at approximately 25° 52'30.00"S / 29° 11' 19.00"E.

Figure 1 : Aerial view of the proposed sire : Google Earth

PROJECT DESCRIPTION

The demolition and reconstruction of the Kalkspruit Bridge project and associated activities will include the following:

- Removal of accumulated silt and sediment built up at the bridge;
- Lining the embankment with gabions and reno mattresses; and
- Guard Railing and Balustrade protection.

The bridge has been deemed as being structurally unstable and undermined and therefore the upgrade of the bridge is also driven by the current safety risk that the bridge poses. The upgrade of the Kalkspruit Bridge will ultimately result in preserving the integrity of the structure and will ensure a safe means of crossing the stream for vehicles and pedestrians. The rehabilitation of this bridge form part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilisation as well as the demolition and re-construction of the bridge.

Figure 2: Existing undermined bridge structure

Figure 3: Excessive illegal dumping.

ALTERNATIVES

The 2010 EIA regulations require that feasible project specific alternatives are identified (including the "do nothing" option). A site alternative has not been considered as the existing bridge structure needs to be upgraded. Two design alternative options (i.e. the use of pre-cast concrete structures or in-situ casting of concrete) are therefore considered as part of this application in addition to the no-go alternative.

ENVIRONMENTAL AUTHORISATION PROCESS

In terms of Government Notice No. 544, of 18 June 2010, promulgated in terms of Section 24 of the National Environmental Act, 1998 (Act No. 107 of 1998), the The Ngangala District Municipality together with the Emalahleni Local Municipality is required to undertake a Basic Assessment process, as the following activity that is triggered (Table 1).

Table 1: Listed Activity

Authority	Legal Reference	Listed Activity*
Mpumalanga Department of Economic Development, Environment and Tourism	GN No. R544 of 18 June 2010	13, 11 , 18; & 39

*Detailed descriptions of listed activity can be provided on request

Currently, we are at the Notification phase. The Draft Basic Assessment Report will be submitted to registered Interested and Affected Parties (I&APs) for review.

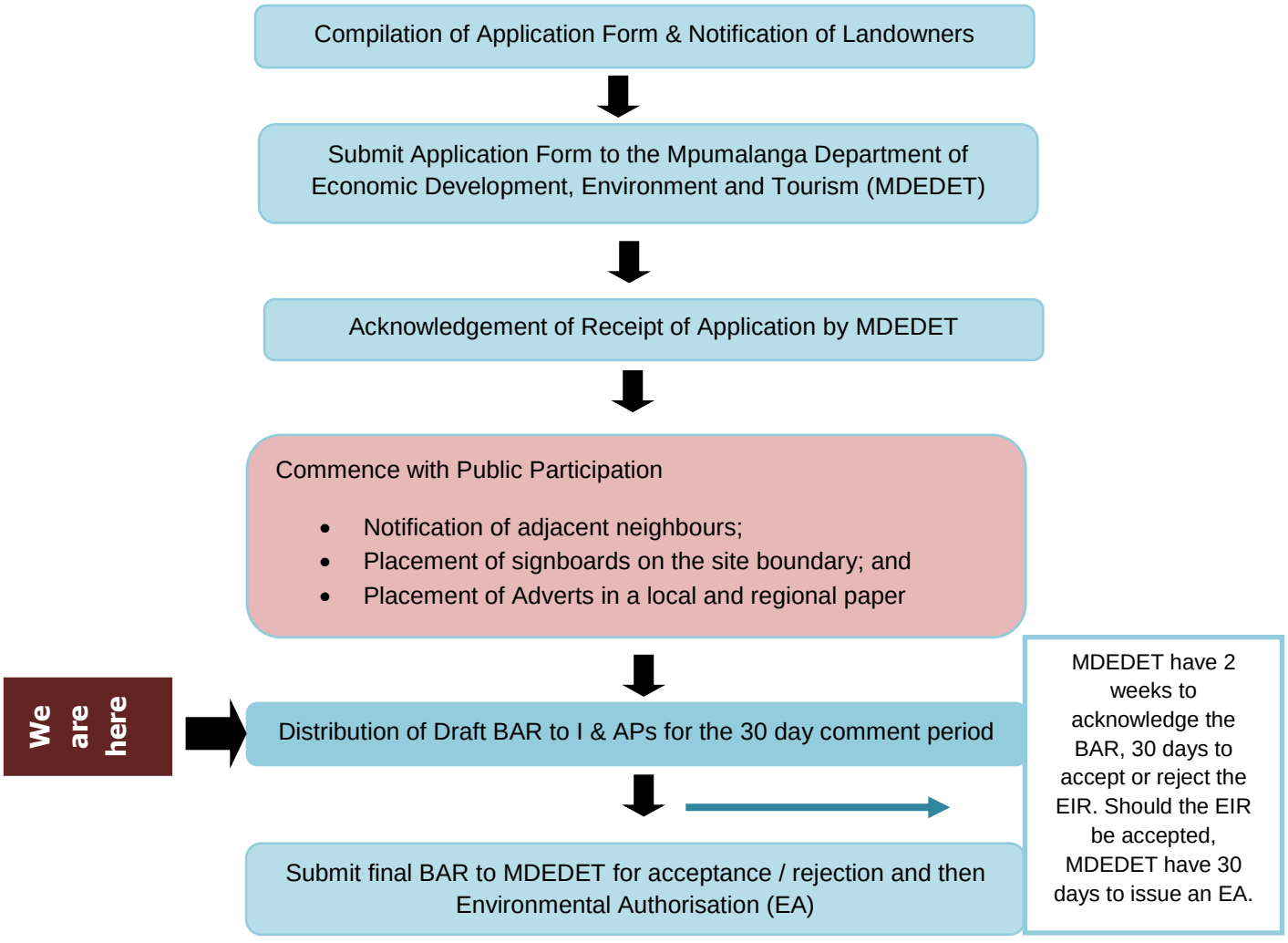

Figure 2: BA process

PUBLIC PARTICIPATION

The notification process for the Basic Assessment involves the following:

- Placement of notice boards
- Distributing the Background Information Document (BID) to I & APs
- Provide written notices to:
  - Landowners
  - Ward councillors
  - Municipalities
  - Organisations such as Rate Payers associations, NGOs etc.
  - Provincial Departments having jurisdiction

In accordance with Regulation 56 (1) of Government Notice No. R. 543 of 18 June 2010, registered Interested and Affected Parties (I&APs) are granted an opportunity to review and comment on the Draft Basic Assessment Report (BAR) for the proposed project. Registered I & APs will be notified of the release of the Draft BAR for comment.

SPECIALIST STUDIES

The following Specialist Studies will be undertaken and will be included in the Draft Basic Assessment report.

- Wetland delineation, Functionality assessment and an aquatic assessment

REGISTRATION AS I&AP

Please note that in order to continue to receive more information regarding the project you are required to register with us as an Interested and Affected Party (I & AP) on the details below or by completing the attached reply form and submitting the completed form to the details below:

Contact Person: Rivani Maharaj

Tel: 031 266 3884 **Fax:** 031 266 5287

E-mail: rivanim@nemai.co.za

Postal Address: PO Box 1673, Sunninghill, 2157

ENVIRONMENTAL & SOCIAL CONSULTANTS

P.O. BOX 1673
SUNNINGHILL
2157

23 Jan Hofmeyer Road
Westville
3630

Phone: (031) 266 3884
Fax: (031) 266 5287
Email: manogriec@nemai.co.za / rivanim@nemai.co.za

Proposed Rehabilitation of the Kalkspruit Bridge, Witbank

Mpumalanga Department Economic Development, Environmental and Tourism Ref No: 17/2/3N -190

Reply Form

Registration as an Interested and Affected Party

Date:			**Official use**
Name of organisation: ***(if applicable)***			**Date received:**
Name & Surname:			**Our reference:**
Address	**Postal:**	**Physical:**	**Status**
Tel No:			
Cell No			
Fax No:			
Email:			
Registration as an I&AP:	**Yes**	**No**	

Please include the contact details of any possible other I&APs you might be aware of:

Comments: *(note - additional pages may be included if the space provided is insufficient)*

List of Registered I & APs

NAME OF ORGANISATION	CONTACT NAME	PYSICAL ADDRESS	POSTAL ADDRESS	CONTACT NUMBER	FAX NUMBER	OTHER	EMAIL
MDEDET	Okwethu Fakude	Cnr Rosemead and Ryan Street, Klipfontein, Witbank, 1035		013 690 2595			oqmatenjwa@yahoo.com
Nkangala District Municipality	E.K. Tshabalala	2A Church Street | Middleburg 1050	P. O Box 437 Middelburg 1050	013 249 2006			nkosinm@nkangaladm.org.za
Municipality	Liziwe Kama	Street, Witbank	Witbank, 1035	013 690 6300	013 690 6392	071 361 2732	kamal@emalahleni.gov.za
Mpumalanga Department of Water Affairs	Mr F Guma	Cnr Brown and Paul Kruger Street. Prorom building, dwa, Nelspruit	Private Bag X11259, Nelspruit, 1200	013 759 7310	013 759 7525		gumaF@dwa.gov.za/ phokyk@dwa.gov.za
Department of Agriculture, Forestry and	Ms. Nelisiwe Sithole	building 6, 2nd floor, no 7, Government Boulevard,	Private Bag X11219, Nelspruit	013 766 6020	013 766 8429		okmosome@mpg.gov.za
Department of Public Works	Mr. Matthew Mohlasedei	7 government bolevard riverside park ext 2,	Private Bag X 11310 Nelspruit	013 766 6554	013 766 8449		kmohlasedi@mpg.gov.za
South African Heritage Resources Agency	Phillip Hine	111 Harrington Street, CAPE TOWN, 8001	P.O. Box 4637, CAPE TOWN,	021 462 4502	021 462 4509	083 289 6888	phine@sahra.org.za
South African National Biodiversity Institute (SANBI)	Andre Beetge	8 Hektaa street, Middelburg Industrial Area, Middelburg, 1050	P.O Box 722, Cranspoort, 1080	084 240 22 64	086 544 5953	084 240 3536	a.beetge@sanbi.org.za
WESSA- Northern Regions	Lemson Betha	18 blackwood street, brianston ext 3,	P.O. box 435 Ferndale, 2160	011 462 5663			lbetha@wessanorth.co.za
Department of Agriculture, Rural Development and Land	Erica van Jaarsveld	Building 4, no 7 Government Bolevard, Riverside park extension 2, Nelspruit. 1200				084 799 5921	Erica@mpg.gov.za
Mpumalanga Economic Growth Agency (MEGA)	Thobile Motha	29 Cnr lukin and botha street, witbank, 1035		013 656 3231	013 656 32 31		Thobile.motha@mega.gov.za
Mpumalanga Tourism and Parks Agency	Frans Krige	Dankie Masango drive, Dullstroom municipal,	P.O Box 1250, Groblersdal 0470	013 254 0279	013 254 0279	084 232 2902	franskrige@telkomsa.net/ frans@mpta.co.za
Mpumalanga Department of sports, Culture and recreation	Vincent Gana	7 Government Boulevard, Building 5, Riverside Park Extension 2 Nelspruit 1200		013 766 5018	013 766 5575	072 296 3984	vgana@mpg.gov.za
Department of Agriculture - Provincial	Jan Venter					0826537611	jv16@telkomsa.net / jan.agric@gmail.com
Local Councillor	Beauty Shabantu		P.O. Box 391, witbank, 1035			079 668 3113	nkosana.kelly@gmail.com
Emalahleni Main Library	Juanet Rozmerek	28 Hofmeyer Street, Emalahleni 1033				082 787 8540	
Nkojane Primary School	Mr J M Mokeona	5043 Wille Akerman Drive, Witbank	P.O.Box 5030 Emalahleni, 1039	013 696 2296			metsimokoena@gmail.com
Lynnville Library - (need to leave document at main library in	Juanet Rozmerek	Hector Way Street, opposite the main municipal office and police station and clinic				082 787 8540	
Private	Mtsweni					071 4611 214	
Private	Phindile					076795 4302	
Private	Magreth					083 7588 499	
Private	Portia					9059	
Private	Radebe					072 251 6391	
Private	G M Khumalo					078 942 1067	
Private	Mhlnaga					0849811 904	
Private	Everlyn Nlanpo					071 832 2273	
Private	Betty					073 926 0443	
Private	Shadrack					084 254 5694	
Private	Victoria					013 696 3442	
Private	Doreen Jabar					073 5065 156	
Private	Molatse					072 4939 651	
Private	Ja Stus					071 7222 227	
Private	Noah					082 8244 039	
Private	Gthemchwene					071 953 7443	
Private	Beauty					079626 1834	
school	Principle	Lynville	Emalaleni, 1039	013 696 2296	013 696 2296		
Itireleng Primary School	Principle	Thusanang	Emalahleni, 1038	013 6999 140	013 6999 140		
Princess Setotosh						013 699 2264	
Private	Michael Mabena					073 1638301	

Notification of I & APs

Kalkspruit Hand delivered notifications

no.	Name and Surname	Street Address	Postal Address	Telephone number	Email	Method of Notification	proof of notification
1	Howard Mtsweni	5042 Luthuli Street, Lynville	SAS	071 4611 214		By Hand	Signed- Register Attached
2		5040 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5135
3		5039 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5136
4	Phindile	5038 Luthuli Street, Lynville	SAS	076795 4302		By Hand	Signed- Register Attached
5	Magreth	5037 Luthuli Street, Lynville	SAS	083 7588 499		By Hand	Signed- Register Attached
6	Portia	5036 Luthuli Street, Lynville	SAS	076v328 9059		By Hand	Signed- Register Attached
7	Radebe	1531 Luthuli Street	SAS	072 251 6391		By Hand	Signed- Register Attached
8						Stuck on House / Gate	Photo 5138
9						Stuck on House / Gate	Photo 5139
10						Stuck on House / Gate	Photo 5140
11		707 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5141
12		706 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5142
13	G M Khumalo	705 Luthuli street, Lynville		078 942 1067		By Hand	Signed- Register Attached
14		704 Luthuli Street, Lynville	SAS			Stuck on House / Gate	Photo 5143
15		1646 Xuma Street, Lynville				Stuck on House / Gate	Photo 5144
16	Mhlnaga	647 Mahabane Street,Lynville	SAS	0849811 904		By Hand	Signed- Register Attached
17	Everlyn Nlanpo	703 Luthuli Street, Lynville	SAS	071 832 2273		By Hand	Signed- Register Attached
18	Betty	701 Luthuli Street, Lynville	SAS	073 926 0443		By Hand	Signed- Register Attached
19						Stuck on House / Gate	Photo 5145
20		699 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5146
21	Shadrack	1519 Luthuli Street, Lynville	SAS	084 254 5694		By Hand	Signed- Register Attached
22		1518 Luthuli Street, Lynville				Stuck on House / Gate	Signed- Register Attached
23		5054 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5148
24	Victoria	5053 Luthuli Street, Lynville	SAS	013 696 3442		By Hand	Signed- Register Attached
25		5052 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5149
26		5051 Luthuli Street, Lynville				Stuck on House / Gate	Photo 5150
27						Stuck on House / Gate	Photo 5151
28		Church				Stuck on House / Gate	Photo 5152
	Bongane Mathebula	329 April Street, Thusanang					
29	Doreen Jabar	House 5078/6		073 5065 156		By Hand	Signed - Register Attached
30	Elizabeth Molatse	House 5078/7		072 4939 651		By Hand	Signed - Register Attached
31						Stuck on House / Gate	Photo 5171

32						Stuck on House / Gate	Photo 5172
33	Eunice	House 5078/77				By Hand	Signed - Register Attached
34						Stuck on House / Gate	Photo 5173
35						Stuck on House / Gate	Photo 5174
36						Stuck on House / Gate	Photo 5175
37	Ja Stus			071 7222 227		By Hand	Signed - Register Attached
38						Stuck on House / Gate	Photo 5176
39	Noah	5078 Twala Street		082 8244 039		By Hand	Signed - Register Attached
40						Stuck on House / Gate	Photo 5177
41	Bekhi Gthemchwene			071 953 7443		By Hand	Signed - Register Attached
42						Stuck on House / Gate	Photo 5178
43						Stuck on House / Gate	Photo 5179
44	Beauty	335 April Street Thushnang	SAS	079626 1834		By Hand	Signed - Register Attached
45						Stuck on House / Gate	Photo 5180
46	Nkonjane CS - Primary school	5043 Willie Ackerman Drive, Lynville	P.O.Box 830, Emalaleni, 1039	013 696 2296	metsimokoena@gmail.com	By Hand	Signed - Register Attached
47	Itireleng Primary School	700 Muleka Street, Thusanang	P.O.Box 831 Emalahleni, 1038	013 6999 140		By Hand	Signed - Register Attached
48	Princess Setotosh	289 Majolani Street, Thushanang	SAS	013 699 2264		By Hand	Signed - Register Attached
49	Michael Mabena	290 Majolani Street, Thushanang	SAS	073 1638301		By Hand	Signed - Register Attached
50		288 Majolani Street, Thushanang				Stuck on House / Gate	Photo 5181
51		251 Majolani Street, Thushanng	SAS			By Hand	Photo 5182
52		247 Modise Street				Stuck on House / Gate	Photo 5184
53						Stuck on House / Gate	Photo 5185

Project Name: Kalkspruit

Date of Notification : 6/03/13

No	Name	Physical Address	Postal adrress	Contact Number	Email	Fax	Signature
1	HOWARD MTSWENI	5042 Luthuli St Lynville		078 4611214			
2	–	5040 –	–	–	–	–	5135
3	–	5039	–	–	–	–	5136/7
4	PHINDILE	5038 LUTHULI STR LYNN	Same	0767954302			
5	Magreth	5037 Luthuli		083 758 8499			
6	Portia	5036 Luthuli		0763289059			
7	[illegible] Radebe	1531 Luthuli		0722516391			
8							5138
9							5139

Project Name: Kalkspruit

Date of Notification : 6/03/13

No	Name	Physical Address	Postal adrress	Contact Number	Email	Fax	Signature
10	—	—	—	—	—	—	S140
11	—	707 Luthuli str	—	—	—	—	S141
12	—	706	—	—	—	—	S142
13	GM Khumalo	Luthuli 705	—	078 962 1069	—	—	
14	—	704	—	—	—	—	S143
15	—	1646	—	—	—	—	S144
16	—	647 Mahabane 1 str					
16	Mhlanga	0849811904	—	—	—	—	
17	Evelyn Nhlapo	071 832 2273 703 Luthuli str		071 832 2273			

Project Name: Kalkspruit

Date of Notification : 6/03/13

No	Name	Physical Address	Postal adrress	Contact Number	Email	Fax	Signature
18	Betty	701 Luthuli		0739260443			Balatsa
19	—	—	—	—	—	—	S145
20	—	699 Luthuli	—	—	—	—	S146
21	Chadwick	1519 Luthuli	—	0842545694	—	—	
22	—	1518	—	—	—	—	S147
23	—	50 54	—	—	—		S148
24	Victoria	5053 luthuli	—	013 6963442	—	—	
25		5052					S149
26		5051					S150

Project Name: Kalkspruit

Date of Notification : 6/03/13

No	Name	Physical Address	Postal adrress	Contact Number	Email	Fax	Signature
27	—	—	—	—	—	—	S1S1
28	Gwwa	—	—	—	—	—	S1S2
29	BONGANE MATHEBULA	329 APRIL STREET THUSANANG	329 APRIL	0735065156			
30	DOREEN JABAR ELIZABETH MOLATUDI	5078/6 5078/7		0761534344 0724939651			D.M.J.
31	—	—	—	—	—	—	S171
32	—	—	—	—	—	—	S172
33	EUNICE	5078/11					Mathubela.
34	—	—	—	—	—		S173

Project Name: Kallspan1

Date of Notification : _____

No	Name	Physical Address	Postal adrress	Contact Number	Email	Fax	Signature
35	—	—	—	—	—	—	S174
36	—	—	—	—	—	—	S175
37	JASTIS			0717222227			
38	—	—	—	—	—	—	S176
39	NOAH	5078 THWALA		0823824405	—	—	
40	—	—	—	—	—	—	S177
41	Bekhi Gthemthe			0719537443			
42	—	—	—	—	—	—	S178
43	—	—	—	—	—	—	S179

Project Name: kalkspruit

Date of Notification : 6/03/13

No	Name	Physical Address	Postal adrress	Contact Number	Email	Fax	Signature
44	Beauby	335 April Street Thushanang,		0796261834			
45	Mkoryane C/S	5043 Willie Ackerman drive Lynnville	Box 820 eMalahleni 1039	013-6962296	metsimokoena@gmail.com	013-6962296	S180
46	↓	↓	↓	↓	↓	↓	↓
47	ITIRELENG PRIMARY SCHOOL	700 MULEKA STR THUSHANANG LOCATION	P.O. BOX 831 EMALAHLENI 1039	013 6999140	N/A	013 6999140	
48	Princess School	291 MAJOLA STR THUSHANANG LOCATION		013 6992264	N/A		
49	MICHAEL MABENA	290 MASOKA THUSANANG	=	0731638301	-	-	
50	—	256 —	—	—	—	—	S189
51	—	251 Majola Thushanang location	—	0 —	—	—	S182/3 Cant write
52		247 Modise Street					S184
53							S185

Site Notice and Placement of Site Notices

Kalkspruit Bridge

Proof of Site Notices

Plate 1 : Site Notice 1

Plate 2 : Site Notice 2

Plate 3 : Site Notice 3

Plate 4 : Aerial view of placements of site notices

Proof of Hand delivered Notification

Plate 5 : House Notification 2 : Photo 5135

Plate 6 : House notification 3 : Photo 5136

Plate 7 : House notification 8 : Photo 5138

Plate 8 : House notification 9 : Photo 5139

Plate 9 : House notification 10 : Photo 5140

Plate 10 : House Notification 11 : Photo 5141

Plate 11 : House Notification 12 : Photo 5142

Plate 12 : House notification 14 : Photo 5143

Plate 13 : House Notification 15 : Photo 5144

Plate 14 : House notification 19 : Photo 5145

Plate 15 : House Notification 20 : Photo 5146

Plate 16 : House Notification 23 : Photo 5148

Plate 17 : House Notification 25 : Photo 5149

Plate 18 : House Notification 26 : Photo 5150

Plate 19 : House Notification 27 : Photo 5151

Plate 20 : House Notification 28 : Photo 5152

Plate 21 : House Notification 31 : Photo 5171

Plate 22 : House Notification 32 : Photo 5172

Plate 23 : House Notification 34 : Photo 5173

Plate 24 : House notification 35 : Photo 5174

Plate 25 : House Notification 36 : Photo 5175

Plate 26 : House Notification 38 : Photo 5176

Plate 27 : House Notification 40 : Photo 5177

Plate 28 : House notification 42 : Photo 5178

Plate 29 : House Notification 43 : Photo 5179

Plate 30 : House notification 45 : Photo 5180

Plate 31 : House Notification 50 : Photo 5181

Plate 32 : House notification 51 : Photo 5182

Plate 33 : House notification 52 : Photo 5184

Plate 34 : House notification 53 : Photo 5185

Advert Placement

ENVIRONMENTAL IMPACT ASSESSMENTS NOTICE

Notice is hereby given that an application for Environmental Authorization in terms of the EIA regulations 2010 (Regulations in terms of Chapter 5 of the National Environmental Management Act, 1998 as amended) has been lodged with the Mpumalanga Department Economic Development, Environment and Tourism.

Mpumalanga Department Economic Development, Environmental and Tourism Ref No: 17/2/3N - 190

The Ngangala District Municipality together with the Emalahleni Local Municipality is proposing to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank. The rehabilitation of this bridge form part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilisation as well as the demolition and re-construction of the aforementioned bridge. The proposed site is located at 25° 52' 29.86"S / 29° 11' 18.96"E.

Table 1: Listed Activity triggered by the proposed activity:

Authority	Legal Reference	Listed Activity*
Department of Economic Development, Environment and Tourism	GN No. R544 of 18 June 2010	13, 11 , 18; & 39

The proposed development requires a Basic Assessment in terms of Government Notice R544. All Interested and Affected Parties (I&APs) are requested to register with NEMAI consulting within 30 days of the date of this notice, in order to receive any future correspondence and information regarding the proposed project. Please note that a public meeting may only be held if requested, and the time and date of the public meeting will be confirmed with all registered I&APs.

Copies of the Draft Basic Assessment Report (BAR) will be made available for public review to registered I & APs.

Representation with respect to this application must be forwarded to **Nemai Consulting**:

Contact : Manogrie Chetty
or Rivani Maharaj
Nemai Consulting
Tel: (031) 266 3884
Fax: 031 266 5287;

Email: manogriec@nemai.co.za
Email : rivanim@nemai.co.za
Postal Address: PO Box 1673
Sunninghill
2157

NEMAI CONSULTING

w/22mrt/nema.km

ACTING MUNICIPAL MANAGER

NKANGALA DISTRICT MUN

NKANGALA DISTRICT MUNICIP
QUALIFYING APPLICANTS TO F
POSTS IN THE TOURISM S

In terms of the National Expanded Public Works Prog directives, Nkangala District Municipality will appoint ers' for a period of twelve (12) months, from the six co palities within its area of jurisdiction:

TOURISM SECTOR : GENERAL

Requirements & competencies: Matric plus Tourism qualification. Able to read and write in English. Qualify physically strong and aged between 18 and 35 years. Fe couraged to apply.

Responsibilities: Various labour-intensive duties as requ Tourism programme' such as tourism safety, guiding, g streets. Applicants are expected to be fit and strong in fieldwork duties.

N.B. Appointments will be limited to candidates who are digent, and residing within the jurisdiction area of the N palities. Qualifying candidates must state Local Municip physical address in their application letter. Successful can to sign a 12-month contract of employment with the mun

Closing date: 28 March 2013 at 16h15.

Enquiries can be directed to Human Resources divi 2062. Qualifying candidates should send an applicatio comprehensive curriculum vitae, as well as certified co

The Acting Municipal Manager, Nkangala District Mun Middelburg 1050, or hand deliver it to: Nkangala Distric Ground Floor, 2 Walter Sisulu Street, Middelburg.

NB: Faxed and e-mailed applications will not be co

Should you not have been contacted for an interview v closing date, you may assume that your application wa

NKANGALA DISTRICT MUNICIPALITY SUBSCRIBES TO THE PRINC
EQUAL EMPLOYMENT AND AFFIRMATIVE ACTION. RECRUITMEN
LECTION ARE GUIDED BY ITS EMPLOYMENT EQUITY PLAN IN O
ENSURE ADEQUATE REPRESENTIVITY AND DIVERSITY OF ITS WO

ZEST Electric Motors PTY LTD

ZEST
WEG Group

Is looking for companies who can assist with the supply of the following:

- Transformer Oil Supply, Filling and Testing
- Local Transport (Durban Port to Site, Kusile Power Station)
- Transformer Assembly
- Transformer Testing & Cold Commissioning
- Transformer Fire Protection

(Transformer scope : 3MVA – 20MVA)

All potential candidates must be able to furnish and demonstrate previous work experience (5-10 years) and provide the necessary qualifications to execute the scope of supply.

All potential candidates must conform to either one of the following criteria:

- SBE (small business enterprise)
- BWO (black woman owned)
- LBS (larger black supplier)

Preference will be given to business concerns based in the following regions in order of priority:

- INkangala
- Witbank
- Mpumalanga
- Johannesburg

Please Submit your applications to marketing@zest.co.za

EYETHU COAL (PTY) LTD;
KENNISGEWING: BELANGHEBBENDE EN GEAFFEKTEE
OMVANGS FASE

Eyethu Coal (Pty) Ltd. (Reg. Nr.: 2003/010416/07) het aansoek gedoen vir 'n m (Aansoek is aanvaar deur DMH) in terme van artikel 22 van die Mineraal en Pe Ontwikkelingswet (Wet nr. 28 van 2002) vir Blesboklaagte Steenkoolmyn, o opsekere gedeeltes van die plaas Blesboklaagte 296 JS in die Emalahleni Mag

Die voorgenome mynbou bedrywighede sal bestaan uit oopgroef mynbou a oopgroef mynbou aktiwiteite sal gebruik maak van die opeenvolgende latera

As deel van die Omgewings Impak Beraming/Omgewings Bestuurs Program Omvangs Verslag by die Departement van Minerale Hulpbronne ingehandig Environmental (Pty) Ltd is aangestel as die omgewings konsultant wat die On saamstel, in terme van artikel 39(1) van die wet, gelees tesame met regulasie en Petroleum Hulbronne Ontwikkelingswet (Wet nr. 28 van 2002), vir die voo bedrywighede op bogenoemde eiendomme. Die konsep Omvangs Verslag sa die Witbank Publieke Biblioteek vanaf 22 Maart 2013 vir publieke ondersoek.

Kommentaar rakende die voorgenome mynbou bedrywighede moet skriftelik op 22 April 2013, met verwysingsnommer MP 30/5/1/2/2/10058 MR, aan:

Konsultant:
GEOVICON ENVIRONMENTAL (Pty) Ltd
Posbus 4050
Middelburg
1050

Tel.: 013 243 0542
Faks.: 086 632 4936
E-pos: geovicon@iafri
Sel no.: 082 359 5604
Kontakpersoon: Riana

w/22mrt/geoviconafr/km

Comments and Response Table

(No comments have been received to date)

Appendix 7: Environmental Management Programme (EMPr)

Proposed Rehabilitation of the Kalkspruit Bridge, Emalahleni Local Municipality, Mpumalanga Province (Ref 17/2/3N-190)

ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr)



May 2013

NEMAI CONSULTING

ENVIRONMENTAL AND SOCIAL CONSULTANTS

P.O. BOX 1673
SUNNINGHILL
2157

147 Bram Fischer Drive
FERNDALE
2194

Tel: 011 781 1730
Fax: 011 781 1731
Email: info@nemai.co.za

TITLE AND APPROVAL PAGE

TITLE: Proposed Rehabilitation of the Kalkspruit Bridge, Emalahleni Local Municipality, Mpumalanga Province (Ref 17/2/3N-190)

CLIENT:
Nkangala District Municipality
P O Box 437
Middelburg
1050

PREPARED:
Nemai Consulting C.C.
P.O. Box 1673
Sunninghill
2157
Telephone: (011) 781 1730
Facsimile: (011) 781 1731

REPORT COMPILED BY:

Manogrie Chetty	Ciaran Chidley

REPORT REVIEWED BY:

Lucky Msoki	Sadiq Addae

TABLE OF CONTENTS

LIST OF ACRONYMS

Acronym	Description
BA	Basic Assessment
CA	Competent Authority
DWA	Department of Water Affairs
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EO	Environmental Officer
I & AP	Interested and Affected Party
km	Kilometer
m	meter
MDEDET	Mpumalanga Department of Economic Development, Environment & Tourism
MSDS	Material Safety Data Sheets
MSDS	Material Safety Data Sheet
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PES	Present Ecological State
RE	Resident Engineer
NDM	Nkangala District Municipality
WUL	Water Use License
WULA	Water Use License Application

DEFINITIONS

Auditing
A systematic and objective assessment of an organisation's activities and services conducted and documented on a periodic basis.

Environment
The surroundings in which humans exist and which comprise:

- The land, water and atmosphere of the earth.
- Micro-organisms, plant and animal life.
- Any part or combination of a) and b) and the interrelationships among and between them.
- The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that can influence human health and well-being.

Environmental Aspect
Those components of the company's activities, products and services that is likely to interact with the environment.

Environmental Authorisation
The written statement from the relevant environmental authority in terms of the National Environmental Management Act (Act 107 of 1998), with or without conditions, that records its approval of a planned activity and the implementation thereof and the mitigating measures required to prevent or reduce the effects of environmental impacts during the life of a contract.

Environmental Impact Assessment (EIA)
The process of examining the environmental effects of a development in terms of the National Environmental Management Act (Act 107 of 1998) and the Environmental Impact Assessment (EIA) Regulations (Government Notice No.R543, R544, R545, R546 and R547).

Environmental Management Programme (EMPr)
An environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced.

Environmental Objective
An overall environmental goal, arising from the environmental policy, that an organization sets itself to achieve, and which is quantified where practicable.

Environmental Target
A detailed performance requirement, quantified where practicable, applicable to the organization or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.

Floodplain
A flat expanse of land bordering a river channel, formed through sediment deposition and other alluvial processes, and often characterized by frequent flooding as a result of bank overspill from the river channel.

Groundwater
Sub-surface water in the zone in which permeable rocks, and often the overlying soil, are saturate.

Hazardous waste
Waste that are proven to be toxic, corrosive, explosive, flammable, carcinogenic, radioactive, poisonous or classified as such in legal terms.

Heritage Resource
Any place or object of cultural significance including buildings, structures, landscapes, graves and geological, archaeological and paleontological sites.

Landscape
Land modified for human use and occupation, embracing both the natural (wilderness) environment and the urban.

Management actions
Practical actions aimed at achieving management objectives and targets.

Management objectives
Desired outcome of management measures for mitigating negative impacts and enhancing the positive impacts related to project activities and aspects (i.e. risk sources).

Monitoring
A systematic and objective observation of an organisation's activities and services conducted and reported on regularly.

Natural Vegetation
All existing vegetation species, indigenous or otherwise, of trees, shrubs, groundcover, grasses and all other plants found growing on the site.

Pollution
Any change in the environment caused by substances, radioactive or other waves, or noise, odours, dust or heat, emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.

Furthermore pollution can also be regarded as a undesirable state of the natural environment being contaminated with harmful substances as a consequence of human activities

Protected Plants
Plant species officially listed on the Protected Plants List (each province has one), and which may not be removed or transported without a permit to do so from the relevant provincial authority.

Reinstatement
Reinstatement is defined as the return of a disturbed area to a state, which approximates the state (where possible), which it was before disruption.

Riparian Vegetation
Vegetation occurring on the banks of a river or a stream (i.e. vegetation fringing a water body).

Runoff
The total water yield from a catchment including surface and subsurface flow.

Sensitive environmental features
Environmental features protected by legislation (e.g. heritage resources), or identified during the EIA as sensitive through specialists' findings and input received from Interested and Affected Parties.

Subsoil
The soil horizons between the topsoil horizon and the underlying parent rock.

Topsoil
Topsoil can be regarded as the fertile upper part or surface of the soil.

Transplanting
The removal of plant material and replanting the same plants in another designated position.

Veld
Unimproved areas of natural vegetation.

Wastewater
Means water contaminated by the project activities.

Watercourse
A geomorphological feature characterized by the presence of a streamflow channel, a floodplain and a transitional upland fringe seasonally or permanently conveying surface water.

Waterlogged
Soil or land saturated with water long enough for anaerobic conditions to develop.

Weeds and Invader Plants
Weeds and invader plants are defined as undesirable plant growth that shall include, but not be limited to all declared category 1, 2 and 3 listed invader species as set out in the Conservation of Agricultural Resources Act (No 43 of 1983) regulations. Other vegetation deemed to be invasive should be those plant species that show the potential to occupy in number, any area within the defined construction area.

Wetland
Land where a surplus of water (i.e. waterlogging) is the key factor determining the nature of the soil development as well as the types of plants and animals living at the soil surface.

1. DOCUMENT ROADMAP

The information documented in this Environmental Management Programme report (EMPr) is intended to meet all requirements as stipulated in Government Notice (GN) No.543 (18 June 2010), Regulation 33. This EMPr also forms part of the Basic Assessment (BA) process. Table 2 below presents the structure of the EMPr in terms of the aforesaid regulatory requirements.

Table 2: Document Roadmap

Content of draft Environmental Management Programme as set out in Regulation 33, of the Environmental Impact Assessment Regulations, 2010 as promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998)			
Correlation with G.N. No. 543	**Description**	**Chapter**	**Title**
R33(a)	Details and expertise of the person who prepared the environmental management programme.	2	Environmental Assessment Practitioner
R33(b)	Information on any proposed management or mitigation measures that will be taken to address the environmental impacts that have been identified in a report contemplated by these Regulations, including environmental impacts or objectives in respect of— • planning and design; • pre-construction and construction activities; • operation or undertaking of the activity; • rehabilitation of the environment; and • closure, where relevant.	12	Impact Management
R33(c)	A detailed description of the aspects of the activity that are covered by the draft environmental management programme;	11	Environmental Activities, Aspects and Impacts
R33(d)	An identification of the persons who will be responsible for the implementation of the mitigation measures.	9	Roles and Responsibilities
R33(e)	Proposed mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon.	6	Monitoring and Auditing
R33(f)	As far as is reasonably practicable, measures to rehabilitate the environment affected by the undertaking of any listed activity or specified activity to its natural or predetermined state or to a land use which conforms to the generally accepted principle of sustainable development, including, where appropriate, concurrent or progressive rehabilitation measures.	13	Site Decommissioning and Rehabilitation
R33(g)	A description of the manner in which it intends to— • Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; • Remedy the cause of pollution or degradation and migration of pollutants; • Comply with any prescribed environmental management standards or practices; • Comply with any applicable provisions of the Act regarding closure, where applicable; and • Comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable.	12	Impact Management
R33(h)	Time periods within which the measures contemplated in the environmental management programme must be implemented.	12	Impact Management
R33(i)	The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity.	12	Impact Management
R33(j)	An environmental awareness plan describing the manner in which— • the applicant intends to inform his or her employees of any environmental risk which may result from their work; and • risks must be dealt with in order to avoid pollution or the degradation of the environment;	8	Environmental Awareness Training
R33(k)	Where appropriate, closure plans, including closure objectives.	N/A	Not Applicable

2. ENVIRONMENTAL ASSESSMENT PRACTITIONER

Nemai Consulting has been appointed by the Nkangala District Municipality (NDM) as the independent Environmental Assessment Practitioner (EAP) to complete all requisite environmental processes and seek environmental authorisation for the Proposed Rehabilitation of the Kalkspruit Bridge, Emahlangeni Local Municipality, Mpumalanga Province, on behalf of the applicant. The members of Nemai Consulting that were involved with compiling the EMPr are tabulated below.

Table 2: Person involved with compiling the EMPr

Name	Qualifications	Experience	Duties
Ms V. Brueton	• MSc Zoology	2 years	EAP
Mr C. Chidley	• B.Sc Eng (Civil); • BA (Economics, Philosophy) • MBA	20 years	Quality Reviewer
Ms M. Chetty	• B.Sc Honours Biological Science	4 years	EAP

3. PROJECT BACKGROUND & MOTIVATION

The Nkangala District Municipality together with the Emalahleni Local Municipality proposes to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank. The rehabilitation of this bridge form part of the greater Kalkspruit Rehabilitation Project, which as a whole comprises of the clean-up of the immediate catchment area of the Kalkspruit River, embankment stabilisation as well as the demolition and re-construction of the aforementioned bridge.

Nemai Consulting has been appointed by HMP Africa Consultants on behalf of the Emalahleni Local Municipality to undertake the requisite Environmental Authorisation Process for the rehabilitation of the Kalkspruit Bridge. The proposed development triggers activities listed in Government Notices No. R 544 and hence requires a basic assessment study as per the August 2010 Environmental Impact Assessment (EIA) Regulations promulgated in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

4. PROJECT OVERVIEW

The Nkangala District Municipality together with the Emalahleni Local Municipality is proposing to rehabilitate and upgrade the Kalkspruit Bridge spanning across the segment of the Kalkspruit River, between Twala Avenue and Botha Street, Witbank.

Kalkspruit Bridge is located within the Emalahleni Local Municipality and Nkangala District Municipality, Mpumalanga Province (See figure 1 and appendix 1 for Topographical Maps). The bridge is located on Farm Kwaguqa 313 JS (T0JS00000000031300011 and T0JS00000000031300000).

Figure 1: Aerial map showing the location of the Kalkspruit bridge, (a) picture of the existing structure

The demolition and reconstruction of the Kalkspruit Bridge project and associated activities will include the following (See figure 2):

- Removal of accumulated silt and sediment built up at the bridge;
- Lining the embankment with gabions and reno mattresses; and
- Guard Railing and Balustrade protection.

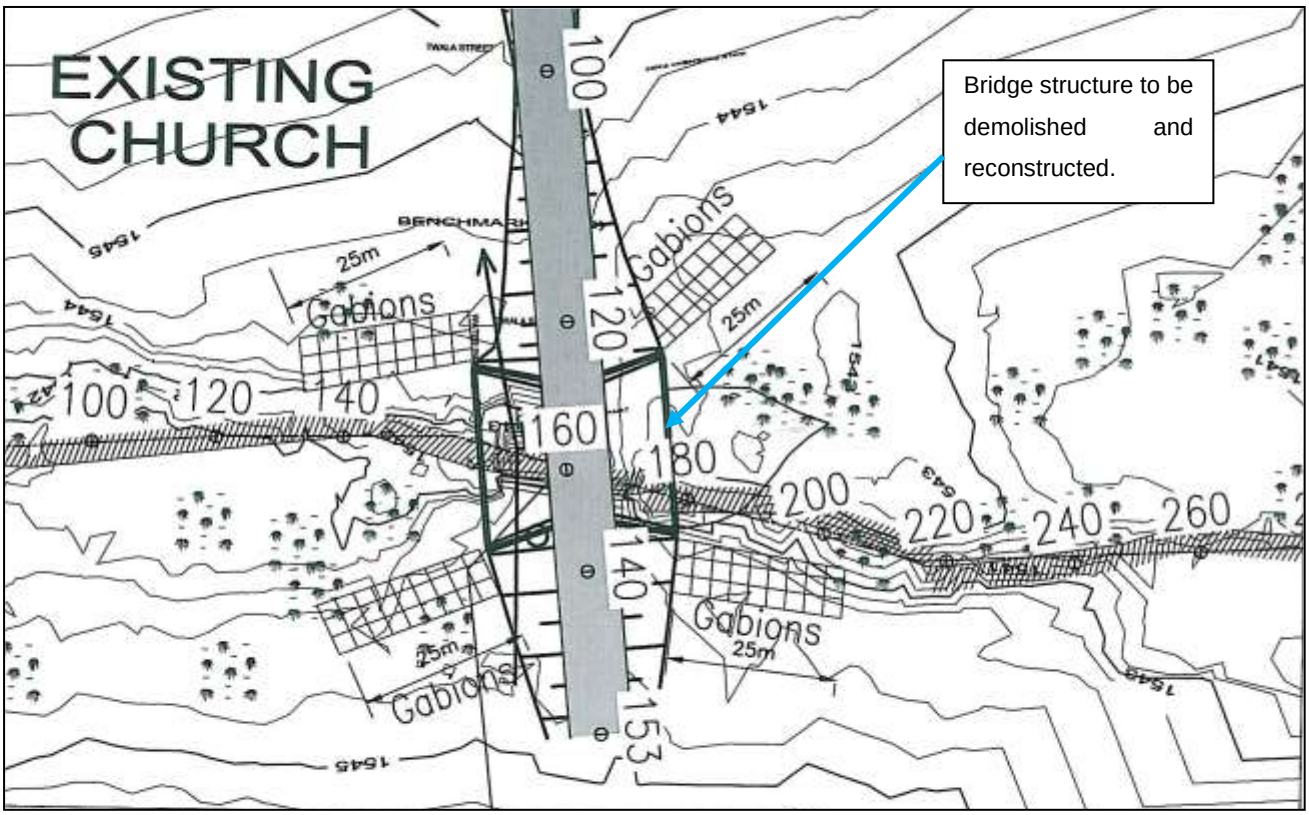

Figure 2: Design map illustrating the bridge and gabion structures

In addition the slope of the channel will be increased on the approach side of the downstream bridge to assist in increasing the velocity of flow. The approach will then be lined with Armorflex for approximately 30m, placed on geotextile material. This will improve the velocity of flow and prevent water weeds growing on the approach side of the channel. The downstream side will then be lined with approximately 10m to allow the flow to pass through (see figure 3).

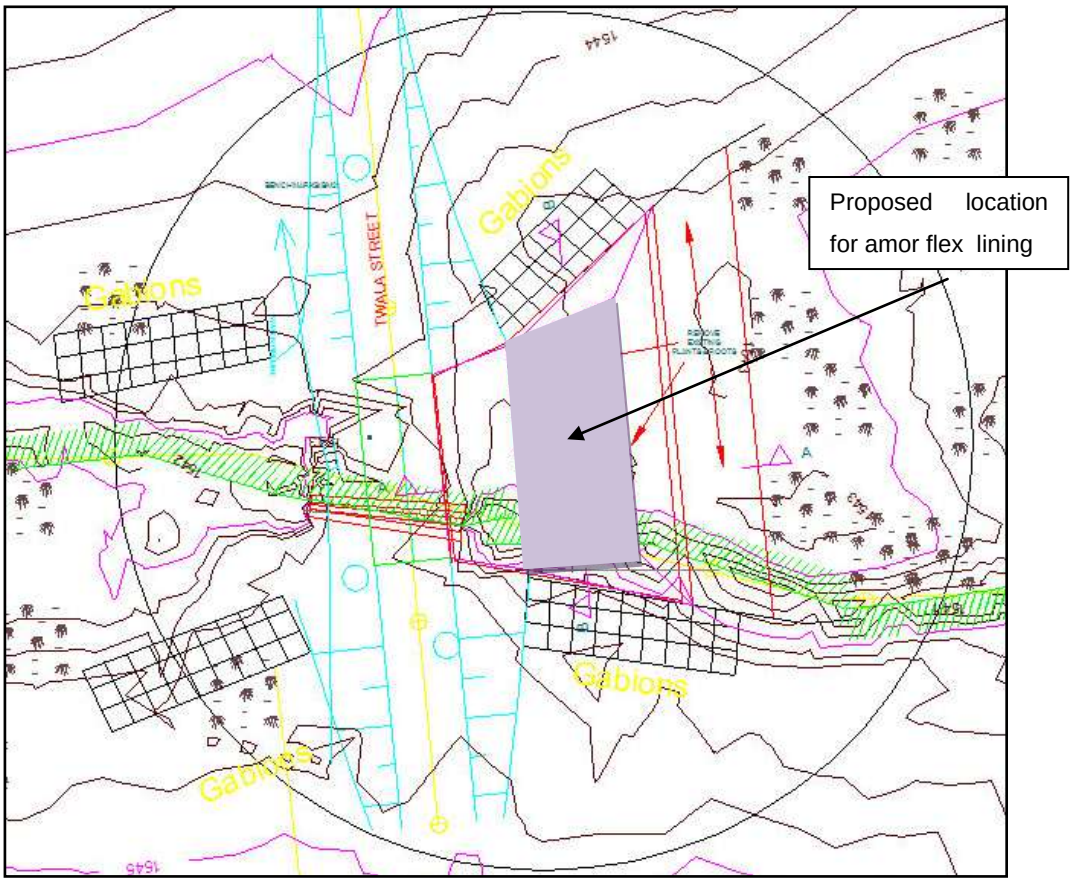

Figure 3: Design map illustrating the bridge and gabion structures as well as location of amor flex lining

5. OBJECTIVES OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME

The EMPr provides performance criteria required to address potential environmental impacts during the life-cycle of a project (i.e. planning, construction, operation and decommissioning phases). This Report must be read in conjunction with the Basic Assessment Report (BA).

This document serves to take into account and satisfy all requirements as outlined in Regulation 33 of the EIA Regulations 2010. According to Lochner (2005), the EMPr is intended to:

- Ensuring compliance with the regulatory authority stipulations and guidelines which may be local, provincial, national and/or international;
- Ensuring that there is sufficient allocation of resources on the project budget so that the scale of EMPr-related activities is consistent with the significance of project impacts;
- Verifying environmental performance through information on impacts as they occur;
- Responding to changes in project implementation not considered in the EIA;
- Responding to unforeseen events; and
- Providing feedback for continual improvement in environmental performance.

This document serves as a Draft EMPr which will be subjected to a 40 day public review period. Following the conclusion of the public review period the final EMPr along with the final BAR will be submitted to the Competent Authority (CA), the DEDET, for review and decision making. The final EMPr will contain recommendations as well as mitigation emanating from the public review period.

6. MONITORING AND AUDITING

All documents shall be kept on site and be made available for monitoring purposes. Site inspections by an Environmental Audit Team may require access to this documentation for auditing purposes. The documentation shall be signed by all parties to ensure that such documents are legal. Regular monitoring of site works by the ECO is imperative to ensure that all problems encountered are solved punctually and amicably. When the ECO is not available, the Contract Manager / Site Supervisor shall keep abreast of all works to ensure no problems arise.

Biweekly / Monthly environmental compliance reports must be undertaken by the ECO and the following, but not limited to, shall be reported on:

- Environmental incidents (e.g. fuel spills) and actions taken;
- Incidents that can lead to legal contraventions and litigation;
- Complaints from Interested and Affected Parties, which should be recorded and kept on file; and
- Environmental damage that needs rehabilitation.

The following documentation shall be kept on site:

- Access negotiations and physical access plan;
- Complaints register;
- Site daily diary;
- Records of all remediation / rehabilitation activities;
- Copies of audit reports;
- Copy of the EMPr and Environmental Authorisation; and
- Minutes of site meetings (including discussions related to environmental matters).

Environmental Audits will be carried out during and upon completion of construction.

7. ENVIRONMENTAL LEGAL FRAMEWORK

As the proposed development falls within the ambit of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) as well as the National Water Act, 1998 (Act No. 36 of 1998) (NWA) these Acts informed and determined the scope and content of the EMPr. As mentioned previously the document as a minimum aims to satisfy all requirements as stipulated in Regulation 33 of the EIA Regulations, 2010. The following authorisations are required prior to the implementation of the project:

- Environmental Authorisation from the DEDET for the listed activities associated with the project; and
- Authorisation from the Department of Water Affairs (DWA), in terms of the NWA as the expansion of the footprint of the bridge falls within the regulated area of numerous watercourses.

Care must be taken to ensure that all legislation relating to the protection of the environment and prevention of pollution is adhered to. This EMPr must form part of the contractual obligations of all contractors and sub-contractors engaged in the project. The EMPr, including a copy of all environmental approvals must be kept on site. The requirements imposed by the EMPr are legally binding in terms of environmental statutory legislation.

The following legislation in addition to the Acts mentioned above governs activities associated with the project and must therefore be complied with includes:

- Constitution of the Republic of South Africa, (no 108 of 1996)
- National Environmental Management Act (no. 107 of 1998);
- Environmental Conservation Act (No 73 of 1989);
- National Environmental Management Air Quality Act (no 39 of 2004);
- National Environmental Management : Biodiversity Act, 2004 (no. 10 of 2004);
- National Environmental management : Protected Areas Act (No. 57 of 2003);
- Occupation Health and Safety Act (No.25 of 1999);
- National Heritage Resource Act (no 25 of 1999);
- Conservation of Agricultural resource Act (no. 43 of 1983);
- National Environmental Management : Waste Management Act (59 of 2008); and
- Any other applicable legislation.

8. ENVIRONMENTAL AWARENESS TRAINING

In terms of the Environmental Impact Assessment Regulations, 2010 all personnel on site must be provided with Environmental Awareness Training. As suggested in the City of Cape Town Environmental Management Programme, "Specification: Environmental Management, Standard Environmental Specification Revision 2007", Environmental Awareness Training should as a minimum entail the following:

- Two types of courses shall be run: one for the Contractors and Subcontractors management and one for all site staff and labourers;
- Courses shall be run during normal working hours at a suitable venue provided by the Contractor;
- All attendees shall remain for the duration of the course and sign an attendance register that clearly indicates participant's names on completion, a copy of which shall be handed to the Engineer/Environmental Officer/ECO;
- The size of each session shall be limited to the numbers shown in the Project Specification and the Contractor shall allow for sufficient sessions to train all personnel;
- Subsequent sessions shall be run for any new personnel coming onto site;
- A Method Statement with respect to the organisation of these courses shall be submitted;
- Revised training shall be conducted as and when required;
- The environmental awareness training course for management shall include all management and foremen. The course, which shall be presented by the Engineer/ECO/EO or his designated representative, is of approximately one-hour duration. The initial course shall be undertaken not more than 7 days prior to commencement of work on site;
- The environmental awareness training course for site staff and labour shall be presented by the Contractor from material provided by the Engineer/ECO/EO unless otherwise indicated in the Project Specification. The course is approximately one-hour long. The course shall be run not more than 7 days after commencement of work on site with sufficient sessions to accommodate all available personnel.
- Proof of induction of all staff and sub-contractors will be required to be kept on file.

9. ROLES AND RESPONSIBILITIES

The implementation and enforcement of the EMPr will require the input of numerous parties, including but not limited to the proponent (Emalahleni Local Municipality), Engineer, Resident Engineer, Environmental Control Officer as well as the Contractor.

9.1 Environmental Control Officer

An independent Environmental Control Officer (ECO) must be appointed by the applicant prior to the commencement of construction activities. The ECOs primary role will be to assess whether construction activities are implemented as per the conditions stipulated in the EA, Environmental Management Programme (EMPr) and all other authorisations.

The ECO will be responsible for the following:

- To monitor, review and verify the execution of the mitigation measures by the Contractor and to ensure the safeguarding of the environment;
- Assisting in ensuring necessary environmental authorisations and permits have been obtained;
- To facilitate communication between I&APs, authorities and the Contractor;
- Provide environmental solutions and guidelines to the daily environmental problems;
- To train the Contractor, Site Agent, Construction Supervisor and Safety Officer on the mitigation measures, and to verify that the Contractor's employees have undergone induction on these measures;
- To keep records of all activities / incidents concerning the environment on site and to monitor the complaints register in order to get a resolution; and
- To address non-conformances as part of the minutes of progress meetings.

In addition the ECO will be responsible for ensuring that the Management Objectives (i.e. desired outcome of management measures for mitigating negative impacts and enhancing the positive impacts related to project activities and aspects) and Targets (i.e. level of performance to accomplish management objectives) are reached through the implementation of the management actions (i.e. practical actions aimed at achieving management objectives and targets) and mitigation measures provided in the approved Basic Assessment Report and EMPr.

A report must be compiled by the ECO, following each monitoring event, detailing the observations made on site, and any activities which are not aligned with the specifications of the Environmental Authorisation (EA) and Water Use License (WUL). The report should also include corrective measures and the timeframes in which these measures must be implemented for any environmental impact caused. A follow-up audit (i.e. monitoring event) must be done to confirm whether these corrective measures have been implemented and to assess the effectiveness thereof.

As a means of facilitating the implementation of the correct management actions and mitigation measures in the event of an environmental impact, a copy of the EA and EMPr must be kept on-site at all times and should be readily available when requested by the ECO or authorities.

9.2 Mpumalanga Department of Economic Development, Environment and Tourism

The Mpumalanga Department of Economic Development, Environment and Tourism (DEDET) as the Competent Authority (CA) is responsible for approving the EMPr in addition to ensuring that the proponent complies with the conditions of the EA.

9.3 The Emalahleni Local Municipality

The Applicant is accountable for the potential impacts of activities that are undertaken and is responsible for managing these impacts. The Emalahleni Local Municipality as the proponent is responsible for ensuring that relevant legislation are complied with in addition to compliance with the EA and the financial cost of all environmental control measures. Furthermore the applicant must ensure that any person acting on their behalf complies with the conditions/specifications contained in this EMPr.

9.4 Engineer

The Engineer will be responsible for managing the planning, design and construction phases of the project. The Engineer shall appoint a Resident Engineer (RE) to act as the onsite implementing agent. The Engineer will furthermore also be required to tend to any environmental matters at the request of the RE and/or the ECO.

9.5 Resident Engineer

The RE will act as the applicant's on-site implementing agent. Any on-site decisions regarding environmental management are ultimately the responsibility of the Engineer or the RE in accordance with their delegated authorities. The RE shall assist the ECO where necessary and shall have the following responsibilities in terms of the implementation of the EMPr:

- Regular site inspections;
- Reviewing and approving the Contractor's Method Statements;
- Monitoring and verifying that the EMPr and Method Statements are adhered to;
- Assisting the Contractor in finding environmentally responsible solutions to problems with input from the ECO where necessary; and
- Communicating all environmental issues to the ECO.

9.6 Contractor

The Contractor will responsible for (but not limited to) the following:

- To implement all provisions of the EMPr and EA;
- Ensure that all construction activities are carried out in an environmentally sound manner;
- To ensure that all staff are familiar with the EMPr and understand the document;
- To ensure that Environmental Awareness Training are provided to all staff on site;
- To monitor and verify that the environmental impacts are kept to a minimum;
- To prepare all Method Statements as requested by the ECO;
- To report any incidents of non-conformance with the EMPr as well as non-compliance with the EA to the RE and the ECO; and
- Rehabilitation and/or environmental compensation must be made for any damage to sensitive areas caused by construction activities. This shall be done in accordance with the Engineer's and ECO's specifications.

10. PROJECT LIFECYCLE

During its lifecycle, projects journey through four distinctive phases, as presented in **Figure 1**.

Figure 1: Four Generic Phases of a Project Lifecycle

Due to this project incorporating the demolition and removal of a structure and the construction of stabilisation measures, its life cycle is characterised by the following phases:

- Planning (land negotiations with land owners, road design and technical assessment);
- Construction Phase (road works, widening of the bridges and culverts and development of the borrow area);
- Operational Phase (operation of the road); and
- Decommissioning (not applicable for this project)

11. ENVIRONMENTAL ACTIVITIES, ASPECTS AND IMPACTS

11.1 Project Life-cycle Approach

The project life cycle for the improvement and upgrade of the bridge includes the following fundamental phases:

- Planning and design phase – In addition to the carrying out the requisite environmental processes (e.g. Basic Assessment process) the planning and design phase also included the following:
  - Preparation of relevant planning documentation, including technical and design documentation.
- Construction phase – During the implementation of the project, the construction activities related to the installation of the necessary infrastructure and equipment is undertaken. Construction can only commence after environmental authorisation had been obtained.
- Operational phase - The completion of the construction phase will be followed by routine road maintenance, which will include (but not limited to) pavement repair, crack sealing and patching, repairing and cleaning of drainage structures (e.g. culverts) and protection of the environment through maintenance of trees and shrubs, weed and litter control. Maintenance of the bridge structure.
- Decommissioning – No decommissioning phase is anticipated.

In order to establish best management practices and prescribe mitigation measures, the following project-related information needs to be adequately understood:

- **Activities** associated with the proposed project;
- **Environmental aspects** associated with the project activities;
- **Environmental impacts** resulting from the environmental aspects; and
- The nature of the surrounding **receiving environment**.

11.2 Project Activities

The main project components include the following:

- The demolition and reconstruction of the Kalkspruit Bridge and associated activities will include the following:
  - Construction of the culverts, deck, road and sidewalks;
  - Removal of accumulated silt and sediment built up at the bridge;
  - Lining the embankment with gabions and reno mattresses;
  - Lining with armor flex; and
  - Guard Railing and Balustrade protection.

In order to understand the impacts related to the project it is necessary to unpack the activities associated with the project life-cycle, as shown below:

Table 4: **Activities associated with the Project Life-Cycle**

Pre-construction
Project Activities
• Detailed engineering design
• Detailed geotechnical investigation
• Geophysical investigations
• Survey of the site
• Arrangements with individual landowners and/or land users
• Procurement process for Contractors
Construction
Project Activities
• *On-going consultation with affected parties*
• Vegetation clearance
• Pegging of overall construction footprint
• Site establishment
• Establish construction camp (including material lay-down areas)
• *Construction employment*
• Delivery of construction material
• Storage and handling of material
• Transportation of equipment, materials and personnel
• Topsoil clearance
• Fencing of site camp
• Upgrade and re-alignment of existing road
• Grading of site (where necessary)
• Excavations and Foundation related activities
• Stormwater Drain
• Traffic Control
• Waste Management
• *Wetland rehabilitation*
• *Refuelling*
• *Crossing* inaccessible sites
• *Crossing* sensitive areas
• *Managing construction sites*
• *Reinstatement and rehabilitation*
• *Final road / bridge surface finishes*
• Handing and taking over of the servitude
Operation
Project Activities
• Access arrangements and requirements
• Routine maintenance inspections
• Management of vegetation clearance
• Repair and maintenance works

11.3 Environmental Aspects

Environmental aspects are regarded as those components of an organisation's activities, products and services that are likely to interact with the environment. The following environmental aspects have been identified for the proposed project, which are linked to the project activities (note that only high-level aspects are provided):

Table 5: **Environmental Aspects associated with the Project Life-Cycle**

Pre-construction
Environmental Aspects
• Poor construction site planning and layout
• Inaccurate site survey
Construction
Environmental Aspects
• *Lack of environmental awareness creation*
• *Poor consultation with affected parties*
• Indiscriminate site clearing
• Poor site establishment
• Poor management of access and use of access roads
• Poor transportation practices
• Poor fencing arrangements
• Erosion
• Disruptions to existing services
• *Disturbance of topsoil*
• Poor management of excavations
• Inadequate s*torage and handling of material*
• Inadequate s*torage and handling of hazardous material*
• Lack of ***equipment maintenance***
• Poor management of labour force
• Pollution from ***ablution facilities***
• Inadequate management of ***construction camp***
• Poor waste management practices
• *Wastage of water*
• *Disturbance to landowners*
• Poor management of pollution generation potential
• *Damage to significant flora*
• *Damage to significant fauna*
• *Environmental damage at crossings of* inaccessible sites
• *Environmental damage at crossings of* sensitive areas
• *Disruption of* archaeological and cultural features
• Poor reinstatement and rehabilitation
Operation
Environmental Aspects
• Inadequate management of access, routine maintenance and maintenance works
• Inadequate management of wetlands and associated vegetation

11.4 Significant Environmental Impacts

Environmental impacts are the change to the environment resulting from an environmental aspect, whether desirable or undesirable. The significant environmental impacts are listed in **Table 6**.

Table 6: **Significant environmental impacts associated with the project**

Construction Phase	
Feature	**Impact**
Topography	• Erosion associated with the upgrade of the bridge and culverts
Surface Water	• Potential contamination of the surface water • Soil erosion resulting in increased sedimentation of the watercourse
Pans and Wetlands	• Damage to wetland habitat • Erosion and sedimentation of the wetland
Geology and Soil	• Erosion of stockpiled soil
Flora	• Excess removal of indigenous vegetation • Damage to sensitive / protected plants • Encroachment of alien vegetation
Fauna	• Disturbance of fauna
Socio-Economic	• Potential job creation for skilled and unskilled labourers from the local community
Archaeological and Cultural Features	• Damage to heritage resources
Infrastructure and Services	• Poor stormwater attenuation resulting damage to surround habitats
Transportation	• Disruption to traffic as a result of construction activities
Visual	• Construction – related activities resulting in negative visual impact
Operational Phase	
Feature	**Feature**
Surface Water	• Inadequate stormwater management resulting in contamination of the watercourse
Wetlands	• Loss of wetland habitat
Soil	• Erosion on site
Flora	• Encroachment by alien vegetation
Fauna	• Impact on faunal biodiversity • Impact on aquatic species
Socio-economic	• Better access road for residents of the nearby township and other community members
Infrastructure and Services	• Inadequate stormwater management resulting in contamination of the watercourse
Transportation	• Better access road with a walkway for pedestrians
Visual	• Inadequate rehabilitation of the construction footprint
Tourism	• More efficient access road to new sports facility

12. IMPACT MANAGEMENT

The impact assessment carried out for each environmental impact that may result from the proposed project, forms the basis for determining which management measures are required to prevent or minimise these impacts. The management measures is furthermore a means by which the mitigation measures, determined in the impact assessment are translated to action items required to prevent or keep those impacts that cannot be prevented within acceptable levels.

Mitigation should strive to abide by the following hierarchy (1) prevent; (2) reduce; (3) rehabilitate; and/or (4) compensate for the environmental impacts.

Figure 3: Mitigation Hierarchy

The basis for the management measures which follows below comprise of the following:

- Management objectives – i.e. desired outcome of management measures for mitigating negative impacts and enhancing the positive impacts related to project activities and aspects (i.e. risk sources);
- Targets – i.e. level of performance to accomplish management objectives; and
- Management actions – i.e. practical actions aimed at achieving management objectives and targets

12.1 Planning Phase

General requirements during the pre-construction phase include the following:

- Design to consider and incorporate environmental requirements.
- Define and communicate roles and responsibilities for the implementation of the EMPr.
- Conduct appropriate environmental baseline studies.
- Develop and implements an environmental awareness programme.

1.1.1 Construction Site Planning and Layout

Management Objective:

Planning and layout of construction site to ensure protection of sensitive environmental features.

Target:

No impacts to sensitive environmental features as a result of construction site planning and layout.

Management Actions:

- Identify sensitive environmental features where special care needs to be taken and implement suitable mitigation measures to safeguard these features (e.g. barricading).
- A qualified and / or appropriately experienced specialist or an experienced person who knows the specific vegetation type well will mark medicinal plants when the layout is pegged and the necessary permits will be obtained if avoidance is not possible.
- The wetland areas that are not part of the working area must be clearly demarcated.
- Identify protected plants and trees. Any protected plants or trees in proximity to the construction servitude that will remain, should be marked clearly and must not be disturbed, defaced, destroyed or removed, unless otherwise specified by the ECO / EO and the Engineer. Acquire the necessary permits under the National Forests Act (No. 84 of 1998) if avoidance of protected trees is not possible.

1.1.2 Managing geotechnical investigations

Management Objective:

Manage environmental impacts associated with detailed geotechnical investigations.

Target:

1. No deviations from agreements made with landowners.
2. No damage to sensitive environmental features (e.g. watercourses, structures and infrastructure).
3. Rehabilitation of test pits.

Management Actions:

- Suitable access arrangements to be made in accordance with agreements.
- Safe operation of plant and equipment required for geotechnical investigations.

- Adequate management of domestic and construction waste.
- Implement measures to mitigate soil erosion, loss of vegetation and pollution.
- Prevent damage to sensitive environmental features.
- Landscape and rehabilitate test pits.

12.2 Construction Phase

12.2.1 *Site Establishment*

Management Objective:

To limit the extent and severity of any environmental impacts, especially any detrimental impact on the riparian area that may result from the establishment of the site.

Management Target:

Ensuring minimal impact on the environment due to activities associated with the Site Establishment.

Actions:

- The site may not be established on a steep slope or within close proximity of the watercourse.
- The extent of the site should by all means be limited, to avoid any additional clearance of vegetation.
- Contractor should take into consideration when identifying a possible site location the regulated area (1:100 floodline). Site camp not to be established within this regulated area.
- The contractor shall draw-up a plan of all parts of the construction site showing the layout of site establishment, topsoil stockpiles, storage areas, planned access and circulation routes etc.
- Every precaution should be taken, in accordance with this specification, to prevent pollution of air, soil, ground and surface water as a result of construction or associated activities at the construction site.
- The contractor will include environmental hazards and impacts into their safety file for inclusion into the contractor's mitigation measures.
- The contractor shall ensure that the site camp and working areas are kept clean and tidy at all times.
- Fuel, lubricants, transmission and hydraulic fluids shall only be stored in the designated areas that comply with the Occupational Health and Safety Act.
- The location of fuel storage sites, vehicle, machinery and equipment maintenance and refuelling sites must be located at least 100 m from water bodies, and must be outside the Regulated Area (1:100 flood line).

- All flammable and hazardous substances storage must comply with legislation and by-laws. M.S.D.S (Material Safety Data Sheets) is to be kept on site with relevant copies on location where the substance is being stored.
- All spillages from any chemical must be reported to the ECO. Soil contaminated with hazardous materials will be disposed of at a licensed hazardous waste disposal site. All related documents are to be copied to the ECO and retained on site to be compiled in the end of project documents.
- The Contractor shall draw-up a plan of all parts of the construction site showing the layout of site establishment, topsoil stockpiles, storage areas, planned access and circulation routes etc. The plan shall be submitted to the ECO, Engineer and SANRAL for comment and approval.
- The contractor will make all staff and people under their control aware of environmental requirements on site. All to sign an induction register for being informed and held accountable for any transgressions.
- The contractor will document awareness sessions with their staff and staff are to sign acknowledgement of these issues.
- In the event of an archaeological site being uncovered during excavations all work will be halted in terms of the Heritage Act until the go ahead is given by the relevant competent person.
- The Contractor shall ensure that the Contractors camp and working areas are kept clean and tidy at all times. The Engineer or/and the Environmental Control Officer shall inspect these areas on a regular basis.
- Movement of vehicles outside the designated working areas shall not be permitted without authorisation from the Engineer and relevant landowner/s.
- All construction activities shall be restricted to working areas designated on the drawings and/or demarcated and approved by the Engineer.
- The Contractor shall provide eating areas for all staff. Eating areas be cleaned on a daily basis and shall provide adequate temporary shade.
- Refuse bins must be placed at all eating areas.

12.2.2 Ablutions/toilets:

Management Objective:

All employees on construction site to have adequate access to ablution facilities.

Actions:

- Contractor to ensure adequate number of ablution facilities are available and not further that 200m from the construction working area.
- All staff to use the provided toilets at all times.
- All sanitary fees that may be payable to any local authority shall be paid by the Contractor.

- Ablutions are to be cleaned/ emptied on a regular basis, before they are full and contaminate the environment.
- Ensure that no spillages occur when ablution facilities are emptied.
- The provision of toilets for each sex is required in terms of the National Building Regulations and Construction Regulation 28.
- At least 1 toilet facility available per 15 workers. Such facilities also to be available on both sides of the river, should work take place in concurrently.
- Informal ablutions within the all riparian areas must be prohibited.
- Ablutions facilities must be situated further than 100m from the watercourse.

12.2.3 Use of land:

Management Objective:

To ensure that all construction activities are confined to the construction footprint and that minimal disturbance is caused to the surrounding community.

- **Actions:**

- All construction activities shall be restricted to working areas designated on the drawings and/or demarcated and approved by the Engineer. Materials shall be stockpiled at designated sites.
- Movement of vehicles outside the designated working areas shall not be permitted without authorisation from the RE.
- All agreements pertaining to access that had been made with landowners shall be recorded and strictly adhered to.
- No members of the construction team/s should be allowed to loiter on private property away from the construction campsite.
- Contractor to ensure that a security person is on site during working hours and at the site camp after working hours and on weekends/ public holidays.
- Any reportable crimes to be reported to the local South African Police Service (SAPS).
- It must be ensure that any lighting installed on the site for does not interfere with road traffic or cause a reasonably avoidable disturbance to the surrounding community.

12.2.4 Traffic control:

Management Objective:

Ensure that construction activities do not cause unnecessary disruptions to the flow of traffic and road users.

Actions:

- The Contractor must comply with all driving, vehicle, licensing and driver ability requirements as indicated in the laws of South Africa.
- Ensure that all alternative routes and traffic control notifications are shown well in advance on either side of the construction activities.
- Ensure that adequate traffic accommodation measures are implemented.
- Efficient management of stop-go systems to prevent unnecessary delays to motorists.
- All temporary traffic accommodation arrangements and the traffic-control facilities used must be in accordance with the specifications, the drawings and Chapter 13 “Roadworks Signing” of the South African Road Traffic Signs Manual.

12.2.5 Road Surfacing:

Management Objective:

Ensure that all activities associated with the road surfacing cause the least impact on the surrounding environment and are contained to the intended area.

Actions:

- Over spray of bitumen products outside the road surface and onto roadside vegetation shall not be allowed.
- When heating of bitumen products, the contractor shall take cognisance of appropriate fire control and safety measures.
- Stone chip/gravel excess shall not be left on road/paved area verges and shall be swept/raked into piles and removed to an area as approved by the ECO and RE.
- Water quality from runoff from any fresh bitumen surfaces must be monitored by the RE and ECO to ensure that remedial action is taken promptly.

12.2.6 Stockpiles:

Management Objective:

Ensure that all activities associated the stockpiling of topsoil and material cause the least impact on the surrounding environment and are contained to the stockpile area.

Actions:

- Stripped topsoil shall be stock piled on sites adjacent to where it has been stripped which have been approved by the RE and ECO.
- Topsoil stripped from different sites shall be stockpiled separately and clearly identified as such. Topsoil obtained from different soil types shall not be mixed.

- Soil stockpiles shall not be higher than 1,5m and the slopes of soil stockpiles shall not have a vertical/horizontal gradient exceeding 1: 1.5.
- No vehicles shall be allowed access onto the stockpiles after they have been placed. Topsoil stockpiles shall be clearly demarcated in order to prevent vehicle access and later identification as the resource for rehabilitation and vegetation establishment.
- Soil stockpiles shall not be allowed to become contaminated with oil, diesel, petrol, garbage or any other matter which may inhibit the later growth of vegetation in the soil.
- Construction activities shall be planned so that materials excavated from the borrow areas are as far as possible transported immediately to the point where it is to be used. However, should temporary stockpiling become necessary, the all demarcated stockpile areas will be subject to the approval of the RE and ECO.
- No material will be stockpiled within a riparian area or in close proximity to any sensitive environmental feature.
- Stockpiles must be placed and sloped in such a manner that the least visual impact is created.
- Stockpiles must be kept free from all alien vegetation.
- After the stockpiled material has been removed, the site shall be re-instated to its original condition.
- All areas affected by stockpiling shall be landscaped, top-soiled, grassed and maintained.
- All material milled from the existing road surface that is temporarily stockpiled in areas approved by the RE within the road reserve, shall be subject to the same condition as other stockpiled materials.
- Excess materials from in situ milling or road construction activities may not be swept off the road and left unless specifically instructed to do so in the contract drawing or under instruction from the RE.
- Topsoil stockpiles shall, where necessary, be protected from wind and water erosion by seeding or placement of hay bales or shadecloth.
- Stockpiles will not be covered with plastic sheets that may cause it to compost or kill the seed bank.

12.2.7 Heritage Resources:

Management Objective:

Prevent any adverse impact on the historical inheritance of the area and to avoid damage to or destruction of previously unknown or excavated archaeological artefacts during construction.

Action:

- Limit the construction footprint to remain within the road reserve.

- Should remains and/or artefacts be discovered on the site during earthworks, all work will cease in the area affected and the Contractor will immediately inform the Construction Manager.
- Should any heritage resources be exposed during excavation or be found on site, a registered heritage specialist must be called to site for inspection.
- Should any heritage resources be exposed during excavation or be found on site, the Mpumalanga Heritage Authority must be informed thereof.
- Under no circumstances may any heritage material be destroyed or removed from site.
- Under no circumstances may any grave within the burial grounds be damaged, altered, exhumed or removed from its original position without a permit issued by the South African Heritage Resources Agency or the Mpumalanga heritage resources authority.
- All archaeological, paleontological and historical sites older than 60 years are protected in terms of the National Heritage Resources Act No 25 of 1999. In terms of this Act it is an offence to disturb any part of such site or material without a permit, should an archaeological or other such discovery be made during any excavations.
- All known and identified archaeological and historical sites should be left untouched. No stones or rocks may be removed from such sites. These rocks may not be painted, whitewashed or similarly treated. Existing sites must not be approached within 5 m of the site.
- The Contractor shall ensure that none of his employees gain access to any archaeological areas (whether fenced or unfenced) except when authorised to do so by the RE or relevant Archaeological authority.
- No construction activities take within 20 - 30m from any identified graves. In the event of exhumation and reburial the necessary procedures must be followed.

12.2.8 Aesthetics:

Management Objective:

To minimise adverse visual impacts associated with construction activities

Action:

- No painting or marking of natural features shall be allowed. Marking for surveying and other purposes shall only be with pegs and beacons.
- Trees and all woody shrubs should be protected from damage to provide a natural visual shield.
- All packed rock and exposed rock cuttings shall be treated in order to blend their colour with the colours of the natural weathered rocks of the adjacent environment. Excavated material of a different colour from local topsoil or surface rocks should either be back filled or removed from site and disposed of in another area. All excavated material should be flattened out (not compacted) or removed from site.
- No construction rubble, construction material, refuse, litter or any other material not found naturally in the surroundings should be allowed at any time to be lying around on the construction site.

- Particular aspects of concern to landowners and local residents should be addressed during construction.

12.2.9 Air Quality:

Management Objective:

To effectively manage construction activities that are likely to generated dust to ensure that minimal impact is caused to the surrounding environment.

Actions:

- Limit the construction footprint to remain within the road reserve and the bridge servitude.
- Washing of tyres and the undercarriage of all construction vehicles in designated areas must take place.
- Construction vehicles to adhere to the 40km/h speed limit to minimise dust.
- Dampening of stockpiled material and exposed soil surface as well as the access road to the borrow area.
- All material loads being transported must be suitably covered and secured during transportation.

12.2.10 Fire prevention:

Management Objective:

To control and assist with fire prevention as well as damage to the environment.

Actions:

- All necessary precautions to protect the surrounding area and material on site shall be taken.
- No open fires shall be permitted in areas unless specifically prepared and controlled for this purpose.
- The contractor shall have fire-fighting equipment available on all vehicles working on site
- At no time shall the contractor's workforce be allowed to collect firewood.
- Cigarette butts must be extinguished properly.
- Packaging and other waste material may not be burned on site under any circumstances

12.2.11 Fencing:

Management Objective:

To ensure and assist with controlled fencing in the working environment.

Actions:

- Fencing must be erected around sensitive or cultural elements to protect them from damage.
- Fencing shall be erected around areas of natural vegetation that are to be protected.
- No pedestrian or vehicular access shall be allowed to such fenced areas.
- Clearing for permanent fencing shall be limited to the removal of trees and shrubs within 1 m of the fence line.
- The construction camp and the working area shall be fenced.

12.2.12 Vegetation clearance:

Management Objective:

To control and limit the clearance of any vegetation on site.

Actions:

- All alien - invasive plants must be removed from the area surrounding the bridge before construction commences to inhibit further spread of these species in these areas as a result of the construction. During the construction phase, alien vegetation must be controlled within the site.

12.2.13 Protection of vegetation:

Management Objective:

To minimise adverse impacts on indigenous / protected vegetation.

Actions:

- Precautions should be taken on remaining natural vegetation on the proposed road and / bridge reserve to cause as little damage as possible during the construction phase.
- Any flora species of conservation importance that are found during the upgrade should be removed and placed in the nursery and should be utilised during rehabilitation.
- Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for rehabilitation and where possible, trees naturally growing on the site should be retained as part of the landscaping.
- Removal of vegetation during stripping and construction will be minimised to reduce the erosion potential. Topsoil will only be removed off areas proposed for the upgrade. All soils should be stored and managed correctly for rehabilitation.
- The removal of any plant material from site, including flowers or bulbs is strictly prohibited unless unavoidable and essential for the purposes of construction.
- No collection of firewood may be allowed.

- The contractor for vegetation clearing must have the knowledge to be able to identify different indigenous species, declared weeds and alien species.
- Indiscriminant destruction of wetlands and wetland vegetation will lead to impacts on the overall wetland-dependent biodiversity;
- Any impacted areas should be rehabilitated and, if necessary, revegetated with local floral species

12.2.14 Protection of fauna:

Management Objective:

To avoid damage to indigenous fauna.

Actions:

- Before construction starts, construction workers should be educated with regards to littering and poaching;
- No fishing is allowed.
- The Contractor and his/her employees shall not bring any domestic animals onto site.
- Animals residing within the designated area shall not be unnecessarily disturbed.
- Toolbox talks should be provided to employees regarding snakes. All snakes all reptiles on site must be removed by a qualified snake handler and all attempts should be made to ensure snakes and reptiles are not killed or collected.
- Nesting sites of birds should not be disturbed.
- Topsoil will only be removed from the proposed working area. All soils should be stored and managed correctly for rehabilitation to create natural habitats for animals; and
- Construction activities should be limited to daylight hours, in order to minimise impacts on nocturnal fauna.
- Trucks should travel at a minimum speed to avoid unnecessary killings of animals found on site.
- Construction areas must be fenced using palisades for the migration of small faunal species out of the construction zone. This excludes areas where animal activity could be hazardous and such areas should be appropriately blocked off.

12.2.15 Erosion prevention:

Management Objective:

Compliance with regulation and prevention of soil erosion is required.

Actions:

- Minimise erosion during or after the construction.
- Rehabilitate all areas disturbed during construction.

- The Contractor shall take measures to the approval of the Engineer to ensure that there is no undue stormwater damage and soil erosion resulting from the construction activities outside the construction camp and works areas.
- Should erosion occur due to negligence on the part of the Contractor to apply the above measures, the Contractor will be responsible for reinstatement of the eroded area to its former state at his own expense.
- Any surface water pollution occurring as a result of this negligence will be cleaned up by the Contractor or a nominated clean up organisation at the expenses of the Contractor.
- All embankments that are disturbed and destabilised (erosion and dongas) should be established with appropriate soil erosion and control procedures, during the rehabilitation process.
- During construction, water diversion soil berms should be constructed to divert surface and stormwater from traversing the disturbed areas.
- Cross and side stormwater drainage measures shall be constructed on access and haul roads to the site and roads within the site.
- The Contractor shall ensure that run off from access and haul roads, and that diverted into cross and side drains, does not cause erosion.
- At all stages of the contract, storm water control measures as specified by the Engineer shall be applied to keep soil on site by minimising:
  - erosion of temporary stockpiles of topsoil and permanent spoil dumps;
  - erosion from construction roads, excavations and other cleared areas;
  - silt-laden run off from all areas stripped of vegetation, including excavation surfaces and stockpiles of spoil and topsoil; and
  - contaminated run off from storage area, thereby preventing it from entering water courses.

12.2.16 Flow Regime of Watercourse

Management Objective:

Minimise impact of watercourse diversions and prevent obstruction of watercourse flow.

Actions:

- Prevent possible erosion caused by temporary instream diversion.
- Remove diversion following construction and reinstate and rehabilitate affected works area.
- Should a dry works area be required construction must take place outside the rainy season and in the shortest possible time period.
- Upon completion of the construction, the natural flow patterns of the stream must be restored.
- If sandbags are used to maintain a dry works area, the diversion sandbags must be correctly designed and packed sufficiently thick so as to minimise water flowing past the construction points where it could be contaminated and degrade water quality.

- All recommendations as indicated in the Wetland Impact Assessment report undertaken by Scientific Aquatic Services (February 2013) must be adhered to.

12.2.17 Prevent water quality deterioration

Management Objective:

Ensure that the Water Quality of the watercourse is not altered as a result of construction related activities.

Management Actions:

- No fuel storage or refuelling of vehicles or equipment will be allowed within 50m of the watercourse/ or within the regulated area, whichever is the greatest.
- Erosion of the river bed as well as the riverbank to be prevented.
- Downstream water quality to remain within acceptable ranges, as prescribed by Resource Water Quality Objectives, as far as practicable. Riparian habitat to be rehabilitated to pre-construction state.
- Ecological category not to be influenced by construction activities.
- Contaminated water may not be disposed of in the watercourse.
- The watercourse may not be used for the purposes of bathing, washing of clothing or vehicles.
- The Contractor shall not in any way modify nor damage the banks or bed of streams, rivers, wetlands, other open water bodies and drainage lines adjacent to or within the designated area, unless required as part of the construction project specification.
- Prohibit the increase of sediment load within the watercourse that may result from construction activities.
- Where necessary, install instream silt traps during construction within the watercourse channel and along the river bank. Instream silt traps are to be maintained and serviced on a regular basis. The style of silt trap will depend on materials used and the water movement patterns. If silt traps are not deemed feasible, other suitable measures need to be taken to limit the suspension of unnaturally high sediment volumes in the stream.
- Implement suitable stormwater measures during construction to manage ingress of runoff into watercourses.
- Ensure proper storage of material (including fuel) that could cause water pollution. Ensure proper storage and careful handling of hazardous substances with spill prevention materials at hand.
- Ensure proper waste management and housekeeping.
- River diversions must be maintained and constructed in such a way that no water will flow through the dry works area.
- All berms or coffer dams should be constructed of non-erodable material such as sand bags.
- Haybales packed in rows across diversions during construction can be used to control sediment inputs.

- Where plastering and/or concrete packing under a bridge takes place sheeting shall be in place to ensure that excess concrete does not end up in a watercourse.

12.2.18 Prevent disturbance to aquatic biota

Management Objective:

Aquatic biota to be impacted on as little as possible over the short and long term.

Actions:

- Temporary diversion to allow for movement of aquatic fauna, as far as possible.
- Rehabilitation of affected areas to allow for re-creation of micro-habitat.
- Prevent water quality impacts.
- Ensure proper site reinstatement.
- Avoid establishment of migratory barriers.
- Prevent siltation of the habitat emanating from soil erosion. Soil erosion must be controlled.
- Vehicles to be in good working order to avoid fluid leaks.
- Provision of adequate on-site sewerage management.

12.2.19 Protect and stabilise river structure

Management Objective:

River bed and banks not to be altered or damaged as part of construction process, except where authorised.

Management Actions:

- Limit construction footprint within regulated area.
- Manage access and plant movement within watercourse.
- On completion of the project, the river bed must be re-contoured to its original state and left in a condition that prevents scouring of the bed, erosion and/or siltation of the watercourse.
- Minimal vegetation clearance.
- No construction vehicles will be permitted on the river bank.
- Exotic vegetation should be managed as this aggravates soil erosion and displaces indigenous biodiversity.
- The removal of any aquatic vegetation, will not be permitted unless unavoidable and essential for the purposes of construction.

12.2.20 *Hazardous Substances*

Management Objective:

- The effective and safe management and handling of hazardous materials on site.
- The prevention of any hazardous substance entering the watercourse.

Actions:

- All potentially hazardous waste generated at the site shall be removed and disposed of by an approved permitted contractor. Hazardous waste materials will be disposed of at a hazardous disposal facility.
- All the hazardous substances on site shall be handled/ utilised by the competent employees/ personnel.
- Potentially hazardous raw and waste materials shall be handled and stored on-site in accordance with the manufacturer's specification and relevant legal requirements.
- A register of all hazardous waste must be kept by the contractor and form part of project documents.
- Cement mixing will occur in a designated area on an impervious layer, bunded area. The runoff water will be contained for re-use in cement mixing or disposed of to the waste water system. Contaminated water must not be dispersed to the environment.
- Unused cement bags will be stored in an area not exposed to the weather and packed neatly to prevent hardening or leakage.
- Material Safety Data Sheets (MSDSs) must always accompany be readily available on site for all chemicals and hazardous substances to be used on site.
- Storage areas containing hazardous substances / materials must be clearly indicated.
- Any storage tanks containing hazardous materials must be placed in a ventilated bundwall area. The bund walls must be high enough to contain 110% of the total volume of the stored hazardous material.
- Hazardous substances must be stored and handled in accordance with the appropriate legislation and standards, which may include the Hazardous Substances Act, the Occupational Health and Safety Act, relevant associated Regulations, and applicable SABS and international standards.
- The Contractor will notify the site engineer and the ECO immediately of any pollution incidents.
- Where vehicles/machinery are leaking oil/fuel drip trays must be used to contain the spill. All vehicles and machinery must be repaired as soon as possible.
- The Contractor to have an emergency spill kit available on site should there be a spillage of a hazardous substance.
- In the event of a hydrocarbon spill, the source of the spillage shall be isolated and the spillage contained.
- The area shall be cordoned off and secured. The Contractor shall ensure that there is always a supply of absorbent material readily available to absorb/breakdown the hydrocarbon spillage.
- Hydrocarbon contaminated material/soil shall be collected and disposed of at a registered hazardous disposal facility.

12.2.21 Management of waste

Management Objective:

Ensure that all wastes arising from construction activities are handled, transported and disposed of in a suitable manner, in accordance with the relevant regulations.

Actions:

Wastewater

- Wastewater may not be disposed of directly into drainage lines, streams or rivers. The Contractor shall provide suitable retention and filtration structures (which shall be properly maintained) for the collection of any wastewater.
- Ablution facilities shall be regularly emptied by a reputable service provider.

Solid waste

- Refuse (i.e. all construction waste such as rubble, cement bags, waste cement, timber, can, other containers, wire and nails) shall be collected and stored in demarcated, fenced areas in skips and/or bins that are weather and vermin proof.
- Wherever possible waste that is recyclable is to be recycled.
- Refuse which cannot be recycled shall be disposed of at an approved landfill site and safe disposal slips must be obtained and kept on site at all times.
- The Contractor shall ensure that the site is cleaned up daily.
- Refuse may not be burned nor buried on site.
- No dumping of any excess building material or other wastes or litter should be allowed within any wetland areas or within the buffer zones. Excess building material or topsoil should be stored outside of the 100 m buffer zones.

Hydrocarbon and Hazardous waste

- All potential hazardous wastes (i.e. waste proven to be toxic, corrosive, explosive, flammable, carcinogenic, radioactive, poisonous or classified as such in legal terms) generated at the site shall be removed and disposed by an approved contractor.
- Potentially hazardous raw and waste materials shall be handled and stored on-site in accordance with the manufacturer's specification and relevant legal requirements.
- All hydrocarbons (e.g. fuel, oils and contaminated soil/materials) and other hazardous waste resulting from spills, refuelling and maintenance activities shall be disposed of in a formally licensed hazardous waste site or, where possible, be removed and disposed by an approved contractor. The Contractor shall provide Safe disposal certificates issued by the hazardous waste disposal facility to the RE and ECO. The Safe Disposal Slips shall be kept on site at all time.

- Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery may be collected in holding tanks prior to disposal.
- No hydrocarbon and hazardous waste shall be burnt or buried on site.
- The spoiling or burial of tar or bituminous products will not be allowed on site.
- Unused or rejected tar or bituminous products shall be returned to the supplier's production plant.

12.2.22 Surface Water and Erosion Control

Management Objective:

Reducing the probability of adverse impacts, with regards to potential erosion, that may result from the proposed works.

Actions:

- At all stages of the contract, storm water control measures as specified by the Engineer shall be applied by minimising:
  - erosion of temporary stockpiles of topsoil and permanent spoil dumps;
  - erosion from construction roads and excavations;
  - silt-laden run off from all areas stripped of vegetation, including excavation stockpiles; construction camp, contaminated run off from storage areas; there by preventing it from entering water courses.
- At all stages of the contract, erosion of bare soil, other excavation surfaces and stockpiles of topsoil and spoil shall be prevented by the application of erosion control measures as specified by the Engineer.
- Should erosion occur due to negligence on the part of the Contractor to apply the above measures, the Contractor will be responsible for reinstatement of the area to its former state at his own expense. Any surface water pollution occurring as a result of this negligence will be cleaned up by the Contractor or a nominated clean up organisation at the expenses of the Contractor.
- Erosion control measures must be implemented to avoid erosion in areas that are prone to erosion, such as the steep slopes and drainage lines, including the riverbank.
- Any increase on stormwater run-off, into the watercourse as result of the construction activities must be avoided.
- All erosion control mechanisms need to be regularly inspected and maintained.
- No impediments to the natural surface flow other than approved erosion control works must occur.
- The surface of the work area must be re-profiled so that the pre-excavation drainage patterns and hydrology are restored. Particular attention should be paid to this aspect with respect to the banks of the river.
- Ensure backfill is well compacted along the stream bank;
- Sediment laden runoff must be diverted from sensitive fish habitat.
- Any spawning beds should be covered with a geotextile layer, until construction is complete.

- Provision must be made to maintain the natural flow of any drainage line affected by construction.

12.3 Operation Phase

Where relevant, all management actions to be carried forward from the construction phase to the operation phase. Specific management measures for the operation phase follow.

12.3.1 Management of access, routine maintenance and maintenance works

Management Objective:

- Ensure suitable management of environment during operation and maintenance activities.

Target:

1. No unacceptable environmental impacts.
2. Safeguarding of sensitive environmental features.
3. No complaints from landowners.

Management Actions:

- Maintenance activities to be undertaken without causing any damage to access gates, access roads, fencing, any private property, reticulation or animals.
- Should maintenance or repair work be required on site, the adjacent landowner should be notified well in advanced. Maintenance work should be undertaken as per the conditions as stipulated under the Pre-Construction and Construction Phase above.
- All roads used for maintenance inspections and maintenance works should be maintained and repaired where necessary.
- Suitable stormwater measures to be implemented.

12.3.2 Management of Wetlands

Management Objective:

- Ensure that the watercourses and associated wetlands are protected and incur minimal negative impact to resource quality (i.e. flow, water quality, habitat and aquatic biota).

Target:

1. Unaltered downstream flow regime.
2. Downstream water quality to remain within acceptable ranges, as prescribed by Resource Water Quality Objectives, as far as practicable.
3. No damage to Riparian habitat during operation and maintenance.
4. Ecological category not to be influenced by operation.
5. No decrease in water quality through poor stormwater and irrigation water practices.
6. Protected natural area (southern wetland) to be maintained at rehabilitated state.

Management Actions:

- **Flow** -
  - Prevent possible erosion and siltation.

- **River morphology** -
  - No damage to wetland and riparian habitat during operation and maintenance.
- **Water quality** -
  - Maintain suitable stormwater measures during operation to manage ingress of runoff into watercourses.

- **Pans and wetlands -**
  - No dumping of any materials or storage of any equipment should be allowed within the wetland zones.
  - Protected natural area (southern wetland) to be maintained at rehabilitated state.

12.3.3 Management of flora

Management Objective:

- Preserve protected flora species within nature area.
- Control alien plants and noxious weeds.

Target:

1. On-going eradication of alien plants and noxious weeds.
2. No disturbance to protected flora species outside of built area.

Management Actions:

- No collection of firewood may be allowed or medicinal plants.

- Remove alien plants and noxious weeds on site. Eradication method to be approved by specialist and the applicant.
- Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.
- Control of alien invasive species and noxious weeds in line with the requirements of the Conservation of Agricultural Resources Act will be undertaken.
- Only indigenous vegetation is to be used for rehabilitation.
- Implement a monitoring programme for eradication of alien invasive plants and noxious weeds.

12.3.4 Management of fauna

Management Objective:

- Ensure the protection of any animals.

Target:

1. No direct harm to animals from construction activities.

Management Actions:

- Make allowance for migration of animals to watering points.
- Proper access control to be maintained.
- Stringent and dedicated control of poaching.
- Workers should be educated with regards to littering and poaching.
- Nesting sites of birds should not be disturbed.
- Trucks should travel at a minimum speed to avoid unnecessary killings of animals found on site.

13. SITE DECOMMISSIONING AND REHABILITATION

Management Objective:

Following the completion of the construction phase the site must be rehabilitated and restored to a condition equivalent to or better than the conditions prior to the commencement of construction activities.

Actions:

13.1.1 Removal of Structures

- The Contractor shall take all reasonable measures to minimise disturbance to the natural environment at the site thereby reducing the degree of rehabilitation required.
- Upon completion of all construction activities, all structures, equipment, materials, waste, rubble, notice boards along the entire length of the road must be removed from site.
- The decommissioning of the site camp must be done in such a manner to cause the least environmental impact.
- All waste generated by the decommissioning of structures must be disposed of at an appropriate waste disposal site.
- In the event of any hydrocarbon spills found in the site camp, the contaminated soil must be removed, placed in a sealed container and disposed of a registered hazardous landfill site.
- All temporary diversion structures will be removed from the watercourses, immediately after the completion of construction activities in the riparian area.
- All rehabilitation and reinstatement efforts shall be implemented immediately after completion of construction activities. .
- Re-vegetation shall take place at the start of the rainy season to maximise water availability and minimise the need for watering.
- All topsoil including mulched vegetation material removed during vegetation clearing, but excluding invasive species), removed and stockpiled must be spread evenly all scared areas.

14. PENALTIES AND CORRECTIVE MEASURES

The applicant will impose penalties upon the contractor if found not compliant to the relevant requirements set out in all environmental authorisations that had been issued. Penalties will be issued per non-compliance as and when deemed appropriate by the applicant.

The Contractor is deemed not to have complied with the EMPr if:

- There is evidence of violation of the provisions made in this document;
- Non – compliance with any condition in the EA, WUL, EMPr and any other permit or license relevant to this project;
- Construction activities take place outside the defined development footprint;
- Environmental damage due to negligence on the part of the contractor;
- The Contractor fails to comply with corrective or other instructions issued by the RE and ECO within a specified time period; and/or
- The Contractor fails to respond adequately to complaints from the public.

15. REFERENCES

DEAT (2004) Environmental Management Plans. Integrated Environmental Management, Information Series 12, Department of Environmental Affairs and Tourism (DEAT), Pretoria.

Lochner, P. 2005. Guideline for Environmental Management Plans. CSIR Report No ENV-S-C 2005-053H. Republic of South Africa, Provincial Government of the Western Cape, Department of Environmental Affairs & Development Planning, Cape Town.