JAN JACOB DE CLERCQ VAN ZYL

PROSPECTING RIGHT

PROPOSED PROSPECTING OF SILLIMANITE ON PORTION 1 OF THE FARM WORTEL NO 42, KHAI MA LOCAL MUNICIPALITY, NAMAKWA DISTRICT MUNICIPALITY, NAMAQUALAND MAGISTERIAL DISTRICT, NORTHERN CAPE PROVINCE

ALIEN INVASIVE MANAGEMENT PLAN

REFERENCE NUMBER	**NC 30/5/1/1/2/12145 PR**
DATE: April 2021	

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EXECUTIVE SUMMARY

Jan Jacob de Clercq Van Zyl (JJCVZ) applied for a prospecting right on Portion 1 of the farm Wortel No 42 (excluding a 5ha area), which falls in the Khai Ma Local Municipality, Namakwa District Municipality, and Namaqualand Magisterial District, Northern Cape Province.

The farm Wortel 42 is situated approximately 74,7km west of Pofadder and 148km east of Springbok, Northern Cape Province. The commodity of interest is Sillimanite (SI).

DESCRIPTION OF PLANNED NON-INVASIVE ACTIVITIES:

(These activities do not disturb the land where prospecting will take place, e.g. aerial photography, desktop studies, aeromagnetic surveys, etc.)

Phase 1 (month 0 to 4)

- Desktop Studies
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- Spatial Database Compilation
  Spatial information will be compiled into a GIS database for access, correlation and evaluation. The GIS system will be used and maintained for the period of the prospecting right exploration program and regularly updated as new information is generated by the exploration program.

- Land Survey
  All spatial information accessed and collected in the field will be standardized using the WGS84 datum.

- Remote Sensing
  As part of the initial review, public domain aerial photos will be acquired and a detailed geological and structural interpretation will be done on these to aid in identifying target areas that are not readily evident on the ground and to provide an independent interpretation of the geology of the area. Satellite imagery will also be acquired to provide a more regional viewpoint of the area of interest. As before a detailed geological and structural interpretation will be done on these images to provide a more regional viewpoint on the target areas. Satellite imagery is used to complement the aerial photos interpretations as the combination of multi-spectral bands can be used to highlight certain lithology's, vegetation types, soil types, alteration minerals, etc.

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(These activities result in land disturbances e.g. sampling, drilling, bulk sampling, etc.)

Phase 2 (month 5 to 16) and Phase 3 (month 17 to 24).

- Drilling:

  The exact location where drilling will be carried out will be determined by the results of geophysical and geological work carried out in Phase 1 of the prospecting programme. It will be assumed that a drill hole will be located in intervals of 350 meters (measured resource as per SAMREC code) with no more than 2 holes being actively drilled at any given time. The initial holes will be drilled on the Prospecting area that forms part of this application. All drill holes will be approved by the team's environmental manager prior to approval thereof. The environmental management plan related to this project will consider environmental sensitivities and advise on the location of drilling holes. By the quarter of exploration, there will be clearly defined targets that will warrant testing by diamond, reverse circulation or percussions drilling. It is envisaged that a combination of HQ (63.5 mm) and NQ (47.63 mm) drilling will be used to drill targets. The core will be logged, cut and sampled at a core yard to be located near the prospecting site. The samples will be crushed and milled and then analysed at an accredited laboratory in for Sillimanite quality. The resultant drill holes will be cased and capped to make it safe for people and animals, and also allow for future access by the exploration team.

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  All data obtained during the proposes activities will be digitally captures and already existing maps updated to form more detailed and accurate models of the study area.

  All findings and results of all prospecting activities will be drafted and explained within a geological report. The geological models created will be used for the purposes and also be included within the report. The report will be further included proven resources, reserve estimation, mineral economy as well as recommendations for future work to be done.

MAIN PROSPECTING ACTIVITIES:

- Dump site establishment:

  A dump site will be established that will require:
  - Clearing of vegetation for sumps and the drill entrance point;
  - Earth sumps for water recycling;
  - Laydown area for screening equipment, fuel and chemical storage;
  - Chemical toilets.
  - Rehabilitation of dump sites.

- Drill site establishment:

  A drill site of approximately 400 m² will be established that will require:
  - Clearing of vegetation for sumps and the drill entrance point;
  - Earth sumps for water recycling;
  - Laydown area for drill rods, fuel and chemical storage;
  - Chemical toilets.

- Drilling and removal of geological cores:

  Drilling a hole of approximately 110 mm in diameter and removing of rock core. Number of boreholes will be finalized once non-invasive prospecting is completed.

- Casing of boreholes:
  - 1m² per borehole.
  - Rehabilitation of drill sites.

DESCRIPTION OF PRE-/FEASIBILITY STUDIES:

(Activities in this section include but are not limited to: initial geological modelling, resource determination, possible future funding models, etc.)

The pre-/feasibility studies team will comprise of a diverse team of technical expertise in the field of mineral projects, including, geologists, mining engineers, metallurgical engineers, civil engineers, mechanical engineers, environmental scientists, marketing professionals and mineral project finance professionals. The list of activities under pre-/feasibility studies includes the following:

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- Metallurgical processing;
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- Human resourcing; and
- Project development and operational costing.

The prospecting site will contain the following:

- Surveying Equipment;
- Drilling equipment;
- Field Vehicles;
- Sample Analysis equipment; and
- Other relevant field equipment.

All diesel storage will be below the threshold as mentioned in the EIA regulation of the National Environmental Management Act, 1998, (Act No. 107 of 1998) as amended 2017. The proposed prospecting area will be reached via the existing gravel access roads to the farm, making use of the internal haul roads to access the material within the prospecting area.

JJCVZ will make use of temporary infrastructure during the prospecting operations. Prospecting only to be done in gravel roads, where no flora will need to be removed or disturbed. Workers will be transported to and from the site daily.

No alternatives regarding the preferred site, activities and technology is considered as the currently planning is to obtain the best possible option to ensure minimal environmental disturbance and cost effective prospecting operations.

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LIST OF DEFINITIONS

Invasive Alien Plant (IAP)	A plant species not indigenous to a location, area, or region, which has either been accidentally or intentionally introduced and whose presence threatens habitats, ecosystems or other species. Their presence may result in economic or environmental harm, or harm to human health.
Alien Species	A species that is not indigenous; or an indigenous species trans located outside its normal distribution range in nature, but that has not spread outside its normal range without human intervention.
Weed	Any plant, indigenous or alien, invasive or otherwise, which is growing where it is not desired.
Emerging weed	Plants with invasive tendencies already present outside of their natural distribution range, but not yet widely so. They often have horticultural value, but can impact negatively on natural ecosystems, biodiversity, livelihoods or human health if allowed to continue to expand to outside of their natural range and become naturalised.

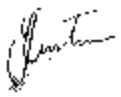
LIST OF ABBREVIATIONS

AIP	Alien Invasive Plants
AIP EDRR	Alien Invasive Plants Early Detection and Rapid Response
ARC-PPRI	Agricultural Research Council - Plant Protection Research Institute
ARC	Agricultural Research Council
CARA	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CEBA	Community-based Ecosystem Adaptation Programme (under EPCPD)
CRM	Crocodile River Mine
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EC	Electrical Conductivity
EMP	Environmental Management Plan
EMPr	Environmental Management Plan report
GIS	Geographic Information System
GPS	Garmin Global Positioning System
IAP	Invasive alien plant
IAPs	Interested and Affected Parties
MPRDA	Mineral Petroleum Resource Development Act
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NEMWA	National Environmental Management Waste Act
NWA	National Water Act
PPE	Personal Protective Equipment
ROM	Run of Mine
SANS	South African National Standards
SANBI	South African National Biodiversity Institute
SLP	Social and Labour Plan
Stats SA	Statistics South Africa
ToR	Terms of Reference

I. DECLARATION OF INDEPENDENCE

I, **Yolandie Coetzee,** in my capacity as a specialist consultant, hereby declare that I:-

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of this project, other than remuneration for the work performed in terms of the National Environmental Management Act 107 of 1998;
- Have and will not have vested interest in the proposed activity nor will I engage myself in any conflicting interest associated with this project
- As a registered member of the South African Council for Natural Scientific Professions, I will undertake my profession in accordance with the Code of Conduct of the Council as well as other associates to which I am a member;
- I undertake to disclose and provide to the competent authority any material or information at my disposal regarding this project as required in terms of the National Environmental Management Act 107 of 1998;
- Based on the information provided to me by the client and in addition to information obtained during the course of this study, I have presented the results and conclusion with regard to this project to the best of my professional ability;
- I reserve the right to modify aspects pertaining to this study should additional information become available through ongoing research and further work on this field;
- I undertake to have my work peer reviewed on a regular basis by a competent specialist in the field of study.



II. CLIENT REVIEW AND COMMENT

I reviewed and understand the contents of this report. I acknowledge that this Alien Invasive Management Plan is a work in progress.

NB: The proposed control methods are only recommendations based on information available to the environmental consultant at the time. The environmental consultants employed at Greenmined Environmental are not registered Pest Control Operators (PCO) and in the circumstances the site should ensure that the expert advice and opinion of a registered PCO is sought prior to the commencement and implementation of control methods pertaining to invasive species.

_____ _____

Print Name **Signed**

_____

Date

1. INTRODUCTION

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1.1. Status of Study Area

The study area is located in a sparsely populated location whose land use feature is mainly agricultural farms. Invasive species know no boundaries; they span landscapes, land ownerships and jurisdictions. Their consequences cost the country / public millions of rands each year (ARC-PPRI, 2007). They are a significant drain on the national economy. Private landowners and small communities are some of the hardest hit by invasive species infestations. They can be exceptionally damaging in urban environments where ecological systems are already stressed. Invasive species threaten the quality of life and the property values of millions of metropolitan residents across the country. Alien invasive plant species populations have depleted water supplies, poisoned wildlife and livestock, and directly impacted thousands of hectares of natural forests and rangelands. Public recreational opportunities and experiences have become severely degraded by rapid infestations of invasive species, in many cases hampering access, reducing recreational quality and enjoyment, and decreasing the aesthetic values of public lands.

Control of invasive plant species and weeds is an important aspect during all phases of the proposed activities. Therefore, an alien invasive management plan was developed for the site to be implemented during the site establishment-, operational-, decommissioning phase and 12 months' aftercare period of the prospecting activity.

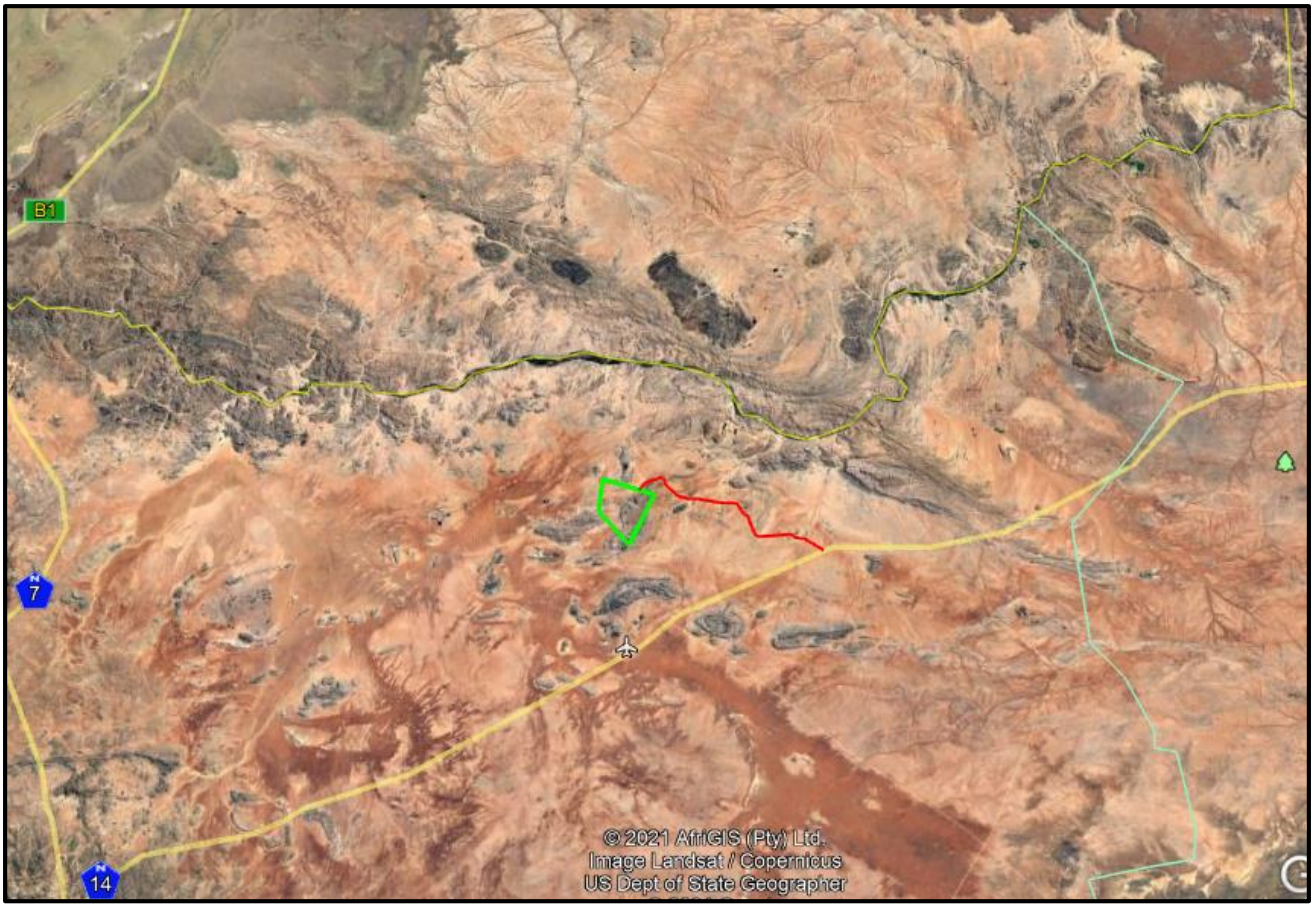

Figure 1: Regional Location of the proposed prospecting area

1.1.1. Vegetation of study area

The prospecting area is situated within the Desert Biome. The vegetation consists of Eastern Gariep Plains Dessert and Eastern Gariep Rocky vegetation types (Dg 9 and Dg10 according to Mucina and Rutherford, 2006). The area is not conserved in statutory conservation areas. Few intact examples of this vegetation still exist. The target conservation of this area is at 34%.

The dominant species outside the disturbed area is covered by sparse open grassland, with prominent *Stipagrostis* grass species, along with scattered drought resistant dwarf shrubs. No protected plant species could be identified at the time of the site inspection.

The eastern gariep plains desert consist out of often sloping plains, sharply contrasting with the surrounding rocky hills and mountains. Typical wash vegetation n in the breaks between the mountains to the Orange River Grassland dominated by “white grasses”, some spinescent (*Stipagrostis* species), on most of the flats with additional shrubs and herbs in the drainage lines or on gravellier or loamy soil next to the mountains.

The Eastern gariep rocky desert consist out of hills and mountains with mostly bare outcrops and covered with very sparse shrubby vegetation in crevices. Separated by broad sheet-wash plains (Dg 9). Habitats are mainly controlled by the topography, aspect, local climate and lithology. On the groot Pellaberg for example there is a sparse shrubland on the southern foothills (*Aloen dichotoma, Rhigozum trichtomum and Petalidium setosum*) and a higher cover of plants in the southern ravines and rocky drainage lines. (*Abutilon pycnodon, Asparagus suaveoles, Ficus cordata, Rhus populifolio and R. viminalis*). On the higher southern slopes *Justicia orchioides* is often very dominant, with localised grassland directly between steep cliffs (*Enneapogon scaber, Troroa [his ramosissima and Danthoniopis ramosa*). The south facing quartzite cliffs and steep slopes support chasmophytes (cremnophytes) such as *Ficus ilicina, Aloe dabenorisana and Bowiea gariepensis*. On the summits and higher northern slopes there is a much higher preponderance of succulent plant inlcudeing *Euphorbia avasmontana, Aloe dictoma, A. microstigma subsp microstigma, Pelargonium aridium and Kleinia longiflora*. Succulent plant are also important on the northern foothills and also include *Aloe dichotoma, Euphorbia avasmontana, Sarcostemma viminale* and the diminutive *Lapidaria margarethae*.

Conservation Areas

Target 34%. None conserved in statuary conservation areas. Few intact examples of this vegetation remain. Heavy grazing and arid climate combined with the ease of accessibility of the vegetation to stock mean that pastoral activities in the past have significantly altered the structure and composition of vegetation of this unit. In some areas *Prosopis* shows potential to become a serious problem, especially around natural springs or aquifers. Some very restricted areas are cultivated, mainly with date palms and grape vines. This unit also occurs north of the Orange River in Namibia where it is potential conserved through the ownership of the farms tsams by the Namibian ministry of environment and tourism.

The project areas fall within the Bushmanland Nama Karoo biome and is dominated by annuals and non-succulent shrubs. In the sandier part of the region the vegetation is dominated by Cauliflower Ganna (*Salsola turbulata*) and after good summer rains by Small Bushman Grass (*Stipagrostis obtuse*) and Tall Bushman Grass (*Stipagrostis ciliate*). The rockier areas, Thorny Kopokbus (*Eriocephalus spinescens*) and especially Threethorn (*Rhigozum trichotomum*), are important species. Scattered individuals of Quiver tree and abundant Bloubos (bluebush) species were seen during the field visits. There are no protected areas in this region.

Species of Conservation Concern / Red Data Species

According to Marsh *et al.* (2009) a total of 854 plant species have been recorded in the Khai Ma Local Municipality area. As many as 41 species are known to be endemic to the area and a further 20 are potentially endemic. Many of the most special plants can be found within the fine grained quartz patches – an area that typically contains a number of special dwarf succulents (Marsh *et al.* 2009).

The Bushmanland Inselbergs are a remarkable feature of this landscape. In total, this 31,400- hectare area includes 429 plant species, of which 67 are found only in this hotspot and 87 are Red List species (Marsh *et al.* 2009).

A Threatened Species and Species of Conservation Concern list was obtained from the POSA database on the SANBI website. Threatened species are those that are facing high risk of extinction, indicated by the categories Critically Endangered, Endangered and Vulnerable. Species of Conservation Concern include the Threatened Species, but additionally have the categories Near Threatened, Data Deficient, Critically Rare, Rare and Declining. This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009).

Table 1: Species of Conservation Concern (SANBI website, Quarter degree square Grid 2918BB)

Family	Species	Status	Endemic
Amaryllidaceae	*Brunsvigia herrei* F.M.Leight. ex W.F.Barker	VU	NO
Mesembryanthemaceae	*Lithops olivacea* L.Bolus	VU	YES
Mesembryanthemaceae	*Conophytum limpidum* S.A.Hammer	NT	YES
Apocynaceae	*Hoodia gordonii* (Masson) Sweet ex Decne.	DDD	NO
Amaryllidaceae	*Brunsvigia namaquana* D.& U.Müll.-Doblies	DDT	NO
Mesembryanthemaceae	*Drosanthemum godmaniae* L.Bolus	DDT	YES
Mesembryanthemaceae	*Trichodiadema obliquum* L.Bolus	DDT	YES
Crassulaceae	*Adromischus diabolicus* Toelken	Rare	YES
Crassulaceae	*Crassula exilis* Harv. subsp. *exilis*	Rare	YES
Eriospermaceae	*Eriospermum pusillum* P.L.Perry	Rare	YES
Hyacinthaceae	*Lachenalia polypodantha* Schltr. ex W.F.Barker	Rare	YES
Mesembryanthemaceae	*Cephalophyllum staminodiosum* L.Bolus	Rare	YES
Fabaceae	*Acacia erioloba* E.Mey.	Declining	NO

In addition to the list above, *Aloe dichotoma* Masson (Vu) are also found within the area. The majority of the threatened species and species of conservation concern may potentially occur on the rocky inselbergs and/or quartz plains. The only protected tree which may occur within the area is *Acacia erioloba* (Camel Thorn). This tree may be present within the prospecting area on the sandy plains, but has not been observed during the site investigation. A further protected species is the halfmens *Pachypodium namaquanum.* The majority of succulent plants are classified as protected plant species.

It can be concluded that although no statutory conservation area exists within the distribution range of the identified vegetation type, very little of the area has been transformed. A local exception is the mine area close to Aggeneys, where mining infrastructure and mine dumps, and also residential areas, transformed some areas. The proposed prospecting area is situated in an area of biodiversity importance. The most important areas are the Inselbergs, including their quartz gravel foot slopes. The dry grassy plains are of relatively less biodiversity importance. Although the proposed prospecting campaign will not result in a progressive loss of ecological sensitive and important habitat units or ecosystem functioning, the areas identified as being of high ecological sensitivity must be avoided and the proposed activities must be in accordance with the conservation policies of the relevant authorities.

Table 2: Important Taxa of the area.

Important taxa		
Succulent Trees		
Aloe dichotoma		
Small Trees		
Parkinsoina africana	*B.foetida*	*Ehretia rigida*
Boscia albitrunca	*Terminalia sericea*	*Acacia melifera*
Euclea pseudebenus	*Maerua gilgii*	*Papea capensis*
Stem & Leaf succulent Shrubs		
Brownanthus pseudoschilichtianus	*Psilocaulon subnodosum*	*Ceraria fruticulosa*
Ruschia barnardii		
Stem succulent shrub		
Euphorbia gregaria	*Ceraria namaquensis*	*Commiphora capensis*
C.cervifolia	*C.gracilifrondosa*	*C.namaensis*
Euphorbia avasmontana	*E. friedrichiae*	*E.gariepina*
E.guerichiana	*E.virosa*	
Other Shrubs		
Sisyndite spartea	*Adenolobus gariepensis*	*Antherothamnus pearsonii*
Apotosimum tragacanthoides	*Barleria lancifolia*	*B.rigidia*
Cadaba Aphylla	*Calcicorema capitata*	*Diospyros acocksii*
Dyerophytym africanum	*Eriocephalus scariosus*	*Hermania stricta*
Justica orchoides	*Monechma mollissimum*	*Petalidium setosum*
Rhigozu, obovatum	*Rhus populifoila*	
Perennial Herbs		
Codon royenii	*Rogerria longiflora*	
Chascanum garipense	*Tribulus cristatus*	
Annual Herbs		
Cleome angustifolia subsp diandra	*C.foliosa var lutea*	
Succulent Herb		
Mesembryanthemum guerichianum		
Leaf Succulent Shrubs		
Zygophyllym microcarpum	*Aloe dabenorisana*	*A.gariepensensis*
Mesembryanthhemum inachabense	*Prenia tetragona*	*Triantheme parvifolia*
Tylecodon rubrovenosus	*Zygophyllum decumbens*	*Z.rigidium*
Other shrubs		
Sisyndite spartea	*Calicorema capitata*	*Gailonia crocyllis*
Hermbstaedia glauca	*Monechma spartioides*	*Petaliduium setosum*
Geophytic Herb		
Boweia garipeensis		
Graminoids		
Schmidtia kalahariensis	*S. obusta*	*Stipagrostis ciliata*
Stipagrostis obusta	*Enneapogon scaber*	

Endemic Taxon

The small tree *Ozoroa namaquensis and the leaf succulent dwarf shrub Tylecodon suplhurreus* is endemic to the region.

The study site is located within the area of jurisdiction of the Khai Ma Local Municipality (KMLM). The KMLM comprises virtually the entire extent of the Bushmanland Inselberg priority area. The latter is one of the nine zones identified through the Succulent Karoo Ecosystems Project (SKEP) process as important conservation areas in the Succulent Karoo. Inselbergs are important refugia for plants and animals and act as steppingstones for rock-loving species migrating east west across the sand-covered plains of Bushmanland. The isolation of populations has led to diversification within the dwarf succulent shrublands, creating remarkable local populations of plant life. The area is unique, containing many rare and fragile habitat types. These unique and confined areas are host to a remarkable number of endemic plants (Marsh et al. 2009).

According to SANBI & DEAT (2009) none of the ecosystems occurring on the prospecting area are considered as threatened ecosystems. Nonetheless, the areas north of Aggeneys are considered as Critical Biodiversity Areas (CBAs) within the Namakwaland District. The main vegetation types occurring on the prospecting area are classified in terms of Mucina & Rutherford (2006), as Eastern Gariep Plains Desert and Eastern Gariep Rocky Desert. An additional unit is the Dry Drainage Lines (Spruits).

According to the Mining and Biodiversity guidelines (as presented in Figure 20) the prospecting area does fall within the Mining and Biodiversity area. Areas that are highlighted in brow falls within the High biodiversity importance area which have a high risk for mining (DEA, 2013). Although the site is situated within an area characterized by areas classified as of moderate to highest biodiversity importance, the nature and scale of the proposed prospecting activities is such that it cannot be considered as a threat to biodiversity. Proper planning and the implementation of management measures, though the implementation of this EMP will prevent and alleviate potential impacts on biodiversity. However, buffer areas around drainage areas must be observed. No prospecting may occur within 30 m from identified drainage lines.

Table 3: All categories of biodiversity priority areas in relation to their biodiversity importance and implications for prospecting

Category	Biodiversity property areas	Risk for mining	Implications for mining
Highest Biodiversity Importance	• Critical endangered and endangered ecosystems • CBA form provincial and spatial biodiversity plans • River and wetlands FEPAs and a 1km buffer around these FEPA's • Ramsar sites	Highest risk for mining	• Environmental screening, EIAs and their associated specialist studies should focus on confirmed the, and to provide site specific basis on which to apply the mitigation hierarchy to inform regulatory decision making for mining, WULA's, and EA's. • If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significant of the biodiversity features in these areas and the associated ecosystems services. These areas are viewed as necessary to ensure protection of biodiversity, environment, sustainability and human wellbeing. • An EIA should include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should take fully into account the environmental sensitivity if the area, the overall environmental and socio-economic cost and benefits of mining, as well as the potential strategic importance of the minerals to the country. • Authorisations may well not be granted. If granted, the authorization may set limits on the allowed activities, impacts, and may specify biodiversity offset that would be written into licence agreements and/or authorizations.
High Biodiversity Importance	• Protected area buffers (including buffers around National Parks, World Heritage Sites* and Nature Reserves) • Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas) • Other identified priorities from provincial spatial biodiversity plans • High water yield areas are possible. • Coastal Protection Zone • Estuarine functional zone • *Note that the status of buffer areas of World Heritage Sites is subject to a current intra-governmental process.	High risk for mining	• High risk for These areas are important for conserving biodiversity, for supporting or buffering other biodiversity mining biodiversity priority areas, and for maintaining important ecosystem services for particular importance communities or the country as a whole. • An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. • Mining options may be limited in these areas, and limitations for mining projects are possible. • Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorizations.

Moderate Biodiversity Importance.	• Ecological support areas • Vulnerable ecosystems • Focus areas for protected area expansion (land based and offshore protection)	Moderate risk for Mining	• These areas are of moderate biodiversity value. • EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. • Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorizations.

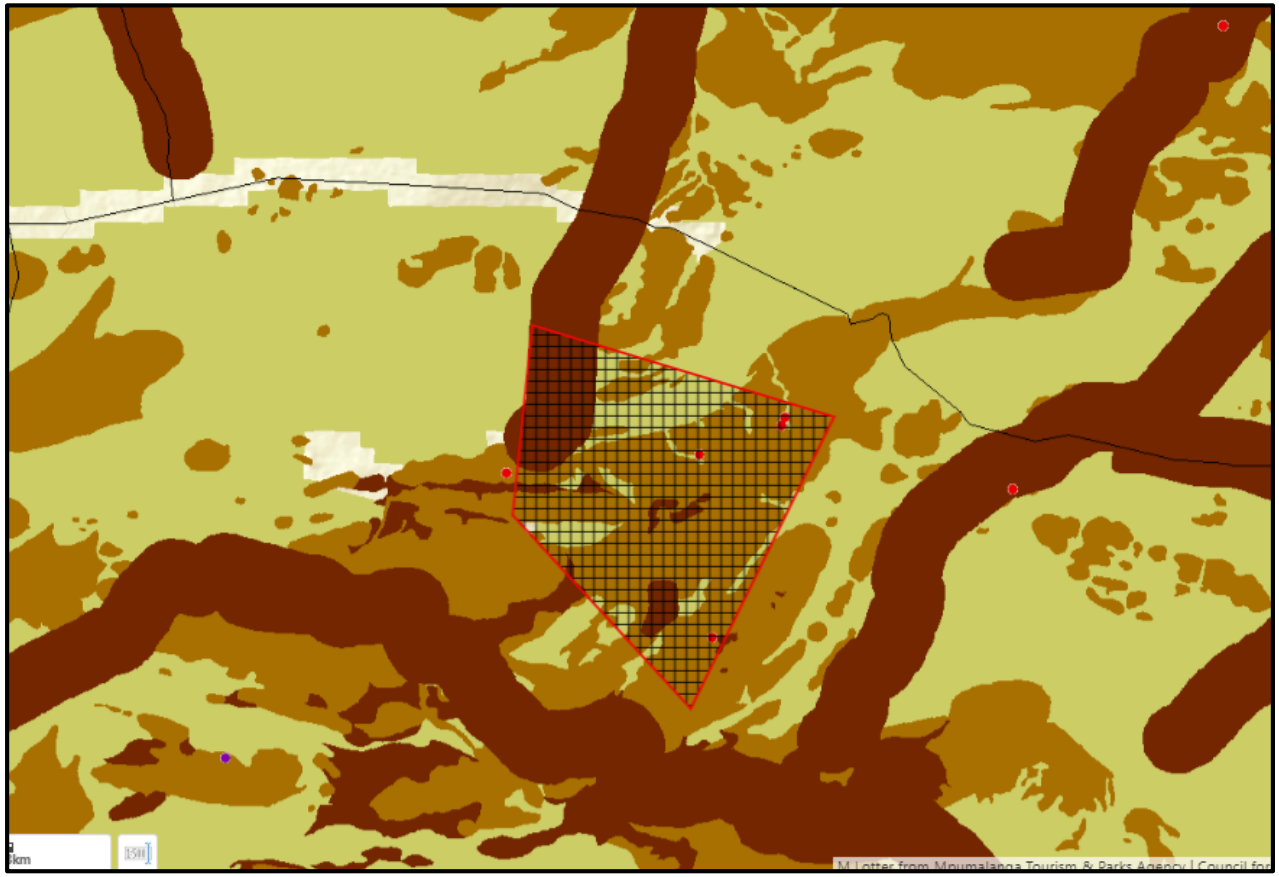

Figure 2: Mining and Biodiversity Guidelines Map (SANBI) (DEA, 2013).

The primary threats to Biodiversity, ecosystem goods and services are habitat transformation and degradation, and invasive alien species. The concern regarding threats to biodiversity is borne out of the recognition that our natural resources base provides a variety of goods and services on which life depends. In Khâi-Ma this natural resource base is directly threatened by mining developments. The management of these is critical in ensuring effective conservation and sustainable use of the biodiversity. Again making the need for Environmental Conservation and Management Plans as well as Plans to eradicate and monitor Alien Invasive Species very important for Khâi-Ma.

1.1.2. National List of Threatened Terrestrial Ecosystems for South Africa (2011)

The National threatened ecosystem classification is based on Mucina & Rutherford's map of 2006. The vegetation types of South Africa have been classified according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are as depicted in the table below, as determined by best available scientific approaches (Driver *et al.* 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al.* 2005).

Table 4: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

Threatened ecosystems which are in need of protection (GN1002 of 2011), was published under the National Environment Management: Biodiversity Act (Act No. 10 of 2004). It lists national vegetation types that are afforded protection on the basis of rates of transformation. The threshold for listing in this legislation is higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM: BA) provides for listing of threatened or protected ecosystems, in one of four categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed in order to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value (SANBI, BGIS).

Table 5: Conservation status of the vegetation types occurring in and around the study area.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation Status	
				Driver *et al*., 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEM:BA)
Bushman land Arid Grassland vegetation type (NKb)	21%	Augrabies Falls National Park Goegap Nature Reserve	Very Little	Least Threatened	Not Listed

The National threatened ecosystem classification is based on Mucina & Rutherford's map. According to the National List of Threatened Terrestrial Ecosystems (2011) the project site **does not** fall in a threatened ecosystem although the project site is in a transformed state due to anthropogenic influences.

1.1.3. Vulnerable ecosystems and habitats

Invasive alien plants threaten three main components of the landscape:

- Agricultural potential of the land;
- Biodiversity value of the land; and
- Water quality and quantity.

Some habitats are more vulnerable to invasion by alien plant species than others and are therefore more likely to become problematic areas with respect to management of alien plant species. In addition, some parts of the site will be subject to greater levels of disturbance than others, which will promote conditions suitable for invasion by alien plant species. Although any parts of the site could become invaded by alien plants, the areas on site that are most likely to be problematic from the point of view of invasion by alien plants are as follows:

- Drainage lines and watercourses;
- Areas with deeper soils, including primarily valley bottom areas;
- Areas immediately adjacent to any disturbance due to mining activities;
- Areas prone to increased runoff following mining activities, for example spoil material; and
- Areas of prolonged disturbance, for example, construction camps and laydown areas.

Most of the information was gathered from the Department of Water and Sanitation (DWS), the Agricultural Research Council (ARC) and the Working for Water web-sites. There are around 379 listed alien invasive species, which have been listed as Category 1, 2 or 3 alien invasive species in the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) and Category 1a and b, 2 and 3 under the National Environmental Management Biodiversity Act (NEM:BA). This clearly does not include all the exotic species that can be found in South Africa, which would go into the thousands of species, but lists the species which have become problematic within South Africa and require attention and control.

This document focuses mainly on alien invasive species which are listed under legislation and that are typically associated with the Savannah Biome or those that have in the past been observed within JJCVZ boundaries. Other problem plants, whether exotic or indigenous species known as indicators of bush encroachment, on the property, have also been included where relevant, but do not form the focus of this document. The document has been compiled in such a way that other species can be added, should they be discovered on the properties concerned, or should they become problematic plants within the area.

The format includes a summary on the legislation, a brief overview of the problems associated with alien invasive species establishment, various control and eradication methods available, a list of chemicals that are registered and can be utilised against alien invasive species and information sheets for the alien invasive species of concern.

Lack of knowledge about how invasive species function in their new environment, significantly inhibits the ability to detect and eradicate new or small infestations. Efforts to find and eliminate new infestations are hampered by the lack of an effective early warning and rapid response systems. In addition, there is a shortage of safe and effective techniques to limit the impact on non-target areas or sensitive natural species. Furthermore, control efforts can be hampered when they extend across multiple political jurisdictions and ownerships especially in urban areas. Rehabilitation and restoration efforts require new and expanded sources of endemic plant materials and improved techniques to repair damaged ecosystems.

1.2. Reference Documents

The following list of documentation was reviewed prior to the audit and was used to formulate the objectives for the AIP management plan:

I. Alien and Invader Species Regulations, 2014 (as amended 2016) (AIS)
II. National Environmental Management Act No. 107 of 1998 (as amended) [NEMA];
III. National Environmental Management: Biodiversity Act No. 10 of 2004 [NEMBA];
IV. National Water Act No. 36 of 1998 [NWA];
V. Conservation of Agricultural Resources Act No. 43 of 1983 (as amended) [CARA];
VI. Fertiliser, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947) (as amended);
VII. The Department of Water Affairs and Forestry Environmental Best Practice Specifications of 2005; and
VIII. Policies on alien invasive eradication methods.

2. OBJECTIVE

This document describes the potential sources of AIP infestation and provides a method for their control and management. Furthermore, it aims to provide methods to minimise and also monitor the AIPs infestation as a result of vegetation clearance due to the activity.

The primary objective of this document is to provide a AIPs control and management plan that focuses on AIPs control measures to be implemented by the client on the site.

This objective will be met through the implementation of the management measures specified in this plan, including:

- Effective management of existing alien species;
- Control and rehabilitation of open or unused areas at the site where possible; and
- Minimize re-invasion through preventative measures such as regular monitoring and planting of plant species like grasses in open areas.

3. WHAT ARE ALIEN INVASIVE PLANT SPECIES?

According to the book, Problem Plants of South Africa (Bromilow, 2001) a weed is a plant in the wrong place at the wrong time. Problem plants are described as vigorous growers that are easily adaptable and mostly exotic or foreign in origin. Weeds usually are pioneer plants that invade disturbed areas such as stockpile areas, overburden and topsoil stockpiles and firebreaks. Invasive plants are plants that have been imported and has the ability to invade the natural vegetation.

Alien invasive plants and alien invasive infestations have several repercussions, which includes environmental, social and economic. Some of the more obvious issues are:

- They absorb and transpire a large amount of water, which gets wasted and removed for utilisation by other water users. This leads to reduction in water flow if in the vicinity of water bodies and alters aquatic ecosystems.
- In situations where the invasive species are very close to watercourses the plants may alter riverbanks and highly increase the potential of erosion, which could impact on the integrity of the stream or river and alter flood lines. This has negative consequences on associated ecosystems and all downstream water users.
- Large stands of alien invasive species result in loss of land which may potentially be productive resulting in associated negative economic and social impacts.
- Large infestations also reduce the land, which would otherwise be inhabited by indigenous species. This has implications for ecology, where biodiversity is directly impacted and socially, where natural resources that could have been harvested are no longer present.
- Alien invasive species consist of dry material, which causes fire hazards with regard to fire intensities in areas where natural fire incidences are not frequent or intense.

The benefits, therefore, of eradicating and controlling alien invasive species would extend to the social, economic and environmental aspects of South Africa.

Invasive species have been characterized as a “catastrophic wildfire in slow motion”. Thousands of invasive plants have infested hundreds of millions of hectares of land and water across the country causing massive disruptions in ecosystem function, reducing biodiversity and degrading ecosystem health. Forests, mountains, wetlands, rivers health and functioning have been affected by plant invasion which outcompete indigenous or endemic plant species and drain the water resources.

A species is considered invasive if it meets these two criteria:

- It is non-native to the ecosystem under consideration; and
- Its introduction causes or is likely to cause economic or environmental harm or harm to human health.

Annexure 1 of this document highlights listed alien invasive species common in the Nama-Karoo Biome (Bushman land Grassveld) and those that have been identified on the property that need to be eradicated and controlled and eradication and control methods that can be applied.

4. LEGAL FRAMEWORK

4.1. National Acts

4.1.1. The Constitution of the Republic of South Africa Act (Act No. 108 of 1996) – Section 24

The Constitution is South Africa’s overarching law. It prescribes minimum standards with which existing and new laws must comply. Chapter 2 of the Constitution contains the Bill of Rights in which basic human rights are enshrined. Section 24 of this chapter states that “*Everyone has the right to an environment that is not harmful to their health or well-being and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*.”

Government's commitment to give effect to the environmental rights enshrined in the Constitution is evident from the enactment of various pieces of environmental legislation since 1996, including the National Water Act, the National Environmental Management Act, etc.

4.1.2. National Environmental Management Act (Act No. 107 Of 1998) (NEMA), As Amended

NEMA replaces a number of the provisions of the Environment Conservation Act, 1989 (Act No. 73 of 1989). The Act provides for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for coordinating environmental functions. The principles enshrined in NEMA guide the interpretation, administration and implementation of the Act with regards to the protection and / or management of the environment. These principles serve as a framework within which environmental management must be formulated. Section 2(4) specifies that *"sustainable development requires the consideration of all relevant factors including the following aspects specifically relevant to biodiversity":*

- The disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimized and remedied;
- The development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardized;
- A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- Negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimized and remedied.

The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.

Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Of particular importance are the Environmental Impact Assessment (EIA) regulations of the Act, which identify activities that may have a substantial detrimental effect on the environment. The identification of these activities results in the activity being prohibited unless the competent authority has granted a written authorization after the consideration of an environmental impact assessment or basic assessment.

4.1.3. Conservation of Agricultural Resources Act (Act No. 43 Of 1983) (CARA)

South Africa has numerous problematic alien invaders, such as black wattle, lantana and queen of the night. CARA sets out to combat invasive plants. The Act categorizes weeds into three categories, with varying degrees of action required for each category of weeds. CARA is currently in the process of being revised. In addition the new regulations on alien and invasive species for the National Environmental Management: Biodiversity Act (NEMBA), Act 10 of 2004 has been published on 1 August 2014.

The Conservation of Agricultural Resources Act, No. 43 of 1983, (CARA) as amended in March 2001, sets out the regulations regarding the control of invasive plants and weeds under Regulations 15 and 16 and provides lists of species declared as invasive plants and indicators of bush encroachment. The Regulations classify the listed alien invasive plants into three categories. The categories can be described as follows:

Category 1 (CARA) plants are alien invasive species and must be eradicated and controlled. These species have little economic or social value and there invasive habits outcompete indigenous species, severely alter ecosystems and threaten local biodiversity.

Section 15A of CARA states that:

1) Category 1 plants may not occur on any land or inland water surface other than in biological control reserves.
2) A land user shall control any Category 1 plants that occur on any land or inland water surface in contravention of the provisions of sub-regulation (1) by means of the methods prescribed in regulation 15E.
3) No person shall, except in or for purposes of a biological control reserve –
    a. establish, plant, maintain, multiply or propagate Category 1 plants;
    b. import or sell propagating material of Category 1 plants or any Category 1 plants;
    c. Acquire propagating material of Category 1 plants or any Category 1 plants.
4) The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with the requirements of sub-regulation (1) on such conditions as the executive officer may determine in each case.

Category 2 (according to CARA) species have commercial or utility value and may only be grown in demarcated areas, in a controlled manner and under a permit.

Section 15B of CARA states that:

1) Category 2 plants may not occur on any land or inland water surface other than a demarcated area or a biological control reserve.
    a. The executive officer may on application in writing demarcate an area as an area where Category 2 plants may occur, be established and be maintained.
    b. An area in respect of which a water use license for stream flow reduction activities has been issued in terms of section 36 of the National Water Act, 1998 (Act No. 36 of 1998) shall be deemed to be a demarcated area.
2) The executive officer shall demarcate an area for the occurrence, establishment and maintenance of Category 2 plants only if –
    a. The Category 2 plants in the area are cultivated under controlled circumstances; and
    b. The land user concerned has been authorised to use water in terms of the National Water Act, 1998 (Act No. 36 of 1998); and
    c. The Category 2 plants or products of Category 2 plants in the area are demonstrated to primarily serve a commercial purpose, use as a woodlot, shelter belt, building material, animal fodder, soil stabilisation, medicinal or other beneficial function that the executive officer may approve; and

d. All reasonable steps are taken to curtail the spreading of propagating material of the Category 2 plants outside the demarcated areas.

3) When an area is demarcated for the occurrence, establishment and maintenance of category 2 plants the executive officer may impose such additional conditions as may reasonably be deemed necessary to keep the Category 2 plants in the area in check.
4) No person shall sell propagating material of Category 2 plants or any Category 2 plants to another person unless such other person is a land user of a demarcated area or of a biological control reserve.
5) No person shall acquire propagating material of Category 2 plants or any Category 2 plants unless such material or such plants are intended for use in a demarcated area or in a biological control reserve.
6) Propagating material of Category 2 plants or Category 2 plants shall only be imported or sold in accordance with the provisions of the Plant Improvement Act, 1976 (Act No. 53 of 1976), the Agricultural Pests Act, 1983 (Act No. 36 of 1983) and the environment conservation regulations.
7) A land user shall control any Category 2 plants that occur on any land or inland water surface in contravention of the provisions of sub-regulation (1) by means of the methods prescribed in regulation 15E.
8) Unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland.
9) The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with one or more of the requirements of sub-regulations (1), (3), (5), (6), (8) and (9) on such conditions as the executive officer may determine in each case.

Category 3 (CARA) species often have ornamental value and may be grown where they currently exist but cannot be planted**,** propagated or traded.

Section 15C of CARA states that:

1) Category 3 plants shall not occur on any land or inland water surface other than in a biological control reserve.
2) Subject to the provisions of sub-regulation (3), the provisions of sub-regulation (1) shall not apply in respect of Category 3 plants already in existence at the time of the commencement of these regulations.
   a. No land user shall allow Category 3 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland.
   b. The executive officer may impose such additional conditions as may reasonably be deemed necessary with regard to Category 3 plants already in existence at the time of the commencement of these regulations.
   c. A land user must take all reasonable steps to curtail the spreading of propagating material of Category 3 plants.
   d. The executive officer may, after consultation with the land user, issue a direction in terms of section 7 of the Act that Category 3 plants in existence at the time of the commencement of these regulations must be controlled by means of the measures prescribed in regulation 15F.

3) No person shall, except in or for purposes of a biological control reserve –
   a. plant, establish, maintain, multiply or propagate Category 3 plants;
   b. import or sell propagating material of Category 3 plants or any Category 3 plants;
   c. Acquire propagating material of Category 3 plants or any Category 3 plants.
4) The executive officer may, on good cause shown in writing by the land user, grant written exemption from compliance with one or more of the requirements of sub-regulations (1), (3) and (4) on such conditions as the executive officer may determine in each case.

The National Department of Agriculture is responsible for administering the CARA regulations and landowners having alien invasive species on their property may be penalised. Penalties can be in the form of fines or imprisonment. It is therefore important to have an alien invasive management plan in place that aims at primarily eradicating and secondly controlling alien invasive species. It is also important to keep records of all procedures followed and to have photographic records, as many alien invasive species are difficult to completely eradicate.

4.1.4. National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA)

NEMBA provides for the management and conservation of biological diversity and components thereof; the use of indigenous biological resources in a sustainable manner; the fair and equitable sharing of benefits rising from bio-prospecting of biological resources; and cooperative governance in biodiversity management and conservation within the framework of NEMA. The Act also gives effect to international Strategic Review of the Status of Biodiversity Management in the South African Mining Industry agreements relating to biodiversity. The Act states that the Minister of Environmental Affairs and Tourism may identify any process or activity in a listed ecosystem as a threatening process and will, thereafter, be regarded as an activity contemplated in Section 24(2)(b) of NEMA which states that:

a) Specified activities may not be commenced without prior authorization from the Minister or MEC and specify such activities. This Act allows for any person, organization or organ of state to contribute to biodiversity management. Such a party may submit to the Minister a draft management plan for an ecosystem or species. Should the Minister approve the management plan, an agreement can be entered into regarding the implementation of the plan.
b) The NEMBA established the South African National Biodiversity Institute (SANBI) and gave it a mandate regarding monitoring, advising and co-coordinating biodiversity issues in South Africa.

The Alien and Invader Species (AIS) regulations was subsequently published in terms of section 97(1) of NEM: BA in August 2014 and amended in July 2016. The AIS regulations, 2014 grouped plants into four categories and prescribes the subsequent management of each category.

- **Category 1a:** Invasive plant species requiring compulsory control. These plants must be removed and destroyed and any species falling within this category is by law required to be eradicated from the environment. No permits should be sought or given to keep or propagate plant species falling within this category. Any form of trade or planting is strictly prohibited.

- **Category 1b:** Invasive plants requiring compulsory control as part of alien invasive plant species control programme. These plants are considered to have high invasive potential, thus require removal and eradication. Plants falling within this category qualify for governmental sponsored alien invasive plants control and management programmes. Furthermore, no permits will be issued to keep or sell plant falling within this category.
- **Category 2:** The plants falling within this category are alien invasive plants regulated by area or locality. These alien invasive plant species requires a demarcation permit in order to import, grow, breed, sell, buy or accept as gifts. However, no permit will be issued for invasive plant species within this category existing in riparian areas or zones.
- **Category 3:** These alien invasive plant species are regulated by activity, thus an individual plant permit is required to import, grow, breed, possess, sell, buy, or move these plants. No permit is issued for Category 3 alien invasive plant species existing in riparian areas.

In order to identifying invasive plants or weeds that need to be controlled/eradicated from site, the plants specified in these groups were used as a guideline.

4.1.5. National Environmental Management Protected Areas Act (Act No. 57 of 2003) (NEMPAA), As Amended

NEM:PAA provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; for the continued existence, governance and functions of South African National Parks; and for matters in connection therewith.

4.1.6. Mineral and Petroleum Resources Development Act (Act No 28 of 2002) (MPRDA, Section 37(1))

According to the MPRDA, any prospecting or mining operations must not result in unacceptable pollution, ecological degradation or damage to the environment and must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of projects. Section 37 (1) of the MPRDA acknowledges that the principles set out in Section 2 of the NEMA, apply to all prospecting and mining operations and serve as guidelines for the interpretation, administration and implementation of the environmental requirements of this Act. In addition, Mining Permit holders must give effect to the objectives of integrated environmental management as laid out in Chapter 5 of the NEMA. The MPRDA also obliges the owner of the Mining Permit to rehabilitate disturbed areas and holds the owner responsible for any environmental degradation on his/her site.

4.1.7. National Water Act (Act No. 36 of 1998) (NWA)

The mining industry is itself dependent on key resource inputs such as water, the provision of which depends on the health and integrity of ecosystems.

The National Water Act (NWA) is a legal framework for the effective and sustainable management of water resources in South Africa. Central to the NWA is recognition that water is a scarce resource in the country which belongs to all the people of South Africa and needs to be managed in a sustainable manner to benefit all members of society. The NWA places a strong emphasis on the protection of water resources in South Africa, especially against its exploitation, and the insurance that there is water for social and economic development in the country for present and future generations.

4.1.8. National Forests Act (Act No. 84 of 1998) (NFA)

The Act protects State Forests, Forest Nature Reserves and Wilderness Areas, and the plant and animal life contained therein. In addition, the Act allows for management programmes to be established in order to prevent soil erosion and fire, maintain the natural genetic and species diversity and control plants and animals which are harmful to a particular area. The Act provides for the control and reasonable access to State Forests for the purposes of recreation, education, culture or spiritual fulfilment as well as prohibiting any person from damaging State Forests or contributing to the threat of fire. Forest officers are empowered to arrest any person who has contravened this Act and may seize such person's property. This act also refers to the protected trees that are listed and the licencing permits that is needed to remove, or relocated if needed.

4.1.9. Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947)

This Act provides for the following:

- Appointment of a Registrar of Fertilizers, Farm Feeds and Agricultural Remedies;
- The registration of fertilizers, farm feeds, agricultural remedies, stock remedies, sterilizing plants and pest control operators;
- Regulate or prohibit the importation, sale, acquisition, disposal or use of fertilizers, farm feeds, agricultural remedies and stock remedies;
- Designation of technical advisers and analysts; and to provide for matters incidental thereto.

In other words, this Act governs the use and application of herbicide:

- All herbicide applications are to be made under the direct supervision of a registered Pest Control Operator.
- All persons applying herbicides are to be trained in their use.
- Correct Personal Protective Equipment (PPE) must be worn.
- Only registered herbicides may be used.
- Correct storage facilities must be used.

4.2. Provincial Acts, Plans, Policy and Environmental guidelines

4.2.1. Bioregional plans

The Bioregional plans aim to provide maps of biodiversity priorities with accompanying land-use planning and decision making guidelines in order to inform decisions associated with land-use planning, environmental assessment, natural resource management and authorization.

4.2.2. Biodiversity management plans (BMP)

BMP's ensure the long term survival in nature of species; to provide the responsible person or organ of state effective monitoring and reporting on species progress and to be consistent with acts, frameworks and applicable bioregional plans or any plans issued in terms of Chapter 3 of the NEMA or any municipal integrated development plans etc.

4.2.3. National biodiversity strategy and action plans (NBSAP)

NBSAP goal is to conserve and managed terrestrial and aquatic biodiversity to ensure a sustainable and equitable benefits

4.2.4. National biodiversity assessment (NBA)

Formerly known as National Spatial Biodiversity Assessment (NSBA) which is a systematic biodiversity planning approach that aims to give a comprehensive biodiversity assessment (previously it focused on spatial only) throughout the country. Its focus is to mainstream biodiversity priorities throughout the economy and making links between biodiversity and socio-economic development.

4.2.5. Mining and biodiversity guideline

The mining industry plays a vital role in the growth and development of South Africa and its economy. Since the earliest discoveries of minerals in the region, this rich endowment of mineral resources has been a key driver of South Africa's social and economic development. Mining continues to be one of the most significant sectors of the country's' economy, providing jobs, growing our GDP and building relations with international trading partners.

On par with this mineral wealth are exceptional endowments of biodiversity and ecosystems. South Africa is globally renowned as a mega-diverse country that harbours an exceptional number of species in relation to most other countries. This rich biodiversity and ecological infrastructure underpin and support the social and economic development in numerous direct and indirect ways. It is currently impacted upon by mining and other land uses in ways that are not sustainable.

Sustaining the goods and services that flow from ecosystems, and the benefits that these provide over the long term, will require limits in mining and other activities in certain areas. South Africa's Constitution and the laws stemming from it recognise the vital role of both ecological and mineral resources in a development path built upon the socially just, environmentally sustainable and economically efficient use of these resources.

The Guideline offers six principles that should be applied towards good decision making when addressing biodiversity issues and impacts in a mining context:

- Apply the law
- Use the best available biodiversity information
- Engage stakeholders thoroughly
- Use best practice environmental impact assessment (EIA) to identify, assess and evaluate impacts on biodiversity
- Apply the mitigation hierarchy in planning any mining-related activities and to develop robust environmental management programmes (EMP)
- Ensure effective implementation of the EMP, including adaptive management.

5. ROLES AND RESPONSIBILITIES

JJCVZ is the responsible proponent who will own the prospecting right and will play a major role in ensuring that this plan is effectively implemented. This plan is environmental legally binding and must be implemented to fulfil the requirements of relevant legislations and recommendation.

6. CONTROL OF ALIEN INVASIVE AND PROBLEM PLANT SPECIES

Alien plant invasions cause a decline in species diversity, local extinction of indigenous species and ecological imbalance. Thus, preventing the onset of an alien invasion and management of further spreading is required as they outcompete the indigenous plant species and quickly establish themselves in an area. Therefore, a national strategy has been compiled and identifies four primary categories of programs to address the management of alien invasive plant species and they are as follows:-

- **Prevention**—Keep the invasive species out;
- **Early detection and rapid response**—Detect and eradicate invasive species to stop them from spreading;
- **Control and management**—Eliminate or control the problem of invasive species; and
- **Rehabilitation and restoration**—Heal, minimize, or reverse the harmful effects from invasive species.

The occurrence of alien invasive plants not only affect the growth and distribution of natural endemic plants, they also use more water than indigenous plants, some have toxic fruits or leaves which when consumed could be poisonous and lead to fatality. Therefore, alien invasive plant species need to be controlled or removed and the following section contains different methods that could be used to control AIP.

The ultimate aim of an alien invasive species management programme is to eradicate species completely. This is often very difficult as many of the species have seeds that remain viable for a very long time and even after physical removal of plants, the seeds germinate to form new infestations. An alien invasive management programme therefore must be an ongoing practice over many years and should follow the following phases:

A. The initial bulk eradication of alien invasive species by chemical or mechanical means, and in some instances biological control agents. This may also require rehabilitation if large stands of alien invasive species are removed. Local, indigenous species should be planted in the disturbed areas;
B. There should also be immediate follow up and all seedlings should be pulled out and removed. This should be done regularly, although the timeframes will vary from species to species depending on their growth forms and rates; and
C. Finally, areas that appear to be under controlled must continue to be managed and observation of these sites should continue on at least an annual basis. Rehabilitation at sites should also be monitored and action taken immediately if issues occur.

Various control methods are available for control of alien invasive species, including mechanical, chemical and biological control. In most instances, mechanical means are utilised and include physical removal of plants. Research on use of herbicides has been conducted on many species and can be applied in conjunction with mechanical methods. For some species, herbicides have not yet been fully researched and/or herbicides have not been registered and these need to be mechanically controlled. The Department of Water and Sanitation's Working for Water section provides guidelines to the preferred clearing methods for most problem plants. This information can be obtained from their website: http://www.dwaf.gov.za/wfw/Control/. The selection of appropriate methods of control shall be based on the species to be controlled, the size of the plants, the density of the stand, the accessibility of terrain and environmental safety.

Biological control of alien invasive species is also an ongoing process and some biological control agents have been released on various alien invasive species and show varying degrees of success. Biological control options need to be carried out with specialist advice from academic or research institutes involved in research of alien invasive species.

Control options utilised must take into account the species being controlled and should take into account the ecosystem in which the control options are being applied. Some of the herbicides registered for control of alien invasive species should not be used in riparian areas, and some should be preferably used over others in areas where natural grass cover occurs. Some herbicides should only be utilised after consultation with a Working for Water technical advisor.

The control options are discussed below as individual actions, but in many cases integrated measures (more than one (1) control measure) are taken for more effective control of alien invasive species. As already mentioned, research with regard to herbicide application and biological control is lacking for certain alien invasive species and these, especially if listed as Category 1 invasive species, need to be managed and mechanical control of these species should be considered as a default control option.

The Department of Water and Sanitation proposes that the following methods of control for age or size target plants:

Seedlings

Hand pulling or hoeing:

- Hand pulling/hoeing should be carried out in sparse stands.
- Seedlings should be severed below the soil surface or removed from the soil. Soil disturbance should be minimized to reduce re-germination.

Herbicides:

- Herbicides can be used on dense stands.

Saplings

Hand pulling or hoeing:

- Where appropriate saplings can be removed manually as described above.

Herbicides:

- Foliar sprays can be carried out depending on the density of the stand. Fan nozzles should be fitted for overall spraying and solid cone nozzles for individual plant treatment. Spraying should be restricted to plants waist high or lower. Ensure there is sufficient foliage to carry the herbicide to the root system.
- Basal stem treatments of suitable herbicides in diesel can be carried out to the bottom 250 mm of the stem. Applications should be by means of a low pressure, coarse droplet spray from a narrow angle solid cone nozzle.
- Cut stump treatments can be used where stems are cut as low as practical. Herbicides are applied in diesel or water as recommended for the herbicide. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.

Mature Trees (trees above shoulder height or robust bushes 12 – 1 months or older)

Ring Barking:

- Bark must be removed from the bottom of the stem to a height of 0.75 – 1.0 m. All bark must be removed to below ground level for good results.
- Where clean de-barking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatment should be carried out.

Frilling or partial frilling:

- Cuts should be made through the bark into the sapwood by means of a light axe and a suitable herbicide must be applied into the cuts.

Basal stem treatments:

- Suitable herbicides should be applied in diesel to the base of the stem and to any exposed roots. Stems with a diameter up to 50 mm should be treated to a height of 250 mm and stems above 50 m diameter to a height of 500 mm. This method is only suitable for stems up to 100 mm in diameter.

Cut stump treatment:

- Stumps should be cut as low as practical and the herbicide applied. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.

When herbicides are chosen as the preferred control method the guidelines of Working for Water (DWS) as stipulated in the Policy on the Use of Herbicides for the Control of Alien Vegetation should be followed:

- Herbicides selected for control shall be registered for use on that species under the conditions specified.
- Protection of the environment is of prime importance. Riparian areas must be protected and only herbicides that are approved may be used. Washing of equipment or disposal of waste spray mixture is prohibited in or near water courses where contamination of water can occur.
- Empty herbicide containers must be disposed of as hazardous waste and may not be used for any other purpose.
- Equipment must be washed where there is no danger of contamination of a water source or natural vegetated area. It is proposed that washing be restricted to the wash bay.
- Product and spray mixtures should be stored so that it is inaccessible to the public. Site management must ensure that the Safety Data Sheet of the product is available on site.

6.1. CHEMICAL CONTROL

Chemical control requires the application of herbicides which can either be highly selective, or non-selective (inhibit certain plants or toxic to all plants respectively), or can be localised or systemic (act on the area where it is applied or attack areas of growth respectively). In most cases, herbicides utilised against alien invasive species are systemic.

Selective herbicides have been registered against specific alien invasive species and the plant names are shown on the labels. Many alien invasive species, however, do not have registered herbicides, and in such cases general herbicides such as Garlon 4 (used with wetter Actipron when applied as spray), Roundup, Mamba, Clearout, or Tumbleweed (the latter 4 on less woody species) can be tested but success is not guaranteed. When the test show positive results, it is suggested that the results be communicated to various research institutes (reference http://www.wessa.org.za).

Chemical control is at times the only viable option for the control of invasive species, and more often than not is more cost effective and less time-consuming than mechanical control options. If used incorrectly, chemical control can be damaging to the receiving environment and affect indigenous species negatively. Specialised equipment and training and/or supervision and, in some cases, technical advice are required.

6.1.1. Control methods, equipment and safety precautions

When applying herbicides, always follow dosage recommendations and application procedures described on the labels. Increasing dosages may have negative impacts on the receiving environment and may reduce the efficacy of the herbicide.

When applying herbicides, it is important to consider the following:

- Chemical control of alien plants is not recommended in aquatic systems due to the risk of pollution, but may be used on the floodplain in conjunction with cutting or slashing of plants;
- Chemicals should only be applied by qualified personnel;
- Only approved chemicals should be applied;
- Follow the manufacturer's instructions carefully;
- Appropriate protective clothing must be worn;
- Chemicals to be applied immediately after cutting;
- Only designated spray bottles to be used for applying chemicals; and
- Decanting of chemicals and cleaning of equipment should be undertaken at a designated location using drip trays and ground sheets to prevent spillage and contamination of the soil.

Do:

- Spray when plants are actively growing;
- Ensure that herbicide is mixed according to label application rates (info on herbicides to use can be requested from Department of Agriculture, Forestry and Fisheries or National Department of Agriculture or relevant entities);
- Ensure correct application of safety gear at all times;
- Plan the application of herbicides before the operation commences;
- Spray when the sun is shining;
- Use a drip sheet and keep herbicide in a demarcated area in the veld, out of direct sunlight;
- Apply spray to the canopy and stems;
- Include dye to assist in the identification of areas that have been cleared; and
- For certain species mainly, for foliar application, a wetting agent should be added to the herbicide mix to allow for better absorption.

Do not:

- Spray during strong wind, or where there is the slightest evidence of drift;
- Spray when it is very hot;
- Spray when plants are stressed or dormant;
- Spray plants that are over 1 m;
- Apply herbicide in the rain or on wet, damp leaves; and
- Spray near children, animals or water bodies.

In addition, it is always best to control invasive alien plants when the plants are young, rather than when it is woody and difficult to remove by hand. Furthermore, it is sometimes difficult to distinguish between young invasive species and natural species, so care should be taken at all times. Consider engaging an experienced alien clearing team (Department of Water Affairs - Working for Water unit could offer assistance and expertise on how best to remove and manage alien plants on the property).

6.1.1.1. Foliar Application

This method requires the herbicide to be sprayed onto leaves and young stems. The herbicide is sprayed in quantities on these plant parts to the extent just prior to running off the leaves and stems. In some instances, other agents are applied to increase the adhesiveness of the herbicide or to increase the liquidity of the herbicide. Sufficient foliage must to be present for the herbicides to be effective and in cases of re-growth, minimum heights of 0.5 m need to be reached prior to application. Equipment will require adequate spray packs, proper measuring equipment to mix correct doses and safety gear, which will include at least rubber gloves, safety glasses and masks. Do not spray just before rain (a rainfall-free period of 6 hours is recommended) or before dew falls. Avoid spraying in windy weather as the spray may come into contact with non-target plants. Spraying dormant or drought stressed plants is not effective as they do not absorb enough of the herbicide.

6.1.1.2. Basal Stem

This method is used for smaller woody species with thin stems (< 20 cm) and bark. The herbicides are mixed with diesel at dosages recommended on labels and applied to the stems from ground level to at least 0.3 m with a paint brush. Spraying can be used as an alternative. This method should also be applied to bark remnants left on the stem during strip-barking. Equipment will require adequate spray packs or paintbrushes, proper measuring equipment to mix correct doses and safety gear, which will include at least rubber gloves, safety glasses and masks.

6.1.1.3. Frilling

This method is described in the mechanical control measures and repeated here as it is always accompanied by the application of herbicides. Herbicides are mixed with water at the recommended dosage and applied with a hand-held syringe or sprayer. Equipment will require adequate spray packs or syringes, proper measuring equipment to mix correct doses and safety gear, which will include at least rubber gloves, safety glasses and masks.

6.1.1.4. Stem Injection

This method is limited for use on cacti. Four (4) holes (for a 2 m plant) are made near the base of the stem and around 2 ml of water-soluble herbicide solution, mixed at recommended dosage is poured in each hole. Equipment will require adequate syringes, proper measuring equipment to mix correct doses and safety gear, which will include at least rubber gloves, safety glasses and masks.

6.1.1.5. Stump Application

This entails the application of herbicides to the cut stumps of felled trees. The stump should be short, level and smooth with all bark in place. Stems should be cut as low as practical and stipulated on the label. The herbicide should be mixed to the correct dosage and applied no later than twelve (12) hours after the felling. For cut stump applications, the herbicide should be closely sprayed onto the outer rings of the stump and the entire stump for stems < 50 mm wide. In specific instances herbicide will need to be applied to the cut surface, the sides and any exposed roots. Equipment will require adequate spray packs, proper measuring equipment to mix correct doses and safety gear, which will include at least rubber gloves, safety glasses and masks. Herbicides are applied in diesel or water as recommended for the herbicide. Applications in diesel should be to the whole stump and exposed roots and in water to the cut area as recommended on the label.

6.1.1.6. Stalk Immersion

There are currently no alien invasive species which have herbicides registered against them for this particular method. It may be successful on climbers and should be tried if mechanical control options are unsuccessful or difficult. The method includes the cutting of main stems at <1 m height, the digging up of roots or treatment of roots with herbicide and the placement of an inverted plastic bottle containing herbicide over the stem. The bottle should be secured in place and checked regularly to see if herbicide is still present. The generic herbicides mentioned above can be tested for this method. A hazardous sign or tape should be placed around the bottle. Equipment will require adequate plastic bottles, proper measuring equipment to mix correct doses and safety gear, which will include at least rubber gloves, safety glasses and masks.

6.1.1.7. Soil application

This requires the application of herbicides to soils and should only be utilised by technical specialists.

6.1.2. Registered herbicides that can be utilised

Various herbicides are mentioned in

Table 6 below. Many alien invasive species do not have specific registered herbicides which have been properly researched and tested. In these instances only mechanical measures have been discussed but the general herbicides listed in

Table 6 can be tried against these species, although success may not be guaranteed.

Table 6: List of herbicides, which can be used for control of alien invasive species and problem plants

TRADE NAME	ACTIVE INGREDIENT	ACTIVE INGREDIENT	GENERAL COMMENTS
Mamba 360 SL	Glyphosphate isopropylammonium salt	360 g/l	Can be used as a general herbicide.
Touchdown Forte	Glyphosphate trimesium	480 g/l	
Viroaxe	Triclopyr butoxyethyl ester	480 g/l	Do not apply in riparian areas. Use preferentially in grassy areas.
Garlon 480 EC	Triclopyr butoxyethyl ester	480 g/l	Can be used as a general herbicide. Use preferentially in grassy areas. Use Actipron for wetter spray applications.
Timbrel 360 SL	Triclopyr triethylammonium salt	360 g/l	Do not apply in riparian areas. Consult working for water technical advisor.
Stumpout	Mycoherbicide		
Chopper SL	Imazapyr	100 g/l	Do not apply in riparian areas
Access 240 SL	Picloram potassium salt	240g/l	Needs to be used in selected areas only. Consult working for water technical advisor.
Roundup	Glyphosphate isopropylammonium salt	450 g/l	Can be used as a general herbicide.
Clearout	Glyphosphate isopropylammonium salt	360 g/l	Can be used as a general herbicide.
Tumbleweed	Glyphosphate isopropylammonium salt	240 g/l	Can be used as a general herbicide.
Taskforce	Flupropanate, present as sodium salt	745g/l	
Starane 200	Fluroxypyr	200 g/l	

N.B. A PCO should always be consulted before applying herbicides to the environment. Always wear the appropriate safety clothing when working with herbicides. Mix all herbicides on a drip groundsheet when working in the veld. Keep away from watercourses. Do not rinse herbicide equipment in the veld. Always read the herbicide label and observe instructions for safe use of herbicide.

6.1.3. Mycoherbicides

A mycoherbicide is applied as an herbicide but is not a chemical agent. It is instead a mixture of fungal spores which tend to be host-specific and on application these spores penetrate the plant where the fungus germinates. The pathogen may result in the killing of the undesirable plant. One (1) mycoherbicide, Stumpout, has been registered for application to various wattle species stumps.

6.2. MECHANICAL CONTROL

Mechanical control means the physical removal of plants from the problem area. It is often accompanied by chemical control although these are further discussed below. Some common mechanical control methods include uprooting, hand pulling, felling, slashing, mowing, ring barking, bark stripping and frilling. It is an effective method if applied frequently, but is labour intensive during times when infestation levels are high, and requires constant follow-up. An advantage is that mechanical control requires minimal technical knowledge, little training and/or supervision. Also, with effective rehabilitation of areas concerned, the disturbance to the environment is minimal, as no other active agents were introduced to the environment.

6.2.1. Control Methods, Equipment and Safety Precautions

When applying mechanical control methods, it is important to consider the following:

- Always start at the highest point and work downwards i.e. downhill or downstream;
- Start from the edge of the infestation and work towards the centre;
- Take care to prevent the spread of cuttings, which could take root further downstream;
- Ensure all root material is removed;
- Once plants have been removed, banks and slopes should be stabilised by erosion protection measures (such as geotextiles or other suitable material); and
- When stacking material, take note of fire protection measures and remember to always stack the material in rows.

6.2.1.1. Uprooting and Hand Pulling

Hand pulling is most effective where plants are small (30 cm), immature or shallow rooted. This entails the physical removal of plants by grabbing them at their base and pulling them out of the ground with their roots. In some situations, the root systems will need to be dug out, and hoes, spades and pick-axes may be required. This process should preferably be conducted when plants are not seeding. If this is not possible, the seed heads should be carefully removed and disposed of prior to the control method being applied. Thick leather gloves and safety glasses should be worn during this process.

6.2.1.2. Felling

In situations where trees are on a slope or in a precarious situation, the species must be controlled *in situ* and not felled. This control option entails the physical removal of woody plants using chainsaws, axes or machetes. Preferably de-branch cut trees. Generally, the plants are cut as low to the ground as possible, but this does vary with some species. Again, gloves and safety glasses should be used during this process and training may be required with felling of large trees as safety precautions has to be adhered to. Herbicides must immediately be applied (no later than 30 min) to the cambium layer; and all the cuts in the cambium layer must be treated. This control measure may be accompanied with chemical control measures where applicable.

6.2.1.3. Slashing and mowing

This method is most effective for plants in the immature stage, or for plants that have relatively woody stems/trunks. This is an effective method for non-resprouters or in the case of resprouters (coppicing), if done in conjunction with chemical treatment of the cut stumps. This is the physical removal of herbaceous plants from the base using machetes or lawn mowers. This process should preferably be conducted when plants are not seeding. If this is not possible, the seed heads should be carefully removed and disposed of prior to control method being applied. Gloves and safety glasses should be worn during this process. Use tools such as pangas (slashers), handsaws, bow-saws, chainsaws, brush cutters and axes.

6.2.1.4. Ring barking and bark stripping

This entails the removal of bark from the base of the stem (from below the soil layer) to a height of about 1 m. In some instances, the cambium (include the cork layer) is also removed in a 30 cm wide band around the stem at a height of around 50 cm. Bush knives or hatchets should be used for debarking and safety gear should include at least gloves and safety glasses. This control measure may be accompanied with chemical control measures where applicable.

Application of suitable herbicide in diesel can be carried out to the bottom 250 mm of the stem. Applications should be by means of a low pressure, coarse droplet spray from a narrow angle solid cone nozzle or by using a paintbrush. If multi stemmed, then each stem needs to be treated. Remove the bark and cambium around the trunk of the tree for a continuous band around the tree at least 25 cm wide, starting as low as possible. Where clean de-barking is not possible due to crevices in the stem or where exposed roots are present, a combination of bark removal and basal stem treatments should be carried out; and for better control of aggressively coppicing species pull off the bark below the cut to ground level (bark stripping), to avoid the use of herbicides.

Note: Since this method means that the tree is left standing, it is only recommended for single trees, not for stands.

Slashers or axes should be used for debarking. Where bark stripping is used, then all the bark shall be stripped from the trunk between the ground level and 1 meter above ground level; and application of suitable herbicide can also be used with this method. Applications should be by means of a low pressure, coarse droplet spray from a narrow angle solid cone nozzle or by using a paintbrush.

6.2.1.5. Frilling

This method uses an axe or bush knife which cut into the bark and cambium layer at angles in a ring around the tree. The cuts are made around 0.5 m above ground.

The cuts should be right through the cambium layer and form a solid ring of cuts around the trunk of the tree. Immediately apply the registered herbicide to the cuts by spraying into the ‘frill’. The ‘frill’ needs to be deep enough to retain the herbicide.

This method is always accompanied by chemical control measures. Safety glasses and gloves should be worn.

6.2.1.6. Grubbing/ hoeing/ digging out/ tree poppers

Grubbing, hoeing, or digging involves the use of a hoe, stick, tree popper or spade. The entire plant and root must be removed. Use the following method:

- Dig around the plant making sure the sand is loosened around the root system;
- Dig down, under the roots, applying pressure, and wrench the entire plant out;
- Kicking the plant may help to dislodge it, however, care should be taken if the plant is seeding, as dry seeds may be dislodged; and
- Stockpile removed material into piles of 2 m high, 3 m wide windrows/stacks.

6.3. BIOLOGICAL CONTROL

Biological control is an attempt to introduce the plant's natural enemies (such as pathogens, invertebrates and vertebrates) to its new habitat, with the assumption that these natural enemies will remove the plant's competitive advantage until its vigour is reduced to a level comparable to that of the natural vegetation.

This method is considered because:

- It is environmentally responsible as it does not cause pollution and affects only the target plant;
- It is cost-effective;
- It does not disturb the soil or create large empty areas where other invaders could establish, as it does not kill all the target plants at once; and
- It allows the natural vegetation to recover gradually in the shelter of the dying weeds.

Natural enemies that are used for biological control are called bio-control agents. In the control of invasive plants, the bio-control agents used most frequently insects, mites and pathogens (disease-causing organisms such as fungi). Bio-control agents target specific plant organs, such as the vegetative parts of the plant (its leaves, stems or roots) or the reproductive parts (flowers, fruits or seeds). The choice of bio-control agents depends on the aim of the control project. If the aim is to eradicate the invasive plant species, scientists select the types of bio-control agents available which will cause the most damage. In such projects, scientists may use agents that affect the vegetative parts of the plant as well as agents that reduce seed production. However, if the target plant is useful in certain situations but becomes a pest when uncontrolled, conflict of interests arises regarding biological control. This conflict is usually resolved by avoiding bio-control agents that have the ability of causing damage to the useful part of the plant, and instead using only seed-reducing agents.

These reduce the reproductive potential of the plants, curb their dispersal and reduce the follow-up work needed after clearing, while still allowing for the continued utilisation of the plant. For instance, trees are normally grown for their wood, but the seeds are seldom utilised. If seeds are needed to replant a plantation, a seed orchard can be specially protected against the bio-control agents in the same way as other crops are protected against insect pests.

If, on the other hand, the pods are the most valuable part of the tree, as in the case of mesquite (*Prosopis* spp.), bio-control agents can be selected that will prevent pod production. The seed-feeding beetles that were introduced against mesquite prevent only the germination of seeds from animal droppings, without significantly reducing the nutritional value of the pods, and in other words do not prevent pod or seed production. Bio-control agents are mostly introduced from the country of origin of the plant. The bio-control method is considered to be the safe and environmentally friendly control method due to the methodology and care taken into implementing it.

6.2.2. Implementing Biological Control

Before the official release of a bio-control agent in South Africa, extensive studies are carried out in a quarantine facility to ensure the agent will not damage other, non-target plants.

A bio-control agent is only released once it has been proved as sufficiently host-specific for release in this country. Tested and approved bio-control agents therefore do not pose a threat to our own crops or indigenous vegetation, or to those of neighbouring countries. No cases have occurred of weed bio-control agents changing their host plant affinities after their release in a new country to include plants other than those known to be acceptable hosts.

6.2.3. Effectiveness of Biological Control Method

Probably without exception, bio-control agents do not completely exterminate populations of their host plants. At best, they can be expected to reduce the weed density to an acceptable level or to reduce the vigour and/or reproductive potential of individual plants. The fact that a few host plants always survive, in spite of the attack by a bio-control agent, actually ensures that the agent does not die out as a result of a lack of food. The small population of bio-control agents that persists will disperse onto any re-growth or newly-emerged seedlings of the weed. For this reason, bio-control can be regarded as a sustainable control method. Biological control works relatively slowly. On average, at least five years should be allowed for a bio-control agent to establish successfully before causing significant damage to its host plant. Unfortunately, not all growth of invasive plant species can be curbed purely by biological control. It could happen that effective bio-control agents do exist, but cannot be released in South Africa because they are not sufficiently host-specific.

Alternatively, the invasive plant might be a man-made hybrid between two or more species, and is no longer an acceptable host to the natural enemies of either of the parent plants. It could also happen that the natural enemies of some plants are not adapted to all the climatic regions in which the plant is a problem in South Africa, or that the habitat already contains predators or parasitoids that attack the bio-control agents. In such cases, biological control will have to be replaced or supplemented by chemical or other control measures.

6.2.4. Integrating Biological Control into Weed Management

In some instances, bio-control agents may effectively control a weed on their own. In other cases, the bio-control agents should be incorporated into a more comprehensive weed control programme that might include other methods of control such as chemical and mechanical control as well as utilisation of products of the weed. To make optimal use of the available bio-control agents, the following points should be considered:

- The possible use of bio-control agents should be kept in mind during the planning phase of any weed control program; and
- The person in charge of planning must find out which agents are available, what they do and how to use them. One then has to consider how best to integrate the use of the bio-control agents with the other control methods.

6.2.5. Biological Control Agent Reserves or Refugia

The mechanical or chemical clearing of large weed infestations may eliminate any bio-control agents present on the weed in that area. It is therefore essential to establish small reserves of healthy, mature plants on which the agents can survive and reproduce and from which they can spread onto plants that may have escaped the clearing process.

Some agents disperse rapidly on their own and can readily colonise extensive areas, while others; such as *cochineal* insects and mealy bugs have to be collected manually from the reserves and released in the target areas. Therefore, a person involved in cactus bio-control should always remove some insect-infested cactus plant material and distribute it to healthy cactus before the *cochineal* or mealy bugs have destroyed their host plants in a specific area. This ensures that the bio-control agents do not become extinct locally, but maintain their presence in the area to colonise re-growth.

6.3. HANDLING AND DISPOSAL OF PLANT DEBRIS OR MATERIAL

The unwanted plant material from mechanical or chemical clearing should not be kept on site as it attributes to the fire risk by providing fuel. Therefore, the following handling and disposal method could be utilized as some of the debris can offer services and some can be completely disposed of:

6.3.1. Stacking

- Stacking the cut material in heaps, or in windrows along slope contours to reduce erosion, facilitates easy access for follow-up. It also assists in containing the resulting fuel load and therefore the risk of uncontrolled fire;
- Keep stacks well apart to prevent fires from crossing easily; not less than five meters apart, this is naturally dependant on the size of the stack and the resulting fire intensity when they burn. Stockpile removed material into piles of 2 m high, 3 m wide windrows/stacks;

- Stack light branches separately from heavy timber (75 mm and more). Preferably remove heavy branches to reduce long burning fuel loads that can result in soil damage from intensely hot fire; and
- Do not make stacks under trees, power and telephone lines, within 30 meters of a fire belt or near watercourses, houses and other infrastructure.

6.3.2. Disposal

- Plant material should be used beneficially wherever possible, as opposed to disposing it at a landfill site where it takes up valuable airspace;
- Woody and dry material, provided no seeds are present, can be chipped and used as mulch or made available to the local community for firewood;
- Wet material and aquatic weeds should be combined with other organic matter and composted. Alternatively, it may be possible to use it for basket making, animal feed or other uses.
- Material which cannot be used beneficially must be disposed of at a registered and approved disposal site.
- When removing material, take care to remove all debris, including shoots and seeds.

6.4. CONTROL PHASES

Alien invasive plant species removal should ideally adopt a hands on approach. The combination of two or all three control methods could prove more effective than using one control method in combating the problematic plant species. Therefore, it is advisable that landowners should:

- not allow conditions to develop on their land that will contribute to the spread of a wildfire;
- remove invasive alien plants that create large fuel loads or cause fires to burn intensely; and
- Take steps to fireproof their property and possessions. These apply especially to those living on the edge of open areas or in close proximity to fire prone areas.

Furthermore, any control programme for alien vegetation must include the following three phases;

1. **Initial control:** drastic reduction of existing population;
2. **Follow-up control:** control of seedlings, root suckers and coppice growth; and
3. **Maintenance control:** sustain low alien plant numbers with annual control.

The initial control in most cases, involves mechanical methods and in the case of heavy infestation, machinery could be used. The initial control is a drastic measure to reduce the number of adult and large invasive plants.

The follow-up control serves are measures to reduce the ability of the mechanically removed plant species for coppice or having the infestation proliferate such as to negate the efforts of initial control. Therefore, follow up control of alien seedlings and coppice re-growth is essential to achieve and sustain the progress made with initial control work.

Maintenance control entails regular monitoring to prevent the occurrence of re-colonisation or re-infestation. The monitoring should take place timeously so to prevent infestation of the cleared area by another alien invasive plant species.

7. ALIEN INVASIVE PLANT ERADICATION TOOL

Working for Water provides the site manager with an implementation tool to control problem species and keep the site free of invasive plants:

Step 1: Conduct Site Assessment;

- Identify areas where alien invasive species need to be eradicated and controlled. Take pictures of these sites so as to have a pre-control photographic reference of the site. In this way comparisons can be made at later stages to see if control measures are adequate.

Step 2: Set objectives based on resources available and priorities:

- Prioritize management of plants according to the categories stipulated in the AIS regulations.
- Consider control options that will be applied in these areas. Consider integrated approaches and ensure approaches are not conflicting with each other. Also consider safety aspects such as trees on a slope which should not be felled but treated *in situ*.

Step 3: Develop and implement an action plan to achieve objectives:

- The plan must be long term and should include a clearing plan that includes follow up actions for rehabilitation of the cleared area.
- The site plan should include a map showing the areas invested with problem plants.
- Lighter invested areas should be cleared first to prevent the build-up of seed banks, while the control plan works progressively towards the areas with denser stands.
- Educate workers on the species that needs to be eradicated, as well as the specific method to be used.
- Conduct control of invasive plant species.
- Remove plant remains to a suitable disposal area.
- Prevent dispersal of seeds.
- Strive for collective management and planning with neighbours to prevent seed dispersal of problem plants across boundaries.
- When removing alien invasive species from infested areas, always work from lower infested areas towards more infested areas and from higher-lying areas to lower areas;
- Try to remove alien invasive species when they are not seeding. If seeding, then seed heads should first be carefully removed and disposed of in a sealed bag so as not to spread the seeds;
- If soils are disturbed during the process, then these should be carefully levelled, slightly pressed down and covered with leaf litter or cut vegetation that is seed-free. Some alien invasive species release chemicals that suppress growth of other plants and these should not be utilised as leaf litter under any circumstances. The soil can also be re-seeded with indigenous vegetation;

- To reduce the risk of spread via seeds, flowers should be removed from the plants prior to seeding. To prevent further infestations, remove seeds, fruits, bulbs, corms, tubers and any other vegetative parts that may root from the site in sealed bags and dispose of safely. In some instances, these parts should be burnt on site immediately;
- Consider herbicide practices to integrate with physical removal where possible, with use of generic herbicides on alien invasive species without registered herbicides;
- Consider the uses of plants that will be removed. Options such as its potential for compost heaps (as long as it is seed free), potential as leaf litter (as long as it is seed free) and possible options for timber and cork markets. As stated earlier, some alien invasive species release chemicals that suppress growth of other plants and these should not be utilised as leaf litter under any circumstances.

Step 4: Monitor performance and change actions if necessary

- Conduct monthly inspections to enable early detection of grow back.
- Regularly follow up on areas where infestations were treated and re-apply control measures if necessary. Once again, take photographs of sites regularly and keep records of actions that were taken so that evidence is in place with regard to control measures that were successful and those that were not.
- Consider rehabilitation of area cleared of invasive species at every stage of the control programme and consider the need to re-introduce local indigenous species to help the natural ecology stabilise within the areas.
- Consider training of employees. Courses range from introductory and awareness courses to those that qualify individuals as alien invasive control officers.

Table 7: Alien invader plants control plan to be implemented by site management		
ALIEN INVASIVE PLANTS CONTROL PLAN		
Method / Procedures	**Equipment**	**Responsibility**
1. PLANT IDENTIFICATION AND LISTING		
• The site must be visually inspected for alien plant species and the observed AIP's must be listed. • All observed and identified plant species should be categorised according to the list contained Appendix 1 and be removed according to the methods stipulated under heading 2 and 3 of this table.	• Camera • Global Positioning System (GPS) • AIPs and problem plants identification guides such as Bromilow's *Problem Plants of South Africa: A guide to the identification and control of invasive plants* as well as Henderson's *Alien Weeds and invasive plants – Complete guide to declared weeds and invaders in South Africa.*	**Stage 1:** Identification and listing should be done by site management utilizing the suggested field guides. • Time frame – for the duration of the operational and decommissioning phases. • AIPs are opportunistic species that will use the gap created by project disturbance to spread and establish themselves. Therefore, a monthly monitoring regime, to assess alien invasion, should be maintained
2. CONTROL OF AIPS		

• Site management shall appoint a suitably qualified specialist and/or contractor who will be able to distinguish between the invasive and indigenous plant and clear the alien invasion.
• Four methods can be applied for alien infestation clearing as stipulated by DWS:
  • Mechanical control;
  • Chemical control;
  • Biological control;
  • Integrated control.
	• It is advised that an experienced alien invasive removal contractor be appointed as there is a need to:
	  • Train personnel on how to handle machinery used in mechanical control;
	  • Train personnel to handle, mix and apply the herbicides used for chemical control; and
	  • Provide guidance on which insects or pathogens to use if management opts for biological control.
		Stage 2: Site management is advised to liaise with the South African National Biodiversity Institute (SANBI) Alien Invasive Plants Early Detection and Rapid Response (AIP EDRR) Unit (contact: 021 799 8837 or alienplants@sanbi.org.za) on the management of AIPs found on the property.
		• Time frame: Operational-, and decommissioning phases as well as the 12 month after care period of the mine.
		• Furthermore, liaison could be established with the Agricultural Research Council - Plant Protection Research Institute (ARC-PPRI) based in Rietondale with regards to guidance on the use of biological control organisms (contacts: Dr Stefan Neser at nesers@arc.agric.za, Dr David Simelane at simelaned@arc.agric.za, Dr Alan Urban at urbana@arc.agric.za or call 012 356 9800).
		• Management can access the DWA-WfW website to download treatment guides for terrestrial AIPs or those identified at the site. Or, to request a clearing form/application for the WfW personnel to clear the site.

3. REMOVAL METHODS FOR AIPS		

Table 7: Alien invader plants control plan to be implemented by site management		
ALIEN INVASIVE PLANTS CONTROL PLAN		
Method / Procedures	**Equipment**	**Responsibility**
• All Category 1a & b species shall be removed from the site on a continuous basis. Method for removal of seedlings: • Seedlings and new sprouts should be removed by hand and not be allowed to reach seed bearing age. • Seedling should be removed when the soil is wet, preferably after rainfall; Method for removal of mature plants: • Mature plants must be cut off using a chainsaw or brush cutter as close as possible to the ground. • Herbicides can be used for application to the stump.	• Chainsaw or brush cutter is recommended (N.B. Training is crucial for operating these machines).	**Stage 3:** Site management is responsible for removal of all AIPs as indicated in the methods. • Time frame: Operational-, and decommissioning phases as well as the 12 month after care period of the mine. • For mechanical removal of mature plants, a trained and experienced individual should be used to operate the equipment.
4. DISPOSAL OF AIP CUTS OR MATERIAL		

Table 7: Alien invader plants control plan to be implemented by site management		
ALIEN INVASIVE PLANTS CONTROL PLAN		
Method / Procedures	**Equipment**	**Responsibility**

• All alien plants removed from the site are to be disposed of at an approved or licensed waste disposal site if no alternative use for the plant material can be identified;
• Alternatively, the removed plants can be buried in a trench of at least 1 m deep. Grow-back will need to be controlled in this area, preferably with herbicides.
• Logs or wood can be donated to the landowner or community;
• Non-seeding woody aliens can be retained and used for dust control purposes (i.e. act as windbreakers) or soil stabilisers;
• Cut plant material should be removed from site within three days, to lower fire potential; and
• Burning of dried alien vegetation should not be allowed on site.
	• Preferably a contractor should be appointed for this aspect.	**Stage 4:** The proponent should seek a contractor to oversee this phase.
		• Time frame: Throughout control phase when deemed necessary, or at least monthly.
		• Record keeping:
		  • There should be a record of the dates the disposal truck collects the plant waste material;
		  • License for the disposal site; and
		  • License for the company tasked with collecting and disposing of the plant waste material.

5. EARLY DETECTION AND RAPID RESPONSE (EDRR)		

Table 7: Alien invader plants control plan to be implemented by site management		
ALIEN INVASIVE PLANTS CONTROL PLAN		
Method / Procedures	**Equipment**	**Responsibility**
• This aims to allow site management to detect and respond to new alien infestation before it escalates; • A monthly inspection should be established to monitor AIP infestation in areas that were re-vegetated. • Seedlings should be removed as explained under heading 2 before they establish and start to produce seeds; • EDRR should be applied in all the project areas and mostly in areas that are newly disturbed; and • AIPs should not be allowed to establish and mature as the bigger they become they more expensive it becomes to control.	• GPS; • Camera; and • Garden fork and gloves for loosening the soil and removing the seedlings.	**Stage 5:** Site management is responsible to ensure that the prospecting area is protected from alien invasion. • Time frame: Operational-, and decommissioning phases as well as the 12 month after care period of the mine.

8. SITE SPECIFIC CONDITIONS

Problem plants mainly germinate in the disturbed areas that were previously mined. A large number of alien invasive species were identified within the previously mined areas. It is difficult to add coordinates to all the plant species as most of the areas have an excessive amount of species. Alien invasive species where mapped by taking the coordinates of a point and identifying all the invasive species within a meter of that point.

A list of the alien invasive species identified during the site visits is provided below inclusive of the mechanical and herbicide control measures for eradication of the identified plant. If no mechanical methods can be used herbicides will be used (refer to

Table 6).

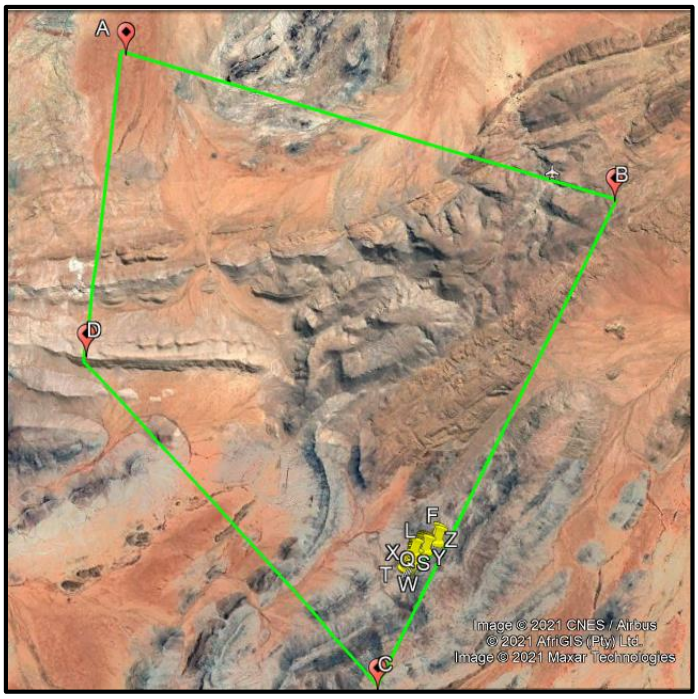

Figure 3: *Satellite view of the JJCVZ prospecting area, where the green polygon indicates the prospecting boundary. (Figure obtained from Google Earth).*

8.1. Species Present On Site.

A survey of the project site was undertaken which covered the basic footprint of the property. During this survey, several declared alien invader plant species and few other exotic species were found on site. The general disturbance of natural vegetation is the main reason for this high diversity of alien invasive species. The prospecting activities may promote conditions that can lead to the introduction and / or spread of invasive exotic species.

The species below are listed species in terms of the National Environmental Management: Biodiversity Act, 2004 (Act no. 10 of 2004), Alien and Invasive Species Lists. These species are listed because they are aggressive invaders and species which change the character and functioning of the ecosystems. These species must be managed in order to lower their number and eventually completely eradicate them from the project site. The following species of concern has been known to occur within the prospecting boundary:

- *Argemone ochroleuca (White flowered Mexican poppy)*
- *Artiplex nummularia* (*Salt bush, Old man*)
- *Artiplex inflata* (*Sponge fruit saltbush*)
- *Cylindropuntia imbricata (Cactaceae)* (*Imbricate prickly pear*)
- *Datura ferox* Sp.
- *Ricinus communis (Castor-oil plant)*
- *Salsola tragus* (*Russian tumbleweed*)
- *Xanthium strumarium (Large cocklebur)*

As everyone isn't familiar with the identification of plant species, photographs of the most important species to be controlled at JJCVZ was included below for ease of reference. Site management can refer to the species listed in Appendix 1 of this document for the proposed management/control methods to be applied.

A list of the alien invasive species identified during the site visits is provided below inclusive of the mechanical and herbicide control measures for eradication of the identified plant. If no mechanical methods can be used herbicides will be used (refer to

Table 6).

9. REHABILITATION OF RECLAIMED AREA

Monitoring and maintenance of reclaimed areas are important to establish the necessity of follow-up operations. It is preferable to follow up on a reclaimed area and remove all seedlings or treat re-sprouting plants prior to the treatment of a new area.

Denuded areas where eradication of weeds/invader species was done needs to be rehabilitated to ensure soil conservation and prevent erosion. Denuded areas also have a much higher potential of re-infestation than areas that has been vegetated with indigenous plant species.

In order to monitor the impact of clearing activities, follow-ups and rehabilitation efforts, monitoring must be undertaken. This section provides a description of a possible monitoring programme that will provide and assessment of the magnitude of alien invasion on site as well as an assessment of the success of the management programme. In general, the following principles apply for monitoring:

- Photographic records must be kept of areas to be cleared prior to work starting and at regular intervals during initial clearing activities. Similarly, photographic records should be kept of the area from immediately before and after follow-up clearing activities. Rehabilitation processes must also be recorded.
- Simple records must be kept of daily operations, e.g. area/location cleared, labour units and, if ever used, the amount of herbicide used.
- It is important that, if monitoring results in detection of invasive alien plants, that this leads to immediate action.

It is proposed that a seed mix of the following replacement plants be used at JJCVZ to fill the areas from where the weeds/invader plants were eradicated:

- *Couch Grass (Cynodon dactylon)*
- *Red Grass (Themeda triandra)*
- *Spear Grass (Heteropogon contortus)*
- *Tef (Eragrostis tef)*
- *Weeping Love Grass (Eragrostis curvula)*

As invasive plant species can lay dormant until favourable conditions arise, monitoring of re-vegetated areas is of extreme importance and should be implemented at least quarterly. Accurate records of monitoring and maintenance actions and associated costs should be compiled to assist with future planning.

Table 8: Monitoring Actions, Indicators and timeframes to be applied during the prospecting phase

Monitoring Action	Indicator	Timeframe
Document alien species distribution and abundance on site	Alien species distribution maps	Annually
Document alien plant control measures implemented & success rate achieved	Records of control measures and their success rate.	Annually
Document rehabilitation measures implemented and success achieved in problem areas	Decline in vulnerable bare areas over time	Annually

Table 9: Monitoring Actions, Indicators and timeframes to be applied during the rehabilitation phase

Monitoring Action	Indicator	Timeframe
Monitor newly disturbed areas where infrastructure has been removed to detect and quantify any aliens that may become established for 3 years after decommissioning and rehabilitation.	Alien species distribution maps	Biannually until natural vegetation has recovered sufficiently to resist invasion

10. References:

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- **Working for Water**. Indigenous Replacement Plants in the KZN region. Department of Water Affairs. South Africa
- **Working for Water**. Policy on the Use of Herbicides for the Control of Alien Vegetation. Department of Water Affairs. South Africa

Annexure 1: PROPOSED MANAGEMENT/CONTROL METHODS FOR THE MOST COMMON ALIEN INVADER PLANT SPECIES

Pictures and information were obtained from the following websites: www.tshwane.gov.za; www.nature.org; www.arc.agric.co.za; www.biodiversity.explorer.co.za; www.sanbi.org; www.invasives.org.za; www.dwaf.gov.za; www.bayercropscience.co.za; www.gardeningeden.co.za and www.britannica.com.

Please refer to Conservation of Agricultural Resources Act (Act No. 43 Of 1983) (CARA) and the National Environmental Management Biodiversity Act (NEM: BA) for a complete list of alien invasive species found in South Africa.

Acacia cyclops (Red eye wattle)




Category:	CARA 2002 – Category 2 NEMBA – Category 1b
Distribution:	In coastal areas, from the Cape Peninsula to the Eastern Cape.
Spread By:	Seeds dispersed by birds and animals.
Impact:	Red eye is a problem because competes with indigenous species for resources, which threatens biodiversity. It also has the ability to increase the severity of fire.
Uses:	Red eye is used in the commercial firewood industry in Western Cape.
General Description:	General description: An evergreen shrub 1.5-4m high, with bright green elongated leaves and yellow flowers, which was brought to South Africa for the primary purpose of stabilising shifting sand dunes in the Western Cape. Leaves: Straight, bright green leaves, with prominent parallel veins. Flowers: All year round (mainly October to February), with bright yellow globe-shaped flower heads. Fruit/seeds: Broad brown twisted pods, with black seeds encircles by a row of bright red.
Form:	Tree
Control Measures:	Biological control: Acacia seed weevils Mechanical and Chemical: Seedlings & Saplings: Hand pull or hoe. Foliar sprays of Mamba 360 SL (150 ml/10l water) for saplings up to 1 m at 3 l/ha; Garlon 480 EC or Viroaxe (25-75 ml/10l water) for saplings up to 1.5 m at 0.5 to 1.5 l/ha; or Touchdown Forte for saplings up to 2 m at 3 l/ha. Young trees: Foliar sprays with Garlon 480 EC or Viroaxe (75 ml/10l water) at 3 l/ha. For mature plants: Cut or frill and apply Timbrel 360 SL (300 ml/10l water) at 1.5 l/ha to freshly cut areas. Cut and apply mycoherbicide (Stumpout□) to freshly cut stumps. Use triclopyr butoxyethyl ester (Garlon 480 EC or Viroaxe) in areas where grasses occur.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Sand olive *(Dodonea angustifolia)*

Agave sisalana (Sisal)

Category:	Existing legislation: CARA 2002 – Category 2 NEMBA – Category 2
Distribution:	All provinces of South Africa
Impact:	Competes with indigenous species. Prolific suckering can create impenetrable thickets especially where plantations have been abandoned, rendering the land useless for grazing. Leaves are poisonous to livestock.
Spread by:	Seeds and suckering
Uses:	Fibre, security hedging; honey source.
Form:	Succulent
General Description:	General description: Succulent shrub with thick, sword-shaped leaves in a basal rosette up to 2m high. Leaves: The leaves are bright green with tiny toothed to smooth margins. Flowers: Greenish yellow flowers are borne on a 5-6m tall flowering spike from December to March. Fruit/seeds: Capsules up to 40mm long.
Control Measures:	Biological control: Various insect agents are being tested. Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding. Light tillage can destroy seedlings.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.
Replacement Species:	*Phoenix reclinata* or *Aloe* species

Argemone ochroleuca (White flowered Mexican poppy)

Category:	1b – Declared weed. Destroy.
Impact:	Invades wastelands, cultivated lands, roadsides, riverbanks, riverbeds. Declared as weeds because of their aggressive growth habit. Difficult to control and contaminate crop fields and disturbed areas.
Distribution:	Throughout South Africa
Form:	Herb
General Description:	A very spiny annual herb growing up to 90cm high with stems that exude a yellow sap when cut. Grey or bluish-green spiny leaves with prominent white veins. Pale yellow or creamy white flowers appear from September to January. Spiny, oblong green fruit capsules turn.
Control Measures:	Biological control: Various insect agents are being tested. Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding. Light tillage can destroy seedlings.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.
Replacement Species:	Indigenous grasses or herbs

Arundo donax (Giant Reed)

Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	Throughout South Africa in wetlands.
Impact:	Competes with and replaces indigenous species. It forms very dense stands on riverbanks and in riverbeds which results in the narrowing of water channels, increased siltation and the exclusion of smaller and less vigorous riverbank species.
Spread By:	Horizontally from rootstocks.
Uses:	Used as an ornamental for screening, ceilings and musical instruments such as wind chimes.
Form:	Reed
General Description:	General description: A tall and robust reed reaching a height of 2-6m with pale green long and slender leaves. Leaves: Pale green to bluish green leaves long and slender in profile and evenly spaced along the stem. Flowers: Cream or brown, compact, erect, spear-shaped silky inflorescences appear throughout the year. Fruit/seeds: None.
Control Measures:	Biological control: Various insect agents are being tested. Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding. Light tillage can destroy seedlings.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.
Replacement Species:	Common reed (*Phragmites australis*), east coast broomgrass (*Miscanthus capensis*), wireleafe broomgrass (*Miscanthus junceus*), bulrush (*Typha capensis*).

Artiplex nummularia (*Salt bush, Old man*)


Category:	Existing legislation: CARA 2002 – Category 2 NEMBA – Category 2
Distribution:	Western Cape, Eastern Cape, Northern Cape
Impact:	Competes with and has the potential to replace and reduce indigenous species.
Spread By:	Seeds
Uses:	Used to make dry fodder in arid regions.
Form:	Reed
General Description:	-Bark: None -Leaves: Greyish or bluish-green, scaly leaves. -Flowers: Greyish to yellowish minute flowers in compact, drooping clusters from September to January. -Fruit/seeds: Grey-green turning pink or straw-coloured fruits.
Control Measures:	Biological control: Various insect agents are being tested. Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding. Light tillage can destroy seedlings.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.
Replacement Species:	*Tarchonanthus camphoratus* (Wild camphor)

Artiplex inflata (*Sponge fruit saltbush*)



Category:	NEMBA Category 1b
Distribution:	Western Cape, Eastern Cape, Northern Cape
Impact:	It forms dense stands particularly in overgrazed land. Competes with and replaces indigenous
Spread By:	Wind water ,wildlife and humans
Uses:	Cultivated for fodder and animals also uses the plant as fodder.
Form:	Shrub
General Description:	Leaves: Alternate – Silver – grey to bluish-green, scaly, about 2x longer than broad, margins smooth or slightly wavy and toothed. Flowers: Cream to yellow, minute, in tight axillary clusters at the ends of leafy stems. Fruit/seeds: Utricle, grey-green turning pink or straw-coloured, spongy and inflated, sub-globose, upper surface flattened, up to 10 mm long and wide, one seeded.
Control Measures:	Biological control: Various insect agents are being tested. Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding. Light tillage can destroy seedlings.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous.

Cereus jamacaru (Queen of the night)




Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	Scattered parts of the Western Cape, Eastern Cape and Free State and more widespread in Gauteng, KwaZulu-Natal, Mpumalanga and especially Limpopo Province
Spread by:	The seeds are spread by birds and monkeys that feed on the fruits
Impact:	It competes with and replaces indigenous species, forming dense infestations which reduces the carrying capacity of the land and the many spines on the plants cause injuries to grazing animals
General Description:	General description: A spiny tree with thick, succulent branches arising from a short, woody trunk; branches green to blue-green with prominent ribs; ribs sometimes broken and wavy. Flowers: White, showy flowers produced in November-January. Fruit/Seeds: Yellowish-pink to pink or red, succulent berries which are white inside with small, black seeds.
Form:	Weed
Uses:	Used as a hedge, ornamental and birds also feed on the fruits
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Common tree euphorbia (*Euphorbia ingens*), tree aloe (*Aloe barberae*), krantz aloe (*Aloe arborescens*).

Cortaderia selloana (Pampas grass)


Category:	a. NEMBA – Category 1b b. Sterile cultivars or hybrids are not listed.
Distribution:	Western Cape, Eastern Cape, KwaZulu-Natal and Gauteng
Spread by:	This grass spreads by seeds and rhizomes
Impact:	It forms large clumps which displace smaller indigenous species
Form:	Grass
General Description:	General description: A robust, tussock grass growing up to 3,5m in diameter with flowering stalks reaching 4m high. Leaves: Long slender leaves with narrowly tapering tips and grey or bluish-green in colour, often v-shaped in cross-section with rough margins. Flowers: Feathery silvery-white to pink or mauve flowers appearing from February-April. Fruit/Seeds: Produces from an open panicle, containing a large number of seeds.
Control Measures:	Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species of the genera below.
Uses:	Mostly used as an ornamental and for mine dump stabilization
Replacement Species:	East coast broomgrass (*Miscanthus capensis*), riverbed grass (*Pennisetum macrourum*), Cape thatching grass (*Chondropetalum tectorum*), papyrus (*Cyperus papyrus*)

Cylindropuntia imbricata (Cactaceae) (*Imbricate prickly pear*)


Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	All provinces of South Africa
Spread by:	Seed dispersal.
Impact:	Competes with and replaces indigenous species. Dense infestations reduce the grazing potential and hence the carrying capacity of the land. Thickets restrict access of domestic and wild animals. The very spiny cladodes adhere to passing animals and the barbed spines can penetrate their skin and feet causing severe injuries. Spines become entangled in sheep's wool and cause downgrading of the wool. All these factors combine to cause the drastic devaluation of agricultural land.
Form:	Succulent Shrub
General Description:	General description: Spiny, much-branched succulent shrub up to 2m high with an erect main stem. Leaves: Small leaves. Flowers: Showy purple-red flowers appear from November to January. Fruit/seeds: Yellow succulent fruit.
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground. Chemical: Control is possible with several herbicides, such as MSMA and glyphosphate. However, continues to be kept under control by the use of the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*. Special control measures are rarely required. Cochineal insects are not very mobile so isolated plants must be inoculated manually by placing an infected cladode on top of the plant to be controlled.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species of the genera below.
Uses:	Ornamental. Birds eat the fruits.
Replacement Species:	*Euphorbia* and *Aloe* spp.

Cirsium vulgare (Spear/Scotch thistle)

Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	Common throughout the Eastern Cape, KwaZulu-Natal, Gauteng, Mpumalanga, Limpopo and North West Provinces
Uses:	No, this is a problem weed
Spread By:	Seed dispersal - birds eat the seeds and also collect the silky plumes for their nests. Seeds are also spread when caught up in bales of contaminated stock feed
Impact:	It causes heavy infestations that reduce the carrying capacity of the veld and can cause injury to man and animals
Form:	Herb
General Description:	Spiny, herbaceous biennial which forms a large, flat rosette of leaves and a deep tap root in the first year and numerous branched stems up to 1,5m high in the second year. Stems have spiny wings. Dark green leaves with stiff hairs above and white woolly beneath. Pink to mauve thistle-like flowers surrounded by spiny bracts appear from September to April. This plant invades grassland, roadsides, vlei and dam margins and river banks in cool, high rainfall areas General description: Branching, erect biennial growing up to 1,5m tall. Leaves: Leaves are deeply lobed and hairy – there are coarse hairs on the leaf tops and woolly hairs on the underside. Flowers: Flower heads are 'gumdrop' shaped and spines extend all around the base of the flower heads. Flowering occurs from September to April. Fruit/Seeds: Grey with longitudinal darker markings, smooth
Control Measures:	Chemical: Herbicides containing picloram are affective against seedlings. Mechanical: Physical removal of plants prior to seeding. Removal of seed heads prior to seeding.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly (more frequent if necessary) to cut back stems that are starting to flower and for any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses or indigenous species of the genera below.
Replacement Species:	*Ceratotheca triloba* *Vernonia sp.*

Datura ferox (*Large thorn apple*)


Category:	NEMBA – Category 1b – Declared weed. Destroy.
Form:	Herbaceous shrub
General Description:	An erect, sub-herbaceous annual growing up to 1,5m high. The stem is sparsely hairy and pale green in colour. Leaves: Relatively large leaves up to 200mm long with an irregular strongly toothed margin, dark green upper surface and paler underneath the surface of the leaves. Flowers: Funnel-shaped white flowers up to 65mm long appear during summer from October-March. Fruit/Seeds: Produces brown fruit capsules covered with hard spines and numerous tiny black seeds.
Origin & Problem:	Tropical America. It competes with indigenous species.
Distribution:	Found throughout all provinces in South Africa.
Control Measures:	Mechanical: Physical removal of the plants, including the underground parts. This should be done when not seeding. If seeding then the seed heads should be carefully removed and burnt. Chemical: *Datura ferox* is susceptible to glyphosate herbicides.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly to cut back any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses and/or indigenous species mentioned below.
Replacement Species:	Indigenous, local grasses.

Datura stramonium (Common thorn apple)


Category:	CARA 2002 – Category 1 NEMBA - 1b
Distribution:	Found throughout South Africa.
Spread By:	Spread by seed dispersal.
Impact	It competes with crops and indigenous species.
Use:	No, however, the poisonous seeds are used for hallucinogenic purposes – hence the Afrikaans name malpitte.
Form:	Herbaceous shrub
General Description:	General description: Sparsely hairy, green, brown or purple, erect annual herb growing up to 1,5m in height. Leaves: Dark green or purple and paler underneath with the margins coarsely and irregularly toothed or lobed, bad-smelling. Flowers: White, mauve or purplish, narrowly funnel-shaped flowers. Fruit/Seeds: Brown, hardened capsules covered with slender spines.
Control Measures:	Mechanical: Physical hand-pulling removal of the plants. This should be done when not seeding. If seeding then the seed heads should be carefully removed and burnt. Tillage will work to some extent with seedlings. Chemical: *Datura stramonium* is susceptible to a range of soil and foliar herbicides available for agricultural markets.
Monitoring Measures:	Photographic evidence should be kept and photographs taken on each site visit in areas of heavy infestation. Sites will need to be revisited monthly to cut back any re-growth. With the removal of plants soils may become exposed and should be re-vegetated with grasses and/or indigenous species mentioned below.
Replacement Species:	Indigenous, local grasses.

Eucalyptus camaldulensis (Red River Gum)

Category:	a. 1b within i. Riparian areas ii. A protected area as declared by the protected areas act iii. Within a listed ecosystem or an ecosystem identified for conservation in terms of a bioregional plan or biodiversity management plans published under the act b. Not listed in the Nama-Karoo, Succulent Karoo and Desert biomes, excluding within any area mentioned in (a) above. c. Category 1b in fynbos, grassland, savanna, Albany thicket, forest and Indian ocean belt biomes but i. Category 2 for plantations, woodlots, bee-forage areas, wind rows and the lining of avenues ii. Not listed within cultivated land that is at least 50m away from untransformed land, but excluding within any area in (a) above iii. Not listed within 50m of the main house of a farm but excluding in (a) above iv. Not listed in urban areas for trees with a diameter of more than 400mm at 1000m height at the time of publishing this notice.
Distribution:	Throughout South Africa, particularly in the Western Cape, Northern Cape, Gauteng and Free State.
Uses:	Mostly used for shelter, timber, firewood, ornament and as a honey source.
Spread By:	Spreads by seed dispersal.
Impact:	Invades riverine habitats, drainage lines. Red River Gum forms dense stands especially when they become multi-stemmed after the main stem has been cut. The plant is still used as a wind –barrier. Cultivated worldwide. It competes with and replaces indigenous riverine species. Extensive stands along watercourses are likely to cause a significant reduction in stream flow.
Form:	Tree
Control Measures:	<u>Mechanical & Chemical</u> **Seedlings:** Hand pull **Coppice/woody growth:** Foliar sprays of Brush Off at 200 g/ha and Mamba 360 SL at 3 l/ha. **Felled trees:** Cut stumps apply Chopper (1250 ml/10 l water) at 6 l/ha.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Indigenous, local grass species in low infestation. Specialists input may be required in heavily infested areas.

Eucalyptus conferruminata (Spider Gum)

Category:	NEMBA - Category 1b in fynbos, grassland, savannah, Albany thicket, forest and Indian Ocean coastal belt biomes, but – Category 2 for plantations, woodlots, bee - forage areas, wind rows and the lining of avenues.
Distribution:	Northern Cape, Western Cape and Eastern Cape.
Uses:	Ornamental.
Spread By:	Spreads by seed dispersal.
Impact:	Invades riverine habitats, drainage lines. Red River Gum forms dense stands especially when they become multi-stemmed after the main stem has been cut. The plant is still used as a wind –barrier. Cultivated worldwide. It competes with and replaces indigenous riverine species. Extensive stands along watercourses are likely to cause a significant reduction in stream flow.
Form:	Tree
Description	Leaves: Adult leaves are elliptical and 9 x 2.5cm in size, glossy and light green, coloured the same throughout. Flowers: Yellow-green. It flowers in spring or summer. Fruit/seeds: The capsule is greyish - brown, fused into a wooden mass up to 50mm long and 80mm wide.
Control Measures:	Mechanical & Chemical **Seedlings:** Hand pull **Coppice/woody growth:** Foliar sprays of Brush Off at 200 g/ha and Mamba 360 SL at 3 l/ha. **Felled trees:** Cut stumps apply Chopper (1250 ml/10 l water) at 6 l/ha.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Indigenous, local grass species in low infestation. Specialists input may be required in heavily infested areas.

Eichorinia crassipes (Water Hycinth)

Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	Throughout many waterways in the Western Cape, KwaZulu-Natal, Gauteng, Free State and Mpumalanga. It is particularly problematic along vast stretches of the Vaal River.
Uses:	Used as a fishpond or water feature ornamental.
Spread By:	It produces flowers and seeds, otherwise it reproduces by runners.
Impact:	Forms dense mats which completely cover the water surface leading to altered water chemistry and composition at the detriment of other organisms.
Form:	Tree
Description	General description: Perennial, aquatic plant, free-floating or anchored in shallow water, usually 10-20cm high but up to 1m when growing in dense mats; roots of floating plants long and feathery. Leaves: Dark shiny green occurring in rosettes with swollen, bladder-like petioles growing above the surface of the water. Flowers: Pale violet or blue, in 8-10 flowered spikes, upper petal with a prominent dark blue, yellow-centred patch. Flowers from November-April. Fruit/Seeds: Produces capsules with very fine seed.
Control Measures:	Mechanical & Chemical **Seedlings:** Hand pull **Coppice/woody growth:** Foliar sprays of Brush Off at 200 g/ha and Mamba 360 SL at 3 l/ha. **Felled trees:** Cut stumps apply Chopper (1250 ml/10 l water) at 6 l/ha.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	White water-lily (*Nymphaea lotus*), blue water-lily (*Nymphaea nouchali*), small yellow water-lily (*Nymphoides thunbergiana*)

Melia azedarach (Seringa Tree)

Category:	CARA 2002 – Category 3 NEMBA – a. Category 1b b. 3 in urban areas.
Impact:	Invades any habitat especially riverbanks and drainage lines. The Seringa Tree forms dense stands in riparian vegetation. The plant spread easily by means of its yellow berries. Birds and monkeys are effective spreaders of the seed.
Spread By:	Fruits are spread by birds, other animals, water and human activities
Uses:	Birds eat the fruits and it is used as an ornamental and shade
Distribution:	Widespread throughout all provinces in South Africa
General Description:	A large spreading tree growing up to 23m high with reddish-brown, smooth bark. Leaves: Serrated dark glossy green leaves which turn yellow in autumn. Flowers: Clustered purple to lilac flowers and heavily scented appearing from September-November. Fruit/Seeds: Green berries which turn yellow and wrinkled at the end of the season.
Form:	Tree
Control Measures:	Biological control: Acacia seed weevils Mechanical and Chemical: Seedlings & Saplings: Hand pull or hoe. Foliar sprays: Garlon 480 EC or Viroaxe (25-50 ml/10l water) at 0.5 to 2 l/ha. Trees up to 1.5 m: Foliar sprays with Garlon 480 EC or Viroaxe (75 ml/10l water) at 3 l/ha. For mature trees: Cut stump and apply Timbrel 360 SL (300 ml/10l water) at 1.5 l/ha or Mamba 360 SL (200 ml/10l water) at 6 l/ha to freshly cut areas. Frill and apply Mamba 360 SL (2 l/10l water) at 6 l/ha.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Cape chestnut (*Calodendrum capense*), pompom tree (*Dais cotinifolia*), mountain seringa (*Kirkia wilmsii*), white seringa (*Kirkia acuminata*), lowveld chestnut (*Sterculia murex*), lavender tree (*Heteropyxis natalensis*)
Vegetation Status:	Common alien invasive species of the (Svcb 9) Gold Reef Mountain Bushveld (Savannah Biome)

Nicotiana glauca (Wild Tabacco)




Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distributiuon:	All provinces of South Africa
Spread By:	Seed dispersal.
Impact:	Competes with pioneering indigenous species. Can form dense and extensive stands along watercourses after flooding; this is of particular concern in conservation areas such as the Kruger National Park. Unpalatable and poisonous to domestic and wild animals.
General Description:	General description: Evergreen shrub or small tree growing up to 6m high. Leaves: Blue-green, leathery leaves sometimes with purplish tints and smooth margins. Flowers: Yellow, tubular flowers in terminal, drooping clusters appear throughout the year. Fruit/seeds: Brown, four-valved fruit capsules with tiny seeds
Form:	Aquatic Plant
Control Measures:	Biological control: Acacia seed weevils Mechanical and Chemical: Seedlings & Saplings: Hand pull or hoe. Foliar sprays: Garlon 480 EC or Viroaxe (25-50 ml/10l water) at 0.5 to 2 l/ha. Trees up to 1.5 m: Foliar sprays with Garlon 480 EC or Viroaxe (75 ml/10l water) at 3 l/ha. For mature trees: Cut stump and apply Timbrel 360 SL (300 ml/10l water) at 1.5 l/ha or Mamba 360 SL (200 ml/10l water) at 6 l/ha to freshly cut areas. Frill and apply Mamba 360 SL (2 l/10l water) at 6 l/ha.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Cape chestnut (*Calodendrum capense*), pompom tree (*Dais cotinifolia*), mountain seringa (*Kirkia wilmsii*), white seringa (*Kirkia acuminata*), lowveld chestnut (*Sterculia murex*), lavender tree (*Heteropyxis natalensis*)
Uses:	Garden ornament.
Replacement Species:	*N. james brittennia, N. grandiflora*

Opuntia fisus-indica (Sweet Prickly Pear)

Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	All provinces of South Africa
Impact:	Invades savanna and dry grassland. Propagates easily from the seeds and leaf-pads (cladodes). Even a small piece lying on the ground can produce roots and flourish.
Spread By:	Seed dispersal by animals
Uses:	Edible fruits, animal fodder and security hedging.
General Description:	Succulent, branched shrub or tree up to 3m high which forms a sturdy trunk with age. Leaves: Minute leaves. Flowers: Bright yellow or orange showy flowers appearing from October to December. Fruit/seeds: Yellowish turning reddish edible fruit covered with minute spines.
Form:	Shrub
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground. Chemical: Control is possible with several herbicides, such as MSMA and glyphosphate. However, continues to be kept under control by the use of the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*. Special control measures are rarely required. Cochineal insects are not very mobile so isolated plants must be inoculated manually by placing an infected cladode on top of the plant to be controlled.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	*Euphorbia* spp. and *Aloe* spp

Opuntia robusta (Common Prickly Pear)




Category:	NEMBA Category 1a Spineless cultivars and selections are not listed
Distribution:	North West, Free State and Northern Cape Provinces
Spread By:	This species reproduces by stem fragments (i.e. stem segments easily become dislodged and produce roots) and also by seeds. Stem fragments are spread by becoming attached to animals, footwear and vehicles and are also dispersed in dumped garden waste. The fruit are eaten by various animals (e.g. birds and foxes) and the seeds spread in their droppings.
Impact:	It's regarded as an environmental weed.
General Description:	Leaves: - No leaves. Flowers: - The large flowers (5-8 cm across) are yellow and occasionally have reddish-coloured streaks on the outer 'petals' (separate male and female flowers are often produced). Flowering occurs mostly during late spring and summer. Fruit/seeds: - Immature fruit are green in colour, but they turn pinkish to purplish in colour as they mature. These large fruit (7-8 cm long and about 6 cm wide) are fleshy, barrel-shaped or rounded (i.e. globose), and have several tufts of tiny barbed bristles on their surface. The dark red coloured pulp in the centre of the fleshy fruit contains large numbers of seeds (3-5 mm across). These seeds are generally light or dark brown in colour and rounded in shape.
Form:	Succulent Shrub
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground. Chemical: Control is possible with several herbicides, such as MSMA and glyphosphate. However, continues to be kept under control by the use of the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*. Special control measures are rarely required. Cochineal insects are not very mobile so isolated plants must be inoculated manually by placing an infected cladode on top of the plant to be controlled.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	*Euphorbia* spp. and *Aloe* spp

Prosopis glandulosa (Fabaceae) (Honey Mesquite)

Category:	CARA 2002 – Category 2 NEMBA – a. 1b in Eastern Cape, Free State, North-West and Western Cape. b. 3 in Northern Cape. c. The utilisation of the pods for fodder is not listen in the Northern Cape, Eastern Cape, Free State, North-West and Western Cape. d. Not listed elsewhere.
Distribution:	Limpopo, North West, Free State, Eastern Cape, and Western Cape
Spread By:	Spread by seeds
Uses:	Fodder, shade, fuel and as a honey source
Impact:	Prosopis trees are extravagant users of readily available ground-water and dense stands could seriously affect the hydrology of the ecosystems they invade. Dense stands compete with and replace indigenous woody and grassland species. Dense stands produce few pods and thus replace natural pasturage without providing pods in return. Dense stands are virtually impenetrable, restricting the movement of domestic and wild animals and causing injuries
Description:	General description: Multi-stemmed acacia-like shrub or small tree up to 10m high with paired, straight spines and reddish-brown branchless. Leaves: Dark green leaves with leaflets 10-25mm long. Flowers: Yellow flower spikes from June to November. Fruit/Seeds: Yellowish to purplish, slender, straight, woody pods. Pods poisonous and pollen is a respiratory tract irritant
Form:	Shrub
Control Measures:	<u>Mechanical:</u> Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.

Pyracantha crenulata (Himalayan firethorn)

Category:	NEMBA Category 1b.
Description:	An evergreen shrub or small tree. It has spiny branches bearing simple leaves. Leaves: It has glossy green leaves up to 5cm long and 8mm wide. Flowers: Flowers are white with five petals and numerous stamens, 8–12mm across, occurring in clusters of 30 flowers along short stems. Fruit/seeds: Fruit is red, orange or yellow and occur along the stems where the flowers were. Berries look like tiny apples, 5–9mm in diameter, and contain seeds. The seeds are brown and irregular in shape, about 2.5mm across.
Form:	Shrub
Origin & Problem:	Western China. The seeds are poisonous if ingested and may result in vomiting.
Distribution:	Mpumalanga, Gauteng, Northern Cape, Limpopo, Free State and Eastern Cape.
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.

Black locust (Robinia pseudoacacia)

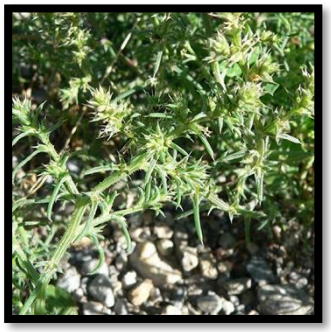


Category:	NEMBA – Category 1b
General Description:	A deciduous tree reaching up to 25m high, but often smaller with dark brown and deeply furrowed bark. Leaves: Small, bright green leaves above and paler beneath which become yellow in autumn and rounded at the tips. Flowers: White, fragrant flowers in drooping clusters appear from September to November. Fruit/seeds: Reddish-brown pods.
Form:	Tree
Distribution:	All provinces in South Africa
Origin & Problem:	North America. Competes with and replaces indigenous species.
Control Measures:	Mechanical and Chemical: Seedlings & Saplings: Hand pull or hoe. Foliar sprays of Mamba 360 SL (150 ml/10l water) for saplings up to 1 m at 3 l/ha; Garlon 480 EC or Viroaxe (25-75 ml/10l water) for saplings up to 1.5 m at 0.5 to 1.5 l/ha; or Touchdown Forte for saplings up to 2 m at 3 l/ha. Young trees: Foliar sprays with Garlon 480 EC or Viroaxe (75 ml/10l water) at 3 l/ha. For mature plants: Cut or frill and apply Timbrel 360 SL (300 ml/10l water) at 1.5 l/ha to freshly cut areas. Cut and apply mycoherbicide (Stumpout□) to freshly cut stumps. Use triclopyr butoxyethyl ester (Garlon 480 EC or Viroaxe) in areas where grasses occur.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Ankle thorn (*Acacia robusta*), hook thorn (*Acacia caffra),* weeping wattle (*Peltophorum africanum*)

Ricinus communis (Castor-oil plant)

Category:	CARA 2002 – Category 2 NEMBA – Category 2
Distribution:	All provinces in South Africa
Spread By:	Seed dispersal
Impact:	Competes with indigenous pioneering species especially in watercourses. Extremely poisonous.
General Description:	A very distinctive plant with green, spreading star-shaped leaves and tall, spiky fruit capsules. Leaves: Shiny, star-shaped dark green or reddish leaves that are paler below with serrated margins. Flowers: Upper flowers are reddish and lower flowers cream. Fruit/seeds: Green, brown or reddish, three-lobed capsules covered with soft spines protruding from the top of the plant.
Form:	Shrub
Uses:	Ornament, castor-oil
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.

Salsola tragus (*Russian tumbleweed*)

Category:	NEMBA Category 1b.
Distribution:	Western Cape, Eastern Cape, Northern Cape, Free State, North West, Limpopo and Gauteng.
Spread By:	Seeds are dispersed over large areas as it tumbles along in the wind.
Impact:	It reduces the yield and quality of numerous agricultural crops such as alfalfa and small grains. It depletes soil moisture and interferes with cultivation operations. It also acts as a shelter food for many insects, vertebrate pests as well as crop diseases such as curly top.
General Description:	Leaves: Leaves are alternate, upper opposite and stalk less. Blades are fleshy, long linear to thread-like, grooved at the base and spine-tipped. Flowers: Regular, small flowers that are white or membranous perianth consisting of five segments. Fruit/seeds: The fruit is a brown, cup-shaped, one-seeded achene. The sepals have a broad longitudinal appendage at the dorsal side.
Form:	Weed
Uses:	The shoots and tips of a young growing plant are edible and can be cooked like greens. They are also used as animal feed.
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Dwarf coral tree (*Erythrina humeana*), September bush (*Polygala myrtifolia*), purple broom (*Polygala virgata*), wild pomegranate (*Burchellia bubalina*)

Solanum elaegnifolium (Silver Leaf Bitter Apple)



Category:	1b – Declared weed. Destroy.
Distribution:	It is found in all provinces in South Africa
Description:	General description: An herbaceous shrub growing up to 60cm high with felty leaves and stems. Leaves: Greyish or silvery-green leaves, often wavy and folded upwards along their midribs. Flowers: Mauve, blue or white flowers appear from October to March. Fruit/seeds: Shiny green berries with white patches, eventually turning yellow
Form:	Shrub
Control Measures:	Mechanical: **Seedlings & saplings:** Hand pull. **All plants:** Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after treatment. Heavily infested areas should be revisited and treated if and as necessary every 6 months.
Replacement Species:	Indigenous, local grass species.

Sesbania punicea (Fabaceae)




Category:	1b
Distribution:	It is found in all provinces in South Africa
Spread By:	Seed dispersal
Impact:	Competes with and replaces indigenous riverine and wetland species. Poisonous, especially the seeds, which are lethal to birds, mammals and reptiles
General Description:	Evergreen shrub or small tree growing up to 4m high. Leaves: Leaves are bright green above, paler below, with sharply toothed margins Flowers: Bright yellow, showy, trumpet-shaped flowers in terminal sprays from October to May. Fruit/seeds: Brown, shiny fruit capsules 12-20cm long that split open to release papery winged seeds.
Form:	Tree
Uses:	Ornament.
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Dwarf coral tree (*Erythrina humeana*), September bush (*Polygala myrtifolia*), purple broom (*Polygala virgata*), wild pomegranate (*Burchellia bubalina*)

Tamarix chinensis (*Chinese tamarisk*)




Category:	Existing legislation: CARA 2002 – Category 1 NEMBA – Category 1b
Distribution:	Western, Eastern and Northern Cape, Free State, Mpumalanga and Limpopo.
Spread By:	Seed dispersal
Impact:	Competes with and replaces indigenous species. Dense stands could significantly reduce stream flow and groundwater reserves.
General Description:	General description: Leaves: Deep green, greyish or bluish-green leaves are minute and scale-like. Flowers: Pale to purplish-pink flowers in clusters 15-70mm long at the end of thin, long twigs. Fruit/seeds: Fruits are papery capsules 3-4mm long.
Form:	Shrub
Uses:	Shade, ornament, erosion control; honey source.
Control Measures:	Mechanical: Seedlings & saplings: Hand pull. All plants: Cut close to ground. Chemical: Control is possible with several herbicides, such as MSMA and glyphosphate. However, continues to be kept under control by the use of the Cactoblastis moth and a cochineal insect, *Dactylopius opuntiae*. Special control measures are rarely required. Cochineal insects are not very mobile so isolated plants must be inoculated manually by placing an infected cladode on top of the plant to be controlled.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after chemical application and treated as required. Heavily infested areas should be revisited and treated if and as necessary at least every 6 months.
Replacement Species:	Tamarix usneoides

Xanthium spinosum (Spiny Cocklebur)

Category:	NEMBA – Category 1b – Declared weed. Destroy.
Description:	A many branched annual growing up to 1,2m high. Yellowish or brownish-grey, downy stems. Green leaves which are densely white-woolly beneath and sparsely downy above. Each leaf base is armed with a yellow, three-pronged spine up to 2cm long. Pale yellowish burrs covered with spines.
Form:	Herbaceous shrub
Origin & Problem:	South America. Competes with crop plants and indigenous species along riverbanks. Its spiny burs adhere to the wool of sheep and become entwined in tails, manes and coats of domestic livestock, causing the animals much discomfort. The seedlings are particularly toxic to domestic livestock. It readily invades overgrazed pastures and spreads at the expense of the indigenous species.
Distribution:	Throughout all provinces in South Africa.
Control Measures:	Mechanical: Hand pull. Remove underground parts preferably when not seeding. Remove seed heads carefully and dispose of. Chemical: Susceptible to a range of soil and foliar herbicides available for agricultural markets.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after treatment. Heavily infested areas should be revisited and treated if and as necessary every 6 months.
Replacement Species:	Indigenous, local grass species.

Xanthium strumarium (Large cocklebur)

Category:	NEMBA – Category 1b – Declared weed. Destroy.
Description:	This is an herbaceous shrub growing up to 1,2m high. The erect stems are brownish or reddish-brown, often with red spots, ribbed and roughly downy. The leaves are dull green, and broad, three-lobed with serrated margins and downy on both sides. Brownish burrs up to 2cm long crowned with two stout horns and covered with hooked spines up to 4mm long.
Form:	Herbaceous shrub
Distribution:	Throughout all provinces in South Africa, particularly the eastern regions.
Origin & Problem:	Competes with crop plants and indigenous species along riverbanks. Its spiny burs adhere to the wool of sheep wool and becomes entwined in tails, manes and coats of domestic livestock, causing the animals much discomfort. The seedlings are particularly toxic to domestic livestock. It readily invades overgrazed pastures and spreads at the expense of the indigenous species.
Control Measures:	Mechanical: Hand pull. Remove underground parts preferably when not seeding. Remove seed heads carefully and dispose of. Chemical: Susceptible to a range of soil and foliar herbicides available for agricultural markets.
Monitoring Measures:	Photographic records should be kept of infested areas and should be taken at each visit. Re-growth should be monitored 2 and 4 months after treatment. Heavily infested areas should be revisited and treated if and as necessary every 6 months.
Replacement Species:	Indigenous, local grass species.