EMPR APPENDIX A3

SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LIMITED (SANRAL)

SITE SPECIFIC REHABILITATION PLAN FOR THE WESTVILLE VIADUCT

STRATEGIC INFRASTRUCTURE PROJECT (SIP2)

PROPOSED CAPACITY UPGRADES TO THE N2 (SOLOMON MAHLANGU TO SOUTH OF UMGENI RD I/C), INCLUDING EXPANSION OF EB CLOETE AND SOLOMON MAHLANGU INTERCHANGES, AND THE N3 (EB CLOETE TO PARADISE VALLEY) INCLUDING PROVISION OF TEMPORARY ACCESS FOR CONSTRUCTION BELOW WESTVILLE AND PARADISE VALLEY VIADUCTS, ETHEKWINI METROPOLITAN MUNICIPALITY, KWAZULU-NATAL

DEA REF NO: *TO BE ASSIGNED*

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1. PURPOSE

This conceptual rehabilitation plan addresses the need to mitigate significant impacts leading to disturbed vegetation, disturbed soil surfaces, and exposed soils prone to erosion and further degradation on the proposed upgrade of the Westville Viaduct, KwaZulu-Natal. This includes rehabilitation of disturbed areas around the proposed Westville Viaduct access track, which although temporary, is expected to be in use for a substantial period before decommissioning. Ultimately, the track will be decommissioned and the site completely rehabilitated according to the guidelines proposed in this document.

The aims of the rehabilitation plan are to provide conceptual guidelines on the proposed methods of habitat rehabilitation including rehabilitation timing, soil stabilisation, re-vegetation, maintenance and monitoring, including the following aspects:

- The search and rescue of plants of high conservation value.
- Rehabilitation of vegetation cover.
- Alien plant control.
- Replanting on the road reserve.
- Post-implementation tasks including timeframes and monitoring.

It must be noted that rehabilitation of a site requires a long-term commitment and successful rehabilitation and re-vegetation requires practical and adaptive management.

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

- EMPr Appendix B: Wetland and Riparian Areas Rehabilitation Plan.
- EMPr Appendix C: Erosion and Soil Management Plan.
- EMPr Appendix D: Storm Water Management Plan.

2. DEVELOPMENT DESCRIPTION

The South African National Roads Agency SOC Limited (SANRAL) is responsible for improving, managing and maintaining the network of national roads which act as the “economic arteries” of South Africa. Sections of the N2 and N3 are operating at full capacity and traffic studies indicate a need to upgrade them to accommodate future growth and improve road safety. Therefore, SANRAL (Eastern Region) plans to provide additional lanes along a section of the N2 in Durban, as well as along the N3 between Durban and Cedara, KwaZulu-Natal. The proposed capacity improvements, which are divided up into sections and covered ultimately by 17 engineering work packages, will be implemented at different stages according to timing priorities and factors related to funding. The proposed capacity improvements will improve safety, increase mobility and accommodate traffic growth to 2047. The project forms part of the suite of Strategic Infrastructure Projects (SIPs) as described in the National Development Plan, 2011.

This Rehabilitation Plan applies to the sections which have received environmental authorisation under the National Environmental Management Act, 1998 (Act No. 107 of 1998) and which correspond to the projects dealt with in the following Basic Assessment:

Basic Assessment 1: Capacity Upgrades to the N2 (Solomon Mahlangu to south of Umgeni Rd I/C), including expansion of EB Cloete and Solomon Mahlangu Interchanges, and the N3 (EB Cloete to Paradise Valley) including provision of temporary access for construction below Westville and Paradise Valley viaducts.

3. SITE DESCRIPTION

The Westville viaduct spans a forested valley which is part of a conservancy and D'MOSS and offers self guided walks (Westville Trail). The trail starts at St James Avenue in Westville and follows the valley down towards the N3, where it links up with other land to the south of the N3, which is also part of D'MOSS.

The main plant communities are described below and alien invasive species are denoted with an asterisk (*). The viaduct spans a steep-sided valley which is dominated by disturbed coastal and scarp forest, with a mosaic of grassland and thicket towards the crests of the valley sides, particularly below the Pavilion shopping centre (Figure 1). With the close proximity of Chesterville, it is likely that extraction of wood, medicinal plants and building materials (e.g. sand) contributes to on-going disturbance of the natural vegetation in the area. The forest canopy supports a diversity of alien invasive and indigenous species. *Litsea sebifera** is a conspicuous component of the canopy, together with *Albizia adianthifolia, Brachylaena sp., Bridelia micrantha, Cestrum laevigatum*, Cinnamomum camphora*, Erythrina lysistemon, Ficus natalensis, Ficus sur, Melia azedarach*, Morus alba*, Searsia chirindensis, Solanum mauritianum*, Strelitzia nicolai, Syzygium cordatum, Syzygium cumini*, Tecoma stans** and *Trema orientalis.* A range of early successional and alien invasive shrubs and climbers are present, including *Berkheya bipinnatifida, Cardiospermum grandiflorum*, Chromolaena odorata*, Dalbergia obovata, Hedychium sp.*, Ipomoea purpurea*, Lantana camara*, Ricinus communis** and *Tithonia diversifolia*.*

As with the coastal and scarp forest, the riparian zone associated with the river at the bottom of the valley is similarly disturbed, with *Litsea sebifera** being a common component of the canopy together with a range of other early successional and alien invasive species. Although the species composition is modified, the riparian zone does play an important role in stream bank stabilisation, amelioration of floods, trapping sediments and nutrients, and maintenance of natural water temperatures for aquatic species.

Other nearby plant communities include a mosaic of grassland and thicket towards the crests of the valley sides, which have been disturbed by construction of the adjacent Pavilion shopping centre and ongoing pedestrian traffic between Chesterville and the Pavilion. It is likely that the original grassland has been encroached by woody species due to alteration of natural fire regimes, resulting in the present mosaic of structural classes and the presence of alien invasive trees and shrubs such as *Tecoma stans** and *Chromolaena*

odorata.* A small, disturbed wetland dominated by *Arundo donax** and *Pennisetum purpureum** is located immediately north-west of Chesterville.

Widening of the Westville Viaduct will require temporary road access to the area below the viaduct for heavy vehicle access, which will involve cutting a bench into the valley slopes, and forming a temporary crossing over the river. Due to the degraded nature of much of the vegetation in the valley, rehabilitation should focus on a) reinstating natural ground levels as far as possible, b) developing a protective groundcover as soon as possible after construction to prevent erosion and siltation, and c) alien plant control.

The proposed viaduct access route enters the valley from Molife Road through Chesterville, south of the viaduct and follows the contour along the west slope of the valley (Figure 1). The proposed route exits Molife Road and turns sharply left along an existing track and area disturbed by sand mining at the toe of the wetland. It then exits the wetland and runs parallel to the wetland approximately 35 m from the wetland edge (i.e. outside of a 30 m wetland buffer) to the western abutment of the viaduct. The route will then cross the stream adjacent to the viaduct to allow for construction of piers and abutments (this route was considered acceptable from an environmental and an engineering perspective and has the support of the EPCPD).

EKZNW's MINSET data for the area of interest was obtained and interrogated for plants of high conservation value potentially present. In the Westville area, modelled data highlights 2 species potentially present:

- *Barleria natalensis* and *Vernonia africana*, both presumed to be extinct, which are grassland species.

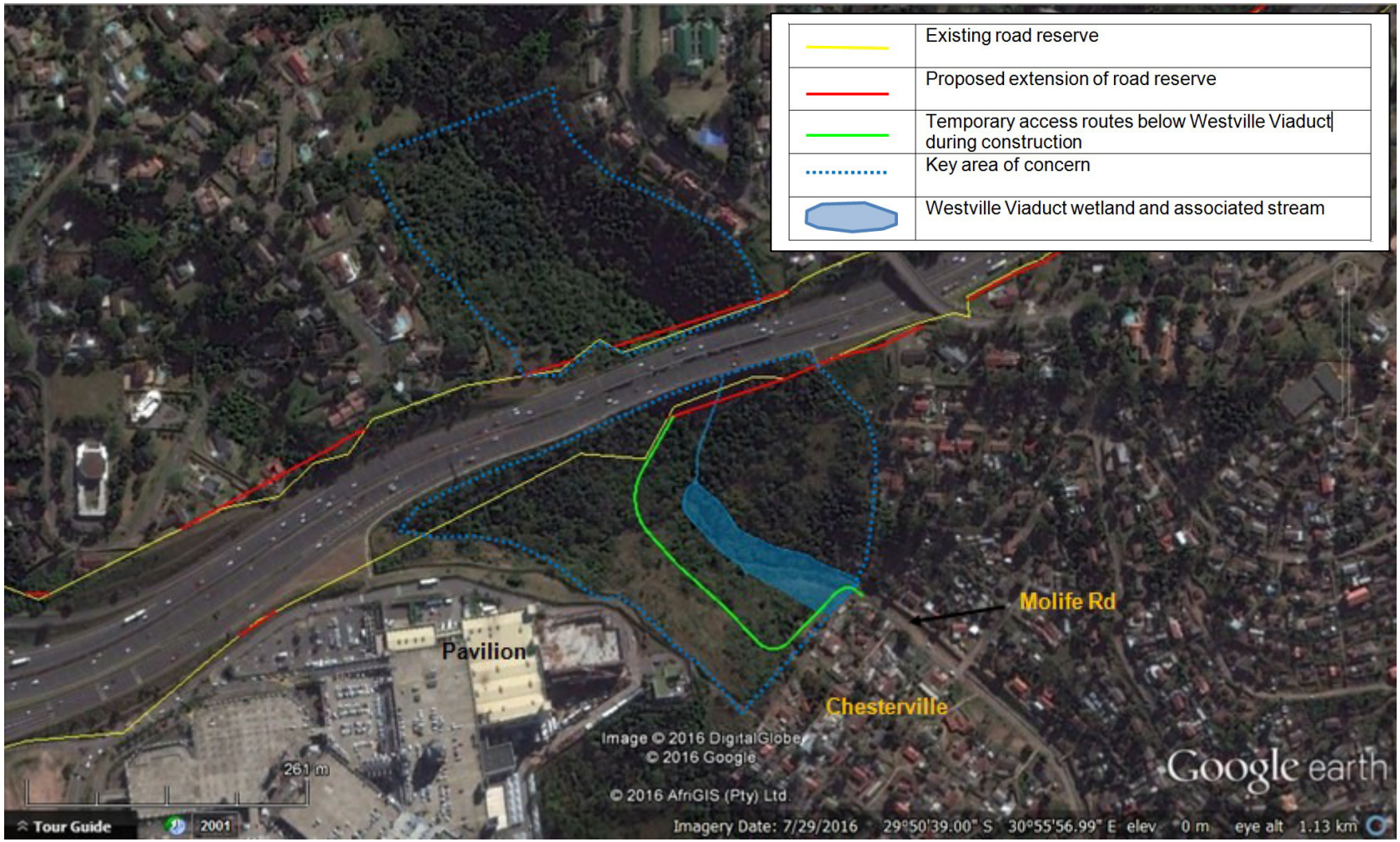

Figure 1 Plan showing proposed route of the construction access road to Westville Viaduct

4. PLANT SEARCH AND RESCUE

4.1 Legal requirements

Prior to plant rescue, the necessary permits and authorisations must be obtained from the relevant authorities:

- Where construction/operation may impact on plants designated as specially protected under the Natal Nature Conservation Ordinance (15 of 1974) and the KwaZulu Nature Conservation Act (29 of 1992), an application must be submitted to EKZNW to clear or translocate these plants as part of the plant rescue operation.
- Where construction/operation may impact on natural forests or individual trees protected in terms of the National Forests Act, 1998, an application must be submitted to the Department of Agriculture, Forestry and Fisheries (DAFF).
- Where construction/operation may impact on plants listed as threatened or protected species (TOPS) under the National Environmental Management Act: Biodiversity Act, 2004 (10 of 2004), an application must be submitted to EKZNW to translocate these plants as part of the plant rescue operation.

4.2 Specifications for plant rescue

A plant 'rescue' operation must be undertaken under the direction of an ecologist/botanist prior to construction, where plants of high conservation value may be impacted by any part of the development (construction or operation phase). This must cover the section of the temporary access route for the viaduct construction and the key area of concern shown in blue in Figure 1. Rescued plants should be carefully transplanted to a suitable site nearby and watered until established. eThekwini Municipality Environmental Planning Department must be contacted as part of the plant rescue planning (Greg Mullins Tel: +27 31 322 4560). Suitable sites to be considered include Roosfontein Nature Reserve and/or suitable habitat outside of the construction footprint.

Because the visibility of herbaceous plants varies depending on flowering season, an ecologist/botanist should visit the site during spring and summer to identify any plants of high conservation value which may be present, so that these plants can be marked and transplanted prior to construction commencing (an accurate layout plan of the development footprint will need to be available).

Refer to "notable species" above for species found in the general area to date, and for species potentially present which should be taken into consideration when searching the site.

The appointed ecologist/botanist or Environmental Control Officer (ECO) should inspect trees and shrubs, before they are cleared, for the presence of epiphytic orchids. Any orchids found should be rescued by relocating them to similar habitat outside of the construction footprint.

4.3 Specifications for transplanting rescued plants

Bulbs and many other geophytes usually transplant easily, providing it is done with some care. Trees and shrubs of high conservation value are normally less frequently encountered but if any are found, consideration should be given to growing these from seed or cuttings, as transplanting large trees is often costly, logistically difficult and has a low survival rate.

Place plants well outside of the construction footprint in suitable habitat (similar shade or sun conditions) in soil of similar wetness/dryness to the area they were removed from.

- Dig bulb/root out carefully, by starting to dig far enough away from the bulb/root so as not to damage it (e.g. by slicing the bulb with a spade).
- Keep some soil with the bulb and associated roots during the process.
- Pour a small amount of water in an empty plastic bag. Shake the bag to wet the inside.
- Place dug out bulbs/plants in bag.
- Do not fill the bag more than halfway with plants.
- Close opening of bag and roll top to keep in moisture. Keep bag out of direct sunlight and in the shade.
- Re-plant on the same day (e.g. dig out plants in the morning, and re-plant in afternoon).
- Dig hole big enough to accommodate bulb/roots.
- Cover with soil and press down lightly to ensure that there are no air pockets around the bulb. Take care to cover with soil up to the same level as it was before.
- Water immediately to settle the bulbs in.
- After planting, watering requirements will vary with weather conditions, and the contractor is responsible for maintaining moisture levels necessary for healthy growth (as a guideline, water every day for the first two weeks, and then three times a week until established). When watering, take care not to damage the soil structure by using an excessive force of water.
- The ECO must familiarise him/herself with the area to which the plants were translocated so that he/she can monitor their progress.

5. REHABILITATION

5.1 Objectives of rehabilitation

Re-vegetation and rehabilitation should aim at stabilising soils on site, controlling invasive alien plants and contributing to the visual landscape. It is important to note that the rehabilitation measures should at least result in an improvement to the current conditions on site and the condition of the environment should never be worse off than prior to project implementation.

5.2 Site access/viaduct access track

Where the temporary access track is required to work under the viaduct, it is required that:

- The route remains as close to the contour as possible to reduce erosion and siltation.

- The route is aligned to avoid the riparian zone, in such a way that the riparian zone is only crossed once, viz: it is only crossed within the extended road reserve.
- The crossing at the river must be no wider that the minimum needed to accommodate a construction vehicle / piling machine / crane.
- The footprint of the road is kept to an absolute minimum and the larger indigenous trees growing amongst the alien vegetation are avoided where possible.
- The route is widened only enough to accommodate one construction vehicle at a time (i.e. one-way traffic) and that lay bys are created to allow for passing vehicles.
- Any plants of high conservation value, which cannot be avoided, are rescued.
- Adequate storm water controls and energy dissipaters are provided at the end of drainage structures coming from the N3 highway towards the stream at the valley bottom.
- Adequate drainage (mitre drains) should be constructed at regular intervals in accordance with the local topography to minimise soil erosion potential. Alien plant control should also be undertaken along the access track.
- Soil compaction should be minimized by keeping vehicle and construction plant access ways and parking areas to a minimum. No vehicles may deviate from the temporary haul road into surrounding areas.
- Where drainage line or stream or crossings are unavoidable (for widening of the temporary access road and construction under the viaduct), drains and culverts must be designed in conjunction with relevant experts to the correct invert levels to prevent damming of flows, complete blockage of the channel or draining of wet areas. Culverts should be designed to prevent concentration of flows, and to maintain natural flows as free flowing as possible. This includes the toe of the wetland (currently disturbed by sand mining) where the temporary access road crosses and then exits the wetland (Figure 1).
- Temporary access tracks are rehabilitated as quickly as possible after construction ceases by removing excess imported material, ripping compacted soils, reinstating natural ground levels as far as possible, implementing soil erosion controls and establishing a dense grass cover (using an appropriate mix of indigenous grass species).

5.3 **Rehabilitation of riparian areas**

In the riparian area of the stream below the Westville Viaduct where a temporary crossing will be formed to facilitate work under the viaduct, it is required that:

- Work is timed for the winter low flow period, where practically possible.
- The width of the crossing is kept to the minimum required for access.
- Where dewatering of silt laden water is required at excavations, this water must not pumped directly into streams and natural water bodies, and separate collection areas/sumps must be created in existing disturbed areas where this water can infiltrate naturally into the surrounding soil.
- Temporary crossings are re-habilitated as quickly as possible using the original soil excavated from the channel bank or channel bed, as appropriate.
- Temporary coffer dams or diversion works must be carefully removed from the riparian zone once construction is complete.
- The original profile and cross-section of the channel is restored, so as not to interfere with the hydrology of the downstream environment and to re-establish the natural water flow patterns within the channel.
- Ripping or scarifying soils which are saturated with water is ineffective and should be avoided.

- Natural re-colonisation of riparian soils is usually rapid; however, where this process needs to be sped up, replanting can be done with locally occurring indigenous grasses, reeds and sedges.

5.4 Soil erosion control

Site stabilisation and soil erosion controls are a necessary prerequisite for successful rehabilitation and re-vegetation to limit environmental degradation and off-site impacts. The following is required:

- Where there is potential for erosion, energy dissipaters must be installed at the end of drainage structures associated with the upgraded highway to reduce the velocity and erosive force of the exiting water. Energy dissipaters could range from reno mattresses to stilling chambers through to planting of indigenous vegetation buffers which may be better able to diffuse high-velocity runoff.
- Where soil requires excavation, the original topsoil (generally the upper most 250 mm of soil, together with plant roots and organic matter) must be stripped and stockpiled separately. Topsoil stockpiles should not exceed 2 m in height nor have slopes steeper than 1:3. They should not be handled/moved, and should be kept free of alien invasive plants.
- During rehabilitation, prompt and progressive reinstatement of bare areas is required. The topsoil layer is to be replaced on top during reinstatement.
- Any trenches associated with the upgrade are to be reinstated to a convex (as opposed to flat or concave) surface to prevent the channelling of any surface runoff as the soil settles/compacts over time.
- The control of soil erosion and siltation associated with construction and operation is important at all locations on site, and particularly on steep slopes and adjacent to drainage lines, the wetland and the stream below the viaduct. Both temporary and permanent soil erosion control measures must be used during the construction and operation phases. Any earth-worked areas, which may lay bare for extended periods, should be temporarily grassed.
- Permanent erosion controls will need to be specified by the engineer and may include measures such as gabion baskets, reno mattresses, honeycomb cellular structures, geo-textiles, rock packing, v-drains and other hard engineering structures. Temporary erosion controls are generally 'softer' options including silt fencing, sand bags, hay bales, soil berms, biodegradable fibre mats, fibre rolls, brush packing, fascine work and staking with truncheon cuttings.
- Bare surfaces must be grassed as soon as possible after construction to minimise time of exposure. Locally occurring, indigenous runner grasses can be used, for example *Cynodon dactylon* and *Dactyloctenium australe.* Alien invasive grasses such as *Pennisetum clandestinum* (Kikuyu) must not be used. Alternatively, an indigenous hydro-seeding mix can be used.
- Due to the rapid establishment and superior soil stabilisation ability, grassing with sods is encouraged over hydroseeding. Results obtained from hydroseeding are highly variable with seed easily washed off during storm events (particularly on steep embankments). Planting of grass runners in rows parallel to the contour is a lower cost alternative to use of sods.
- Where large bare areas remain which are particularly prone to water and wind erosion, these should be re-seeded with an indigenous grass mix in combination with brush-packing. Brush-packing with locally cleared indigenous vegetation will allow local plant seed to enter the topsoil and allow for the re-establishment of natural vegetation on these bare areas, while limiting erosion.

- Final levels of all disturbed areas are, where feasible, are to be consistent with the natural topography of the area.
- Regular monitoring for erosion must be conducted across the site (particularly near hardened surfaces and infrastructure) to ensure that no erosion is occurring. Rectification of erosion problems should include brush-packing and/or re-vegetation.
- Soil erosion controls must be inspected and maintained on a regular basis during construction and operation phases.
- Reinstatement and rehabilitation are required for all areas disturbed by the project. This includes the entire development site, road embankments, access roads, construction camps and servitudes for any services that may have been established.
- Should areas be disturbed outside of the demarcated working area the contractor shall reinstate and rehabilitate all disturbed areas at his own cost and to the satisfaction of the ECO.

6. ALIEN PLANT CONTROL

Alien invasive plants around any excavated areas/work areas and within the road reserve must be kept under control during construction. Mechanical methods should be encouraged as the main form of control, together with the judicial use of herbicides[1]. The colonisation and rate of growth of alien plants must be closely monitored so that they can be controlled by simple hand pulling while plants are still small. If alien plants are allowed to grow too large, herbicide use will be compounded. Clearance, follow-up operations (at 3 month intervals) and monitoring should continue during both the construction phase and the 12 month maintenance period. Follow-up operations will become easier if done regularly.

Sufficient funds must be set aside to ensure that alien plants are adequately controlled during construction, because without repeated follow-up operations, alien plant control as part of rehabilitation is unlikely to be successful.

Whichever method or combination of methods is chosen to control alien plants, there are a few general principles worth considering:

- Lighter peripheral infestations are normally best to start with as they can become denser over time, while heavy infestations are unlikely to become denser (start with the easiest problem areas first).
- Start alien plant control at the top of slopes/catchment areas and work progressively down slope because alien infestation generally proceeds downhill, particularly in riverine areas.
- Alien plant control operations usually don't succeed the first time. A number of follow-up operations are essential to control re-growth after the initial clearance. When attempting to clear a large area piece-meal it is better to make the second effort a follow-up operation on the first area cleared, than to start on a second area (depending on financial and labor resources available). Cleared areas should be regularly inspected to ensure that elimination of aliens is complete.

[1] Recommended reference book: Invasive alien plants in KwaZulu-Natal. Management and control. KZN Branch of the Wildlife and Environment Society of South Africa. Fishwicks Printers.

6.1 Alien plant control principles

Alien plants must be eradicated by means of a systematic plant removal and control programme (including follow-ups) using a combination of mechanical and chemical methods where applicable:

- The alien plant control team must be well trained to identify the alien plants in all of their different growth stages (seedlings, saplings, mature trees/shrubs) and to apply methods and herbicides appropriate to the type of infestation.
- Follow up operations are essential. An alien plant control programme will fail without a number of follow up operations at the same site to control any missed plants and seedlings and any coppicing stumps. Provided they are done on a regular basis, these operations are often not unduly time consuming and become easier each time the site is revisited. It is important to remove any re-growth before alien plants have time to seed and re-infest cleared areas.
- Use of herbicides can be hazardous both to people and the environment. Methods used, safety precautions and requirements for protective gear must be in accordance with manufacturer's instructions and in accordance with the Occupational Health and Safety Act.
- The removal of alien plants constitutes disturbance in itself and opens the area up to re-colonisation by aliens. Care should be taken to use the least disruptive methods and those that keep the footprint of clearing and soil disturbance to a minimum, for example:
    - Undertake activities such as mixing of herbicides and stockpiling of equipment on roads or existing disturbed areas outside of sections of natural vegetation.
    - Enforce strict methods of handling, disposal and application of herbicide and herbicide containers, to prevent excess or accidental spillage and death of indigenous plant cover.
    - Leave dead plant material *in situ*[2] i.e. do not leave bare patches of soil uncovered.

6.2 Alien plant control methods

In this situation, manual labour will be required to remove and/or apply herbicide to alien plants. The following control methods (Plant Protection Research Institute, 1996[3]) can be employed:

- **Hand pulling**, where seedlings and plants are small enough and root systems shallow enough, is preferable to using herbicides.
- **Cut stump herbicide treatment**, where larger trees/shrubs are felled and the freshly cut stumps are treated by painting with herbicide.
- **Basal stem treatment**, where trees are treated without felling, by application (painting or spraying) of herbicide to the lower part of the stem. For trees with thin bark, herbicide can be applied directly to the bark. For thicker bark, either strip the bark or cut into it with an axe (called frilling) and insert herbicide into the wound.
- **Foliar spraying**, where the herbicide is sprayed onto the leaves and stems (foliage) of the target plant. The volume applied depends on the density and height of the plants but

[2] Succulent aliens such as *Pereskia aculeata* must be removed from site due to their ability to root from plant fragments

[3] Plant Protection Research Institute, 1996. Alien plant control for land managers. Plant Protection Research Institute, Cedara, KwaZulu-Natal

as a general rule the leaves should only be sprayed to the point where run-off is seen. Foliar spraying can potentially affect and kill adjacent indigenous plants, which would be detrimental to the rehabilitation program. Thus, to allow for more targeted spraying, it is recommended that the alien shrubs and trees are first cut/slashed back to ground level, and then foliar sprayed using a knapsack spray after foliage has re-sprouted to between 30 and 50cm in height (if cut stump treatment is not chosen as the preferred method).

In addition, when using herbicide, the following needs to be taken into account:

- *Plant condition*: plants should be actively growing for maximum uptake of herbicide. Plants suffering from stress, caused by a long hot spell, drought or water logging, severe disease or insect damage, may not be completely controlled by a treatment. Plants covered in dust should not be sprayed.
- *Water on leaves*: after application, it takes a period of time for herbicide to be absorbed by the plant. This period should be rain free and will vary with each herbicide, generally between one and six hours. Do not spray leaves wet from either dew or rain as the herbicide will run off and uptake will be minimal.
- *Herbicide selectivity*: it is important to understand the characteristics of each herbicide before making a selection. Some herbicides such as Roundup control a wide spectrum of plants, including grasses and broadleaves, whereas other such as Garlon are selective in controlling only broad-leafed plants. Garlon is ineffective on Lantana camara.

6.3 Herbicides

The use of chemical herbicides must be kept a minimum as they can be hazardous to the environment. The use of chemical herbicides should be minimised in riparian areas and wetlands which are considered sensitive environments. Mechanical methods of control should be used as far as possible, particularly after the initial clearance where the re-colonization and rate of growth of alien plants must be closely monitored so that they can be controlled by simple hand pulling while plants are still small. If alien plants are allowed to grow too large, use of herbicides will become unavoidable. Various options are available and the final choice would need to be made by the Contractor in consultation with the herbicide supplier.

See the plant community descriptions in Section 3 for an indication of the common alien invasive species found on site. Please note that it is possible that new alien plant species may appear on site over time, and these will also need to be kept under control.

6.4 Schedule

1. Where herbicide is to be used, the first clearance/control should be undertaken during early summer, when plants are growing vigorously and uptake of herbicide will be more effective.

2. Follow up operations are usually conducted at 6-12 week intervals but this may vary according to site specific conditions (amount of rain, effectiveness of first clearance etc), and would need to be assessed by a suitably competent person. Follow ups are aimed at plants that were missed initially, plants that have recovered from the initial treatment and seedlings which have germinated as a result of disturbance or changed conditions above ground (e.g. more light).

3. Follow up control may be fairly demanding for the first two years after initial clearance. However, if regularly carried out, alien plant populations will decline to a level where they can be controlled with a minimum annual input (maintenance control). Maintenance control will be an annual or biannual commitment to ensure that re-infestation by alien plants does not occur. It is usually very light work and one labourer can cover a fairly extensive area in a day. Maintenance control usually entails hand-pulling seedlings or uprooting scattered individuals, and should continue for as long as invasive species continue to appear.

7. RE-ESTABLISHING VEGETATION COVER POST CONSTRUCTION AND AFTER DECOMMISSIONING OF THE TEMPORARY VIADUCT ACCESS TRACK

Natural vegetation in the vicinity of the viaduct is largely disturbed with a high cover of alien invasive species. Consequently, rehabilitation of the temporary access road, and any other areas disturbed below the viaduct and on road reserve as a result of construction, must aim at re-establishing a dense cover of indigenous grasses once construction is complete. The aim must be to stabilise the site and control soil erosion and siltation by providing a dense cover of indigenous grasses. It is recommended that:

- A key step in the process of creating a dense cover of indigenous grasses will be to strip and protect the original topsoil (generally the upper most 250 mm of soil, together with plant roots and organic matter). This must be stripped and stockpiled separately. The topsoil stockpile should not be handled/moved between stripping and rehabilitation, and should be kept free of alien invasive plants.
- After construction, the topsoil will need to be carefully replaced on the cleared construction servitude and establishment of grass cover can commence.
- Locally occurring, indigenous runner grasses can be used, for example *Cynodon dactylon* and *Dactyloctenium australe*. Alien invasive grasses such as *Pennisetum clandestinum* (Kikuyu) must not be used. Alternatively, an indigenous hydro-seeding mix can be used including tufted and runner grasses such as *Chloris gayana, Cynodon dactylon, Dactyloctenium australe, Digitaria eriantha, Eragrostis curvula* and *Panicum maximum.*
- Due to the rapid establishment and superior soil stabilisation ability, grassing with sods on steep slopes is encouraged over hydroseeding. Results obtained from hydroseeding are highly variable with seed easily washed off during storm events. Planting of grass runners in rows parallel to the contour is a lower cost alternative to use of sods.
- On slopes steeper than 1:6, a biodegradable geo-fabric should be placed on the soil surface together with grass seed to control soil erosion (in situations where blanket sodding with grasses is not used).
- Maintenance of the replanted area will be important, and should involve temporary soil erosion control measures where necessary, on-going alien plant control, watering until grasses are established and re-seeding bare patches where grasses have not established.
- Because the N3 is an important entry route to Durban for tourism, eThekwini Municipality EPCPD has requested that, on whatever road reserve remains after construction, alien invasive plants are removed and indigenous species are planted, particularly visually pleasing material such as *Aloe* spp. The plants used must be in accordance with SANRAL approved species for road reserves (this is important from a road safety and fire perspective).

- This can be achieved by translocating suitable indigenous plant material from areas designated for earthworks, bearing in mind that certain priority plants may first need to be replanted at receiving areas specified by the EPCPD (refer to Section 4). Suitable material from cleared areas can also be stored and bulked up in a simple nursery (on or offsite) for later replanting on verges/road reserve and areas in need to rehabilitation, depending on the availability of funding. The area from which this material is taken must be approved by the ECO and must not result in environmental degradation.

Post-construction monitoring of the rehabilitation effort will be necessary to allow adjustments in management to ensure the aims of the rehabilitation are met over time.

8. TIMEFRAMES AND MONITORING FOR GRASSING AND REHABILITATION

The re-vegetation and rehabilitation of the site should take place during the construction and operational phases of the proposed development:

- Progressive rehabilitation must occur during construction, as and when areas for the re-application of topsoil and grassing become available.
- The rehabilitation phase (including post planting/seeding maintenance) should be at least 12 months (depending on time of planting/seeding and rainfall) to ensure establishment of plants with a minimum 80% cover achieved (excluding alien plant species).
- If the grasses have not established and the 80% is not achieved within the specified maintenance period, maintenance of these areas shall continue until at least 80% cover is achieved (excluding alien plant species).
- Additional planting/seeding may be necessary to achieve 80% cover.
- Any bare patches which appear during the maintenance period shall be re-seeded.
- Succession of natural plant species should be encouraged on site.
- Monitoring of rehabilitation success and follow-up adaptive management, together with clearing of emerging invasive aliens, shall be carried out during the 12 month post-construction maintenance period.

Throughout the lifecycle of the development, regular monitoring and adaptive management must be in place to detect any impacts to the environment caused by the proposed development and to remedy these as soon as detected. During the construction phase, the ECO and contractor will be responsible for initiating and maintaining a suitable monitoring system. Once the development is operational, eThekwini Municipality would need to maintain the monitoring cycle and initiate adaptive management as required. Monitoring personnel must be adequately trained in identifying both the impacts and causes of the impacts observed on site.

9. CONCLUSION

This rehabilitation plan provides the contractor, SANRAL, and the ECO with guidelines on how to plan re-vegetation and rehabilitation work, and assists in understanding the concepts behind successful rehabilitation. This plan must be implemented in conjunction with the approved EMPr as well as any other management plans prepared for the proposed development.

Detailed planning around rehabilitation of the temporary access road over the stream below the Westville Viaduct will also be required, with input from the contractor, engineer and ECO when detailed construction methodologies / methods statements are being developed.