EMPr APPENDIX C

SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED (SANRAL)

EROSION AND SOIL MANAGEMENT PLAN

FOR THE

STRATEGIC INFRASTRUCTURE PROJECT (SIP2)

PROPOSED CAPACITY UPGRADES TO THE N2 AND N3 FROM DURBAN TO PIETERMARITZBURG, KWAZULU-NATAL

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1. PURPOSE

The Erosion and Soil Management Plan (ESMP) addresses the management and mitigation of significant impacts relating to soil erosion on site. The aims of the ESMP are to provide:

- A general framework for erosion management, which enables Contractors to identify areas where erosion can be accelerated from their actions.
- An outline of general methods to monitor, manage and rehabilitate erosion to ensure that all erosion caused by this development is addressed.

This ESMP serves as a guideline to be applied by all contractors on the N2 and N3 upgrades as part of the requirements of Environmental Authorisation from the Department of Environmental Affairs. This management plan is an evolving guideline that needs to be updated or adapted as conditions change within the project area, and successes and failures of procedures are identified.

The objectives of the ESMP are:

- To reduce the effects of raindrop splash erosion on exposed soil surfaces.
- To keep rainwater on the soil surface for as long as possible to increase the infiltration rate and reduce surface runoff.
- To reduce the speed of surface runoff to reduce the erosion effect of the soil surface.
- To provide methods to retain soil, debris, seed banks and organic matter being carried away by runoff.
- To improve water retention of the area.

This ESMP must be read in conjunction with the following rehabilitation plans and procedures as identified by the appointed specialists:

- EMPr Appendix A1: N2/N3 Sensitive Areas Rehabilitation Plan (with plant rescue, plant translocation, alien invasive plant control, erosion control and soil management guidelines).
- EMPr Appendix A2: Paradise Valley Viaduct Rehabilitation Plan (with plant rescue, plant translocation, alien invasive plant control, erosion control and soil management guidelines).
- EMPr Appendix A3: Westville Viaduct Rehabilitation Plan (with plant rescue, plant translocation, alien invasive plant control, erosion control and soil management guidelines).
- EMPr Appendix A4: Umhlatuzana Viaduct Rehabilitation Plan (with plant rescue, plant translocation, alien invasive plant control, erosion control and soil management guidelines).
- EMPr Appendix B: Wetland and Riparian Areas Rehabilitation Plan.
- EMPr Appendix D: Storm Water Management Plan

2. APPLICABLE LEGISLATION AND STANDARDS

There are a host of legal requirements (National, Provincial and Local Government spheres) to which the project proponent must adhere for the proposed development. Fundamentally, the proponent is required to include and integrate environmental principles and values into all planning and implementation procedures taken for development purposes.

Underlying the reasoning above is the Constitutional right that people have to environmental protection, as set out in the Bill of Rights in the Constitution (Section 24). These rights have now been interpreted and included into the National Environmental Management Act, 1998 (Act 107 of 1998), which, together with other national and provincial legislation, governs the way environmental principles are incorporated into any form of development.

Soil conservation pertaining to erosion has been included in South African legislation since the 1930s and internationally there are standards that have been set by funding institutions such as the International Financial Corporation and the World Bank to address soil erosion during the lifecycle of developments. As such, this document outlines what the developer needs to implement to meet the South African legislative requirements and international standards concerning monitoring, managing and rehabilitating soil erosion on site.

2.1 National Environmental Management Act, 1998 (Act 107 of 1998)

The National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) provides for the right to an environment that is not harmful to the health and well being of South African citizens. In addition, there is recognition that development must be socially, environmentally and economically sustainable, and that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied (Government Gazette, 1998).

2.2 Conservation of Agricultural Resources Act 43 of 1983

The aim of the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA) is to provide for control over the utilisation of the natural agricultural resources within South Africa and to promote the conservation of soil and water resources, indigenous vegetation and the control of invasive plants.

Thus, in terms of CARA, the landowner or land user is responsible for the maintenance of all soil conservation works located on his/her property. Added to this, the maintenance and improvement of the structure and function of wetlands furthers the aims of CARA.

2.3 Environment Conservation Act 73 of 1989

The primary objective of the Environment Conservation Act, 1989 (Act 73 of 1989) (ECA) is to provide for the effective protection and controlled utilisation of the environment. In terms of Section 20 of ECA, all wastes generated from the construction and operational phases of a development may only be disposed at licensed waste disposal sites.

Cognisance must also be taken of the relevant provincial legislation given that controlling authority and regulations pertaining to litter in terms of ECA (Sections 19, 19A and 24A) have been delegated to provinces.

3. TYPES OF EROSION

Erosion comes in several forms, some of which are not immediately apparent. The major types of erosion are briefly described below.

Raindrop impact
This type of erosion occurs due to the “bomb blast” effect of raindrop impact. Soil particles can be blasted more than a metre into the air.

Sheet erosion
This type of erosion involves the removal of a shallow and uniform layer of soil from the surface. It is caused initially by raindrop splash and then by runoff. Sheet erosion is often difficult to see as no perceptible channels are formed. Accumulated sediment at the bottom of the slope is often the only indicator.

Rill erosion
This type of erosion is caused through the removal of soil from the surface whereby small channels or rills up to 300 mm are formed. It is caused by runoff concentrating into depressions, wheel tracks etc.

Gully erosion
This type of erosion involves the removal of soil from the surface and sub-surface by concentrated runoff eroding channels greater than 300 mm deep. Gully erosion often begins as rill erosion, which is not addressed.

4. FACTORS LEADING TO EROSION

Rainfall
High-intensity, short-duration storm events have much greater erosion potential than low intensity, longer duration storm events with the same runoff volume. Intense storms produce larger raindrops, and are more likely to break up the soil and dislodge particles. The erosion potential of rainfall is dependent on its geographical location. Rainfall within the winter-rainfall region is generally less erosive than rainfall within the summer rainfall region of South Africa.

Soil erodibility
Soil erodibility is determined by the soils ability to resist detachment and transport due to rainfall, runoff and infiltration capacity. Well-structured soils with high clay content are generally least erodible. Some clays are dispersible meaning that they break down when wet and become highly erodible. Silts and fine sands are highly erodible.

Length and steepness of slope
Steeper slopes result in higher runoff flow velocities, resulting in increased erosion. As the slope length increases, the opportunity for runoff to concentrate and achieve an erosive velocity increases.

Soil surface cover
Soil surface covers such as vegetation and mulches protect the soil surface from raindrop impact, reduce flow velocity, disperse flow, and promote infiltration and the deposition of sediment. This is a basic principle underlying many erosion control approaches which aim to modify the surface characteristics in order to reduce the flow velocity and reduce the potential for erosion.

5. EROSION CONTROL PRINCIPLES

The goals of erosion and sediment control during and after construction at the site should be to:

- ❑ Protect the land surface from erosion.
- ❑ Intercept and safely direct run-on water from undisturbed upslope areas through the site without allowing it to cause erosion within the site or become contaminated with sediment.
- ❑ Progressively revegetate or stabilise disturbed areas.

These goals can be achieved by applying the following principles:

- ❑ Integrate project design with site constraints.
- ❑ Plan and integrate erosion and sediment control with construction activities.
- ❑ Minimise the extent and duration of disturbance.
- ❑ Control stormwater flows onto, through, and from the site in stable drainage structures.
- ❑ Use erosion controls to prevent on-site damage.
- ❑ Use sediment controls to prevent off-site damage.
- ❑ Control erosion and sediment at the source.
- ❑ Stabilise disturbed areas promptly.
- ❑ Inspect and maintain control measures.

6. SOIL MANAGEMENT

Where excavation is required during construction, soil management practices must be adhered to in order to limit soil loss and encourage rehabilitation efforts post-construction. The two most import aspects to consider when removing topsoil are the depth of soil to remove as topsoil, and the conditions for storing topsoil.

6.1 The correct handling of top soil

Topsoil must be retained on site in order to be used for site rehabilitation. The correct handling of the topsoil layer is, in most cases, the key to rehabilitation success. Local and international studies indicate that the correct handling of topsoil is vital in conserving the seed bank and nutrients which occur within this layer, thereby ensure rehabilitation success.

6.1.1 Management measures to be implemented for the handling of topsoil

- ❑ It is important that the correct depth of topsoil is excavated in order to ensure good plant growth. When the need arises for the excavation of topsoil it is recommended that the top 25 cm of soil be viewed as topsoil unless otherwise advised by the Engineer/ECO after site evaluation (if the excavation is too shallow, then an important growth medium for new seedlings could be lost. If the excavation is too deep, this could lead to the dilution of the new seed and nutrient rich topsoil with deeper sterile soils).

- ❑ Topsoil must not be mixed with deeper soils (the mixture of topsoil with the deeper sterile soil hinders the germination of seeds. The mixing of soil layers also leads to the dilution of nutrient levels, which are at highest concentration within the topsoil, resulting in lower levels of nutrients available for seedlings).
- ❑ Topsoil should be handled twice, once to strip and stockpile and once for rehabilitation.

6.2 Storage of topsoil

Topsoil must be stored separately from other soils until construction in an area is complete. Ideally, removed topsoil should be re-applied immediately after the works have been undertaken. The next best option is to minimize the duration of topsoil storage as the storing of topsoil for long periods (> 3 months) leads to seed bank depletion following germination during storage, and anoxic conditions developing inside large stockpile heaps.

Even in small stockpiles, it is likely that a high proportion of micro-organisms, fungi and soil biota are killed. Associated with the loss of biological communities is a significant depletion in soil nutrients. The length of time that the top soil is stored is also important as the viability of the seeds, the activity of the biological elements and the nutrients present in the soil reduce with time. This is due to the creation of anaerobic conditions, which occur within the topsoil heaps which results in the decomposition of biological material.

6.2.1 Management measures to be implemented for the storage of topsoil

- ❑ Topsoil stockpiles should as far as possible[1] not exceed a height of 1 m in order to preserve micro-organisms within the topsoil, which can be lost due to compaction and lack of oxygen.
- ❑ Topsoil should not be stripped or stockpiled when wet, as compaction will occur.
- ❑ Overburden must not be mixed with topsoil stockpiles.
- ❑ All stockpiles must be positioned away from drainage lines.
- ❑ Sediment fencing should be erected down slope of all stockpiles to intercept any sediment runoff from the stockpiles.
- ❑ Sediment fencing should be erected upslope of topsoil stockpiles to prevent upslope runoff from eroding the topsoil stockpiles.

6.3 Prevention of wind erosion

After replacement of the topsoil layer during rehabilitation, it is important to ensure that the areas are protected against wind erosion in order to prevent topsoil from being blown away. In undisturbed areas, fully-grown plants provide protection to seedlings and sensitive species against strong winds. In a disturbed area, however, there is nothing to reduce the wind speed, resulting in new seedlings and relocated plants being easily buried or blown away. Strong winds also results in erosion and the loss of valuable topsoil, which makes rehabilitation even more difficult.

[1] In some cases, it may not be possible to stockpile at this height if insufficient space is available.

6.3.1 Management measures to be implemented for the prevention of wind erosion

- The use of wind nets has been shown to be an effective method of minimizing the loss of soil through wind erosion. It is, therefore, important that wind nets are erected as soon as the topsoil is replaced in an area. If correctly implemented, the use of wind nets in rehabilitation areas can assist in reducing the wind speed and protect new plant growth.

7. SOIL EROSION ON SITE

Exposed and unprotected soils are the main cause of erosion in most situations.

For the identification of erosion sources, site-specific information must be acquired to establish the various on-site parameters associated with soil erosion in the study area. These data will include:

- The mechanisms of erosion taking place.
- The various soil environments within which the erosion takes place.
- The significance of erosion should it continue unabated.
- Whether such erosion is natural or a function of anthropogenic disturbance.

Remedial actions must be established to ensure that existing erosion concerns are addressed with an erosion control strategy towards long-term rehabilitation.

The following generic points should be noted regarding the erosion risk in the study area:

- Soil loss from the site is related to the time that the soils are exposed, prior to rehabilitation/stabilization. The time from commencement of construction to rehabilitation should be restricted to a minimum.
- Rehabilitation efforts should commence as soon as practical once construction activities are completed at a particular location.
- Construction staging and progressive rehabilitation of disturbed areas is important.
- The extent of the disturbance will influence the risk and consequence of erosion at the site.

7.1 Management measures to be implemented for the prevention of erosion on site

- Utilise existing stabilized roads for site access.
- Sediment fences may be utilized as a temporary measure during the construction phase in order to minimize sediment movement off site.
- Prevent the concentration or flow of surface water or storm water down cut or fill slopes or along pipeline routes or roads and ensure measures to prevent erosion are in place prior to construction.
- Storm water and any runoff generated by hard surfaces should be discharged into retention swales (shallow vegetated channels) or areas with rock rip-rap (crushed rock/rubble). These areas should be grassed with indigenous vegetation. These energy dissipation structures should be placed in a manner that flows are managed prior to being discharged back into the natural environment, thus, not only preventing erosion,

but also supporting the maintenance of natural base flows within these systems, i.e. the hydrological regime (water quantity and quality) is maintained.

- ❑ Mitigate against siltation and sedimentation through the use of the above mentioned structures and ensure that all structures do not cause erosion.
- ❑ Ensure that all storm water control features have soft engineered areas that attenuate flows, allowing for water to percolate into the local aquifers.
- ❑ Minimise and restrict site clearing to areas required for construction purposes only and restrict disturbance to adjacent undisturbed natural vegetation.
- ❑ Vegetation clearing should occur in parallel with the construction progress to minimise erosion and/or run-off.
- ❑ If implementing dust control measures, prevent over-wetting, saturation and run-off that may cause erosion and sedimentation.

Construction and post construction rehabilitation activities include:

- ❑ Proper stockpile management of topsoil will be required during the construction phase.
- ❑ Rehabilitation of disturbed areas will commence as these areas become available for rehabilitation.

Rehabilitation steps to mitigate the eroded areas include:

- ❑ Stockpiled topsoil must be evenly spread over disturbed areas (150 – 200 mm thick) just prior to planting/seeding.
- ❑ Organic fertilizers or compost shall be used if site conditions require it and can be applied as part of hydro-seeding applications (if required).
- ❑ Seed must be sown into weed-free topsoil that has been stockpiled (i.e. original topsoil).
- ❑ Bare surfaces are grassed as soon as possible after construction to minimise the time of exposure.
- ❑ Applying the seed through hydro-mulching (hydro-seeding) is advantageous (or organic mulching after seeding).
- ❑ Watering is essential and rehabilitation should ideally occur during the wet season.
- ❑ The topsoil in the area is vulnerable to erosion therefore the hydro-seeded surfaces must be covered with a shade cloth material or natural fibre (hessian material) to reduce the loss of soil while the plants establish.
- ❑ Soil compaction should be minimised by keeping vehicle and construction plant access ways and parking areas to a minimum.
- ❑ The re-growth of alien plant species will need to be monitored and removed as per the Alien Vegetation Management Plan (See Appendix D of the EMPr).
- ❑ The removal of aliens will be the responsibility of the Contractor during construction and the project proponent during operation. The project proponent should implement the Alien Vegetation Management Plan.
- ❑ Generous watering during the first two weeks, or until the seeds have germinated, is required (unless adequate rainfall occurs), i.e. seed beds will need to be kept moist for germination to occur.

8. CONCLUSION

The ESMP is a document to assist the Contractor, SANRAL and the ECO with guidelines on how to manage erosion, which is good practice to ensure minimisation of degradation to the environment. To achieve full compliance, the management actions stipulated in this document must be adhered to as well as the conditions stipulated within the EMPr, its associated appendices and the Environmental Authorisation.