NATIONAL ROAD 3: KEEVERS FonTEIN TO WARDEN (De Beers Pass Section)

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ENVIRONMENTAL MANAGEMENT PLAN

DRAFT FOR PUBLIC COMMENT

VOLUME 4

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On behalf of

SANRAL SOC LTD

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1 GENERAL EMP

C1001 SCOPE

The Employer recognises environmental management as a key component of road infrastructure development and as part of its environmental policy has developed this Environmental Management Plan (EMPl) as a tool for continual improvement in environmental performance.

This EMPl prescribes the methods by which proper environmental controls are to be implemented by the contractor. The duration over which the contractor’s controls shall be in place cover the construction period of the project as well as the limited time after contract completion defined by the Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer (1999 edition) published by the Federation Internationale des Ingenieurs-Conseils (FIDIC) as the Defects Notification Period (maintenance period).

The provisions of this EMPl are binding on the contractor during the life of the contract. They are to be read in conjunction with all the documents that comprise the suite of documents for this contract, particularly the conditions of any environmental authorisation and associated Environmental Management Programme (EMPr). In the event that any conflict occurs between the terms of the EMPl and the project specifications or environmental authorisation, the terms herein shall be subordinate.

The EMPl is a dynamic document subject to similar influences and changes as are brought by variations to the provisions of the project specification. Any changes to the EMPl and/or environmental authorisation cannot occur without being submitted to the Employer who will manage the process of seeking approval of the change from the relevant authority.

The EMPl identifies the following:

- Relevant parties and their responsibilities;
- Construction activities that will impact on the environment;
- Specifications with which the contractor shall comply in order to protect the environment from the identified impacts; and
- Actions that shall be taken in the event of non-compliance.
C1002 DEFINITIONS

**Alien Vegetation**: undesirable plant growth which includes, but is not limited to all declared category 1 and 2 listed invader species as set out in the Conservation of Agricultural Resources Act (CARA), 1983 regulations. Other vegetation deemed to be alien are those plant species that show the potential to occupy in number, any area within the defined construction area and which are declared to be undesirable.

**Construction Activity**: any action taken by the contractor, his sub-contractors, suppliers or personnel during the construction process as defined in the contract documents.

**Environment**: the surroundings within which the contract exists and comprises land, water, atmosphere, micro-organisms, plant and animal life (including humans) in any part or combination thereof as well as any physical, chemical, aesthetic or cultural inter-relationship among and between them.

**Environmental Aspect**: any component of a contractor’s construction activity that is likely to interact with the environment.

**Environmental authorisation**: a written statement from the National Department of Environmental Affairs, (DEA), with the general and specific conditions and the EMPI recording its approval of an application for a planned undertaking that triggers listed activities in the Environmental Impact Assessment (EIA) regulations of the National Environmental Management Act (NEMA) as amended.

**Environmental Impact**: any change to the environment, whether desirable or undesirable, that will result from the effect of a construction activity. An impact may be the direct or indirect consequence of a construction activity.

**Environmental Impact Assessment (EIA)**: a systematic process of identifying, assessing and reporting environmental impacts associated with an activity and includes basic assessment and scoping and environmental impact reporting and mitigation of identified negative impacts.

**Environmental Management Programme (EMPr)**: the embodiment of this EMPI to ensure that undue or reasonably avoidable adverse impacts of a development are prevented or reduced, and to ensure that positive impacts are enhanced. It thus addresses the how, when, who, where and what of integrating environmental mitigation and monitoring measures through identified projects.

**Road Reserve**: a corridor of land, defined by co-ordinates and/or proclamation, within which the road, including access intersections or interchanges, is situated. A road reserve may, or may not, be bounded by a fence.
Site: the site is defined in the FIDIC Conditions of Contract and in the scope of works. It is bound by the limits of construction as shown in the drawings or the title of the project and extends to also include the following:

- Areas outside the construction zones where accommodation of traffic is placed;
- All borrow pits and quarries defined in the applications approved by the relevant Department of Mineral Resources (DMR);
- All haul roads constructed by the contractor for purposes of access;
- Any non-adjacent sites specified in the contract documentation; and
- The contractor’s and his subcontractors’ camp sites;

For the purposes of this EMPI includes areas outside of the road reserve that may be affected by construction activities;

Spoil material: is material unsuitable for construction of the road pavement and for which no other useful purpose can be found in appurtenant works on the project (e.g. for the provision of protection berms). Such material is considered as waste material that requires spoiling at convenient areas to be identified by the engineer and/or contractor within the Site. Spoil material does not require removal to a designated landfill site unless it contains identifiable hazardous contaminants.

C1003 LEGAL REQUIREMENTS

a) General

Construction shall be according to the best industry practices, as identified in the project documents. This EMPI, which forms an integral part of the contract documents, informs the contractor as to his duties in the fulfilment of the project objectives, with particular reference to the prevention and mitigation of environmental impacts caused by construction activities associated with the project. The contractor should note that obligations imposed by the EMPI are legally binding in terms of this contract. In the event that any rights and obligations contained in this EMPI contradict those specified in the standard or project specifications then the latter shall prevail.

b) Statutory and Other Applicable Legislation

The contractor is deemed to have made himself conversant with all legislation pertaining to the environment, including provincial and local government ordinances, which may be applicable to the contract.

Major environmental legislation, as amended from time to time, includes but is not limited to the following:
• **Conservation of Agricultural Resources Act (Act No. 43 of 1983)**

This act provides for control over the utilisation of the natural agricultural resources of South Africa in order to promote the conservation of soil, water sources and vegetation, as well as combating weeds and invader plants.

• **The Constitution (Act 6 of 1996)**

The Constitution states that everyone has the right to an environment that is not harmful to their health or well-being, and to have the environment protected through reasonable legislative and other measures to prevent pollution and ecological degradation; promote conservation and ensure ecologically sustainable development and use of natural resources.

• **Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)**

This act makes provision for equitable access to, and sustainable development of, minerals and petroleum resources.

• **National Environmental Management Act (NEMA) (Act No. 107 of 1998)**

This act supports the Bill of Rights within the Constitution and highlights principles of sustainable development including preservation of ecosystems and biological diversity and avoidance, minimisation and remediation of pollution and environmental degradation. It also sets the stage for the EIA Regulations.

• **National Environmental Management: Air Quality Act (Act No. 39 of 2004)**

This act provides reasonable measures for the prevention of pollution and ecological degradation; and provides for specific air quality measures; for national norms and standards regulating air quality monitoring, management and control by all spheres of government.

• **National Environmental Management: Biodiversity Act (Act No. 10 of 2004)**

This act makes provisions to accomplish the objectives of the United Nations’ Convention on Biological Diversity. The Employer may be required to apply for permits to conduct certain listed activities which, together with the listed threatened or protected species, may be identified by the Minister.

Section 73 (3) of this act empowers a competent authority to direct a person to take steps to remedy any harm to biodiversity resulting from the actions of that person or as a result of occurrence of listed invasive species occurring on land on which that person is the owner. Thus the Employer may be directed to remedy harm caused by listed invasive species.
• **National Environmental Management: Protected Areas Act (Act No. 57 of 2003)**

This act provides for the protection and conservation of ecologically viable areas representative of South Africa’s biological diversity, natural landscapes and seascapes.

• **National Environmental Management: Waste Act (Act No. 59 of 2008)**

This act aims to regulate waste management practices through provision of national norms and standards, specific waste measures, licensing and control of waste activities, remediation of contaminated land as well as providing for compliance and law enforcement.

• **National Forests Act (Act No. 84 of 1998)**

This act makes provision for promoting the sustainable management and development of forests, and for the protection of certain forests and trees for environmental, economic, educational, recreational, cultural, health and spiritual purposes.

• **National Heritage Resources Act (Act No. 25 of 1999)**

This act provides for an integrated and interactive system for identification, assessment and management of South Africa’s heritage resources, and empowers civil society to nurture and conserve their heritage resources.

• **National Water Act (Act No. 36 of 1998)**

This act makes provision for the protection of surface water and groundwater and their sustainable management for the prevention and remediation of the effects of pollution, as well as for the management of emergency situations.

**C1004 ADMINISTRATION OF ENVIRONMENTAL OBLIGATIONS**

Copies of this EMPI shall be kept at the site office and must be distributed to all senior contract personnel who shall familiarise themselves with its contents.

Implementation of this EMPI requires the involvement of several stakeholders, each fulfilling a different but vital role as outlined herein, to ensure sound environmental management during the construction phase of a project.

a) **The Employer**

The Employer is the holder of authorisations issued by the relevant environmental regulating authorities responsible for authorising and enforcing environmental compliance. The Employer and anyone acting on the Employer's behalf is
accountable for the potential impacts of the activities that are undertaken and is responsible for managing these impacts.

b) **The Engineer**

The engineer has been appointed by, and acts for, the Employer as its on-site implementing agent and carries the responsibility to ensure that the contractor undertakes its construction activities in such a way that the Employer's environmental responsibilities are not compromised.

The engineer will, within seven days of receiving a contractor's request for approval of a nominated Designated Environmental Officer (DEO), approve, reject or call for more information on the nomination. The engineer will be responsible for issuing instructions to the DEO where environmental considerations call for action to be taken.

If in the opinion of the engineer the DEO is not fulfilling his/her duties in terms of this EMPl, the engineer may, after discussion and agreement with the Employer, exercise his powers under FIDIC general condition of contract and instruct replacement of the DEO in writing and with stated reasons.

c) **The Contractor**

The contractor is responsible for project delivery in accordance with the prescribed specifications, among which this EMPl shall be included.

The contractor shall receive and implement any instruction issued by the engineer relating to compliance with the EMPl including the removal of personnel or equipment.

Compliance with the provisions contained herein or any condition imposed by the environmental approvals shall become the responsibility of the contractor through an approved Designated Environmental Officer (DEO). The contractor shall nominate a person from among his site personnel to fulfil this function and submit to the engineer for his approval the *curriculum vitae* of the proposed DEO. This request for approval shall be given, in writing, at least fourteen days before the commencement of any construction activity clearly setting out reasons for the nomination, and with sufficient detail to enable the engineer to make a decision.

d) **The Designated / Dedicated Environmental Officer (DEO)**

Once a nominated representative of the contractor has been approved he/she shall become the DEO and shall be the responsible person for ensuring that the provisions of this EMPl are complied with during the life of the contract. The DEO shall submit regular written reports to the engineer, but not less frequently than once a month.
The DEO may undertake other construction duties unless the Appendix to Tender prescribes this position as ‘dedicated’ as opposed to the standard position being ‘designated’. Refer to Appendix E, Dedicated Environmental Officer’s Duties. However, the DEO’s environmental duties shall hold primacy over other contractual duties and the engineer has the authority to instruct the contractor to reduce the DEO’s other duties or to replace the DEO if, in the engineer’s opinion, he/she is not fulfilling his/her duties in terms of the requirements of this EMPI. Such instruction will be in writing clearly setting out the reasons why a replacement is required.

As a minimum the DEO shall have an accredited diploma qualification in environmental or natural sciences or equivalent and have a minimum of 2 years’ experience in the environmental regulatory field in construction.

In addition to the compliance duties relating to EMPI the DEO shall also provide full cooperation whenever the contractor is subjected to regular environmental audits.

(Note to compiler: the environmental sensitivity of the project will dictate whether the approved DEO should be able to assume other construction duties, or should be a dedicated officer with no other encumbrances. Such decisions will need to be made in conjunction with the relevant project manager and the Appendix to Tender appropriately completed).

e) Environmental Control Officer (ECO)

The Environmental Control Officer (ECO) is an independent environmental specialist appointed by the engineer to objectively and regularly monitor the contractor’s implementation of this EMPI and the EMPs as may be determined by the sensitivity of the project or by conditions of authorisations. These are ‘internal’ audits and the regularity determined by the environmental approvals, usually once a month. Other ad hoc or ‘external’ audits ordered by the Employer may be conducted by other environmental specialists.

C1005 TRAINING

a) Qualifications

The (DEO) shall have the minimum qualifications as prescribed above, and must be conversant with all legislation pertaining to the environment applicable to the contract. He/she must be appropriately trained in environmental management and possess the skills necessary to impart environmental management skills to all personnel involved in the contract.

The contractor shall ensure that adequate environmental training takes place. All employees shall have been given an induction presentation on environmental
awareness. Where possible, the presentation needs to be conducted in the language of the employees.

b) **Content**

Apart from induction environmental training should, as a minimum, include the course content below and no induction or course should be given until the engineer has been afforded the opportunity to appraise it and provide comment.

- The importance of conformance with all environmental policies and the consequences of departure from standard operating procedures;

- Environmental impacts, actual or potential, caused by work activities, prevention measures to avoid them and mitigation measures when they occur;

- Work force roles and responsibilities in achieving conformance with the environmental policy and procedures and with the requirement of the Employer’s environmental management systems, including emergency preparedness and response requirements; and

- The environmental benefits of improved personal performance.

- **Induction**

In the case of permanent staff the contractor shall provide evidence that such induction courses have been presented. In the case of new staff (including contract labour) the contractor shall inform the engineer when and how he intends concluding his environmental training obligations.

**C1006 ACTIVITIES / ASPECTS CAUSING IMPACTS**

Typical environmental aspects and impacts associated with road construction are listed in Table 1: Aspects and Impacts Associated with Road Construction. Actual impacts will differ from project to project and, therefore, so may the mitigation measures employed. The commonest aspects and impacts are addressed separately and typical avoidance and/or mitigation measures described. The list and descriptions are not by any means exhaustive and they shall be used for guideline purposes only.
Table 1: Aspects and Impacts Associated with Road Construction

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<td>Water pollution; nuisance; visual impact</td>
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<td>Water use and stormwater discharge</td>
<td>Change in flow regime and/or reduction in downstream availability; soil erosion; water pollution</td>
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<tr>
<td>Vehicle use and maintenance</td>
<td>Air pollution; noise</td>
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<tr>
<td>Chemical/fuel storage</td>
<td>Water/air/soil pollution; health impacts; accidents e.g. slips, fire</td>
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<tr>
<td>Site clearing; earthworks; layer-works; seal works</td>
<td>Change in landform; impact on heritage resources; noise; soil erosion; air pollution</td>
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<tr>
<td>River bridges; installing drainage structures</td>
<td>Water pollution; impact on river flows; noise</td>
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<tr>
<td>Land acquisition</td>
<td>Loss of land &amp;/or livelihood; change in land use</td>
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<tr>
<td>Acquisition of road building material from quarries and borrow pits</td>
<td>Change in landform and use, dust, noise</td>
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<tr>
<td>Asphalt Plants</td>
<td>Dust nuisance and air quality, health impacts</td>
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(a) General Approach

The role of the DEO cannot be underestimated and once approved he/she shall be on the site at all times, and before the contractor begins each construction activity he/she shall give to the engineer a written statement setting out the following:

- The type of construction activity about to be started.
- Locality where the activity will take place.
- Identification of the environmental aspects and impacts that might result from the activity.
- The method of impact prevention for each activity or aspect.
- The method of impact containment for each activity or aspect.
- Identification of the emergency/disaster potential for each activity (if any) and the reaction procedures necessary to mitigate impact severity.

- Treatment and continued maintenance of impacted environment.

The contractor shall programme his work in such a way that each cause and effect of a construction activity is also identified and the activity planned so as to prevent any impact from happening and shall demonstrate that he is capable of carrying out any repair and reinstatement of the damaged environment. These requirements shall be concurrent with the time constraints to produce method statements for each construction activity in compliance with the provisions of these project specifications.

The contractor shall provide such information in advance of any or all construction activities provided that new submissions shall be given to the engineer whenever there is a change or variation to the original.

The engineer may provide comment on the methodology and procedures proposed by the DEO, but he shall not be responsible for the contractor's chosen measures of impact mitigation and emergency/disaster management systems. However, the contractor shall demonstrate at inception and at least once during the contract that the approved measures and procedures function properly.

(b) Spillages and Incidents

i) Spillage

Streams, rivers and dams shall be protected from direct or indirect spillage of pollutants such as refuse, garbage, cement, concrete, sewage, chemicals, fuels, oils, aggregate, tailings, wash water, organic materials and bituminous products. In the event of a spillage, the contractor shall be liable to arrange for professional service providers to clear the affected area.

Responsibility for spill containment and treatment (whether hazardous or not) lies with the contractor. The individual causing a spill, or who discovers a spill, must report the incident to his/her DEO or to the engineer. The DEO will assess the situation in consultation with the engineer and act as required. In all cases, the immediate response shall be to contain the spill. The exact treatment of polluted soil / water shall be determined by the contractor in consultation with the DEO and the engineer. Areas cleared of hazardous waste shall be re-vegetated according to the engineer’s instructions. All hazardous waste shall be removed to an approved hazardous waste site that has been accredited to receive the particular grade of waste being disposed of.

Should water downstream of the spill be polluted, which may result in the deterioration or death of fauna and flora, specialist hydrological or ecological advice will be sought by the DEO (who must be familiar with and use the procedures already in place in the existing Incident Management System for the
N3), for appropriate treatment and remedial procedures to be followed as soon as possible after the spill event. The requirement for such input shall be agreed with the engineer. The costs of containment and rehabilitation shall be for the contractor’s account, including the costs of specialist input as well as the sampling and testing of the water quality upstream and downstream of the spill.

Water quality sampling and testing, and further treatment shall continue until upstream and downstream results correspond with each other.

ii) Incidents

These include spillages, accidents, external influences, natural disasters and others and their management will require a register of events, reporting requirements, clean up requirements, disposal, monitoring and close-out after successful rehabilitation and so on.

(c) Water Use and Control

The contractor’s use of water shall take into consideration that it is a scarce commodity, and accordingly the use shall be optimised. Where applicable, authorisation shall be obtained from the Department of Water Affairs (DWA) before water is drawn from streams or new boreholes developed.

The contractor shall also ensure that any stream deviations or diversions are undertaken in such a manner that the impact on the environment is minimised. Method statements shall be submitted to the engineer for comment, detailing how the work will be undertaken, what risks are foreseen and what measures will be employed to minimise such risks. Notwithstanding any comments by the engineer, no work on stream deviations or diversions can commence without written approval from DWA.

The quality, quantity and flow direction of any surface water runoff shall be established prior to disturbing any area for construction purposes. Cognisance shall be taken of these aspects and incorporated into the planning of all construction activities. Before a site is developed or expanded, it shall be established how this development or expansion will affect the drainage pattern. Recognised water users / receivers shall not be adversely affected by the expansion or re-development. No water source shall be polluted in any way due to proposed changes.

Streams, rivers, pans, wetlands, dams, and their catchments shall be protected from erosion and from direct or indirect spillage of pollutants such as refuse, garbage, cement, concrete, sewage, chemicals, fuels, oils, aggregate, tailings, wash water, organic materials and bituminous products.

The contractor shall submit to the engineer his proposals for prevention, containment and rehabilitation measures to guard against environmental damage of the identified water and drainage systems that occur on or near the site.
Consideration shall be given to the placement of sedimentation ponds or barriers where the soils are of a dispersive nature or where toxic fluids are used in the construction process. The sedimentation ponds must be large enough to contain runoff so that they function properly under heavy rain conditions up to 1:5 year severity.

If instructed by the project specification, the contractor shall submit to the engineer the results of monthly testing of water samples taken above and below the site of new culvert or bridge construction. No taking-over can be authorised until the water quality is shown to be at pre-construction levels or better.

(d) **Vegetation Management**

The contractor shall be responsible for the management of vegetation by protection of indigenous vegetation, especially identified protected species, and the prevention of alien vegetation that germinate in areas disturbed by road construction activities within and outside the road reserve. This includes, for example, service roads, stockpile areas, stop/go facilities, windrows and wherever material generated for or from road construction has been stored temporarily and other construction related sites. This responsibility shall continue for the duration of the defects notification period. The project specification may instruct the removal of CARA-listed category 1 and 2 alien species and planting of specified indigenous species.

(e) **Dust Control**

Dust caused by construction activities shall be controlled by means such as water spray vehicles and applied at sufficient frequency so as not to cause a nuisance to adjacent habitation or farming activities and vegetation. Vegetation/grass cover should also be kept for as long as possible to reduce the area of exposed surfaces and consequently dust. Dust emissions from batching, screening plants and stockpile areas shall be subject to the relevant legislation and inspection by the relevant authorities.

(f) **Noise Control**

The contractor shall endeavour to keep noise generating activities and machinery to a minimum. Noise that could cause disturbance, for instance blasting and crushing activities, should only be carried out during the hours prescribed by the conditions of contract (i.e. normal working hours). Should such noise generating activities need to occur at any time outside normal hours, people in the vicinity of the noise-generating activity shall be advised well in advance. The contractor shall endeavour to keep the activities to a minimum. Relevant legislation shall be taken into consideration, and practical mitigation measures adopted. Noise generating activity outside of normal hours, regardless of its proximity to residences, shall not take place without prior approval from the engineer. The engineer shall be informed of the proposed noise containment measures.
(g) **Energy Consumption**

The contractor shall take into consideration the negative cost and emission (such as exhaust fumes from poorly maintained engines and other plant) consequences of high energy consumption. Energy use shall be minimised, and where possible, alternative energy such as solar radiation utilised (such as for heating water for ablution facilities).

Furthermore, the contractor shall undertake a study, in conjunction with the engineer, of the estimated production of the carbon equivalent units of his chosen method of construction. The engineer will provide cooperate in this study that will include monthly the results of which shall be compared followed by efforts to curtail and reduce carbon equivalent emissions.

**C1007 ENVIRONMENTAL MANAGEMENT OF CONSTRUCTION ACTIVITIES**

The contractor shall undertake “good housekeeping” practices during construction as stated in the COLTO Standard Specifications for Roads and Bridges and the FIDIC conditions of contract. This will help avoid disputes on responsibility and promote smooth running of the contract and the protection and care of the natural environment within which the site is situated.

The construction activities below become part of the contractor’s obligations in the programme of work into which the required method statements for workmanship and quality control are incorporated.

a) **Site establishment**

i) **Site Plan**

The site refers to an area with defined limits on which the project is located. The contractor shall establish his construction camps, offices, workshops, staff accommodation and testing facilities on the site in a manner that does not adversely affect the environment. However, before any site establishment can begin, the contractor shall submit to the ECO for his/her comments and to the engineer for his approval, plans of the exact location, extent and construction details of these facilities and the impact mitigation measures the contractor proposes to put in place.

The plans shall detail the locality as well as the layout of the waste management facilities for litter, kitchen refuse, sewage and workshop-derived effluents. The site should not be in close proximity to steep areas, as this will increase soil erosion. Where the route traverses wetlands, streams and rivers, the offices, in particular the ablution facilities, aggregate stockpiles, spoil areas and hazardous material stockpiles are located as far away as possible from any water course. No camp establishment, including satellite camps, can be placed within 32 metres of an identified wetland. Regardless of the chosen site, the contractor’s intended
mitigation measures shall be indicated on the Site Establishment Plan which shall be approved by the engineer before establishment commences. Detailed, digital colour photographic record shall be taken of the proposed site before any clearing may commence. This record shall be kept by the ECO and the engineer for consultation during rehabilitation of the site in order that rehabilitation is, done to a standard that compares favourably to the pre-construction condition.

ii) Vegetation

The contractor has a responsibility to inform his staff of the need to be vigilant against any practice that will have a harmful effect on vegetation.

The natural vegetation encountered on the site is to be conserved and left as intact as possible. Vegetation planted at the site shall be indigenous and in accordance with instructions issued by the engineer. Only trees and shrubs directly affected by the works, and such others as may be indicated by the engineer in writing, may be felled or cleared. In wooded areas where natural vegetation has been cleared out of necessity, the same species of indigenous trees as were occurring shall be re-established. Protected and other trees may not be removed without a permit from the Department of Agriculture, Forestry and Fisheries.

Contravention of a notice of listed protected tree species under the National Forests Act, No 84 of 1998 Government Gazette 29th April 2009 may result in a fine or imprisonment.

Rehabilitation shall be undertaken using only indigenous tree, shrub and grass species. Special attention shall be given to any search and rescue operation identified during the environmental application process, removal to an on-site nursery for continuous nurturing and protection and later replanting. The contractor should be alert to this procedure and apply to the engineer to approve it even though no allowance has been made in the contract documents.

Any proclaimed weed or alien species that germinates during the contract period shall be removed by an approved method before seeding of grasses for soil stabilisation commences.

Fires shall only be allowed in areas where and in facilities or equipment specially constructed for this purpose are available. The need for a firebreak shall be determined in consultation with the engineer and the relevant authorities, and if required an area shall be cleared and maintained around the perimeter of the camp office sites and other construction related areas e.g. Asphalt Plants. The contractor’s staff shall at no time make fires for purposes of keeping out the cold unless they are contained in purpose-built containers capable of preventing runaway fires if knocked over. All the ash from fires shall be collected and disposed of daily in an environmentally acceptable manner.
iii) Water Management

Water for human consumption shall be available at the site offices and other convenient locations on site.

All water effluent including grey water from the camp / office sites shall be treated and disposed of into a properly designed and constructed retention and filter system. The location and discharge from such a system shall not be closer than 32m from streams, rivers, pans and dams.

iv) Heating and Cooking Fuel

The contractor shall provide adequate facilities for his staff so that they are not encouraged to supplement their comforts on site by accessing what can be taken from the natural surroundings. The contractor shall ensure that energy sources are available at all times for construction and supervision personnel for heating and cooking purposes.

b) Sewage Management

Particular reference in the site establishment plan shall be given to the treatment of sewage generated at the site offices, site laboratory and staff accommodation and at all localities on the site where there will be a concentration of labour. Sanitary arrangements and disposal of waste shall be to the satisfaction of the engineer, the local authorities and legal requirements.

Safe and effective sewage treatment will require one of the following sewage handling methods: septic tanks and soak-aways, dry-composting toilets such as “enviro loos”, or the use of chemical toilets which are supplied and maintained by a specialist service provider. The type of sewage management will depend on the geology of the area selected, the duration of the contract and proximity (availability) of providers of chemical toilets. Should a soak-away system be used, it shall not be closer than 800 metres from any natural water course or water retention system. The waste material generated from these facilities shall be removed on a regular basis by an approved contractor. The location of the chemical toilets shall be done in consultation with the engineer.

Toilets and latrines shall be easily accessible and shall be located within walking distance from the works area. Use of the veld for this purpose shall not, under any circumstances, be allowed.

Outside toilets shall be provided with locks and doors and shall be secured to prevent them from toppling over. The toilets shall also be placed outside areas susceptible to flooding. The contractor shall arrange for regular emptying of toilets and shall be entirely responsible for enforcing their use and for maintaining such latrines in a clean, orderly and sanitary condition to the satisfaction of the engineer.
c) Waste Management

The contractor’s intended methods for waste management shall be outlined and implemented at the outset of the contract, and shall be to the satisfaction of the engineer. Opportunities for avoiding, reducing, reusing and recycling of materials should be identified and implemented where appropriate. All personnel shall be instructed to dispose of all waste in the proper manner.

i) Solid Waste

Solid waste shall be stored in an appointed area in covered, tip-proof metal drums or similar container for collection and disposal. Disposal of solid waste shall be at a licensed landfill site or at a site approved by the relevant authority in the event that an existing operating landfill site is not within reasonable distance from the project area. No waste shall be burned or buried at or near the project area.

ii) Litter

No littering by construction workers shall be allowed. Any locality where motorists are encouraged or forced to stop shall be cleared of litter daily. During the construction period, the various contractor’s facilities shall be maintained in a neat and tidy condition and the site shall be kept free of litter. Measures shall be put in place to reduce the litter and prevent its negligent disposal. At all places of work the contractor shall provide litter collection facilities for disposal at approved dump sites.

Particular emphasis on litter control measures shall apply at stop/go facilities.

iii) Hazardous Waste

Hazardous waste such as oils shall be disposed of at an approved landfill site. Special care shall be taken to avoid spillage of bitumen products such as binders or pre-coating fluid to avoid water-soluble phenols from entering the ground or contaminating surface water.

Under no circumstances shall the spoiling of bituminous products occur on the site, over embankments, in borrow pits or by burying, be allowed. Unused or rejected bituminous products shall be returned to the supplier’s production plant. Any spillage of bituminous products shall be immediately removed and the affected areas promptly reinstated to the satisfaction of the engineer.

iv) Construction and Demolition Waste

The opportunity for recycling and re-use of construction and demolition waste as fill for road embankments, land reclamation and drainage control must be explored before the option of declaring these materials a ‘waste’.
The contractor is encouraged to actively engage with authorities and landowners adjacent to the site and identify where such ‘waste’ materials can be usefully deployed to repair existing degraded areas such as erosion dongas.

d) Control at the Workshop

The contractor’s management and maintenance of his plant and machinery will be strictly monitored according to the criteria given below, regardless of whether it is serviced on the site (i.e. at the place of construction activity or at a formalised workshop).

i) Hazardous Material Storage

Petrochemicals, oils and identified hazardous substances shall only be stored under controlled conditions. All hazardous materials such as bitumen binders shall be stored in a secured, appointed area that is suitably fenced, bunded and has restricted entry. Storage of bituminous products shall only be in suitable containers approved by the ECO and the engineer.

The contractor shall provide proof to the engineer that relevant authorisation to store such substances has been obtained from the relevant authority. In addition, hazard signs indicating the nature of the stored materials shall be displayed on the storage facility or containment structure. Before containment or storage facilities can be erected the contractor shall furnish the engineer with details of the preventative measures he proposes to install in order to mitigate pollution of the surrounding environment from leaks or spillage. The preferred method shall be a concrete floor that is bunded. Any deviation from the method will require proof from the relevant authority that the alternative method proposed is acceptable to that authority. The proposals shall also indicate the emergency procedures to be followed in the event of misuse or spillage.

ii) Fuel and Gas Storage

The contractor shall take cognisance of the limits set by legislation for the storage of fuels and acquire the necessary authorisation for storage capacity beyond these. All fuel shall be stored in a secure area in steel tanks supplied and maintained by the fuel suppliers. An adequate bund wall, 110% of volume, shall be provided for fuel and diesel areas to accommodate any leakage or spillage of these substances. The area inside the bund wall shall be lined with an impervious lining to prevent infiltration of the fuel into the soil. Any leakage, spillage or overflow of fuel shall be attended to without delay.

Gas welding cylinders and LPG cylinders shall be stored in a secure, well-ventilated area exterior to any building wall.
iii) Oil and Lubricant Waste

Used oil, lubricants and cleaning materials from the maintenance of vehicles and machinery shall be collected in a holding tank and sent back to the supplier or collected by a reputable recycling company (e.g. the Rose Foundation). Water and oil should be separated in an oil trap. Oils collected in this manner, shall be retained in a safe holding tank and removed from site by a specialist oil recycling company. For the disposal of toxic/hazardous materials refer to C1007 c (iii) and (iv) above. Oil collected by a mobile servicing unit shall be stored in the service unit’s sludge tank and discharged into the safe holding tank for collection by the specialist oil recycling company.

All used filter materials shall be stored in a secure bin for disposal off site. Any contaminated soil shall be removed and replaced with uncontaminated soil of the same type. Contaminated soils shall be collected and disposed of at a facility designated by the local municipality to accept contaminated materials.

e) Clearing the Site

In all areas where the contractor intends to, or is required to clear the natural vegetation and soil, either within the road reserve, or at designated or instructed areas outside the road reserve, a Method Statement shall first be submitted to the engineer for his approval. Working areas shall be clearly defined and demarcated on site to minimise the construction footprint. ‘No-go- areas’ and other sensitive areas shall also be clearly demarcated on site, and staff must be made aware of them.

The plan of action shall contain a photographic record and chainage / land reference of the areas to be disturbed. This shall be submitted to the engineer for his records before any disturbance/stockpiling may occur. The record shall be comprehensive and clear, allowing for easy identification during inspections.

f) Soil Management

i) Topsoil/Top Layer of Soil

Topsoil shall be removed from all areas where physical disturbance of the surface will occur and shall be stored and adequately protected. The contract will provide for the stripping and stockpiling of topsoil from the site for later re-use. Topsoil is considered to be the natural soil covering, including all the vegetation and organic matter. Depth may vary at each site and therefore this shall be as agreed by the ECO and checked before removal to stockpile the minimum depth shall be 150m. The areas to be cleared of topsoil shall include all topsoil stockpile areas. The topsoil stockpiles shall be located and formed in such a way that they do not interfere with the flow of water.

The contractor shall ensure that no topsoil is lost due to erosion – either by wind or water or by being used as fill on the contract. The contractor shall take the
necessary measures to ensure that the areas to be topsoiled will not wash away in rainstorms. Failure to do this shall require that additional soil is brought in for the repair at the contractor’s cost. The contractor’s programme shall clearly show the proposed rate of progress of the application of topsoil and grassing. The contractor’s responsibility shall also extend to the clearing of drainage or water systems within and beyond the boundaries of the road reserve or other contract related sites that have been affected by siltation.

ii) Subsoil

The subsoil is the layer of soil immediately beneath the topsoil or top layer of soil. It shall be removed, to a depth instructed by the engineer, and if not used for road building it shall be stored and maintained separately from the topsoil so that neither stockpile is contaminated by the other. This soil shall be used for rehabilitation purposes.

g) Earthworks and Layer Works

This section includes all construction activities that involve the mining of all materials, and their subsequent placement, stockpile, spoil, treatment or batching, for use in the permanent works, or temporary works in the case of deviations. Before any stripping prior to the commencement of construction, the contractor shall have complied with the requirements of this EMPl. In addition, the contractor shall take cognisance of the requirements set out below.

i) Quarries and Borrow Pits

The contractor’s attention is drawn to the requirement of the Department of Mineral Resources, that before entry into any quarry or borrow pit, an EMPr for the establishment, operation and closure of the quarry or borrow pit shall have been approved by the Department. It is the responsibility of the contractor to ensure that he is in possession of a copy of the approved EMPr, prior to commencement of work on the quarry or borrow pit. The conditions imposed by the relevant EMPr are legally binding on the contractor and may be more extensive and explicit than the requirements of this specification. In the event of any conflict occurring between the requirements of the specific EMPr and these specifications the former shall apply. The cost of complying with the requirements shall be deemed to be included in existing rates in the Pricing Schedule.

ii) Excavation, Hauling and Placement

The contractor shall provide the ECO and the engineer with detailed plans of his intended construction processes prior to starting any cut or fill or layer. The plans shall detail the number of personnel and plant to be used and the measures by which the impacts of pollution (noise, dust, litter, fuel, oil and sewage), erosion, vegetation destruction and deformation of landscape will be prevented, contained and rehabilitated. Particular attention shall also be given to the impact that such activities will have on the adjacent built environment. The contractor shall
demonstrate his “good housekeeping”, particularly with respect to closure at the end of every day so that the site is left in a safe condition from rainfall overnight or over periods when there is no construction activity.

iii) Spoil Sites

The contractor shall be responsible for the safe siting, operation, maintenance and closure of any spoil site he uses during the contract period, including the defects notification period. This shall include existing spoil sites that are being re-entered. Before spoil sites may be used proposals for their locality, intended method of operation, maintenance and rehabilitation shall be given to the ECO for his/her comments and to the engineer for his approval. The location of these spoil sites shall have signed approval from the affected landowner before submission to the ECO and the engineer. No spoil site shall be located within 500m of any watercourse. A photographic record shall be kept of all spoil sites for monitoring purposes. This includes before the site is used and after re-vegetation.

The use of approved spoil sites for the disposal of hazardous or toxic wastes shall be prohibited unless special measures are taken to prevent leaching of the toxins into the surrounding environment. Such special measures shall require the approval of the relevant provincial or national authority. The same shall apply for the disposal of solid waste generated from the various camp establishments. The engineer will assist the contractor in obtaining the necessary approval if requested by the contractor.

Spoil sites will be shaped to fit the natural topography. Depending on availability, these sites shall receive a minimum of 75mm topsoil and be grassed with the recommended seed mixture. Appropriate grassing measures to minimise soil erosion shall be undertaken by the contractor. This may include both strip and full sodding. The contractor may motivate to the engineer for other acceptable stabilising methods. The engineer may only approve a completed spoil site at the end of the defects notification period upon receipt from the contractor of a landowner’s clearance notice and an engineer’s certificate certifying slope stability.

iv) Stockpiles

The contractor shall plan his activities so that materials excavated from borrow pits and cuttings, in so far as possible, can be transported directly to and placed at the point where it is to be used. However, should temporary stockpiling become necessary, the areas shall be indicated on the site plan submitted to the engineer for his approval, together with the proposed measures for prevention of environmental damage, containment and subsequent rehabilitation. This shall be known as the Stockpile Method Statement.

The areas chosen shall have no indigenous trees and shrubs present that may be damaged during operations. Care shall be taken to preserve all vegetation in the immediate area of these temporary stockpiles. During the life of the stockpiles the contractor shall at all times ensure that they are positioned and sloped to create
the least visual impact, constructed and maintained so as to avoid erosion of the material alien vegetation.

After the stockpiled material has been removed, the site shall be re-instated to its original condition. No foreign material generated / deposited during construction shall remain on site. Areas affected by stockpiling shall be contoured, top soiled, seeded with grass and maintained at the contractor’s cost until clearance from the engineer and landowner is received.

Material milled from the existing road surface that is temporarily stockpiled in areas approved by the engineer within the road reserve, shall be subject to the same conditions as other stockpiled materials. Excess materials from windrows, in situ milling or any detritus of material from road construction activities may not be swept off the road and left unless specifically instructed to do so in the contract documentation or under instruction from the engineer.

In all cases, the ECO shall comment on and the engineer shall approve the areas for stockpiling and disposal of construction rubble before any operation can commence and shall approve their closure only when they have been satisfactorily rehabilitated.

v) Blasting Activities

Wherever blasting activity is required on the site (including quarries and/or borrow pits) the contractor shall rigorously adhere to the relevant statutes and regulations that control the use of explosives. In addition, the contractor shall, prior to any drilling of holes in preparation for blasting, supply the engineer with a risk assessment and locality plan of the blast site on which shall be shown the zones of influence of the ground and air shock-waves and expected limits of fly-rock. The plan shall show each dwelling, structure and service within the zones of influence and record the existing positions and conditions of the dwellings/structures/services. This shall include the length and width of cracks, as well as the condition of doors, windows, roofing, wells, boreholes etc. The contractor, alone, shall be responsible for any costs that can be attributed to blasting activities, including the collection of fly-rock from adjacent lands and fields. The submission of such a plan shall not in any way absolve the contractor from his responsibilities in this regard. The contractor shall also indicate to the engineer the manner in which he intends to notify the adjacent communities and/or road users of the times and delays expected for each individual blast.

h) On Site Plant

i) Crusher, Screening Plants and Concrete Batching Plants

Crushing plants and concrete batching plants, whether sited inside or outside of defined quarry or borrow pit areas, shall be subject to the requirements of the applicable legislation that governs gas and dust emissions into the atmosphere. Such sites will be the subject of regular inspections by the relative authorities
during the life of the project. In addition, the selection, entry onto, operation, maintenance, closure and rehabilitation of such sites shall be the same as for those under section C1007 (g) (i) of this EMPl, with the exception that the contractor shall provide additional measures to prevent, contain and rehabilitate against environmental damage from toxic/hazardous substances. In this regard the contractor shall provide plans that take into account such additional measures as concrete floors, bunded storage facilities, linings to drainage channels and settlement dams. Ultimate approval of these measures shall be from the relevant national authority, as shall approval of closure. The engineer will assist the contractor in his submissions to the relevant authority.

The screening of the activities shall be undertaken so that dust and noise is minimised. This can be done by carefully choosing the site for the activity, and by using slightly damp material.

Effluent from concrete batch plants and crusher plants shall be reused where possible or treated in a suitable designated sedimentation dam to the legally required standards to prevent surface and groundwater pollution. The designs of such a facility should be submitted to the engineer for approval. The accumulated settled waste material shall be removed to an approved waste disposal site depending on the nature of the material that shall be analysed to determine whether there are toxic elements present and in what concentration.

The contractor shall invite the relevant department to inspect the site within 2 months after any plant is commissioned and at regular intervals thereafter, not exceeding 12 months apart.

ii) Asphalt Plant

Asphalt plants are a scheduled process listed in the Environmental Impact Assessment Regulations of 2010. The activity triggered by the asphalt for road construction purposes is activity 26 of GN. R. 545, which states: “Commencing of an activity, which requires an atmospheric emission license in terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (Act No 39 of 2004) except where Activity 28 in Notice No R544 of 2010 applies.” Commencing with activity 26 of GN R. 545 requires Scoping and Environmental Impact Reporting (S&EIR) in order to obtain an environmental authorisation. In the event the use of an on-site asphalt plant is considered the contractor shall be responsible to obtain the necessary permit from the Department of Environmental Affairs, regardless of where the site is situated.

Operation of the plant shall conform to the same requirements as for a crushing plant or concrete batching plant under C1007 (h) (i) above.
C1008 AREAS OF SPECIFIC IMPORTANCE

Any area, as determined and identified within the project documents as sensitive or of special interest within the site shall be treated according to the express instructions contained in these specifications or the specific, approved EMPs. The contractor may offer alternative solutions to the engineer in writing should he consider that construction will be affected in any way by the hindrance of the designated sensitive area or feature. However, the overriding principle is that such defined areas that require protection should not be changed. Every effort to identify such areas within the site will have been made prior to the project going out to tender. The discovery of graves or other sites with archaeological or historical interest that have not been identified shall receive ad hoc treatment.

a) Archaeological Sites

If an artefact on site is uncovered, work in the vicinity shall be stopped immediately. The contractor shall take reasonable precautions to prevent any person from removing or damaging any such article and shall immediately upon discovery thereof inform the engineer of such discovery. The South African Heritage Resource Agency (SAHRA) is to be contacted, and a SAHRA-registered archaeological consultant may undertake the necessary work involved to confirm the find and advise on the preservation and removal. Work may only resume once clearance is given in writing by the archaeologist. (Read with FIDIC condition of contract clause 4.24 as).

If a grave or midden is uncovered on site, or discovered before the commencement of work, then all work in the vicinity of the graves / middens shall be stopped and the engineer informed of the discovery. The South African Heritage Resource Agency and the South African Police Services (SAPS) should be contacted and in the case of graves, arrangements made for an undertaker to carry out exhumation and reburial. The undertaker will, together with SAHRA, be responsible for attempts to contact family of the deceased and for the place where the exhumed remains can be re-interred. Alternatively the contractor can appoint specialist contractors who handle this process.

C1009 REHABILITATION

The contractor shall be responsible for the re-establishment of grass within the road reserve boundaries for all areas disturbed during construction. This includes, for example, service roads, stockpile areas, stop/go facilities, windrows and wherever material generated for, or from, construction has to be stored temporarily, and designated or instructed areas outside the road reserve. It also includes the area where site offices were erected which may require rehabilitation at the end of the contract. All construction material, including concrete slabs and barbecue (braai) areas shall be removed from the site on completion of the contract unless written approval from the relevant landowner requests that it is to be left in place.
Responsibility for re-establishment of vegetation shall extend until expiry of the defects notification period. However, the employer reserves the right to continue holding retention monies (or not releasing guarantees in lieu of retention) depending upon the state of vegetation cover at the end of the defects notification period. Such extension may continue until a Closure Certificate for the relevant quarry or borrow pit has been secured.

Rehabilitation of affected areas should be undertaken as early as possible when the relevant activities are done in order to reduce further environmental damage. All re-vegetation should be undertaken using indigenous vegetation. The standard of rehabilitation should be to the satisfaction of the engineer and the relevant authorities. The Department of Minerals Resources will only issue Closure Certificates for borrow pits and quarries when they are satisfied with the rehabilitation undertaken. It should also be noted that in some cases there is a requirement for a final environmental audit covering the extent of the project.

C1010 RECORD KEEPING

The Contractor shall maintain a filing system that meets the project’s Quality Management Plan.

This system should make provision for a) record keeping and b) non-compliance.

i) Record Keeping and Document Control

This would include the latest versions of all documents such as method statements, site plans, authorisations in a central location.

Copies of any authorisations or EMPRs (including those for specific borrow pits or quarries used on the project) shall be kept on site and made available for inspection by visiting officials from the employer, relevant environmental departments or auditors.

ii) Record of Non-compliance

All incidents of non-compliance which will include terms of root cause, nature of non-compliance, the magnitude, actions to be taken, time frames and results of actions.

The engineer and the DEO will continuously monitor the contractor’s adherence to the approved impact prevention procedures and the DEO shall submit regular written reports to the ECO and to the engineer, at least once a month. The engineer shall issue to the contractor a notice of non-compliance whenever transgressions are observed. The DEO shall document the nature and magnitude of the non-compliance in a designated register, the action taken to discontinue the non-compliance, the action taken to mitigate its effects and the results of the
actions. The non-compliance shall be documented and reported to the engineer in the monthly report.

C1011 COMPLIANCE AND PENALTIES

The contractor shall act immediately when a notice of non-compliance is received and correct whatever is the cause for the issuing of the notice. Complaints received regarding activities on the construction site pertaining to the environment shall be recorded in a dedicated register and the response noted with the date and action taken. This record shall be submitted with the monthly reports and an oral report given at the monthly site meetings.

Any non-compliance with the agreed procedures of the EMPr and this EMPi is a transgression of the various statutes and laws that define the manner by which the environment is managed and, therefore, any avoidable non-compliance, dependant on severity, may be considered sufficient grounds for contact to be made with relevant provincial or national authorities to invite their sanction.

The engineer’s decision with regard to what is considered a violation, its seriousness and the action to be taken against the contractor shall be final. Failure to redress the cause shall be reported to the relevant authority. The responsible provincial or national authority may ensure compliance and impose penalties relevant to the transgression as allowed within statutory powers.

Any penalties from the authorities will be passed on to the Contractor should he be found to have been negligent.

C1012 PROJECT SPECIFIC CONDITIONS

Refer to Section 2, Specific EMP of this document.

This Section provides information on the impacts identified together with the sensitive areas along the route in maps and the methods to be applied that mitigate the negative impacts associated with the construction of the new road.

These are:

- A spread sheet of the identified negative impacts of the DBPR and the specific mitigation measures that apply. Refer to Appendix A.
- A map of the overall sensitive areas within the corridor and the surrounding areas and referred to as the Environmental Characteristics Map.
- A map sequence of more detail of the wetlands, the road reserve, noise risk for homesteads, and sensitive areas associated with flora and fauna.
- Method statements and diagrams that relate to specific mitigation for water management and drainage required at points within the road reserve.
2 SPECIFIC EMP

2.1 Introduction

The biophysical environment within the road reserve and in the road corridor has been identified by specialists to have a high biodiversity. This is mainly because of the landform, grassland, rivers, streams and the wetland network which together provide habitats for a number of Red Data listed (rare) animals, birds and plants.

This section of the Environmental Management Plan (EMP) has therefore been developed to address the specific mitigation that shall be applied to areas of high environmental sensitivity, the location of which is delineated on maps and described in method statements that form part of this document.

This section forms part of the Project EMP that comprises of Section 1, Generic EMP and forms part of the contract documentation for the construction of the road.

2.2 Associated Documents

The documents /maps that are part of this Section 2 are:

- Figure 1: Environmental Characteristics Map. This map shows the sensitive areas of the region, Appendix B.

- Figure 2: Wetlands, road reserve and noise risk along the DBPR. This key map is accompanied by 15 maps at larger scale that show the extent of wetlands, noise risk portions and flora and fauna sensitive areas related to the road reserve of the DBPR, Appendix B.

- Table 1-1: Summary of Environmental Impacts and Mitigation, Appendix A.

- Table 1-2: Impact Mitigation for Quarries, Borrow Pits, Concrete Batching Plants and Asphalt Plants, Appendix D.

- Method Statements and Plans for Coffer Dams for Bridge foundations. Access over Wetlands and Large Culverts over Streams, Appendix C.

2.3 Specific Environmental Mitigation Measures

- The Specific Mitigation Measures apply to identified areas within the road reserve and those outside that will need to be avoided or taken into account when areas for site camps, laydown areas and stockpiles, temporary access roads and ancillary works such as asphalt plants and batching plants, are selected.
2.4 Contract Areas

- The ECO must indicate/point out to contractors all sensitive areas that will be excluded from road building and associated activities such as access roads to be used, construction lay-down areas, materials storage and delivery requirements, contractors’ offices, operational demarcation etc. Aspects pertaining to temporary housing for persons involved in the project shall also be included. Material delivery and storage areas should be demarcated. All facilities must be planned to limit the footprint of the area required.

- No camp sites etc. will be allowed within 100m of the edge of rivers, streams and wetlands and highly sensitive areas. These are shown on Figure 2 and Maps in Appendix B.

2.5 Sensitive Ecology and Wetland Areas

Prior to the commencement of construction, the proposed site/s and access routes must be inspected by the DEO and the ECO (where necessary), in order to:

- Confirm the absence or presence of Red Data Species;

- Relocate, demarcate or recommend conservation/preservation measures for any identified ecologically ‘sensitive’ and/or protected species and areas; and

- Point out and/or demarcate all ecological ‘sensitive’ areas to the contractors (e.g. habitats of red data species, rivers, streams, drainage lines, wetlands, sensitive soils, steep slopes and area susceptible to erosion).

2.6 Heritage Areas

All known archaeological sites, graves and sensitive areas in and close to the road reserve identified in the Heritage Assessment Report must be inspected by the DEO or ECO or archaeologist in order to:

- Confirm the absence of archaeological sites and/or artefacts and graves.

- Relocate, demarcate or recommend further actions and measures for any identified archaeological ‘sensitive’ area and/or artefacts prior to the commencement of any work at these sites and areas and

- Point out and/or demarcate all archaeologically and palaeontological ‘sensitive’ areas to the contractors.
2.7 **Temporary Access Roads**

- The final alignment of the access roads required for the construction phase shall be planned with the Land Owner, the engineer and DEO and/or ECO and once finalised only the agreed roads shall be used.

- The agreed roads shall deviate around large trees and sensitive areas and shall be marked out in an approved manner.

2.8 **Vegetation Clearing**

The DEO must be present during vegetation clearing.

a) **Plant Search and Rescue**

- Plant search and rescue (i.e. the location and removal of specified plant species, without unnecessary damage, and their transfer to a specified location, a plant nursery or an area nearby) and the collection of seed shall be conducted by the DEO prior to the onset of any site clearing operations.

- The list of endangered species that can occur along the route has been drawn up by the ecologist and is attached as Appendix F.

- De-stumping shall only occur at the approval of the Engineer in consultation with the DEO or ECO. Where roots can act as erosion protection, trees should be cut as close as possible to ground level.

b) **Vegetation Removal and Trimming in Watercourses**

- No heavy machinery shall be permitted within watercourses to clear vegetation. Clearing of vegetation shall be done by hand. All cleared and trimmed vegetation shall be removed from any watercourse to prevent flooding/snagging hazards being created.

c) **Rehabilitation**

- The engineer, ECO and contractor must agree on rehabilitation of areas. The contractor shall be held responsible for rehabilitation for all areas disturbed during construction. This includes for example temporary access roads, stockpile areas, windrows and wherever material generated for, or from, road construction has to be stored temporarily or otherwise within the road reserve, or at designated or constructed areas outside the road reserve. This responsibility shall extend until expiry of the Defects Liability Period.
2.9 Protection of Fauna

- Under no circumstances shall any animals be handled, removed, killed or be interfered with by the contractor, his employees, his subcontractors’ employees.

- The contractor and his employees shall not bring any domesticated animals onto the site.

- The contractor shall ensure the work site be kept clean, tidy and free of rubbish that would attract animals.

- No poaching or fauna and flora shall be tolerated by the contractor or his personnel on Site. There is a severe fine for those found guilty of setting snares.

2.10 Soil Management

- The contractor is required to strip topsoil together with grass / groundcover from all areas where permanent or temporary structures are located, construction related activities occur, and access roads are to be constructed, etc. This must be read together with the contract specifications and conditions.

- Topsoil must be stockpiled for later rehabilitation of stripped areas.

- Topsoil is to be replaced by direct return where feasible (i.e. replaced immediately on the area where construction is complete), rather than stockpiling it for extended periods.

2.11 Erosion Control

- The contractor shall protect all areas susceptible to erosion and shall take measures, to the approval of the ECO. The contractor shall not allow erosion to develop on a large scale before effecting repairs and all erosion damage shall be repaired as soon as possible.

- The specifics of erosion protection work will vary from situation to situation. These specifics shall be approved by the engineer and comply with contract specifications.

- Where required, cut-off trenches can be installed to divert substantial water run-off and prevent erosion of soil.

- During construction, areas that are susceptible to erosion shall be protected by the installation of temporary or permanent drainage works and energy
dispersion mechanisms that shall be approved by the engineer with consideration to cost, and could include the following:

- Vegetation
- Mitre drains
- Earth berms
- Berms consisting of sand bags
- Earth leveller berms
- Packing branches and rocks in small gullies and disturbed areas
- Storm water drainage measures are required on site to control water runoff and prevent soil erosion.

### 2.12 Slope Protection

- Cut and fill slopes shall be shaped and trimmed to approximate the natural condition and contours as closely as possible and, were possible, be undulating. Levels and form that are out of place in the surrounding landform, shall be reshaped as per the contract specifications.

- Slopes that need protection shall be identified by the ECO and the specifications needed must be established using the latest approved methods and technology.

- Cut slopes in the vicinity if the tunnel portals will require stabilising specially designed for the conditions. The standard cut slope to 1:1.5 (vert:hor) will not be acceptable due to soil type and existing steep slopes. The slope will need to be as steep as practical given the geotechnical characteristics of the in-situ material.

- Methods to be used would be soil nails and steel mesh with gunnite over to hold the steep cut slopes to the road. The slope should have a bench midway up the slope to enable planting of shrubs and to accommodate a longitudinal drain for surface runoff water.

- Retaining walls above and on the sides of the tunnel portals should be extended as need be on the cut side.

- Similarly on the fill side the slope should be benched midway and retaining blocks should be keyed in the fill above by the use of geotextiles or similar.

### 2.13 Excavation, Backfilling and Trenching

- Excavations shall not stand open for longer than 2 days, and should preferably be opened and closed the same day. Excavations shall be marked with tape.
• Removed soil shall be used to backfill areas where required (e.g. such as existing borrow pits).

• Excavated material is to be stockpiled along the trench within the working servitude, unless otherwise ordered.

• Deficiency of backfill material will not be made up by excavation within the protected/site area but shall be made up by importation from an approved borrow pit.

2.14 Access Roads

• Construction staff may only use authorised paths and roads.

• Construction roads must follow existing roads and tracks and should not be wider than necessary with a maximum width of 3m. Should a wider road be required approval of the ECO will be required.

• If two way traffic movement is to take place, passing bays are to be used where specified by the ECO to prevent access/detours into surrounding areas. Drivers delivering construction materials to site are to be made aware that they may not drive off the road to allow another to pass.

• There will need to be continual monitoring of the state of the dirt and tar roads that are used by heavy vehicles related to the construction of the road because the roads are likely to deteriorate. There will need to be regular grading as soon as rutting and potholes occur. There may need to be a substantial repair done to tar roads that have been damaged due to the construction traffic. The condition of the access roads will be included in the monthly audit report by the ECO.

2.15 Service and Refuelling of Construction Equipment

• All maintenance and repair work will be carried out within and area designated for this purpose and shall be equipped with the necessary pollution containment equipment, vessels and bunds.

• The ground under the servicing and refuelling areas must be protected against pollution caused by seepage of spills or overflow.

• The contractor may only change oil lubricant at agreed and designated locations, except if there is a breakdown or emergency repair, and then accidental spillages must be cleaned up and removed immediately.

• In such instances the contractor shall ensure that there is always a drip tray available to collect any spilled oil or vehicle fluid.
- All equipment that leaks must be repaired immediately or must be removed from site.

- Fuel required during construction must be stored in a central depot at the construction camp. This storage area should be located on a slab and be contained within a bund wall capable of containing 110% of the full volume of the containers.

- Temporary fuel storage tanks and transfer areas also need to be located on an impervious surface adequately bunded to contain accidental spills. Appropriate run-off containment measures must be in place.

### 2.16 Solid Waste Management

- An adequate number of ‘scavenger proof’ refuse bins shall be provided at construction sites and at the construction camps.

- These bins must be provided with lids and an external closing mechanism to prevent their contents from blowing out and from being opened by animals.

- The Contractor shall ensure that all personnel immediately deposit waste in the bins provided.

- The Contractor shall not dispose of waste and / or construction debris by burning or burying.

- All construction waste shall be discarded at a registered and approved waste site/landfill facility.

- The Contractor shall maintain ‘good house-keeping’ practices at all the work sites and that the construction camp and office sites are kept tidy and litter free.

### 2.17 Liquid Waste Management

- The Contractor shall take all reasonable precautions to prevent the pollution of the ground and /or water resources on and adjacent to the site as a result of his activities.

- No natural water course spring or seep is to be used for the cleaning of machines, vehicles or any other apparatus. This includes bathing and the washing of clothes.

- The Contractor may discharge ‘clean’ silt laden water overland and allow this water to filter into the ground. The discharge of this water shall not be closer than 32 m from the edge of a water course or a wetland. Refer to map showing wetland extent.
- No spills may be hosed down into a storm water drain or sewer, or into the surrounding natural environment. These shall be removed in-situ from the area and deposited in an approved waste facility or bin. Soil that has been contaminated by the spill e.g. oil shall be removed to a depth below the contamination and clean soil of the same kind shall replace the soil removed.

- Adequate ablution facilities shall be provided at each camp site and together with the sewerage facility shall be located not closer than 32m from the edge of a wetland, stream or river.

- Adequate site toilets chemical or similar, shall be provided on site. These shall be emptied regularly by the supplier and shall be removed from site and their content deposited at an approved sewerage disposal works.

2.18 Water Runoff from Construction Camps

- The Contractor must ensure that rainwater runoff that contains pollutants, does not directly enter natural and sensitive areas such as wetlands streams and rivers.

- Drainage / runoff diversion systems shall be installed to divert runoff from areas that have material that is considered a pollutant to the natural environment. These include batching plants, vehicle washing bays, workshops, chemical stores, asphalt plants and so on.

- This runoff shall be contained in a series of retention ponds/areas where the liquid will be treated, evaporated or pumped into containers and removed from site by an approved service provider.

2.19 Fire

- The Contractor shall take all the necessary precautions to ensure that fires are not started as a result of activities on site.

- The Contractor shall ensure that there is adequate fire fighting equipment at the fuel store and he shall supply all living quarters, site offices, workshop areas, material stores and any other areas identified with suitable, tested and approved fire fighting equipment.

2.20 Dust

- The Contractor shall take all necessary precautions to the satisfaction of the ECO to limit the production of dust from construction activities. This is important as dust has negative effects on crops and livestock and nearby homesteads.
2.21 Noise

- Silencer units are to be maintained in good functioning order on all machinery and vehicles. Vehicles and machinery that do not comply with the manufacturer's noise emission values will be banned from use on site until the levels of noise are met. This is of particular importance given the rural setting and the sensitive breeding and roosting areas for animals and birds in the vicinity of the road reserve.

- The Contractor shall take note of the areas along the road reserve that have been demarcated on the attached plans as having a noise risk to nearby homesteads and therefore take additional precautions to limit construction related noise in those areas at all times during road construction.

- Earth berms 3m high measured from the level at the edge of road surface and side slopes of 1:2.5 will be required on both sides of the road at the Alex Pan Important Bird Area (IBA). The detail of the placement and shape to accommodate road runoff water shall be provided by the Engineer in consultation with the ECO.

2.22 Visual

- Security and area lighting shall be placed and angled such that they do not pose a nuisance due to light spill, to bird roosts, residents and tourists to the area. Light fittings that have their light source recessed will limit light spill or the light should have shields fitted to provide the same effect.

- No painting or marking of natural features shall take place. The marking for surveying and other setting out purposes shall only be done with pegs and beacons.

- All packed rock and exposed rock cuttings shall be treated in order to blend their colour with the colour of the weathered rocks of the adjacent environment.
Figure 1: Environmental Characteristics (A3)
Figure 2: Wetlands along DBPR key plan (A3) for 15 sheets
3  **METHOD STATEMENTS FOR DRAINAGE AND BRIDGES**

Method statements to describe and diagrams to illustrate how the various drainage structures and bridges are installed and erected are provided in Appendix C.

This includes the method statements for:

- Coffer Dams and Bridges
- Construction access over wetlands
- Large Culvert over perennial stream

and drawings for:

- Typical cross section and drainage details
- Typical Drainage details
- Bridge over the Wilge River

### 3.1 References

#### 3.1.1 Environmental Management Plan

- SANRAL Environmental Management Plan for Road Construction Activities.
- N3 EIA Specialist Reports 2014

#### 3.1.2 Coffer Dams and Bridges, Access over Wetlands, Culverts over Perennial Stream

- SANRAL Drainage Manual
- SANRAL Geometric Design Manual
- COLTO Standard Specifications for Road and Bridge Works
- SANRAL Code of Procedures for The Planning and Design of Highway and Road Structures.
4 QUARRIES, BORROW PITS, BATCHING PLANTS, ASPHALT PLANTS

These activities and plants provide materials and process them for road construction and are not confined to the road reserve ‘site’ but are generally some distance away. These activities can be disruptive to the biophysical and natural environment and therefore care must be taken in their site selection and the manner in which their operation is managed. Impacts caused by the activities are both site specific and extend beyond the boundaries of the site.

The Table 1-2: Quarries, Borrow Pits, Batching Plants and Asphalt Plants – Impact and Mitigation explains the impact that can be caused and the mitigation required to reduce or eliminate the impact during the planning, operation and decommissioning stages of the activity.

Refer to Appendix D.
APPENDIX A

SUMMARY OF IMPACTS AND MITIGATION
<table>
<thead>
<tr>
<th>Category of impact</th>
<th>Description of impacts within and outside the Road Reserve</th>
<th>Mitigation measures required</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ENVIRONMENTAL</strong></td>
<td><strong>Biophysical</strong></td>
<td></td>
</tr>
<tr>
<td>Wetlands</td>
<td>1 Water quality negatively affected where road runoff or liquid spill discharges to wetlands.</td>
<td>1a Provide settlement areas such as a gabion weir, to receive road runoff and to slowly discharge to wetland and to hold spill temporarily to allow emergency clean-up crews to neutralise and limit the extent of spill contamination.</td>
</tr>
<tr>
<td></td>
<td>2 Scour and siltation at culverts and pipes in drainage lines crossed.</td>
<td>2a Culvert inlet and outlet to be at the base flow level of the wetland and have erosion and siltation prevention structures or surfaces, e.g. boulder beds.</td>
</tr>
<tr>
<td></td>
<td>3 Interrupted, deviated and reduced flow where road crosses wetlands.</td>
<td>3a Place rock pioneer layer and pipe culverts of sufficient size and number to allow preconstruction subsurface and surface flow in and across wetland to be maintained.</td>
</tr>
<tr>
<td></td>
<td>4 Ground water intercepted by tunnel through porous rock or joints is diverted to other drainage lines.</td>
<td>4a Plan the discharge of water from the tunnel to be directed to the same drainage line down slope that it would naturally have entered.</td>
</tr>
<tr>
<td>Flora</td>
<td>5 Rare and endangered plant species in reserve removed for construction.</td>
<td>5a Remove identified selected plants and or collect seed and propagules, prior to commencement of construction by appointed 'Plant Rescue' team, and place in onsite nursery, grow them out or immediately plant elsewhere in similar habitat. Maintain all</td>
</tr>
<tr>
<td>Category of impact</td>
<td>Description of impacts within and outside the Road Reserve</td>
<td>Mitigation measures required</td>
</tr>
<tr>
<td>-------------------</td>
<td>---------------------------------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>Fauna</td>
<td>Fragmentation of habit and restricted range of movement of large and small creatures as a result of the new road that acts as a barrier. The destruction of habitat in the road reserve of the Sungazer lizard <em>Smaug giganteus</em>.</td>
<td>transplanted vegetation to ensure its survival in the long term.</td>
</tr>
</tbody>
</table>

- **6a** Design culverts and bridges to provide adequate space for the passage for small and larger mammals, reptiles, etc under the road.
- **6b** Direct small reptiles etc. to culverts by use of silt fences or similar.
- **6c** The road reserve shall be scanned for the lizard prior to any construction.
- **6d** The road reserve shall be scanned prior to the commencement of any construction activity for the occurrence of *S. giganteus* populations/individuals.
- **6e** When encountered the area shall be barricaded to prevent any access by vehicles.
- **6f** Record the GPS locality and determine the population size by counting the individuals.
- **6g** Scan the surrounding area for a distance of 200m for any other individuals or populations.
<table>
<thead>
<tr>
<th>Category of impact</th>
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<th>Mitigation measures required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birds</td>
<td>Disturbance of feeding, roosting and breeding birds by noise of vehicles related to nearness to the road.</td>
<td>6h Translocate the population in accordance with the advice provided by a herpetologist experienced in the field of the Sungazer lizard habits. Contact Dr Ian Little of the Endangered Wildlife Trust.</td>
</tr>
<tr>
<td>Physical</td>
<td></td>
<td>7a Avoid the identified sensitive areas by deviation of new construction access roads, construct temporary noise barriers alongside the road or create earth berms 3 m in height to screen the noise and the visibility of the areas from the road. These areas will be identified by the DEO in consultation with the Engineer.</td>
</tr>
<tr>
<td>Noise</td>
<td>Increase in traffic noise disturbs quality of life in residential areas and the rural ambience.</td>
<td>8a Erect noise barrier walls and construct earth berms to visually eliminate views of the road from sensitive areas, such as residential areas and identified roosting and breeding bird areas. These areas will be identified by the DEO in consultation with the Engineer.</td>
</tr>
<tr>
<td>Air quality</td>
<td>Carbon dioxide and nitrous oxide concentrations in the atmosphere in and near the road reserve can become a health hazard.</td>
<td>9a Ensure that the building line is well away from the road reserve boundary to allow for sufficient dispersion and dilution in residential areas.</td>
</tr>
<tr>
<td>Category of impact</td>
<td>Description of impacts within and outside the Road Reserve</td>
<td>Mitigation measures required</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------------------------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td><strong>SOCIAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>Expected increase in sexually transmitted diseases along the new road corridor.</td>
<td>10a Health awareness programmes to be actively introduced to communities and workers at risk along the corridor.</td>
</tr>
<tr>
<td>Safety and Security</td>
<td>A new road corridor across what is essentially an untransformed rural landscape improves access to previously inaccessible locations, increasing the risk of criminal activities at these locations. A large, foreign work force during construction, plus an induced population in search of employment opportunities, and improved access may lead to an increase in criminal activity, especially if job seekers are unsuccessful and remain in the area essentially destitute.</td>
<td>11a Engage with the SAPS and local safety and security firms to devise crime prevention and response strategies.</td>
</tr>
<tr>
<td>Heritage</td>
<td>The disturbance of archaeological sites and the removal of graves within the road reserve.</td>
<td>12a Comply with the requirements of the South African Heritage Resources Act and the KZN Heritage Resources Act for recording, removing, or destroying archaeological sites and graves. Relocate all graves that occur in the road reserve before construction commences in the affected Sections. Identify together with the Contractor, all sites within the road reserve.</td>
</tr>
<tr>
<td>Category of impact</td>
<td>Description of impacts within and outside the Road Reserve</td>
<td>Mitigation measures required</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Paleontological</td>
<td>13 The exposure of geological strata that are known to contain fossils is likely during the excavation of the road bed.</td>
<td>13a Comply with the requirements of the South African Heritage Resources Act and the KZN Heritage Resources Act for recording and removing fossils exposed during the construction of the road.</td>
</tr>
<tr>
<td>Visual</td>
<td>14 The scenic value of the entire length of the DBPR will be compromised by landform change especially the section that is particularly scenic in the vicinity of the escarpment in the Free State and KZN.</td>
<td>14a Design and implement the shape of the cut and fill sections to reduce steep slopes and commit to thorough and effective re-establishment of vegetation and the use of other slope stabilisation methods, e.g. retaining walls, gabions and gunnite. Hard stabilisation methods are to blend in colour and form with the adjacent and surrounding landscape.</td>
</tr>
<tr>
<td>ECONOMICS</td>
<td>15 The value of agricultural land removed from productivity temporarily due to construction of a new road i.e. for access.</td>
<td>15a Discuss and agree with landowners the need for temporary use and agree the solution that will cause the least disruption and the compensation to be paid.</td>
</tr>
</tbody>
</table>

Cave Klapwijk and Associates
APPENDIX B

MAPS OF WETLANDS, ROAD RESERVE, NOISE RISK TO HOMESTEADS
AND FLORA AND FAUNA SENSITIVITY
National Road 3: Keewersfontein to Warden

Environmental Management Plan

Cave Klapwijk and Associates
APPENDIX C

METHOD STATEMENTS
1. INTRODUCTION

- Cofferdams are temporary enclosures to keep out water and soil so as to permit dewatering and construction of the permanent structural elements in the dry.
- A cofferdam involves the interaction of the structure, soil, and water. The loads imposed include the hydrostatic forces of the water, as well as the dynamic forces resulting from currents and waves.
- In the construction of cofferdams it is difficult to maintain close tolerances since cofferdams are usually constructed in flowing water and sometimes under severe weather conditions. Under these circumstances, significant deformations of cofferdam elements may happen during the course of construction, and therefore it may be necessary to deviate from the design dimensions in order to complete the project according to plan and in time.
- The loads imposed on the cofferdam structure by construction equipment and operations must be considered, both during installation of the cofferdam and during construction of the permanent structure itself.
- Removal of the cofferdam must be planned and executed with the same degree of care as its installation, on a stage by stage basis. The effect of the removal on the permanent structure must also be considered. For this reason, it may be advisable that sheet piles extending below the permanent structure are cut off and left in place, since their removal may damage the foundation soils adjacent to the structure.
- In cofferdam construction, safety is of paramount importance, since workers will be exposed to the hazards of flooding and collapse.
- Safety requires that every cofferdam and every part thereof shall be of suitable design and construction, of suitable and sound materials and of sufficient strength and capacity for the purpose for which it is used.
- Proper construction of the cofferdam, verification that the structure is being constructed as planned, monitoring the behaviour of the cofferdam and surrounding area, provision of adequate access, light and ventilation, and attention to safe practices on the part of all workers and supervisors is required.
- Finally, the cofferdam construction shall be properly maintained.
2. **ADVANTAGES OF COFFERDAMS**

Some of the advantages of cofferdams are:

- Allows excavation and the construction of structures in otherwise poor environment.
- Provides safe working environment.
- Contractors typically have design responsibility.
- Sheet piles are easily installed and removed.
- Materials can often be re-used on other parts of the same project or other projects.

3. **INSTALLATION OF COFFERDAMS**

Piling operations require completion of the following stages for successful construction:

- Competent site investigation, sampling and relevant testing to build up an informed picture of the task.
- Adequate design of all the stages of the construction.
- Proper setting out and installation of the piles.
- Strict adherence to all health and safety requirements.
- Items needed for installation are:
  - Pile driving hammer. (vibratory or impact)
  - Crane of sufficient size.
  - Steel sheet piles.
  - Wide-flange beams for wales and stringers.
  - In specific cases, barges may be required for efficient installation.

4. **IMPOSED LOADS ON COFFERDAMS**

A typical cofferdam will experience several loading conditions during installation and during the various construction stages. The significant forces are:

- Hydrostatic pressure
- Pressures due to soil loads
- River currents
- Wave forces from floods
- Ice forces
- Seismic forces
- Accidental loads
5. CONSTRUCTION METHOD AT EACH FOUNDATION

- Pre-dredge to remove soil or soft sediments and level the area of the cofferdam.
- Drive temporary support piles.
- Temporarily erect bracing frame on the support piles.
- Set steel sheet piles, starting at all four corners and meeting at the centre of each side.
- Drive sheet piles to grade.
- Block between bracing frame and sheets, and provide ties for sheet piles at the top as necessary.
- Excavate inside the grade or slightly below grade, while leaving the cofferdam full of water.
- Drive or otherwise construct bearing piles.
- Place rock-fill as a levelling and support course.
- Place underwater tremie concrete seal.
- Check blocking between bracing and sheet piles.
- Dewater.
- End of cofferdam construction.
- Construct new foundation and substructure.
- Start of cofferdam removal.
- Flood cofferdam.
- Remove sheet piles.
- Remove bracing.
- Backfill as required.

6. CONCLUSION

Every cofferdam is unique and requires thorough analysis. The designer must take into account a large number of parameters. The design must be compatible with the weather conditions, waves, currents, construction equipment, construction methods, permanent structures and ground conditions.

As soon as reliable geotechnical information is available, comparable cost studies should be analysed to determine if the cofferdam method should be favoured over other techniques, such as pre-cast or caisson construction.
PERMANENT OR CONSTRUCTION ACCESS OVER WETLANDS

1. INTRODUCTION

Understanding wetlands and their hydrologic function is a specialist field of study. When construction activities cross wetlands, very careful investigations and planning must be executed in order to establish and limit the overall effect of the final product on the wetland. Best management practices (BMP) must be applied to construct access without serious long term impact on the natural functioning of the particular wetlands.

There are presently two accepted methods of providing access for crossing wetlands:

- Permanent road must be built on a porous fill with properly designed cross drainage to minimize the impact. This will require very careful planning, collaboration with environmental experts, and execution.
- Temporary access required for construction purposes, such as for bridge foundations and substructures, involves making use of decks or mats designed and supplied by Specialist Suppliers to construct a temporary roadway for the construction vehicles.

2. CONSTRUCTION METHOD FOR PERMANENT ROADS CROSSING WETLANDS

- Establish depths of wetland bottom at various chainages along the road.
- Establish approximate bearing capacities of soil at bottom of wetland.
- If required, excavate further to acceptable bearing capacities.
- Lay down a layer of suitable geo grid.
- Lay down a double layer of suitable geotextile to road bed width plus 1m and fold open.
- Place rock fill, size between 50mm and 150mm to width of road bed. Top of layer not to extend above required culvert invert levels.
- Fold geotextile back over rock fill and tuck in on other side.
- Construct road sub-base layers to specified compactions.
- Construct base course layers to specified compaction.
- End of roadway construction.

3. CONSTRUCTION METHOD FOR CULVERTS ON PERMANENT WETLAND CROSSINGS

- Trench for culverts at the specified positions down to grade but not less than 300mm above top geotextile layer.
If required that the culvert invert be lowered further, carefully excavate by hand ensuring that the geotextile is not damaged.

- Construct culvert bedding to correct fall and specification.
- Lay culvert to correct crossing angle and fall.
- Backfill according to the specifications indicated on the construction drawings with material approved by the engineer.
- Perform required compaction tests on all backfill material.
- Repeat process for all culverts.
- End of culvert installations.

4. CONSTRUCTION METHOD FOR TEMPORARY ACCESS OVER WETLANDS USING DECKS OR MATS

- Mark out temporary access LH edge line. (direction of increasing chainage)
- Use DURA-BASE Composite Mat System or other Deck/Mat system approved by the Engineer.
- Lay mats to 3 overlapped widths along complete route.
- Where wider work areas are required, lay extra mats as needed.
- Lock all mats in position with the twist lock or other specified fasteners.
- If a proprietary Deck system is approved, construction and fasteners must be in accordance with the Supplier’s specifications.
- End of mat/deck access surface construction.

5. CONCLUSION

Road-planning and road-building practitioners understand wetlands and their hydrologic functions. However, Inputs from environmental experts must be incorporated in the design process.

Where bearing capacity permits, it is possible to construct a permeable road base from large aggregate to allow for water movement under the road. Geotextile can be used to contain the rock fill and to ensure that it does not get clogged by fine material.

Culverts can be used for streams with well-defined channels or for balancing water to either side of the road in the absence of defined channels. Installing a battery of culverts, or placing culverts at a set spacing may be a cost effective alternative or addition to a permeable layer. Bridges are used over defined channels within wetlands.
CONSTRUCTION OF A LARGE CULVERT OVER A PERENNIAL STREAM

1. INTRODUCTION

Culverts are used to:

- Transfer water from one side of the highway (or road) to the other;
- Equalize ponds and marshes on both sides of a road; and
- Permit cattle, wildlife or vehicles to pass beneath the road.

2. PLANNING OF CULVERT STRUCTURES

Planning the construction of culverts over a perennial stream requires attention to the following:

- Culvert construction may affect all or any of water quality, navigation, wetlands, flooding, agricultural drainage, erosion, fish, other aquatic organisms, bird nesting, endangered species habitat, and natural scenic beauty.
- Appropriate storm water soil erosion control.
- Culvert size and placement, fish passage, and flow control during installation.
- For large culverts concrete and corrugated metal pipe structures is a cost effective option.
- When considering a fish passage, corrugated metal culvert pipes are preferred over smooth bottom culverts in shallow water conditions and steep slopes. The corrugated surface slows down water velocity, making it more fish friendly. Nevertheless metal culverts are not recommended where significant load bearing and longevity are required.
- Pipe culverts may be circular, elliptical or even pipe arches. Circular is the most common shape, but it may be necessary to use other shapes, or multiple smaller pipes, when roadway height is a constraint.
- Selection of culvert shape is based on water depth, roadway embankment height, hydraulic performance, and fish and wildlife concerns.
- When closed section pipes are used, the invert of at least one pipe per culvert should be buried 150mm to 300mm into the stream bed and aligned with the stream channel as close as possible, to cater for wildlife and low-flow periods.
- Where fish and wildlife migration is a major concern, open-bottom culverts are preferred. However, bottomless structures are generally 30% to 50% more expensive than circular or oval pipes and require concrete support footings. The creation of a bypass or similar arrangement must also be considered during installation.
- On certain high-value streams, bridges are the preferred option.
3. **POSSIBLE CAUSES OF FAILURE**

Attention must be given to the follow to avoid possible failure of installed culverts:

- Inadequate culvert capacity.
- Structural failure due to excessive soil loading.
- Washout due to water overtopping the road.
- End scouring from poor end treatment.
- Improper jointing resulting in water piping along the outside of the culvert.
- Erosion due to excessive water transport of sand and gravel.
- Corrosion from acid or salt laden soils and water.
- Improper end walls resulting in embankment failures.
- Poor installation and/or bedding condition resulting in settlement, joint separation, or structural failure of the culvert.

4. **INSTALLATION OF CULVERTS**

Culvert installation requires completion of the following stages for successful construction:

- Competent site investigation, sampling and relevant testing to build up an informed picture of the task.
- Adequate design of all the stages of the construction.
- Channelization of the stream with the minimum possible alteration to the natural stream flow in order to enable construction work to proceed.
- Proper alignment of the culvert with the stream channel to prevent erosion and also to facilitate fish and wildlife migrations.
- All Environmental as well as Health and Safety requirements and good practice must strictly be adhered to.
- Items needed for installation are:
  - Excavators
  - Crane of sufficient size
  - Compacting equipment
  - Culvert components
  - Equipment for construction of foundations where required
  - Equipment for construction of inlet- and outlet end walls

5. **CONSTRUCTION METHOD FOR CULVERTS**

- Relocate the stream channel to facilitate construction of the culvert in the dry.
- Set out crossing angle for culvert in relation to road alignment.
- Excavate culvert trench inside the grade or slightly below grade.
- Construct foundations where required for bottomless structures.
• Place and compact bedding in accordance with specifications and drawings.
• Place culvert components, ie pipe sections, box sections or arch sections, to correct levels and falls and secure.
• Ensure adequate anchorage of the culvert components against flood forces.
• Backfill either side of the culvert (and also between barrels where required) in accordance with the specifications.
• Backfill over the culvert in accordance with the specifications.
• Construct road layers.
• Construct inlet- and outlet end walls.
• Relocate channelization back to original stream channel.
• Re-instate stream bed and embankments as well as possible.
• End of culvert construction.

6. CONCLUSION

Every culvert is unique and requires thorough analysis. The design must be compatible with the stream type, stream flow, fish and wildlife requirements, construction equipment, construction methods, culvert structures and ground conditions.

As soon as reliable geotechnical information is available, comparable cost studies should be analysed to determine if the chosen culvert option is economically acceptable.

For streams crossing existing major roads, other methods of culvert installation such as jacking, boring or tunnelling may prove to be economical due to cost of traffic control and disruption of services added to normal construction.

7. REFERENCES

• SANRAL Drainage Manual
• SANRAL Geometric Design Manual
• COLTO Standard Specifications for Road and Bridge Works
• SANRAL Code of Procedures for The Planning and Design of Highway and Road Structures.
APPENDIX D
QUARRIES, BORROW PITS, BATCHING PLANTS, ASPHALT PLANTS - IMPACT AND MITIGATION
### TABLE 1-2

<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
| **AIR QUALITY**      | • The generation of large quantities of dust is a characteristic of quarries and crusher plants. Particularly in the case of the latter as the process needs to be dry. The dust generated by blasting is not continuous as there is usually one blast a day in an established quarry.  
  • Additional dust generators are the trucks and heavy machinery used to transport, drill and move material around. | • Wet down all soil surfaces on the site and gravel access roads to the site regularly. The frequency will depend on the weather and the dust generated.  
  • The monitoring of dust fallout on the boundaries of the site may be required to establish the effectiveness of mitigation measures, near dust sensitive environments such as residential areas.  
  • Install water sprays at the crushers and their discharge points.  
  • Ensure that workers in dusty areas have dusk masks. |
| **WATER QUALITY**    | • Water quality is compromised in the local streams when rain carries silt and blasting chemical laden water beyond the quarry, crusher and aggregated storage sites.  
  • Where quarry sites are on steeper terrain the volume of water is considerable and extensive erosion and deposition of silt can result. | • Separate the clean water runoff from the contaminated water runoff and direct the latter to retention ponds where the water quality can be tested to determine the appropriate treatment to comply with the DWA standards.  
  • Draw up a water runoff management plan that ensures high runoff does not cause erosion and silt deposition lower in the landscape.  
  • Construct catch pits for the collection of water from the |
### ASPECT | IMPACTS | MITIGATION
--- | --- | ---
**WASTE PRODUCT** | • Waste from ablution facilities on site will require removal. | • Where a septic tank is used for the ablution facility the content must be cleared by a municipal waste tanker at least twice a month, and disposed of at the nearest Waste Water Treatment Plant.  
• Where chemical toilets are used these are not considered to be ‘treatment of waste on site’ and no license is required under the Waste Act. These facilities are to be cleared of waste under contract of the supplier.

• Water contaminated with oils and diesel is generated from the washing bays where vehicles are cleaned. | • Truck washing bays into a main collector tank that will settle the fines. Recycle the water to the wetting down of areas.  
• At workshops where vehicles are cleaned, collect the water in a sump and separate the oil from the water using skimming devices. Contract the services of an oil recycling firm to remove the oil waste.  
• Construct catch pits at the transfer points of diesel and connect these pits to the central tank that holds the runoff from the workshop wash bay.  
• Remove the soil that has been contaminated by oil, diesel, bitumen and place in a specially bunded area where it can be treated with Ecosorb or similar organic compound that biodegrades the contaminant.  
• Bund areas that store hazardous material so that spillage is contained and easily dealt with.
<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
| SOIL     | • Loss of the top layer of soil that has organisms, nutrients and a seed bank.  
• Contamination of soil is caused by the spillage of diesel and oils when these are transferred to vehicles.  
• Contamination of soil is caused by the spillage of the granular blasting agent as this is pumped into the drill holes.                                                                                                                                                                                                                                                                                                                                                     | • Strip the entire area of the quarry, crusher and aggregate store areas of the top layer of soil (minimum 300mm) and stockpile to the sides of the planned extent of the entire operation, for later use in the rehabilitation.  
• Remove soil that has been contaminated by oil or diesel and place in a specially bunded area where it can be treated with Ecosorb or similar organic compound that biodegrades the contaminant.  
• Replace the removed soil with uncontaminated soil.  
• All soil contaminated with substances that are considered noxious should be removed as soon as possible after the spill to limit the depth that the contaminant will move down the soil profile.  
• The storage tanks of each hazardous good such as diesel shall be placed on a concrete slab that has a bund wall of sufficient height to contain 110% of the total stored volume of each substance.                                                                                                                                                                                                                   |
| NOISE    | • The high impact noise of the quarry operation is the blast to break the rock.  
• The continuous noise is generated by drilling rigs as they bore holes for the explosives and the various crushers that produce the                                                                                                                                                                                                                                                                                                                               | • Ensure that all vehicles and machinery that are involved in the quarrying and transport have silencers that reduce the noise of the engine exhaust to the manufacturer’s specification.  
• Locate the crushing plant away from sensitive noise receivers.  
• Attempt to arrange that the blasting time is |
### ASPECT | IMPACTS | MITIGATION
--- | --- | ---
**VISUAL** | - The greatest visual impact of a quarry is the alteration of the landform.  
- The operation or production stage is characterised by the activity of the machinery, the stockpiles of material and the constant plumes of dust from the crushers.  
- The structures of the crushing plant, the stockpiles and the quarry can occupy areas of 3 to 5 ha and because of the industrial form and image are visually intrusive in most settings | - Create earth berms using the stripped topsoil and overburden to screen views of the quarry and crushing plant along the side of the property that will have the greatest visual exposure.  
- Use shade cloth to clad the fence that should be at least 1.5 m high, along the side of the property that will have the greatest visual exposure.  
- Maintain a tidy site at all times.  
- Avoid using the site limits as a temporary storage of waste or damaged products.  
- Paint the site buildings a colour that blends in with the surrounding land use.  
- Progressively rehabilitate the quarry site according to the approved rehabilitation and closure plan.  
- Prepare the soil well to support a vigorous growth of grass or similar crop. Follow up with maintenance of the rehabilitated areas until acceptable cover of 80% is reached and continue until a closure certificate has been issued by the Dept. of Mineral and Petroleum Resources.  

aggregate.  
approximately the same each day within working hours and announce the time by a siren before each blast is set off.
<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BORROW PITS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIR QUALITY</td>
<td>• The generation of large quantities of dust is a characteristic of borrow pits. The dust is generated by excavation, loading and transporting the material.</td>
<td>• Wet down all soil surfaces on the site and gravel access roads to the site regularly. The frequency will depend on the weather and the dust generated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• The monitoring of dust fallout on the boundaries of the site may be required to establish the effectiveness of mitigation measures, near dust sensitive environments such as residential areas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Ensure that workers in dusty areas have dusk masks.</td>
</tr>
<tr>
<td>WATER QUALITY</td>
<td>• Water quality is compromised in the local streams when rain carries silt laden water beyond the borrow pit sites.</td>
<td>• Ensure that the clean water runoff upslope is diverted around the edge of the pit. Direct water in the pit to a low point from where it will be pumped. Make provision for the pit to be self-draining after rehabilitation wherever possible.</td>
</tr>
<tr>
<td></td>
<td>• Where borrow pits are on steeper terrain the volume of water is considerable and extensive erosion and deposition of silt can result.</td>
<td>• Draw up a water runoff management plan that ensures that the pit does not receive water from upslope and discharge pumped water from the pit over vegetated areas.</td>
</tr>
<tr>
<td></td>
<td>• Water contaminated with oils and diesel spill will be carried into the nearby drainage lines and end up in local streams.</td>
<td>• Remove the soil that has been contaminated by oil and diesel, and place in a specially bunded area where it can be treated with Ecosorb or similar organic compound that biodegrades the contaminant.</td>
</tr>
<tr>
<td></td>
<td>• Ablution facilities are portable chemical toilets that are serviced by</td>
<td></td>
</tr>
<tr>
<td>ASPECT</td>
<td>IMPACTS</td>
<td>MITIGATION</td>
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<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>WASTE PRODUCT</td>
<td>The waste product of a borrow pit is the overburden (the material between the top layer of soil and the material required). This material is stored on site to be used in the rehabilitation of the borrow pit, it is not classified as a waste product.</td>
<td>Where chemical toilets are used these are not considered to be 'treatment of waste on site' and no license is required under the Waste Act. These facilities are to be cleared of waste under contract of the supplier.</td>
</tr>
<tr>
<td>SOIL</td>
<td>Contamination of soil is caused by the spillage of diesel and oils from machinery or trucks on site.</td>
<td>Strip the entire area of the borrow pit of the top layer of soil (minimum 300mm) and stockpile to the sides of the planned extent of the pit for later use in the rehabilitation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remove soil that has been contaminated by oil, diesel or bitumen and place in a specially bunded area where it can be treated with Ecosorb or similar organic compound that biodegrades the contaminant.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Replace the removed soil with uncontaminated soil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All soil contaminated with substances that are considered noxious should be removed as soon as possible after the spill to limit the depth the contaminant will move down the soil profile.</td>
</tr>
<tr>
<td>NOISE</td>
<td>The noise of the excavators as these load haul and dump material into the trucks.</td>
<td>Ensure that all vehicles and machinery that are involved in the quarrying and transport have silencers that reduce the noise of the engine exhaust to the</td>
</tr>
</tbody>
</table>
### Visual Impacts
- The greatest visual impact of a borrow pit is the alteration of the landform through excavation and the stockpiled topsoil and overburden.
- The operation stage is characterised by the activity of the machinery that generates dust. This is also a visual element.
- Create earth berms using the stripped topsoil and overburden to screen the borrow pit along the side of the property that will have the greatest visual exposure.
- Maintain a tidy site at all times.
- Avoid using the site limits as a temporary storage area for waste or damaged products.
- Progressively rehabilitate the borrow pit site according to the approved rehabilitation and closure plan.
- Prepare the soil well to support a vigorous growth of grass or similar crop. Follow up with maintenance of the rehabilitated areas until acceptable cover of 80% is reached and continue until a Closure Certificate has been issued by the Dept. of Mineral and Petroleum Resources.

### Asphalt Plants
**Air Quality**
- As a result of heating the rotating drum with fuel oil and the addition of heated bitumen and aggregates, the discharge from the stack will contain the following substances (The following are known as Criteria Air Contaminants (CAC)):
  - Dust

  ✓ Wet down all soil surfaces on site and gravel access roads to the site regularly. The frequency will depend on the dust generated. Surface the entire area of the site with Reclaimed Asphalt as this becomes available. Later
### ASPECT

<table>
<thead>
<tr>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
| Particulate Matter (PM)  
(Total - TPM, <10 microns - PM10, and <2.5 microns - PM2.5)  
Nitrogen oxides (NOx)  
Includes nitrogen oxide (NO) and nitrogen dioxide (NO2). NOx is formed primarily from the liberation of nitrogen contained in fuel and nitrogen contained in air during combustion processes. NO emitted during combustion quickly oxidizes to NO2 in the atmosphere. NO2 dissolves in water vapour in the air to form acids, and interacts with other gases and particles in the air to form particles known as nitrates and other products that may be harmful to people and their environment.  
Sulphur Oxides (SOx)  
Sulphur dioxide, or SO2, belongs to a family of sulphur oxide gases (SOx). It is formed from the sulphur contained in raw materials such as coal, oil and metal-containing ores during combustion and refining processes. SO2 dissolves in water vapour in the air to form acids, and interacts with other gases and particles in the air to form | remove the RA as part of the rehabilitation programme.  
Ensure that the bag filters are undamaged and are in the required condition to filter the dust to the specified limits.  
Place the plant and the aggregate stockpiles downwind of sensitive receivers.  
Cover the stock piles of aggregate with tarpaulins to limit dust dispersion during high winds.  
At aggregate transfer points on conveyer systems enclose this area to limit dispersion by wind. Where the situation requires, strict control of fugitive dust may require extractor fans with the exhaust discharging to a bag filter or a purpose made hood to limit dispersion.  
Emissions  
Ensure that the plant is operating at the specified standard with regard to the fuel and bitumen usage.  
Prevent spillage of diesel particularly when the transfer of this substance is carried out.  
Monitor emissions of plant at regular intervals to determine the efficiency of the emission control. |
<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>particles known as sulphates and other products that can be harmful to people and their environment.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Carbon Monoxides</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Volatile Organic Compounds (VOCs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Carbon Dioxide (CO2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Toxic substances</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Polycyclic Aromatic Hydrocarbons (PAH)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓ Heavy Metals</td>
<td></td>
</tr>
<tr>
<td>WATER QUALITY</td>
<td>• The runoff water from the asphalt plant site will contain silt, oils and metal oxides from the slag and aggregate. This is the result of spillage of product on the site while loading or transferring these products. This contaminated water must not reach the natural drainage lines, streams and farm dams without being treated to comply with the Department of Water Affairs water discharge quality standards.</td>
<td>• Separate the clean water runoff from the contaminated water runoff and direct the latter to retention ponds. Test the water to determine the appropriate treatment necessary to comply with the DWA discharge standards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construct catch pits to collect water from washing bays and direct to a main collector tank where the oil is separated from the water using skimming devices. Contract the services of an oil recycling firm to remove the collected oil waste.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Construct catch pits at the transfer point of diesel and connect this pit to the central tank that holds the runoff from the wash bay.</td>
</tr>
<tr>
<td>ASPECT</td>
<td>IMPACTS</td>
<td>MITIGATION</td>
</tr>
<tr>
<td>--------</td>
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<td>------------</td>
</tr>
</tbody>
</table>
| **WASTE PRODUCT** | • Dust collected from bag or cyclone filters  
• Sewerage from ablution facilities on site usually in a septic tank or chemical toilets. | • Dust from bag or cyclone filters that is reintroduced into the asphalt mix is not considered a waste product. However should this material prove unsuitable for recycling it will have to be removed to an approved dump site. Temporary storage of 10 cubic metres is allowed on the site with the excess to be removed to an approved waste dump.  
• Where a septic tank is used for the ablution facility the content must be cleared by a municipal waste tanker at least twice a month, and disposed of at the nearest Waste Water Treatment Plant.  
• Where chemical toilets are used these are not considered to be ‘treatment of waste on site’. These facilities must be serviced regularly and not be placed in sensitive areas. |
| **SOIL** | • Loss of the top layer of soil that has organisms, nutrients and a seed bank.  
• Spillage of product on the site of oil, diesel, bitumen while loading or | • Strip the entire area of the top layer of soil (minimum 300mm) and stockpile to the sides of the planned extent of the asphalt plant site, for later use in the rehabilitation.  
• Remove the soil that has been contaminated by oil, |
<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
|        | transferring these products add to the contamination of the surface of the asphalt plant site and the underlying soil.  
- These products if not cleared immediately seep into the soil over time thereby contaminating this resource and render it unsuitable for growth of vegetation.  
- Accidental spills of hazardous substances of diesel, oil, bitumen that will contaminate the soil. | diesel or bitumen and place in a specially bunded area and treat with Ecosorb or similar organic compound that biodegrades the contaminant.  
- Replace the removed soil with uncontaminated soil.  
- All contaminated soil should be removed as soon as possible after the spill to limit the depth the contaminant will move down the soil profile.  
- The storage tanks of each hazardous good such as diesel, oil, and bitumen shall be placed on a concrete slab that has a bund wall of sufficient height to contain 110% of the total stored volume of each substance. |
| NOISE  | Noise is associated with the operation of the asphalt plant and the vehicles that load and transport the product. | Ensure that all vehicles that are involved in the transport of asphalt and the raw product, have silencers that reduce the noise of the engine exhaust to the required level to meet the manufacturer’s specification.  
- Locate the asphalt plant away from sensitive noise receivers. |
| VISUAL | The structures of the plant and the stockpiles of temporary asphalt plants generally occupy areas of 1 to 2 ha and because of the industrial form and image are visually intrusive in most settings. | Create earth berms using the stripped topsoil to screen views into the activities of the concrete batching plant and workshops along the side of the property that will have the greatest visual exposure.  
- Use shade cloth to clad the fence that should be at
### ASPECT

<table>
<thead>
<tr>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The generation of dust from the handling of the sand and aggregates has a visual impact particularly on windy days.</td>
<td>least 1.5 m high, along the side of the property that will have the greatest visual exposure.</td>
</tr>
<tr>
<td>Maintain a tidy site at all times</td>
<td>Avoid using the site limits as a temporary storage of waste or damaged products.</td>
</tr>
<tr>
<td>Paint the site buildings a colour that blends in with the surrounding land use.</td>
<td>Rehabilitate the site as close to the original landform as possible and prepare the soil well to support a vigorous growth of grass or similar crop.</td>
</tr>
</tbody>
</table>

### CONCRETE BATCHING PLANTS

<table>
<thead>
<tr>
<th>AIR QUALITY</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust is generated by the handling of aggregate and sand and by vehicles associated with the transport of the aggregates, cement and the concrete mix.</td>
<td>Wet down all soil surfaces on the site and gravel access roads to the site regularly. The frequency will depend on the weather and the dust generated. Surface the entire area of the site with Reclaimed Asphalt if this product is readily available.</td>
<td></td>
</tr>
<tr>
<td>The monitoring of dust fallout on the boundaries of the site may be required to establish the effectiveness of mitigation measures, near dust sensitive environments such as residential areas.</td>
<td>Ensure that workers in dusty areas have dusk masks.</td>
<td></td>
</tr>
</tbody>
</table>
## ASPECT

<table>
<thead>
<tr>
<th>WATER QUALITY</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
|               | • Surface water runoff from the site will contain a large amount of silt that will contaminate water courses.  
  • Cement contaminated decanted water from the vehicle washing bay will pollute water courses.  
  • Spillage of oil, diesel and other lubricants from the workshops will contaminate water courses. | • Separate the clean water runoff from the contaminated water runoff and direct the latter to retention ponds where the water quality can be tested to determine the appropriate treatment to comply with the DWA standards for discharge into water courses.  
  • Construct catch pits for the collection of water from the truck washing bays and direct into a main collector tank that will settle the cement fines. Recycle the water to the concrete mixer.  
  • At workshops where vehicles are cleaned collect the water in a sump and separate the oil from the water using skimming devices. Contract the services of an oil recycling firm to remove the oil waste.  
  • Construct a catch pit at the transfer point of diesel and connect this pit to the central tank that holds the runoff from the workshop wash bay.  
  • Remove the soil contaminated by oil, diesel, bitumen and place in a specially bunded area where it can be treated with Ecosorb or similar organic compound that biodegrades the contaminant. |

<table>
<thead>
<tr>
<th>WASTE PRODUCT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
</tr>
</thead>
</table>
|               | • The cement sludge from the settlement pond or tank is a waste product. Discharge of the sludge into the environment will cause long term contamination of drainage lines and water with resultant die off of | • The cement sludge from the settlement pond or tank has to be removed to and approved waste dump. The product can be temporarily stored on site as long as the stored volume does not exceed 10 cubic metres.  
  • Where a septic tank is used for the ablution facility the content must be cleared by a municipal waste tanker at |
<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>vegetation and micro fauna. The product can be temporarily stored on site as long as the stored volume does not exceed 10 cubic metres.</td>
<td>least twice a month, and disposed of at the nearest Waste Water Treatment Plant.</td>
</tr>
<tr>
<td></td>
<td>• Where a septic tank is used for the storage of ablution sewerage this waste must be removed by a municipal tanker at least every two weeks and disposed of at a Municipal Water Care Works.</td>
<td>• Where chemical toilets are used these are not considered to be ‘treatment of waste on site’ and no license is required under the Waste Act. These facilities are cleared of waste under contract of the supplier.</td>
</tr>
<tr>
<td></td>
<td>• Where chemical toilets are used these are not considered to be ‘treatment of waste on site’ and no license is required under the Waste Act. These facilities are cleared of waste under contract of the supplier.</td>
<td></td>
</tr>
<tr>
<td>SOIL</td>
<td>• Loss of the top layer of soil that has organisms, nutrients and a seed bank.</td>
<td>• Strip the entire area of the top layer of soil (minimum 300mm) and stockpile to the sides of the planned extent of the concrete batching plant and workshop, for later use in the rehabilitation.</td>
</tr>
<tr>
<td></td>
<td>• Spills of oil, diesel and brake fluids will contaminate the soil and prevent vegetation growth.</td>
<td>• Remove the soil that has been contaminated by oil, diesel or bitumen and place in a specially bunded area where it can be treated with Ecosorb or similar organic compound that biodegrades the contaminant.</td>
</tr>
<tr>
<td></td>
<td>• Water containing cement that is allowed to lie on or run over soil will affect the ability of the soil to sustain vegetation.</td>
<td>• Replace the removed soil with uncontaminated soil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• All contaminated soil should be removed as soon as</td>
</tr>
</tbody>
</table>
### ASPECT | IMPACTS | MITIGATION
--- | --- | ---
**NOISE** | • Noise is associated with the operation of the concrete batching plants and the vehicles that load and transport the product. | • Ensure that all vehicles that are involved in the transport of concrete and the raw product have silencers that reduce the noise of the engine exhaust to the manufacturer’s specification.  
• Locate the concrete batching plant away from sensitive noise receivers. |
**VISUAL** | • The generation of dust from the handling of the sand and aggregates has a visual impact particularly on windy days.  
• The structures of the plant and the stockpiles of concrete batching plants generally occupy areas of 1 to 2 ha and because of the industrial form and image are visually intrusive in most settings. | • Create earth berms using the stripped topsoil to screen views into the concrete batching plant and workshops along the side of the property that will have the greatest visual exposure.  
• Use shade cloth to clad the fence that should be at least 1.5 m high, along the side of the property that will have the greatest visual exposure.  
• Maintain a tidy site at all times  
• Avoid using the site limits as a temporary storage area for waste or damaged products.  
• Paint the site buildings a colour that blends in with the surrounding land use.  
• Rehabilitate the site to the original landform and...
<table>
<thead>
<tr>
<th>ASPECT</th>
<th>IMPACTS</th>
<th>MITIGATION</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>prepare the soil well to support a vigorous growth of grass or similar crop.</td>
</tr>
</tbody>
</table>
APPENDIX E

DESIGNATED / DEDICATED ENVIRONMENTAL OFFICER DUTIES
APPENDIX E

DESIGNATED / DEDICATED ENVIRONMENTAL OFFICER DUTIES

- To establish an effective Environmental Control Programme that will include appropriate monitoring of water air and waste quality according to the legislated standards.
- To establish routine management, liaison and reporting systems, including the establishment of an environmental data base.
- To interpret the results of the monitoring programme and advise the Engineer or N3TC of action required.
- To prepare routine management reports.
- To advise on the Contractor’s proposals for site establishments in terms of landscape, drainage, erosion control, liquid, solid and hazardous waste management, fuel and chemical storage and site restoration.
- To review the Contractor’s proposals for pollution control facilities and advise on their adequacy.
- To vet the Contractor’s proposed methods of working for environmental impacts and recommend safeguards.
- To coordinate the sampling and analysis programme with the nominated laboratory.
- To liaise on a routine basis with the N3TC in respect of environmental matters.
- To manage the procurement of the equipment required for Environmental Control Officer.
- To advise on the need for expert assistance when required.
- To undertake Environmental Control Officer through site inspections on a day to day basis and notify the Engineer of any problems.
- To carry out the routine sampling and analysis programmes, and take ad-hoc samples as and when necessary.
- To look after the Environmental Control Programme’s equipment and advise the Engineer of any defects. Problems or replacement / additional requirements.
- To be responsible for the day to day management of the data base systems established.
- To liaise in collaboration with the social change officer, with the local communities and act as a channel for their concerns.
- To audit the EMP implementation and, to report on non-conformance and to revise accordingly.
- To effectively carry out the above duties, it is imperative that a dedicated vehicle is assigned to the Environmental Control Officer to allow inspections, etc. to be carried out as required. Since the Environmental Control Officer will regularly have to take the employer’s environmentalists to different sections of the Works for inspections or community liaison (often before the
Works have commenced or access roads to it have been constructed), the use of a double cab vehicle will be of great benefit.
APPENDIX F

RED DATA PLANTS OF THE AREA
## APPENDIX F

### RED DATA PLANTS OF THE AREA

Note: Arranged alphabetically according to family, species and conservation status

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Genus</th>
<th>FAMILY</th>
<th>Conservation status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barleria argillicola Oberm.</td>
<td>Barleria</td>
<td>ACANTHACEAE</td>
<td>CR</td>
</tr>
<tr>
<td>Barleria greenii M.&amp; K.Balkwill</td>
<td>Barleria</td>
<td>ACANTHACEAE</td>
<td>CR</td>
</tr>
<tr>
<td>Blepharis subglabra Vollesen</td>
<td>Blepharis</td>
<td>ACANTHACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Ruellia pilosa L.f.</td>
<td>Ruellia</td>
<td>ACANTHACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Clivia robusta B.G.Murray, Ran</td>
<td>Clivia</td>
<td>AMARYLLIDACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Cyrtanthus brachysiphon Hilliard</td>
<td>Cyrtanthus</td>
<td>AMARYLLIDACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Cyrtanthus nutans R.A.Dyer</td>
<td>Cyrtanthus</td>
<td>AMARYLLIDACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Nerine pancriatoides Baker</td>
<td>Nerine</td>
<td>AMARYLLIDACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Rhus rudatsis Engi.</td>
<td>Rhus</td>
<td>ANACARDIACEAE</td>
<td>EN</td>
</tr>
<tr>
<td>Dracosciadium italic Hilliard</td>
<td>Dracosciadium</td>
<td>APIACEAE</td>
<td>VU</td>
</tr>
<tr>
<td>Peucedanum wilmsianum H.Wolff</td>
<td>Peucedanum</td>
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<td>Asclepias bicuspis N.E.Br.</td>
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<td>Asclepias concinna (Schltr.) Schltr.</td>
<td>Asclepias</td>
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<td>Asclepias disparilis N.E.Br.</td>
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<td>Asclepias gordon-grayae Nicholas</td>
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<td>Asclepias schlechteri (K.Schum.)</td>
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<td>Asclepias woodii (Schltr.) Schltr.</td>
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<td>Aspidoglossum xanthosphaerum Hilliard</td>
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<td>Brachystelma franksiae N.E.Br.subsp.</td>
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<td>Brachystelma gerrardii Harv.</td>
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<td>Brachystelma molaventi Peckover</td>
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<td>Brachystelma ngomense R.A.Dyer</td>
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<td>Brachystelma petraeum R.A.Dyer</td>
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<td>Brachystelma tenue R.A.Dyer</td>
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<td>Brachystelma vahrmeijeri R.A.Dyer</td>
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<td>Ceropogia cimicioidora Oberm.</td>
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<td>Ceropogia crabii J.Victor</td>
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<td>Ceropogia rudatisii Schltr.</td>
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<td>Orbea woodii (N.E.Br.)</td>
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<td>Pachycarpus rostratus N.E.Br.</td>
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<td>Raphionacme elsana Venter &amp; R.L.Verh.</td>
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<td>Riocreuxia alexandrina (H.Huber)</td>
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<td>Sisyranthus fanniniae N.E.Br.</td>
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<td>Tenaris christianeae (Peckover)</td>
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Aponogeton ranunculiflorus Jacot Guill.& Marais, Aponogeton, APONOGETONACEAE, VU
Raphia australis Oberm.& Strey, Raphia, ARECACEAE, VU
Asparagus fractiflexus (Oberm.) Fellingham & N.L.Mey., Asparagus, ASPARAGACEAE, EN
Aloe gerstneri Reynolds, Aloe, ASPHODELACEAE, VU
Aloe inconspicua Plowes, Aloe, ASPHODELACEAE, VU
Aloe kniphofoides Baker, Aloe, ASPHODELACEAE, VU
Aloe modesta Reynolds, Aloe, ASPHODELACEAE, VU
Aloe priniosa Reynolds, Aloe, ASPHODELACEAE, VU
Aloe reitzii Reynolds var. vernalis D.S.Hardy, Aloe, ASPHODELACEAE, CR
Aloe saundersiae (Reynolds) Reynolds, Aloe, ASPHODELACEAE, CR
Gasteria croucheri (Hook.f.) Baker, Gasteria, ASPHODELACEAE, VU
Haworthia limifolia Marloth var. gigantea M.B.Bayer, Haworthia, ASPHODELACEAE, VU
Kniphofia flammula Codd, Kniphofia, ASPHODELACEAE, EN
Kniphofia latifolia Codd, Kniphofia, ASPHODELACEAE, EN
Kniphofia leucocephala Baijnath, Kniphofia, ASPHODELACEAE, CR
Kniphofia pauciflora Baker, Kniphofia, ASPHODELACEAE, CR
Gerbera aurantiaca Sch.Bip., Gerbera, ASTERACEAE, EN
Helichrysum citrecephalum Hilliard & B.L.Burtt, Helichrysum, ASTERACEAE, CR
Helichrysum ingomense Hilliard, Helichrysum, ASTERACEAE, EN
Senecio exuberans R.A.Dyer, Senecio, ASTERACEAE, EN
Senecio ngoyanus Hilliard, Senecio, ASTERACEAE, VU
Senecio villifructus Hilliard, Senecio, ASTERACEAE, EN
Impatiens flanaganiae Hems.l., Impatiens, BALSAMINACEAE, VU
Raspalia trigyna (Schltr.) Dummer, Raspalia, BRUNIACEAE, CR
Warburgia salutaris (G.Bertol.)Chiiov., Warburgia, CANELLACEAE, EN
Lydenburgia abbottii (A.E.van Wyk & Prins)Steenkamp, A.E.van Wyk & Prins, Lydenburgia, CELASTRACEAE, EN
Maytenus abbottii A.E.van Wyk, Maytenus, CELASTRACEAE, EN
Maytenus oleosa A.E.van Wyk & R.H.Archer, Maytenus, CELASTRACEAE, VU
Pseudosalacia streyi Codd, Pseudosalacia, CELASTRACEAE, VU
Crassula obovata Haw.var. dregeana (Harv.) Toelken, Crassula, CRASSULACEAE, VU
Gerrardanthus tomentosus Hook.f., Gerrardanthus, CUCURBITACEAE, VU
Carex subinflata Nelmes, Carex, CYPERACEAE, VU
Fimbristylis aphylla Steud., Fimbristylis, CYPERACEAE, VU
Dioscorea brownii Schinz, Dioscorea, DIOSCOREACEAE, VU
Cephalaria foliosa Compton, Cephalaria, DIPSACACEAE, VU
Erica abbottii E.G.H.Oliv., Erica, ERICACEAE, VU
Erica psittacinia E.G.H.Oliv.& I.M.Oliv., Erica, ERICACEAE, VU
Euphorbia woodii N.E.Br., Euphorbia, EUPHORBIACEAE, VU
Albizia suluensis Gerstner, Albizia, FABACEAE, EN
Argyrolobium campicola Harms, Argyrolobium, FABACEAE, VU
Argyrolobium longifolium (Meisn.)Walp., Argyrolobium, FABACEAE, VU
Calpurnia woodii Schinz, Calpurnia, FABACEAE, VU
Eriosema populifolium Benth.ex Harv. subsp. populifolium, Eriosema, FABACEAE, EN
Eriosema umtamvunense C.H.Stirt., Eriosema, FABACEAE, VU
Lotononis dichilooides Sond., Lotononis, FABACEAE, CR
Macrotyloma coddii Verdc., Macrotyloma, FABACEAE, VU
Psoralea abbrevii C.H.Stirt., Psoralea, FABACEAE, VU
Tephrosia inandensis H.M.L.Forbes, Tephrosia, FABACEAE, EN
Geranium ornithopodioides Hilliard & B.L.Burtt, Geranium, GERANIACEAE, EN
Streptocarpus floribundus Weigend & T.J.Edwards, Streptocarpus, GESNERIACEAE, VU
Streptocarpus molweniensis Hilliard subsp. eshowicus Hilliard & B.L.Burtt, Streptocarpus, GESNERIACEAE, VU
Streptocarpus molweniensis Hilliard subsp. molweniensis, Streptocarpus, GESNERIACEAE, VU
Bowiea volubilis Harv.ex Hook.f. subsp. volubilis, Bowiea, HYACINTHACEAE, VU
Hypoxis uniflora Markötter, Hypoxis, HYPOXIDACEAE, VU
Dierama dubium N.E.Br., Dierama, IRIDACEAE, VU
Dierama erectum Hilliard, Dierama, IRIDACEAE, EN
Dierama luteoalbidum I.Verdc., Dierama, IRIDACEAE, VU
Dierama nixonianum Hilliard, Dierama, IRIDACEAE, EN
Dierama pallidum Hilliard, Dierama, IRIDACEAE, VU
Gladiolus cruentus T.Moore, Gladiolus, IRIDACEAE, CR
Watsonia bachmannii L.Bolus, Watsonia, IRIDACEAE, VU
Watsonia canaliculata Goldblatt, Watsonia, IRIDACEAE, VU
Watsonia inclinata Goldblatt, Watsonia, IRIDACEAE, VU
Watsonia mtamvunae Goldblatt, Watsonia, IRIDACEAE, VU
Syncolostemon latidens (N.E.Br.) Codd, Syncolostemon, LAMIACEAE, VU
Syncolostemon ramulosus E.Mey.ex Benth., Syncolostemon, LAMIACEAE, VU
Wolffiella denticulata (Hegelm.)Hegelm., Wolffiella, LEMNACEAE, VU
Cyphia bolusii E.Phillips, Cyphia, LOBELIACEAE, VU
Nesaea wardii Immelman, Nesaea, LYTHRACEAE, VU
Hermannia sandersonii Harv., Hermannia, MALVACEAE, VU
Turraea pulchella (Harms) T.D.Penn., Turraea, MELIACEAE, VU
Delosperma macellum (N.E.Br.) N.E.Br., Delosperma, MESEMBRYANTHEMACEAE, EN
Delosperma velutinum L.Bolus, Delosperma, MESEMBRYANTHEMACEAE, VU
Lampranthus fugitans L.Bolus, Lampranthus, MESEMBRYANTHEMACEAE, VU
Morella microbracteata (Weim.)Verdc.& Polhill, Morella, MYRICACEAE, EN
Eugenia simii Dummer, Eugenia, MYRTACEAE, VU
Bonatea lamprophylla J.L.Stewart, Bonatea, ORCHIDACEAE, VU
Cynorkis compacta (Rchb.f.) Rolfe, Cynorkis, ORCHIDACEAE, VU
Diaphananthe millaria (Bolus) H.P.Linder, Diaphananthe, ORCHIDACEAE, VU
Didymoplexis verrucosa J.Stewart & Hennessy, Didymoplexis, ORCHIDACEAE, VU
Disa scullyi Bolus, Disa, ORCHIDACEAE, EN
Disa zuluensis Rolfe, Disa, ORCHIDACEAE, EN
Habenaria woodii Schltr., Habenaria, ORCHIDACEAE, VU
Holothrix majubakensis C.& R.H.Archer, Holothrix, ORCHIDACEAE, VU
Huttonaea woodii Schltr., Huttonaea, ORCHIDACEAE, VU
Mystacidium aliceae Bolus, Mystacidium, ORCHIDACEAE, VU
Satyrium rhodanthum Schltr., Satyrium, ORCHIDACEAE, CR
Schizochilus gerrardii (Rchb.f.) Bolus, Schizochilus, ORCHIDACEAE, EN
Adenia natalensis W.J.de Wilde, Adenia, PASSIFLORACEAE, CR
Colpodium drakensbergense Hedberg & I.Hedberg, Colpodium, POACEAE, VU
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. oribinum I.Williams, Leucadendron, PROTEACEAE, VU
Leucospermum innovans Rourke, Leucospermum, PROTEACEAE, EN
Protea nubigena Rourke, Protea, PROTEACEAE, CR
Restio zuluensis H.P.Linder, Restio, RESTIONACEAE, VU
Colubrina nicholsonii A.E.van Wyk & Schrire, Colubrina, RHAMNACEAE, VU
Phylica natalensis Pillans, Phylica, RHAMNACEAE, VU
Cassipourea flanaganii (Schinz) Alston, Cassipourea, RHIZOPHORACEAE, VU
Theesium polygaloides A.W.Hill, Theesium, SANTALACEAE, VU
Manilkara nicholsonii A.E.van Wyk, Manilkara, SAPOTACEAE, EN
Melanospermum italae Hilliard, Melanospermum, SCROPHULARIACEAE, VU
Selago longiflora Rolfe, Selago, SCROPHULARIACEAE, EN
Struthiola anomala Hilliard, Struthiola, THYMELAEACEAE, VU
Encephalartos aemulans Vorster, Encephalartos, ZAMIACEAE, CR
Encephalartos cerinus Lavranos & D.L.Goode, Encephalartos, ZAMIACEAE, CR
Encephalartos friderici-guilielmi Lehm., Encephalartos, ZAMIACEAE, VU
Encephalartos ghellinckii Lem., Encephalartos, ZAMIACEAE, VU
Encephalartos laevifolius Stapf & Burtt Davy, Encephalartos, ZAMIACEAE, CR
Encephalartos msinganus Vorster, Encephalartos, ZAMIACEAE, CR
Encephalartos ngoyanus I.Verd., Encephalartos, ZAMIACEAE, VU
Encephalartos senticosus Vorster, Encephalartos, ZAMIACEAE, VU
Siphonochilus aethiopicus (Schweinf.) B.L.Burtt, Siphonochilus, ZINGIBERACEA