



**DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME
FOR THE
PROPOSED CONSTRUCTION AND MAINTENANCE OF THE RAND WATER 3KM Q6 PIPELINE
WITH A DIAMETER OF 1400 MM FROM THE RAND WATER EIKENHOF PUMP STATION TO
MEREDALE RESERVOIR AS PART OF THE INLET AND OUTLET PIPES.**

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INTRODUCTION

1.1 Introduction

Rand Water intends to construct a 3km Q6 pipeline with a diameter of 1400 mm from the Rand Water Eikenhof pump station to Meredale reservoir as part of the inlet and outlet pipes. The project requires an Environmental Authorization before it can commence.

This environmental management plan is developed to minimize negative environmental impacts and to maximize positive ones. All the parties involved in the project will have to put a concerted effort to ensure that the EMPr (Environmental Management Programme) is implemented and pollution to the environment is minimized or prevented.

Issues related to compliance monitoring during construction are also discussed in this EMPr. It is also important to note that this EMPr will be implemented during the construction of the pipeline and the fact that this is a living document which is subject to regular update and review.

1.2 The purpose and scope of the EMPr Report

The purpose of the Environmental Management Programme report is to ensure that all impacts associated with the project are minimised, mitigated and monitored to comply with the provisions of the National Environmental Management Act 107 of 1998 and other legislations. The Environmental Management Programme summarises the types of impacts that might occur because of the project activities and provide solutions on how those impacts can be mitigated and minimised.

The Environmental Management Programme report (EMPr) prescribes and directs the management of all environmental aspects, physical, natural and / or social, associated with the construction of the Q6 pipeline. This Environmental

Management Programme must be read as a whole and complete document and is numbered accordingly.

IMPACTS DURING THE CONSTRUCTION PHASE			
Potential impacts:	Significance rating of impacts:	Proposed mitigation:	Significance rating of impacts after mitigation:
Dust – Will be generated during construction. This could obstruct visibility and be a nuisance factor for nearby residents. This will be a local impact.	Medium	Dust – Use of water tanks to spray un-vegetated areas especially during dry periods.	Low
Noise – will be generated during construction. This will be a local impact.	Low	Noise – Construction activities will be limited to normal working hours. Nearby residents should be informed of any after hour's activities.	Low
Traffic – Traffic may become congested during construction and maintenance due to construction vehicles and sections where	Medium	Traffic – Precautions must be taken to avoid severely interrupting traffic flow on existing roads, especially during peak periods. A traffic marshal could be used to control flow of traffic,	Low

IMPACTS DURING THE CONSTRUCTION PHASE			
Potential impacts:	Significance rating of impacts:	Proposed mitigation:	Significance rating of impacts after mitigation:
roads area crossed.		to avoid unnecessary traffic interruptions or traffic congestion.	
Water and land pollution – Water and land may be polluted by construction workers if waste management on site is not practiced. This impact may have a local impact.	Medium	Water and land pollution – Onsite waste management should be practiced to ensure adequate waste disposal measures are in place and sufficient provision is made for disposal of waste.	Low
Safety – Open trenches and construction vehicles may pose a safety risk to pedestrians and animals. Security of the surrounding area may be compromised by the presence of a	Medium	Safety – Construction vehicles should be equipped with reverse hooters and trenches should be clearly marked and fenced off where possible. Access control to construction areas should be implemented. Management of construction staff to	Low

IMPACTS DURING THE CONSTRUCTION PHASE			
Potential impacts:	Significance rating of impacts:	Proposed mitigation:	Significance rating of impacts after mitigation:
construction crew.		prevent loitering outside of the demarcated working areas.	
Access to private properties – Construction workers may wander into unauthorized areas during the construction period. This comprises the privacy of landowners.	Low	Access to private properties – Construction workers will be bound to demarcated construction areas. Workers will be required to wear identifiable clothing.	Low
Erosion – Erosion may occur if construction is conducted close to wetland areas and may also impact on silt may impact on surrounding storm water systems.	Medium	Erosion – all areas prone to erosion should be monitored and erosion addressed at an early stage to prevent further degradation. Further management measures are discussed in the EMPr	Low
Pollution –	Medium	Pollution – Onsite waste	Low

IMPACTS DURING THE CONSTRUCTION PHASE			
Potential impacts:	Significance rating of impacts:	Proposed mitigation:	Significance rating of impacts after mitigation:
Wetlands and the areas surrounding the construction area may be polluted with construction activities and waste material.		management should be conducted according to the conditions of the EMPr. Reference is made to Section 6, point number 6.1.	

Disruption of services – services that cross the construction area could be damaged causing a disruption of services. These include roads, electricity, sewerage and water supplies.	High	Disruption of services – services that cross the construction area must be identified prior to commencement. A safety risk assessment must be done prior to commencement of work. Way leaves must be applied for prior to commencement. Roads and property access is reestablish as soon as possible.	Low
Loss of fauna and flora – Construction footprints crossing	High	Loss of fauna and flora – all areas prone to loss of fauna and flora will follow the	low

areas where fauna and flora could be damaged.		management strategies. measures as identified in the EMP attached	
Lack of proper rehabilitation – Poor rehabilitation will result to infrastructure stability being compromised, bad publicity and poor recovery of the site after construction.	High	Lack of proper rehabilitation - reinstatement after the pipeline construction must be done by the principal contractor and rehabilitation will be conducted by EMS rehabilitation section. They will conduct rehabilitation until the site is stabilized. The site will be monitored regularly to ensure no deterioration occurs. Rehabilitation will follow the management strategies. Measures as identified in the EMPr attached.	low
Disruption of water flow -during linear construction. Poor practices could result in damming	High	Disruption of water flow the mitigation proposed in the EMPr will reduce the negative impact of deviations of water	

up of water in drainage lines, preventing continuous flow of water movement.		another related impacts during linear constructions.	
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1.3 Terms

Abbreviations/ Acronyms

BA	Basic Assessment as per EIA
CARA	Conservation Agricultural Resource Act
DEA	Department of Environment Affairs
DWA	Department of Water Affairs
EA	Environmental Authorization
EIA	Environmental Impact Assessment
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
EMS	Environmental Management Services
I&AP	Interested and Affected Parties
NEMA	National Environmental Management Act
RoD	Record of decision as per ECA but the term is commonly substituted for EA
RW	Rand Water
SABS	South African Bureau of Standards
SAHRA	South African Heritage Resource Act

1.4 Definitions

Affected environment -Those parts of the socio -economic and biophysical environment impacted on by the development.

Alternatives - A possible course of action, in place of other, that would meet the same purpose and need.

Auditing - A systematic, documented, periodic and objective evaluation of how well the environmental management Programme is being implemented and is performing with the aim of helping to safeguard the environment by: facilitating management control which would include meeting regulatory requirements. Results of the audit help the organisation to improve its environmental policies and management systems.

Biodiversity: The variety of life in an area, including the number of different species, the genetic wealth within each species, and the natural areas where they are found.

Cumulative Impact - An action that in itself is not significant but is significant when added to the impact of other similar actions.

Development - The act of altering or modifying resources in order to produce potential benefits

EMS representative – shall mean the Environmental management section (EMS) manager, his/her representative or an environmental control officer (ECO).

Environment - Means the surroundings within which humans exist and that are made up of

- Micro - organisms, plant and animal life;
- The land, water, and atmosphere of the earth;
- The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well - being.

Environmental Impact Assessment-(EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of a proposed development. The EIA includes an evaluation of alternatives; recommendations for appropriate management

actions for minimising or avoiding negative impacts and for enhancing positive impacts; as well as proposed monitoring measures

Environmental Management Programme – (EMPr) a system which provides a structured process for continual improvement and which enables an organization to achieve and systematically control the level of environmental performance that it sets itself. In general, this is based on a dynamic cyclical process of "plan, implement, check and review ". The EMPr aims at

- Minimizing impacts by limiting aspects of an action.
- Minimizing impacts by optimizing processes, structural elements and other design features.
- Avoiding impacts by not performing certain actions.
- Compensating for impacts by providing substitute resources or environments
- Any part or combination of the above and the inter - relationships among and between them; and

Environmental Resources - Goods, services or environmental conditions that have the potential to enhance social well - being".

Impacts - A description of the potential effect or consequence of an aspect of the development on a specified component of the biophysical, social or economic environment within a defined time and space. The outcome of an action, whether considered desirable or undesirable".

Fence A physical barrier in the form of posts and barbed wire and/or "Silex" or any other concrete construction, ("palisade"- type fencing included), constructed with the purpose of keeping humans and animals within or out of defined boundaries.

Interested and Affected Parties (I&APs) - Individuals and groups concerned with or affected by its consequences. These include the authorities, local communities, investors, workforce, customers and consumers, environmental interested groups, and the general public.

Mitigation - Measures designed to avoid, reduce or remedy adverse impacts

Plan - A purposeful, forward - looking strategy or design often with coordinated priorities, options and measures that elaborates and implement policy

Policy - A general course of action or proposed overall direction that is being pursued and which guides ongoing decision - making.

Pre- cautionary Principle –“This involves applying a risk -averse and cautious approach that recognises the limits of current knowledge about the environmental consequences of decision making or action.”

Programme - "A coherent, organised agenda or schedule of commitments, proposal instruments and activities that elaborate and implement policy".

- Provide ongoing monitoring and management of environmental impacts of a development and documenting of any digressions /good performances.
- Rectifying impacts through rehabilitation, restoration, etc. of the affected environment.
- The EMPr is a legally binding document that all parties involved in the project must be aware of.

Rehabilitation- is defined as the return of a disturbed area to a state which approximates the state, as far as possible, which it was before disruption. Rehabilitation should aim to accelerate the natural succession processes so that the plant community develops in the desired way.

Reinstatement-is defined as the initial soil works that replaces soil levels back to the original state as far as possible. It may include an initial light temporary grassing.

Water course – A water course as defined in the National Water Act:

- a) A river or spring
- b) A natural channel in which water flows regularly or intermittently
- c) A wetland, lake or dam in which or from which, water flows; and
- d) Any collection of water which the minister may, by notice in the Gazette, declare to be a water course , and a reference to a watercourse includes , where relevant, its bed and banks

Wetlands – means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in

a saturated soil. Waterlogged habitat containing characteristic vegetation species and soil types e.g. vleis

1.5 References

Document title	Document No	Location
The National Environmental management Act	Act 107 of 1998	Internet/ library
Constitution of South Africa (Act No. 108 Of 1996) particularly Section 24 of the Bill of Rights	(Act No. 108 Of 1996) particularly Section 24 of the Bill of Rights	Internet/ library
Environmental Best Practice Specifications: Construction For Construction Sites, Infrastructure Upgrades and Maintenance Work.	Edition 3 February 2005	DWA website
Environment Conservation Act	(Act No. 73 Of 1989)	Internet/ library
National Environmental Management Act (Act No. 107 Of 1998)	(Act No. 107 Of 1998) as amended	Internet/ library
National Environmental Management (Waste Act 59 of 2008)	Waste Act 59 of 2008	Internet/ library
National Environmental Management (Air Quality Act 39 of 2004)	Act 39 of 2004	Internet/ library
Hazardous Substances Act (Act No. 15 Of 1973)	(Act No. 15 Of 1973)	Internet/ library
Occupational Health and Safety (Act No. 85 Of 1993)	(Act No. 85 Of 1993)	Internet/library
National Water (Act No. 36 Of 1998)	Act (Act No. 36 Of 1998) as amended	Internet/ library
Water Services Act	Act 108 Of 1997	Internet/ library

Document title	Document No	Location
Conservation of Agricultural Resources Act	(Act No. 43 Of 1983)	Internet/ library
National Veldt and Forest Fire Act	(Act No. 101 1998)	Internet/ library
National Environmental Management: Biodiversity	Act 10 Of 2004	Internet/ library
National Forest Act	(Act No. 84 Of 1998)	Internet/ library
National Environmental Management: Protected Areas	Act 57 Of 2003	Internet/ library
Fencing Act	Act 31 Of 1963	Internet/ library
National Building Regulations and Building Standards	Act 103 Of 1977	Internet/ library
Disaster Management	Act 57 Of 2002	Internet/ library
National heritage Act	Act 25 of 1999	Internet/ library
Applicable South African National Standards (SANS).	SANS 10142 (SABS0142)	Internet/ library
Rehab manual	Draft	Tdrive at EMS

1.6 Responsibility and Authority

Although various parties are involved in projects, the most important, from an environmental perspective are the following:

DEA	National Department of Environmental Affairs	The designated authority tasked with granting Environmental Authorization as well as approval of the EMPr on regulated activities as per NEMA.
EAP	Environmental Assessment Practitioner	The definition of an environmental assessment practitioner in section 1 of NEMA is “the individual responsible for the planning, management and coordination of environmental impact assessments, strategic environmental assessments, environmental management plans or any other appropriate environmental instruments introduced through regulations”.

ECO	Environmental Control Officer	<p>This position may be a permanent position on the Project Organogram or it might be a service rendered by a line Division which may be managed by a Service Level Agreement. The responsibility of the Environmental Control Officer is to provide assurance, advice, assist and support to the Rand Water Project Manager in the management of the environmental issues on the project which includes ensuring compliance to the Environmental Authorizations and the Environmental Management Programme (EMPr). RW must appoint an ECO to objectively monitor implementation of relevant environmental legislation, conditions of Environmental Authorizations (EA's), and the EMPr for the project. The ECO must be on site prior to any site establishment and must endeavor to form an integral part of the project team. The ECO must be proactive and have access to specialist expertise as and when required, these include botanist's ecologists etc. Further the ECO must also have access to expertise such as game capture, snake catching, etc. The ECO must conduct audits on compliance to relevant environmental legislation, conditions of the EA, and the EMPr for the project. The size and sensitivity of the development, based on the EIA, will determine the frequency at which the ECO will be required to conduct audits/ site monitoring. (A minimum of a weekly site inspection must be undertaken). The ECO must also do monthly site inspection and compile a monthly report. Before work can commence on site the ECO must run environmental induction with the contractor on the EMPr and the condition of the EA.</p>
ER	Engineers Representative	<p>The consulting engineer's representative on site has the power/mandate to issue site instructions and in some instances, variation orders to the contractor, following request by the ECO. The ER oversees site works, liaison with Contractor and the ECO.</p>
GDARD	Gauteng department agriculture and	<p>The designated authority tasked with granting Environmental Authorization as well as approval of the EMPr on regulated activities as per NEMA in Gauteng.</p>

LA	Lead Authority	The authorities are the relevant environmental department that has issued the Environmental Authorisation. The authorities are responsible for ensuring that the monitoring of the EMPr and other authorization documentation is carried out, this will be achieved by reviewing audit reports submitted by the ECO to them when required and conducting regular site visits.
OA	Other Authority	Other authorities are those that may be involved in the approval process of an EMPr. Their involvement may include reviewing EMPr to ensure the accuracy of the information relevant to their specific mandate. Other authorities may be involved in the development, review or implementation of an EMPr. For example if a specific development requires a water use license for the relevant national authority then that authority should review and comment on the content of the particular section pertaining to that mandate.
PM	Project Manger	The Project manager has over-all responsibility for managing the project, contractors, sub-contractors and consultants, for ensuring that the environmental management requirements are met. All decisions regarding environmental procedures must be approved by the PM with the ECO. The PM has the authority to stop any construction activity in contravention of the EMPr in accordance with an agreed warning
PrM	Client/ RW Program Manager/The Engineer/Agent' Representative	The overall Program Manager is the overall accountable person for the overall management of the project both on and off-site. If applicable: If an Agent is to be appointed, - Appointment of PM for all environmental compliance
RE	Project/Resident Engineer:	The Project Engineer is the person responsible for ensuring that the project takes place as per specified specifications. Professional and legal obligations with respect to the implementation of his design.

RW	Rand Water (Employer)	As contained in the relevant South African environmental legislation (NEMA, 1998) the Applicant/Employer is responsible and accountable for the potential impact of the activities that are undertaken and is responsible for managing these impact. Rand Water, as the employer, therefore has overall environmental responsibility to ensure that the implementation of the EMPr complies with all relevant legislation, and conditions as stipulated by the EMPr.
SAM SHERQE MANAGER	SHERQ Manager/SHEQ Officer:	The responsibility of the SHERQ Manager/SHEQ Officer is to provide assurance, as well as advice, assist and support the Project Manager in the management of the SHEQ issues on the project. The SHERQM/SHEQO will also be responsible for assisting in the development.

Principal Contractor Supervisors and Sub-Contractor Supervisors	<p>The principle contractor, known as the 'Contractor', is responsible for implementation and compliance with the requirements of the EMPr and conditions of the EA's and WUL, contract and relevant environmental legislation. The Contractor must ensure that all sub-contractors have a copy of and are fully aware of the content and requirements of this EMPr, EA and WUL.</p> <p>The contractor is required, where specified, to provide Method Statements setting out in detail how the management actions contained in the EMPr will be implemented</p> <p>Note: No work may commence and or continue without the presence of appointed supervisor appointees during performance of the contracted work.(As per construction regulations of OHS but also in terms of environmental compliance) In determining the number of appointed competent supervisors, the nature and scope of work being performed, shall be taken into consideration.</p>
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	<p>a) The Principal Contractor shall ensure that his managers and supervisors give clear and unambiguous instructions for the work in hand to the personnel for whom they are responsible for. The instructions shall include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> • description of the objective/scope of work • sequence of work/method statements • hazard identification and risk assessment (prior to commencement of work) • Precautionary/preventative measures that are to be taken. • Identification of sensitive features that may be impacted upon by the project.
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Project SHE/Environmental Control/Liaison Officer	<p>Depending the size and complexity, and sensitivity of the project, the appointment of a full time SHE/EC Officer is required for the duration of the contracted work and part time appointments will not be allowed. The Contractor SHE/EC Officer(s) shall assist and support the Contractors Construction Manager to ensure that the contractors SHER responsibilities are fulfilled and compliance to the SHER specifications and SHER plan are met.</p> <p>In determining the number of appointed competent SHE/EC Officer /s, the nature and scope of work being performed shall be taken into consideration.</p>
Employees on the Project	<p>The Principal Contractor is responsible for adequately informing his employees and sub-contractors of all relevant information relating to the environmental management of the site.</p> <ul style="list-style-type: none"> • Employees are responsible for the environmental management of the site. • They must be made aware of their responsibilities during induction and awareness sessions. some of which are: • Familiarizing themselves with their workplaces with respect to environmental related issues.

Other positions within the GSSE portfolio that administer the environmental authorization processes

GSSE	Group shared Services Executive	The execution responsibility for the entire shared services portfolio
CEA	Corporate Environmental Advisor	The advisor to the organization on environmental related legal and technical requirements. Falls within the Risk Advisory Services department, and is overall responsible for assisting with environmental risk identification and mitigation from strategic to operational risks, auditing and monitoring compliance with environmental standards and ISO 14001, and maintenance of related corporate standards.

ECA	Environmental Coordinator Assessments	The Manager of the Environmental Compliance sub-section of EMS, and is overall responsible for all compliance, actions and activities of this subsection.
ECO	Environmental Control Officer:	As described above
ER	Environmental Rehabilitation	The Manager of the Environmental Rehabilitation sub-section of EMS, and is overall responsible for all rehabilitation and related activities of this subsection.

M- EA	Environmental Manager Authorizations	The Manager of the Environmental authorizations and compliance section of EMS department, and is overall responsible for all actions and activities of this subsection. Is responsible to ensure that all authorization required for projects identified are obtained on time, correctly and allow the project to proceed. Also to ensure that all role players know of and understand what is required of them in order to ensure compliance on projects. Also to ensure that compliance is monitored in line with authorization and other legal requirements and that non compliances are both addressed and corrected timeously by the project manager.
M- EMS	Environmental Manager EMS	The Manager of the Environmental Management Services department (EMS) of Rand Water, and is overall responsible for all actions and activities of the department.

The Organogram describes the relationship of the ECO on the construction site with construction team.

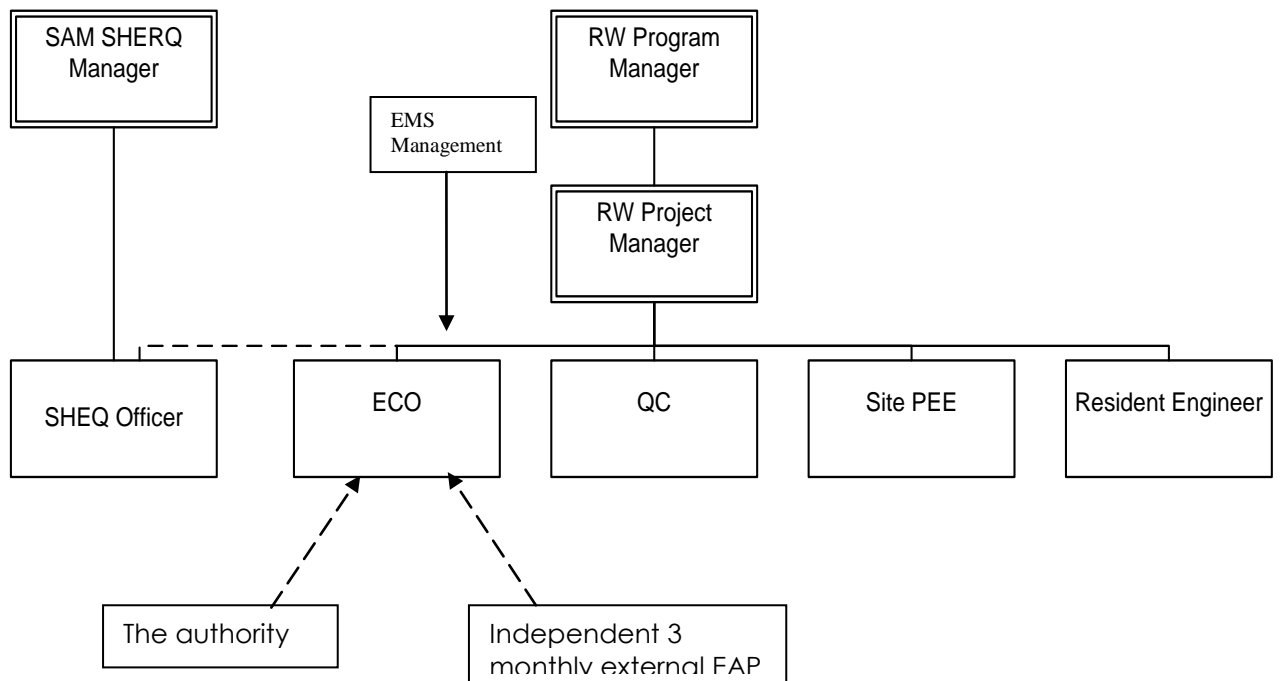


Figure 1. Organogram describes the relationship of the ECO on the construction site

2. ACTION

2. The control of generally occurring impacts:

During the construction of the pipeline and structures, there are anticipated to be impacts that will occur directly or indirectly as a result of this work. All anticipated and known impacts are will be dealt with in this document and suggested mechanisms to mitigate the negative impacts are addressed.

The list of the identified activities below is followed by more elaborate discussion in point form:

2.1. Administrative matters

- Items to be monitored
- Environmental awareness of employees-Administrative processes
- Compliance with environmental protection specifications
- Response to public complaints
- Safety and security
- Checklist of minimum environmental provisions on site
- The environmental file on site
- Penalties
- Induction

2.2. Socio economic

- Use and access of land
- Access to property
- Scenic quality visual intrusion
- Work force management
- Archaeological artefacts
- Interruption of services
- Noise

2.3 Establishment of construction site







- General
- Establishment of a construction campsite
- Ablutions/toilets
- Batching areas
- Blasting
- Access roads
- Earthworks
- Fire risk and burning
- Demarcated Areas
 - ✚ Fencing
 - ✚ Demarcation of sensitive areas
 - ✚ Demarcation of the work area and Soil management program

2.4. Pollution

- Waste
 - ✚ General waste
 - ✚ Waste water
 - ✚ Hazardous waste
 - ✚ Storage and handling of fuel and other hazardous materials
- Water
- Air/ dust

2.5. Protection of the natural environment during construction

- Preservation of flora
 - ✚ Search and rescue/ removal of flora
 - ✚ Vegetation outside the works area
 - ✚ Vegetation within or adjacent to the works area:
 - ✚ Methodology to transplant a tree
 - ✚ Transplanting Aloes and bulbous plants
- Preservation of fauna
- Storm water

-  Construction of berms for storm water diversion
- Diversion of a water cause during construction of a pipeline
- Topsoil and soil preservation
 -  Source of topsoil
 -  Topsoil stripping
 -  Topsoil stockpiling
 -  Topsoil replacement
 -  Other soil
- Boulders
- Erosion prevention
- Alien invasive control
- Final shaping

2.6. Restoration of the site after construction

- Rehabilitation and re-vegetation
- Recycling old dead wood
- Ripping and scarifying
- Control of Alien invasive vegetation
- Seeds and seedlings
- Grassing
- Grassing specification
- Plugging
- Sodding
- Runners
- Splitting of plant on site for aquatic sites
- Hand seeding and seedlings
- Planting nursery plants
- Hydro seeding
- Maintenance

3. ADMINISTRATIVE MATTERS

3.1. Items to be monitored

3.1.1. Objectives:

To monitor compliance with the EMPr

3.1.2. Actions:

- Monitoring will be done as per the ECO monitoring protocol.
- A checklist of items, works and behaviors as outlined in the EMPr will be created that will be monitored.
- Non-compliance of the EMPr will be reported as per the ECO monitoring protocol
- The Contractor is deemed not to have complied with the Performance Specifications if:
 - ✚ There is evidence of willful or accidental contravention of any specification included in the Specification.
 - ✚ There is evidence of the contractor carrying out activities not permitted in terms of the Contract and / or the Specification.
 - ✚ There is evidence of environmental negligence and / or mismanagement resulting in negative impacts on the environment.
 - ✚ The contractor has failed to meet with the requirements of the approved schedule.
- The contractor will be informed via monitoring and auditing reports as well as by means of direct instruction as to what corrective actions are required in terms of environmental compliance:
- Disregard for instruction, and failure to respond adequately to complaints from the public will be construed as non-compliance.
- Non-compliance may lead to the contractor forfeiting his environmental retention or being penalized. (see penalties for more detail)in more serious cases, the project manager may give notice, and then halt construction works until such a time that the contractor has upgraded his site to comply with the performance specifications.

Resultant delays may not be claimed, and will be for the contractor's own cost.

- In prolonged cases of persistent non-compliance, the contractor may be evicted from site. Only the pm may issue such instruction, retaining any costs required to remedy situations perpetuated by environmental negligence, mismanagement and / or non-compliance.

3.2. Environmental awareness of employees-administrative processes

3.2.1. Objectives:

Improved environmental management of the site and surrounds

3.2.2. Actions:

- The ECO will use a template form approved by EMS to conduct inductions
- The ECO will place awareness poster up on site on related aspects to provide environmental awareness.
- The Contractor together with the ECO shall arrange (site induction) that all his employees and those of his sub-contractors be informed of the findings of the EIA report and the requirements of the EMPr before the commencement of construction to the satisfaction of the Engineer or ECO in order that these employees:
- Employees must acquire a basic understanding of the key environmental features of the work site and environment.
- Employees are to be made aware of any other environmental matters, such as pollution, protection of fauna and flora, ablution facilities, hazardous waste, and any other matter raised in the EMPr.
- Proof of induction of all staff and sub-contractors will be required to be kept on file.

3.3. Compliance with environmental protection specifications

3.3.1. Objectives:

Contractors, employees and subcontractors to all comply with environmental protection specifications as laid out in this document.

3.3.2. Actions:

- Any employees of the Contractor or his sub-contractors found to be in breach of any of the Environmental Protection specifications may be ordered to leave the site forthwith, stop work or be instructed to provide corrective actions.
- Supervisory staff of the contractor, Rand Water, or sub-contractors shall not direct any person to undertake any activities, which would place such person/organization in contravention to any law, regulation or the EMPr itself.
- The main contractor is liable for all subcontractors on site for environmental compliances
- Depending on the type of contravention or action it may also be necessary for the work to be called to a halt until such time as the contravention or action is corrected and investigated.
- Penalties may be awarded for non-compliance. These penalties will be administrated by the site project manager. A record of penalties may be kept for the adjudication of environmental performance on later tenders.
- No compensation will be awarded for lack of production due to work stop ages or delays in line with poor environmental performances

3.4. Response to public complaints

3.4.1. Objectives:

- Ensure adequate responsiveness to the public.
- Provide control over information leaving the site

3.4.2. Actions:

- The contractor must ensure that communication with the public is proactive to avoid complaints due to miss information, or lack of information. This includes notification of work starting on site to the private land owners
- A complaints register must be available for complaints to be entered.
- All communication must be in line with media relations policy of Rand Water
- No media interviews are allowed without the Rand Water protocols for such.
- The Contractor shall assist the Engineer with responding to queries and complaints from the public regarding the construction activities by: documenting the details of such communications and submitting the information to the Engineer for inclusion in the complaints register; bringing any such matters to the attention of the Engineer immediately they arise; taking any remedial action as per the Engineer's instruction.
- The Contractor shall make selected staff available for any formal consultation with affected parties for the purpose of explaining the construction process and answering questions of interest to such parties
- Particular aspects of concern (complaints queries, request etc.) to landowners and local residents should be addressed during construction and documented accordingly.

3.5. Safety and security

3.5.1. Objective:

- Safety is provided for the community from construction site

3.5.2. Actions

- The contractor is responsible for the safety of all staff, and visitors and by standers on the construction site throughout all the phases of the project remains the contractor.
- Contractor to ensure that there is security on site, at the site camp after working hours and on weekends/ public holidays.
- Any crimes to be reported to the local South African Police Service (SAPS). These incidents are either reported by the contractor though the knowledge of the Project Manager.
- All employees to be clearly identifiable.
- Proper supervision of employees at all times.
- Construction activities must remain within construction footprint.
- No unauthorized people to be allowed on site.

3.6. Checklist of minimum environmental provisions on site

3.6.1. Objective:

- The checklist is aimed at a high level guideline for budget provision of provisions to be able to implement the EMPr. It must be read in-conjunction with the whole EMPr document and does not exempt any other clause that has been stipulated for compliance within the EMPr document. In the event of apparent contradiction the conditions within themes will apply above the checklist.

3.6.2. Actions

- The contractor will not be reimbursed for the items on the list as they are to form part of budgeting for environmental compliance.

The following items are to be available on all construction sites, for immediate implementation:

3.6.3. General

3.6.3.1. Signage

- No go area
- A sign at the entrance of the construction site offices indicating the following information
 - Environmental authorization and reference numbers applicable to the project
 - The appointed ECO with contact numbers
 - The responsible PM with contact numbers ,
 - The contractor with contact numbers
 - Other relevant emergency numbers

3.6.3.2. Pollution prevention

- Fire protection equipment
- Waste bins and receptacles that comply with the waste clauses of the EMPr
- Adequate serviced ablution facilities
- Designated eating and smoking areas.
- Screening for unsightly works
- Water cart/s to adequately water the site a minimum of twice a day
- Spillage kits for all construction vehicles and be easily available on site
- Drip trays for all vehicles parked overnight
- Barricading the demarcation of edge of the working area
- Hard impervious surfaces for storage of chemicals
- Budding for hazardous products
- Labeled containers for decanting of liquids

3.6.3.3. Erosion control and silt management

- Silt fences for inside water courses and all slopes
- Hay bales (minimum of 50)
- Sand bags
- Lining for settling ponds
- Hessian cover protection of topsoil left exposed for longer than 14 days (unless seeded with local indigenous grasses)
- Sock fitted to trench pumps
- Hessian or similar type product for all slopes that start to erode

3.6.3.4. Documentation to be on site at all times

- Permits
- Environmental Authorizations
- Water Use License
- EMPr
- Environmental audit reports
- Complaints register
- Appointment letter of the ECO
- Appointment letter of the contractor responsible for compliance on site
- Penalties register as per Administrative matters 1.8
- Hazard waste documentation

3.7. The environmental file on site

After the kick off meeting where roles and responsibilities are delegated by the PM, the contractor will be asked to submit a SHE file. This file will go to the SHE section and approved by the safety officer. A second environmental file is required and this file will be approved by the ECO from the EMS department.

3.7.1.Objectives:

Provide an opportunity for the team to identify concerns with regards to compliance to the EMPr.

3.7.2. Actions:

- The ECO will evaluate the submission of the contractor with regards compliance method statements and plans for the project
- The EMPr is a dynamic document and the ECO may amend clauses to benefit the environment, provide adequate reasonable reasons can be provided

3.8. Penalties

The penalty system will be the responsibility of the project manager to implement. The ECO must recommend penalties when required to the Project Manager attention, however, in addition the Project Manager who remains the accountable party may institute penalties at any time as required at their discretion over and above that of the ECO's recommendation. The values for penalties may differ according to the EMPr, the tender contract and the discretion of the project manager. A penalty system is one in which monetary values are ideally attached to various specifications. **All repeatable fines of the same incident should double in value on each successive occasion.** It is recommended that the penalties are logged on a register against the track record of the contractor and may form part of latter tender adjudications. All penalties are to be photographed as evidence where possible. To enable this list of penalties should be available to the procurement department. Funds from penalties should be made available for the rehabilitation that will follow. The items in the list below provide a guideline for typical non-conformance's that are recommended for penalties, but this list may be extended according to the situation at hand.

- Access into a designated 'no-go area: R2500 per incident (excluding specific costs that may be required to rehabilitate this which will be charged to the contractor);
- Vehicles, plant equipment or material outside of the demarcated site: R1500 per incident;
- Un-authorized contract staff/ workers/ or other project people, found outside of the authorized areas of the working strip /footprint: R500 per incident;
- Persistent un-repaired machinery leaks on site and not in designated areas: R2000 per incident;
- Litter on site: R750 per incident;
- Lighting of fires outside of designated areas: R3000 per incident
- Penalties for fires that are caused by the contractor and result in damaging the environment will be assessed according to the monetary damage and the environmental damage and issued at the discretion of the project manager ;
- Eating meals outside of designated areas: R1500 per incident;
- Individual not making use of site ablution facilities: R750 per incident;
- Persons, vehicles, items or plant causing a public nuisance: R1500 per incident;
- Erosion: Cost to rehabilitate plus 20% per incident;
- Oil spills that are recurring from the same source, thus remain uncorrected after three weekly reports.
- Unauthorized damage to vegetation: Cost to replace plus 20% per incident;
- Unauthorized damage to the environment: Cost to rehabilitate plus 20% per incident;
- Unauthorized damage to cultural historical sites or other sensitive sites: to a maximum of R100 000 per incident;(however all cost for restoration and relative specialist such heritage specialist or wet land specialist must also be covered)

- Unauthorized damage or deformation of small trees; R1500 per incident; (This excludes costs for protect species that were demarcated)
- Un-authorized damage or deformation of medium trees; R3000 per incident; (This excludes costs for protect species that were demarcated)
- Un-authorized damage or deformation of large trees; R 10 000 per incident. (This excludes costs for protect species that were demarcated).

3.9. Induction

3.9.1. Objectives:

Inductions provide for awareness of staff on site. The actions enable consistence and documentation of the process.

3.9.2. Actions:

- The EMS template for induction presentation will be used
- An attendance register must be taken and be kept on site
- EMS approved awareness posters for on-going awareness will be used
- All staff are induced on all relevant documents such as but not limited to the EMPr, Authorisations, and Permits etc.

4. SOCIO ECONOMIC FACTORS

4.1. Use and access of land

4.1.1.Objectives:

- To minimize any adverse effects on productive land, including soil erosion.
- To avoid secondary and tertiary impacts occurring along these installations due to the primary impact of construction activities.

4.1.2 Actions

- The Contractor shall not use the land forming the site, or connected with the Works, for any purpose whatsoever other than for the proper carrying out of the Works under the Contract.
- The contractor must demarcate the working area, and enforce his staff to remain within that working area, to avoid the footprint expanding outside of the agreed designated working area.
- No storage or lay down areas to be created outside of agreed sites.
- No spoiling of soil off site in a manner that may harm the environment. All spoiling must have the approval of the ECO. The contractor will be responsible for rehabilitation cost of environmental degradation off site on other property where such actions relate to the spoil of the existing contract.

4.2 Access onto the property

4.2.1. Objectives

To reduce conflict between property owners and construction personal

4.2.2. Actions

- All agreements that occur during and prior to construction made with the landowners shall be approved by the Project Manager/ECO, recorded and strictly adhered to. The ECO must have knowledge of such agreements and monitor them in the interest of managing conflict and retaining a "good" name for Rand Water.
- Agreements in terms of land negotiations are confidential; however the negotiation team must inform the ECO of agreed commitments that will require additional monitoring such as the closing of gates or special restoration requirements.
- The rehabilitation team must be made aware of any obligations that may affect them.
- The ECO will be responsible for informing the rehabilitation team of agreements that affect rehabilitation.

4.3. Scenic quality /Visual intrusion

This issue covers potential impacts on landscape characteristics, open space quality, tourism activities and unique physical features.

4.3.1. Objectives:

- To minimize adverse visual impacts associated with new constructions
- To significantly minimize adverse impacts on the landscape character and sense of place of the affected area.

4.3.2. Actions

- The Contractor shall position all temporary structures as well as temporary plant on site in locations and at elevations which limit visual intrusion on neighbors. The type and color of roofing and cladding materials shall be selected to reduce reflection.
- Damage to the natural environment should be minimized.
- Vegetation should be cut only if absolutely necessary.
- The clearing of all sites should be kept to a minimum and surrounding vegetation should as far as possible be left intact as a natural shield.
- The Contractor shall not establish or undertake any activities, which in the opinion of the PM or ECO are likely to adversely affect the scenic quality of the area. The PM may direct the Contractor to refrain from such activities or to take ameliorative actions to reduce the adverse effect of such activities on the scenic quality of the environment.
- New access roads should be constructed with consideration the visual impact thereof and may only be approved by the ECO and PM.
- No painting or marking of natural features shall be allowed. Marking for surveying and other purposes shall only be with pegs and beacons.
- Natural out crops of vegetation, rocky ridges and other natural linear features, should not be bisected. Vegetation on such features should not be cut unless absolutely necessary for construction.
- Trees and all woody shrubs should be protected from damage to provide a natural visual shield. Excavated material should not be placed on such plants and movement across them should not be allowed as far as practical.
- All packed rock and exposed rock cuttings shall be done in such a manner that it may blend back into to the environment as much as practically possible
- The finishes of introduced rock work should consider color with the colors of the natural weathered rocks of the adjacent environment.

- Excavated rock material of a different color from local rock should either be back filled treated to accelerate aging effect of the rock or removed from site and disposed of in another area.
- No construction rubble, construction material, refuse, litter or any other material not found naturally in the surroundings should be allowed at any time to be lying around on the construction site.
- The PM or ECO may instruct the contractor to screen unsightly construction works where it has become evident that a visual disturbance is been encountered.
- Reinstatement of soil levels, roadways, entrances, verges must be prioritized to be undertaken as soon as construction works are complete to lessen the visual and scenic degradation of the site by the contractor.

4.4. Work Force Management

4.4.1 Objectives

- Management of people, on and off the site under the control of the project.

4.4.2 Actions:

- No members of the construction teams should be allowed to loiter on private property away from the construction campsite.
- Property owners must be notified by the contractor in writing prior to accessing the site. Normally two weeks is considered a reasonable notice.
- Local residents should not be allowed on the construction campsite.
- Wherever possible, employment opportunities shall be created for local labour.

4.5. Archaeological Artefacts

This issue covers potential impacts on monuments, historical and archaeological sites.

4.5.1 Objectives:

- To have no adverse impact on the historical inheritance of the area.
- The protection of land considered to be of traditional cultural value.
- The protection of known archaeological sites against vandalism, destruction and theft during the construction phase.
- To avoid damage to or destruction of previously unknown or excavated archaeological artifacts during construction.
- The preservation and appropriate management of new findings should these be discovered during construction.

4.5.2. Actions:

- All archaeological, paleontological and historical sites and buildings older than 60 years are protected in terms of the National Monuments Act (Act 28 of SHARA). In terms of this Act it is an offence to disturb any part of such site or material without a permit should an archaeological or other such discovery be made during any excavations.
- No artifacts may be removed off site unless authorized by the appropriate authority. Work on the area where the artifacts were found should cease immediately and the Engineer and the ECO be notified as soon as possible. Upon receipt of such notification, the PM or ECO will arrange for the excavation to be examined by an Archaeologist as soon as possible.
- The relevant authority shall be informed to ensure that appropriate management
- Action is taken immediately in collaboration with the specialist.

- Under no circumstances shall archaeological artifacts be removed, destroyed or interfered with by the Contractor, his employees, his sub-contractors or his sub - contractors' employees. Any person who causes intentional damage to archaeological or historical sites and artifacts could be penalized or legally prosecuted in terms on the Act.
- A three - strand fence shall protect archaeological sites, which will be at least 2 m outside the extremities of the site. The fence shall be clearly marked with danger tape. Vehicular traffic should not be allowed on archaeological and historical sites, within at least a 5 m radius from the perimeter of the site.
- A 15m buffer must be clearly demarcated around suspected graves and these must be considered as No-Go areas. This includes graves outside of the working area that may come into contact with operations of the construction works. An example will be for access routes.
- All known and identified archaeological and historical sites should be left untouched.
- No stones or rocks associated with a ruin may be removed, moved or changed in any way (painted, whitewashed).
- The Contractor shall ensure that none of his employees gain access to any archaeological areas (whether fenced or unfenced) except when authorized to do so by the PM or ECO or relevant Archeological authority.

4.6. Interruption of Services

Roads and road crossings, rail lines, telecommunication and broad casting facilities, dams, agricultural installations, power lines, pipelines, air fields, buildings and residences, new developments, quarries, traffic movement, access and other structures.

4.6.1. Objectives:

- The control of temporary or permanent damage to the installations activities.
- The control of interference with the normal operation of these installations or activities.
- The securing of the safe use of the installations or activities.
- The prevention of injury or loss of life on these installations or activities.
- The control of de-stabilization of the soil surfaces around the installations or activities.

4.6.2. Actions:

- The Contractor shall comply with all legislation with regard to man-made facilities and activities in the area, including the Occupational Health and Safety Act (Act 85 of 1993).
- The relevant authorities should be notified of any interruptions of services, especially water supply lines, sewerage lines, and telecommunication lines. These should be identified before any construction activities commence and appropriate protective measure should be implemented.
- Disruption of access for local residents during road construction, haulage, or any other construction activity shall be kept to a minimum and shall only take place with the prior consent of the PM.
- The Contractor shall liaise with the PM on a regular basis with regard to specific activities which could cause inconvenience to neighbors, especially the disruption of services. The PM will inform neighbors of such activities in good time.
- The contractor will notify the relevant landowners two weeks prior to entering their land in writing. The receiving landowner must sign receipt of this notification.
- Where community liaison officers are required, the contractor will work through the community liaison officer to notify the community of

relevant activities and hazards on site. All communication is to be listed by the site engineer in charge of the project.

- Gates that may be found open or closed will be left in the same state as they were found, subject to the requirements of the landowner/lessee.
- The contractor is to ensure that all necessary required way-leaves approvals are available on site at all times.
- The PM must be notified by the contractor should it become evident that way-leave agreements have not been obtained as soon as it becomes known.

4.7. Noise

4.7.1 Objective:

- Noise emanating from construction activities must not be "disturbing noise",
- Note that the sound level from the site measured at the nearest dwelling must not exceed the ambient noise level 80dBA or more in urban areas that are densely habituated.

4.7.2 Actions

- The operational layout shall be designed so as to control noise at source by the selection and positioning of temporary and permanent plant. Appropriate directional and intensity settings should be maintained on hooters and sirens.
- Silencer units on plant and vehicles shall be maintained in good working order where feasible for use.
- Where required, the Contractor shall provide noise attenuation measures in the form of cladding and earth beams between sources of on-site noise and neighbors

5. ESTABLISHMENT OF CONSTRUCTION SITE

5.1. General

The Contractor shall take into account any limitations and recommendations made in the environmental studies when establishing the construction site. The recommendations may apply to some or all of the following:

- Access routes to working areas.
- Construction camp layout, location, size and composition with regard to office areas, maintenance areas and construction plant washing areas, stockpile and storage areas, staff accommodation and ablution facilities, refueling areas, batching plant, lighting, crushers, other construction plant areas which may be necessary for the completion of the contract.
- Working area boundaries.
- Storm water control measures.
- Means of, and routes for, conveying materials to and about on the site.
- Pollution control.
- Management of waste.
- Storage and stockpiling of materials.
- Ablutions facilities
- Parking areas

Where no environmental assessment was undertaken during the planning and/or design phase, the Contractor shall establish the construction site in consultation with the Environmental Control Officer and PM.

5.2. Establishment of a Construction Campsite

5.2.1 Objectives:

To minimize the impact away from the main construction site

5.2.2 Actions:

- Site establishment is to be done only in an area identified as not being environmentally sensitive and approved by the ECO or EMS representative, prior to establishment.
- Prior to establishment of the site camp(s), the Contractor shall produce a plan showing the positions of all buildings, lay down yards, batch plants, vehicle wash areas, vehicle repair area, batching areas and infrastructure for approval by the Resident Engineer or PM.
- Camps are not to be placed within the 1:100 year flood line area or within the environmentally sensitive areas/buffers.
- No accommodation for workforce on site except a security presence.

5.3. Ablutions/toilets

5.3.1 Objectives:

- Installation of ablutions at convenient locals and safe disposal of waste.

5.3.2 Actions:

- The Contractor shall provide sanitation facilities in the form of chemical toilets, at all camps, offices, workshops and construction sites for staff and visitors. No other form of sanitation will be permitted unless a connection with a local sewer main is possible. The provision of this facility will comply with current legislation. A minimum of one toilet per 11 people or within 100 meters of the work site in order to prevent any breach of sanitary bylaws or offence to public decency.

- All the staffs are to use the toilets at all times rather than informal defecation in the environment.
- Toilets are to meet the minimum requirements of the OHS ACT.
- All sanitary fees that may be payable to any local authority shall be paid by the Contractor.
- Ablutions are to be cleaned / emptied before they are full and contaminate the environment.
- Toilets are not to be located within sensitive areas such as drainage lines and 1:100 year flood lines
- Any sewerage spillages must be regarded as hazardous and cleaned up immediately using appropriate PPE.
- A sewage leak due to accidental damage to a sewerage service must contain the spillage. The spillage may not leave the site. The relevant authority must be notified,

5.4. Batching Areas

5.4.1. Objectives:

- The batching area both during and after construction does not negatively affect the site and immediate environment.

5.4.2. Actions:

- The position of the batching plant is to be located and indicated on the site plans.
- The contractor is to ensure that when the batching plant is washed, that residue and wastewater does not pollute the soil or any surrounding area.
- The base and footings of the batching plant are to be removed from the site immediately after completion of the project.
- The removal of the base and footings is not to allow for the delay of the rehabilitation plan.
- Position batching plants on the basis of convenient location to the Work Sites as well as environmental limitations / opportunities.

- In linear developments (i.e. canals), plan the progressive movement of batching plants to have the least disturbance.
- Do not locate batching plants or associated sludge dams within the 1:100 year flood line, or within a horizontal distance of 100m (whichever is greater) of a watercourse, drainage line or identified wetland.
- Do not locate batching plants or associated sludge dams within any riparian vegetation zone.
- Protect the batching plant on the up-slope side by an earth berm or sandbag system to deflect clean surface runoff away from the plant.
- Contain the batching plant on the down-slope side by a trench and earth berm or sandbag system to control contaminated runoff and construction water emanating from within the plant.
- Collect all construction water and contaminated runoff emanating from within the batching plant (and associated wash bays) and contain within a sludge dam for later disposal in the appropriate manner
- Clean out all sludge dams on a regular basis, and disposed of sludge in the appropriate manner
- Ensure that appropriate measures are in place to prevent the overflow of sludge dams during heavy rains and storm conditions.
- Scrape waste concrete and cement sludge off the side of the batching plant on a regular basis, and dispose of in the appropriate manner.
- Ensure that water usage at batching plants and crusher plants is regulated – maintain the proper moisture content and avoid waste.

5.5. Blasting

Blasting permit to be on site at all times. These mitigation actions do not exempt the need for blasting permits

5.5.1 Objectives:

Specific safety of blasting activities in terms of environmental matters

5.5.2 Actions:

- When doing blasting the Contractor shall take measures to limit flying rock
- All blasting shall be carried out under proper control by licensed persons and shall be adequately protected.
- The Contractor shall be liable for any damage of any nature caused by such blasting.
- All properties and structures in the vicinity of the blasting that may in any way be affected must be proactively inspected and photographed prior to the blasting to facilitate the reduction in damage claims after the event. The manner in which this inspection is carried out must facilitate good neighborliness with I&AP's.

5.6. Access Roads

5.6.1 Objectives:

To control and assist with access control as well as damage to the environment.

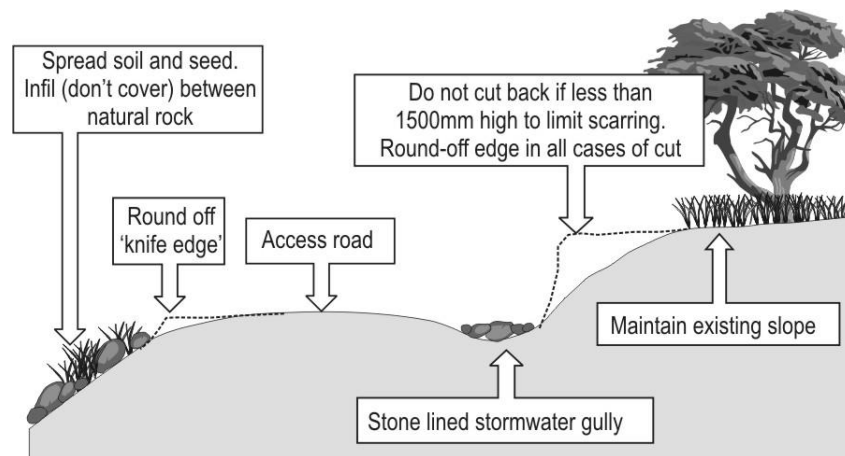
5.6.2 Actions:

- No new access permanent roads shall be developed by the Contractor other than those determined or approved by the PM.
- Existing roads shall be used as far as possible for construction purposes.
- Where new access roads are constructed, the Contractor shall:
- Peg out the proposed access road before construction starts, for assessment by the ECO and any other relevant authority.
- Install soil stabilization and erosion prevention measures at the time of road construction.
- If the road requires the stripping of topsoil it shall be stripped as described prior to construction and reinstated on completion of use of the road.
- Ensure that the maximum width of any new road shall not exceed 4m unless agreed by all parties. (Roads wider than 4m may require additional authorization in terms of NEMA.)
- Install water diversion berms from the start of construction. The berms shall be maintained at all times and be repaired at the end of the contract. Where

berms are installed on steep slopes the outflow shall be suitably stone pitched to prevent erosion from starting at the berms outlets.

- Minimize the visual impact of the new road.
- All access roads shall be properly marked. Roads not to be used shall be marked with **"NO ENTRY"** signs. When private roads are used the roads shall be maintained at all times.
- Any damage to private roads shall be repaired immediately and to the satisfaction of the landowners and the PM.
- A photographic record should be kept of all existing roads used to ensure that all roads repaired to at least their original status. This will also be available should any claim be instituted by any landowners.
- Should dust abatement be necessary on the road it must be carried out as described under items of air pollution/ dust suppression.
- Routes for temporary access and haul roads shall be located within the approved demarcated areas and vehicle movement shall be confined to these roads.
- Movement of vehicles outside the designated working areas shall not be permitted without authorization from the PM and ECO.
- Ensure that adequate vehicle turning areas are allowed for.
- Where construction will obstruct existing access, be sure to allow for alternative temporary access routes.
- Passing bays where two-way traffic is required must be planned in the least sensitive areas.
- Any additional routes and turning areas required by the contractor must be approved by the EO / ECO, in the form of an amended ESM & R Plan indicating the position and extent of the proposed route / area.
- Plan additional access routes to avoid significant vegetation specimens and communities, natural features and sites of cultural and historical significance.
- Routes should not traverse slopes with gradients in excess of 8%. Where this is unavoidable, stabilize the road surface.

- Maintain all access routes and roads adequately in order to minimize erosion and undue surface damage. Repair rutting and potholing and maintain storm water control mechanisms.
- Runoff from roads must be managed to avoid erosion and pollution problems.
- Regularly remove topsoil (and other material) accumulated in side drains of roadways to keep these open and functional.
- Clear up any gravel or cement spillage on roads.
- Clean and make good any damage to public or private roads caused by the Contractor during the construction phase.



Section through a typical cut and fill scenario for a road (Diagram as per DWA)

Figure 2. Section through a typical cut and fill scenario for a road

5.7. Earthworks

5.7.1 Objectives:

- The Demarcation of the work area in order to retain the footprint and avoid unnecessary damage to the adjacent environment due to an uncontrolled footprint
- Preservation of topsoil for reuse
- Control the movement of soil on site

5.7.2 Actions:

- The Contractor shall draw-up a plan of all parts of the construction site showing the layout of site establishment, topsoil stockpiles, planned access and circulation routes etc.
- The plan shall be submitted to the Environmental Control Officer and PM for comment and approval ~prior to site establishment commences.
- The contractor will indicate to the PM during tendering if the proposed working strip layout proposed below cannot be met and provide adequate reasons.
- An alternate plan must be produced and agreed upon for every area where the working strip will deviate from proposed working strip.
- The working strip may be made wider than the proposed layout below for difficult terrain or deep wide trenching, provided the landowner and the PM have granted consent in writing.
- The proposed layout for a pipeline working strip will be a permitted width of 20 m for machine excavation in normal situations and 15m within wetlands, unless otherwise specified and or agreed upon by the PM and ECO. It must be noted that at times the official servitude will not be as wide as 20m. This means the working strip will be partly outside of the official servitude.
- This working strip must accommodate all construction related activities, including materials storage, access routes etc.
- The outer edges of the working strip must be demarcated using visible barrier tape.

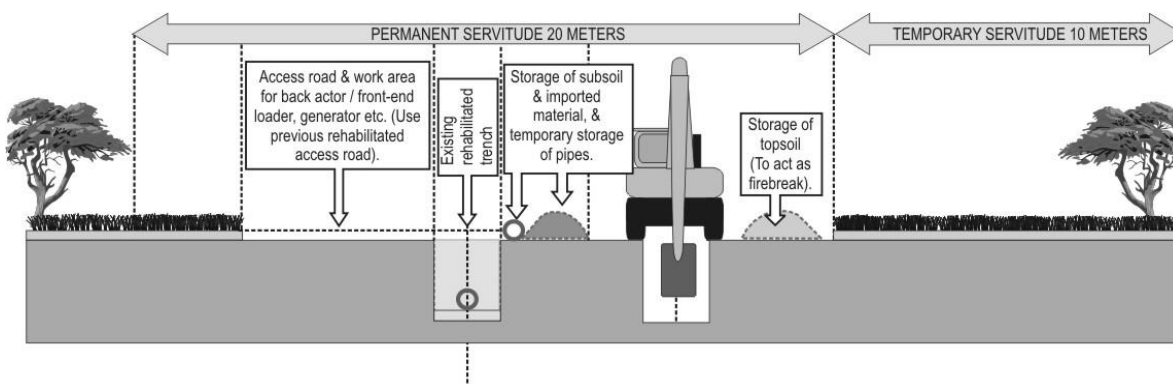


Figure 3. Diagram from DWA best practice guideline

- Program excavation to take place once the required materials are on site. This facilitates the immediate laying of services and / or construction of subsurface infrastructure and minimizes open trench time.
- The contractor must produce a diagrammatic representation method statement of the site layout, as per the examples above and below for approval by the PM and the ECO. If no provision has been made to deviate from the example below prior to construction with the approval of the PM then it can be assumed that the program below will be the official program.

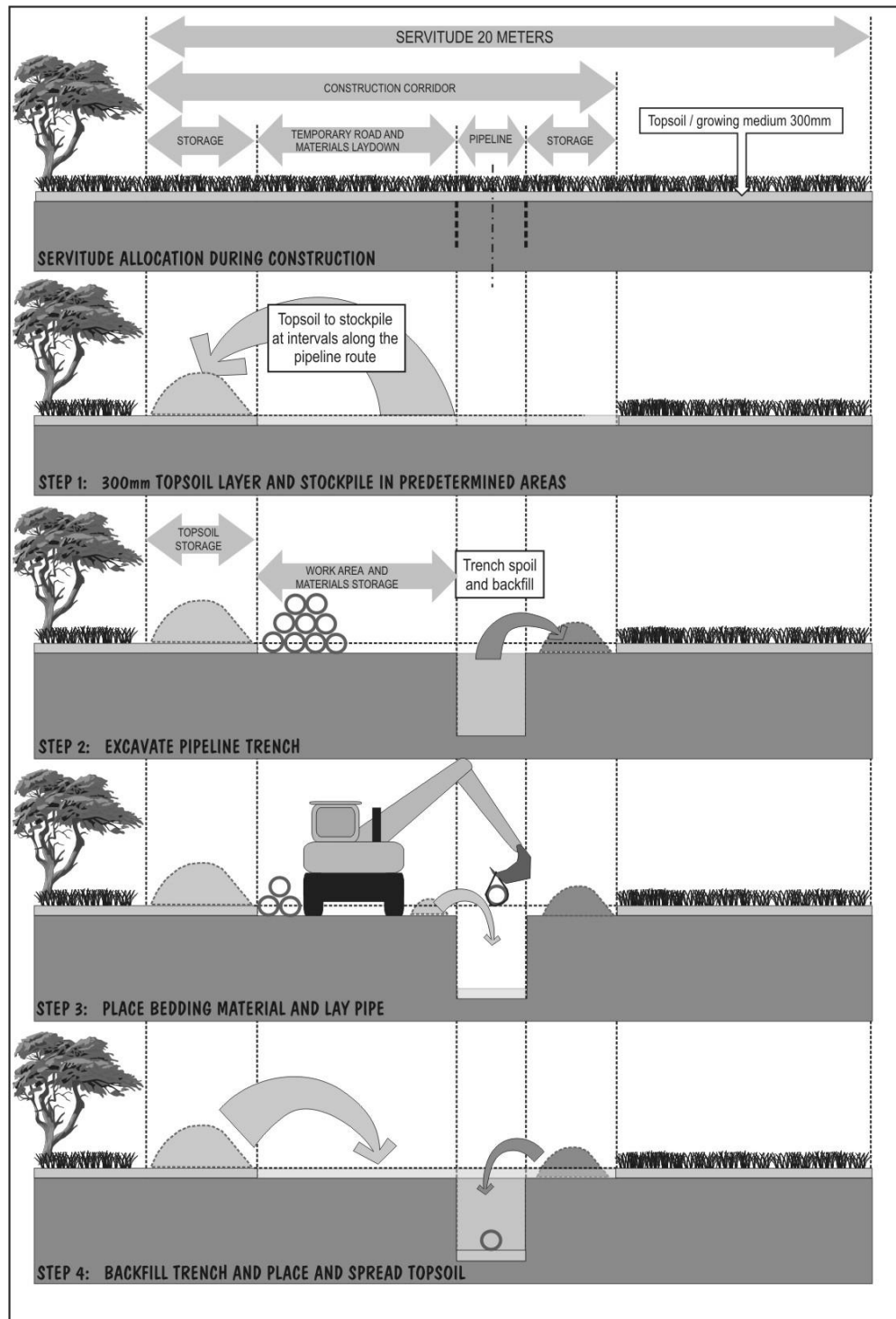


Figure 4. Example of works program

5.8 Fire Risk and Burning

5.8.1 Objectives:

To control and assist with fire prevention as well as damage to the environment.

5.8.2 Actions:

- All necessary precautions against veldt fires and also to protect material on site shall be taken.
- The contractor shall have fire-fighting equipment easily available on site especial during the winter period.
- At no time shall the contractor's workforce be allowed to collect firewood from the veldt.
- Packaging and other waste material may not be burned on site under any circumstances
- As outlined in the National Veldt and Forest Act 101 of 1998 (periods when the veldt is dry) a firebreak is to be in place by end May each year. If the firebreak is to be built the requirements as laid out in the Act must be followed. If the firebreak is to be scraped, the same requirements of a new access road are to be followed.
- Burning of vegetation including tree trunks and stumps cut during site clearing and establishment shall not be permitted. Woody material should be chipped and reused as mulch back on the site. No organic matter other than alien invasive material should leave the site. This will enable the environment to be rehabilitated easier.
- The Contractor shall supply firefighting equipment in proportion to the fire risk presented by the type of construction and other on-site activities and materials used on site. This equipment shall be kept in good operating order. This particularly applies to welding activities.
- Smoking is only allowed in designated safe smoking areas.
- No fires for warming or cooking are allowed outside of secured areas in the construction camp.

- Cooking fires in secure areas to be low in smoke pollution and restricted to the purpose for which they were lit. Bomb fires are strictly not allowed.

5.9. Demarcated Areas

5.9.1. Fencing.

5.9.1.1 Objectives:

To ensure and assist with controlled fencing in the working environment.

5.9.1.2 Actions:

- Under no circumstances will fences be cut or disturbed without an agreement with the landowner/lessee. Fencing erected during construction, be it temporary or permanent, must be inspected and maintained to the standard intended for the fencing.
- Fencing must not cause a safety hazard where low visibility may be of concern. Fencing must be made clearly visible by means of reflective tags or signage for animals and traffic
- Fencing shall be erected around sensitive natural vegetation or cultural elements to protect them from damage.
- Fenced areas are to be considered "**No-Go**" areas. This means no pedestrian or vehicular access shall be allowed to fenced areas.
- Any fences damaged by the Contractor shall be repaired as soon as possible at his/her cost, and shall be of the standard of the original fence.

5.9.2. Demarcation of sensitive areas

5.9.2.1 Objective

Protection of special features on site during construction

5.9.2.2 Action

- Heritage sites, sensitive vegetation, and wet lands are examples of sensitive features that may need to be retained and protected during construction.
- Sensitive features must be clearly marked on site.
- Fencing and barricading around sensitive features must be monitored and maintained at all times.
- Awareness of sensitive features on site must be done by the ECO
- All sensitive features are to be considered No- Go areas.

5.9.3. Demarcation of the work area as per the program of events and soil management program

5.9.3.1 Objective

- Demarcation of the works area to retain the footprint and avoid unnecessary damage to the adjacent environment due to an uncontrolled foot print
- Preservation of topsoil for reuse
- Control the movement of soil on site

5.9.3.2 Action

- The Contractor shall draw-up a plan of all parts of the construction site showing the layout of site establishment, topsoil stockpiles, planned access and circulation routes etc.
- The plan shall be submitted to the Environmental Control Officer and PM for comment and approval ~prior to site establishment commences.
- The contractor will indicate to the PM during tendering if the proposed working strip layout proposed below cannot be met and provide adequate reasons.
- An alternate plan must be produced and agreed upon for every area where the working strip will deviate from proposed working strip.

- The working strip may be made wider than the proposed layout below for difficult terrain or deep wide trenching, provided the landowner and the PM have granted consent in writing.
- The proposed layout for a pipeline working strip will be a permitted width of 20 m for machine excavation in normal situations and 15m within wetlands, unless otherwise specified and or agreed upon by the PM and ECO. It must be noted that at times the official servitude will not be as wide as 20m. This means the working strip will be partly outside of the official servitude.
- This working strip must accommodate all construction related activities, including materials storage, access routes etc.
- The outer edges of the working strip must be demarcated using visible barrier tape.

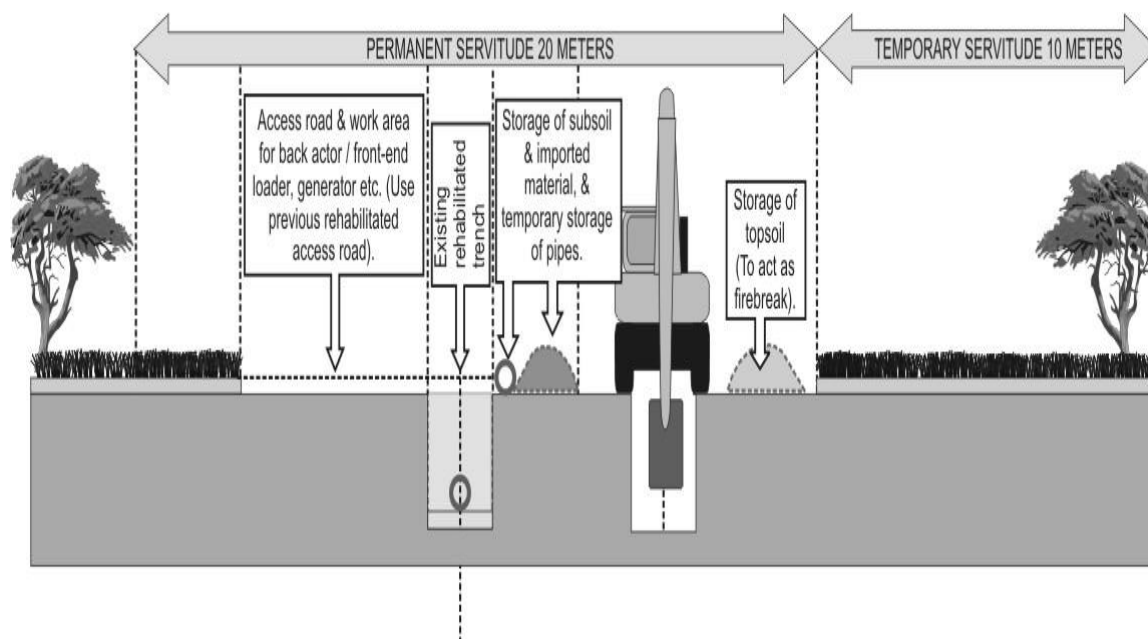


Figure 5. Diagram from DWA of best practice guideline

- Program excavation to take place once the required materials are on site. This facilitates the immediate laying of services and / or construction of subsurface infrastructure and minimizes open trench time.
- Method statement is included as part of the Basic Assessment and Water Use License.

6. POLLUTION

Definition: "Refuse" refers to all construction waste (such as rubble, cement bags, waste cement, timber, can, other containers, wire and nails), household and office waste.

6.1. Waste

6.1.1. General waste

6.1.1.1 Objective

- To avoid pollution to the environment
- To ensure that once construction activities are completed and all site rubble is removed, that the site is rehabilitated to blend in (as near as possible) with surrounding landscape.

6.1.1.2 Actions

- The entire site will be cleared of general litter /construction material, metal, tins, glass bottles, and food packaging or any other type of empty container or waste material or waste equipment used by the construction team on a daily basis.
- The contractor shall on a weekly basis dispose of all refuse at an approved refuse disposal site. Proof of disposal must be kept on record.
- Clearly marked litterbins must be provided on site for the separation of waste streams.
- The ECO should monitor the presence of litter on the work sites as well as at any offsite sites.
- All staff shall be sensitized to the use of litter bins for litter.
- Waste material that may harm man or animals should be removed immediately.
- No refuse or litter is allowed to be burnt on site.
- The recycling of all waste is to be encouraged of both the contractor and staff.

- The disposal of waste to have a paper trail proving that it was disposed of at a legal permitted waste site

6.1.2. Wastewater

6.1.2.1 Objective

To avoid pollution to the environment

6.1.2.2 Actions

- All runoff from fuel depots, workshops, truck washing areas and wash water from concreting vehicles and other equipment shall be collected and directed through oil traps to settlement ponds.
- The settlement ponds shall be suitably lined at the Contractor's expense if required in the opinion of the Environmental Officer.
- Wastewater may not be disposed of directly into drainage lines, streams or rivers.
- The Contractor shall provide suitable retention and filtration structures (which shall be properly maintained) for the collection of wastewater

6.1.3. Hazardous waste

Definition: Hazardous wastes are those which are proven to be toxic, corrosive, explosive, flammable, carcinogenic, radioactive, poisonous or classified as such in legal terms

6.1.3.1 Objective:

- The effective and safe management and handling of hazardous materials on site.
- The prevention of any hazardous substance entering the wetland area.

6.1.3.2 Actions

- A register of all hazardous waste must be kept by the contractor and form part of end of project documents.

- All potentially hazardous waste generated at the site shall be removed and disposed by an approved permitted contractor in terms of legislative requirements.
- Potentially hazardous raw and waste materials shall be handled and stored on-site in accordance with the manufacturer's specification and relevant legal requirements.
- The following waste products are examples of products that shall be disposed at a hazardous permitted landfill site:
 - ✚ cement;
 - ✚ diesel, petroleum, oil and lubricants;
 - ✚ explosives;
 - ✚ drilling fluids;
 - ✚ pesticides;
 - ✚ concrete additives; and
 - ✚ Water purification and chemicals.

6.1.4. Storage of fuel and other hazardous materials

6.1.4.1 Objectives:

- The safe storage and handling of hazardous material to safe guard the environment and people on the construction site.
- To provide for the correct handling storage and mitigation in the event of spillages.

6.1.4.2 Actions:

- Safety Data Sheets (SDSs) must always be readily available on site for all chemicals and hazardous substances to be used on site.
- An incompatibility study of chemicals that cause fires when stored to close to each other must be included in the safety data sheets.
- All the hazardous substance on site shall be handled/ utilized by the competent employees/ personnel.

- Cement mixing will occur in a designated area on an impervious layer (e.g. plastic or cement mixing pit). The runoff water will be contained for re-use in cement mixing or disposed of to the waste water system.
- Unused cement bags will be stored in an area not exposed to the weather and packed neatly to prevent hardening or leakage.
- Storage areas containing hazardous substances / materials must be clearly indicated.
- Any storage tanks containing hazardous materials must be placed in a ventilated bund wall area. The bund walls must be high enough to contain 110% of the total volume of the stored hazardous material.
- Hazardous substances must be stored and handled in accordance with the appropriate legislation and standards, which may include the Hazardous Substances Act, the Occupational Health and Safety Act, relevant associated Regulations, and applicable SABS and international standards.
- The Contractor will notify the site engineer and the ECO immediately of any pollution incidents.
- The Contractor to have an emergency spill kits available on site should there be a spillage of a hazardous substance.
- In the event of a hydrocarbon spill, the source of the spillage shall be isolated and the spillage contained.
- The area shall be cordoned off and secured. The Contractor shall ensure that there is always a supply of absorbent material readily available to absorb/breakdown the hydrocarbon spillage.
- Hydrocarbon contaminated material/soil shall be collected and disposed of at a registered hazardous disposal facility.
- Construction vehicles must have designated spillage kits so that oil spillages can be picked up immediately once noted.
- Staff is to receive awareness training on picking up oil spillages.
- Drip trays must be placed under all vehicles when immobile for longer than 24 hours. Vehicles suspected of leaking must be monitored. Dripping oil must be stopped immediately once detected.

- Drip trays must be of a sufficient size and volume to catch any hydrocarbons that might leak from a stationary vehicle
- No maintenance that could result in oil spillages to be done on site.
- Fuel, lubricants, transmission and hydraulic fluids shall only be stored in the designated areas.
- All spillages from any chemical must be reported to the ECO.
- Unless otherwise directed, contaminated soil will be disposed of at appropriate dumping site that is permitted to accept contaminated soil.
- All related documents for disposal of hazardous waste are to be copied to the ECO and retained on site to be included in the end of project documents.
- Empty containers in which hazardous substances were kept are to be treated as hazardous waste

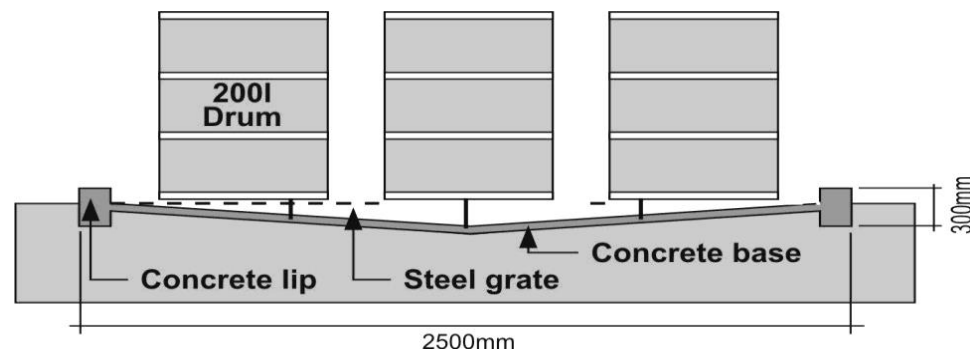


Figure 6. Section through a typical concrete bund

6.2. Water.

6.2.1 Objective:

Ensure that the water quality of the wetland is not altered as a result of construction related activities

6.2.2 Actions

- Contaminated water will not be dispersed to the environment.

- No fuel storage or refueling of vehicles or equipment will be allowed within 50 m of the watercourse/ or within the regulated area, whichever is the greatest.
- Downstream water quality to remain within acceptable ranges, as prescribed by Resource Water Quality Objectives, as far as practicable.
- The watercourse may not be used for the purposes of bathing, washing of clothing or vehicles.
- The Contractor shall not in any way modify nor damage the wetlands or any other open water bodies and drainage lines adjacent to or within the designated area, unless required as part of the construction project specification.
- Prohibit the increase of sediment load within the watercourse that may result from construction activities.
- Where necessary, install in stream silt traps during construction. In stream silt traps are to be maintained and serviced on a regular basis. The style of silt trap will depend on materials used and the water movement patterns. If silt traps are not deemed feasible, other suitable measures need to be taken to limit the suspension of unnaturally high sediment volumes in the stream.
- Where plastering and/or concrete packing under a bridge takes place sheeting shall be in place to ensure that excess concrete does not end up in a watercourse.
- Water from dewatering pumps must not be allowed to cause erosion or silt up the receiving environment.
- The outlet from a dewatering pump must be fitted with a sock to collect the silt when silt is observed.
- The outlet must point away from the water course allowing a longer time period and a diffusion of water energy back towards the water course.
- Settling ponds are to be used to retain dewatering silt before it flows into the environment.
- Where possible, recycle water on the construction site.
- Avoid over-wetting, saturation and unnecessary runoff during dust control activities and irrigation.

6.3. Air/ dust

6.3.1 Objective:

Ensure that the air quality is not harmful or offensive to workers and neighbors

6.3.2 Actions

- A speed limit of 40km/h to be maintained on all dirt roads.
- Dust suppression by means of either water or biodegradable chemical agent is required.
- A provision for a minimum of twice daily dampening by water cart must be provided.
- The first dampening must commence with the start of work daily and the second watering to commence no later than four hours later.
- During exceptional circumstances additional dampening may be required, should the watering not be deemed effective by the ECO. The ECO will determine the nuisance and health issues in considering this recommendation.
- All reasonable measures should be taken to minimize air emissions in the form of smoke, dust and gases.
- All vehicles and other plant should comply with road worthy requirements and comply with legislation in terms of allowable emissions.

7. PROTECTION OF THE NATURAL ENVIRONMENT DURING CONSTRUCTION

7.1. Preservation of flora

The flora on the site plays many important roles but not limited to the following:

- The integrity environment, in providing habitat and preservation of biodiversity
- The stabilising the site thus securing the stability of infrastructure.
- The scenic aesthetic value of the site is largely influence by the flora on a site

- The RW EMS section will play a leading role in the preservation of vegetation in the form of rehabilitation services.

Objectives:

To minimise adverse impacts on indigenous vegetation, the reinstatement of landscaped areas and the control of invasive species. "Flora" with a conservation status of endangered, vulnerable or rare are of particular interest in preserving biodiversity.

7.1.1. Search and rescue/ removal of flora

7.1.1.1 Objectives:

- To retain genetic material for reintroduction during rehabilitation
- To relocate plants so that they are not destroyed in the construction process

7.1.1.2 Actions

- Trees selected for preservation by ECO within or adjacent to the works areas shall be fenced by the Contractor around their drip line. The fence shall be clearly marked with danger tape. No open fires shall be allowed within this fenced area nor shall vehicles be parked underneath these trees.
- For significant trees that are marked to be retained (as indicated by the ECO), trenching must remain 3m away from the stem.
- Excavate and backfill trenches on a progressive basis around trees as per the diagram shown below whenever space allows.
- Where trenching is unavoidable and directly next to a tree ensure that the roots of the tree are neatly cut and treated to limit the susceptibility of disease onto the roots.
- Make provision for additional watering of the tree to reduce stress until the tree shows signs of recovery.
- Provide boarding support to the edge of the trench to avoid the soil crumbling thus exposing roots unnecessary

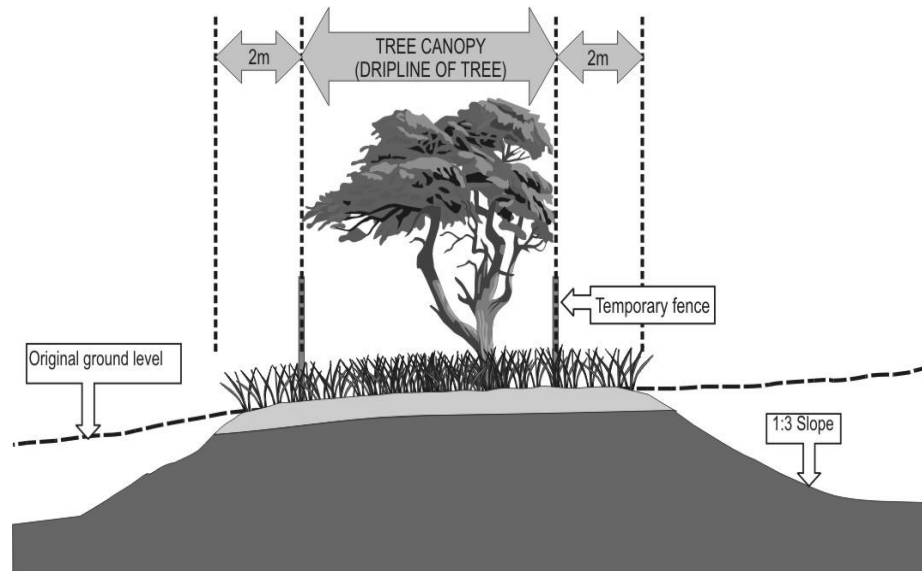


Figure 7. Section for rescue and removal of flora (Diagram as per DWA)

- All flora species of conservation importance, bulbs and aloes that are found during the search and rescue action or construction should be removed and placed in the nursery and should be utilized during rehabilitation.
- The removal of any plant material from site, including flowers or bulbs is strictly prohibited unless unavoidable and essential for the purposes of construction
- The contractor/person for search and rescue /vegetation clearing must have the knowledge to be able to identify different species, declared weeds and alien species.
- Prior to vegetation clearing any rare or endangered plant species, or other plant which have been identified by ECO, shall be removed and transplanted as instructed.
- The penalty for the offense of unauthorized removal of flora shall be determined by the ECO and shall be payable by the Contractor to Rand Water
- All vegetation damaged due to the unauthorized activities of the contractor will be reinstated and cost will be for the contractors account
- The removal of plant material for medicinal purposes is prohibited

- Any incident of unauthorized removal of plant material as well as accidental damage to priority flora must be reported and documented to the ECO who will investigate within 7 working days
- The felling and cutting of trees and clearing of shrubs should be minimized. Shrubs should only be cleared to provide essential access for construction p

7.1.2. Vegetation outside the works area

7.1.2.1 Objective

- Protection of areas of vegetation adjacent to the works areas.

7.1.2.2 Action

- No tree or shrub outside of the works area shall be felled, lopped, cut or pruned or burnt without the prior written approval of the ECO.
- Collection of firewood is prohibited.

7.1.3. Vegetation within or adjacent to the works area

7.1.3.1 Objective

- Protection of areas of vegetation within the works area

7.1.3.2 Action

- No tree or shrub outside of the works area shall be felled, lopped, cut or pruned or burnt without the prior written approval of the ECO.
- Collection of firewood is prohibited
- See photos showing current status of the proposed site. Most of the pavements are bear with the exception of an area close to the Randfontein road that is characterized by natural vegetation and scattered alien species (See appendix A).

7.1.4. Methodology to transplant a tree

7.1.4.1 Objective

- The safe relocation of specific trees.

7.1.4.2 Action

- Trees to be transplanted must be carefully removed from the soil so as to retain as large a root ball as practically possible. Use the tree's drip lines as an indicator: the larger the tree the larger the root ball (and subsequently the planting hole)
- Minimise disturbance of the soil and the remaining roots in the root ball during the lifting, moving and or transportation of all species.
- Wrap the root ball in Hessian or in plastic sheeting to retain the soil and to keep the root ball moist.
- Holes for transplanting trees and shrubs shall be dug before these plants are dug out. The hole must be of an adequate size to comfortably fit all tree roots (root ball) with the addition of one spade width on all sides.
- The root ball size that is removed should be to the extent of the drip line of the tree where ever possible.
- Cut and treat all damaged roots.
- Preserve all fine hair roots by covering them, shielding them from desiccation while in the process of transplanting.
- Transplanted plants shall be pruned to limit transpiration. Plants can be sprayed with an evapo-transpiration retardant liquid if they are evergreen. The use of products containing the hormone cytokines stimulate the re-growth of roots e.g. "kel pack"
- Trees and shrubs shall be planted so that their stems or trunks are at the same depth as in their original location. The orientation of the transplanted plants must be the same as in their original location.
- The use of the technique "puddle planting" is generally most successful for ensuring no air spaces are left around the roots.
- Provide a large water bowl for thorough watering to occur.

- Transplanted plants shall be watered immediately after planting and then once a week for 5 weeks and thereafter once every 2 weeks. Watering must be kept up until the tree has established.
- Stake all trees using three weather resistant wooden or steel stakes anchored firmly into the ground. Two of the three stakes are to be located on the windward side of the plant. Galvanised wire binding, 3 mm thick, covered with a 20mm diameter plastic hosepipe must be tied tightly to the stakes, half to two thirds the height of the tree above the ground and looped around the trunk of the tree.
- Place stakes at least 500mm apart and away from the stem and roots of the tree, so as not to damage the tree or its roots. This distance will depend upon the size of the tree planted and must be approved by the EO / ECO before staking.
- Where necessary, protect newly planted trees against wind, frost and wild animals by means of fencing, sacking or frost nets, as specified by the EO / ECO.
- Remove stakes and wire binds over time as required, as plants become established.
- All transplanting will either be directly undertaken by the EMS Section or under the direction of the ECO.
- Transplanting of trees: Possible methods of transplanting that could be used are outlined below, but shall not be specifically limited to these methods below

7.1.5. Transplanting of Aloes and bulbous plants

7.1.5.1 Objective

- The safe relocation of specific aloes and bulbous plants.

7.1.5.2 Action

- Aloes and evergreen bulbous plants may be transplanted at any time of the year. Deciduous plants shall be transplanted when they are leafless.

- Aloes and bulbous plants shall be planted in similar soil conditions and to the same depth as they were before removal.
- Transplanted aloes and bulbs shall be watered once directly after transplanting to settle the soil.

7.2. Preservation of fauna

7.2.1 Objectives:

- To avoid damage to or destruction of indigenous fauna.

7.2.2 Actions:

- The Contractor shall ensure that all works are undertaken in a manner, which minimizes the impact on the local fauna and shall apply the following specifications with respect to fauna management and protection
- The contact detail for animal rescue such as snake and bee removal shall be made available at the construction site, so as to rescue them should they be found on the construction site.
- Trenches shall be inspected regularly for fauna that may have fallen into them and become trapped. All fauna found in trenches must be rescued.
- Under no circumstances shall any animals be handled, removed, killed, scared or interfered with by the Contractor, his/her employees, his/her sub - contractors, or his/her sub-contractors' employees.
- No species of animals may be poached, snared, hunted, captured or willfully damaged or destroyed.
- Any incidents of poaching, willful disturbance or damage to wild animals as well as accidental damage to or death of wild animals should be reported to the ECO and recorded. It shall be treated in terms of the law.
- The Contractor and his/her employees shall not bring any domestic animals onto site.

- The Contractor shall ensure that domestic animals and native animals belonging to the local community are kept away from unprotected works.
- The Contractor shall ensure that the work site is kept clean and tidy and free from rubbish, which would attract animal pest species.
- Anthills that occur should not be disturbed unless it is unavoidable for construction purposes. Before construction starts, construction workers should be educated with regards to littering and poaching;
- No fishing is allowed.
- Photographs of sensitive animals (e.g. Otter) must be displayed in the construction camp to heighten awareness of the creatures.
- Toolbox talks should be provided to employees regarding snakes. All snakes and reptiles on site must be removed by a qualified snake handler and all attempts should be made to ensure snakes and reptiles are not killed or collected.
- Nesting sites of birds should not be disturbed.
- Construction activities should be limited to daylight hours, in order to minimize impacts on nocturnal fauna.
- Trucks should travel at a minimum speed to avoid unnecessary killings of animals found on site.
- Animals residing within the designated area shall not be killed nor unnecessarily disturbed. Where sensitive species occur, these shall be relocated by the relevant conservation authority. A cooler box with vermiculite will be used to move hibernating animals to reduce their stress. All relocations are to be reported and ideally photographed.
- Identify animal species, populations and nests to be relocated. Relocate these two areas where there will not be at risk. Plan such operations well in advance.
- No wild animal may be fed on site.
- Regularly undertake checks of the surrounding natural vegetation, in fences and along game paths to ensure no traps have been set. Remove and dispose of any snares or traps found on or adjacent to the site.

- Ensure that the Work Site is kept clean, tidy and free of rubbish that would attract animal pests.
- Have problem animals and vermin removed by an appropriate organization or authority (i.e. such as the Parks Board, the SPCA or a registered exterminator).
- Ensure that domesticated animals belonging to the local community are kept away and are safe from any unprotected Works.
- Do not make use of any pesticides, unless approved by the EO / ECO.

7.3. Storm water

7.3.1 Objectives:

- To avoid damage to or destruction of the environment caused by storm water.

7.3.2 Actions:

- No impediments to the natural surface flow other than approved erosion control works must occur.
- Do not drain, fill or alter in any way, any wetland or drainage line, including the riverbanks unless this forms part of the construction Works, or upon specific instruction by the PM / ECO.
- Do not allow surface water or storm water to be concentrated, or to flow down cut or fill slopes or along pipeline routes without erosion protection measures being in place.
- The surface of the work area must be re-profiled so that the pre-excavation drainage patterns and hydrology are restored. Particular attention should be paid to this aspect with respect to the banks of the stream. At all stages of the contract, storm water control measures as required shall be applied to keep soil on site by minimizing: erosion of temporary stockpiles of topsoil and permanent spoil dumps; erosion from construction roads, excavations and other cleared areas; silt-laden run off from all areas stripped of vegetation, including excavation surfaces and stockpiles of spoil and topsoil; and

contaminated run off from storage area, thereby preventing it from entering water courses.

7.3.3. Construction of berms for storm water diversion

7.3.3.1 Objectives:

- To provide a guideline on the implementation of berms and off shoots.
- To manage surface water to avoids soil erosion
- To manage silt laden water entering water courses thus increasing the turbidity.

7.3.3.2 Actions:

- The minimum height of berms is to be not less than 300 mm, measured from the surrounding soil level to the peak of the berm.
- The water gully/offshoot on the upward (top) side of each berm/water offshoot is to be not less than 300 mm deep, measured from the surrounding soil level to the trough of the gully.
- Each berm/water offshoot must be constructed in such a way that the water runs down the offshoot and off the area (road, scarred area).
- No berm/water offshoot is to have an angle of more than $\nabla 25\text{E}$, measured from the horizontal down towards the vertical. This is to ensure that water run-off is slow enough not to start unwanted erosion problems.

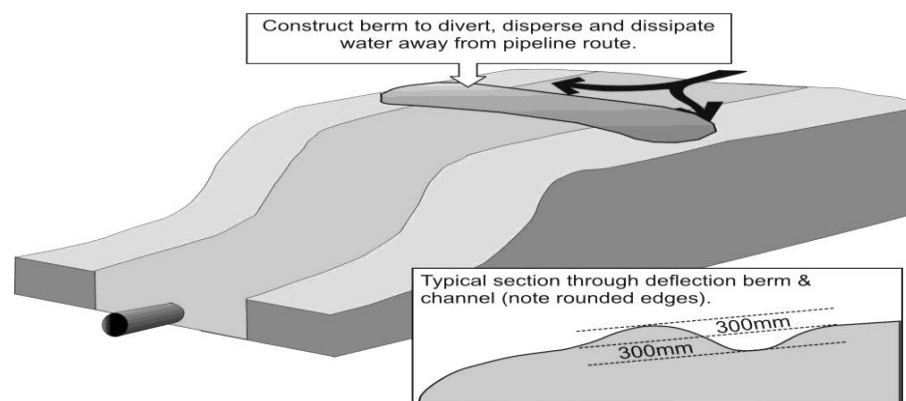


Figure 8. Typical application of a deflection berm to avoid erosion of a pipeline route

- The length of the berm shall commence at least 1 m into vegetated soil on the top side of the berm and will continue across the scarred area/road requiring protection from erosion and end at least 2 m into vegetated soil on the down side of the berm.
- This is to ensure that water removed from the protected area spreads out sufficiently over a vegetated area without causing any further erosion and simultaneously does not return to the area being protected.
- The minimum width of a berm is to be not less than 2 m. The gradual height differences in the berm is to ensure that a standard 2 wheel drive vehicle can transgress the berm without the potential of getting stuck and cause skid of tyres. The berm must allow vehicles to cross easily without undue jerking.
- Position of berms:
- The position of the berms will be indicated on site by the ECO. The following guidelines shall apply in all instances where the position and length of the berms is not indicated by the ECO.

10° slope	every 200 to 300 m
20° slope	every 150 to 250 m
30° slope	every 50 to 150 m
45° slope	every 25 to 75 m
Greater than 45° slope	every 25 to 150 m

The factors influencing distances between berms:

- Rainfall of the area
- Soil types
- Length of slope
- Catchment area plus surface runoff water
- Potential to establish vegetation

7.4. Diversion of a water course during construction of a pipeline

During the construction of the Q6 pipeline there will be no diversion of a water course, however because there is a stream within the stipulated 500m buffer

zone by the Department of Water Affairs, authorisation in the form of General Authorisation or Water Use License before construction starts.

The use of these proposed mitigations does not exempt the user for having a section 21C&I water use licence for this activity.

7.4.1 Objectives:

- To allow continuity of migration for biota in water courses
- To limit the negative impacts on the environment
- To avoid damming up of water unnecessary.

7.4.2 Actions:

- This must be a temporary impact and the area rehabilitated upon completion of the proposed service installations.
- Diversion must be for as short a time as possible and preferably in the winter months.
- All temporary works must be removed from the stream upon completion of the crossing.
- Diversion should be done such that "water ways" are achieved whereby surface flow will not be impeded
- River diversions must be maintained and constructed in such a way that no water will flow through the dry works area.
- Diversions can be constructed by using lined channels, rubber dams or a pipe.
- All berms or coffer dams should be constructed of non-erodible material such as sand bags.
- Hay bales packed in rows across diversions during construction can be used to control sediment inputs.
- Institute adequate sedimentation control measures at river crossings and when excavation or disturbance within riverbanks, or the riverbed takes place Avoid the tipping of loose soil into the stream or trenches dug in the stream banks.
- Any debris, waste, excess material must be removed from the stream.

- The diversion sandbags must be correctly designed and packed sufficiently thick so as to minimize water flowing past the construction points where it could be contaminated and degrade water quality downstream.
- Line overflow and scour channels with stone pitching along their length and at their points of discharge to prevent soil erosion. The point of discharge must be at a point where there is dense natural grass cover.
- Ensure that channels do not discharge straight down the contours. These must be aligned at such an angle to the contours that they have the least possible gradient.
- Locate any point of overland discharge at least 50m away from any river, stream or drainage way.
- Ensure that overland discharge occurs over areas that have a minimum cover of 90% grass cover at a minimum height of 150mm. This applies to areas down slope of the discharge point as well.
- The disturbed stream banks must be re-vegetated with locally indigenous plant species chosen to enhance the stability of the soil and protect the surface from erosion. Any exotic trees, shrubs or plants must be removed from the riparian vegetation along with the rest of the development site.
- All access ways into the stream bed that disturbed the banks in any way must be reinstated and rehabilitated.

7.5. Topsoil and soil preservation

Within this section the preservation and management of soil will be discussed under the following headings:

- Source of topsoil
- Topsoil stripping
- Topsoil Stockpiling
- Topsoil Re Placement
- Other soil

7.5.1 Source of topsoil

7.5.1.1 Objectives:

- To allow for the preservation of topsoil
- To limit the negative impacts on the environment

7.5.1.2 Actions

- Topsoil means that layer of soil covering the earth and which provides a suitable environment for the germination of seed, allows the penetration of water, is a source of micro-organisms, plant nutrients and in some cases seed, and of a depth of up to 0,3m.
- Topsoil (top 300mm as a minimum) must be temporarily stockpiled separately from subsoil or rocky material (the topsoil contains both the seedbed and nutrient supply necessary for plant growth - if mixed with subsoil layers the usefulness of the topsoil for rehabilitation will be lost) Topsoil shall be stripped from all areas to be utilized during construction period and where permanent structures and access is required.

These areas will include all temporary and permanent access roads, construction camps and borrow pits.

- Topsoil shall be stripped after clearing of woody vegetation and before excavation or construction commences.
- Disturbance of topsoil on construction sites with severe slopes should be minimised at all costs.
- The site is known to have minimal topsoil, but nevertheless what topsoil is on site MUST be saved and stored.
- It is imperative that this soil be collected and stored to ensure that valuable seeds in the soil are not lost to the process of eventual rehabilitation of the site.

7.5.2. Topsoil Stripping

7.5.2.1 Actions

Soil shall be stripped to a minimum depth of 300 mm or to the depth of bedrock where soil is shallower than 300 mm.

Herbaceous vegetation, overlying grass and other fine organic matter shall not be removed from the stripped soil.

Topsoil shall be stripped when it is in a dry condition in order to prevent compaction.

7.5.3 Topsoil Stockpiling

7.5.3.1 Actions

The Contractor will be held liable for the replacement of any topsoil rendered unsuitable for use during rehabilitation, for reasons due to his negligence or mismanagement on site.

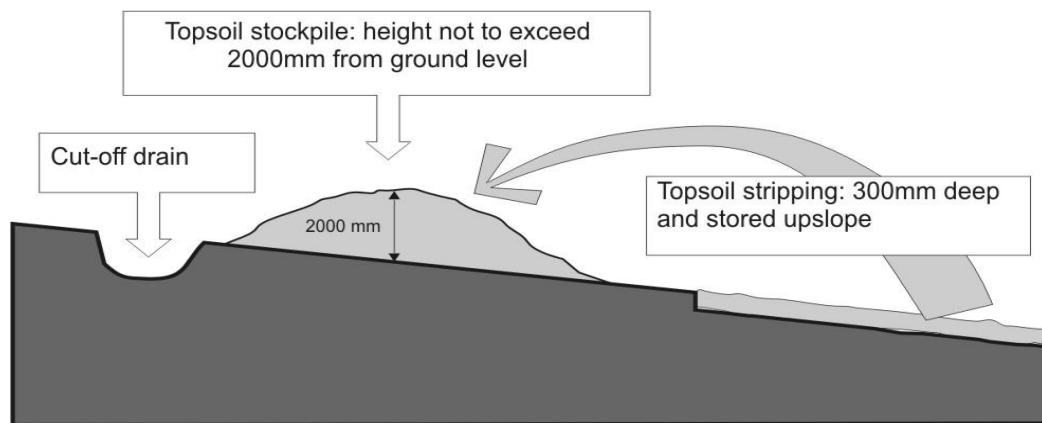


Figure 9. Section through a typical topsoil stripping and stockpiling operation

- Position topsoil stockpiles as indicated on the approved ESM&R Plan.
- When possible and space allows: Stockpiled soil (particularly topsoil) must be protected by erosion-control berms if exposed for a period of greater than 14 days during the wet season (this will prevent topsoil being leached of its nutrient content and/or being washed away or mixed with other stockpiled soil).
- In linear projects, stockpile topsoil in windrows parallel to the excavation.
- The topsoil will be stored in such a way and at such a place that it will not cause damming up of water or wash away itself

- When applicable consider position topsoil stockpiles on the higher side of a disturbed area, and above a 1:50 year flood line wherever possible.
- Ensure that all topsoil is stored in such a way and in such a place that it will not cause the damming up of water, erosion gullies, or wash away itself.
- If topsoil is to be stockpiled for extended periods, especially during the wet season, then the ECO may recommend one of the following measures:
- The covering of the stockpiles with a protective material such as hessian mats.
- Seeded with a temporary grass to keep the microbial activity within the soil alive.
- Soils stockpiles must be located away from the streams watercourses and wetlands or areas of temporary or permanent inundation.
- It must not be stored on top of sensitive vegetation or outside of demarcated working area.
- Remove exotic / invasive plants as per CARA listing.
- Slash weeds before seeding and leave them on site as mulch. (The roots help to stabilize the soil and keep micro-organism alive.
- Ensure that topsoil is at no time buried, mixed with spoil (excavated subsoil), rubble or building material, or subjected to compaction or contamination by vehicles or machinery. This will render the topsoil unsuitable for use during rehabilitation.
- Topsoil stripped from different sites shall be stockpiled separately and clearly identified as such. Topsoil obtained from different soil types shall not be mixed.
- Soil stockpiles shall not be higher than 1,5m and the slopes of soil stockpiles shall not have a vertical/horizontal gradient exceeding 1: 1.5.
- Stockpiled topsoil must not be compacted; this includes the movement of any form of vehicles over the stockpiles.
- Soil stockpiles shall not be allowed to become contaminated with oil, diesel, petrol, garbage or any other matter which may inhibit the later growth of vegetation in the soil.

7.5.4 Topsoil and Other Soil Re Placement

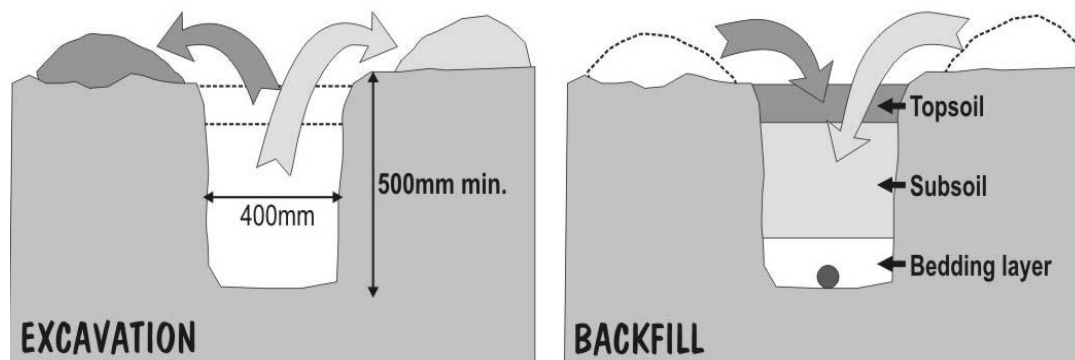


Figure 10. Section through a typical trenching operation

7.5.4.1 Actions

- The stockpiled topsoil must be replaced as the final soil layer.
- Topsoil placement shall be done concurrent with construction as soon as construction in an area has ceased. After topsoil placement is complete, stockpiled vegetative matter may be spread randomly by hand over the topsoiled area which may serve as mulch.
- Execute topsoil placement concurrently with construction where possible, or as soon as construction in an area has ceased.
- Replace and redistribute stockpiled topsoil together with herbaceous vegetation, overlying grass and other fine organic matter in all disturbed areas of the construction site, including temporary access routes and roads.
- Replace topsoil to the original depth (i.e. as much as was removed prior to construction - These areas will be quantified by the PM / ECO.
- Place topsoil in the same area from where it was stripped. If there is insufficient topsoil available from a particular soil zone to produce the minimum specified depth, topsoil of similar quality may be brought from other areas of similar quality. The PM / ECO will advise
- Remove all stones with a diameter in excess of 50mm in areas to be mown by machines. Dispose of excess debris material in the agreed manner

- Plan shaping and trimming operations to allow for topsoil application: final trimmed levels must make provision for the specified depth of reapplied topsoil
- All areas onto which topsoil is to be spread shall be graded to the approximate the original land form with maximum slopes of 1:2, 5 and shall be ripped prior to topsoil placement.
- The entire area to be topsoiled shall be ripped parallel to the contours to a minimum depth of 150 mm.
- Vehicle access onto the topsoil must be strictly prohibited once it has been prepared as per above for seeding to take place and up until the grass has germinated and become established.

7.5.5 Other soil

7.5.5.1 Actions

- The soil deeper than the topsoil excavated for the pipeline should be stockpiled separately and where suitable, it should be used for backfill.
- In water courses, wetlands, riparian areas, this sub soil when be returned to the trench, should be compacted to a density similar to the in situ material. If different layers exist the soil soul be returned in the same order
- The height of the subsoil will be determined by safety principals. The PM must ensure that landslide and washing away of subsoil does not occur.

7.6. Boulders

7.6.1 Actions

- To assist the site with eventual rehabilitation all possible natural surface boulders are to be saved.

- Boulders that can in any way be picked up or moved (by machinery on site), are to be positioned to one side of the site. These boulders are to be fenced off and protected.
- Any identified boulder outcrops that can be saved and that will not be directly affected by construction activities are to be fenced off.
- Boulders that are moved are to be moved in the presence of the ECO. When moving boulders care must be taken, **not** to damage the outer surface of the rock (this is the very reason for saving the boulders).
- Once construction is completed, the construction contractor is to reposition rocks with direct specific assistance from the ECO.

7.7. Erosion Prevention and Management

Compliance with all other related sections is essential for compliance in this section

7.7.1. Objectives:

- Loss of soil due to erosion.
- Siltation of watercourses and storm water systems due to uncontrolled erosion on site
- Stop erosion before it become more expensive and serious to rehabilitate.
- Ensure that the infrastructure remains stable during construction and is not undermined by erosion

7.7.2. Actions:

- Minimize erosion during or after the construction.
- Install berms on to the trench area where slopes are encountered in the same process of backfilling of the trench. See berm specification.
- The Contractor shall take measures ensure that there is no undue storm water damage and soil erosion resulting from the construction activities outside the

construction camp and works areas as a direct or even indirect result of the construction activities on site.

- During construction, water diversion soil berms should be constructed to divert surface and storm water from traversing the disturbed areas.
- The PM is accountable to ensure that adequate budget provisions have been made for proper rehabilitation to take place.
- Notify the rehabilitation team prior to completion of the completion date of construction to enable rehabilitation of all disturbed areas during construction.
- All embankments that are disturbed and destabilized (erosion and dongas) should be established with appropriate soil erosion and control procedures, during the rehabilitation as soon as possible.

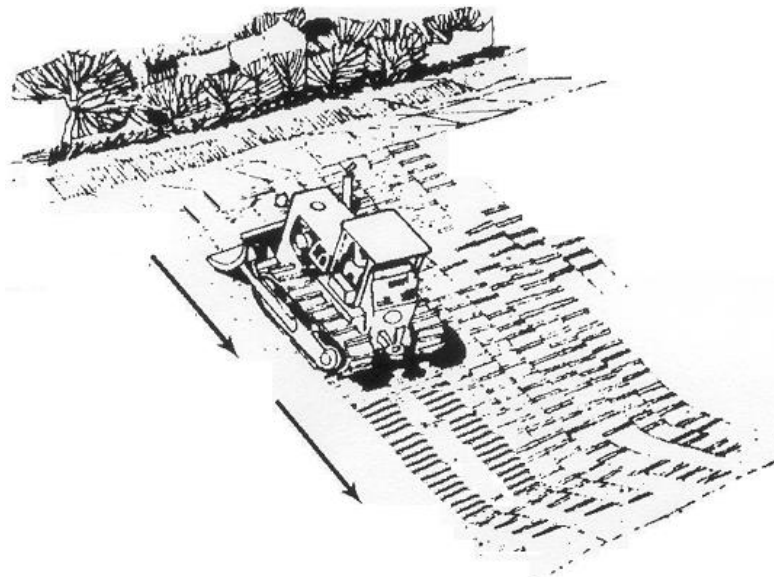


Figure 11. Example of stabilizing and roughening of slopes using a front end loader on tracks

7.8. Alien invasive and Weed Management on Site

7.8.1 Objectives:

- Control of invasive plant material during construction.

7.8.2 Actions:

- The Contractor shall remove all alien invasive vegetation as per the C.A.R.A listing from the works area for the duration of construction. Such vegetation will be identified by the ECO or EMS representative and the method of eradication will be specified.
- Weeds are to be slashed before seeding occurs and left on site as mulch.
- The site is to be kept clean and tidy in line with proper housekeeping at all times.
- Invasive plant material that has been taken out must not be let on site if they have viable seed that could cause the spread of the plant.

7.9. Final shaping

- Make safe all dangerous embankments and excavations by backfilling, grading and blasting as In general, slopes steeper than 1(V):3(H) or slopes where the soils are by nature dispersive or sandy must be stabilised. The PM / ECO will specify a solution in terms of the most appropriate approved method and technology. One or more of the following methods may be required:
 - Topsoil covered with a geotextile plus a specified grass seed mixture.
 - A 50:50 by volume rock: topsoil mix 200mm thick, plus specified grass seed mixture.
 - Logging or stepping (logs placed in continuous lines following the contours).
 - Earth or rock-pack cut-off berms.
 - Benches (sand bags).
 - Packed branches.
 - Ripping and / or scarifying along the contours.
 - Storm water berms.
- Near vertical slopes of 1(V):1(H) or 1(V):2(H) must be stabilized using hard structures, preferably with a natural look, and with facilities allowing for plant growth. The EO / ECO will specify a solution in terms of the most appropriate

approved method and technology. One or more of the following methods may be required:

- Retaining walls (loffel or otherwise).
 - Stone pitching.
 - Gabions.
 - Shotcrete.
- Protect the slopes of all river diversions. One or more of the following methods may be used, as specified by the EO / ECO:
 - Sandbags.
 - Reno mattresses.
 - Plastic liners and / or coarse rock (undersize rip-rap).required.
 - In general, no slopes steeper than 1(V):3(H) are permitted, unless otherwise specified by Rand Water and the Engineer. Steeper slopes require protection. New slopes must mimic the natural slopes and topography, where possible.
 - Monitor backfilled areas for subsidence (as the backfill settles) and fill depressions using available material.
 - Shape all disturbed areas to blend in with the surrounding landscape, where possible.
 - Ensure that no excavated material or stockpiles are left on site and that all material remaining after backfill is landscaped to blend in with the surrounding landscape.

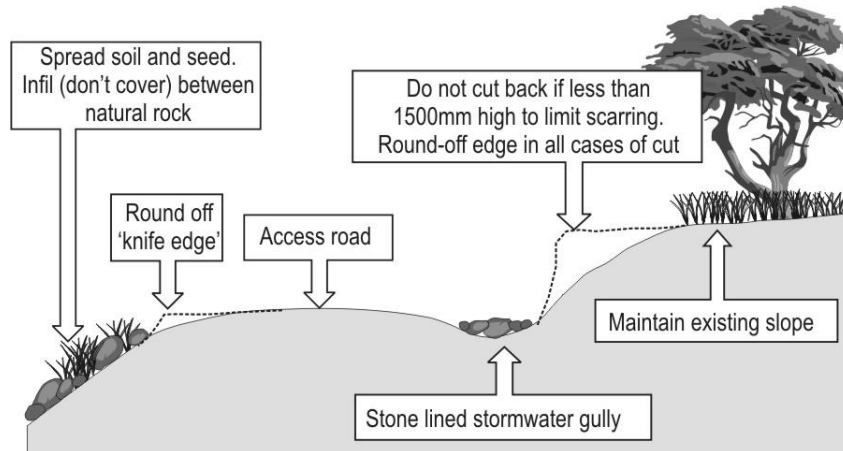


Figure 12. Section through a typical cut and fill scenario for a road. Diagram as per DWA

7.9.1. Reinstatement of infrastructure

7.9.1.1 Objectives:

- To restore infrastructure such as roads gates driveways, paving wall, fencing as soon as possible.

7.9.1.2 Actions:

- Before and after photograph pictures of all infrastructure must be kept by the contractor and the ECO.
- Copies of written or other agreements with external parties must be made known to the ECO on site.
- Reinstatement of services and infrastructure must be done as soon as reasonably possible not to inconvenience the external party unnecessary.

8. RESTORATION OF THE SITE AFTER CONSTRUCTION

The restoration or rehabilitation will commence after the construction site has been handed over to the rehabilitation EMS team. The process on average may take three years.

Objectives:

- To return the site to as close as possible to its original condition.
- Loss of soil due to erosion.
- Ensure biodiversity returns to the site.
- Ensure adequate grass cover of all surfaces
- Siltation of watercourses and storm water systems due to uncontrolled erosion on site
- Stop erosion before it become more expensive and serious to rehabilitate.
- Ensure that the infrastructure remains stable during construction and is not undermined by erosion
- Control of invasive plants in the long term

8.1. Rehabilitation and Re-vegetation

- All rehabilitation on site will be undertaken by and be the responsibility of the Rand Water Corporate EMS Section (excluding returning of topsoil and boulders infrastructure and services).
- Once the major construction activities have been completed the site must be inspected in order to determine specific rehabilitation measures.
- A site-specific rehabilitation plan must be drawn up in order to return the land to its original state.
- Only indigenous species should be used for the rehabilitation and stabilization of the sites that are natural.
- Similar plant material to the original plant material should be used when the re-landscaping of constructed landscapes is conducted. The original intention and character of the landscape must be considered and reinstated where possible.
- The re-establishment and introduction of suitable shelter, habitat and fodder plants must be considered for the selection of plants for the preservation of fauna
- Where necessary extra erosion prevention mechanisms shall be installed.
- Access roads no longer required and to be closed shall be ripped re-vegetated and properly rehabilitated.
- Grassing - All areas that require grassing due to the stripping or damage of grassed areas during construction.
- Trees, shrubs and selected bulbs will be re-established on and around the site.
- Trees are discouraged on the pipeline in line with the tree root policy due to the damage caused to the pipeline by the roots of these plants.

8.2. The Recycling of Old Dead wood

- The re use of dead wood is encouraged for the following reason
- Dead wood can be chipped and used as effective mulch.
- Branches can be laid down on site and flattened by driving over them, providing for mulch.

- The introduction of dead wood will serve as suitable bird perches particularly for raptors.
- Dead wood in water courses will assist fauna escaping from drowning.
- Dead wood is an important feature for habitat of lizards as they feed on insects that feed on the wood. It also provides shelter.
- Dead wood can make compost
- Dead wood shortens the lifespan of registered waste fill sites due to the bulky nature of wood. Thus disposal of wood should remain as a last resort.

8.3. Ripping and Scarifying

- Rip and / or scarify all areas following the application of topsoil to facilitate mixing of the upper most layers. The EO / ECO will specify whether ripping and / or scarifying is necessary, based on the site conditions immediately before these works begin.
- Rip and / or scarify all disturbed (and other specified) areas of the construction site, including temporary access routes and roads, compacted during the execution of the Works.
- Rip and / or scarify along the contour to prevent the creation of down-slope channels.
- Rip and / or scarify all areas at 300mm intervals (but not more than 400mm intervals) with tractor mounted single tine sub soiler, ensuring that the lines overlap.
- The area is then to be renovated to obtain an even (fine) tilth (not dug over). To a depth of 100 mm.
- Prepare the final levels of the area ensuring that once the veldt grass seed is planted the finished level will tie in with the existing hard landscape levels.
- Do not rip and / or scarify areas under very wet conditions, as the soil will not break up.

8.4. Control of Alien Invasive Vegetation

- Fell or remove all alien trees as per CARA list.
- EMS to approve the method of control for Alien invasive vegetation

- Chip all branches and applicable wood which does not have viable seed that can spread back on site.
- Spread woodchips back onto the site.
- Remove all logs too big to chip to a safe legal disposal area.
- Chemically treat all tree stumps, only registered pest control operators (PCO license) to apply herbicides.
- Monitor the site to prevent alien invasive trees spreading out into the larger environment.

8.4.1 Felling Trees

- All safety aspects to be observed as advised by ECO.
- The contractor will be held liable for all non-alien trees felled and will be required to pay compensation.
- Tree stumps must be left at a height of 750mm with chemical treatment or de-rooted as advised by EMS.
- Trees that are to be felled may not rip the soil up as the integrity of the embankment must remain in place. (To do this the contractor must control the falling of the tree so that it does not cause the tree to become up rooted.)
- No debris may fall into the river. Any branches falling into the river must be retrieved in a safe manner.
- Chip All Branches and Applicable Wood
- All branches and logs suitable for chipping must be chipped and left on site.
- The chips must be spread evenly.

8.4.2 Removal of logs

- No removal of any logs to occur.
- All logs to be remain on site to assist in bank stabilization.
- Logs may to be used for soil stabilization by securing them horizontally on slopes. These logs must not be in danger of rolling or moving into any water way.

- All cut stumps small enough to chip must be chipped and spread back on site.

8.4.3 Chemically treat all tree stumps

- Saplings and trees to be cut to no more than 750mm.
- All root to remain in the soil.
- Stumps must be treated with a herbicide and color die.
- Contractor to guarantee effectiveness for twelve months after acceptance of invoice.
- Details of herbicide to be provided.
- Contractor to supply name of herbicide Safety Data Sheet (SDS) for approval.
- The herbicides must be 100% effective at the scheduled time for inspection as per pricing schedule.
- Deductions may be considered in line with non-conformance.
- The contractor will be expected to rectify inadequate treatment within the period of 2 weeks of notification.
- No herbicides should be sprayed on the surrounding vegetation other than tree stumps.
- Contractor must be registered to spray herbicide. He must have a relevant Pest control License (PCO) license

8.5. Seeds and Seedling.

- All planting work is to be undertaken by a suitably qualified Contractor, making use of the appropriate equipment (refer to section 3.3.6).
- An alternative to harvesting seeds and germinating these is to uproot small seedlings between 40mm to 100mm high from an area of mature forest undergrowth where there are many. Best results are obtained immediately after heavy rain.
- Tree seedling material should be fresh and of local origin. Resist using plants from far afield as they may not be best suited to local climatic or soil conditions.

- Small seedlings are likely to transplant more successfully than the large ones. These should be potted and kept under nursery conditions (see section 3.2.6) until they are large enough to plant out.

8.6. Grassing

- Areas where topsoil has been redistributed shall be grass seeded with a seed mixture approved by the ECO.
- Grassing will be done in accordance to the specification provided for grassing.

8.7. Grassing specification

Soil preparation: as per above

8.7.1 Seeding Mixture

EMS on has to date successfully used a seeding mixture of *Eragrostis teff*, *Digitaria smutsii*, *Chloris gayana* and *Cynodon dactylon*. The mixture ensures adequate variety and blends in well with surrounding grass species. This mixture is recommended yet remains open to further species being added. Should the Contractor wish to recommend additional/replacement indigenous grass species, these must be specified in the quotation together with the Contractors' recommended application rate. (See other known mixtures below) Preference will be given to improved seeding mixtures recommended by the Contractor.

EMS recommended seeding rate:

- *Eragrostis teff* 5 kg/ha
- *Digitaria smutsii* 5 kg/ha
- *Chloris gayana* 5 kg/ha
- *Cynodon dactylon* 10 kg/ha
- *Themeda triandra* 5 kg/ha
- *Melinis repens* 5 kg/ha

Other seed mixtures recommended by (Source: Plant protection research institute handbook No 11: Rehabilitation after alien plant control and Grab-a grass-dial).

8.7.2 Grassveld / Highveld

8.7.2.1 Summer mix:

Table 1. Summer mix:

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Paspalum notatum</i>	Bahia grass	20
TOTAL		32

8.7.2.2 Winter mix:

Table 2. Winter mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Dactylis glomerata</i>	Cocksfoot	15
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Medicago sativa</i>	Lucerne	4
<i>Paspalum notatum</i>	Bahia grass	20
TOTAL		51

8.7.3 Dry / Arid Lowveld and Mopaneveld

8.7.3.1 Summer mix:

Table 3. Summer mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Antheophora pubescens</i>	Wool grass	5
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	4
<i>Cynodon dactylon</i>	Couch grass	5
<i>Digitaria eriantha</i>	Smutsfinger grass	8

<i>Eragrostis tef</i>	Teff	8
<i>Panicum maximum</i>	Guinea grass	6
TOTAL		40

8.7.3.2 Winter mix

Table 4. Winter mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	4
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Panicum maximum</i>	Guinea grass	6
TOTAL		22

8.7.4. Mixed Bushveld

8.7.4.1 Summer mix

Table 5. Summer mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Antheophora pubescens</i>	Wool grass	5
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	4
<i>Cynodon dactylon</i>	Couch grass	5
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Eragrostis tef</i>	Teff	8
<i>Panicum maximum</i>	Guinea grass	6
TOTAL		44

8.7.4.2 Winter mix

Table 6. Winter mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	4
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Panicum maximum</i>	Guinea grass	6
TOTAL		26

8.7.5. Waterberg

8.7.5.1 Summer mix

Table 7. Summer mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	4
<i>Cynodon dactylon</i>	Couch grass	5
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Eragrostis tef</i>	Teff	8
<i>Panicum maximum</i>	Guinea grass	6
<i>Paspalum notatum</i>	Bahia grass	20
TOTAL		59

8.7.5.2 Winter mix

Table 8. Winter mix

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	4
<i>Digitaria eriantha</i>	Smutsfinger grass	8
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Panicum maximum</i>	Guinea grass	6
<i>Paspalum notatum</i>	Bahia grass	20
TOTAL		46

8.7.6 Anticipated Percentage Cover

It is envisaged that with the above-mentioned seeding mixture and at the given application rate a 95% cover can be -obtained by the end of the second growing season. The Contractor shall ensure then that no single area 2 m² or larger is left uncovered with a total uncovered area not in excess of 5% over the entire scarred area. Should these conditions not be acceptable to a Contractor, it must be stipulated in writing together with the quote for grass seeding and the Contractors' guaranteed percentage cover.

8.7.7 Areas to be grassed

The entire scarred area is to be grassed with no omissions whatsoever.

8.8 Plugging

The entire area is to be treated with grass plugs. Planting holes are to be created within the pockets of soil between rocks on the disturbed areas with a minimal disturbance as possible.

8.8.1 Selection of grass plugs

Selection of indigenous grass plugs will be supplied by Rand Water for reinstatement of the embankment.

8.8.2 Plugging technique

A hole must be created of sufficient size to accommodate the size of the grass plug. Water retention granules **must** be inserted into the hole prior to planting as per the manufacturers mixing/dosage rates. The grass plug must be lightly compacted. Plugs are to be watered after planting and lightly (2 cm) covered with straw/grass or any suitable biodegradable mulch to minimize evaporation.

8.9 Sodding

- Sodding is defined as the laying of grass sods.
- Grassing must be undertaken by a suitably qualified Contractor, making use of the appropriate equipment.
- Grass areas using the method specified on the plant plans.
- Trim areas to be grassed to the required level.
- Sodding may be done at any time of the year, but seeding must be done during the summer when the germination rate is better.
- The soil should be uniformly wet to a depth of at least 150mm before planting of grass sods.
- Protect sods against drying out: keep these moist from the time of harvesting until final placement.
- Rake or spike the area to give a loose surface to a depth of 100mm.
- Lay the first row of sods in a straight line, starting at the bottom of a slope, where possible.
- Place the next row of sods in the same way, tightly against the bottom row with the joints staggered, until the full area is covered with sods.
- Tightly butt sods together, taking care not to stretch or overlap sods.
- Where a good fit cannot be obtained, the intervening spaces may be filled with parts of sods or topsoil.
- After planting, water sods to prevent drying out.

- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

8.10 Runners

- Plant grass runners evenly by hand or by mechanical means at a rate of at least 400 runners per hectare (i.e. at 250mm centres).
- Use only fresh runners, avoiding grass runners that have been allowed to dry out.
- Rake or spike the area to give a loose surface to a depth of 100mm.
- The soil should be uniformly wet to a depth of at least 150mm before planting of grass runners.
- After planting, runners must be given copious amounts of water and, when sufficiently dry, must be rolled with a light agricultural roller and re-watered.
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

8.11. Splitting of Plants on Aquatic Sites

- In wet soils the vegetation has an anthropogenic quality in that it is able to recover. To retain the genetic stability of the vegetation harvesting and splitting of plants is very successful.
- The harvesting of plants should be done by hand
- Access routes into the existing vegetation must be limited so that vegetation is not unnecessary trampled.
- Care must be taken not to disturb birds nesting in the vegetation.
- The area must be levelled and prepared preferably by hand before plant harvesting occurs.
- Only harvest the amount of plants that can be planted in the same day.
- Do not allow the plants to dry out in the sun after harvesting, rather cover them and regular splash them with water so they remain turgid.
- Avoid fertilizer or manure as this will affect the water quality of the wetland.

- A hessian blanket can be used and plants planted to the blanket where the soil may need additional stabilisation. Ensure the blanket is well pegged down every 30cm.
- Trim all foliage back on planting to encourage new root and shoot growth.
- Monitor and repair damage from flooding

8.12. Hand Seeding and Seedlings

- All seed supplied should be labelled in accordance with the Government Seed Act (Act No. 20 of 1961).
- The soil should be loose and uniformly wet to a depth specified by the EO / ECO, before any seeding commences.
- Halve the seed and fertiliser mixture as specified and apply evenly in two immediate successive applications perpendicular to each other.
- The seeded area must be raked over after seed application and well watered.
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).
- All planting work is to be undertaken by suitably experienced personnel, making use of the appropriate equipment.
- Tree seedling material should be fresh and of local origin. Resist using plants from far afield as they may not be best suited to local climatic or soil conditions.
- Small seedlings are likely to transplant more successfully than will large ones. These should be potted and kept under nursery conditions until they are large enough to plant out.
- Establish further specifications for seeds and seedlings.
- It is encouraged that cuttings and seed be collect from the area for long term reintroduction of plants.

8.13. Planting nursery plants

- All planting work is to be undertaken by suitably experienced personnel, making use of the appropriate equipment.

- Plant all trees, shrubs and individual plants in designated positions.
- Planting should preferably be done during the rainy season, alternatively frost cover and adequate watering must be provided.
- After planting, each plant must be well watered, adding more soil upon settlement if necessary.
- Establish further specifications for nursery plants.
- Adequate watering (minimum of 35l per week) arrangements must be made for three months. There after a review of watering requirements must be made.
- All plant must be planted with layer of mulch to assist in water retention and water saving.

8.14. Hydro seeding

- Hydro seeding entails adding a specified seed mix to a slurry containing water and other approved materials to enhance plant growth potential. This mixture is applied by means of a spraying device onto the prepared ground areas to be seeded.
- All seed supplied should be labelled in accordance with the Government Seed Act (Act No. 20 of 1961).
- The soil should be loose and uniformly wet to a depth specified by the EO / ECO, before any seeding commences.
- Add the specified seed mix and necessary fertiliser to the required amount of water and apply using an approved hydro seeding machine.
- Unless otherwise specified, the rate of application of the slurry will not be less than 30 cubic metres per hectare and will be applied in such a manner as to ensure even distribution of seed and fertiliser throughout.
- Additional ingredients to be added to the slurry may be specified.
- In certain cases, the specification may require that mulch be applied by hand to the area to be hydro seeded, prior to hydro seeding.
- If possible, keep the seedbeds moist after hydro seeding, to ensure good germination.

- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

8.15. Maintenance

- Fertilizer shall be worked in at a rate and depth to be determined by the ECO
- Fertilizers shall be spread evenly over the ground at the rate determined by the ECO to ensure a uniform distribution for all vegetation except within water courses.
- Follow up fertilizer program is to be advised by the EMS rehabilitation team
- Allow for a maintenance period of one year following practical completion of rehabilitation activities, unless otherwise specified.
- Landscape maintenance is to be undertaken by suitably qualified persons, making use of the appropriate equipment.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Delay the re-introduction of stock to all rehabilitation areas until an acceptable level of re-vegetation has been reached. Fencing may be used, or the area may be covered by branches.
- Re-vegetation must match the vegetation type which previously existed, unless otherwise indicated in the Contract or specified by the EO / ECO.
- Base the new carrying capacity of rehabilitated land on the status quo rather than the regional estimate.
- Water all transplanted, planted and grassed areas as specified (refer to sections 4.7 and 4.8).
- Where hydro seeding is carried out, the commencement of watering may be postponed until a more favourable time of the year.
- Watering must, however, commence and continue immediately after the seeds have germinated and growth begins.
- Mow lawns regularly to a height of 50 mm above ground level. This promotes adequate coverage.

- Mowing of veldt grass is to take place once a year after the grass has shed its seed and not before the grass has fully grown.
- Where mechanical mowing is not possible, an approved method of cutting the grass by hand (e.g. by means of scythe) may be used.
- Prune trees and shrubs at the end of winter so as to stimulate growth. Avoid pruning during the growing season as this stunts growth.
- Check all plants for pests and diseases on a regular basis and treat the plants accordingly, using approved method and products as per manufacturers specifications.
- Control weeds by means of extraction, cutting or other approved methods.
- For planted areas that have failed to establish, replace plants with the same species as originally specified. The same species as originally specified must be used unless otherwise specified by the EO / ECO.
- A minimum grass cover of 95% is required, and individual plants must be strong and healthy growers at the end of the Maintenance Period.
- In the case of sodding, acceptable cover entails that 100% cover is attained by the specified vegetation.
- Bare areas that show no specified vegetation growth after three months of the Rehabilitation Work are to be spread with additional topsoil, ripped to a depth of 100mm and re-planted, re-sodded, re-hand sown or re-hydro seeded.
- Plants that have been staked must be monitored to ensure the staking remains secure. Once the plant is established the stakes must be removed

9. SUMMARY OF THE SPECIALISTS STUDIES

Heritage Study

It is concluded based on the findings of the survey that the Q6 pipeline may proceed provided mitigation measures are adhere to, otherwise the heritage resources found on site, especially graves will be impacted and the damage will be irreversible. The final report will be submitted to PHRA-G and SAHRA for review; and based on the findings and mitigation measures provided, it is recommend that PHRA-G and SAHRA grant Rand Water the approval to proceed with the proposed construction of the Q6 pipeline in terms of the Heritage Resources Act (Act No.25 of 1999) provided they shift

the pipeline on the far right of the servitude at the vicinity of the graves or a permit for exhumation and relocation be applied for should Rand Water decide to keep the pipeline to the left.

Flora and Fauna Assessment

Results of this study show that the anticipated effects of the proposed project of the Q6 Pipeline from Eikenhof pumping station via Meredale to Baragwanath area will not be highly significant if the suggested mitigation measures assigned are to be implemented and environmental monitoring programmes are established in view to comply with the Conservation of Agricultural Resources Act, 43 of 1983.

In addition, the current investigation in the area showed that the surrounding area was already disturbed by different activities such as construction of houses which has resulted in emigration of many fauna species.

From this study, the following is concluded:

- During the construction phase, bush clearing will take place to clear the pipeline route of trees and shrubs;
- There are no endangered species or those belonging to the Red List found on site.

Recommendations:

- Construction of the pipeline should be restricted to daylight hours reducing the potential impact on the nocturnal activities of the majority of amphibian species;
- Ideally the construction of the bulk water pipeline should be undertaken during the dry winter months (May – September) when the majority of amphibian species are dominant;
- As a precaution, the developer and contractor should be made aware of the possible presence of certain threatened amphibian species prior to the commencement of the construction of the new pipeline;
- Any animals rescued or recovered will be relocated to a suitable habitat away from the construction area, and after construction they will naturally move back;
- Trees including stumps; bark and holes in trees are vital habitats for numerous arboreal reptiles (chameleons, snakes, agamas, geckos and monitors);
- The removal of indigenous tree species as well as vegetation clearance must be kept to the minimum;
- Dead or decaying wood piles should be created as these will provide valuable refuge areas especially due to the clearance of vegetation cover. Logs and stumps also provide important habitats for several reptile species as well as smaller mammals, amphibians, arachnids and scorpions;

- Any lizard, geckos, agamids, monitors or snakes encountered should be allowed to escape to suitable habitat away from the disturbance. No reptile should be intentionally killed, caught or collected during any phase of the project;
- No hunting or poaching activities must be allowed along the servitudes during all phases of the project;
- Construction vehicles should be restricted to approved access roads.

The proposed construction of the **Rand Water** pipeline will require several measures to soften impacts on the nearby environment. Some of them are:

- Prevention of erosion, and where necessary rehabilitation of eroded areas;
- Rehabilitation/restoration of indigenous vegetation cover;
- Alien plant control;
- Implementation of best management practises regarding stormwater and earthworks; and
- Minimise the destruction of shrubs and trees.

Frequent monitoring inspections must be done to evaluate the sites for signs of pollution, erosion and alien plant invasions. A regular monitoring and mitigation measures will reduce the impacts.

MITIGATION MEASURES

Destruction of Vegetation

Considering the dynamics of the available habitats, the fauna species most likely to be affected will include species occupying warrens or burrow systems such as the various rodent species and black backed jackal whose breeding, foraging and roosting habitats could be destroyed, as well as the wetland mammal species and amphibians. The following mitigation measures should be included to prevent unnecessary damage to the fauna habitat and bring the significance of the impact to moderate

Mitigation Measures

An Environmental Control Officer (ECO) should be appointed to oversee construction.

- A temporary fence or demarcation must be erected around the construction area (include the servitude, construction camps, areas where material is stored and the actual footprint of the development) to prevent access to sensitive environs.
- Prohibit vehicular or pedestrian access into natural areas beyond the demarcated boundary of the construction area.
- No open fires are permitted within naturally vegetated areas.

- Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas.
- A vegetation rehabilitation plan should be implemented. Grassland can be removed as sods and stored within transformed vegetation – remove alien invasive vegetation prior to storing grasslands sods in transformed areas. The sods must preferably be removed during the winter months and be replanted by latest springtime. The sods should not be stacked on top of each other. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks.
- Construction workers may not remove flora and neither may anyone collect seed from the plants without permission from the local authority.
- No activities should take place during rainy events and at least 2 days afterwards.

Exposure of Erosion

- The route impacting mostly on disturbed areas, with the least impact on moist grasslands should take preference. Do not allow erosion to develop on a large scale before taking action.
- No construction / activities should be undertaken within the moist grasslands. The extent of wetland conditions should be verified by a wetland specialist and no activities should take place within these areas without that a Water Use License was granted by the Department of Water and Sanitation (DWS) for these activities.
- Make use of existing roads and tracks where feasible, rather than creating new routes through grassland areas. Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. The grassland can be removed as sods and re-established after construction is completed.
- Colonisation of the disturbed areas by plants species from the surrounding natural vegetation must be monitored to ensure that vegetation cover is sufficient within one growing season. If not, then the areas need to be rehabilitated with a grass seed mix containing species that naturally occur within the study area.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas.

Faunal Disturbance

- Areas identified with high ecological sensitivity should be avoided during construction activities. Where areas of high ecological sensitivity need to be disturbed, the necessary permits and mitigation measures recommended by the wetland specialist should be implemented;
- Areas that are not part of the site development plan should be marked as no-go zones;
- The development should promote connectivity between ecologically important habitats by retaining natural corridors for the movement of fauna;
- Roads should be planned to encourage faunal dispersal. Roads should preferably be maintained as gravel tracks;
- Construction activities should be limited to daylight hours; and
- Construction vehicles transporting materials to and from the construction site must be covered to reduce the formation of dust.

Hunting or Cruelty to Animals

- Construction personnel should be informed of the Animal Protection Act no. 71 of 1962 and encouraged not to harm any wildlife; and
- Construction personnel should undergo awareness training regarding fauna assemblages and the correct procedures to follow should fauna be found within the site. They should be encouraged not to harm any wildlife. They should also be informed of any policies and procedures applicable for fauna and the environment

Alien Species

- Alien invasive species that were identified within the study area and in specific along the final route alignment should be removed prior to construction-related soil disturbances. By removing these species, the spread of seeds will be prevented into disturbed soils which could thus have a positive impact on the surrounding natural vegetation.
- All alien seedlings and saplings must be removed as they become evident for the duration of construction.
- Manual / mechanical removal is preferred to chemical control.
- All construction vehicles and equipment, as well as construction material should be free of plant material. Therefore, all equipment and vehicles should be thoroughly cleaned prior to access on to the construction areas. This should be verified by the ECO.

Positive impact by removing Alien Species

- Compile and implement an alien invasive monitoring plan to remove alien invasive plant species along the chosen route alignment, prior to construction.

- Rehabilitate all areas cleared of invasive plants as soon as practically possible, utilising specified methods and species.
- Monitor all sites disturbed by construction activities for colonisation by exotics or invasive plants and control these as they emerge. Monitoring should continue for at least two years after construction is complete.
- Follow manufacturer's instruction when using chemical methods, especially in terms of quantities, time of application etc.
- Ensure that only properly trained people handle and make use of chemicals.
- Dispose of the eradicated plant material at an approved solid waste disposal site.
- Only indigenous plant species naturally occurring in the area should be used during the rehabilitation of the areas affected by the construction activities.

Deterioration of natural vegetation

- After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land must be left in a condition as close as possible to that prior to construction.
- Ensure that maintenance work does not take place haphazardly, but according to a fixed plan.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Delay the re-introduction of livestock (where applicable) to all rehabilitation areas until an acceptable level of re-vegetation has been reached.
- Maintenance workers may not trample natural vegetation and work should be restricted to previously disturbed footprint. In addition, mitigation measures as set out for the construction phase should be adhered to.

The Ridge Study

From Eikenhof pump station to the Meredale reservoir, rocky ridges are Class 3 rocky ridge systems with 38% natural state and 53% urbanised. Rocky ridges at the southern parts of the site containing the *Eragrostis racemosa* –*Helichrysum miconiifolium* plant community. The rocky ridge at the South westerly direction of the site, containing the *Themeda triandra* – *Celtis africana* community is of very important and should be carefully conserved.

The vegetation cover at the rocky ridges should be included in the proposed development and be managed so that this vegetation can slow down water runoff and keep loss of soil down to natural levels.

The ridges that enters the river system of the site contains a strikingly unique plant community with a high diversity of indigenous plant species, a high structural diversity (of plant growth forms) and which include threatened and highly localised plant species. A high diversity of invertebrates is also suspected at this part of the site and possibly also smaller vertebrates depending on conservation management of this part of the site in future.

Water course **Assessment**

The findings of the water course (Stream) assessment indicate that although the water course have been subjected to disturbances, they are able to provide eco-services at a moderately low level. In addition, the sensitivity of these water course (Stream) range from moderate to high and they will have to be protected throughout the development phases in order to prevent further degradation and lowering of their Present Ecological Status (PES).

Based on the findings of the water course (Stream) assessment and the results of the impact assessment, it is the opinion of the ecologist that the proposed development be considered favourably, provided the proponent obtains a WUL and environmental approval from the relevant authorities. In addition it is essential that mitigation measures as provided in the report be adhered to. Although the application of buffer zones will not be feasible, due to the linear nature of the proposed development, the sensitivity map presented in Section 4 should be taken into consideration in order to highlight areas where the duration of the proposed construction activities should be limited, and all non-essential activities should be excluded in order to minimise impacts on the water course (Stream) affected by the proposed development.

10. RECORD AND DATA KEEPING

Record Document	Form/ Number	Location	Retention Period
Weekly inspection reports	N/A	ECO office or EMS archives	Minimum 1 year unless otherwise specified.
Weekly consolidated report to SAM	N/A	ECO office or EMS archives	Minimum 1 year unless otherwise specified.
Month audit report	N/A	ECO office or EMS archives	Minimum 20 years unless otherwise specified.
General consolidated report on all projects	N/A	ECO office or EMS archives	Minimum 1 year unless otherwise specified.
General Repeat monthly non-compliance report	N/A	ECO office or EMS archives	Minimum 1 year unless otherwise specified.
Escalation of open findings and ineffective actions	N/A	ECO office or EMS archives	Minimum 1 year unless otherwise specified.
Amendments	N/A	Assessor office or EMS archives	Minimum 20 years unless otherwise specified.
EMPr	N/A	Assessor office or EMS archives	Minimum 20 years unless otherwise specified.
Environmental Authorizations	N/A	Assessor office or EMS archives	Minimum 20 years unless otherwise specified.
Landscape or rehabilitation plans	N/A		Minimum 1 year unless otherwise specified.

11. DOCUMENT CHANGE HISTORY

The following table contains the history of this document with a description of each revision.

Date	Previous revision number	New revision number	Description of each revision
01 February 2017	N/A	00	New Procedure