

REPORT

Environmental Management Programme for the Upgrades and Associated Link Road Infrastructure to the R102 in the eThekweni Metropolitan Municipality

EMPr

Client: KwaZulu-Natal Department of Transport

Reference: MD1717

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Appendix A: Details of EAP

Appendix B: Wetland & Riparian Rehabilitation Plan

Appendix C: Stormwater Management Plan

Appendix D: Spill Contingency Plan

Acronyms

BA	Basic Assessment
CA	Competent Authority
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EDTEA	Department of Economic Development, Tourism and Environmental Affairs
EMPr	Environmental Management Programme
ERP	Emergency Response Plan
GN R	Government Notice Regulation
I&APs	Interested and Affected Parties
IAP	Invasive Alien Plant
IEM	Integrated Environmental Management
KZN DoT	Kwa-Zulu Natal Department of Transport
LUSM	Land Use and Soil Management
MSDS	Material Safety Data Sheet
NCR	Non-Conformance Report
NEMA	National Environmental Management Act (Act No. 107 of 1998) (as amended)
NEM:AQA	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEM:ICMA	National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008)
NEM:PAA	National Environmental Management: Protected Areas Act (Act No. 57 of 2003)
NEM:WA	National Environmental Management: Waste Act (Act No. 36 of 1998) (as amended)
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
NWA	National Water Act (Act No. 36 of 1998)
OHSA	Occupational Health and Safety Act (Act No. 85 of 1993)
PES	Present Ecological State
PM	Project Manager
PPE	Personal Protective Equipment
QMS	Quality Management System
RoW	Right of Way
SDC	Safe Disposal Certificate
SEF	Site Environmental File
SEMA	Suite of Environmental Management Acts
SHE Officer	Safety, Health and Environmental Officer
WUL(A)	Water Use Licence (Application)

Glossary

Accident	A road vehicle accident.
Building and Demolition Waste	Building and demolition waste means waste, excluding hazardous waste, produced during the construction, alteration, repair or demolition of any structure, and includes rubble, earth, rock and wood displaced during that construction, alteration, repair or demolition.
Contractor	Companies appointed on behalf of the Developer to undertake activities, as well as their sub-contractors and suppliers.
Construction Project Management Team	The team consists of a Project Manager as well as a Safety, Health and Environmental officer.
Degradation	The lowering of the quality of the environment through human activities e.g. river degradation, soil degradation.
Domestic Waste	Domestic waste means waste, excluding hazardous waste, that emanates from premises that are used wholly or mainly for residential, educational, health care, sport or recreation purposes.
Emergency	An undesired event that results in a significant environmental impact and requires the notification of the relevant statutory body such as a local or provincial authority.
Environment	In terms of the National Environmental Management Act (NEMA) (Act No 107 of 1998)(as amended), “Environment” means the surroundings within which humans exist and that are made up of: <ul style="list-style-type: none"> (i) the land, water and atmosphere of the earth; (ii) micro-organisms, plants and animal life; (iii) any part or combination of (i) of (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and wellbeing.
Environmental Control Officer	An individual nominated through the Developer to be present on-site to act on behalf of the Developer in matters concerning the implementation and day to day monitoring of the EMPr and conditions stipulated by the authorities.
Environmental Impact	A change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation’s activities, products or services.
Environmental Management Programme	A detailed plan of action prepared to ensure that recommendations for enhancing or ensuring positive environmental impacts and limiting or preventing negative environmental impacts are implemented during the life-cycle of the project.

General Waste	General waste means waste that does not pose an immediate hazard or threat to health or to the environment, and includes - <ul style="list-style-type: none"> (i) domestic waste; (ii) building and demolition waste; (iii) business waste; and (iv) inert waste.
General Waste Landfill Site	A waste disposal site that is designed, managed and permitted to allow for the disposal of general waste.
Hazardous Waste Landfill Site	A waste disposal site that is designed, managed and permitted to allow for the disposal of hazardous waste.
Impact	A description of the potential effect or consequence of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space.
Incident	An undesired event which may result in a significant environmental impact but can be managed through internal response.
Mitigation	Measures designed to avoid, reduce or remedy adverse impacts.
Principal Agent	The principal agent is appointed by the Developer to oversee the overall project management and the management of the professional project team.
Recovery	The controlled extraction of a material or the retrieval of energy from waste to produce a product.
Re-Use	To utilise articles from the waste stream again for a similar or a different purpose without changing the form of properties of the articles.
Recycle	A process where waste is reclaimed for further use, this involves the separation of waste from a waste stream for further use and the processing of that separated material as a product or raw material.
Safety, Health And Environmental Officer	The SHE officer is a Contractor representative, responsible for the safety, health and environmental aspects on the construction-site. The SHE officer will be responsible for the day-to-day monitoring of the EMPr and Health and Safety Plan.
Waste	Waste means any substance, whether or not that substance can be reduced, re-used, recycled and recovered - <ul style="list-style-type: none"> (i) that is surplus, unwanted, rejected, discarded, abandoned or disposed of; (ii) which the generator has no further use of for the purposes of production; (iii) that must be treated or disposed of; or (iv) that is identified as a waste by the Minister by notice in the Gazette, and includes waste generated by the mining, medical or other sector, but— <ul style="list-style-type: none"> o a by-product is not considered waste; and o any portion of waste, once re-used, recycled and recovered, ceases to be waste.

Waste Disposal Facility	Waste disposal facility means any site or premise used for the accumulation of waste with the purpose of disposing of that waste at that site or on that premises.
Workforce	The entire project team including people employed by the Principal Agent or the Contractor, persons involved in activities related to the project, or person present at or visiting the construction area, including permanent contactors and casual labour.

1 INTRODUCTION

1.1 Project Background

The KwaZulu-Natal Department of Transport (KZN DoT) has appointed Royal HaskoningDHV to conduct the Basic Assessment (BA) study and Water Use Licence Application (WULA) for the proposed R102 Upgrades Project.

Due to increasing traffic volumes along the R102 as a result of increased urbanisation, an improvement to transport infrastructure is required. As the R102 is an existing road serving the communities along its route and it could possibly serve as an alternative route to the N2 Highway to the King Shaka International Airport, the proposed upgrade of the R102 is an extremely important project in terms of overall transport planning in the City.

Royal HaskoningDHV, together with Naidu Consulting, have been appointed by the KZN DoT to construct a partial interchange and upgrade the R102 as illustrated in **Figure 1-1**. A Basic Assessment (BA) study was previously conducted for the proposed R102 and partial interchange. The length of road upgrade presented in this BA was approximately 20 km. The route assessed started at the existing R102 from the Duffs Road Interchange to Verulam near the entrance to the King Shaka International Airport. The upgrade proposed comprised of the widening of the existing route to a dual carriageway (i.e. two lanes in both directions divided by a centre median which would comprise either a barrier or island).

An Environmental Authorisation (EA) was obtained (Reference number: DM/0133/08), for this work and a portion of the road was constructed, however, since then, three additional components were proposed which did not form part of the previous assessment:

- The P79 Grade separation (indicated as 'A' in **Figure 1-2**) is a new bridge and linkage at the Mount Edgecombe partial interchange which will provide a link from the future south bound carriageway of the R102 from Verulam, over the M41, en route to Mount Edgecombe and Durban;
- The M41 Northbound off-ramp (indicated as 'B' in **Figure 1-2**); and
- SASA pedestrian bridge (indicated as 'C' in **Figure 1-3**) is a new pedestrian bridge traversing the R102 which will allow for the safe movement of pedestrians across the upgrade R102.

The P79 Grade separation ('A') and SASA pedestrian bridge ('C') components are the subject of this Basic Assessment (BA) study. However the SASA pedestrian bridge does not trigger any listed activities in Government Notice Regulation (GNR.) No. 983 to 985. Therefore the P79 Grade separation is the primary development activity in this BA study. It should also be noted that the M41 Northbound off-ramp ('B') is no longer proposed and has thus been excluded from the BA study and this Environmental Management Programme (EMPr).

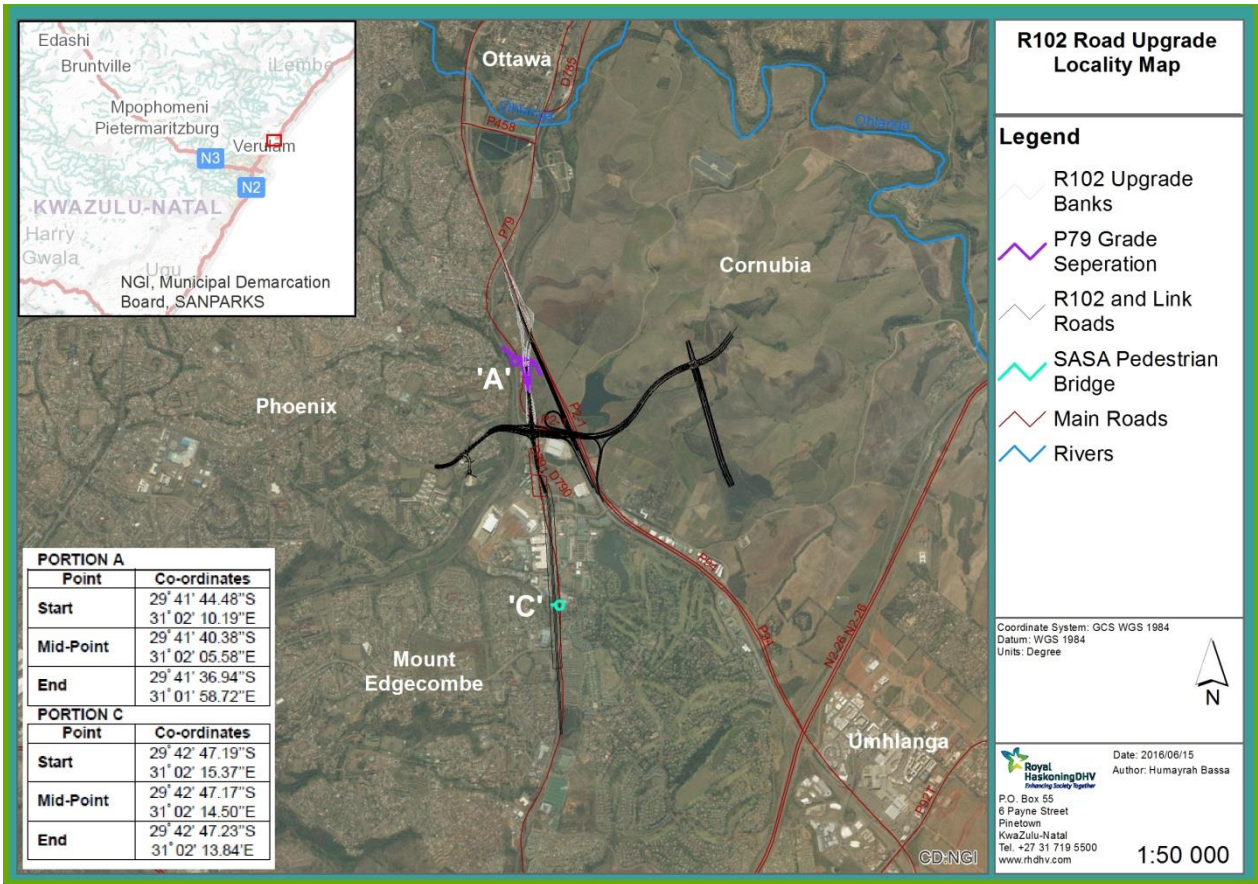


Figure 1-1: Locality map



Figure 1-2: Additional components

1.2 Purpose of the Environmental Management Programme

In terms of The Constitution of the Republic of South Africa (1996), everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for benefit of present and future generations, through reasonable legislation and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development (Section 24). The needs of the environment as well as affected parties should thus be integrated into overall project management.

The Constitution is underpinned by the suite of Specific Environmental Management Acts (SEMA) – including the;

- National Environmental Management Act (Act No. 107 of 1998, NEMA),
- National Environmental Management Waste Act (Act No. 59 of 2008, NEM:WA),
- National Environmental Management Air Quality Act (Act No. 39 of 2004, NEM:AQA),
- National Environmental Management Biodiversity Act (Act No. 10 of 2004, NEM:BA),
- National Environmental Management Integrated Coastal Management Act (Act No. 24 of 2008, NEM:ICMA),
- National Environmental Management Protected Area Act (Act No. 57 of 2003, NEM:PAA),

as well as the National Water Act (Act No. 36 of 1998, NWA) – which combined serve to control all relevant facets of the environment so as to ensure that Section 24 of the Constitution is ensured.

The EMPr is developed in terms of the SEMA and ensures that construction activities meet the requirements of existing environmental legislation and good environmental practice in terms of local and international standards and guidelines. This is achieved by identifying those construction activities for the proposed development that may have a negative impact on the environment; outlining the mitigation measures that will need to be taken and the steps necessary for their implementation and describing the reporting system to be undertaken during construction.

It is noted that protection of the environment is enshrined in the Duty of Care requirement (**Section 28**) of the National Environmental Management Act (Act No. 107 of 1998) (as amended), which thus means that it is the duty of all land-owners and users to ensure that the activities they carry out on a site do not cause detriment to the environmental facets thereof. The EMPr thus functions as a programme which can be monitored and audited that will allow the Developer the ability to ensure that all that operate on the site do so in an environmentally safe manner. It is also structured in such a way that the conditions may be linked to a standard construction contract. It is essential that the EMPr requirements be carefully studied, understood, implemented, and adhered to at all time. Each action within the EMPr is supported by the priority of when the specific action will need to be implemented.

Core to the purpose of the EMPr is to implement the ‘mitigation hierarchy’¹, which is illustrated in **Figure 1-3** below:

¹ Department of Environmental Affairs, 2013. *Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector.* Pretoria.

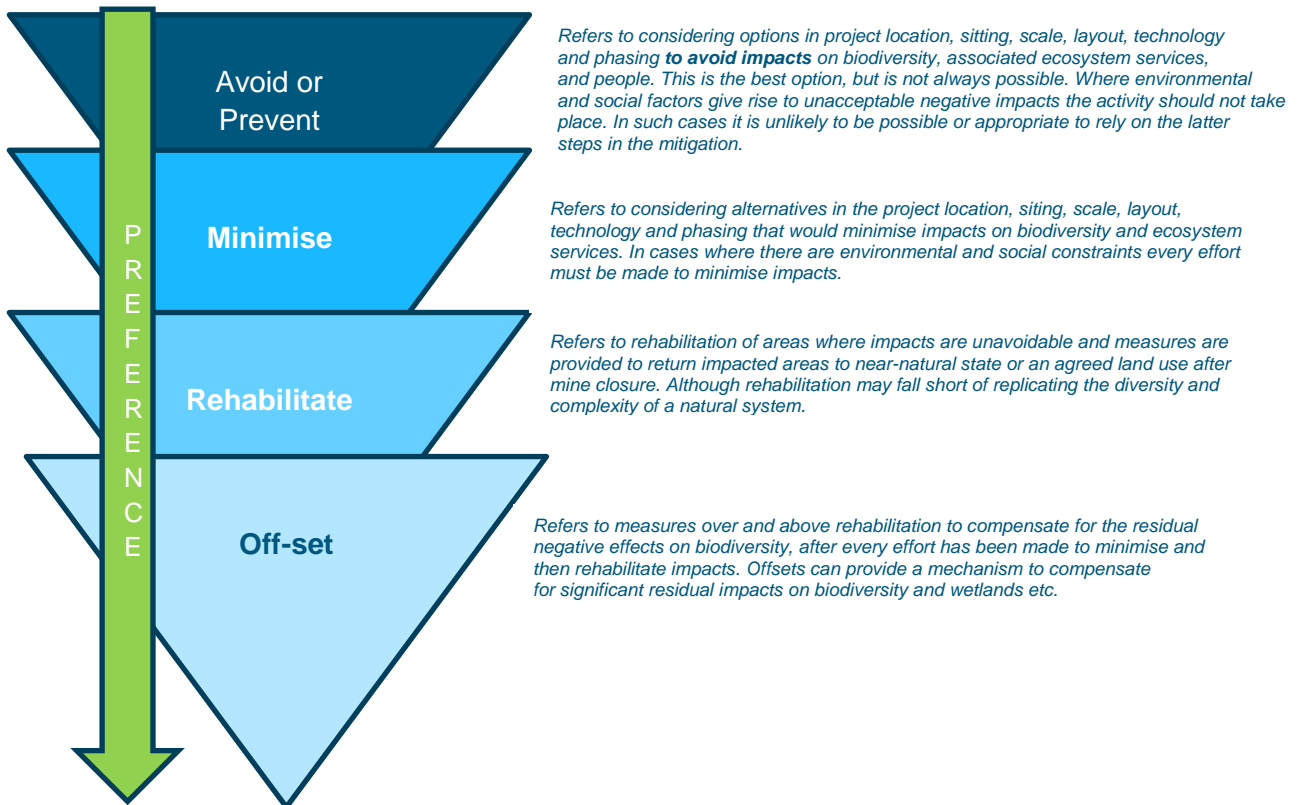


Figure 1-3: Mitigation hierarchy

1.3 Objectives of the EMPr

The EMPr has the following objectives:

- To ensure compliance with regulatory authority stipulations and guidelines; which may be local, provincial, national, and / or, international.
- To outline functions and responsibilities of responsible persons.
- To state standards and guidelines, which are required to be achieved / complied with in terms of environmental legislation.
- To outline mitigation measures and environmental specifications which are required to be implemented for all phases of the project in order to minimise the extent of environmental impacts, and to manage environmental impacts associated with the proposed project.
- To identify measures that could optimise beneficial impacts.
- To prevent long-term or permanent environmental degradation.
- To establish a method of monitoring and auditing environmental management practices during all phases of development.
- Detail specific actions deemed necessary to assist in mitigating the environmental impact of the project.
- Ensure that the safety recommendations are complied with.
- Propose mechanisms for monitoring compliance with the EMPr and reporting thereon.

- Specify time periods within which the measures contemplated in the draft EMPr must be implemented, where appropriate.
- To provide an environmental awareness plan.
- Provide rational and practical environmental conditions / requirements to:
 - Minimise disturbance of the natural environment;
 - Ensure water resource protection;
 - Prevent or minimise all forms of pollution;
 - Protect indigenous flora and fauna;
 - Prevent soil and sand erosion and facilitate the re-vegetation of affected areas;
 - Maintenance of newly re-vegetated areas;
 - Restrict noise disturbance;
 - Ensure compliance with all applicable laws, regulations, standards and guidelines for the protection of the environment;
 - Adopt the best practical means available to prevent or minimise adverse environmental impacts;
 - Develop waste management practices based on prevention, minimisation, recycling, treatment or disposal of waste; and
 - Train the Developer, their employees and contractors (including all sub-contractors) with regard to their environmental obligations.

The EMPr is essentially, a written programme of how the environment is to be managed in practical and achievable terms.

An independent Environmental Control Officer (ECO) should be appointed by the Developer (KZN DoT), to ensure compliance with the EMPr.

1.4 Scope of the Environmental Management Programme

In accordance with the requirements of the National Environmental Management Act (Act No. 107 of 1998, NEMA), this EMPr is to be implemented by the Developer as well as any employee, contractor, agent, or sub-contractor appointed to act on behalf of the Developer in the execution of the project, in order to ensure environmental compliance on site.

The specifications outlined in this EMPr are thus applicable to all activities undertaken by the Developer as well as their appointed contractors and all persons involved in the execution of the works, including sub-contractors, the workforce, suppliers, and volunteers, for the duration of construction, operation and future maintenance.

Included within the EMPr is guidance for on-going training with respect to the implementation of the conditions included therein, including induction by all new people coming onto site to carry out work, and 'top-up' activities such as regular 'toolbox talks' on specific key issues.

An Environmental Code of Conduct has also been developed that provides a simplified set of rules that must be adhered to by all persons involved with the project at all times. This is to be displayed at strategic points to ensure constant environmental awareness.

The effectiveness of the EMPr is limited by the level of adherence to the conditions set forth in the EMPr by the Developer, the Contractor and Sub-contractors. It is further assumed that compliance with the EMPr will be monitored and audited as set out in this EMPr and contractual clauses.

1.5 Structure of the EMPr

The EMPr provides proposed mitigation and management measures for the following phases of the project (Table 1-1).

Table 1-1: Different phases of the project life-cycle

Phase	Description
Pre-Construction	This section will provide guidelines on pre-construction activities including site establishment and clearance; environmental induction and training and awareness; site access and health and safety.
Construction	This section will provide guidelines on construction methods and considerations.
Post-Construction	This section of the EMPr provides management principles for the rehabilitation, maintenance and operational phases of the P79 Grade Separation Bridge and Linkage. This will include best practice, procedures and responsibilities as required for various associated activities.

1.6 The EMPr as a “Live” Document

The approach adopted for this EMPr is derived from the Deming Cycle (**Figure 1-4**), a cycle of continuous improvement that entails the reiterative actions of plan, do, check, act, and critically to then return to the planning phase.

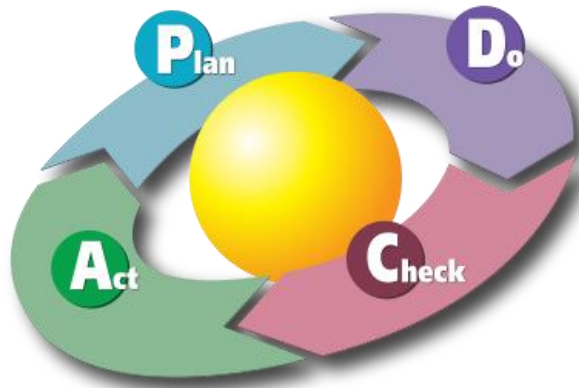


Figure 1-4: Deming Cycle of continuous improvement

1.6.1 Plan

Project-specific planning for the proposed project involves consideration of the legal triggers, the specifics of the proposed development, and the nature of the receiving environment. This provides a starting point for targeted environmental management objectives.

Environmental performance indicators are then determined with measurable targets prescribed to monitor the environmental performance of the project. Achieving the targets depends on compliance with this EMPr and the legislative requirements that underpin it.

1.6.2 Do

Throughout the development's life-span, the Developer will be required to develop and maintain a Quality Management System (QMS) – designed to ensure that best management practices are implemented in day-to-day management.

Such a QMS must at least include the following information:

- Location and extent of associated infrastructure;
- Associated activities, such as the transportation of people and equipment;
- Resources and experience required (staffing);
- Materials and equipment to be used;
- Management actions;
- Human resources used;
- Construction-monitoring activities;
- Emergency / disaster incident and reaction procedures; and
- Rehabilitation procedures for the impacted environment.

These topics will be cross-linked into the contracts related to the development of the project.

1.6.3 Check

A system of assessing monitoring results has been developed to check the environmental management performance. Continuous assessment facilitates proactive management of the environmental issues. Mitigation measures can then be successfully implemented on an on-going basis to keep environmental indicators within their target thresholds. Moreover, the assessment system also enables the assessment of the efficacy of the EMPr. Regular auditing of environmental performance is prescribed to prove and preserve accountability.


1.6.4 Act

The assessments and monitoring of the results and findings of the regular audits must be documented within a reporting system. Precautionary mitigation measures and corrective actions will be prescribed and instructions will be given in order to implement these in the field. The findings of monitoring and auditing programmes can also be used to update the EMPr. Although the EMPr is a project-specific document, it is dynamic and must be updated regularly to address the changing circumstances of the scheme.

1.7 Details of the Developer

The Developer is the KZN DoT and the details of the responsible person are listed below.

Table 1-2: Details of the developer

Applicant	KwaZulu-Natal Department of Transport	
Representative	Ms Khumbu Sibiya	
Physical Address	172 Burger Street, Pietermaritzburg, 3200	
Postal Address	Private Bag X9043, Pietermaritzburg, 3200	
Telephone	033 355 0594	

Applicant	KwaZulu-Natal Department of Transport	
Facsimile	033 345 7537	
E-mail	Khumbu.Sibiya@kzntransport.gov.za	

1.8 Details of the Environmental Assessment Practitioner

Royal HaskoningDHV have been appointed by the Developer as the Independent Environmental Assessment Practitioner (EAP) to prepare the EMPr. The team responsible for the preparation of the EMPr has been identified below:

Table 1-3: Details of the environmental team

CONSULTANT	ROYAL HASKONINGDHV	ROYAL HASKONINGDHV
Contact Persons	Humayrah Bassa (EAP)	Prashika Reddy
Postal Address	PO Box 1243, Umhlanga, 4320	PO Box 25302, Monument Park, 0105
Telephone	087 350 6760	012 367 5973
E-mail	humayrah.bassa@rhdhv.com	prashika.reddy@rhdhv.com
Qualification	MSc Environmental Science	BSc (Hons) Geography
Expertise	Humayrah Bassa is an Associate with 5 years' experience in various facets of environmental management. These include conducting environmental impact assessments and the public participation process (PPP); compiling environmental impact reports; developing environmental management programmes; compiling water use licence applications; conducting environmental control officer duties; and conducting legal compliance audits. She is a Professional Natural Scientist (400032/15) with the South African Council for Natural Scientific Professions.	Prashika Reddy is a Principal Associate at Royal HaskoningDHV with extensive experience in various environmental fields including: EIAs, EMPRs, PPP and environmental monitoring and audits. She is/has been part of numerous multi-faceted large-scale projects, including the establishment of linear developments (roads and power lines), industrial plants, electricity generation plants, mixed-use developments and mining projects. She is a Professional Natural Scientist (400133/10) with the South African Council for Natural Scientific Professions.

Detailed CVs of the EAP and Royal HaskoningDHV's Environmental Management & Planning Knowledge Group's profile is included as **Appendix A**.

2 SITE DESCRIPTION

2.1 Site Description and Ownership

2.1.1 Property Descriptions

The proposed activity is situated on the following properties **Table 2-1**.

Table 2-1: Property Name and Ownership

Property Description	Ownership
Portion A: P79 Grade Separation	
Erf 6 Mount Edgecombe 127	National Government
Ptn 4 of Erf 27 Cornubia 217	eThekwini Municipality
Rem of Erf 851 Mount Edgecombe 127	Mount Edgecombe Park Properties
Erf 851 Mount Edgecombe 127	Mount Edgecombe Park Properties
Ptn 1 of Erf 851 Mount Edgecombe 127	Mount Edgecombe Park Properties
Rem of Ptn 13 of the Farm Lot 19 No 1555	Transnet
Ptn 39 of the Farm Lot 19 No 1555	National Government
Erf 434 Grove End	eThekwini Municipality
Portion C: SASA Pedestrian Bridge	
Erf 18 Mount Edgecombe 127	National Government

2.1.2 Land Use Zoning

The land use within the region is dominated by urban / industrial areas and sugarcane cultivation.

Land use along the R102 from the P79 Grade Separation Bridge to SASA Pedestrian Bridge comprises a mixture of high density residential, commercial, light industrial and agricultural use.

2.1.3 Route Coordinates

Table 2-2: Co-ordinates of the Preferred Alignment

	Start	Mid-Point	End
Portion A	29° 41' 44.48"S 31° 02' 10.19"E	29° 41' 40.38"S 31° 02' 05.58"E	29° 41' 36.94"S 31° 01' 58.72"E
Portion C	29° 42' 47.19"S 31° 02' 15.37"E	29° 42' 47.17"S 31° 02' 14.50"E	29° 42' 47.23"S 31° 02' 13.84"E

2.2 Project Description

The existing Main Road 2 section 1 (Main Road 2/1) is a single carriageway arterial road which commences at the Duffs Road Interchange at Main Road 25 (P93), viz. KwaMashu Highway, and ends at the Umdloti River Bridge in Verulam. The proposal by the KZN DoT is to upgrade Main Road 2/1 by constructing a new partial directional interchange bypassing the existing Mount Edgecombe Interchange together with a link road to Main Road 79. This interchange will provide continuity and free-flow on Main Road 2/1 and forms part of the overall upgrading of the R102 corridor to the King Shaka International Airport.

The P79 Grade Separation is a new bridge required to form part of the proposed Mount Edgecombe partial interchange, which will provide a link from the future southbound carriageway of the R102 from Verulam, over the M41, en route to Mount Edgecombe and Durban. This grade separation is located at km 0,800 on the southbound off-ramp of the partial interchange. The underpass will form part of the Main Road 79 link to Main Road 2/1.

It is proposed that this section of Main Road 2/1 be classified as a Class U2 Major Arterial. The route will be designed accordingly for a design speed of 80 km/h. In order to remain within the minimum and maximum grade requirements a considerable volume of earthworks will be required.

The partial interchange off-ramp will have two lanes exiting the M41 and the onramp will be a single lane (refer to **Figure 2-1**).

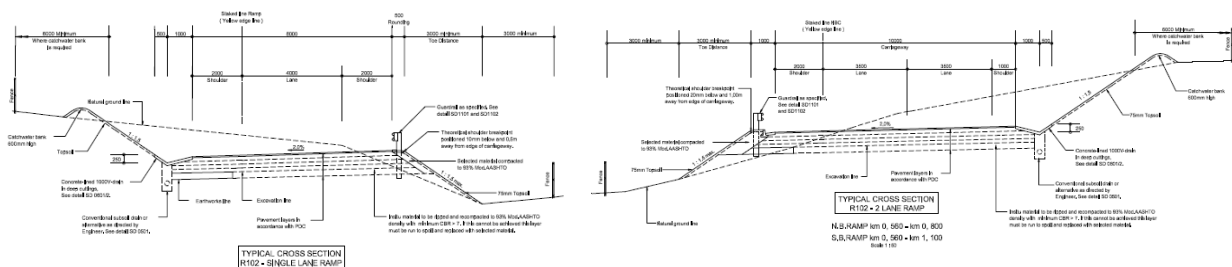


Figure 2-1: Proposed Typical Ramp Cross Section

It is proposed that formal drainage will be constructed in accordance with the typical cross sections, consisting of concrete-lined v-drains through the cuts and concrete pipe culverts (with headwalls and apron slabs) where necessary.

Mobility on the road is adversely impacted by the number and spacing of intersections and accesses on it. According to Technical Recommendations for Highways 26 (TRH26), a Class 2 Road should have accesses with at least 800 m spacings ($\pm 15\%$). This spacing is based on an 80 km/h design speed. The P79 link road does not make any allowance for crossing manoeuvres which would impede traffic flow.

The position of pedestrian walkways has been considered and included in the design report (**Appendix D**). The recommended design speed of 80 km/hr for Main Road 2/1 represents a risk to the significant number of pedestrians travelling along the road edge, therefore necessitating the need for walkways protected by guardrails along the length of Main Road 2/1.

It should be noted that an 18 month period has been estimated for the construction of the P79 Grade Separation Bridge and Linkage, and the SASA Pedestrian Bridge.

2.3 Description of the Sensitive Environments

2.3.1 Freshwater Habitats

The following watercourses were subject to further assessment as part of the assessment and included one (1) wetland and two (2) rivers / streams (circled in red in **Figure 2-2**):

- **C1-R01**: uMhlangane River 1
- **C1-W01**: Hillslope seep (wetland)
- **C2-R01**: Tributary of the uMhlangane River

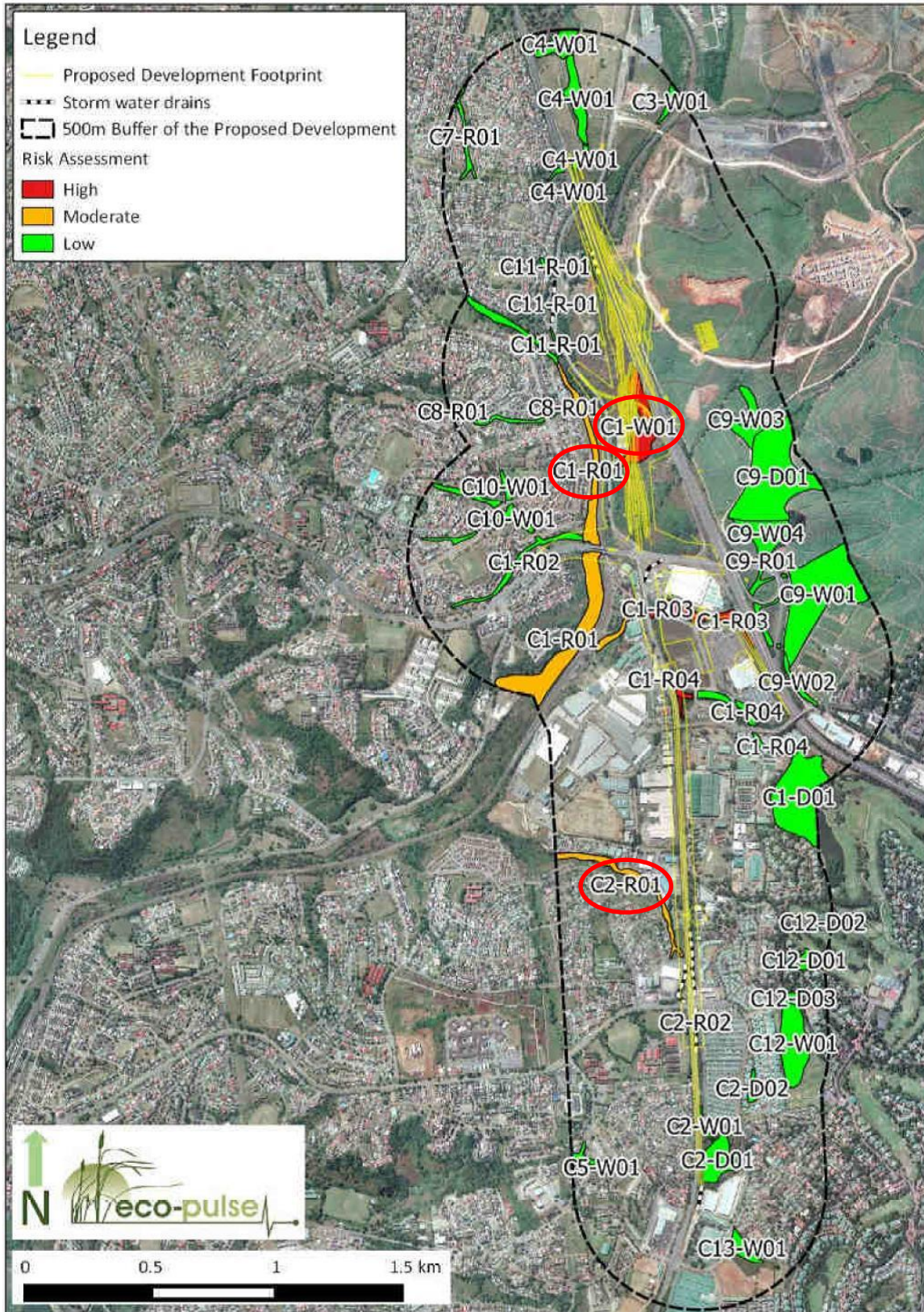


Figure 2-2: Risk rating of delineated water resource units within a 500 m radius from the development

2.3.1.1 C1-R01: uMhlangane River 1

The uMhlangane River reach assessed occurs on the western side of the proposed interchange and road upgrade. The uMhlangane River is a perennial river, characterised by a relatively narrow, incised active channel within a broad, alien infested woody-herbaceous riparian zone. The active channel is a single, sinuous, mixed alluvial bedrock channel measuring up to 3 m in width and 2 m in depth. The river's catchment is characterised by high levels of transformation, including; formal housing, road and railway infrastructure and high levels of alien plant infestation. On-site impacts include infilling, active channel excavation and re-alignment, river bank modification, solid waste dumping and high levels of Invasive Alien Plant (IAP) infestation.

2.3.1.2 C2-R01: Tributary of the uMhlangane River

This tributary of uMhlangane River (C2-R01) is located on the western side of the R102 just north of the intersection of the R102 with Hillhead Drive. The river is perennial and is fed primarily by stormwater flows emanating from buildings and roads in the catchment. The channel is significantly incised with near vertical and undercut banks in places and controlled along its length by stepped sandstone bedrock outcrops. The macro-channel measures up to 4 m in width and 2 m in bank height (clearly incised channel). Evidence of channel straightening and re-alignment is apparent in the upper sections of the river course. The stream's catchment is characterised by a high density of hardened surfaces (building and road infrastructure) and with open spaces dominated by maintained parks and areas infested with IAPs.

2.3.1.3 C1-W01: Hillslope Seepage Wetland

Wetland C1-W01 can be classified as a relatively small (approximately 2.6 ha in extent) hillslope seepage wetland occurring primarily on a west-facing slope in the central to northern study area. The P79 Grade Separation Bridge and Linkages traverses the C1-W01 Wetland. The seepage wetland has formed on a relatively steep slope mainly as a result of the discharge of sub-surface water which moves diffusely through the soils. It is linked via a drainage channel, which drains in a westerly direction towards the uMhlangane River. The wetland is characterised by temporal to seasonally saturated soils whilst the lower lying areas towards the mid reaches and toe end of the system are characterised by seasonal to permanently saturated soils. The wetland's catchment area is largely transformed by sugarcane farming and road infrastructure development, with a new housing development currently underway in the upper catchment on the eastern side of the M41 highway. On-site impacts include infilling linked with development of the western edge of the wetland, channel incision and artificial drainage, vegetation clearing, IAP infestation, woody plant encroachment and sediment deposition at the lower reach of the wetland.

2.3.2 Vegetation

The terrestrial environment and habitats at the proposed P79 Grade Separation Bridge and Linkage was characterised by three (3) distinct terrestrial vegetation communities, namely:

- Wooded alien thicket along the existing R102 highway to the west;
- Wooded grassland in the southern portion of the site; and
- *Hyparrhenia filipendula* grassland along the north-eastern edge of the study area.

A substantial portion of the study area in the north-west was transformed (existing construction site camp) and another stripped of vegetation and left bare during recent construction of a bulk pipe line in the south-eastern section of the focal study area assessed. The central portions of the focal study area comprised wetland / riparian habitat.

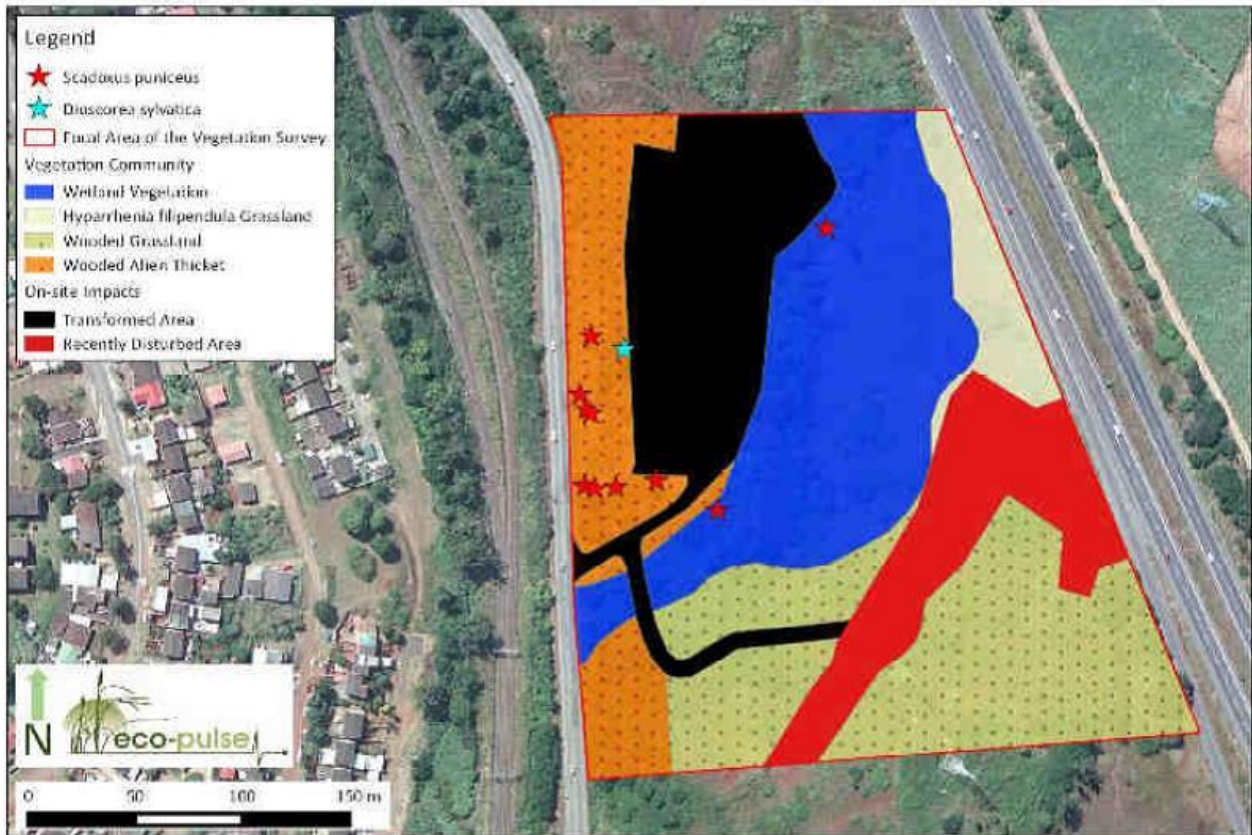


Figure 2-3: Terrestrial and aquatic vegetation communities at the proposed P79 grade separation

Two vegetation communities were identified within the study area linked with the proposed SASA Pedestrian Bridge crossing (i) Ruderal herbaceous community within in the R102 road reserve on the western side, and (ii) Wooded alien thicket within the road reserve on the eastern side of the R102.

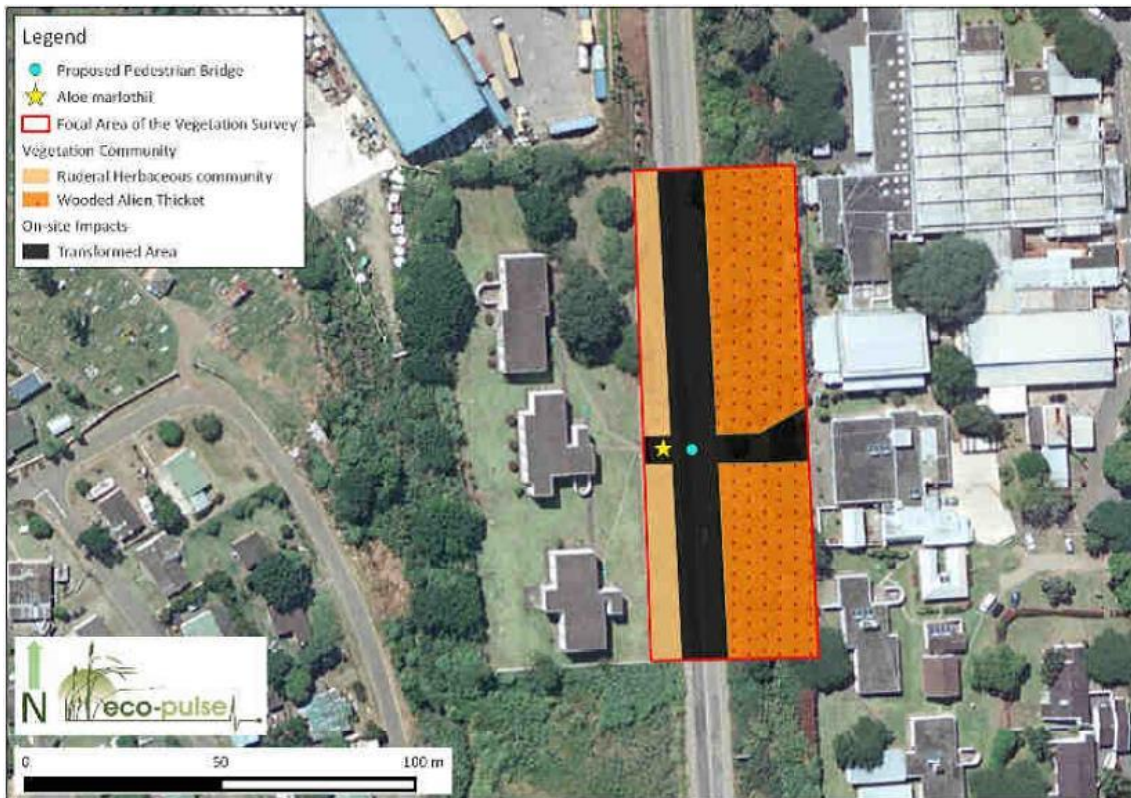


Figure 2-4: Two terrestrial vegetation communities at the proposed pedestrian bridge crossing

Based on this, the results of the assessment (Table 2-3) indicate that the *Hyparrhenia filipendula* dominated open grassland habitat associated with the proposed P79 Grade Separation Bridge and Linkage is of moderate sensitivity due to its limited level of degradation / disturbance, high level of naturalness (% natural composition) and limited extent of alien infestation. All other communities considered in the study were assessed as being of low sensitivity due to the secondary nature of the plant communities, moderate to high levels of alien plant / weed infestation, poor natural plant proportion and diversity and high level of degradation caused by humans.

Table 2-3: Summary of the various terrestrial vegetation communities assessed in terms of their ecological sensitivity

Assessment Focal Area	Vegetation Community	Ecological Sensitivity	Level of Naturalness	Level of Disturbance/ Transformation
A: P79 Grade Separation	<i>Hyparrhenia filipendula</i> open grassland	Moderate	High	Low
	Wooded grassland	Low	Moderately Low	Moderately High
	Wooded alien thicket	Low	Low	High
C: SASA Pedestrian Bridge	Ruderal herbaceous community	Low	Low	High
	Wooded alien thicket	Low	Low	High

2.4 Sensitive & 'No-Go' Areas

The overall sensitivity map is illustrated in **Figure 2-5**. Only Wetland Unit C1-W01 may be traversed and impacted upon by the proposed activities. A 30 m construction servitude from the toe of the road infrastructure is permitted. All other watercourses are strictly 'no-go' areas and a 32 m buffer must be maintained to these watercourses. Protected plants identified in **Figure 2-5** are detailed in

Table 2-4. It is expected that occurrences of *Scadoxus puniceus* and the *Aloe marlothii* will need to be relocated. A permit is required from Ezemvelo KZN Wildlife prior to relocation. All protected plants may not be removed, unless a permit is obtained.

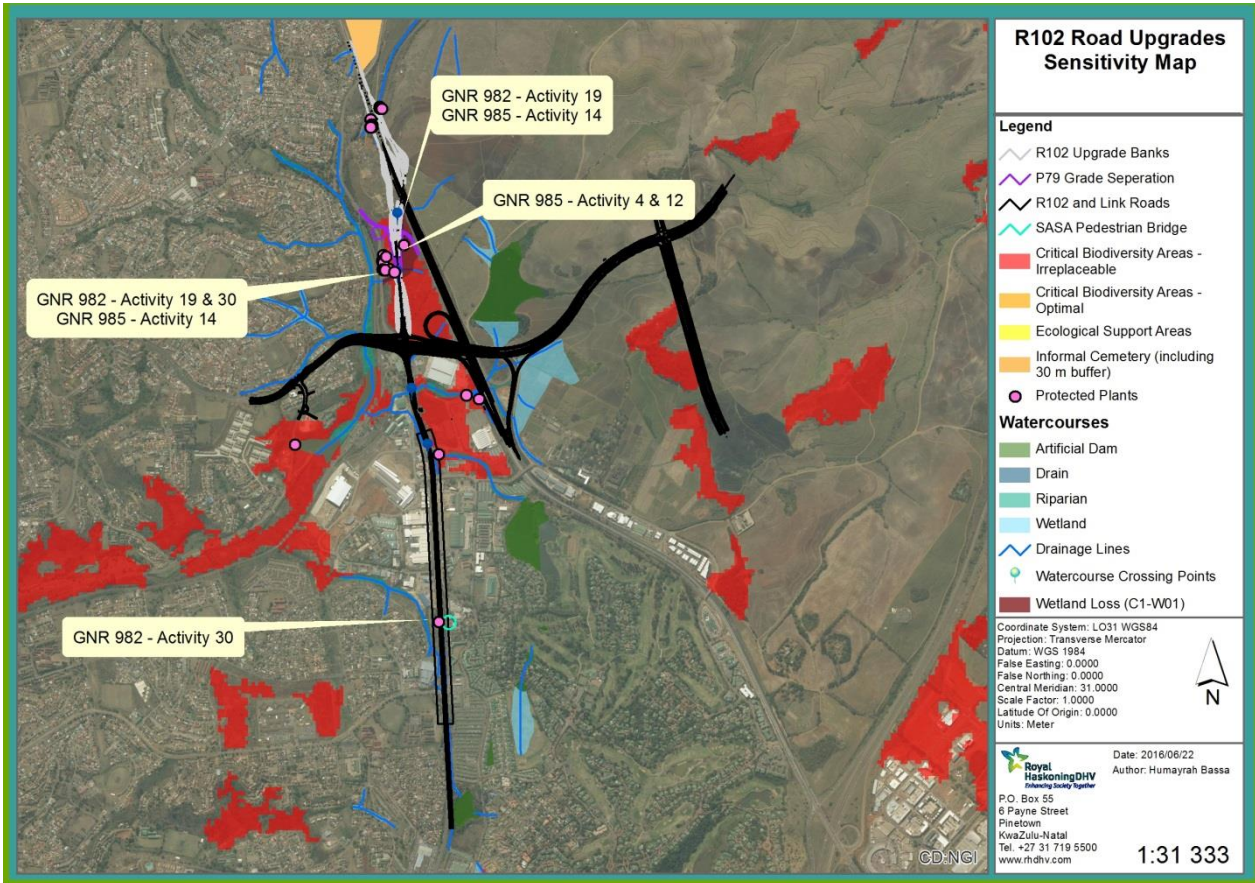


Figure 2-5: Sensitivity Map & 'No-Go' Areas

Table 2-4: List of protected plants

Protected Plant Species	GPS Co-ordinates
<i>Scadoxus puniceus</i>	29°41'43.05"S and 31°02'07.41"E
	29°41'44.78"S and 31°02'03.32"E
<i>Dioscorea sylvatica</i>	29°41'44.98"S and 31°02'03.90"E
<i>Scadoxus puniceus</i>	29°41'45.72"S and 31°02'03.13"E
	29°41'45.95"S and 31°02'03.24"E
	29°41'46.01"S and 31°02'03.31"E
	29°41'47.18"S and 31°02'03.21"E
	29°41'47.22"S and 31°02'03.39"E
	29°41'47.20"S and 31°02'03.75"E
	29°41'47.09"S and 31°02'04.46"E
	29°41'47.57"S and 31°02'05.52"E
<i>Barringtonia racemosa</i>	29°42'08.52"S and 31°02'19.53"E
	29°42'09.18"S and 31°02'22.01"E
<i>Aloe marlothii</i>	29°42'47.05"S and 31°02'14.16"E

3 ENVIRONMENTAL CODE OF CONDUCT

One of the objectives of the EMP is to ensure that all the workforce, contractors, sub-contractors and construction staff have an understanding of environmental issues and potential impacts on-site activities. This environmental code of conduct provides the basic rules that must be strictly adhered to.

It is the responsibility of the Safety, Health and Environment (SHE) Officer and ECO (as appointed) to ensure that each Contractor, Sub-contractor and workforce understand and adhere to the Code of Conduct.

All persons are obliged to keep to the rules of this code of conduct

Ignorance, negligence, recklessness or a general lack of commitment resulting in environmental degradation or pollution must not be tolerated!

Environmental Rules

- Do not waste electricity, water or consumables;
- Only use authorised accesses;
- Do not litter;
- Dispose solid waste to the correct waste containers provided;
- Prevent pollution;
- Use the toilet facilities provided;
- Do not dispose contaminated waste water to the stormwater system or the environment;
- Immediately report any spillage from containers, plant or vehicles;
- Do not burn or bury any waste in the sand;
- Do not trespass onto private properties;
- Strictly leave all animals alone. Never tease, catch or set devices to trap or kill any animal;
- Never damage or remove any trees, shrubs or branches unless it forms part of working instructions;
- Do not deface, draw or cut lettering or any other markings on trees, rocks or buildings in the area;
- Know the fire-fighting procedure and locations of fire-fighting equipment; and
- Know the environmental incident procedures.

4 LEGAL FRAMEWORK

4.1 Summary of Relevant Environmental Legislation

The following is a summary of the environmental legislation applicable to the proposed project.

Table 4-1: Legislative requirements²

LEGISLATION	SECTIONS	RELATES TO
The Constitution (No. 108 of 1996)	Chapter 2	Bill of Rights.
	Section 24	Environmental rights.
National Environmental Management Act (Act No. 107 of 1998 [as amended])	Section 2	Defines the strategic environmental management goals and objectives of the government. Applies through-out the Republic to the actions of all organs of state that may significantly affect the environment.
	Section 24	Provides for the prohibition, restriction and control of activities which are likely to have a detrimental effect on the environment.
	Section 28	The Developer has a general duty to care for the environment and to institute such measures as may be needed to demonstrate such care.
EIA Regulations (2014)	GNR.983	Activities requiring a Basic Assessment study to be undertaken.
	GNR.984	Activities requiring a Scoping and Impact Assessment study to be undertaken.
	GNR.985	Activities in special geographical areas requiring a Basic Assessment study to be undertaken.
National Waste Act (Act No. 59 of 2008) and List of Waste Activities (November 2013)		Provides for specific waste management measures and the remediation of contaminated land.
Norms and Standards for the Storage of Waste, 2013	GNR.926 – Sections 7 – 20	Provides specific guidelines for the operational procedures for a facility for the storage of waste.
National Heritage Resources Act (Act No. 25 of 1999) and regulations	Section 34	No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.
	Section 35	No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or paleontological site.
	Section 36	No person may, without a permit issued by the South African Heritage Resource Agency (SAHRA) or a provincial heritage resources authority destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority. "Grave" is widely defined in the Act to include the contents,

² It is noted that the legal framework provided in this document relates to the most recent legislation at the time of compiling this document. It is noted that legislation changes continuously and it is the Developers responsibility to ensure that they are compliant with the most relevant legislation at any given time.

LEGISLATION	SECTIONS	RELATES TO
		headstone or other marker of such a place, and any other structure on or associated with such place.
	Section 38	This section provides for Heritage Impact Assessments (HIAs), not already covered under the environmental law. Where covered under such law the provincial heritage resources authorities must be notified of a proposed project and must be consulted during the HIA process. The HIA is thus approved under the environmental authorisation, which must take into account the provincial heritage resources authorities' comments prior to making a decision on the HIA.
National Environmental Management: Air Quality Act (Act No. 39 of 2004)	Section 34	Control of noise.
	Section 35	Control of offensive odours.
National Dust Control Regulations (GNR 827 of November 2013)		Control of dust.
Occupational Health and Safety Act (Act No. 85 of 1993)	Section 8	General duties of employers to their employees.
	Section 9	General duties of employers and self-employed persons to persons other than their employees.
National Water Act (Act No. 36 of 1998) and regulations	Section 19	Prevention and remedying the effects of pollution.
	Section 20	Control of emergency incidents.
	Section 21	Water uses.
Minerals and Petroleum Resources Development Act (Act No. 28 of 2002) (as amended)	Section 22	Application for a mining permit/right.
	Section 39	Environmental management programme and environmental management plan.
Hazardous Substances Act (Act No. 15 of 1973) and regulations		Provides for the definition, classification, use, operation, modification, disposal or dumping of hazardous substances.
National Environmental Management: Biodiversity Act (No. 10 of 2004)		Provide for the protection of species and ecosystems that warrant national protection and the sustainable use of indigenous biological resources.
	Section 53	Protection of threatened or protected ecosystems.
	Section 65	Control of alien species.
	Section 71	Control of invasive species.
National Forests Act (Act No. 84 of 1998) and Regulations	Section 7	No person may cut, disturb, damage or destroy any indigenous, living tree in a natural forest, except in terms of a licence issued under section 7(4) or section 23; or an exemption from the provisions of this subsection published by the Minister in the Gazette.

LEGISLATION	SECTIONS	RELATES TO
	Sections 12-16	These sections deal with protected trees, with the Minister having the power to declare a particular tree, a group of trees, a particular woodland, or trees belonging to a certain species, to be a protected tree, group of trees, woodland or species. In terms of section 15, no person may cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister.
National Road Traffic Act (Act No. 93 of 1996)		Road safety.
Ordinance		Town Planning and Townships Ordinance 15 of 1986.
By-laws		Promulgated by-laws: <ul style="list-style-type: none"> ▪ Waste Management ▪ Property Rates by laws ▪ Legal Services ▪ Municipal Cemeteries ▪ Discharge of Industrial Effluent ▪ Electricity Supply
SANS 10103 (Noise Regulations)		The measurement and rating of environmental noise with respect to annoyance and to speech communication.
KZN Nature Conservation Ordinance (Ordinance 15 of 1974)		Sensitive species are protected under this Ordinance and must be considered.

4.2 Application Documentation

The following environmental documentation is applicable for the project, and must be read in conjunction with this EMPr:

- Environmental Authorisation (EA) for the Upgrades and Associated Link Road Infrastructure to the R102 in the eThekweni Metropolitan Municipality – *once issued*;
- Final Consultation Basic Assessment Report for the Upgrades and Associated Link Road Infrastructure to the R102 in the eThekweni Metropolitan Municipality;
- Water Use Licence for the Upgrade of the R102– *once issued*;
- Ezemvelo KZN Wildlife Permits for the removal / relocation of indigenous plants – *once issued*;
- Stormwater Management Plan for the Mount Edgecombe Partial Interchange and Link Road at km 8,0 on Main Road 2, Section 1– dated 18 May 2016;
- Wetland and Open Space Rehabilitation Plan for the Proposed R102 Interchange & Upgrade of Associated Road Infrastructure in the Phoenix/Mount Edgecombe Area, eThekweni Municipality, Kwazulu-Natal – once approved by DWS – dated 15 September 2015; and
- Construction Method Statement for the R102 Upgrades.

Once the relevant confirmations have been obtained, these must be appended to this EMPr and kept on site.

5 MANAGEMENT AND MONITORING PROCEDURES

5.1 Organisational Structure and Responsibilities

Figure 5-1 below gives an indication of the organisational and team structure for the project.

The KZN DoT is the Developer for the project. The organisational structure between the Developer's Project Team is illustrated in **Figure 5-1**.

Each of the team roles are elaborated on in terms of their specific duties hereafter.

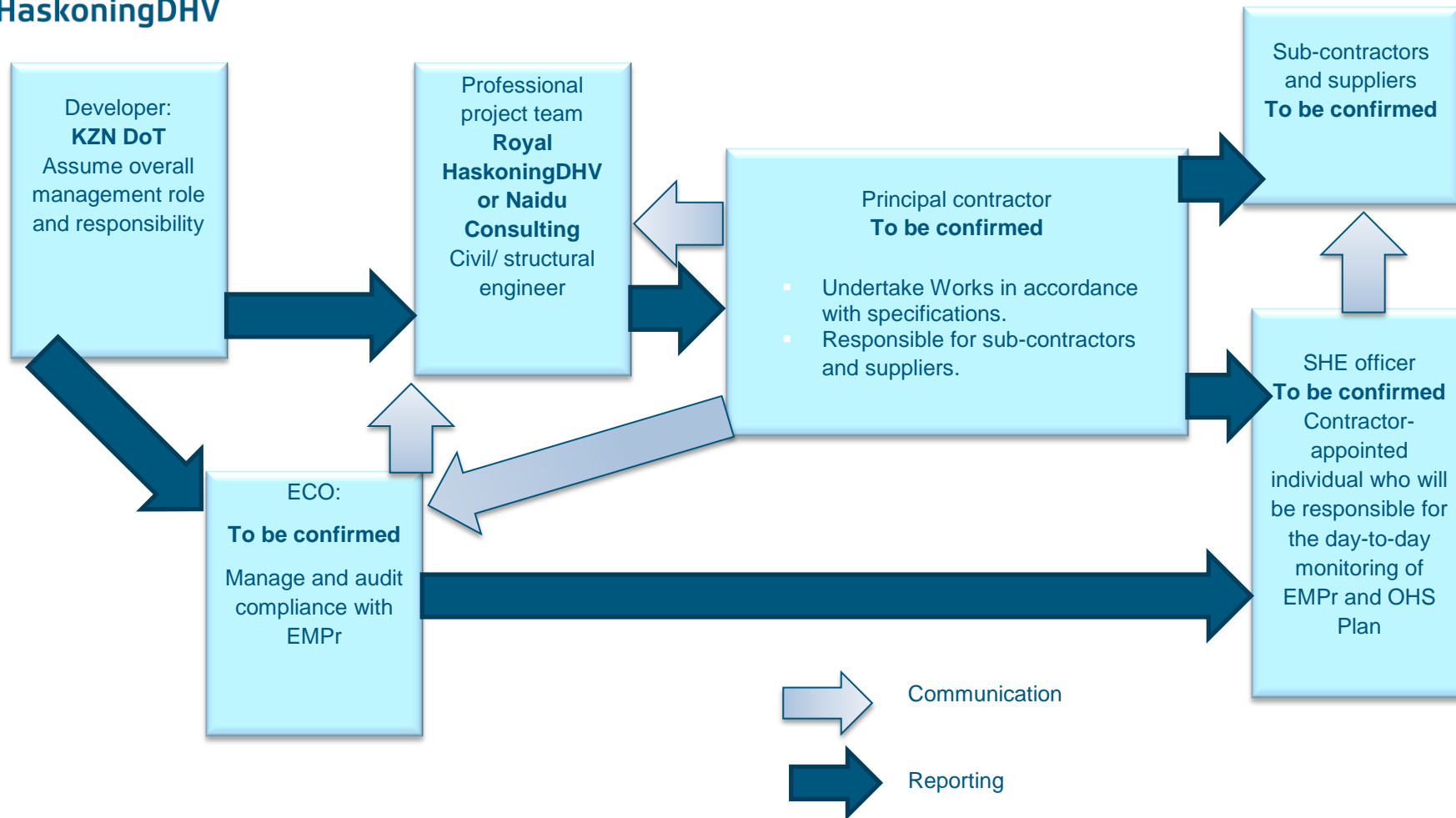


Figure 5-1: Team organogram³

³ The organisational structure will need to be reviewed and finalised on inception, especially in terms of both reporting and responsibility of the parties involved

The following outlines the defined and specific roles and responsibilities of each team member:

Table 5-1: Roles and responsibilities

Roles and Responsibilities
Developer
<p>The Developer is ultimately responsible for ensuring compliance with the environmental specification and upholding KZN DoT's environmental commitment to 100% compliance with all National, Provincial and local legislation that relates to management of the environment.</p> <p>The Developer will:</p> <ul style="list-style-type: none"> ■ Appoint a Project Manager (PM) to assume ultimate project responsibility; ■ Be familiar with the contents of the EMPr; ■ Ensure the EMPr is in the tender documentation issues to prospective contractors; ■ Issue penalties as and when necessary; and ■ May on the recommendation of the Engineer and / or SHE Officer order the Contractor to suspend any or all works on-site if the Contractor or his Sub-Contractor / Supplier fails to comply with the said specifications.
Engineer
<p>The Engineer will:</p> <ul style="list-style-type: none"> ■ Enforce the environmental specification on site; ■ Be familiar with the contents of the EMPr; ■ Ensure the EMPr is in the tender documentation issues to prospective contractors; ■ Request for, review and approve the Method Statements prepared by the Contractor; ■ Review and comment on environmental assessments and/ or reports produced by the Contractor and ECO; ■ Undertake regular site visits and ensure environmental specifications are implemented; ■ Monitor compliance with the requirements of the specification; ■ Discuss with the ECO the application of penalties for the infringement of the Environmental Specifications, another possible enforcement measures necessary; ■ Arrange information meetings for or consults with I&APs about the impending construction activities; ■ Assess the Contractor's environmental performance in consultation with the SHE Officer from which a brief monthly statement of environmental performance is drawn up for record purposes and to be reported to project meetings; and ■ Ensure the documentation, in conjunction with the Contractor, the state of the site prior to construction activities commencing. This documentation will be in the form of photographs or video record. ■ Maintain a register of complaints and queries by members of the public at the site office; and ■ Ensure the EMPr is implemented as well as revised and updated as and when required.

Roles and Responsibilities

Contractor (Including Sub-Contractors)

The Contractor is required to:

- Be fully conversant with the EMPr;
- Implement, manage and maintain the EMPr for the duration of the contract;
- Appoint a suitably qualified SHE Officer whose responsibility includes on-going monitoring and control of all construction activities concerning minimisation of environmental impact and adherence to the EMPr for the duration of the construction phase;
- Provide information on previous environmental management experience and company environmental policy in terms of the relevant forms contained in the Contract Document.
- Supply method statements timeously for all activities requiring special attention as specified and/ or requested by the Developer, SHE Officer and / or Engineer during the duration of the Contract.
- Be conversant with the requirements of this environmental specification / EMPr. Brief all his / her staff about the requirements of the environmental specification;
- Comply with requirements of the EMPr and any subsequent revisions in terms of this specification and the project specification, as applicable, within the time period specified.
- Ensure any Sub-Contractors / Suppliers who are utilised within the context of the contract comply with the environmental requirements of the project, in terms of the specifications. The Contractor will be held responsible for non-compliance on their behalf;
- Provide appropriate resources - budgets, equipment, personnel and training - for the effective control and management of the environmental risks associated with the construction of the development;
- Bear the cost of any delays, with no extension of time granted, must he or his Sub-Contractors / Suppliers contravene the said specifications such that the Engineer orders a suspension of work. The suspension will be enforced until such time as the offending party(ies), procedure, or equipment is corrected;
- Bear the costs of any damages / compensation resulting from non-adherence to the said specifications or written site instructions;
- Review ECO reports and take cognisance of the information / recommendations contained therein;
- Comply with all applicable legislation;
- Ensure that he informs the Engineer timeously of any foreseeable activities which will require input from the SHE Officer;
- Notify the ECO and PM, verbally and in writing at least 10 working days in advance of any activity he has reason to believe may have significant adverse environmental impacts, so that mitigatory measures may be implemented timeously;
- Ensure environmental awareness among his employees, sub-contractors and workforce so that they are fully aware of, and understand the Environmental Specifications and the need for them;
- Maintain a register of environmental training for site staff and Sub-contractor's staff for the duration of the contract; and
- Communicate and liaise frequently and promptly with the ECO and the PM to ensure effective, proactive environmental management with the overall objective of preventing or reducing negative environmental impacts while enhancing positive environmental impacts.

Roles and Responsibilities

- The Contractor will conduct all activities in a manner that minimises disturbance to the natural environment as well as directly affected residents and the public in general.
- The Primary Contractor assumes responsibility and accountability of all appointed Sub-Contractors and must ensure their compliance with this EMPr.

Roles and Responsibilities

Environmental Control Officer

The ECO will:

- Be familiar with the recommendations and mitigation measures of the associated EMPr for the project;
- Monitor the implementation of the EMPr during the construction and rehabilitation phases;
- Ensure site protection measures are implemented on-site;
- Monitor that the Principal Contractor, sub-contractors, construction teams and the Developer are in compliance with the EMPr at all times during the construction and rehabilitation phases of the project;
- Monitor all site activities monthly for compliance;
- Conduct monthly audits of the site according to the EMPr, and report findings to the Developer/Contractor;
- Attend monthly site meetings;
- Recommend corrective action for any environmental non-compliance at the site;
- Compile a monthly report highlighting any non-compliance issues as well as progress and compliance with the EMPr prescriptions; and
- Conduct once-off training with the Contractor on the EMPr and general environmental awareness.

It must be noted that the responsibility of the ECO is to monitor compliance and give advice on the implementation of the EMPr and not to enforce compliance. Ensuring compliance is the responsibility of the Developer and the SHE Officer.

Safety, Health and Environmental (SHE) Officer

The Safety, Health and Environmental officer will:

- Be fully conversant with the EMPr;
- Be fully conversant with all relevant environmental legislation applicable to the project, and ensure compliance with them;
- Compilation of Method Statements together with the Principal Contractor that will specify how potential environmental impacts in line with the requirements of the EMPr will be managed, and, where relevant environmental best practice and how they will practically ensure that the objectives of the EMPr are achieved;
- Convey the contents of this EMPr to the construction-site staff and discuss the contents in detail with the Contractor;
- Undertake regular and comprehensive inspection of the site and surrounding areas in order to monitor compliance with the EMPr;
- Take appropriate action if the specifications contained in the EMPr are not followed;
- Monitor and verify that environmental impacts are kept to a minimum, as far as possible;
- Order the removal from the construction-site of any person(s) and / or equipment in contravention of the specifications of the EMPr;
- Report any non-compliance or remedial measures that need to be applied to the appropriate environmental authorities, in line with the requirements of the EMPr;
- Submitting a report at each site meeting which will document all incidents that have occurred during the period before the site meeting;

Roles and Responsibilities

- Ensuring that the list of transgressions issued by the ECO is available on request; and
- Maintain an environmental register which keeps a record of all incidents which occur on the site during construction.

5.2 Training and Environmental Awareness

It is important to ensure that the Contractor has the appropriate level of environmental awareness and competence to ensure continued environmental due diligence and on-going minimisation of environmental harm. Training needs must be identified based on the available and existing capacity of site personnel (including the Contractors and Sub-contractors) to undertake the required EMPr management actions and monitoring activities. It is vital that all personnel are adequately trained to perform their designated tasks to an acceptable standard.

The environmental training is aimed at:

- Promoting environmental awareness;
- Informing the Contractor of all environmental procedures, policies and programmes applicable;
- Providing generic training on the implementation of environmental management specifications; and
- Providing job-specific environmental training in order to understand the key environmental features of the construction site and the surrounding environment.

Training will be done in a verbal format. The training will be a once-off event. In addition to training, general environmental awareness must be fostered among the project's workforce to encourage the implementation of environmentally sound practices throughout its duration. This ensures that environmental accidents are minimised and environmental compliance maximised.

5.3 Monitoring

A monitoring programme will be in place not only to ensure compliance with the EMPr through the contract / work instruction specifications, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are, or could result in significant environmental impacts for which corrective action is required.

A monitoring programme will be implemented for the duration of the construction phase of the project. This programme will include:

- Monthly audits will be conducted by the ECO for the duration of the construction phase – the ECO shall undertake this environmental monitoring with the audits considering compliance with the EMPr.
- On-going monitoring is to be undertaken by the Contractor's SHE officer – this will include notification to the ECO should an incident take place.
- External auditing may take place at unspecified times by the authorities and / or other relevant authorities.
- The Contractor's SHE Officer must undertake regular site inspections (at least twice weekly) to ensure all legislative requirements are adhered to.

5.4 Reporting Procedures

5.4.1 Documentation

The following documentation must be kept on site in order to record compliance with the EMPr:

- An Environmental File which includes:
 - Copy of the EA;
 - Copy of the EMPr;
 - Copy of the Stormwater Management Plan;
 - Copy of relevant legislation;
 - Environmental Policy of the Main Contractor;
 - Environmental Method Statements compiled by the Contractor;
 - Non-conformance Reports;
 - Environmental register, which shall include:
 - Communications Register – including records of Complaints, and, minutes and attendance registers of all environmental meetings;
 - Monitoring Results – including environmental monitoring reports, register of audits, non-conformance reports; and
 - Incident book – including copies of notification of Emergencies and Incidents, this must be accompanied by a photographic record.
 - Waste Documentation such as, but not necessarily limited to: Waste Manifest Documents, Safe Disposal Certificates (SDCs) and Sewerage Disposal Receipts;
 - Material Safety Data Sheets (MSDSs) for all hazardous substances;
 - Dust suppression register;
 - Written Corrective Action Instructions; and
 - Notification of Emergencies and Incidents.

5.4.2 Environmental Register

The Developer will put in place an Environmental Register. The Contractor will ensure that the following information is recorded for all complaints / incidents:

- Nature of complaint / incident.
- Causes of complaint / incident.
- Party/parties responsible for causing complaint / incident.
- Immediate actions undertaken to stop / reduce / contain the causes of the complaint / incident.
- Additional corrective or remedial action taken and / or to be taken to address and to prevent reoccurrence of the complaint / incident.
- Timeframes and the parties responsible for the implementation of the corrective or remedial actions.
- Procedures to be undertaken and / or penalties to be applied if corrective or remedial actions are not implemented.
- Copies of all correspondence received regarding complaints / incidents.

The above records will form an integral part of the Contractors' Records. These records will be kept with the EMPr, and will be made available for scrutiny if so requested by the Developer.

5.4.3 Non-Conformance Report

A Non-Conformance Report (NCR) will be issued to the Contractor as a final step towards rectifying a failure in complying with a requirement of the EMPr. This will be issued by the ECO to the Contractor in writing. Preceding the issuing of an NCR, the Contractor must be given an opportunity to rectify the issue.

Should the ECO assess an incident or issue and find it to be significant (e.g. non-repairable damage to the environment), it will be reported to the relevant authorities and immediately escalated to the level of a NCR. The following information must be recorded in the NCR:

- Details of non-conformance;
- Any plant or equipment involved;
- Any chemicals or hazardous substances involved;
- Work procedures not followed;
- Any other physical aspects;
- Nature of the risk;
- Actions agreed to by all parties following consultation to adequately address the non-conformance in terms of specific control measures and must take the hierarchy of controls into account;
- Agreed timeframe by which the actions documented in the NCR must be carried out; and
- ECO must verify that the agreed actions have taken place by the agreed completion date, when completed satisfactorily; the ECO and Contractor must sign the Close-Out portion of the Non-Conformance Form and file it with the contract documentation.

5.4.4 Environmental Emergency Response

The Contractor's environmental emergency procedures must ensure appropriate responses to unexpected / accidental actions / incidents that could cause environmental impacts. Such incidents may include:

- Accidental discharges to water (i.e. into the watercourse) and land;
- Accidental spillage of hazardous substances (typically oil, petrol, and diesel);
- Accidental damage to existing utilities e.g. sewer and water pipelines;
- Accidental toxic emissions into the air; and
- Specific environmental and ecosystem effects from accidental releases or incidents.

The Environmental Emergency Response Plan is separate to the Health and Safety Plan as it is aimed at responding specifically to environmental incidents and must ensure and include the following:

- Construction employees shall be adequately trained in terms of incidents and emergency situations;
- Details of the organisation (i.e. manpower) and responsibilities, accountability and liability of personnel;
- A list of key personnel and contact numbers;
- Details of emergency services (e.g. the fire department / on-site fire detail, spill clean-up services) shall be listed;

- Internal and external communication plans, including prescribed reporting procedures;
- Actions to be taken in the event of different types of emergencies;
- Incident recording, progress reporting and remediation measures to be implemented; and
- Information on hazardous materials, including the potential impact associated with each, and measures to be taken in the event of accidental release.

The Contractor and their Sub-contractor(s) must comply with the environmental emergency preparedness and incident and accident-reporting requirements as per the relevant legal requirements.

5.4.5 Method Statements

It is a statutory requirement to ensure the wellbeing of employees and the environment. To allow the mitigation measures in this document to be implemented, task-specific method statements must be developed for each set of tasks.

A Method Statement details how and when a process will be carried out, detailing possible dangers / risks, and the methods of control required.

- Type of construction activity;
- Timing and location of the activity;
- Construction procedures;
- Materials and equipment to be used;
- Transportation of the equipment to / from site;
- How equipment / material will be moved while on site;
- Location and extent of construction site office and storage areas;
- Identification of impacts that might result from the construction activity;
- Methodology and / or specifications for impact prevention / containment;
- Methodology for environmental monitoring;
- Emergency / disaster incident and reaction procedures (required to be demonstrated); and
- Rehabilitation procedures and continued maintenance of the impacted environment.

The Contractor will be accountable for all actions taken in non-compliance of the approved Method Statement(s). The Contractor shall keep all the Method Statements and subsequent revisions on file, copies of which must be distributed to all relevant personnel for implementation.

As a minimum the following Method Statements will be required to be generated:

- Bunding;
- Construction site and office / yard establishment;
- Cement mixing / concrete batching / bentonite mixing;
- Contaminated water;
- Dust;
- Environmental awareness course(s);

- Environmental monitoring;
- Erosion control;
- Fire, hazardous and/or poisonous substances;
- Fuels and fuel spills (may form part of the item above);
- Storage, handling and decanting of diesel (may form part of the item above);
- Personnel, public and animal safety;
- Rehabilitation of modified environment(s);
- Solid and liquid waste management;
- Sources of materials (including MSDSs);
- Topsoil management;
- Haulage, stockpiling and management of surplus fill material;
- Stormwater Management; and
- Wash areas.

5.4.6 Public Communication and Liaison with I&APs

The Developer must ensure that the adjacent land-owners are informed and updated throughout the construction phases.

Sufficient signage must be erected around the site (including at the entrance), informing the public of the construction activities taking place. The signboards must include the following information:

- The name of the Contractor; and
- The name and contact details of the site representative to be contacted in the event of emergencies or complaint registration.

6 COMPLIANCE WITH THE ENVIRONMENTAL SPECIFICATION

The EMPr forms part of the Contract Documentation and is thus a legally binding document. It is also necessary for the Contractor to make provisions as part of their budgets for the implementation of the EMPr. In terms of *Polluter Pays Principle*. Section 28 of the NEMA, an individual responsible for environmental damage must pay the costs for both environmental and human health damage. As far as possible preventative measures must be in place to reduce or prevent additional pollution and/or environmental damage from occurring.

The Contractor is deemed not to have complied with the Environmental Specification / EMPr if:

- There is evidence of contravention of clauses within the boundaries of the site, site extensions and haul / access roads;
- Environmental damage ensues due to negligence;
- The Contractor ignores or fails to comply with corrective or other instructions issued by the Developer, ECO or Engineer within a specified time; or
- The Contractor fails to respond adequately to complaints from the public.

6.1 Penalties

Application of a penalty clause will apply for incidents of non-compliance. The Contractor will be allowed one offence and a written warning will be issued to the Contractor's SHE officer. Failure to rectify the offence within one (1) working week of the issue of the warning or a repeat offence will result in a penalty.

The penalty will be issued by a representative of the Developer. The penalty imposed will be per incident at the discretion of the Developer's SHE Manager or any other duly authorised representative. The value of the penalty imposed shall be as defined in the contract and enforcement shall be at the discretion of the Developer. Such fines will be issued in addition to any remedial costs incurred as a result of non-compliance with the EMPr. The Developer will inform the Contractor of the contravention and the amount of the penalty, and will deduct the amount from monies due under the Contract.

The penalty monies will become the property of the Developer to be used for rehabilitation and maintenance of the site. Unless stated otherwise in the project specification, the penalties imposed per incident or violation will be:

Table 6-1: Penalties applicable

Offence	Amount
Failure to demarcate working areas	R10,000
Working outside of demarcated areas	R30,000
Failure to strip topsoil with intact vegetation	R50,000
Failure to stockpile topsoil correctly	R30,000
Failure to stockpile materials in designated areas	R10,000
Failure to take measures to prevent soil contamination	R10,000
Failure to take measures to control dust dispersion on-site	R10,000

Offence	Amount
Washing of vehicles on-site	R10,000
Pollution of water bodies and/or groundwater	R20,000
Failure to implement stormwater management provisions during construction	R20,000
Failure to control stormwater run-off	R30,000
Downstream erosion	R30,000
Failure to provide adequate sanitation	R10,000
Failure to erect temporary fences around trenches	R10,000
Failure to provide adequate waste disposal facilities and services	R50,000
Failure to reinstate disturbed areas within the specified time-frame	R30,000
Any other contravention of the project specific specification	R10,000

The Developer is responsible for the implementation of the EMPr and for compliance monitoring of the EMPr.

The EMPr will be made binding on all Contractors (including sub-contractors) operating on the site and will be included with the Contract.

Non-Compliance with, or any deviation from, the conditions set out in this document constitutes a failure in compliance. Non-compliance with the conditions of the EMPr constitutes a breach of Contract.

6.2 Removal from Site and Suspension of Works

Failure to remediate after the issue of a financial penalty, depending on the severity and significance of the impact related to non-compliance, the ECO may undertake to report directly to Department of Economic Development, Tourism and Environmental Affairs (EDTEA) (Compliance) recommending that for:

- High impact: to issue a notice to cease construction;
- Medium impact: to issue a notice instructing the Client to implement recommended remedial action; or
- Low impact: ECO to notify, but up to discretion of EDTEA to apply sanction.

The Developer, at the direction of the ECO, or of his own conviction, has the power to remove from site any person who is in contravention of the EMPr, and if necessary, the Developer can suspend part or the whole of the works, as required.

7 DETAILED ENVIRONMENTAL MANAGEMENT PROGRAMME

The EMPr specifies the minimum requirements to be implemented by the Developer as per the scope of works, in order to minimise and manage the potential environmental impacts and ensure sound environmental management practices. It also provides the framework for environmental monitoring throughout the construction and operational phases.

The provisions of this EMPr are binding on the Developer and their teams during the life of the project (i.e. across all phases of the development process). The EMPr must be binding to KZN DoT or any authority to which responsibility for the construction activities has been delegated to.

It is essential that the EMPr requirements be carefully studied, understood, implemented, and adhered to at all time.

To simplify the EMPr requirements, each aspect related to the EMPr has been addressed in the tables hereafter.

Each action within the EMPr is supported by the priority of when the specific action will need to be implemented. Each of these aspects is briefly described below (**Table 7-1**) for ease of reference.

Table 7-1: Summary of aspects included in the EMPr tables

ENVIRONMENTAL MEASURES, ACTIONS AND CONTROLS:

This section indicates the actions required to either prevent and / or minimise the potential impacts on the environment that is associated with the project.

RESPONSIBILITY:

This section indicates the party responsible for implementing the environmental measures and action plans laid out in the EMPr.

MONITORING FREQUENCY:

This section indicates when the actions for that specific aspect must be implemented and / or monitored

7.1 Pre-Construction Phase

Table 7-2: Pre-construction phase EMPr

Environmental Specification	Responsibility	Frequency
7.1.1 Authorisations, Permits and Licences		
All necessary authorisations, permits and licences must be obtained by the Developer prior to the commencement of construction (if required).	Developer	Once-off and On-going
All activities must comply with the EMPr.		
7.1.2 Appointment of Contractor		
The Developer must ensure that this EMPr forms part of any contractual agreements with a Contractor(s) and sub-contractors for the execution of the proposed project. The Contractor must make adequate provision in their budgets for the implementation of the EMPr.	Developer	Once-off
The Principal Contractor (including sub-contractors and suppliers) must comply with the relevant provisions of the EMPr, applicable environmental legislation, by-laws and associated regulations promulgated in terms of these laws.		
Tender documents must include statements to include the use of local communities or local community organisation in supplying services and labour to the construction activities.		

Environmental Specification	Responsibility	Frequency
7.1.3 Monitoring		
<p>A monitoring programme must be in place not only to ensure compliance with the EMPr through the contract / work instruction specifications, but also to monitor any environmental issues and impacts which have not been accounted for in the EMPr that are, or could result in significant environmental impacts for which corrective action is required. A monitoring programme must be implemented for the duration of the construction phase of the project. This programme must include:</p> <ul style="list-style-type: none"> ■ Monthly audits will be conducted by the ECO for the duration of the construction phase. The ECO must undertake environmental monitoring on a monthly basis and the audits will consider compliance with the EMPr. ■ External auditing may take place at unspecified times by the authorities and / or other relevant authorities. ■ The ECO must undertake regular site inspections to ensure all legislative requirements are adhered to. ■ The ECO must compile a monthly audit report with a quantitative rating of the compliance with the EMPr. ■ The ECO must keep a photographic record of any damage to areas outside the demarcated site area. The date, time of damage, type of damage and reason for the damage must be recorded in full to ensure the responsible party is held liable. The Contractor must be held liable for all unnecessary damage to the environment. 	Developer	Once-off and On-going
<p>The monitoring by the ECO must be extensive and inclusive; this involves the monitoring of construction related impacts as identified. Regular monitoring of the construction activities is critical to ensure that any problems with are picked up in a timeous manner. In this regard, the following potential concerns must be taken into consideration:</p> <ul style="list-style-type: none"> ■ Destruction of habitat outside the construction servitude including 'No-go' areas; ■ Erosion of the bed and banks of water resources; ■ Signs of intense or excessive erosion (gullies, rills, scouring and head cuts) and / or sedimentation within, along the edge and / or immediately downstream of the construction zone; ■ Erosion of disturbed soils and soil stockpiles by surface wash processes; ■ Sedimentation of aquatic habitats downstream of work areas; ■ Altering the hydrology and through flows to downstream habitat during construction across rivers / streams / wetlands; ■ Pollution of water resources (with a particular focus on water turbidity and hazardous substances such as fuels, oils 		

Environmental Specification	Responsibility	Frequency
<p>and cement products);</p> <ul style="list-style-type: none"> ■ Poorly maintained and damaged erosion control measures e.g. sand bags, silt fences and silt curtains; and ■ Evidence of unsafe working conditions (e.g. evidence of flow overtopping the bund wall / running tracks). 		
7.1.4 Public Communication		
<p>The Developer / Engineer must ensure that the adjacent landowners are informed and updated throughout the construction phases. Sufficient signage must be erected around the site (including at the entrance), informing the public of the construction activities taking place. The signboards must include the following information:</p> <ul style="list-style-type: none"> ■ The name of the Contractor. ■ The name and contact details of the site representative to be contacted in the event of emergencies or complaint registration. 	Contractor / ECO	Once-off
7.1.5 Site Set-Up		
<p>Prior to the establishment of the site area, the Contractor must produce a site layout plan showing the positions of all equipment storage, waste stockpiling, fuel storage areas and other infrastructure for comments and approval by the ECO and by the EDTEA. Choice of location for construction item storage must take into account location of local residents and environmentally sensitive areas (No-go areas) where applicable.</p>	Contractor	Once-off
<p>The construction area must be clearly demarcated on the layout plan, and all other areas must be considered No-go areas for the construction personnel. All sensitive areas such as the wetlands must be protected by appropriate temporary fencing and 'No-go' signage during construction, and vehicular access into these sensitive areas must be restricted.</p>		
<p>No-go areas must be agreed to in consultation between the ECO, SHE officer, and Developer prior to construction.</p>		
<p>Adequate signage must be placed in the area where construction will take place informing the public of the activities taking place.</p>		
<p>The site camp must be secured.</p>		
<p>The Contractor must take responsibility for the site to conform to all contractual aspects and environmental standards applicable.</p>		
<p>On-site accommodation (if required) and the construction camp must be comprised of:</p> <ul style="list-style-type: none"> ■ Site office; 		

Environmental Specification	Responsibility	Frequency
<ul style="list-style-type: none"> ■ Residential accommodation which meets the basic needs of site workers and is compliant with the relevant standards; ■ Ablution facilities; ■ Designated first aid area; ■ Eating areas; ■ Staff lockers; ■ Storage areas; ■ Batching plant (if required); ■ Refuelling areas (if required); ■ Maintenance areas (if required); and ■ Crushers (if required). 		
<p>Vegetation removed for any additional construction camp establishment must be kept to a minimum. No trees are to be removed with the exception of alien weeds and invader plants identified and approved by the ECO.</p>		
<p>The size of the construction camp must be minimised.</p>		
<p>Adequate yet not extensive parking must be provided for site staff and visitors at the construction camp with the intention to disturb as little grassland as possible.</p>		
<p>The Contractor must provide adequate refuse bins that must be cleaned / emptied and the waste removed from site on a regular basis.</p>		
<p>The construction areas must be kept in an orderly state at all times.</p>		
<p>Unauthorised entry, stockpiling, dumping or storage of equipment, material or waste must be strictly prohibited in identified No-go areas.</p>		
<p>The Contractor must ensure that drainage on-site is such to prevent standing water and / or sheet erosion from taking place or that it is not altered even temporarily which adversely impacts on drainage.</p>		
<p>Unauthorised access onto/into private properties is strictly prohibited.</p>		
<p>7.1.6 Ablution / Sanitation</p>		
<p>Where waterborne sewerage is not available, temporary chemical toilets must be provided by a company that has been approved by the Developer. Such toilets must be available for all site staff, both at the construction camp, and on-site</p>	<p>Contractor</p>	<p>Daily</p>

Environmental Specification	Responsibility	Frequency
as agreed by the Developer. The temporary toilet supplier must provide proof of their credentials and a licence / permit from the registered disposal area that they have permission to dispose of waste at that facility.		
The SHE Officer and ECO must be consulted on the location of any temporary chemical toilets.		
Temporary toilets must be located outside of wetland and buffer areas.		
In cases where facilities are linked to existing sewage structures, all necessary regulatory requirements concerning construction and maintenance must be adhered to.		
7.1.7 Access		
Access to the site is permitted only <i>via</i> existing road infrastructure. Any new access roads must be approved by the ECO and the CA prior to establishment. Access routes should be designed to limit potential impact on the environment, bearing in mind steep slopes and areas that are already showing reduced groundcover and soil erosion.	Contractor Engineer Developer	On-going
Traffic accommodating during the construction phase must be carefully considered. A Traffic Management Plan must be compiled and communicated to affected stakeholders.		
Temporary chutes / berms must not be aligned perpendicular to the slope.		
The Contractor is only permitted to make use of the existing road entrances to the site as well as those agreed to with by the relevant authorities prior to construction commencing.		
The location of all underground services and servitudes must be identified and confirmed.		
The construction site must have strict access control to reduce the risks associated with vehicular transportation and pedestrian access on the site.		
Watercourses and steep gradients must be avoided as much as possible.		
The contractor must ensure that no vehicles drive on the retained wetland or other sensitive areas and No-go areas. All No-go areas must be indicated and demarcated as such with warning signs in all relevant languages.		
7.1.8 Equipment, Vehicles and Storage Areas		
Washing of vehicles on-site is prohibited.	Contractor	On-going
Note that vehicle maintenance is not permitted on-site. If emergency repairs are required to vehicles or construction plant then the conditions as specified below must be implemented.		
Fire prevention facilities must be present at all storage facilities.		
Material Safety Data Sheets (MSDSs) must be readily available on-site for all chemicals and hazardous substances to be used on-site. Where possible and available, MSDSs must additionally include information on ecological impacts and measures to minimise negative environmental impacts during accidental releases or escapes.		
An oil balance must be implemented to demonstrate appropriate management of hydrocarbons.		
Plant and equipment must be adequately maintained to prevent spillage of oil, diesel, fuel or hydraulic fluid. The		

Environmental Specification	Responsibility	Frequency		
Contractor must repair or withdraw equipment or machinery from use if they consider these to be polluting the environment and cannot be repaired.				
Suitably covered receptacles must be available at all times and conveniently placed for the disposal of waste oils and greases. All used oils, grease or hydraulic fluids must be placed therein and these receptacles must be removed from the construction camps on a regular basis for recycling by an accredited recycling company, that have the relevant permits for the transport and recycling of said waste.				
A procedure for the management of oils spills must be introduced. This must address the cleaning of spillage from hard surfaces, utilising environmental friendly cleaning materials as well as the removal and disposal of polluted sand.				
Fuel must be stored in tanks with lids, which will be kept firmly shut and under lock and key at all times, within a secondary containment facility.				
Fuel decanting and refuelling must take place within the construction camp. 50 kg of hydrocarbon absorbent to be placed at the construction camp at all times and replenished as and when required.				
7.1.9 Waste Disposal Facilities				
<p>General waste produced on-site includes:</p> <ul style="list-style-type: none"> ■ Office waste (e.g. food, waste, paper, plastic); ■ Operational waste (clean steel, wood, glass); and ■ General domestic waste (food, cardboards, paper, bottles, tins). <p>An adequate number of general waste receptacles, including bins must be arranged around the Construction area, on-site to collect all domestic refuse, and to minimise littering.</p> <p>Different waste bins, for different waste streams must be provided to ensure correct waste separation and subsequent recycling, where applicable. (Wildlands Trust supply these bins)</p> <p>Bins must be clearly marked and lined for efficient control and safe disposal of waste.</p> <p>A fenced area must be allocated for waste sorting and disposal on the site.</p>	Contractor	Daily		
7.1.10 Security and Safety				
<p>A security guard must be appointed for guard the site at all times.</p> <p>Potentially hazardous areas such as trenches must be demarcated and clearly marked.</p> <p>Lighting on-site is to be set out to provide maximum security and to enable easier policing of the site, without creating a visual nuisance to local residents or businesses.</p> <p>Material stockpiles or stacks, such as pipes, must be stable and well secured to avoid collapse and possible injury to</p>			Contractor	Once off
	Daily			

Environmental Specification	Responsibility	Frequency
site workers/ local residents.		
Flammable materials must be stored as far as possible from adjacent residents/ businesses.		
Fire-fighting equipment must be present on-site at all times.		
Obstruction to driver's line of sight due to stockpiles and stacked materials must be avoided, especially at intersections and sharp corners.	Developer	On-going
No materials are to be stored in unstable or high-risk areas, such as on steep slopes.		
7.1.11 General and Hazardous Substances and Materials		
Storage areas must not be within any watercourses or within 100 m of any drainage lines.	Contractor SHE Officer	Daily
Storage areas must be designated, demarcated and fenced. Storage areas must be secure, under lock and key, so as to minimise the risk of crime.		
Fire prevention facilities must be present at all storage facilities.		
Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the storage area(s). These pollution prevention measures for storage must include a bund wall high enough to contain at least 110% of any stored volume. Such a facility must be on an impervious surface. The storage area must be securely fenced and all hazardous substances such as fuel, oils, chemicals, etc., must be stored therein. Drip trays or a thin concrete slab, must be installed in such storage areas with a view to prevent soil and water pollution.		
All fuel storage tanks and associated facilities must be designed and installed in accordance with the relevant oil industry standards, SANS codes and other relevant requirements.		
Symbolic safety signs depicting "No Smoking", "No Naked Flames" and "Danger" are to be prominently displayed in and around the fuel storage area.		
The capacity of the tank must be clearly displayed and the product contained within the tank clearly identified.		
Only empty and externally clean tanks may be stored on the bare ground. All empty and externally dirty tanks must be sealed and stored in an area where the ground has been protected.		
If fuel is dispensed from 200 litre drums, the proper dispensing equipment must be used.		
The drum must not be tipped in order to dispense fuel. The dispensing mechanism of the fuel storage tank must be stored in a waterproof container when not in use.		
All waste fuel and chemical contaminated rags must be stored in leak-proof containers and disposed of at an approved hazardous waste site.		
Storage sites must be provided with bunds to contain any spilled liquids and materials. These storage facilities (including any tanks) must be on an impermeable surface that is protected from the ingress of stormwater from surrounding areas in order to ensure that accidental spillage do not pollute local soil or water resources.		

Environmental Specification	Responsibility	Frequency
Material Safety Data Sheets (MSDSs) must be readily available on-site for all chemicals and hazardous substances to be used on-site. The MSDSs must include information on ecological impacts and measures to minimise negative environmental impacts during accidental releases or spillages.		
Staff dealing with these materials / substances must be aware of their potential impacts and follow the appropriate safety measures.		
A suitable Waste Disposal Contractor must be employed to remove waste oil. These wastes must only be disposed of at licenced landfill sites designed to handle hazardous waste. Appropriate SDCs must be provided for all hazardous waste being disposed of and must be kept on-site within the Site Environmental File.		
The Contractor must ensure that his staff are made aware of the health risks associated with any hazardous substances used and has been provided with the appropriate protective clothing / equipment in case of spillages or accidents and have received the necessary training.		
Cement / concrete must not be mixed directly on the ground. Shutter boards, mixing trays and impermeable sumps must be used at all mixing and supply points. Unused cement bags must be stored so as not to be effected by rain or run-off events.		
The washing of concrete trucks on-site is prohibited.		
Used cement bags must be stored in weatherproof containers to prevent windblown cement dust and water contamination. Used cement bags must be disposed of on a regular basis via the solid waste management system, and must not be used for any other purpose.		
All visible remains of excess concrete must be physically removed on completion of the plaster or concrete pour section and disposed of.		
Washing the remains into the ground is not acceptable as groundwater contamination could occur.		
No paint products may be disposed of on-site.		
The Contractor must maintain a record of the sourcing of all materials (including topsoil, sands, natural gravels, crushed stone, asphalt, clay liners, etc.) used during construction.		

7.3 Construction Phase

Table 7-3: Construction Phase EMPr

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
7.3.1 Health and Safety		
<p>All Procedures and equipment must be in accordance with the Occupational Health and Safety Regulations (OHSA) of South Africa, Act No. 85 of 1993. The Contractor must familiarise himself and his employees with the contents of the aforementioned legislation.</p>	Contractor SHE Officer	Daily
<p>First Aid contents must be on hand at all times.</p>		
<p>The Contractor must implement adequate and mandatory safety precautions relating to all aspects of the deconstruction. Such safety measures and work procedures / instructions must be communicated to construction workers.</p>		
<p>The wearing of Personal Protective Equipment (PPE) on-site is mandatory for all personnel and construction team members. Minimum requirements must include the wearing of an approved safety helmet, safety boots, safety eyewear, safety reflective jackets and dust masks, ear plugs, etc.</p>		
<p>PPE signs must be erected on-site at the areas where it is required and the integrity and availability of the signs must be maintained.</p>		
<p>No person is allowed on-site unless they are wearing approved safety equipment.</p>		
<p>Casual visitors must be required to sign a register at the security checkpoint and undergo a site induction by the SHE Officer. The responsible person must then be contacted before the visitor is allowed access to site. No unauthorised visitors are to be allowed on-site.</p>		
<p>Workers' right to refuse work in unsafe conditions must be respected.</p>		
<p>All personnel must be trained in basic site safety procedures.</p>		
<p>The Contractor must design, test / exercise appropriate emergency preparedness programmes (plans, schedules, procedures and methods) for addressing environmental accidents, incidents and events such as spills of fuel, oil or lubricants; fires, etc.</p>		
<p>The Developer and / or Developer's agent must carry out regular audits on the Principal Contractor at least once per month. Similarly, Principal Contractors must be responsible for carrying out regular audits on their contractors at least once per month. The results of both audit types must be tabled for action and discussed at the Health and Safety Committee meetings or the site meetings, as appropriate.</p>	Developer	Monthly

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
7.3.2 Fires		
No fires are permitted on-site.	Contractor	Daily
Fire-fighting measures such as fire extinguishers must be located on-site.		
The workforce must be made aware of fire prevention and fire-fighting measures.		
7.3.3 Worker Conduct On-Site		
<p>A general regard for the social and ecological wellbeing of the site and adjacent areas is expected of the site staff. Workers need to be made aware of the following general rules:</p> <ul style="list-style-type: none"> ■ No alcohol / drugs to be present on the site. ■ No firearms allowed on-site or in vehicles transporting staff to and from site, unless used by security personnel. ■ Prevent excessive noise. ■ Prevent unsocial behaviour. ■ Bringing pets onto the site is forbidden. ■ No harvesting of firewood from the site or from the areas adjacent to it. ■ Construction staff must make use of the facilities provided for them, as opposed to ad hoc alternatives (e.g. fires for cooking, the use of surrounding bush for toilet facilities). ■ Trespassing on private properties adjoining the site. ■ Driving under the influence of alcohol is prohibited. 	Contractor SHE Officer	Daily
7.3.4 Clearing and Protection of Fauna and Flora		
The clearing of vegetation through sensitive areas must be reduced to a minimum and the contractor must ensure that clearing occurs in parallel with the construction progress.	Contractor	Daily
Protected species of plants / trees must not to be removed or damaged unless the requisite licence or permit has been obtained.		
Where protected or rare / threatened species (namely <i>Scadoxus puniceus</i> , <i>Dioscorea sylvatica</i> , and <i>Aloe marlothii</i>) do occur on site and where these are likely to be disturbed during construction, a plant 'rescue' operation must be undertaken by an appropriate ecologist prior to construction.		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
No further impacts to the wetland are permitted and a 20 - 30 m buffer around the wetland must be maintained during and following the proposed upgrades to the road system in as far as possible given existing infrastructure.		
The ECO will need to demarcate / mark any indigenous trees that may be impacted and the necessary permits for plant removal / relocation of any threatened / protected species will need to be prior to removing trees.	ECO	Once Off
Construction activities, site camps and equipment lay-down areas must be limited to the road servitude and disturbed areas. They must not to be located within sensitive / undisturbed vegetation.	Contractor SHE Officer	Daily
No natural vegetation is to be collected for use as firewood.		
No animals are to be disturbed unnecessarily and no animals are allowed to be shot, trapped or caught for any reason. Any wildlife that is injured or killed on the site by accidental means i.e. hit by a vehicle, must be reported to the Developer, who must take appropriate action to facilitate the recovery of the animal where possible i.e. take the animal to the SPCA.		
Indigenous vegetation and topsoil cleared for the construction servitude / working area must be rescued and stored at the designated vegetation and soil stockpile area outside of the wetland / aquatic zone for later use in rehabilitation. In this regard, vegetation will need to be cleared in-situ (with sods/topsoil).		
All alien invasives found must be immediately removed and disposed of responsibly in accordance with the requirements of the ECO. No alien plants are permitted to be brought to site.		
Cleared areas must be planted with the present, indigenous grass sods as soon as is possible. All alien invasive vegetation that has colonised the construction-site must be removed, preferably by uprooting. The contractor must consult the ECO regarding the method of removal.		
All bare surfaces across the construction-site must be checked for alien invasive plants at the end of every month and alien plants removed by hand pulling / uprooting and adequately disposed of.		
Herbicides must be utilised where hand pulling / uprooting is not possible. Only herbicides which have been certified safe for use in wetlands by independent testing authority must be used. The ECO must be consulted in this regard.		
Where alien plants have been introduced on to the site during clearing and infilling, they must be removed. The Contractor must develop an Action Plan for the removal of alien invasive species and submit it to the ECO for approval.		
Invader species and weeds must be removed and disposed of in accordance with existing legislation on a regular basis.		
7.3.5 Heritage		
A buffer zone of at least 30 m around the large cemetery that is located almost 800 m to the north of the footprint, must be maintained.	Contractor	Daily
Attention is drawn to the South African Heritage Resources Act, 1999 (Act No. 25 of 1999) which, requires that operations that expose all graves, as well as archaeological and historical remains should cease immediately, pending		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
evaluation by the provincial heritage resources authority.		
7.3.6 Traffic and Safety		
Temporary loading and off-loading areas and holding of construction vehicles must be designed prior to construction activities to ensure that the most preferable access and haulage routes has been identified.	Contractor	Daily
Implement proper road signs to warn motorists of construction activities ahead.		
Ensure that there are flag men and signs in place at access points to the construction-site.		
Road signs for all lane closures to be done in accordance to the South African Road Traffic Signs Manual (SARTSM, 1999).		
Construction routes must be clearly defined. Disruption to the peak traffic periods 06h00 – 9h00 and 15h00 – 18h00 must be minimised or if possible avoided.		
A Traffic Management Plan must be compiled before construction commences in liaison with all affected parties.		
All Contractors must ensure that their employees and in particular, construction vehicle drivers / operators comply with the safe access and egress plans that are to be put in place during the construction process. Appropriate warning and reduced speed signage must be erected where necessary.		
7.3.7 Pedestrian Protection		
Pedestrians must be protected from construction activities at all times.	Contractor	Daily
Pedestrian conflict with site access and construction vehicles to be managed by traffic officer.		
The construction-site camp must remain fenced for the entire construction period.		
7.3.8 Construction Vehicles		
Access of all construction and material delivery vehicles must be strictly controlled.	Contractor	Daily
No vehicles should be allowed to cross rivers or streams in any area other than an approved crossing, taking care to prevent any impact (particularly erosion) on the surrounding habitat.		
Holding of all construction vehicles must be controlled to ensure that through traffic is not unnecessarily impeded.		
Vehicles and equipment must be serviced regularly to avoid the contamination of the area from oil and hydraulic fluid leaks, etc.		
Servicing of vehicles must be done off-site.		
All speed limits must be adhered to.		
Machinery or equipment used on-site must not constitute a pollution hazard in respect of the above substances. The Contractor must order such equipment to be repaired or withdrawn from use if they consider the equipment or		

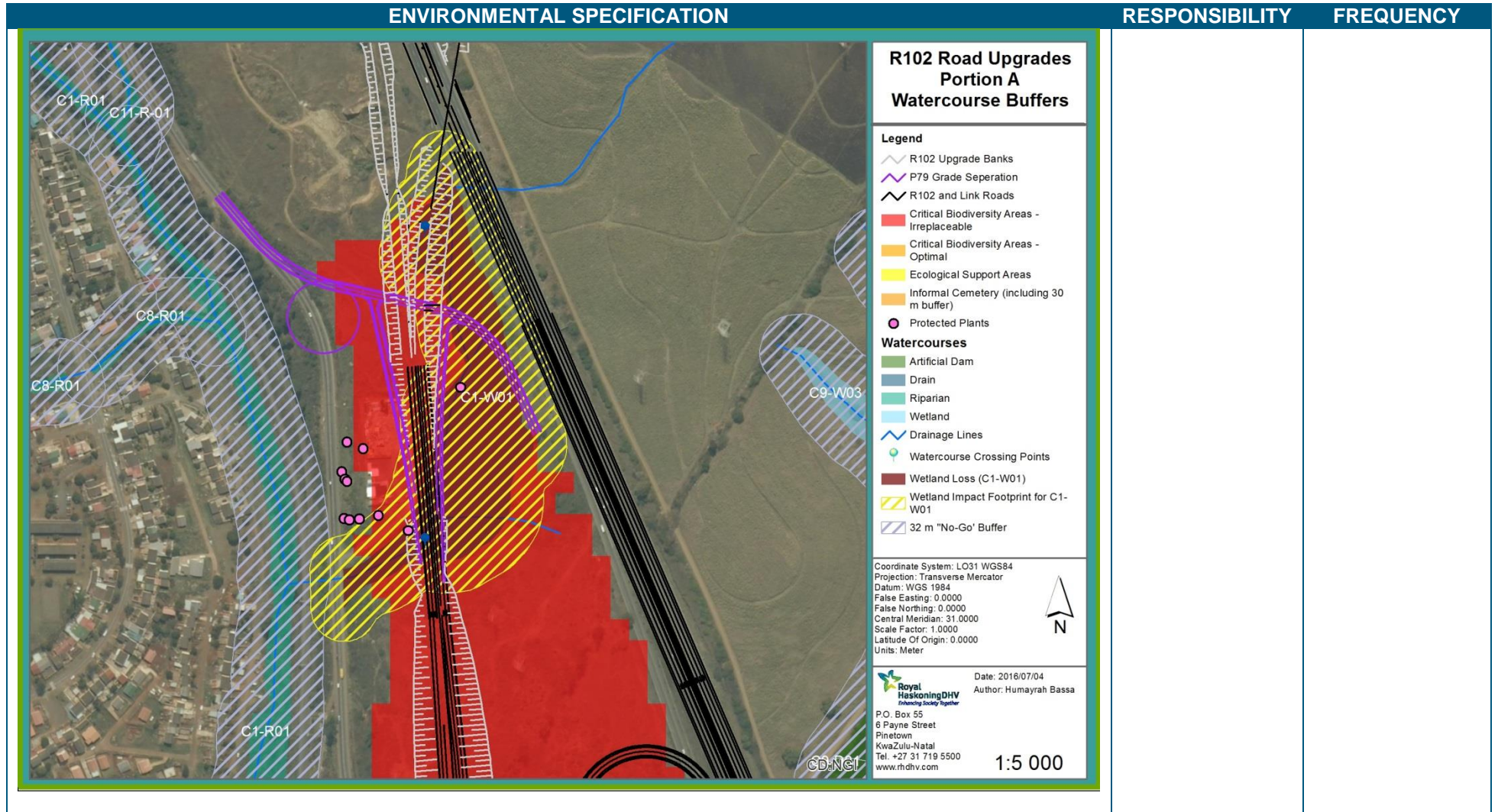
ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
machinery to be polluting and irreparable.		
Suitably covered receptacles must be available at all times and conveniently placed for the disposal of waste. All used oils, grease or hydraulic fluids must be placed therein and these receptacles will be removed from the site on a regular basis for disposal at a registered or licensed disposal facility.		
7.3.9 Road Maintenance		
Contractors must ensure that any damage to the pedestrian walkway or holding areas are maintained in good condition by attending to any damages (e.g. road signs or stormwater damage, etc.) as soon as these develop.	Contractor	Daily
If necessary, staff must be employed to clean surfaced roads adjacent to construction-sites where materials have spilt.		
All temporary road signs to be removed and pavement reinstated at completion of works.		
All covered road signs to be reinstated.		
7.3.10 Topsoil		
The Contractor must strip and stockpile all topsoil within the work area for subsequent use at a later stage.	Contractor	Daily
Indigenous vegetation and topsoil cleared for the construction servitude/working area must be rescued and stored at the designated vegetation and soil stockpile area outside of the wetland/aquatic zone for use later in rehabilitation. In this regard, vegetation will need to be cleared in-situ (with sods/topsoil).		
Stockpiles of construction materials must be clearly separated from soil stockpiles in order to limit any contamination of soils. The stockpiles must only be placed within demarcated stockpile areas, which must fall within the demarcated construction area.		
The removal of any topsoil from site is prohibited and this must be stockpiled and used solely in the rehabilitation of the works area.		
Stockpiles must be located outside of the 20 m wetland buffer.		
Stockpiles must be protected from wind and rain with the use of tarpaulins where necessary. The Engineer is to use his discretion as to the mechanism to be used to ensure this protection.		
Topsoil must be kept separate from overburden and must not be used for infilling.		
Noxious weeds must be eradicated from topsoil stockpiles.		
The Contractor must exercise suitable precautions with the storage, handling and transport of all materials that could adversely affect the environment.		
If pollution of any surface or groundwater occurs, it must immediately be reported to the DWS and appropriate mitigation measures must be employed.		
The topsoil and spoil material must be used to create stormwater attenuation berms and contour the topography accordingly, were required, rather than be spoiled.		

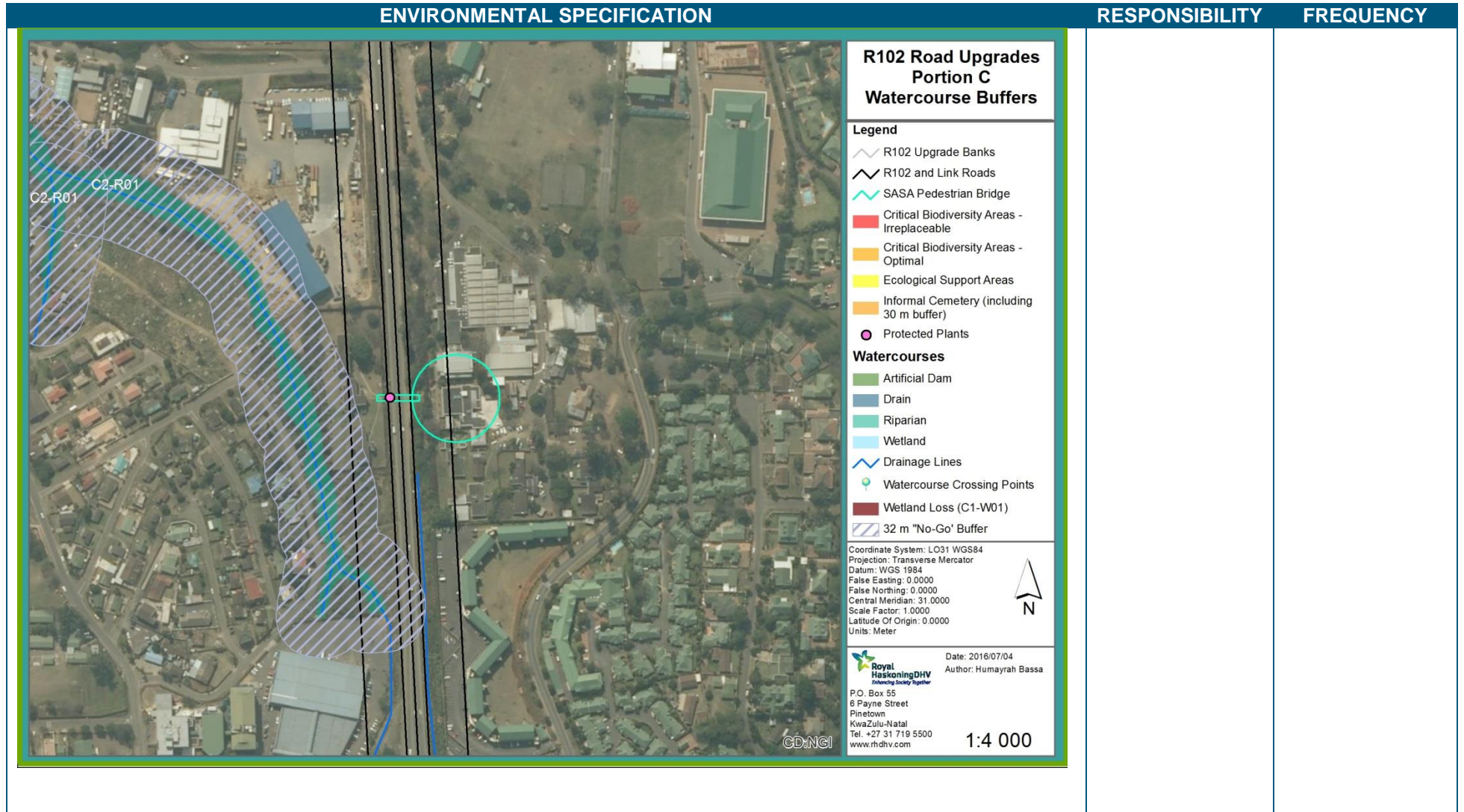
ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
7.3.11 Soil Erosion and Sedimentation		
Disturbed areas of terrestrial and riparian vegetation must be rehabilitated immediately to prevent soil erosion.	Contractor SHE Officer	Daily
As far as possible, all construction activities within water resources must occur in the low flow season, during the drier winter months.		
Stockpiles of soil must be limited in height to between 2 m and 4 m, and must either be dampened on a regular basis or vegetated depending on the length of time the stockpile will exist.		
Suitable erosion control measures shall be implemented at stormwater discharge points, exposed areas and high embankments. These measures may include the following options: <ul style="list-style-type: none"> ■ Sand bags on trenches (trench breakers). ■ Bunds or grips adjacent to watercourses. ■ Technologies similar to Soil Saver on embankments. ■ Planting of indigenous vegetation on embankments. ■ Minimise clearing and grubbing to necessary sections within the road reserve. ■ Excavating borrow pit areas to ensure they are self-draining. ■ Over-wetting, saturation and unnecessary runoff during dust control, curing and irrigation activities will be avoided. 		
Sandbag berms must be placed at regular intervals on all steep slopes and on the trench line before and after backfilling in order to minimise erosion and the discharge of contaminated storm water runoff into watercourses.		
The natural flow of rivers or streams must not be permanently diverted or blocked.		
Adequate through flows to downstream aquatic ecosystems must be maintained to protect aquatic life, and prevent the interruption of existing downstream uses.		
Clearing activities must only be undertaken during agreed working times and permitted weather conditions. If heavy rains are expected, clearing activities must be put on hold. In this regard, the contractor must be aware of weather forecasts.		
Construction activities must be scheduled to minimise the duration of exposure to bare soils on-site, especially on steep slopes.		
Run-off generated from cleared and disturbed areas / slopes that drains into rivers, streams or wetlands must be controlled using erosion control and sediment trapping measures like silt fences, sandbags, earthen berms and synthetic logs, particularly where slopes are exposed. These control measures must be established at regular intervals perpendicular to the slope to break surface flow energy and reduce erosion as well as trap sediment.		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
The berms, sandbags and / or silt fences must be maintained and monitored for the duration of the construction phase and repaired immediately when damaged. The berms, sandbags and silt fences must only be removed once vegetation cover has successfully re-colonised the disturbed areas post-rehabilitation.		
During construction, the Contractor must check the site for erosion damage after every rainfall event, and rehabilitate this damage immediately.		
Any Contractors found working inside the 'No-go' areas (areas outside the working servitude) must be fined as per fining schedule / system setup for the project.		
Erosion / sediment control measures such as silt fences, low soil berms or wooden shutter boards must be placed around the stockpiles to limit sediment run-off from stockpiles.		
The slope and height of stockpiles must be limited to 2 m to avoid collapse. If rehabilitation is undertaken effectively and is signed off after successful indigenous vegetation re-establishment, the risks of these impacts must be minimised.		
Constant cognisance of the inherent high erosion risk potential of all soils and sites on the property must be taken and appropriate control and preventative measure put in place.		
7.3.12 General Waste Management		
General waste produced on-site must be collected in skips for disposal at a registered landfill site. Hazardous waste must not be mixed or combined with general waste earmarked for disposal at the municipal landfill site.	Contractor SHE Officer	Daily
Under no circumstances is waste to be burnt or buried on-site. The excavation and use of rubbish pits on-site is forbidden.		
Waste bins must be cleaned out on a regular basis to prevent any windblown waste and / or visual disturbance.		
All general waste must be removed from the construction areas on a daily basis and disposed of in suitable waste receptacles. No general waste is to be disposed of on-site.		
Any form of waste material and rubble generated during construction must be removed from the site and disposed of at a facility registered in terms of section 20(b) of the NEM:WA (Act No. 59 of 2008), if it cannot be responsibly re-used or recycled on-site.		
No waste material must be buried (for the sole purpose of final disposal) or burnt. The Contractor responsible for the removal of the rubble and waste must supply the applicant with a certificate indicating safe disposal.		
7.3.13 Hazardous and Industrial Waste Management		
Hazardous waste produced on-site includes:	Contractor	Daily

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
<ul style="list-style-type: none"> ■ Oil and other lubricants, diesel, paints, solvent; ■ Containers that contained chemicals, oils or greases; and ■ Equipment, steel, other material (rags), soils, gravel and water contaminated by hazardous substances (oil, fuel, grease, chemicals or bitumen). <p>Hazardous waste must be disposed of at a licenced hazardous waste landfill site. The ECO must approve a licensed waste disposal site at the inception of the project.</p> <p>Hazardous waste bins must be clearly marked, stored in a contained area (or have a drip tray) and covered (either stored under a roof or the top of the container must be covered with a lid).</p> <p>SDCs must be obtained from the waste removal company as evidence of correct disposal and kept on-site within the Site Environmental File.</p> <p>It may be feasible for the waste to be transported to a central point where it can be collected in bulk by the waste disposal company. It must however be noted that:</p> <ul style="list-style-type: none"> ■ Transport of hazardous materials must be done in accordance with legislative control; and ■ Relevant SABS Codes of Practice must be adhered to. 	SHE Officer	
7.3.14 Wastewater		
<p>All wastewater generated at the proposed development must be disposed of in a suitable manner so as not to cause any surface or subsurface water pollution or health hazard.</p> <p>Contaminated wastewater including cement-contaminated water must not enter any watercourse and must be managed by the Contractor to ensure that the existing water resources on and off site are not polluted by activities emanating from the above development.</p> <p>Used oil and wastewater must be disposed of at a registered facility. A SDC is to be obtained by the Contractor and kept on-site within the Site Environmental File.</p> <p>Water containing waste must not under any condition be discharged into the natural environment. Measures to contain water containing waste and safe disposal of such must be implemented.</p>	Contractor SHE Officer	Daily
7.3.15 Water Pollution Management (including groundwater and soil contamination)		
<p>The proper storage and handling of hazardous substances (e.g. fuel, oil, cement, bitumen, paint, etc.) needs to be administered. Construction materials liable to spillage must be stored in appropriate containment structures (e.g. drip trays).</p>	Contractor	Daily

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
The stormwater system must be maintained to remove and reduce debris that may pose any pollution risk. The lack of maintenance will lower the transportation of the runoff to the existing watercourses and which may cause flooding.		
Storage containers must be regularly inspected so as to prevent leaks.		
All employees handling fuels and other hazardous materials must be properly trained in their safe use, environmental restrictions and methods for proper disposal.		
Mixing and/or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater.		
Spillages of fuels, oils and other potentially harmful chemicals must be cleaned up immediately and contaminants properly drained and disposed of using proper solid / hazardous waste facilities (not to be disposed of within the natural environment).		
The flow direction of any surface water run-off must be established prior to disturbing any area.		
The stockpiling of soil or any other material must not be allowed near a watercourse or water body in order to prevent pollution or impede surface run-off.		
Construction methods must comply with the stormwater management plan (Appendix C).		
Every effort must be made to ensure that any chemicals or hazardous substances do not contaminate the soil or ground water on-site.		
Dirty water originating from maintenance activities must be contained and disposed of correctly, to prevent the contamination of soil and / or any watercourses.		
Bathing or washing of clothes, equipment or machinery within any watercourse is prohibited.		
Bare areas must be rehabilitated as soon as the areas become available or after use.		
All water consumption on-site must be recorded on a daily basis.		
The abstraction of water from any water resource for construction purposes and / or dust suppression must not be permitted without a water use authorisation from the Department of Water and Sanitation (DWS).		
7.3.16 Watercourse and Wetland Management		
A Method Statement for working within the riverine / stream habitats must be compiled in conjunction with the appointed Contractor in order to confirm all methods of watercourse encroachment and the most practical and effective steps to minimise the impacts to wetland, instream and riparian habitat.	Contractor SHE Officer ECO	Daily Monthly
Construction activities within wetland unit C1-W01 must be limited to a 30 m working servitude on either side measured from the toe of the road infrastructure. A 32 m buffer must be maintained during and following the proposed upgrades to the road system around the all watercourses not authorised for construction activities (i.e. C1-W01). Under no circumstances may these watercourses be encroached on or disturbed.		





ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
Delineated water resource units outside of the construction footprint are considered sensitive areas ('No-go' areas). Access through and construction activities within the No-go areas are strictly prohibited in these areas.		
Site camp and equipment lay-down areas must not to be located within delineated water resource units and should rather be located within transformed or disturbed terrestrial areas. These areas will need to be pre-approved by the ECO / CA before commencing with construction.		
No clearing or infilling of the adjacent wetland is permitted.		
Access by construction workers or staff into the wetlands must be prohibited. All staff must be informed of this requirement.		
No stockpiling of construction materials or spoil material or any construction activities whatsoever are allowed to take place within this fenced off area.		
No batching or chemical / fuel storage areas to be located within 50 m of the area of residual hydromorphic soils or the stream and associated riparian corridor.		
Adequate measures must be put in place to protect the water resources, including the wetland which flows in close proximity to the site. Visible markings showing the buffers demarcated must be provided during the construction phase.		
Eating areas must not be located within 20 m of the wetland / riparian habitats. Provide adequate rubbish bins and waste disposal facilities on-site and educate / encourage workers not to litter or dispose of solid waste in the natural environment but to use available facilities for waste disposal. Clear and completely remove from site all general waste, constructional plant, equipment, surplus rock and other foreign materials once construction has been completed. Recycling/re-use of waste is to be encouraged.		
The use of protective measures such gabions and revetments to protect the riverine habitats.		
7.3.17 Spills, Incidents and Pollution Control		
Any spill incident, which may occur, must be investigated and immediate action must be taken. This must also be reported to the ECO and SHE Officer.	Contractor SHE Officer	Daily
In the case of a spill of hydrocarbons, chemicals or bituminous material in the construction camp or on the construction-site / bunding area, the spill must be contained and cleaned up and the material together with any contaminated soil collected and disposed of as hazardous waste to minimize pollution risk and reduce bunding capacity.		
An Emergency Response Plan (ERP) must be developed by the Contractor for approval by the Developer and review by the ECO.		
Should a pollution incident occur on-site, the Contractor must: <ul style="list-style-type: none"> ■ Implement reasonable measures immediately to contain and minimise the impacts of the incident; 		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
<ul style="list-style-type: none"> ■ Contain the spill; ■ Notify all persons whose health may be affected by the incident; ■ Undertake clean up procedures immediately; ■ Notify the Contractor of the incident immediately who will advise the employee as to the measures that must be implemented; ■ Record the incident in the Environmental Incident Register; and ■ Implement measures to prevent similar incidents from occurring in the future. 		
<p>The following measures must be implemented in conjunction with the generic pollution prevention measures:</p> <ul style="list-style-type: none"> ■ Hazardous storage and refuelling areas must be bunded prior to their use on-site during the construction period following the appropriate SANS codes. ■ The bund wall must be high enough to contain at least 110% of any stored volume. ■ The surface of the bunded surface must be graded to the centre so that spillage may be collected and satisfactorily disposed of. ■ The proper storage and handling of hazardous substances (e.g. Fuel, oil, cement, bitumen, paint, etc.) needs to be administered. ■ Storage containers must be regularly inspected so as to prevent leaks. ■ Mixing and / or decanting of all chemicals and hazardous substances must take place on a tray, shutter boards or on an impermeable surface and must be protected from the ingress and egress of stormwater. 		
Drip trays must be utilised at all dispensing areas.		
No vehicles transporting concrete, asphalt or any other bituminous product may be washed on-site.		
Vehicle maintenance must not take place on-site unless a specific bunded area is constructed for such a purpose.		
The contractor must ensure that transport, storage, handling and disposal of hazardous substances is adequately controlled and managed.		
Correct emergency procedures and cleaning up operations must be implemented in the event of accidental spillage.		
If a water pump is required, the water pump must operate inside or on top of a drip tray to prevent any spillage of fuel and limit the risk of soil / water contamination. The drip tray will need to be lined with absorbent pads and checked daily while in use.		
All equipment to be used within the sensitive working areas (within the channel) must be checked daily for oil and diesel		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
leaks before gaining access to these working areas.		
An emergency spill response procedure must be formulated and staff are to be trained in spill response		
All necessary equipment for dealing with spills of fuels / chemicals must be available at the site. Spills must be cleaned up immediately and contaminated soil / material disposed of appropriately at a registered site, 44-gallon drums must be kept on-site to collect contaminated soil. These must be disposed of at a registered hazardous waste site.		
Concrete mixing must be confined to as few areas as possible and <i>ad hoc</i> mixing is to be avoided. Areas where concrete was mixed must be cleaned up after use. Concrete mixing must be undertaken on an impervious surface.		
Subsoil and construction material stockpiles must be bermed to prevent leachate and polluted run-off.		
In the event of a spill incident, the Emergency Response developed by the contractor must be followed.		
7.3.18 Noise		
Neighbouring landowners must be notified about construction activities.	Contractor	Daily
All construction vehicles and equipment are to be kept in good repair and must be fitted with standard silencers prior to construction.		
Where possible, stationary noisy equipment (for example compressors, generators etc.) must be encapsulated in acoustic covers, screens or sheds. Portable acoustic shields must be used in the case where noisy equipment is not stationary (for example drills, angle grinders, chipping hammers).		
Construction activities, and particularly the noisy ones, must be contained to reasonable hours during the day and early evening.		
Machines in intermittent use must be shut down in the intervening periods between work or throttled down to a minimum.		
In general, operations must meet the noise standard requirements of the Occupational Health and Safety Act (Act No. 85 of 1993).		
Construction staff working in areas where the 8-hour ambient noise levels exceed 75 dBA must wear ear protection equipment.		
Noise levels must be kept within acceptable limits.		
All noise and sounds generated must adhere to SANS 10103 specifications for maximum allowable noise levels for central business districts.		
No pure tone sirens or hooters may be utilised except where required in terms of SANS standards or in emergencies.		
Noisy operations must be combined so that they occur where possible at the same time.		
Noise from labourers must be controlled.		
Noise suppression measures must be applied to all construction equipment.		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY		
<p>Construction equipment must be kept in good working order and where appropriate fitted with silencers which are kept in good working order. Should the vehicles or equipment not be in good working order, the Contractor must be instructed to remove the offending vehicle or machinery from site.</p>				
<p>The Contractor must take measures to discourage labourers from loitering in the area and causing noise disturbance. Where possible labour must be transported to and from the site by the Contractor or his sub-contractors by the contractors own transport.</p>				
<p>Construction activities are to be contained to reasonable hours during normal working hours.</p>				
<p>7.3.19 Air Quality Pollution Management and Odour Control</p>				
<p>Any oil containing equipment or containers must be managed in a manner to avoid oil exposure to atmosphere to limit evaporation of volatiles to atmosphere.</p>	Contractor	Daily		
<p>Portable toilets must be regularly emptied to avoid and minimise sanitary odour pollution.</p>		Weekly		
<p>Vehicles must be maintained to avoid excessive emissions and smoke. Similarly equipment must be serviced.</p>		Daily		
<p>7.3.20 Dust Control</p>				
<p>Dust track-on from disturbed areas to gravel road surfaces must be avoided by making use of one of the following measures to:</p> <ul style="list-style-type: none"> ■ Road sweeping. ■ Chemical dust suppression of disturbed areas to reduce the amount of dust which can be lifted by the wheels of trucks. ■ Wet suppression to the roads using a light spray. ■ The washing down of the wheels of trucks before they exit only paved road surfaces. 	Contractor SHE Officer	Daily		
<p>If water is abstracted from a water resource for dust suppression, a Water Use Licence / General Authorisation must be obtained from the DWS.</p>				
<p>Dust liberated to atmosphere must not reduce the visibility for private vehicles making use of the road passing by the site.</p>				
<p>Wet suppression and wind speed reduction are common methods used to control open dust sources at construction-sites.</p>				
<p>Re-vegetation of exposed areas for long-term dust and water erosion control is commonly used and is the most cost-effective option. Plant roots bind the soil, and vegetation cover breaks the impact of falling raindrops, thus preventing</p>				

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
<p>wind and water erosion. Plants used for re-vegetation must be indigenous to the area, hardy, fast-growing, nitrogen-fixing, provide high plant cover, be adapted to growing on exposed and disturbed soil (pioneer plants) and must easily be propagated by seed or cuttings.</p>		
<p>All construction vehicles and equipment are to be kept in good repair.</p>		
<p>Speed limits of a maximum of 40 km/hr are to be implemented on-site and enforced by the Contractor.</p>		
<p>Dust liberated to atmosphere must not reduce the visibility for vehicles making use of the road passing by the site.</p>		
<p>Shade cloth fencing must be used to reduce dust aggravation.</p>		
<p>Construction activities must be contained to reasonable hours during the day avoiding periods of sunrise and sunset.</p>		
<p>In areas where there is a large potential for dust liberation (high wind days) wet suppression using a light spray must be applied to the areas in question.</p>		
<p>A dust suppression register as well as a complaints register must be kept.</p>		
<p>All complaints received must be investigated with remedial action taken communicated to the affected party within 14 days.</p>		
<p>7.3.21 Stormwater Management</p>		
<p>Stormwater and erosion control measures must be implemented during the construction phase to ensure that erosion and sedimentation impacts to water resource units are avoided or minimised.</p>	<p>Contractor Engineer</p>	<p>Daily</p>
<p>Run-off generated from cleared and disturbed areas such as access roads and slopes that drain into stream or wetlands must be controlled using erosion control (e.g. sand bags, earthen berm etc.) and sediment trap measures (e.g. silt fence).</p>		
<p>Sediment barriers (e.g. silt fences, sandbags, hay bales, earthen filter berms or retaining walls) must be established to protect downstream water resource units from erosion and sedimentation impacts from upslope.</p>		
<p>Berms, sandbags and / or silt fences employed must be maintained and monitored for the duration of the construction phase and repaired immediately when damaged.</p>		
<p>Any dewatering must be done in such a manner that water does not result in concentrated flow down slope that could cause soil erosion.</p>		
<p>The contractor must ensure that any trenches or excavations are closed and compacted immediately after construction is completed.</p>		
<p>All river/stream channel embankments at crossings must be rehabilitated to ensure both longitudinal and cross sectional stability against summer floods. Depending on the circumstances, this may necessitate stabilizing structures such as gabions or reno-mattresses as well as careful attention to vegetation rehabilitation.</p>		
<p>The following aspects should be undertaken:</p>		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
<ul style="list-style-type: none"> ■ Maintaining adequate ground cover at all times and in all areas to negate erosion caused by wind, water and vehicular traffic. ■ Preventing the concentration of stormwater flow where the soil is susceptible to erosion. ■ Adding devices to reduce the stormwater flows to acceptable levels. ■ Ensuring that the development does not increase the stormwater flow above that which the natural ground can safely accommodate. ■ Ensuring that the construction of the stormwater devices is carried out in safe and aesthetic manner. ■ Preventing pollution of water ways and water features. ■ Containing soil erosion during construction. ■ Avoiding conditions where the embankments may become saturated and unstable. 		
<p>The Stormwater Management Plan must be implemented to ensure proper management of stormwater on the site during and after construction to ensure that pollutants and sediment are not released into any water resources.</p>		
<p>Stormwater drainage must be <i>via</i> open drains / swales adjacent to the road with energy check structures rather than concrete drains. Under no circumstances must drop inlets and concrete pipes be utilised.</p>		
<p>Wherever possible, the temporary berms must not be aligned perpendicular to the slope.</p>		
<p>Outlet erosion protection structures must be designed to reduce outflows to energy levels that do not pose an erosion risk to downslope soils.</p>		
<p>Outlet erosion structures must be properly installed along the grade and elevation of the slope.</p>		
<p>Under no circumstances must the structures be placed higher than the ground surface thereby creating a drop off that may cause erosion.</p>		
<p>Temporary stormwater management facilities / silt fences and traps must be formalised prior to bulk earthworks commencing. These attenuation ponds / silt traps can help considerably with stormwater attenuation as well as sediment trapping and erosion prevention during the construction phase.</p>		
<p>Designs for the site development in general must avoid concentration of stormwater run-off both spatially and in time and must provide for on-site attenuation of stormwater run-off to limit peak flows to pre-development levels.</p>		
<p>Detailed plans to control and prevent erosion by water must be agreed prior to the commencement of any works, including site clearance, on any portion of the site.</p>		
<p>Precautions must be taken at all times on building sites to contain soil erosion and prevent any eroded material from being removed from the site.</p>		
<p>On-site stormwater control systems, such as swales, berms, soil fences and attenuation ponds must be constructed</p>		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
before any construction commences on the site. As construction progresses, the stormwater control measures must be monitored and adjusted to ensure complete erosion and pollution control at all times.		
Earthworks on-site must be kept to a minimum.		
Where embankments have to be formed, stabilisation and erosion control measures must be implemented immediately.		
Stormwater must not be allowed to pond in close proximity to existing building foundations.		
No materials, fluids or substances are allowed to enter the stormwater system that could have a detrimental effect on the flora, fauna and aquatic life in the water courses and wetlands.		
Regular monitoring of the sites must be undertaken.		
7.3.22 Social Considerations		
Working hours are restricted to 07:00 – 18:00 during weekdays and 08:00-17:00 over weekends if necessary. Should work be required after these hours, the ECO must be notified and any person who resides in close proximity to the site and who may be impacted upon by the disturbance must also be notified.		
All neighbouring landowners and those that are disturbed due to construction activities must be notified of construction activities and provided with regular feedback on the status of construction.		
The Contractor must arrange for a suitable candidate to assist with the appointment of local labour and assist with labour disputes.		
Due to the concentration of a workforce in the area over the construction period, the Contractor must implement an HIV/AIDS Awareness Programme on-site. The Contractor must appoint an HIV/AIDS Awareness Officer for the duration of the construction period. Activities for HIV/AIDS awareness and prevention will be broad based, targeting both individuals and groups. They may consist of: <ul style="list-style-type: none"> ■ Information posters in public places both on and off site (eating places, bars, guest houses, etc.); ■ Peer educators (reference people) drawn from the local labour force and trained in HIV/AIDS issues for discussions with colleagues (estimate 1 per 30 employees); ■ Small focus group discussions and information covering key issues must be held; ■ Inclusion of HIV/AIDS activities at site meetings and other discussions; and ■ Voluntary Counselling and Testing. 	Contractor SHE Officer	Daily
Education must cover:		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
<ul style="list-style-type: none"> ■ Stigma and discrimination issues; ■ Preventative behaviours including partner reduction, condom use, and awareness and importance of treatment of STDs; ■ Skills including negotiating safer sex, correct condom use, purchase without embarrassment; and ■ Referral to local health centres and services available. 		
7.3.23 Visual Considerations		
<p>Storage facilities, elevated tanks and other temporary structures must be located such that they have as little visual impact on local residents as possible. Special attention must be given to the screening of highly reflective materials on-site.</p>	Contractor	Daily
7.3.24 Reporting & Record Keeping - Complaints Register		
<p>Complaints received must be registered and recorded by the contractor and also brought to the attention of the contractor. Both parties will respond accordingly. The following information must be recorded in the case of any complaint / incident:</p> <ul style="list-style-type: none"> ■ Time, date and nature of complaint; ■ Response and investigation undertaken; and ■ Corrective and preventative actions taken and by whom. 	Contractor	Daily
<p>All complaints received will be investigated and a response is to be given to the complainant within 7 days.</p>		
7.3.25 Reporting & Record Keeping - Environmental Incidents Register		
<p>All environmental incidents occurring on the site will need to be recorded in an Environmental Incident Book and brought to the attention of the ECO. The following information must be provided:</p> <ul style="list-style-type: none"> ■ Time, date and nature of complaint; ■ Response and investigation undertaken; and ■ Corrective and preventative actions taken and by whom. 	Contractor SHE Officer	Daily

7.4 Post Construction / Rehabilitation / Operational and Maintenance Phase

Table 7-4: Post construction phase EMP

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
7.4.1 Construction areas		
All structures comprising the construction affected areas must be removed from the site and surrounding areas.	Contractor Developer	Post-Construction
The area that previously housed the construction materials must be checked for spills of substances such as oil, paint, diesel, etc. and these must be cleaned up.		
All hardened surfaces within the construction affected area must be ripped, all imported materials removed, and the area must be top soiled and re-grassed accordingly with indigenous species.		
The Contractor must arrange the cancellation of any temporary services.		
7.4.2 Vegetation		
All vegetation that has been cleared during construction must be removed from site or used as mulch, (except for vegetation which may result in inadvertently seeding alien vegetation).	Developer	Post-Construction
7.4.3 Alien Invasive Species		
Eradicate and control alien invasive plants that invade the road servitude and all areas disturbed during construction and operation of the proposed road infrastructure.	Developer ECO	Post-Construction Bi-annually
Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.		
The methods employed to control and eradicate a listed invasive species must also be directed at the new growth, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.		
It is recommended that bi-annual alien plant clearing be undertaken by the applicant for the first year post-rehabilitation. Thereafter, alien plant clearing must be undertaken annually.		
7.4.4 Materials and Infrastructure		
All residual stockpiles must be removed to spoil or spread on-site as directed by the Developer and / or Engineer.	Developer Engineer	Post-Construction
All leftover building materials must be returned to the depot or removed from the site.		
The Contractor must repair any damage that the construction works has caused to neighbouring properties.		
Fences, barriers and demarcations associated with the construction phase must be removed from the site unless		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
stipulated otherwise by the Developer.		
7.4.5 Rehabilitation		
The Developer is responsible for compliance with the provisions for Duty of Care and Remediation of Damage in accordance with Section 28 of NEMA.	Contractor Engineer Developer ECO	Post-Construction
All remaining maintenance materials, building rubble and waste must be removed from the site to an approved disposal site. Burying rubble on the site is prohibited.		
All disturbed surfaces compacted by maintenance activities including the ablutions and loading areas must be ripped to a minimum depth of 30 cm to allow organic contaminants to breakdown and promote vegetation establishment.		
The Contractor is required to rehabilitate all impacted areas according to the approved Method Statement for the Rehabilitation of Wetlands and Riparian Areas.		
Final rehabilitation must be completed within a period specified by the Engineer.		
The site and surrounding areas must be cleared of all litter.		
Surfaces must be checked for waste products from activities such as concreting or asphaltting.		
All embankments must be trimmed, shaped and replanted to the satisfaction of the ECO.		
Immediately after construction disturbed areas must be re-vegetated using the rescued plant sods and supplemented with transplants from adjoining like habitats if required. Alternatively, reseeding via broadcasting using an indigenous seed mix reflecting the general species composition of the area must be used. If such seed mixes are not available, seed will need to be harvested from the area and grown nearby for later re-vegetation using plugs /sprigs.		
A biodegradable geo-fabric mat (or vegetation blanket) must be utilized to protect the topsoil on steep slopes from water and wind erosion during re-vegetation. Alternatively, the plants can be secured using a coarse mesh (steel wire or plastic). The mesh or mat is placed over the vegetation securing it until it can fully establish. The plants must be able to grow unhindered through the mesh or matting. Mats can be staked down.		
The soils must be adequately prepared prior to planting by a contractor with experience in re-vegetation and under no circumstances must fertiliser be applied.		
Once the initial transplants / plugs are planted, the contractor must conduct weekly site visits to monitor re-establishment and remove alien plants (in accordance with the latest revised NEM:BA requirements) and address any re-vegetation concerns until re-vegetation is considered successful (i.e. >90% indigenous cover). Thereafter, the rehabilitation must be signed off by the ECO.		
All disturbed areas must be prepared and then re-vegetated to the satisfaction of the ECO as per the relevant re-vegetation / replanting plan.		
Where drainage channels have been disturbed, the channels must be re-graded, stabilised using erosion control measures and re-vegetated as per the relevant re-vegetation / re-planting plan.		

ENVIRONMENTAL SPECIFICATION	RESPONSIBILITY	FREQUENCY
The Contractor must check that all watercourses are free from building rubble, spoil materials and waste materials.		
7.4.6 End of Contractor Services		
A meeting is to be held on-site between the Developer and the ECO to approve all remediation activities and ensure that the site has been restored to a condition acceptable to the ECO and the Developer.	ECO Developer	Post-Construction
A site close-out audit must be undertaken by the ECO prior to handover of the site by the Contractor.		
7.4.7 Waste Management		
<p>The site must be kept void of litter.</p> <p>Waste management at the site must subscribe to the principles of sustainable waste management. This includes:</p> <ul style="list-style-type: none"> ■ Waste prevention - the prevention and avoidance of the production of waste at source; ■ Waste reduction - the reduction of the volume or hazardous nature of the waste during production; ■ Resource recovery - recycling or re-use of the waste; ■ Waste treatment - the treatment of waste to reduce volume or risk to human and environmental safety and health to reduce the degree of hazard when waste is disposed of in a landfill or discharged into a water source; and ■ Waste disposal - the environmentally acceptable and safe disposal or discharge of waste, (e.g. encapsulation, incineration, landfill or discharge to a water source). <p>These principles must be practiced to the greatest extent possible.</p>	Developer	On-going
7.4.8 Social Concerns		
Job creation expectations will have to be well managed via management systems and communication mechanisms that regularly inform the local community (on-site and at local community centres) of the progress and job / skills needs at the development sites.	Developer	Construction and operational phases – on-going

8 METHOD STATEMENT FOR WETLAND CROSSINGS

One wetland crossing is proposed. The following construction method is required.

The construction methodology adopted for the watercourse will be dependent on:

- The season within which construction is undertaken; and
- The permanent / semi-permanent saturation status of the wetland.

Ultimately, the method to be adopted by the approaching construction stage will be dictated by the saturation status of the wetland (wet or dry), in order to protect and preserve existing hydrological functionality. At all times, the Contractor must take cognisance of the measures detailed within the Environmental Management Programme (EMPr), Wetland and Riparian Rehabilitation Plan (**Appendix B**) and all other relevant documentation.

General guidelines for construction of the wetland crossing are provided below, following which the sequence to be followed by the Contractor shall be elaborated upon.

8.1 General Guidelines

Before the implementation of any of the proposed mitigation measures / rehabilitation activities, it is important to understand the following general site guidelines and restrictions:

- 1 Indigenous vegetation must not be removed during rehabilitation unless this has been specifically specified for use in vegetation by means of transplanting.
- 2 The site is characterised by erodible soils that are sensitive to disturbance. Site clearing and movement of workers / equipment within the site must therefore be aware of any steep, sandy and unstable slopes and restrict movement and activities where necessary.
- 3 The use of chemicals / herbicides in alien plant control must be strictly restricted to a certified herbicide control applicator only. The application of herbicides must take into account the presence of aquatic systems (stream and riparian zone) on site.
- 4 Water and herbicide solutions must be used instead of diesel and herbicide solutions. Water and herbicide solutions have lower pollution risks when compared to diesel and herbicide solutions.
- 5 The education of field workers is very important as they will be primarily responsible for undertaking the rehabilitation work.
- 6 Workers must be strictly monitored by a suitably trained site supervisor as they undertake rehabilitation.
- 7 All vehicles used to access the site and transport equipment must be restricted to existing disturbed areas only and should not be permitted to move into undisturbed vegetation or habitat.
- 8 Good timing and follow-ups are very important for a successful rehabilitation process which often reduces capital expense in the long-term.
- 9 Basic equipment requirements: alien plant control teams must wear the necessary personal protective clothing (PPE) and use appropriate equipment to do the work.

8.2 Pre-Construction Plant Rescue and Translocation

Prior to commencement of construction, a suitably qualified botanist must be commissioned to undertake a search and rescue for plants of conservation importance (namely *Scadoxus puniceus*, *Dioscorea sylvatica* and *Aloe marlothii*) within the development footprint at the watercourse crossing. The appointed botanist will need identify plants translocation receiving sites and apply for the necessary permits to remove and relocate these plants.

8.3 Site Preparation Prior to Re-vegetation

8.3.1 General Land Preparation Measures

The following are general land preparation requirements for all wetland and riparian areas requiring rehabilitation / re-vegetation:

- All rubble, litter, foreign materials and waste products must be removed from wetlands and riparian areas and disposed of at proper local waste disposal / landfill facilities. Minimise additional disturbance by limiting the use of heavy vehicles and personnel during clean-up operations.
- Any large plumes of sediment washed into the wetlands from upslope must be removed, taking care not to remove or disturb the natural soil profile.
- All Invasive Alien Plants (IAPs) and weeds must be removed from target sites, preferably by uprooting. The Contactor should consult the ECO regarding the method of removal. Herbicides should be utilised where hand pulling / uprooting is not possible. Only herbicides which have been certified safe for use in wetlands / aquatic environments by an independent testing authority may be considered. The ECO must be consulted in this regard.
- All embankments must be shaped to the specification of the project or recommendations of the Engineer / Wetland specialist. Prior to commencing with any re-vegetation activity (e.g. planting / seeding), it is important that disturbed wetlands / riparian areas must be adequately prepared in advance.
- Where significant soil compaction has occurred, the soil must be ripped in order to reduce the bulk density of the soil such that vegetation can establish. Rip and / or scarify all disturbed and compacted areas of the construction site. The ECO with the assistance of the Engineer must specify whether ripping and / or scarifying is necessary, based on the site conditions. Do not rip and / or scarify areas that are saturated with water, as the soil will not break up.
- In addition, any erosion features immediately upslope and / or within the wetland habitats that have been created during the road construction must be stabilised. This must also include the need to deactivate any erosion headcuts / rills / gullies that may have developed. Compacted soil infill, rock plugs, gabions or any other suitable measures must be used for this purpose.
- Immediately after ripping and scarifying disturbed areas, about 300 mm of topsoil must be applied on top. The thickness of the topsoil maybe reduced at the instruction of the engineer only if 300 mm of topsoil compromises the integrity of the works.
- Topsoil must be placed in the same area from where it was originally stripped. If there is insufficient topsoil available from a particular soil zone to produce the minimum specified depth, topsoil of similar quality may be brought from other areas. Where topsoil is lost during construction as a result of erosion, topsoil must be imported to the site and re-established. Such topsoil must be sourced responsibly and legally.

- The topsoil must be compacted to similar compaction levels as natural soils in the area. The Engineer will provide detailed advice on this.
- For seeding, the soil needs to be prepared to optimise germination. This is typically undertaken by hand hoeing to loosen the soil in the seedbed but must be firm enough to facilitate good contact between the seeds and the soil.

8.3.2 Rivers, Road Batters and Roadside Drains

The following are land preparation requirements for river (if encountered), road batters and side drains that need to be taken into account:

- Road batters linked with the R102 interchange and associated road infrastructure range from gentle to steep slopes on which vegetation must be established. Where slopes are gentle, general land preparation requirements will apply but where slopes are steep, soft intervention techniques must be employed to provide sufficient slope stabilisation.
- As a principle, soft interventions must be favoured over hard interventions wherever possible to ensure that the rivers and stream retains their natural flow regimes and habitat.
- The following soft interventions are recommended for steep slopes:
 - Soil savers;
 - Vegetation blankets or mats;
 - Geo-cells; and
 - Fibre rolls or bags.
- It is important to note that bioengineering interventions are vulnerable to failure if not adequately implemented or poorly maintained.
- Retaining structures such as silt fences, sandbags, hay bales, brush packs, timber logs placed in continuous lines following the slope contours or cut-off trenches can be used across the entire slope to retain eroded sediment.
- Use sand bags or timber logs placed at regular intervals along the contour of slopes to retain sediment and stabilize the soils.
- Temporary sediment barriers must remain in place until such time as re-vegetation and stabilization of disturbed areas is judged to be a success and the risk of erosion / sedimentation has been reduced to a respectfully low level.
- Note that care must be taken not to disturb the vegetation, river banks, soils or in-stream areas during site clean-up. No natural material (e.g. sediment, rocks, and stones) from the stream channel or river banks shall be removed during this activity.
- Slope instability or where slumping / erosion of stream banks has occurred, these must be identified and recorded during and immediately after the initial clearing. These areas must then be stabilised / repaired using suitable interventions depending on the extent / intensity of erosion / destabilisation and risk of further bank instability. Potential measures suitable for bank stabilisation may include:
 - Compaction of soils on stream banks by hand (no machinery to be used within sensitive riparian areas);
 - Planting of suitable indigenous ground-cover to stabilise soils on stream banks;
 - Use of rock pack for eroded banks; and
 - Use of gabion baskets for eroded banks.

8.3.3 Wetlands

The following are additional land preparation requirements for wetlands that must be taken into account in addition to the general land preparation measures described above:

- Re-establish the natural water flow patterns within the wetland through re-shaping of disturbed areas.
- The original surface topography of the wetland prior to disturbance must be reinstated as close as possible through appropriate earthworks / landscaping, taking care not to disturb additional wetland areas adjacent to the disturbed zone. The hillslope seepage wetland (C1- W01) must be re-shaped to promote diffuse flows rather than concentrated flows paths. Use of manual labour during re-shaping of the landscape is highly recommended however light construction vehicles (e.g. bobcats) can also be used under strict supervision from the ECO / Wetland specialist.
- Wetland soils are considered highly erodible and sensitive to disturbance, therefore erosion control measures such as soil savers, eco-logs, sand bags and biodegradable silt fences must be installed prior to re-vegetation.
- In general, fertilizer / lime is not necessary nor is it recommended for re-vegetation in wetlands / riparian areas (particularly in wetlands that have inherently lower nutrient levels, as this may promote increased weed growth).
- A weed-free mulch is recommended to help retain moisture for germination. Mulch should be crimped in if possible to limit floatation if flooding is likely to occur. It is very important that mulch not be derived from stands of invasive exotic species or weeds.

8.4 Re-vegetation of Disturbed Areas

Once construction is completed and alien vegetation and waste products have been removed and soils are prepared for planting, vegetation is to be reinstated as soon as weather conditions allow for good plant growth.

8.4.1 Road Batters, Road Reserve and Roadside Drains

Immediately after preparing the soil, re-vegetation must commence in order to help bind the soil and prevent soil erosion and to inhibit IAP / weed establishment which will compete with the natural vegetation for space, light, nutrients and water. In this regard, the following mitigation measures must be implemented for road batters, roadside drains and general road reserves disturbed during construction:

7.4.1.1 Method 1: Sodding

- Runner grass sods composed of indigenous species must be laid out on all road batters and secured in place using wooded pegs. Use of grass sods is the most preferred re-vegetation method because it offers instant protection of vulnerable areas. It is best to install the sod as soon as it is delivered.
- Earthen side drains characterised by low water saturation rates will need to be re-vegetated with grass sods and those characterised by high water saturation rates will need to be re-vegetated with rescued tall robust vegetation such as *Typha capensis* (Common bulrush), *Cyperus dives* (Giant sedge) and *Phragmites australis* (Common reed).
- No exotic / alien plants must be used in sodding.
- Prior to installing sods, rake or harrow to achieve a smooth, final grade.

- When sodding is carried out in alternating strips, or other patterns the areas between the sods should be seeded immediately after the sodding.
- Immediately after re-vegetation, the grass sods must be watered thoroughly. Watering must be undertaken on a daily basis until such time as the sod becomes well rooted within the soil.
- Thereafter, less frequent watering should be sufficient until such time as the vegetation is established to the satisfaction of the rehabilitation implementer and ECO / resident engineer.

7.4.1.2 Method 2: Hydro-seeding

- Hydro-seeding is the second preferred option to re-vegetating slopes. The advantages of hydro-seeding include faster germination, increased plant survival, and the ability to cover large, often inaccessible areas rapidly.
- The slurry (basic materials) for hydro-seeding must consist of water, seed, fertiliser, anti-erosion compounds (soil binders) and organic supplements to enhance grass growth.
- Prior to hydro-seeding water must be sprayed over target area to provide added moisture.
- The target groundcover of re-vegetated areas shall be no less than 80% of specified vegetation and there must be no bare patches of more than 500 x 500 mm in maximum dimension.
- Ideal species for hydro-seeding include runner and short tufted species, such as *Cynodon dactylon* or suitable alternative indigenous grasses species.
- No exotic/alien plants are to be used in hydro-seeding.

Active re-vegetation refers to the manual planting / seeding of vegetation within a wetland and is considered important if there are risks involved in waiting for natural recruitment to occur or in situations where re-vegetation may be useful or even necessary, depending upon the objectives of rehabilitation or the particular conditions at a site⁴. Re-vegetation of different wetlands is likely to require planting mixes and planting strategies specific to a particular bioregion, or even at a local site level⁵. Planting the “wet zone” can be a complicated task that requires consideration of water management levels, restrictions on use of herbicides, equipment limitations, site preparation and a good understanding of the “wetness requirements” for various wetland plants⁶.

8.4.2 Wetlands with Herbaceous Plants

Disturbed herbaceous (i.e. non-woody areas characterised by grasses, sedges, rushes and reeds) at the head of wetland unit C1-W01 will require re-vegetation as soon as the bulk earthworks and side drainage construction is complete. It is recommended that methods of re-vegetation that have proven successful, efficient and cost effective be used. This may include seeding, harvesting and planting of whole plants from nearby donor wetland habitat or planting cuttings from donor sites. Two of the more common wetland planting methods are recommended and are discussed below. A trained wetland rehabilitation expert should be contracted to oversee the re-vegetation of wetland areas and provide input into the selection of appropriate plant species and seeds.

⁴ Russell, W.B., 2009. *WET-Rehab Methods: National guidelines and methods for wetland rehabilitation*. WRC Report No. TT 341/09. Water Research Commission, Pretoria.

⁵ Jacobson, R.L., 2006. *Restoring & Managing Native Wetland & Upland Vegetation*. Minnesota Board of Soil & Water Resources Minnesota Department of Transportation. January 2006.

⁶ Clarkson, B. and Peters, M., 2012. *Wetland Restoration: A handbook for New Zealand Freshwater Systems*. Chapter 10: Revegetation. NSW Murray Wetlands Working Group Inc., Albury NSW.

7.4.2.1 Method 1: Seeding

- Ideally, local grass / sedge seed will need to be harvested, temporarily stored and sown at the appropriate times of year under the guidance of a re-vegetation specialist.
- By planting eco-sourced native plants this will help to maintain the unique local characteristics of native plants in the region and these plants will generally have a greater chance of growing successfully because they are adapted to the local conditions.
- A mix of *Hyparrhenia filipendula*, *Imperata cylindrica* and *Leersia hexandra* grass species is recommended for use in re-vegetation as these are the dominant indigenous species occurring in wetland unit C1-W01.
- *I. cylindrica* is a prolific producer of seeds of which 95% can germinate within one week of being harvested but can also retain viability for at least one year⁷. It can also be grown from rhizomes.
- Seeds can be harvested from undisturbed areas within the wetland, taking care not to unduly disturb these areas.
- No exotic / alien plants must be used in seeding.
- Seed mixtures must be sown at the correct time of year specified for the mixture.
- On application, seeds must be manually / hand broadcasted or can be planted in rows either by hand and then raked in the soil then watered immediately after.
- The seeding rate (seed used in kg/ha) varies according to the method and the type of seed being used. A good rule of thumb is to use twice the amount of seed used for row planting when broadcasting.
- Generally, the small-seeded sedges, rushes, grasses and forbs should be placed near the soil surface as they require light to germinate, whilst the larger-seeded species can be buried deeper and may prefer to be buried.
- The seed should be planted no deeper than 2.5 times the width of the seed but never left lying on the surface of the soil. The more sandy a soil, the deeper the seed should be planted and the more rich in clay a soil is, the shallower the seed should be sown (within the above limits).
- When broadcasting seed it is necessary to lightly cover the seed with soil by hand raking the seed into the soil to ensure the seed has good contact with the soil.
- Avoid sowing or thatching in areas where runoff concentrates (i.e. naturally channelled flow, drains, etc.).
- All planted areas should be mulched preferably immediately following planting, but in no later than 14 days from planting. Mulch conserves water and reduces erosion. The most common type of mulch used is hay or grass that is crimped into the soil to hold it.
- Thorough weed control is essential for the seeding method to be successful, as germinating native seedlings tend to be out-competed by faster growing introduced species.
- Temporary erosion protection measures must only be removed once good vegetation cover has established.

⁷ Santiago A, 1965. *Studies on the autecology of Imperata cylindrica (L.) Beauv. Proceedings of 9th International Grassland Congress, Sao Paulo, Brazil, 1965, 409-502.*

7.4.2.2 Method 2: Transplanting or Planting of Live Plants

- Planting or transplanting of live wetland plants can be used to establish emergent aquatic vegetation in shallow open water, deep marsh and shallow marsh zones where seed can often be difficult to establish in these “wet” zones.
- The timing of planting is best done shortly before or at the beginning of the growing season (i.e. spring, or at the onset/early summer).
- It is recommended that one starts by establishing an interim herbaceous/grass community using easily-establishing ground cover such as fast growing, stoloniferous annual grasses (e.g. *Leersia hexandra*, *Eragrostis ciliaris*, *Isolepis spp.*). This will serve a dual purpose of exerting a competitive influence, thereby inhibiting alien seed recruitment, and stabilizing the bare soil until the natural climax community has established itself. It is anticipated that, with the return of a more evenly distributed hydrological regime, indigenous wetland grasses, reeds and sedges will naturally colonise the rehabilitated area.
- Indigenous sedges (*Cyperus spp.*), spike rushes (*Eleocharis spp.*) and rushes (*Juncus spp.*) are also recommended for use in wetland revegetation because of their aggressive root systems⁸.
- Opportunistic / invasive indigenous species should be avoided where possible (e.g. *Phragmites australis*, *Typha capensis*, *Stenotaphrum secundatum*) unless these characterise the predevelopment wetland template.
- No exotic / alien plants are to be used in re-vegetation.
- The maintenance requirements of individual species should also be considered in plant selection.
- Mono-specific planting should be avoided as diversity is the key to robustness, which will assist in retaining sediment and preventing erosion.
- When sourcing plants from nurseries, it is important to consider the genetic origin of the plants. It is considered best to use small regional nurseries that breed plants from the region, instead of large commercial nurseries that are likely to obtain stock from large regional suppliers.
- When looking at transplanting live plants, select a nearby wetland that is well-vegetated with herbaceous wetland that is characteristic of the region. Sites immediately upstream and downstream of the interchange crossing wetland C01-W01 contain an abundance of potentially harvestable mature plants, including indigenous sedges, grasses, rushes and reeds. If a donor wetland site is to be used, there must be sufficient sites where it is safe to remove plants without seriously damaging the donor wetland. Harvesting of plants must be done with caution so as not to unduly disturb the donor wetland. Material from within stream channels, flow concentration zones or in any other areas susceptible to erosion should not be targeted for plant harvesting.
- For whole / growing plants, ensure that plants are dug up with as much of their roots intact and such that the soil around the roots is not disturbed (i.e. intact root ball). Care also needs to be taken that weeds/alien plants are not transplanted with the donor plants.
- Collected plants should be replanted as quickly as possible following removal (i.e. within a day or two of harvesting).
- Large clumps of plants can be carefully separated into smaller clumps or into several individual stems with attached roots, known as slips.
- A recommended approximate planting density of 1–3 plants per m² generally applies to wetlands.

⁸ Hoag, J.C., 2005. *Wetland Revegetation Planning. Technical Notes: Plant Material*. U.S. Department of Agriculture: Natural Resources Conservation Service. Spokane, Washington. February 2005.

- When using vegetation plugs, the spacing of plugs should not be too wide and planting should be done in patches rather than wider spacing. Its recommended that a spacing of 46- 50 cm centres in patches that are about 3 m² spaced about 3 m apart. Over time the plants will then spread from the planted areas into adjoining unplanted parts of the wetland, particularly along water flow paths.
- The plants should be planted with their roots in as much of the original soil medium as possible from which they were removed and in a water depth similar to that where they were collected.
- Plants in general must be planted with their tops out of the water or they will die.
- When planting the material, dig a hole deep enough to ensure that the roots do not bend upwards.
- The bottom of the root ball should be in contact with the saturation zone.
- The soil around the plant should be firmly compacted.
- Leaves of large plants must be trimmed back to about 10 to 15 cm in length so as to reduce water losses through transpiration.
- Vegetation that has very recently been planted is generally susceptible to being washed away until it has become well established, particularly in areas of permanent water flow or high energy environments. The plants may need to be secured using a coarse mesh (steel wire or plastic) and / or a fine biodegradable mat placed over the vegetation to secure the plants while they become established.
- Temporary erosion protection measures must only be removed once good vegetation cover has established.

8.4.3 Wetlands and Riparian areas with Trees/Woody Species

For all wooded riparian habitats disturbed: once the site has been cleared of alien plants, areas of bare ground (and where dense infestations have been removed), will need to be re-vegetated using a suitable indigenous plant mix. This will be critical in combating slope instability and erosion risks and in suppressing the re-growth of alien seed as well as serving to enhance the biodiversity of the degraded riparian zone of the stream to the south of the site. Trees and shrubs must be planted in the wooded riparian area within the mid to lower reaches of wetland unit C1- W01.

7.4.3.1 Planting in Wooded Riparian Areas

- It is recommended that for each large exotic tree removed / poisoned along the riparian zone, two indigenous tree species be planted. Where large gaps in the riparian areas have resulted (i.e. where indigenous vegetation has been replaced by dense alien plant infestations), it is recommended that herb, shrub and canopy cover components be reinstated appropriately.
- The following tree species mix is recommended for use based on documented indigenous species occurrence within the riparian habitats in the study area and surrounds : *Acacia robusta* (Narrow-pod Robust Thorn), *Albizia adianthifolia* (Flat Crown), *Barringtonia racemosa* (Powder Puff Tree), *Brachylaena discolor* (Silver coastal leaf), *Bridelia micrantha* (Mitzeeri), *Cryptocarya latifolia* (Broad-leaved Laurel), *Ficus burkei* (Common Wild Fig), *Ficus natalensis* (Natal Fig), *Ficus sur* (Broom Cluster Fig), *Hibiscus tiliaceus* (Lagoon Hibiscus), *Macaranga capensis* (Swamp Poplar), *Rauvolfia caffra* (Quinine Tree), *Syzygium cordatum* (Umdoni/Waterberry), *S. guineense* (Water Pear), *Trema orientalis* (Pigeonwood), *Phoenix reclinata* (Wild Date Palm), *Psychotria capensis* (Blackbird tree), *Trichilia emetica* (Natal Mahogany), *Millettia grandis* (Umzimbeet), *Strelitzia nicolai* (Wild Banana) and *Voacanga thouarsii* (Wild Frangipani).
- No exotic / alien trees or plants to be planted.

- The following planting procedures are recommended:
 - All tree holes shall be square in plan (minimum of 600 mm length x 600 mm width x 700 mm deep);
 - Holes are to be backfilled with excavated soil in a ratio of 3:1 with compost. Where possible, any available topsoil should be placed in the hole at the level where the tree root ball will rest.
 - All trees shall be tied (using a tree tie) to a suitable timer stake planted in the ground to a depth of at least 500 mm. The stake shall have a minimum diameter of 35 mm and shall be at least 300 mm taller than the planted tree;
 - The planting of shrubs will be in accordance with the tree planting method with the exception that the holes are to be smaller;
 - Do not plant trees in straight lines but at random with approximately 3-5 m gaps between trees;
 - Water retaining basins / berm of at least 500 mm diameter are to be formed around each tree (do not simply leave the excavated plant hole partially backfilled for this purpose – the berm must be raised above the natural soil level); and
 - The contractor will need to determine the water requirements for trees and whether this will even be relevant for species planted within naturally 'wet' habitats;
- The site should be monitored through visual inspections at regular intervals to determine whether planting has been successful and whether further intervention may be required.

9 METHOD STATEMENT FOR ALIEN INVASIVE PLANTS

An IAP eradication and control programme must be developed for areas disturbed during construction and will need to comprise of the following three (3) phases:

- 1 Initial control phase: This involves the initial, intensive clearing and drastic reduction of existing alien plant infestations at the site. Must be undertaken during the construction period.
- 2 Follow-up control phase: The follow-up phase involves the control of seedlings, root suckers and coppice growth after the initial control phase to control re-growth of alien seed. Must be undertaken during the construction phase through to the rehabilitation phase.
- 3 Maintenance control phase: This final phase involves a programmed control of alien plants to sustain or maintain low alien plant numbers by suppressing regeneration. Depending on the success of the initial phases this maintenance phase may be carried out at intervals ranging from quarterly clean ups to once a year clean-ups. Must be undertaken during the operational phase of the proposed development.

A Method Statement for IAP clearing and control has been compiled and details the requirements and strategy for IAP eradication & control within disturbed terrestrial areas of the site. The method statement is presented below.

Method Statement 1. IAP Eradication & Control for terrestrial areas

1 Planning for IAP Control:

Proper planning and preparations are fundamental to achieving cost-effective and successful IAP control. The following steps must be followed during planning:

- i. The contractor must visit the site and assess the extent of IAP infestation and topographic challenges he will have work in.
- ii. Identify and gather field equipment and personal protective equipment (PPE) required.
- iii. Gather all chemicals required to control IAPs. Only herbicides registered for use on the target species may be used (note that the application of herbicides on different types of alien invasive plant species is limited in South Africa. It is therefore necessary to assess the herbicide's activity such as its residual effect in the soil; its ability to work under wet conditions etc.).
- iv. Train project workers and supervisors on target IAPs and identified clearing methods. This may include: environmental protection with emphasis on aquatic resources, IAP identification; safety training for use of specialised equipment such as chainsaws; specialised training for working in difficult or sensitive terrain and under difficult climatic conditions.

2 Strategy for IAP eradication/control:

The strategy for the removal of IAPs and weeds on the site shall be in accordance with the following practice measures and guidelines for control / eradication of IAPs:

- i. Identify, locate and demarcate Protected indigenous plants (i.e. *Scadoxus puniceus*, *Dioscorea sylvatica*, and *Aloe marlothii*) and large indigenous trees that should be conserved within areas to be cleared.
- ii. Begin clearing at the top of the valley, moving down towards the riparian zone at the southern end of the site.
- iii. Keep the team working in a line, with the daily tasks pegged out where possible.
- iv. Target dense infestations of woody and herbaceous alien plants, focusing on the removal of Invasive Alien Plants (IAPs).
- v. Recommended methods of IAP control and their application are summarised in Box 1, below.
- vi. For large specimens that cannot be easily removed entirely, cut plants as low to ground as possible and apply herbicide to all cut surfaces and exposed roots. The "cut-stump" application method is the safest method of applying herbicides.
- vii. The roots system of large, mature trees (including exotics) often play an important role in stabilising soil and therefore the cutting down or up-rooting of large mature specimens of trees is not generally advocated. It is recommended instead that large exotic trees (such as *Melia azedarach*, *Eucalyptus* sp.) be ring-barked and poisoned / painted with the relevant herbicides.
- viii. All IAPs must be removed carefully and exposed soil should be covered with cut vegetation or leaf litter that is free of weed seeds to ensure that re-growth of alien flora will not occur.
- ix. Press any loosened soil down carefully but firmly and mulch with plant material where possible.
- x. All alien seeds, fruit bulbs, tubers and stems must be stacked and burnt onsite or removed for disposal at a registered land fill for example.
- xi. Stack/move the slashed brush off the stumps to aid herbicide application and re-establishment of indigenous plant species.
- xii. Stack the brush into hips for collection and disposal at a landfill site.

3 Follow-up control:

Follow-up inspections are necessary to ensure the success of the control phase. It is preferable to follow up on an area and remove all seedlings or treat re-sprouting plants, rather than treat a new area.

Follow-up operations must be carried out if inspections establish that initial removal efforts have failed or have had a limited impact.

4 Maintenance:

Maintenance control entails conducting regular control of invasive alien plants. This helps to sustain low alien plant numbers and keep the alien plants in check. Inspections of the site must be carried out every six (6) months.

5 Monitoring requirements:

The site should be monitored through visual inspections at regular intervals to determine whether IAP control has been successful and if further follow-up treatment is required.

Notes on the use of herbicides in IAP control:

Note that herbicide application will need to be carried out strictly in accordance with the manufacturer's specifications and according to current legislation. The following pollution and safety measures must be also adhered to regarding the handling, use and storage of herbicides:

- i. All herbicides, concentrated and diluted, must be stored in a secure and covered area, or offsite under lock and key.
- ii. All containers into which the herbicide or mixers are decanted must be clearly marked and a copy of the original label secured to the container.
- iii. Herbicides must at all times be applied according to the recommendations on the labels.
- iv. All MSDS sheets are to be made available on site along with a fully kitted Medical Aid Kit.
- v. Herbicide equipment must under no circumstances be washed in a local stream, river or wetland Suitable protective clothing like gloves, aprons, overalls and eye protection must be worn by herbicide applicators at all times.
- vi. The correct protective clothing is to be used in line with manufacturer's instructions and/or the Occupational Health & Safety Act, Act 85 of 1993 (and amendments).
- vii. Avoid contact of herbicide with skin and eyes.
- viii. After contact, all applicators must wash their hands with soap and water or as recommended on the herbicide label.

There are various means of controlling invasive alien plants in South Africa. The primary methods are discussed below in Box 1. The suitability of control methods depends on a number of factors, including practical constraints, economic constraints and applicability of methods for particular species of alien plants. It is generally advised that a form of integrated control be implemented, based on a combination of two or more of the control measures outlined below (depending of course on the species present at the site). Selection of the appropriate methods of control should be based on the following criteria:

- Species to be controlled: herbicides are registered for specific species. Selection should be based on "A Guide to the use of Herbicides" issued by the Directorate: Agricultural Production Inputs and labels and information brochures provides by herbicide suppliers.
- Size/age of target plants:
 - For seedlings: hand-pulling or hoeing and foliar applications of herbicides for dense stands.
 - For saplings: hand-pulling or hoeing, foliar applications of herbicides for dense stands, basal stem treatments and cut stump treatments recommended.
 - For mature trees: ring barking, frilling, basal stem treatments and cut stump treatments recommended.
- Density of stands: Overall applications of herbicide can be made to dense stands of seedlings or saplings. Where dense stands of large trees are present, treatment of standing trees may be appropriate to obviate the problem of disposing felled trees.

- Accessibility of terrain: In inaccessible areas, methods that rely on the minimum amount of transportation of equipment and chemicals should be given preference.
- Environmental considerations: Riparian / wetland areas require a careful approach to treatment / control. Only herbicides approved for use in wetland / riparian areas are to be considered because washed-away herbicides often end up in aquatic systems.
- Desirable vegetation: Control methods that will cause the least damage to desirable vegetation must be considered. Selective herbicides or mixes that will not damage other desirable vegetation should be applied where relevant.
- Disposal of dead vegetation: Where possible, utilizable wood should be removed after tree felling. This is also the case for trees that could cause the blockage of water courses. Brushwood should be spread rather than stacked to limit soil damage in instances where burning is planned.
- Cost of application: the cost of application and re-treatment should be taken into consideration when selecting methods/herbicides, etc.

Box 1. Alien Plant Control Methods

The control methods detailed below have been adapted from the ARC-PPRI (Agricultural Research Commission: Plant Protection Research Institute) Weed Research Programme (online at www.arc.agric.za/arc-ppri/), the DWA Working for Water Programme (<http://www.dwaf.gov.za/wfw/Control/>) and eThekweni Municipality's Practical tips on the management and eradication of invasive alien plants (EcoFiles Sheet 4. Local Action for Biodiversity).

1 Mechanical control

Mechanical control entails physically damaging or removing the target alien plant. Mechanical control is generally labour intensive and therefore expensive, and can also result in severe soil disturbance and erosion. Different techniques can be applied and include uprooting / hand-pulling, felling, slashing, mowing, ring-barking or bark stripping. This control option is only really feasible in sparse infestations or on a small scale, and for controlling species that do not coppice after cutting. Species that tend to coppice (e.g. *Eucalyptus* sp., *Melia azedarach*) need to have the cut stumps or coppice growth treated with herbicides following mechanical treatment.

- Hand pulling / uprooting: The hand-pulling should be reserved for small plants and shrubs with shallow root systems (not recommended for trees with a stem diameter of more than 10 cm). Grip the young plant low down and pull out by hand (using gloves). Uprooting is similar but is undertaken on slightly older individuals with the major drawback being that a relatively large area can be disturbed with the soils being altered and opening the area up to re-infestation.
- Chopping / cutting / slashing: This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/trunks. An effective method for non-re-sprouters or in the case of re-sprouts, it must be done in conjunction with chemical treatment of the cut stumps. Cut / slash the stem of the plant as near as possible to ground level. Paint re-sprouting plants with an appropriate herbicide immediately after they have been cut.
- Strip bark: Using a bush knife, strip bark away from tree from waist height down to soil. Cambium is stripped with the bark. No herbicide used.
- Felling: Large trees can be cut-down in their entirety, however, this is often not recommended unless absolutely necessary as large trees can play a pivot role in soil protection and biodiversity maintenance.
- Girdling: Girdling involves cutting a groove or notch into the trunk of a tree to interrupt the flow of sap between the roots and crown of the tree. The groove must completely encircle the trunk and should penetrate into the wood to a depth of at least 1.5 cm on small trees, and 2.5 to 4 cm on larger trees. The effectiveness of girdling can be increased by using herbicides.

2 Chemical control

Chemical control involves the use of registered herbicides to kill the target weed. The use of herbicide is often essential to the success of an eradication/control programme as it greatly reduces the re-growth potential of alien plants. Unfortunately, if the wrong herbicide is chosen, one can potentially cause more harm than good to the environment. When choosing the most appropriate herbicide, one needs to consider the following:

- Relative toxicity to humans / animals
- Selective vs non-selective herbicides: There are advantages and disadvantages to using each type. When dealing with light to moderate infestations in grass-dominated veld types, a broadleaf selective herbicide is recommended so as to reduce the danger that spray drift could kill natural grass. In areas of heavy infestation, a non-selective herbicide is recommended.

- Residual effect: Some active ingredients in herbicides will remain in the environment for months, even years, before denaturing. Others start to denature as soon as they enter the soil. If a persistent herbicide is used, ensure that it is not used near any watercourse or area with a high water table (such as wetlands & riparian areas).
- Is the herbicide registered for the target species: A list of registered herbicides can be obtained from the Department of Water Affairs: Working for Water Programme – Policy on the Use of Herbicides for the Control of Alien Vegetation (January 2002). Also see <http://www.arc.agric.za/arc-ppri/Pages/Weeds%20Research/Specific-IAP-Species-and-theircontrol-according-to-botanical-names.aspx>

Some additional recommendations regarding herbicide use include:

- Herbicides should be applied during the active growing season.
- Always observe all safety precautions printed on the labels and manufacturer's instructions when mixing and applying herbicide.
- Herbicides can be applied in various ways. They can be sprayed onto dense infestations or painted onto the main stem of the plant or cut stump.
- Spraying herbicide on small infestations is not recommended, rather cut and apply herbicide to the stumps either with a brush.
- Spraying should be restricted to windless days when there is less risk of droplets drifting onto non-target species.
- Pressure or flow regulators should be fitted to sprayers for overall application. Spraying should be restricted to plants waist height or lower, but also ensuring there is sufficient foliage to carry the applied herbicide to the root system of the target plant.
- For water-based applications, Actipron Super Wetter should be added where recommended on the herbicide label, at a rate of 1.75 /ha for dense-closed stands of alien vegetation.
- For all water-based treatments, a suitable brightly coloured dye should be added to the mix to ensure that all target plants are treated. For diesel-based applications, Sudan Red Dye should be added.
- Chemical control of IAPs is not recommended in aquatic systems due to the risk of water pollution, but may be used in conjunction with cutting or slashing of plants.
- Chemicals should only be applied by qualified personnel.
- Only herbicide registered for use on target species may be used.
- Follow the manufacturer's instructions carefully.
- Appropriate protective clothing must be worn.
- Only designated spray bottles to be used for applying chemicals.
- The number of herbicides for safe use under wet conditions is very limited.

3 Biological control

Biological weed control involves the releasing of natural biological enemies to reduce the vigour or reproductive potential of an invasive alien plant.

Research into the biological control of invasive alien plants is the main activity of the Weeds Research Programme of ARC-PPRI and a list of biocontrol agents released against invasive alien plants in South Africa can be downloaded from their website. To obtain biocontrol agents, provincial representatives of the Working for Water Programme or the Directorate: Land Use and Soil Management (LUSM), Department of Agriculture, Forestry and Fisheries (DAFF).

4 Mycoherbicides

A mycoherbicide is a formulation of fungal spores in a carrier, which can be applied to weeds in a similar way as a conventional chemical herbicide (using herbicide application equipment). The spores germinate on the plant, penetrating plant tissues and causing a disease which can eventually kill the plant. Mycoherbicides are indigenous to the country of use and therefore are already naturally present in the environment and do not pose a risk to non-target plants. Under natural conditions they do not cause enough damage to the weed to have a damaging impact and are therefore mass produced and applied in an inundative inoculation, which leads to an epidemic of the disease knocking the weed population down. Mycoherbicides need to be re-applied at regular intervals.

5 Integrated control

It is frequently advisable to use a combination of two or more of the control method mentioned above, which is referred to as integrated control. Killing plants without cutting down causes the least disturbance to the soil and is the ideal.

The following integrated control options are available:

- Basal bark and stem application: apply recommended herbicide mixed in diesel carrier to the base of the stem of trees (<25 cm stem height) and saplings. This method is appropriate for plants with thin bark or stems up to 25 cm in diameter. Do not cut the bark. Apply herbicide mix with paintbrushes or using a coarse droplet spray from a narrow angle solid cone nozzle at low pressure. For multi-stemmed plants, each stem must be treated separately.
- Ring barking: Invasive trees growing away from any structures or roads can be ring-barked, poisoned and left standing rather than felled. They will slowly collapse over time and can establish habitat for birds, etc. Strip all bark and cambium from a height of 75 cm to 100 cm down to just below soil level. Cut a ring at the top and pull strips. All bark must be removed to below ground level for good results. Where clean de-barking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatments should be carried out. Bush knives or hatchets should be used for debarking.
- Frilling: Using an axe or bush knife, make angled cuts downward into the cambium layer through the bark in a ring. Ensure to effect the cuts around the entire stem and apply herbicide into the cuts.
- Cut stump treatment: This is a highly effective and appropriate control method for larger woody vegetation that has already been cut off close to the ground. The appropriate herbicide should be applied to the stump using a paintbrush within 30 min of being cut. Apply recommended herbicide mixture to the cut surface with hand sprayers, a paintbrush or knapsack sprayer at low pressure. Apply only to the cambium or outer layer of large stumps and the entire cut surface of small stumps. Ensure the stumps are cut as low to the ground as practically possible (about 10 – 15 cm or as stipulated on specific herbicide label). Herbicides are applied in diesel or water as recommended for the herbicide. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.

- Scrape and paint: This method is suitable for large vines and scrambling plants i.e. creepers. Starting from the base of the stem, scrape 20-100 cm of the stem to expose the sapwood just below the bark. Within 20 seconds apply the herbicide to the scraped section. Do not scrape around the stem. Stems over 1 cm in diameter can be scraped in 2 sides. Leave the vines to die in place to prevent damaging any indigenous plants they may be growing over.
- Foliar spray: This is not an advocated method of application by unqualified applicators due to the danger of spraying indigenous species. Should be restricted to droplet application made directly on the leaves on plants that are no higher than knee height. Use a solid cone nozzle that ensures an even coverage on all leaves and stems to the point of runoff. Do not spray just before rain (a rainfall-free period of 6 hours is recommended) or before dew falls. Avoid spraying in windy weather as the spray may come into contact with non-target plants. Spraying dormant or drought stressed plants is not effective as they do not absorb enough of the herbicide.

6 Disposal of alien plant material

Treated / removed alien plant material will need to be removed from the site and disposed of at a proper / registered receiving area such as a local registered land fill site.



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