GA Environment

ALIEN INVASIVE SPECIES MANAGEMENT PLAN

FOR THE PROPOSED MINING OF QUARRY 4 ASSOCIATED WITH THE UPGRADE OF NATIONAL ROAD R573 (MOLOTO ROAD), GAUTENG PROVINCE

September 2021

SANRAL

KBK ENGINEERS

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PROJECT INFORMATION

Title:	Alien Invasive Management Plan for Proposed Mining of Quarry 4 Associated with the Upgrade of National Road R573 (Moloto road), Gauteng province
Competent Authority:	Department of Mineral Resources and Energy (DMRE)
Applicant:	South African National Roads Agency SOC Ltd
Environmental Assessment Practitioner:	GA Environment (Pty) Ltd.
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0	16th September 2021	Final for Submission to Authority	Kirthi Peramaul	Nkhensani Khandlhela

SIGNING OF THE ORIGINAL DOCUMENT

Original	Prepared by	Reviewed by	Approved by
Date: **16th September 2021**	Name: **Kirthi Peramaul**	Name: **Nkhensani Khandlhela**	Name: **Nkhensani Khandlhela**
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DISTRIBUTION LIST (KEY PARTIES)

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ABBREVIATIONS

CA	Competent Authority
CBA	Critical Biodiversity Area
DFFE	Department of Forestry, Fisheries and Environment
DMRE	Department of Mineral Resources and Energy
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act No. 73 of 1989
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EO	Environmental Officer
ERAP	Emergency Response Action Plan
FPA	Fire Protection Agency
MSDS	Material Safety Data Sheet
NEMA	National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998),
NEM:BA	National Environmental Management: Biodiversity Act (Act 10 of 2004)
NEM:PAA	National Environmental Management: Protected Areas Act (Act 57 of 2003)
PM	Project Manager
SANBI	South African National Biodiversity Institute

1. INTRODUCTION

1.1 Project background

It is the intention of the South African National Roads Agency SOC Ltd to establish various Quarries to provide the necessary construction materials for the proposed upgrading of national road R573-1 (K139) from Baviaanspoort Road in Tshwane (km 0,00) to the Gauteng / Mpumalanga Provincial Border (± 46.00 km). The upgrading of the R573 Moloto Road includes the following projects:

- Upgrading of the entire length of the R573/1 Moloto Road to a 4-lane barrier-divided dual carriageway from Stormvoël Road to the Gauteng border;
- Construction of the southern link between Stormvoël Road and Baviaanspoort Road;
- Construction of the new PWV2 link between the N1/N4 Interchange and the R573/1 Moloto Road;
- Construction of the Moloto/Sefako Makgatho Interchange;
- Construction of the Big Tree Mall Interchange;
- Construction of the De Wagendrift bypass along the R573/1; and
- Various upgrades to local roads and upgrading of intersections to small interchanges (Moepel Overpass; Baviaanspoort Road East extension; Dewar, Sakabuka and Maroela interchanges and road developments).

The SANRAL appointed KBK Engineers to provide engineering services for the proposed development. KBK Engineers appointed GA Environment (Pty) Ltd on behalf of SANRAL as independent Environmental Consultants to undertake the required Environmental approvals for the mining of four Quarries for the purpose of the proposed development. All four Quarries are situated along the R573 Moloto Road and are as follows:

- Quarry 6A;
- Quarry 6B;
- Quarry 4 and
- Quarry 5.

This Alien Species Management Plan is specifically for Quarry 4. The proposed Quarry 4 is located within the Moloto training facility of the South African Police Service (SAPS), between 4km and 6km southwest of the Moloto township near the Gauteng/ Mpumalanga provincial border. The Foxtrot Primary School is situated west of the entrance of the site, and with the Total Jakkalsdans fuel station situated across of the R573 roadway which borders the entry and exit points of the site in the north.

The project area is located in a region characterised by mostly undeveloped land and small holdings, interspersed with gravel roads and occasional agricultural fields, within a rural setting. The site centre geographic coordinates are 25°31'11.31" S, 28°37'14.03" E (**Figure 1**). The project area is located on Portion 2 of the Farm Farm Jakkalsdans 243 JR. The site earmarked for the proposed mining activities is owned by the South African Government and is currently zoned as agricultural.

The proposed study area where Quarry 4 is located, is considered as a potential source of rock material. According to the material investigation report, the unweathered quartzite bedrock was proven to be suitable for the production of crushed G1 aggregate material. In addition, the weathered sandstone bedrock can be crushed as a source of G7 material, provided a suitable grading envelope can be maintained. Approximately, 56 500m^3 of overburden overlies the site. The overburden overlies weathered sandstone bedrock with an estimated volume of 230 000m^3, which can potentially be used for the production of crushed rock G7. A total of 624 000m^3 of unprocessed quartzite is available for crushing and production of G1 aggregate. The rock material will only be stored temporarily in stockpiles on site before being crushed and taken off site. The commodity to be mined is aggregates

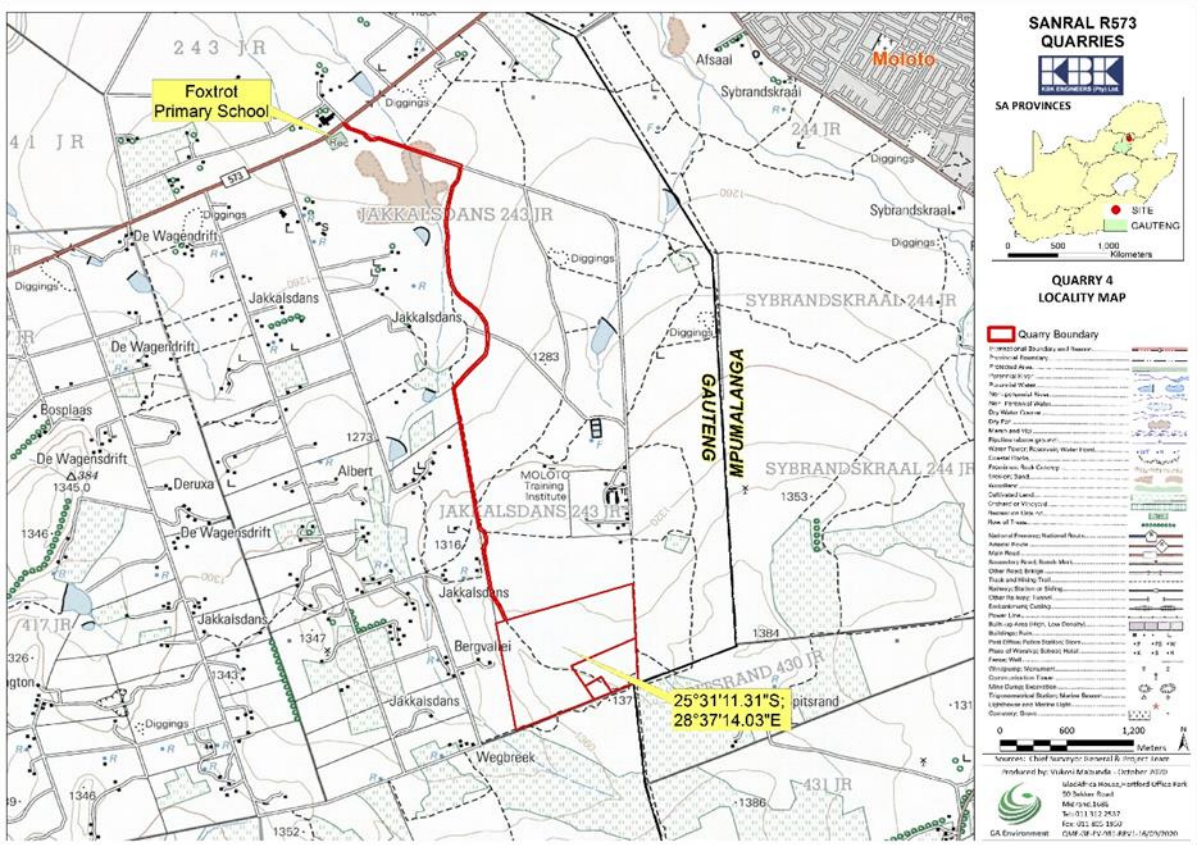

Figure 1: Project site locality

As part of the Environmental Impact Assessment process for the clearance of vegetation, an alien invasive management plan must be compiled to support the application. This document will provide the Contractor, the developer, and the ECO with guidelines on how to effectively manage alien invasive species throughout the proposed mining activities. This plan must be implemented in conjunction with the approved EMPr as well as other management plans prepared for this proposed development. The exact details of the alien invasive management plan will depend on the extent of site, working area conditions, available manpower, and the desired environmental compliance state of the site as stipulated on the EA and EMPr.

1.2 Alien Invasive Species

Alien Invasive Species (plants, animals, and micro-organisms) are species that occur outside of their natural habitat or country of origin and due to their ability to outperform and outgrow indigenous species; they establish themselves in these non-native habitats. Alien Invasive Species (AIS) have also been called weeds, pests, encroachers, aliens, invasives, exotics or non-indigenous. They are native to a particular area or region, but have been introduced elsewhere, either by accident or on purpose. Alien Invasive Species can be animals (e.g. rats), plants (e.g. lantana) and micro-organisms (e.g. cholera). AIS can be found in households as decorative plants, pets, or pests or on land as terrestrials and in water as aquatics. The most aggressive invaders can spread far from parent plants and cover large areas.

South Africa has a long history of problem plants. Alien plants were first introduced in South Africa in more than thousand years ago. These were plants mainly from central and northern African origin and were associated with human activities. Plants from other continents were introduced by colonists from 1652 onwards. Invasive alien plants (IAPs) pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate.

Vehicles often transport many seeds, and some may be of invader species, which may become established along the roads inside the study area, especially where the area is disturbed. The construction phase of developments in the area will almost certainly carry the greatest risk of Alien Invasive Species being imported to the site, and the high levels of habitat disturbance also provide the

greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. Continued movement of personnel and vehicles on and off the development sites, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. The biggest risk is that Alien Invasive Species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

1.3 Site Ecological setting

The project area is located in a region characterised by mostly undeveloped land and small holdings, interspersed with gravel roads and occasional agricultural fields, within a rural setting. **Table 1** presents the floral ecological setting of the study area.

Table 1: Desktop assessment of the floral ecological setting of the study area (Field and Form, 2020)

Aspect	Conservation Characteristic
Biome	Savanna Biome
Bioregion	Central Bushveld Bioregion
Quarter Degree Square (QDS)	2528BC & 2528DA
Listed Threatened Ecosystems (2011)	N/A
Protected and Conservation Areas (PACA; 2019) and NPEAS Focus Areas (2010)	N/A
National Biodiversity Assessment: Terrestrial Remnant Vegetation (2018)	The majority of the project area falls within the remaining extent of Central Sandy Bushveld(Threat Status: Least Concern (LC); Protection Status: Poorly Protected)
Mining and Biodiversity Guidelines (2012)	The majority of the project area falls within areas indicated as being of Highest Biodiversity Importance: highest risk for mining.
Important Bird and Biodiversity Areas (2015)	N/A
Gauteng Conservation Plan (C-Plan) (2011)	The majority of the project area falls within areas indicated as a CBA: Important area.
Gauteng Ridges v7	A Class 1 ridge is located in the southwest of the project area.
Vegetation Type (2006, 2012; NBA 2018)	Central Sandy Bushveld (Conservation Status: Vulnerable (VU))

According to the Terrestrial Biodiversity Assessment undertaken by Field and Form Landscape Science, four broad habitat units were identified within the project area, based primarily on floral species composition and vegetation structure, faunal species' habitat provision, the topographical position of the habitat unit in the landscape, as well as the degree of anthropogenic impact and disturbance within the unit. These habitat units are:

- Ridge habitat located within the south eastern and south western portions of the project area. According to the 2001 Gauteng Development Guideline for Ridges (GDACE, 2001), the essential characteristic defining these topographic features is the slope of the site, whereby any topographic feature in the landscape that is characterised by slopes of 5° or more (i.e. >

8.8%, > 1 in 11 gradient), as determined by means of a GIS digital elevation model, is defined as a ridge. The portion of the ridge indicated by the Gauteng Ridges v7 Dataset is defined and designated by GDARD as a Class 1 ridge. The field assessment indicated that this ridge however extends, at lower slope, beyond the boundaries of the Class 1 ridge. These areas are indicated as the Ridge habitat unit, while the designated Gauteng Class 1 Ridge is indicated as the Class 1 Ridge habitat unit.

- Rocky slope habitat occurring between the ridge in the south western portion of the project area and the *Burkea africana* Woodland habitat unit.
- Degraded *Burkea africana Woodland*, which comprises a large portion in the south of the project area; and
- Wetland habitat associated with an unnamed tributary of the Elands River. This habitat unit occurs to the southwest of the project area, and extends within the north of the project area in the vicinity of the access road.

Three further habitat units that are not well represented within the project area itself, were identified within 200m of Quarry 4 in line with GDARD (2014) requirements. Although these habitat units were considered, they are unlikely to be significantly impacted by the proposed project due to their relative distance from the proposed development footprints. These habitat units are:

- Mixed Woodland, occurring adjacent to the access road and within adjacent properties.
- Modified Grassland, also occurring along the proposed access road and within adjacent properties; and
- Modified and disturbed habitat, including agricultural fields and existing modified areas such as access roads and built infrastructure.

Figure 2 provides the spatial representation of the habitats identified with the study area.

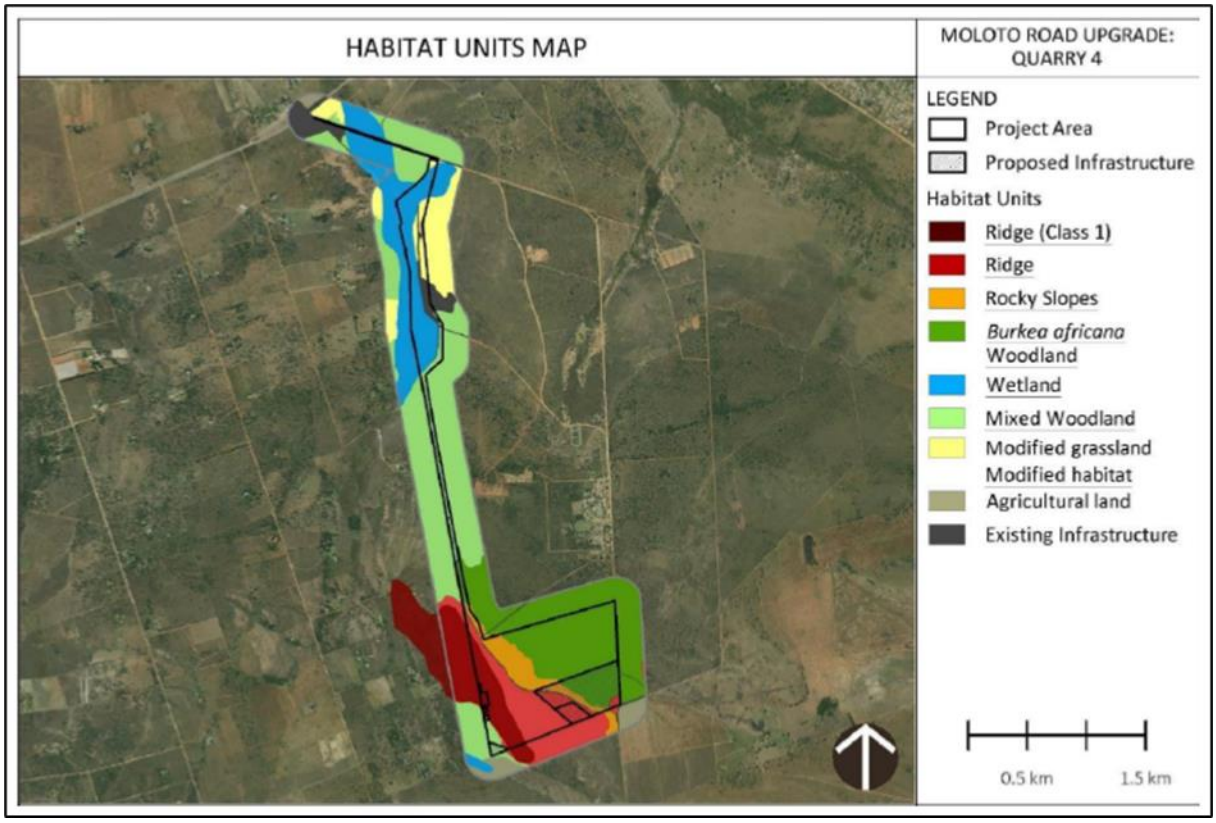

Figure 2: Habitat Unit Map (Field and Form Landscape Science, 2020)

1.4 Alien and Invasive Floral Species

According to the Terrestrial Biodiversity Assessment, alien, and invasive floral species encountered during the field investigation are presented in **Table 2.** The various listed invasive species' categories as indicated by the NEMBA Alien and Invasive Species Lists (2016) are shown, as well as the categories as per CARA (Act No. 43 of 1983).

Table 2: Alien floral species identified during the field assessment across habitat units within the project area (Field and Form Landscape Science, 2020)

Species	Common name	NEMBA Category*	CARA Category
Acanthospermum australe	Sheep bur/ Spiny bur	N/A	N/A
Achyranthes aspera	Devil's horsewhip	N/A	N/A
Ageratum conyzoides	Goat weed	N/A	N/A
Bidens bipinnata	Spanish needles	N/A	N/A
Campuloclinium macrocephalum	Pompom Weed	1b	1
Cereus jamacaru	Queen of the night	1b	1
Chenopodium carinatum	Keeled goosefoot	N/A	N/A
Gomphrena celosioides	Prostrate globe amaranth	N/A	N/A
Hibiscus trionum	Bladder hibiscus	N/A	N/A
Lantana camara	Lantana	1b	1
Richardia brasiliensis	Mexicana clover	N/A	N/A
Schkuhria pinnata	Dwarf marigold	N/A	N/A
Solanum elaeagnifolium	Silverleaf bitter apple	N/A	N/A

Tagetes minuta	Tall khaki weed	N/A	N/A
Zinnia peruviana	Redstar zinnia	N/A	N/A

N/L – Not Listed

NEMBA

Category 1b – Invasive species that must be controlled.

Category 2 – Invasive species that require a permit to carry out a restricted activity within an area, as specified in the permit.

Category 3 – Ornamentally used plants that may no longer be planted. Existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread.

CARA

X – proposed CARA category

Category 1 – Declared weeds that are prohibited.

Category 2 – Invader plants with a commercial value that must be controlled.

Category 3 – Ornamental species that must be controlled.

When considering the table above, it is evident that a low diversity of listed alien species that require mandatory control, are present within the project area. The most prominent of these species are *Lantana camara* and *Campuloclinium macrocephalum*. A high diversity and abundance of ruderal weeds are however present. Alien species are expected to be introduced and proliferate further should quarrying and other disturbances occur within the project area, and it is therefore important that an invasive species management programme be implemented.

1.5 Key role players and responsibility matrix

For the Alien and Invasive Management plan (AIMP) to be successfully implemented, all the role players involved in the project need to co-operate. For this, role players must clearly understand their roles and responsibilities, they must be professional, and they must form respectful and transparent relationships and maintain open lines of communication. The key role players for the rehabilitation phase and the post rehabilitation monitoring phases are as follows:

- Developer.
- Engineer.
- Contractor; and
- Environmental Control Officer.

The functions and responsibilities of each of these role players are outlined in Table 3.

Table 2: Functions and responsibilities of the project team for the implementation AIMP

ROLE	PHASE OF INVOLVEMENT	RESPONSIBILITIES
Developer ***SANRAL***	Construction, Rehabilitation and Operational phases	• Appointing project team; and • Ensuring that the AIMP, is circulated to the project team. • Ensuring overall compliance with the rehabilitation plan
Consulting Engineer ***KBK Engineers***	Construction, Rehabilitation and Operational phases	• Ensuring that the Contractor undertakes all construction, operational and maintenance activities in line with the AIMP, • Ensuring that all non- compliances, environmental or otherwise are actioned by the Contractor.
Contractor *To be appointed*	Construction, Rehabilitation and Operational phases	• Implement the AIMP, • Addresses all areas of concern raised by the Consulting Engineer or Environmental Control Officer during construction, operational and maintenance
Environmental Control Officer *To be appointed*	Construction, Rehabilitation and Operational phases	• Ensuring that the Contractor undertakes all co activities in line with the AIMP • Undertaking of Environmental Audits and circulating reports to the project team

2. ALIEN INVASIVE SPECIES MANAGEMENT PLAN

This Alien Invasive Species Management Plan (AIMP) acts as a guideline to be applied by all Contractors and other role players involved in the project. The AIMP is an evolving guideline that needs to be updated or adapted as progress is made in terms of the control of alien invasive species within the project area, and successes and failures of procedures identified. The objectives of the AIMP are thus:

- Actively aid the improvement of indigenous biodiversity within and around the site by removing all invasive alien plant species.
- Improving the ecosystem function of natural landscapes and their associated vegetation.

The overall aim of this AIMP will be to control and manage alien and invasive plant species during the construction, operational and maintenance phases of the Quarry 4 mining activities and ancillary infrastructure.

2.1 Applicable Legislation

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. The legislation states that certain exotic plant species should also be cleared or prevent from spreading.

Below is a brief explanation of the four categories of Invasive Alien Plants as per the regulation.

- **Category 1a:** *Invasive species requiring compulsory control*. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- **Category 1b:** *Invasive species requiring compulsory control as part of an invasive species control programme*. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- **Category 2:** *Invasive species regulated by area*. A demarcation permit is required to import, possess, grow, breed, move, sell, buy, or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- **Category 3:** *Invasive species regulated by activity*. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy,

or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

2.2 Legal Obligations of Landowners with regards To Listed Alien Invasive Species Control

As per the definition clauses, an "Invasive species" means any species whose establishment and spread outside of its natural distribution range:

(a)Threaten ecosystems, habitats or other species or have demonstrated potential to threaten ecosystems, habitats, or other species; and

(b)May result in economic or environmental harm or harm to human health.

The obligations contained in the Act do not however apply to all invasive species. A distinction is drawn between "invasive species" and "listed invasive species", which means –Any invasive species listed in terms of section 70 (1)". As far as listed invasive species are concerned, the situation is slightly different from that of alien species as the Act places some additional obligations on parties other than permit holders. A person wishing to conduct a restricted activity in relation to a listed invasive species will also require a permit and is subject to the same duty of care as is the case with alien species. However, in addition to those requirements, section 75 (4) mandates the Minister to coordinate and implement programmes for the prevention, control or eradication of listed invasive species. S 75 (4) reads as follows:

- "75. Control and eradication of listed invasive species

  (4) The Minister must ensure the coordination and implementation of programmes for the prevention, control or eradication of invasive species."

  These programmes, referred to in the regulations as "Invasive Species Management Programmes" must be prepared by the governing bodies of all parastatal protected areas and all other organs of state. These programmes may also impact and be carried out on private land but it is the Department who is responsible for its implementation, not the land owner.

However, in the context of certain "listed invasive species", specifically those categorised as 1a invasive species in terms of the regulations, the Act does place a limited obligation on the owner of land where listed invasive species occur. In this regard, section 73 (2) of the Act reads as follows:

- "73. Duty of care relating to listed invasive species

  (2)A person who is the owner of land on which a listed invasive species occurs must-

  (a)notify any relevant competent authority, in writing, of the listed invasive species occurring on the land;

(b)take steps to control and eradicate the listed invasive species and to prevent it from spreading; and

(c)take all the required steps to prevent or minimise harm to biodiversity.

(3)A competent authority may, in writing, direct any person who has failed to comply with subsection (1) or (2), or who has contravened section 71 (1), to take such steps-

(a)As may be necessary to remedy any harm to biodiversity caused by-

(i)The actions of that person; or

(ii)The occurrence of the listed invasive species on land of which that person is the owner; and

(b)As may be specified in the directive"

This provision certainly does place an obligation on a land owner to report the presence of any relevant listed invasive species (As per the regulations, category 1a species) to the competent authority and to rid the property of listed invasive species as well as prevent it from spreading.

2.2 Principles to ensure effective management of alien invasive

Invasive alien plant species are difficult to control. Methods should be used that are appropriate for the species concerned, as well as to the ecosystem in which they occur. When performing the controlling methodology for weeds and invaders, damage to the environment must be limited to a minimum. The methodology must be performed for at least three growing seasons to ensure the seed bank is depleted. Continual monitoring will be needed for seeds that are likely to be blown in from adjacent areas. The clearing of vegetation for the Quarry and associated infrastructure will leave bare patches of soil, thereby enhancing the colonisation by ruderal weeds (mostly annual weeds) or declared alien species that will prohibit the natural succession during rehabilitation activities. Such soil disturbances (as well as the inappropriate handling of topsoil) could enhance the establishment or spread of invasive adjacent to the development. The following must be included when addressing invasives in the area.

- Alien control programs are long-term management interventions and should include a clearing plan which includes follow up actions for rehabilitation of the cleared area.
- Alien problems at the site should be identified during preconstruction surveys (should there be indications) of the development footprint.
- The clearing plan should then form part of the preconstruction reporting requirements for the site.

- The plan should include a map showing the alien density also indicating potential alien species in each area.
- Lighter infested areas should be cleared first to prevent the build-up of seed banks.
- Collective management and planning with neighbouring landowners may be required as seeds of alien invasive species are easily dispersed across boundaries by wind and the movement of people and livestock.
- All clearing actions should be monitored and documented to keep track of which areas are due for follow-up clearing.
- Chemical mechanism of alien invasive plant control should be avoided unless necessary.
- Alien and invasive plant species must be cleared on site and re-vegetated by planting indigenous vegetation.
- The mitigations highlighted in the Rehabilitation report must be considered in instances where applicable.

2.3 Declared Weeds and Invader Plants Categories

Declared weeds and invaders have the tendency to dominate or replace the canopy or herbaceous layer of natural ecosystems, thereby transforming the structure, composition, and function of natural ecosystems. The National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004) – Alien and Invasive Species (AIS) Regulations lists about 383 invasive plant species into four categories that must be managed, controlled or eradicated from areas where they may cause harm to the indigenous environment. These four categories of problem plants are as follows:

- **Category 1 plants** may not occur on any land other than a biological control reserve and must be controlled or eradicated. Therefore, no person shall establish, plant, maintain, propagate or sell/import any category 1 plant species. These plants may no longer be planted or propagated, and all trade in these species is prohibited.
- **Category 1B** - Invasive species which must be controlled and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited.
- **Category 2 plants** are plants with commercial application and may only be cultivated in demarcated areas (such as biological control reserves) otherwise they must be controlled. These plants pose a threat to the environment but nevertheless have commercial value. These species are only allowed to occur in demarcated areas and a land user must obtain a water use license as these plants consume large quantities of water.

- **Category 3 plants** are ornamentally used plants and may no longer be planted, except those species already in existence at the time of the commencement of the regulations (30 March 2001), unless they occur within 30 m of a 1:50 year floodline and must be prevented from spreading. These plants have the potential of becoming invasive but are considered to have ornamental value. Existing plants do not have to be removed but no new plantings may occur, and the plants may not be sold.

In general, invasive alien plant control relies on four main methods - *manual, mechanical, chemical* and *biological* control. Long-term success of any programme is best achieved through a combination of these. This is called an integrated control approach. For the purpose of this report, a three-phase control programme presented in a section that follow must be considered in order to manage the alien invasive.

2.4 Alien invasive management plan (Three-phased Control Programme)

As mentioned, different species require different clearing methods such as manual, chemical, or biological methods or in combination. During construction, mechanical methods should be encouraged as the main form of control, together with the judicial use of herbicides. The preferred clearing methods for most alien species can be obtained from the DWS Working for Water Website http://www.dwaf.gov.za/wfw/. For any alien eradication programme to be successful, a three-phased control approach that should be followed and is briefly presented as follows:

- Initial control - Initial control requires an “aggressive” remedial approach with the aim to drastically reduce the number of alien invader vegetation to acceptable and manageable levels.
- Follow-up control - Follow-up control is vital to control any re-growth or new seedlings. Follow-up control methods may occur as soon as re-growth or seedlings are and
- Maintenance control – this approach involves the continual monitoring of the alien vegetation on a regular (preferably bi-monthly) basis to identify any re-growth or seedlings. It is expected that the infestation densities will have been reduced dramatically by this stage and that only individual specimens may appear from time to time. It is preferred that any alien re-growth be removed manually to exclude the unnecessary use of chemicals

Such a three-phased control programme may consider the use of a combination of chemical and mechanical control options. Chemical control of alien plants shall not be undertaken, especially as the site is located within a protected environment. Chemical control must be considered as the last option

and if required should only be applied by qualified personnel. It is usually preferable to use manual clearing methods where possible, although such methods may create additional disturbance which may stimulates alien invasion and may also be ineffective for many woody alien invasive species. Should herbicides be considered, all care must be taken to prevent contamination of any water bodies. Where herbicides are to be used, the impact of the operation on the natural environment should be minimised by implementing some of the following measures:

- Equipment should be washed where there is no danger of contaminating water sources and washings carefully disposed.
- To avoid damage to indigenous or other desirable vegetation, products should be selected that will have the least effect on non-target vegetation.
- Coarse droplet nozzles should be fitted to avoid drift onto neighbouring vegetation.
- No spraying of herbicides should take place in windy conditions or during wet conditions.
- The appropriate health and safety procedures should also be followed regarding the storage, handling and disposal of herbicides.
- For all herbicide applications, the following guidelines should be followed: Working for Water: Policy on the Use of Herbicides for the Control of Alien Vegetation http://www.dwaf.gov.za/wfw
- Only herbicide registered for use on target species may be used. It is a high priority of any eradication programme that makes use of herbicides or power equipment to implement the correct safety procedures and to prevent chemical spillages. Strictly follow the specified treatment concentrations for the relevant herbicides as specified by the product label. Always ensure that all staff members are properly trained and make them wear protective clothing when working with herbicides or other equipment (e.g. handsaws).

With regard to manual labour, hand pulling is most effective with small (30cm), immature or shallow rooted plants. This method is mostly preferred especially in sensitive areas. Mitigation to ensure maintain environmental standards that may be considered include the following:

- It is important that records in the form of site photographs be kept for all steps that are during the removal and management of aliens, should these be required by the Competent Authority during close out.
- Once the vegetation clearance and soil preparation processes commence, conduct weekly walkthrough of the proposed development area as well as a minimum 50 m perimeter around

the area, in order to identify all seedlings of any alien invasive species which might start to germinate and establish.

- Physically remove all identified alien invasive species seedlings from the soil by manually pulling them out with as much as possible of their root systems still intact.
- Place all removed alien invasive species seedlings in a metal drum or any other suitable containing unit and close the drum/containing unit in order to isolate the seedlings.
- Place the closed drum/containing unit on a concrete slab or any other suitable impermeable surface in direct sunlight in order to isolate the alien invasive species seedlings from any natural vegetation and prevent spreading of materials.
- Leave the closed drum/containing unit in direct sunlight for a minimum period of one week in order for all alien invasive species seedlings and materials to adequately dry out and die.
- Once all alien invasive species seedlings and materials have adequately dried out and died, remove the material from the drum/containing unit and place the materials in a minimum 1 m deep hole which is isolated from any natural vegetation for disposal at nearby registered, landfill site.

2.5 Integrated Alien species Control Strategies

An integrated control strategy uses a combination of control options for a number of species during a particular situation. This approach is based on ranking the study site into priority areas for control. Therefore, high priority areas should be controlled first. As a general rule, maintenance control should consider areas with low infestations first and then move to areas of higher infestation since control of these areas will be rapid and cost-effective. Also, the direction of control should be in a downstream direction, meaning that initial control should start upstream and terminate downstream. In addition, control measures should aim to remove alien infestation from the edge of a grove or patch to prevent any further spread.

2.5.1 Control Zones

It is known that clearing of vegetation in preparation for construction that will leave bare patches of soil, thereby enhancing the colonisation by alien species that will prohibit the natural succession during rehabilitation activities. Such soil disturbances (as well as the inappropriate handling of topsoil) could enhance the establishment or spread of *alien species* to natural systems adjacent of the development. A control team shall be responsible to control alien vegetation identified within the study area. The control team members will be responsible for applying foliar spray. When appointing

this method, certain precautions such using it on rain free days or dew falls must be observed. Spraying in windy weather must be avoided as the spray may encounter non target plants.

Follow-up control will commence within a week or latest two weeks after initial control was completed. However, in the event of very little re-growth, follow-up control should be postponed for at least another month. Should re-growth be vigorous, a second follow-up treatment may be necessary.

2.6 Monitoring and Auditing

The re-emergence of aliens can simply be monitored as part of the internal and external auditing requirements that may come as a condition in the Environmental Authorisation. Monitoring of alien invasives can simply be undertaken as follows:

- Undertaking follow-up inspections are required in order to establish whether follow-up operations are required.
- It is preferable to follow up on an area and remove all seedlings or treat resprouting plants, rather than treat a new area.
- Post rehabilitation monitoring plan is used to ensure that critical aspects of rehabilitation are monitored.

Table 4: Specifications for monitoring (Construction and Post Monitoring)

Environmental Aspect	Description	Frequency and record keeping method
Planning Phase		
Alien removal plan	The Contractor must submit a plan 45 days before site establishment for review by KBK Engineers and ECO if required	• Once off, 45 days before site establishment • ECO and Contractors 's Environmental file
Alien removal plan approval	KBK/ECO must approve Alien removal plan before site establishment	• Once off, before site establishment
Site control	The construction must remain demarcated with appropriate fencing. These areas are no-go areas (this must be explained to all staff) that must be excluded from all development activities	• Daily, as, and when necessary • Bi weekly inspection for the first 2-3 weeks after establishment of vegetation
	Alien vegetation regrowth must be controlled throughout the entire site during the construction period	• Daily, as and when necessary

Environmental Aspect	Description	Frequency and record keeping method
Approval of clearance	The ECO is to approve all vegetation clearance prior to clearing commencing for the proposed development.	• Daily, as, and when necessary • Weekly inspection for the first 2-3 weeks after establishment of vegetation
Management of vegetation clearance	Only vegetation within the development footprint may be cleared and must take place as construction progresses on site. Mass clearing is not allowed unless the entire cleared area is to be rehabilitated immediately.	• Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
Herbicide Management	Cleared areas that have become invaded with alien invasive species can be sprayed with appropriate herbicides provided that these are such that they break down on contact with the soil. Residual herbicides should not be used. Such must be undertaken by a qualified specialist Pesticides may not be used. Herbicides may be used to control listed alien weeds and invaders only.	• Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
Management and Control Alien vegetation	Surveys for alien species should be conducted weekly until end of construction. All aliens identified should be removed from site.	• Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
	Care must be taken to avoid the introduction of alien plant species to the site and surrounding areas. (Particular attention must be paid to imported material such as building sand or dirty earth-moving equipment.) Stockpiles should be checked regularly and any weeds emerging from material stockpiles should be removed.	• Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
	Clearing activities must be contained within the affected zones and may not spill over into demarcated No Go areas.	• Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
Access control	Alien vegetation regrowth must be controlled throughout the entire site during the construction period	• Weekly inspection for the first 2-3 weeks after establishment of vegetation • Photographic record
Post Construction (Rehabilitation)		
Rehabilitation	Revegetation with indigenous, locally occurring species should take place in areas where natural vegetation is slow to recover or where repeated invasion has taken place	• Once off, post construction
	No alien species should be cultivated onsite. If vegetation is required for aesthetic purposes, then non-invasive, water-wise locally occurring species should be used.	

Environmental Aspect	Description	Frequency and record keeping method
	The Contractor is responsible for the control of weeds and invader plants within the mining footprint for the duration of the rehabilitation phase. Removing of alien invasive species from the fence line.	• Monthly, post construction
	Cleared sites will thus have to be constantly monitored, and as soon as a seedling can be identified as alien invasive species, these must be pulled out by hand.	• Monthly, post construction

3. ALIEN INVASIVE SPECIES MANAGEMENT PLAN

Any land management programme in South Africa will inevitably include an alien plant control program. Alien control programs are essential to protect valuable resources such as economically viable agricultural land, surface and ground water, biodiversity, and the beautiful landscapes of our country. An alien control program however requires a high level of commitment, coordination between landowners and authorities, professional planning and implementation and a good dose of common sense. Competent land managers are essential for cost effective and professional implementation programmes. The guidelines provided are compiled from a wide source and will hopefully provide insight to land managers in order for financial and human resources to be effectively used in an integrated control programme.

4. REFERENCES

1) Bromilow C. (2010) Problem Plants and Alien Weeds of South Africa, Briza Publications

2) Field and Form Landscape Science. 2020. Terrestrial Biodiversity Assessment for the Proposed Quarries as part of the Upgrade of Provincial Road R573 (K139/ Moloto road), City of Tshwane, Gauteng province – Quarry 4

3) Hoare, D. (2014). Vegetation Rehabilitation Plan Longyuan Mulilo Maanhaarberg Wind Energy Facility, De Aar, Northern Cape.

4) *http://www.dwaf.gov.za/wfw*

5) Mucina, L. & Rutherford, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

6) Van der Meulen, F. 1979. Structural Analysis of Bushveld Vegetation in Transvaal, South Africa. *Journal of Biogeography*, 7(4): 337 - 348.

7) Van Rooyen, N. 1983. Die plantegroei van die Roodeplaatdam-natuur-reservaat. II. Die plantgemeenskappe. *South African Journal of Botany*, 2: 115 - 125.

8) Van Rooyen, N. 1984. 'n Fenologiese studie van die plantegroei van die Roodeplaatdam-natuurreservaat. D.Sc. thesis, Department of Botany, University of Pretoria.

9) Panagos, M. D., Westfall, R. H., Van Staden, J. M. and Zacharias, P. J. K. 1998. The plant communities of the Roodeplaat Experimental Farm, Gauteng, South Africa and the importance of classification verification. *South African Journal of Botany*, 64: 44 – 61.