



APPENDIX I – ENVIRONMENTAL MANAGEMENT PROGRAMME

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ENVIRONMENTAL MANAGEMENT PROGRAMME

PORTION 54 OF FARM 516, POTTEBERG ESTATES, INFANTA



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KEY TERMS AND ABBREVIATIONS

Auditing - A systematic and objective assessment of an organization's activities and services conducted and documented on a periodic basis to a predetermined standard.

Contractor –

- (i) the main or specialised contractors as engaged by the applicant from time to time for the execution of the works, including all sub-contractors appointed by the main contractor of his own volition for the execution of parts of the works;
- (ii) any other contractor from time to time engaged by the applicant directly in connection with any part of the Works which is not a nominated subcontractor or a subcontractor to the main contractor.

Council – the local authority, Swellendam Local Municipality, its successors in title or assigns.

Department of Environmental Affairs and Development Planning (DEA&DP)– the provincial authority for sustainable environmental management and integrated development planning.

Developer/ Owner/ Applicant – WABD Investments (Pty) Ltd

Environmental Management Programme (EMPr) an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation, and decommissioning of a project are managed, and that positive benefit of the projects are enhanced.

Environmental Control Officer (ECO) – a suitably qualified environmental consultant to be appointed by the Owner to oversee the implementation of the EMPr until the completion of works on the site.

National Environmental Management Act (Act 107 of 1998, as amended) (NEMA)– national legislation that provides principles for decision-making on matters that affect the environment.

National Water Act (NWA) – national legislation that provides principles for decision making on matters that relate to watercourse/water use/water bodies.

Alien Invasive Plants (AIP)– Introduced, non-indigenous plant species that out-compete indigenous vegetation and disrupt natural ecosystem processes.

Site - Area where the proposed development will take place

Workdays – the days of the week excluding Sundays and public holidays.

SECTION 1: CONTEXTUAL INFORMATION

1.1. Project Background

This report aims to supply an Environmental Management Programme (EMPr) for the management of Portion 54 of Farm 516, Potteberg Estates, Infanta. The farm is located within the Swellendam rural area between Malgas and Infanta, approximately 13 kilometres northwest of Infanta and borders the Breede River which is located to the north of the property (Figure 1). Access to the farm is obtained via existing gravel roads leading off the Malgas/Infanta main gravel road. The farm is situated within a rural landscape, with surrounding land predominantly natural and subject to varying degrees of alien invasive vegetation. Historically, the property has been used solely for residential purposes. The current owner would like to continue the residential use of the property through the expansion of the existing main dwelling onsite and addition of a caretaker's cottage.

In February 2024, development activities—including vegetation clearance, excavation, and construction within 100m of an estuary—commenced onsite without the required Environmental Authorization (EA) (Figure 2). The applicant intends on applying for retrospective environmental authorization. This EMPr forms part of the application documentation and incorporates the findings of specialist assessments undertaken to evaluate the impacts of the activities already carried out, as well as measures required to manage, mitigate, and avoid future impacts.

This EMPr describes management and mitigation measures in detail, and is prescriptive, identifying specific individuals responsible for undertaking specific tasks to ensure that impacts on the environment are minimized during construction, operational and related activities. This EMPr is an open-ended document and information gained during on-going monitoring of procedures on site could lead to changes in the recommendations and specifications of this document.

This document forms an agreement between the Department of Environmental Affairs and Development Planning (DEA&DP) and the Applicant that the environmentally sensitive features on the site will be suitably protected during the lifespan of the activity through the implementation of the applicable mitigation measures.

1.2. Activity Description

The following activities have already taken place on site:

- Unlawful clearing and levelling of approximately 0.24 ha (2363 m²) around the existing main dwelling (Footprint 1) – *to be retained*.

- Unlawful clearing and soil removal of approximately 0.12 ha (1206 m²) within a floodplain saltmarsh (Footprint 2) – *to be rehabilitated*.
- Unlawful clearing of approximately 0.02 ha (267 m²) in the southern portion of the property adjacent to the access road (Footprint 3) – *200m² to be retained*.
- Construction of an approximately 64 m² double garage within Footprint 1 – *to be retained*.
- Construction of an approximately 8 m² pumproom within Footprint 1 – *to be retained*.
- Construction of an approximately 36 m² caretaker's cottage within Footprint 3 – *to be retained*.

The following development activities are still to be completed:

- Proposed additions to the existing main dwelling within Footprint 1, comprising a bedroom extension (approximately 72 m²), a roofed deck area (approximately 164 m²), and a carport (approximately 54 m²).
- Landscaping with primarily indigenous vegetation within all remaining disturbed portions of Footprints 1 and 3 not occupied by structures or access roads.
- Rehabilitation of the floodplain saltmarsh within Footprint 2, where unauthorized clearing occurred and where no development is proposed.



Figure 1: Location of Portion 54 of Farm 516, Potteberg Estates, Infanta



Figure 2: Site map indicating the location of the cleared areas within Portion 54 of Farm 516, Potteberg Estates, Infanta.

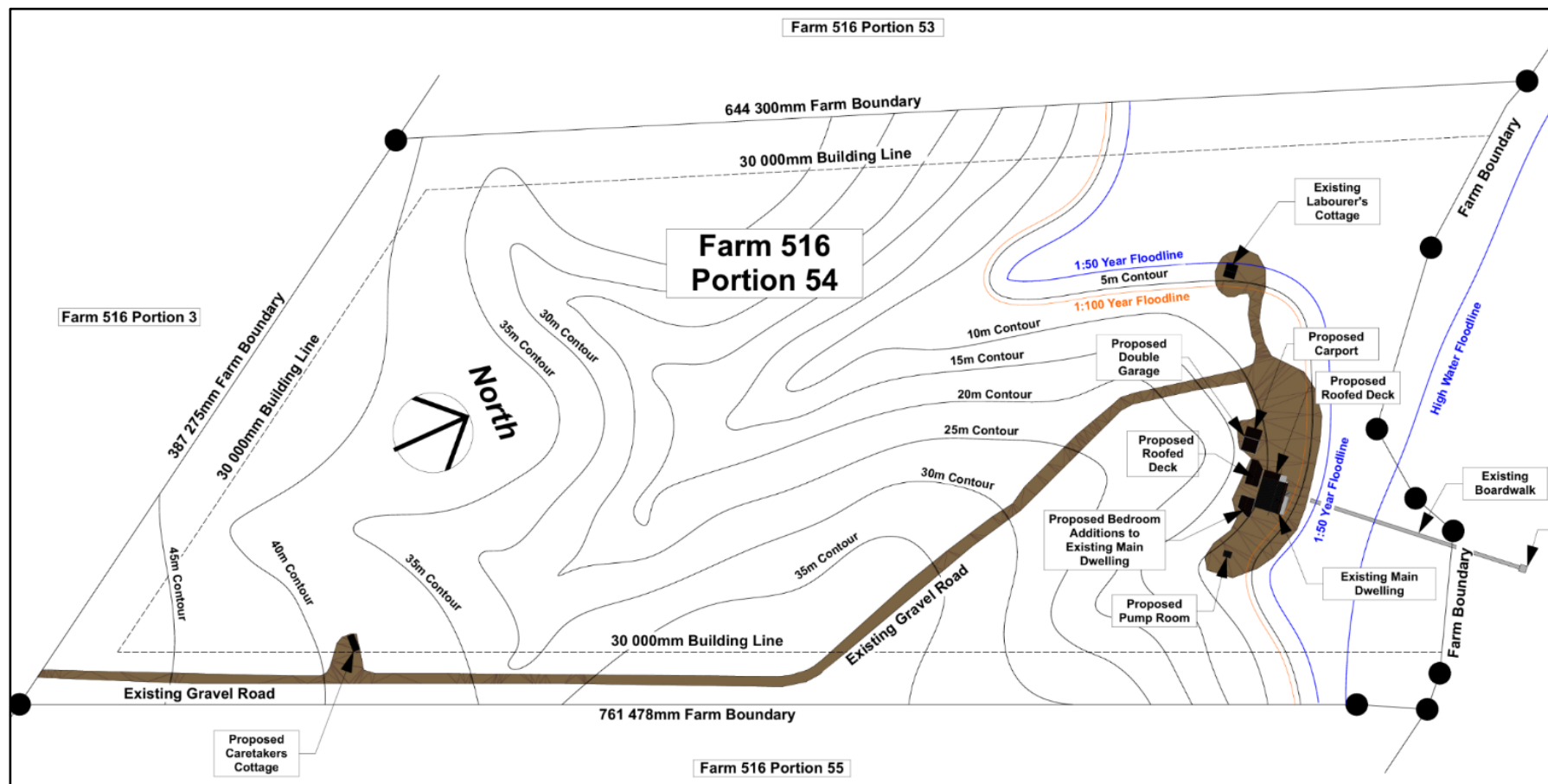


Figure 3: Proposed Site Development Plan

1.3. Relevant legislation and policies

This EMPr aims to highlight historic design, capacity, management, and use issues and proposes a means to manage these within the framework of environmental best practice, the guiding principles of the National Environmental Management Amendment Act (Act 62 of 2008).

The following is a list of the legislation that may be pertinent to the project and its long-term operational management. All activities on site must ensure compliance with the provisions of the legislation as applicable:

- The Constitution of the Republic of South Africa (Act 108 of 1996)
- National Environmental Management Act (Act 107 of 1998) – NEMA
- Government Notices 327, 325 and 324 in terms of NEMA
- National Water Act 1998 (Act 36 of 1998) – NWA
- National Environmental Management: Biodiversity Act 2004 (Act 10 OF 2004)
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) Alien and Invasive Species regulations
- The National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) ("ICMA").
- National Building Regulations and Building Standards Act No. 103 Of 1977
- Natural Heritage Resources Act 1999 (Act 25 of 1999)
- Occupational Health and Safety Act (No. 85 of 1993)
- National Veld and Forest Fire Act, Act 101 of 1998
- Basic Conditions of Employment Act 75 of 1997
- Conservation of Agricultural Resources Act 43 of 1983

1.4. The EMPr Document

The purpose of this Environmental Management Programme (EMPr) is to ensure that the environmental impacts associated with the various phases of the proposed development are effectively managed, mitigated, and kept to a minimum. The EMPr provides clearly defined and easily understood actions that must be implemented during each phase of the development in order to achieve the required environmental outcomes.

The EMPr is a dynamic document that is flexible and responsive to new or changing circumstances. It is legally binding on the Applicant, all contractors, sub-contractors, employees, and visitors to the site. The EMPr must be incorporated into all tender documents, contractual agreements, and conditions of appointment between the Applicant and any contractors.

The Environmental Authorisation (EA) confers legal status on the EMPr and any approved amendments thereto. This EMPr includes all relevant documentation contained within, and referenced by, this report and must be read in conjunction with all legally obtained authorisations, including the EA. Approval of the EMPr by the Department of Environmental Affairs and Development Planning (DEA&DP) requires that the applicant and all appointed contractors comply fully with its provisions. Any amendments, changes, or upgrades to the EMPr must be submitted to and approved by DEA&DP before implementation.

Copies of the EMPr must be kept on site and made available to all senior personnel, who are required to familiarise themselves with its contents and ensure that the prescribed procedures are implemented accordingly.

The EMPr forms part of the contractual framework for this project and identifies the procedures to be followed by all contractors and employees to eliminate or reduce adverse environmental impacts associated with the works. Should any contractor or employee persistently fail to comply with the provisions of the EMPr, the Environmental Control Officer (ECO) may recommend that the individual be removed from the site. Should the owner or any employee continue to disregard the EMPr requirements, the ECO must notify the relevant authority to initiate a compliance audit.

The EMPr further sets out environmental goals and objectives required to achieve acceptable environmental standards. Issues identified in the Section 24G report must be addressed during the construction and operational phases to ensure that environmental impacts are appropriately mitigated.

The Applicant is ultimately responsible for the overall implementation of the EMPr.

NOTE: This EMPr incorporates the findings of the Botanical and Faunal Impact Assessment (September 2025) and the Aquatic Ecosystems Impact Assessment (November 2025) undertaken for the site. The identified risks have been incorporated into the EMPr, and additional general risks have been included. The EMPr must be implemented in conjunction with conditions contained in the Environmental Authorization. The applicant and ECO must use the above-mentioned documents throughout the operation of the development. This should also become a condition in the Environmental Authorization.

SECTION 2: PROJECT PHASES

2.1. Construction Phase

The construction phase relates to the physical construction activities associated with the development on the farm and includes all earthworks, building works, and the installation of services (including water, sewerage, and electricity). Vegetation clearance and bulk earthworks required for the proposed development have already been completed, and a garage, pump room, and caretaker's cottage have been constructed. The construction works still to be completed onsite relate to the proposed additions to the existing main dwelling, comprising a bedroom extension (approximately 72 m²), a roofed deck area (approximately 164 m²), and a carport (approximately 54 m²).

The applicant must ensure that the construction phase is conducted in accordance with the 'duty of care' principle as set out in the National Environmental Management Act (Act No. 107 of 1998). No expansion of the approved development footprint may occur without prior environmental authorisation.

2.2. Operational Phase

The operational phase refers to the ongoing activities associated with the use and occupation of the development once construction has been completed.

The following activities form part of the operational phase of the development:

- Site occupation and use by the landowner
- General maintenance of buildings, associated infrastructure and access roads
- Operation and servicing of service infrastructure (water supply, sewerage systems, electricity and stormwater management)
- Waste management, including storage and lawful disposal of domestic waste
- Clearing and control of alien invasive plants (AIPs)
- Maintenance of landscaped and garden areas

The applicant must ensure that the operational phase is conducted in accordance with the 'duty of care' principle as set out in the National Environmental Management Act (Act No. 107 of 1998). No expansion of the approved development footprint may occur without prior environmental authorisation.

2.3. Mitigation and Rehabilitation Phase

The terrestrial and aquatic ecologists appointed for the project have recommended mitigation measures to address and reduce the negative impacts associated with the development activities already undertaken. These measures include the rehabilitation of selected disturbed areas, as well as the removal and ongoing management of AIPs across the property.

A site-specific Rehabilitation Plan is included in Section 7 of this EMPr and a site-specific AIP Management Plan is included as are included in Section 8 of this EMPr. These plans incorporate the recommendations and mitigation measures outlined in the Faunal and Botanical Impact Assessment (Helme, 2025) and the Aquatic Ecosystems Impact Assessment (Snyman, 2025).

SECTION 3: RESPONSIBILITIES AND ENFORCEMENT OF THE EMPR

3.1. The Competent Authority

DEA&DP will review the EMPr and on approval they may have the following role to play:

- Review and monitor implementation of the EMPr;
- Review whether there is compliance by the applicant;
- Perform random control checks;
- Review ECO, incident and audit reports;
- Enforce legal mechanisms for contraventions of the EMPr.

3.2. The Applicant

The holder of the EA (i.e. the applicant) is accountable for the potential impacts of the activities that are undertaken and is responsible for managing these impacts. The Applicant has the overall environmental responsibility to ensure that the implementation of the operational requirements complies with the relevant legislation and the conditions of the approved EMPr. The Applicant is also responsible for ensuring that all other environmental related legislation is complied with. The Applicant is responsible for the development and implementation of the conditions of the EA in terms of the life cycle of the development.

Amongst the general responsibilities above the Applicant is also responsible for:

- Appointing a Site Manager, ECO and where required an Environmental Auditor.
- Take the necessary action in terms of non-compliances.

- Ensuring that all the applicant's, staff, representatives, contractors, consultants and any other agent operating under the employ of the applicant comply with the EA and that suitable environmental awareness training is undertaken.
- Considering the ECO's observations and recommendations and acting where required.

3.3. The Contractor

The contractor will be required, where specified, to provide Method Statements setting out in detail how the management actions contained in an EMPr will be implemented in order to ensure that the environmental management objectives are achieved. The responsibilities will include:

- Demarcate the no-go areas within the vicinity of the proposed activities through the appropriate methods as discussed and agreed upon with the ECO.
- To oversee the implementation of environmental procedures set out in this document.
- The Contractor must ensure that all management staff involved with the project are aware and familiar with the requirements of this EMPr.
- Provide inputs to the regular (e.g. monthly) environment report to be prepared by the ECO.
- Liaise with the 'construction team' on issues related to implementation of, and compliance with, the EMPr.

3.4. The Site Manager

A Site Manager must be identified to assume overall responsibility for managing the property, employees, and contractors and for ensuring that the environmental management requirements are met. All decisions regarding environmental procedures and protocol must be approved by the site manager, who also has the authority to stop any activity in contravention of the EMPr.

The site manager will have the following environmental control responsibilities:

- Present environmental awareness training to all contractors/staff in conjunction with the ECO.
- Regularly monitor the site and operation of the facility for potential environmental issues. It is recommended that weekly site inspections are undertaken during the construction phase of the development.
- Consult with the ECO, landowner, and all staff/contractors to resolve emerging environmental issues,
- Issue any instructions from the ECO to the management team via an appropriate management tool, and
- Keep a Site Control Register consisting of the following sections (please refer to Appendix A for a template):

- The **Site Control Sheet and Site Instruction Section** will be used to record observations and comments from weekly site monitoring relating to potential environmental aspects and any issues encountered during site works. This section will also be used to document general site instructions aimed at protecting environmentally sensitive areas or any site features that may be potentially impacted by the works.
- The **Incidents Reporting Section** will be used to record all incidents pertaining to environmental issues onsite as well as remedial actions steps that were or need to be taken [refer to Appendix A for a incident report template]
- The **Complaints Register** will be used to record all complaints received and responses thereto.

Please note the above list is not exhaustive, the responsibilities of the site manager are adaptive.

3.5. The Environmental Control Officer (ECO)

A suitably qualified individual must be designated and appointed by the Landowner to fulfill the role of Environmental Control Officer, to ensure and oversee the implementation of the EMPr onsite during construction. The role of the ECO is essentially seen as an interactive one which involves site visits approximately once a month during construction. Site visits may need to be less frequently during certain stages of the development, depending on the sensitivity of the area in which construction is taking place.

The responsibilities of the ECO during the life span of the project will include:

- Monitor compliance with the EMPr
- To environmentally educate and raise the awareness of the Contractors and their staff as to the sensitivity of the site.
- Review method statements and advise on environmentally responsible practices
- Maintain open and direct communication with the landowner, site manager, contractors, and authorities
- Monitor site activities and report on environmental performance and non-compliance
- To take immediate action on site where clearly defined no-go areas are violated, or in danger of being violated, and to inform the RE and Site Manager immediately of the documents and the action taken.
- To keep an up-to-date record of works on site, as they relate environmental issues.
- To be contactable by the public regarding matters of environmental concern as they relate to the development.

3.6 The Environmental Auditor

Where required by the EA an environmental auditor will be appointed by the applicant. The auditor will be an independent environmental consultant. The auditor will carry out a compliance audit based on the EA and EMPr of all of the activities being undertaken. The auditor will conduct, and report audit findings based on the audit requirements stipulated in the EA. Any audit costs are for the applicant account.

SECTION 4: ENVIRONMENTAL IMPACTS

4.1. Potential Environmental Impacts

The following possible impacts have been identified within the existing and proposed scope of work for the project phases:

IDENTIFIED IMPACTS	SIGNIFICANCE PRIOR TO MITIGATION	SIGNIFICANCE POST MITIGATION
PLANNING, DESIGN & CONSTRUCTION PHASES		
Excavation to expand the existing house platform resulting in localised disturbance of soil and landform, with potential for erosion.	Low-Medium Negative	Low Negative
Soil removal altering the geomorphology within the Floodplain Saltmarsh Wetland	Low-Medium Negative	Low Negative
Hardening and compaction of soil within a largely natural landscape	Low-Medium Negative	Low Negative
Removal of indigenous vegetation – Permanent Loss	Low-Medium Negative	Low-Medium Negative
Removal of indigenous vegetation – Temporary Loss	Low-Medium Negative	Low Negative
Plant SoCC – Loss of footprint subpopulations of 3 or 4 plant species of conservation concern	Low-Medium Negative	Low-Medium Negative
Faunal Impact – Permanent & temporary habitat loss	Low Negative	Low Negative
Loss of biodiversity & ecological function within the Floodplain Saltmarsh	Low-Medium Negative	Low Negative
Potential sedimentation and water quality impacts on the Breede River Estuarine Functional Zone.	Low Negative	Low-Negligible Negative

Employment (direct and indirect) during construction	Low Positive	Low Positive
Stimulation of the local economy and supply chain through the procurement of goods and services during construction.	Low Positive	Low Positive
Noise created during construction	Low Negative	Very Low Negative
Dust created during construction	Low Negative	Very Low Negative
Waste generation from construction activities – general construction waste.	Low Negative	Low Negative
Visual Impact during construction activities	Low Negative	Low Negative
OPERATIONAL PHASE		
Increased hardened surfaces within a largely natural landscape	Low Negative	Very Low Negative
Habitat fragmentation	Low Negative	Low Positive
Local increase in alien invasive vegetation caused by soil disturbance	Low Negative	Low Positive
Proposed rehabilitation activities within the floodplain saltmarsh wetland altering surrounding geomorphology	Low Negative	Low Positive
Employment (direct and indirect) creation	Low Positive	Low Positive
Waste generation from operational activities – sewage, domestic waste, garden waste	Low Negative	Low Negative
Visual impact of expanded development footprint	Low Negative	Low Negative
DECOMMISSIONING AND CLOSURE PHASES (NO-GO ALTERNATIVE)		
Removal of new infrastructure onsite. Existing infrastructure and land left derelict.	Low Negative	Low Negative
Extensive ongoing alien plant invasion	Low-Medium Negative	Low-Medium Negative
Loss of operational phase long term employment	Low Negative	Low Negative

4.2. Mitigation Measures

The following mitigation measures have been identified and must be implemented in full in order to mitigate the above-mentioned impacts to acceptable levels:

- No further excavation or soil disturbance (including machine scraping) should be allowed anywhere onsite, unless authorised via a formal environmental application process.
- Reuse excavated material onsite where feasible or dispose of it at an approved off-site facility. Do not store or dispose of excavated material onsite. No excavated material may be stockpiled or temporarily stored within 32 m of any delineated watercourse.
- Stabilise any of the remaining exposed soils using geotextiles, mulch, and/or vegetative cover.
- Rehabilitate all undeveloped and disturbed areas surrounding the main dwelling through planned landscaping with locally indigenous vegetation, with particular emphasis on the revegetation and stabilisation of cleared slopes.
- Install temporary silt fences or sediment traps if and where necessary during rehabilitation of the slopes within the cleared area around the main dwelling.
- Monitor rehabilitated areas and undertake follow-up maintenance to ensure successful vegetation establishment.
- Maintain active erosion monitoring throughout the development's lifecycle. If erosion has occurred, it must immediately be rehabilitated through stabilisation of embankments and revegetation, where applicable.
- Incorporate suitable stormwater management measures into the overall development design to avoid the generation of concentrated runoff and associated erosion. Effective stormwater management must include measures to slow, spread and deplete the energy of concentrated flows thorough effective stabilisation and the re-vegetation of any disturbed areas.
- Rehabilitate disturbed areas of the floodplain saltmarsh wetland using locally indigenous wetland and riparian plant species. This would include mostly *Salicornia perennis*, *Atriplex semibaccata* and *Disphyma crassifolium* for the floodplain marsh. Please refer to section 7 of the EMPr for detailed rehabilitation actions.
- Identify and remove invasive plant species within and adjacent to the wetland and riparian areas as per Section 8 of the EMPr. This would include mostly *Acacia saligna*.
- Implement follow-up monitoring and control at least annually to prevent re-establishment as per Section 8 of the EMPr.
- A buffer zone of 20m should be applied around the floodplain saltmarsh, with all future activities kept outside of this area.
- A buffer zone of 30m should be applied around the Breede River Estuarine Functional Zone, with all future activities kept outside of this area.

- Use existing farm roads and tracks for all onsite vehicle and machinery movement. Avoid traversing natural areas except where necessary for alien invasive vegetation clearing, in accordance with the EMPr.
- All woody invasive alien vegetation (notably *Acacia cyclops* and *A. saligna*) within 100m of all footprints noted in this report (i.e. new houses, levelled areas, new garage, depression area, and prefab house) must be felled, using appropriate methodology (following best practise as outlined in Martens et al 2021). No heavy machinery may be used, and stems should be cut at close to ground level and immediately painted (not sprayed) with a suitable herbicide such as Garlon (but this not necessary for Rooikrans). This must be completed within one year of Environmental Authorisation and should be externally audited as per Section 8 of this EMPr.
- A team trained in invasive alien invasive plant management (see Martens et al 2021) should be appointed to remove all woody alien invasive species on the on the applicant property (section of Portion 54 of Potteberg Estate 516) over the next three years, as well as all seedlings of invasive alien *Acacia* species, such that there is less than 1% overall woody alien vegetation cover on the property. The least densely invaded areas should be cleared first, as this is the most cost and ecologically effective strategy. This must be completed within three years of the date of Environmental Authorisation (thus at a rate of about 8ha/yr), and should be externally audited as per Section 8 of this EMPr. If not adequately completed within three years the DEA&DP or similar authority should be tasked with enforcing this. The only alien trees that could be kept are a few of the larger Rooikrans (*Acacia cyclops*) in the vicinity of the main house and outbuildings, which may be needed for screening or shade.
- No spraying of herbicide should be allowed anywhere where there is any natural vegetation.
- All natural vegetation in moderate to good condition on the applicant property (about 23.4ha in total, excluding just the built and developed footprints) should be signed up with CapeNature's Stewardship program within one year of any authorisation, with the applicant being responsible for all costs associated with this registration, and all Stewardship site management costs going forward.
- No alien invasive kikuyu grass (*Cenchrus clandestinus*) should be planted anywhere on site.
- Keep working hours 7am to 6pm during weekdays, work half day on Saturdays and no work on Sundays or public holidays.
- All vehicles and machinery/equipment used onsite must be well maintained and kept in good working order to prevent excessive noise
- A suitable speed limit of 20-40km/h must be enforced on all private access roads.
- Revegetated cleared areas around development as soon as possible after clearing (already partially implemented around main dwelling).
- Minimise new materials brought on site.
- Reuse existing materials where possible.
- No burning of waste on site
- Maximise recycling of waste from construction activities.

- Provide portable toilets where work is being undertaken (1 toilet per 10 workers). These toilets must be located on level ground within the already disturbed footprint of the main dwelling and more than 30m from the edge of the Breede River Estuarine Functional Zone. Portable toilets must be regularly serviced and maintained.
- Provide an adequate number of bins on site and encourage construction personnel to dispose of their waste responsibly.
- Waste should be stored in closed containers to prevent dispersal by wind.
- Waste generated by construction personnel must be removed from the development area and disposed of at a registered waste disposal facility on a weekly basis.
- No material (incl. excavated material, building materials or removed vegetation) may be stockpiled, temporarily stored, or dumped within 32m of the delineated onsite wetlands or Breede River Estuarine Functional Zone
- Spoil material must be appropriately disposed of at a registered waste disposal facility.
- The Contractor must ensure that no building rubble or waste is left behind onsite.
- All construction waste must be disposed of at an appropriate registered facility.
- As far as possible carry out wetland rehabilitation activities manually without the use of heavy vehicles or machinery.
- Limit work areas to cleared areas only. No disturbance should occur within the adjacent (uncleared) portions of this wetland system. The only disturbance permitted within these areas is that related to alien invasive vegetation clearance as outlined in the EMPr.
- Educate users on recycling and resource saving initiatives
- Separate waste at source and suitably dispose of all waste generated onsite at a registered landfill.
- Domestic waste should be removed from the site to the Infanta transfer station at least once a month. Removal must be undertaken or arranged by the applicant.
- All domestic waste generated onsite must be stored in a secure refuse bin prior to removal.
- No burning/burying of waste on the property.
- No dumping on property verges
- All garden waste/ organic waste to be chipped and responsibly reused or disposed of at a registered offsite facility
- Regularly inspect and service septic tanks to ensure proper functioning.
- Ensure all sewage systems are appropriately sized for the number of users and designed to prevent leaks, overflows, or groundwater contamination.
- Any leaks/ spills should be cleaned and repaired immediately.
- Make use of natural colours for walls and roofing

Please refer to Figure 4 showing the site to be developed in relation to the aquatic environmental sensitivities and associated buffer zones.

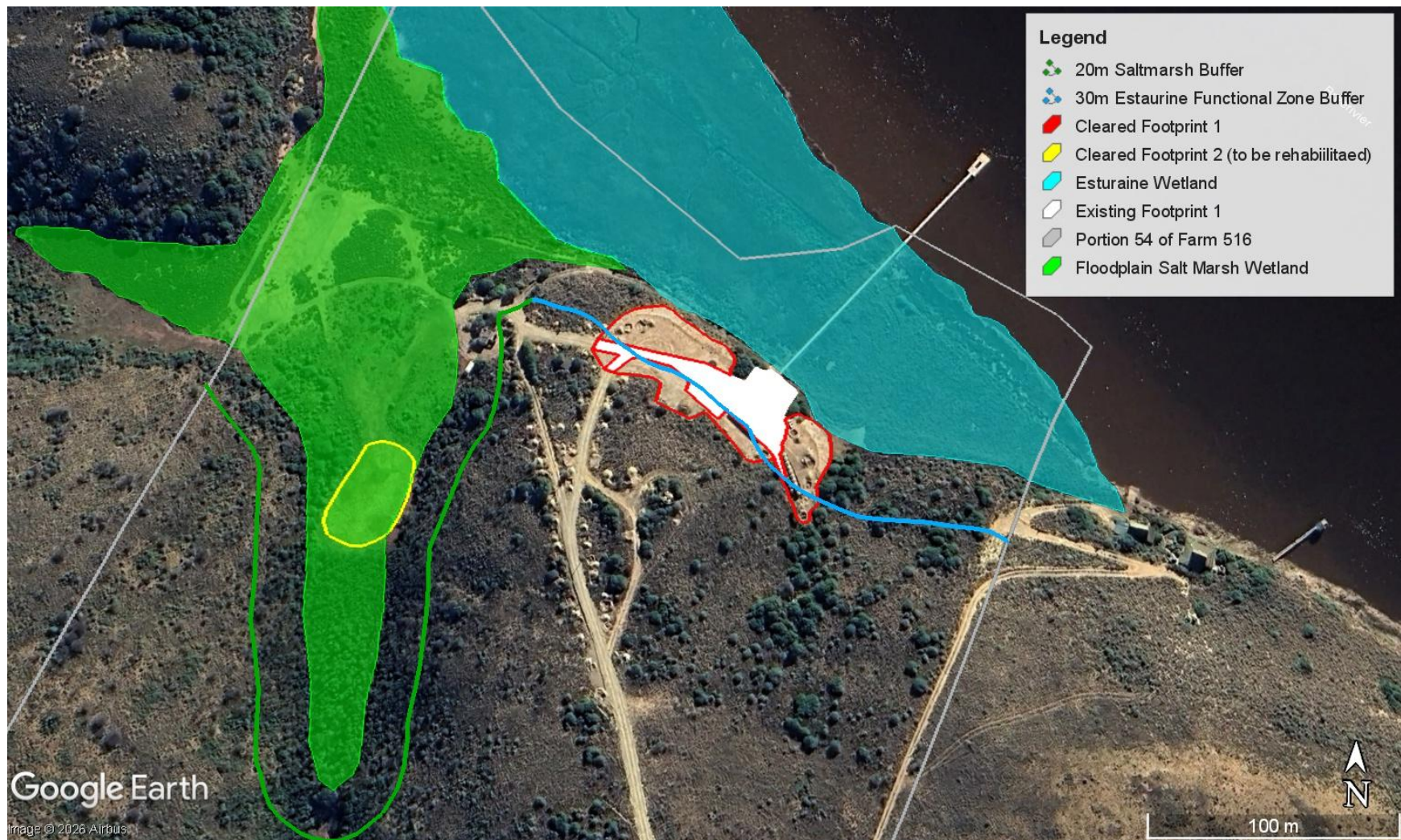


Figure 4: Onsite aquatic systems and associated buffer zones as defined and outlined within the Aquatic Ecosystem Assessment (Snyman, 2025). Cleared Footprint 2 (indicated in yellow) will be rehabilitated as outlined in Section 7 of this EMPr.

SECTION 5: IMPACT MANAGEMENT OUTCOMES AND ACTIONS

This section describes the proposed impact management actions and outlines how the desired impact management outcomes will be achieved. Where applicable, it also identifies measures to avoid, modify, remedy, control, or cease any action, activity, or process that may cause pollution or environmental degradation, and to ensure compliance with prescribed environmental management standards and practices.

5.1. Pre Construction Phase Management Plan

5.1.1. Environmental Awareness Training

All contractor teams involved in work on the development must be briefed on their obligations towards environmental controls and methodologies. The briefing should take the form of an on-site talk and demonstration by the ECO and/or Site Manager. The education program should be aimed at all levels of management within the Contractor team.

The environmental awareness education program should commence with entry onto the site, prior to any construction activities taking place by each team. All personnel must be made aware of the details of the EMPr which will be applicable to them. It must be ensured that staff members who are not proficient in the language of instruction are provided with training in a suitable alternative language.

As a minimum the training must include:

- Explanation of the reason of complying with the EMPr;
- Discussion of the potential environmental impacts of construction and operation activities;
- Employees' roles and responsibilities on site, including emergency preparedness;
- Explanation of the mitigation measures that must be implemented when carrying out the activities;
- Explanation of the specifics of this EMPr and its specifications (no-go areas, smoking areas etc.);
- Information on human/wildlife conflict mitigation.

5.1.2. Communication Procedures

There is to be continual communication between the contractor, landowner, site manager, and the ECO. The ECO will advise the site manager on factors relating to the EMPr and all environmental matters on site.

On-site communication and record keeping

- A Site Control Register as outlined in Section 3.4 must be kept on site for recording environmental instructions issues by the site manager, environmental observations, and any issues that arise during activities and corrective actions taken (Please refer to Appendix A).
- The register should be kept for at least two years after completion of activities and made available to the relevant authority upon request.
- A photographic record of the site before and after activities must be kept for reference.
- The file must remain accessible on site at all times and be available for inspection during monitoring visits by the local authority, ECO or Auditor.

Method Statements

For any activity, the Contractor must submit a Method Statement to the ECO for review and approval before construction may begin. The Method Statement must outline a step-by-step plan describing what work will be done, how it will be carried out, where it will take place, and when it will occur. Its purpose is to ensure that activities are conducted in a logical, controlled manner that minimises environmental impacts within reasonable time and cost limits.

Programming of Construction Activities

The ECO must be supplied with a detailed program of all construction events to allow for proper monitoring on site. Any amendments to the program of construction events for any reason must be forwarded to the ECO.

Suspension of works

The ECO & site manager is empowered to order the contractor to immediately cease any activities or operations that are required to be stopped as a matter of urgency to prevent serious adverse environmental impacts or potential impacts on the site or any of the adjacent properties or areas outside the boundaries of the site. The ECO / site manager shall without delay report any such actions to the landowner. The suspension will be enforced until corrective action has been taken, with no extension of time for such delays. In such a case, all costs are to be borne by the contractor.

Public Complaints

All public complaints received are to be registered by the site manager and addressed immediately. Public complaints and responses are to be recorded in the Site Control Register and included in the monthly environmental report by the ECO.

Safety

The Contractor is to appoint a safety steward, who will be responsible for safety of the labour force, construction activities and handling emergency situations on site during construction hours.

5.1.3. Site Definition and Demarcation

Prior to the commencement of any further development activities, the applicant must appoint a suitably qualified and experienced ECO. No new disturbance may occur outside the already cleared disturbance footprints. Within Footprint 1, where construction is still to be completed, the edge of the disturbance footprint must be clearly demarcated using temporary barrier tape to the satisfaction of the ECO. All areas outside the exiting access road and demarcated disturbance footprint are to be regarded as "no-go" zones for construction related activities.

The ECO must also identify and clearly demarcate areas within the existing cleared footprint that are suitable for the storage of construction materials and the parking of construction vehicles and machinery. No stockpiling of construction materials, storage of vehicles, machinery or building rubble should occur within 30 m of the delineated edge of the Breede River Estuarine Functional Zone.

Where construction is still to be completed, temporary silt fences must be installed downslope of the construction area (within the cleared footprint) prior to the commencement of construction activities. Construction-related activities should preferably be undertaken during the dry season to minimise site runoff. Any remaining exposed soils in areas where no further construction will take place must be stabilised using appropriate erosion control measures (e.g., geotextiles, mulch, or vegetative cover) to prevent erosion and sedimentation.

Contractor's Camp

A single Contractor's Camp must be established for use by all contractors and subcontractors, providing staff facilities and storage for all materials and equipment. Construction vehicles and machinery can be accommodated along the existing road footprint when not in active use. The most suitable location for the Contractor's Camp must be determined by the ECO prior to the commencement of construction. The camp must be located within the already disturbed footprint, on a flat or gently sloping area, more than 30 m from the edge of the Breede River Estuarine Functional Zone. All building materials are to be prepared at a dedicated batching area within the

contractor's camp, to enable the effects of cement and other substances, and the resulting effluent and building waste to be more easily managed.

Toilet Facilities

Sanitary facilities must be provided at a ratio of one toilet per ten workers, located on level ground within the already disturbed footprint and more than 30m from the delineated extent of the Breede River Estuarine Functional Zone. Chemical toilets must be regularly serviced, maintained in a hygienic condition, and secured to prevent tipping. Spillage must be avoided, and all waste safely stored and removed off-site. A contingency plan for spills must be submitted to and approved by the ECO. Toilets should be sited to minimise environmental impact and must not be placed in areas of standing or running water during winter.

5.2. Construction Phase Management Plan

5.2.1. Material Handling and Storage

Stockpiles of construction material may only be stored within the already cleared disturbance footprint in areas approved by the ECO prior to the onset of construction activities. Storage areas must be managed in terms of best practice codes. Stockpiles of erodible material must be covered by an erosion blanket (geotextile weighted with bricks) and may not be located within 30m from the delineated edge of the Breede River Estuarine Functional Zone.

All building materials are to be prepared within a dedicated batching / contractor's area approved by the ECO, or within the Contractor's Camp. Concrete should preferably be imported as "ready-mix" concrete from a local supplier. Should onsite concrete mixing be required it must be mixed on an impermeable surface in an area of low environmental sensitivity identified by the ECO outside of the no-go areas. Surplus or waste concrete must be sent back to the supplier who will dispose of it. Temporary bunds must be constructed around areas where cement is to be cast in situ.

Fuels and hazardous materials

Fuels and flammable materials are to be stored in suitably equipped storage areas, inside the Contractor's Camp. These areas shall comply with general fire safety requirements. Impervious materials are to be used in these storage areas to prevent contamination of the ground in the event of spillages or leaks.

The quantities/volumes of hydrocarbons stored on-site must be kept to a minimum and must be stored in an appropriate manner. Bulk fuel depots are to be placed within hardened bunded areas. Bunds are to have a holding capacity equal to 110% of the largest fuel container. The Contractor is to ensure that he is aware of the effects of all

substances on staff and the environment, and the correct action to take in the case of any incident involving these materials, according to the MSDS. The responsible management of hazardous chemicals should be practiced, and no storage or handling of chemicals must take place within or within close proximity to the onsite watercourses.

5.2.2. Waste and Effluent Management

Waste management during the construction phase is the responsibility of the contractor. Refuse refers to all construction debris (cement bags, rubble, timber, cans, nails, wire, spilt bitumen, glass, packaging, plastic, organic matter, etc.). Refuse generated during the execution phase of the works should be stored in secured on site bins, protected against wind dispersion, and removed on a regular basis for disposal at a permitted disposal site. The Contractor must supply adequate refuse bins on site to manage waste generated. No burning or burying of refuse on site should be allowed. Refuse bins must be watertight and windproof. No dumping of building rubble allowed. All waste materials are to be removed from the site once construction is completed.

Concrete should preferably be imported as “ready-mix” concrete from a local supplier. Should onsite concrete mixing be required it must take place on an impermeable, bunded surface in an area designated by the ECO as suitable. All cement effluent from mixer washings and run-off from batching areas and other work areas shall be contained in suitable sedimentation ponds. Sedimentation ponds, which must be suitably lined to prevent contamination of the ground, shall be allowed to dry on a regular basis to allow for solid material to be removed. The material must be disposed of in a suitable manner, depending on the nature of the material, and according to the discretion of the ECO. Concrete and cement-related mortars must be disposed of in an environmentally sensitive manner as these can be toxic to aquatic life.

Stormwater management must ensure that no effluent, including harmful substances such as paint or solvents, may leave the disturbance footprint. Contaminated water must be collected in suitable containers and removed from site for suitable disposal.

5.2.3. Stormwater Management

The Contract should take appropriate measures to control run-off from the site. A construction and operational stormwater management plan must be developed, detailing the structures and actions that must be installed to prevent the increase of surface water flows directly into any natural systems. Effective stormwater management must include measures to slow, spread and deplete the energy of concentrated flows thorough effective stabilisation and the re-vegetation of any disturbed areas.

The Contractor must take suitable measures to prevent erosion resulting from a diversion, restriction or increase in flow of stormwater caused by the presence of his own works, operations, and activities to the satisfaction of the ECO. Measures must be put in place to prevent silt from entering any downstream areas.

The Contractor may need to construct a berm or similar control measures to prevent stormwater from running from excavated areas, stockpiles of waste and excavated material into adjacent areas. Any runoff collected in such bunded areas, which contain oils, fuels, chemicals, or other potentially harmful substances, must be pumped out, collected in suitable containers, and removed from site for suitable disposal.

5.2.4. Construction Machinery

All construction machinery used must be suitable for the scale of the project at hand. Construction vehicles and machinery can be accommodated along the existing road footprint when not in active use. All construction vehicles and machinery must be maintained in a good, working condition and must be regularly inspected for possible oil / fuel leaks. Should any leaks be detected they must be repaired as soon as possible. All maintenance and refuelling of vehicles and machinery should take place offsite as far as possible alternatively within bunded areas as designated by the ECO. Drip trays should be placed under vehicles overnight. The ECO may order the removal of equipment that is causing continual environmental damage by leaking oil or diesel for example, until such equipment has been repaired.

5.2.5. Noise Impacts

The contractor must take appropriate measures to limit the impact of unreasonable noise from construction activities. Construction activities to be limited to working hours weekdays (07:00 – 18:00) and half day Saturdays (08:00 – 13:00). No work may be undertaken on Sundays and on public holidays. All construction vehicles and machinery should be maintained in good working condition and additional noise screening mechanisms also included in the design.

5.2.6. Cleanliness of Roads

The contractor must ensure that construction vehicles do not spill or drop any construction materials (sand, cement, debris, etc) onto public or private roads. If this should occur, it is the responsibility of the contractor to ensure that the roads are suitably cleaned.

5.2.7. Erosion Control

Care must be taken to prevent erosion of soils on the construction site. Should any erosion be detected on site, the ECO or site manager must identify the cause of such erosion and ensure that the most appropriate method of mitigation or stabilisation is employed as soon as possible. Runoff generated during construction should not cause any damage and should be controlled or contained during periods of high rainfall.

5.2.8. Dust Control

The contractor shall take appropriate measures, to the satisfaction of the ECO to minimise the generation of dust and mud on the site. Where relevant this may include supplying suitable stabilisation (such as mulch or straw stabilisation) for all cleared ground or watering ground during exceptionally windy conditions. A suitable speed limit (20-40km/h) must be enforced on all gravel/ dirt roads. Given the limited number of nearby receptors, significant dust impacts are not anticipated, and such measures are expected to be required only if nuisance conditions arise.

5.2.9. Trenching and Service Installation

To minimize trenching, where new service installation is required, these are to be installed above ground within the existing disturbance footprint or existing access road. Where unavoidable, the excavation of trenches for service installation should be undertaken in a phased manner where possible, to allow for trenches to stand open for a maximum of three days only. Materials removed from trenches must be stockpiled in a suitable position and should be stabilised if backfilling is not expected to occur within the following two days. Service installation should be coordinated to prevent the undue reopening of trenches for the installation of additional services. Since most of the service infrastructure is already in place on the property, service installation and trenching is expected to be minimal.

5.2.10 Archaeology and Cultural Heritage

If any heritage remains are exposed during excavations or any other action on the site these must immediately be reported to the Provincial Heritage Resources Authority of the Western Cape. Heritage remains uncovered or disturbed during earthworks must not be further disturbed until the necessary approval has been obtained from the competent authority.

5.2.11. Sensitive Environmental Features

The relevant development footprints may only be accessed via the existing access road. This road may not be extended or expanded. No alternative access routes may be utilized. The approved disturbance footprint must be clearly demarcated. All areas outside the exiting access road and demarcated disturbance footprint are to be regarded as “no-go” zones during the construction phase. No one is permitted to enter no-go zones. No materials, rubble or equipment is to be stored or stockpiled outside the predetermined storage locations identified by the ECO. Any deviations from these specifications are subject to the approval of the ECO. Please refer to Figure 4 for an indicated of onsite aquatic features and associated buffer zones where strict management must be applied to avoid environmental impact.

All wild animals, including reptiles, amphibians and birds may not be harmed. The ECO must be notified if any fauna needs to be removed and relocated from the construction site. A suitable relocation site will have to be identified. No poaching / hunting may be undertaken by construction staff.

5.2.12. Fire

Please refer to Section 6.1 of this EMPr for detailed fire management measures. Due to the fire-prone nature of the vegetation on site, open fires are prohibited during the construction phase. Smoking is not permitted in fire-hazard areas, including workshops, fuel storage areas, or areas with vegetation that could promote the spread of fire, and must not occur outside the existing disturbance footprint. All cigarette butts must be disposed of in fire-safe containers. Appropriate fire extinguishers must be available during welding or any other hot-work activities.

The Contractor is responsible for informing all employees of these requirements and for enforcing them at all times. The Contractor must also implement all necessary measures to prevent accidental fires on site. Any artificial bushfire that originates within the construction site, or within 100 m of the site boundary, during the construction period will be presumed to be the responsibility of the contractor and may result in legal liability. Each contractor involved in the project will be expected to sign for, and thus acknowledge receipt of the final EMPr, inclusive of this fire management section, and thereby will be expected to abide by the requirements outlined herein.

5.2.13. First Aid

The contractor must provide and maintain a suitable first aid kit on site, with a member of staff suitable qualified in first aid on site during working hours, in accordance with the Occupational Health and Safety Act.

5.2.14. Post-Construction Clean-Up

The applicant and contractor must ensure that all areas are fully cleaned up and rehabilitated upon completion of construction activities. This includes, but is not limited to, the following actions:

- Removal of excess building materials from the property,
- Removal and lawful disposal of all stockpiled materials, including excess building material and excavated soil,
- Removal of all materials used to demarcate the disturbance footprint,
- Removal of all temporary toilet facilities,
- Removal of all temporary signage,
- Removal of all waste from construction camps,
- Removal and correct disposal of all alien vegetation removed,
- Removal of vehicles from site,
- Rehabilitation of any terrestrial and aquatic areas (reshaping and vegetation) affected by construction activities.

5.3. Operational Phase Management Plan

The Operational Phase of this EMPr covers the day-to-day management activities required to ensure the sustainable operation of the development. The following section outlines clear objectives and associated management actions to ensure that potential environmental impacts during operations are effectively managed.

Six key goals have been established to minimize environmental impacts throughout the operation and life cycle of the project:

1. Protect sensitive ecological areas within the property
2. Implement and maintain suitable landscaping onsite
3. Remove and manage alien invasive vegetation throughout the property
4. Minimize resource use and promote efficient usage where required
5. Manage and minimize onsite waste and prevent environmental pollution
6. Implement suitable fire risk management

5.3.1. Protect sensitive ecological areas within the property

Management Objective:	Ensure that no further disturbance occurs within delineated wetlands, estuarine functional zones or Critical Biodiversity Areas by strictly enforcing buffer zones and limiting all activities to existing disturbance footprints.
Management Actions:	
- No further indigenous vegetation removal or soil disturbance is permitted anywhere on site without the required approvals. - In Footprint 1, where construction is still to be completed, the edge of the existing disturbance footprint must be clearly marked to prevent encroachment beyond the approved area. - All on-site watercourses and associated buffer zones are designated as No-Go areas and must be protected from any new development or operational activities. - A buffer zone of 20m should be applied around the Floodplain saltmarsh, with all future activities kept outside of this area. - A buffer zone of 30m should be applied around the Breede River Estuarine Functional Zone, with all future activities kept outside of this area. - No spraying of herbicide should be allowed anywhere where there is any natural vegetation. - No alien invasive kikuyu grass (<i>Cenchrus clandestinus</i>) should be planted anywhere on site. - All natural vegetation in moderate to good condition on the applicant property (about 23.4ha in total, excluding just the built and developed footprints) should be signed up with CapeNature's Stewardship program within one year of any authorisation, with the applicant being responsible for all costs associated with this registration, and all Stewardship site management costs going forward. - No dumping within the no-go area shall be permitted, and no waste may be buried or burned. - Ensure control of staff movements to clearly designated areas and access routes to limit disturbances. - Ensure strict poaching control. No hunting, trapping, or setting of snares by personnel is to be allowed. - The site manager must regularly monitor No-Go areas for unauthorised use or vegetation damage and monitor vegetation establishment and slope stability. - All employees involved in the operational phase of the development must be briefed on their obligations towards environmental controls and methodologies. The briefing should take the form of an on-site talk and demonstration by the site manager or the landowner. Operational phase environmental impacts and aspects and their mitigating measures must be discussed, explained, and communicated to employees.	
Implementation:	
Responsible Party:	Holder of the EA
Timeframe for Implementation:	Throughout the developments lifespan
Monitoring:	

Responsible Party:	The Holder of the EA must ensure that all the management actions above are implemented.
Frequency:	As per the requirements of the competent and/or local authorities.
Evidence of Compliance:	As per the requirements of the competent and/or local authorities.

5.3.2. Implement and maintain suitable landscaping onsite

Management Objective:	Actively rehabilitate all disturbed and cleared areas not required for development using locally indigenous vegetation
Management Actions:	
- Rehabilitate the cleared portion of the floodplain saltmarsh wetland as per Section 7 of this EMP. - Rehabilitate the undeveloped portions of the cleared footprints as per Section 9 of this EMP. - No alien invasive kikuyu grass (<i>Cenchrus clandestinus</i>) should be planted anywhere on site. - Maintain the disturbance footprints free from alien invasive vegetation. The only alien trees that could be kept are a few of the larger rooikrans (<i>Acacia cyclops</i>) in the vicinity of the main house and outbuildings, which may be needed for screening or shade. - Conduct regular erosion monitoring within and around all disturbance footprints to detect and address any signs of erosion promptly. If erosion has occurred, it must immediately be rehabilitated through stabilisation of embankments and revegetation, where applicable. - Verify that the landscaping contractor complies with the environmental requirements. - Monitor the success of rehabilitated and landscaped areas to ensure vegetation establishment, health, and long-term survival. Implement corrective action or additional planting if needed. - Conduct external audits to verify compliance with the EMP and ensure the site is managed in an environmentally responsible manner.	
Implementation:	
Responsible Party:	Holder of the EA
Timeframe for Implementation:	Throughout the developments lifespan
Monitoring:	
Responsible Party:	The Holder of the EA must ensure that all the management actions above are implemented.
Frequency:	As per the requirements of the competent and/or local authorities.
Evidence of Compliance:	As per the requirements of the competent and/or local authorities.

5.3.3. Remove and manage Alien Invasive Plants throughout the property

Management Objective:	Implement ongoing alien invasive vegetation management in accordance with the EMP and best-practice guidelines with the aim of achieving less than 1% Alien Invasive Vegetation cover within 3 years after a valid EA.
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Management Actions:	
- Identify and remove AIP species as per the AIP Vegetation Management Plan outlined in Section 8 of this report. - An AIP Management programme follows three phases: - Phase 1 – Initial control: Drastically reducing the existing population - Phase 2 – Follow-up: Controlling seedlings and regrowth - Phase 3 – Maintenance: Sustaining low and decreasing AIP numbers with annual control - Should a fire occur onsite, the burnt areas must be monitored for alien seedling germination and suitable removal carried out. - All cut/pulled material must be disposed of at a licensed refuse facility / chipped and may not be mulched or burned on site. - No alien invasive kikuyu grass (<i>Cenchrus clandestinus</i>) should be planted anywhere on site. - The only alien trees that could be kept are a few of the larger rooikrans (<i>Acacia cyclops</i>) in the vicinity of the main house and outbuildings, which may be needed for screening or shade. - Conduct regular monitoring throughout the property to detect any re-emergence of alien invasive species as outlined in the alien invasive management plan (Section 8 of the EMPr) - Conduct external audits to verify compliance with the EMPr and ensure the site is managed in an environmentally responsible manner. Please refer to Section 8 of this EMPr as well as Appendix D: A Practical Guide to Managing Invasive Alien Plants, WWF.	
Implementation:	
Responsible Party:	Holder of the EA
Timeframe for Implementation:	Throughout the developments lifespan
Monitoring:	
Responsible Party:	The Holder of the EA must ensure that all the management actions above are implemented.
Frequency:	As per the requirements of the competent and/or local authorities.
Evidence of Compliance:	As per the requirements of the competent and/or local authorities.

5.3.4. Minimize resource use and promote efficient usage where required

Management Objective:	To minimize the consumption of natural resources onsite—including water, energy, and raw materials—to what is strictly necessary for the safe and efficient operation of the development.
Management Actions:	
<u>Water:</u> Water for domestic use will be supplied from rainwater that is captured and stored onsite. This will be supplemented with treated river water abstracted from the Breede River when needed. River abstraction will only occur during the winter months, when water quality is fresh. No abstraction will take place during summer due to increased salinity. This seasonal approach will ensure that abstraction occurs during periods of water abundance and does not place stress on the resource. Additional storage tanks have recently been installed onsite to ensure sufficient storage volume for domestic needs. Onsite water usage will be managed according to water saving principles: - Reduce hard surfacing to encourage rainwater to seep back into the ground. - Water wise locally indigenous vegetation must be used for landscaping purposes	

- Remove alien invasive vegetation in accordance with the Alien Invasive Vegetation Management Plan (Section 8 of this EMPr).
- Maintain all water infrastructure in good working condition and repair leaks promptly.
- Ensure all taps remain closed when not in use.
- Educate employees on the importance of conserving natural resources and practicing water-wise use.
- If needed, efficient irrigation methods, such as drip irrigation should be used and irrigation should be scheduled during periods of minimal evaporation (early morning or late evening).
- Include all onsite water infrastructure on a maintenance schedule to detect leaks and perform regular servicing.
- Repair leaking taps and pipes promptly; clean filters and service pumps regularly.
- As far as possible ensure buildings are harvesting rainwater for domestic supply.
- Washbasin and shower taps should be fitted with flow reduction devices and aerators to ensure water conservation;
- Use dual-flush toilets where installed
- Washing appliances should be used only when sufficiently full to warrant operation;
- To keep the volume of polluted water to be disposed of to a minimum, stormwater should not be mixed with greywater (e.g. from baths, showers, sinks, washing machines etc.);
- Physical brushing or sweeping used in preference to water cleansing wherever possible (e.g., cleaning pathways).
- Regularly inspect onsite water use practices to ensure relevant rules are being followed.
- Conduct external audits to verify compliance with the EMPr and ensure the site is managed in an environmentally responsible manner.

Electricity:

Electricity supply to the existing main dwelling is by means of existing ESKOM infrastructure and will be supplemented by solar. The caretakers cottage is supplied solely by solar energy. The following energy saving mechanisms should be implemented:

- Solar energy to be utilised as far as possible
- Energy saving bulbs in all structures, alternatively use low voltage or compact fluorescent lights;
- Use and maintain solar geysers for hot water supply to kitchen and bathrooms;
- Use proper insulation;
- Avoid the use of air conditioning alternatively ensure that the correct size is installed and that use of the unit is minimised.
- Natural light used wherever possible during the day in preference to artificial light;
- Photovoltaic batteries and solar panels used;
- Low energy downward facing LED lights used for general lighting around the site.

Materials:

Materials used in the life cycle of the project should be focused on renewable and recyclable elements:

- Select building materials for durability to minimize maintenance or replacement;
- Use standard materials to increase the potential for re-use and re-cycling;
- Materials should be sourced locally where possible.

Implementation:

Responsible Party:	Holder of the EA
Timeframe for Implementation:	Throughout the developments lifespan

Monitoring:

Responsible Party:	The Holder of the EA must ensure that all the management actions above are implemented.
Frequency:	As per the requirements of the competent and/or local authorities.
Evidence of Compliance:	As per the requirements of the competent and/or local authorities.

5.3.5. Manage and minimize onsite waste and prevent environmental pollution

Management Objective:	To minimize and manage all waste generated onsite, including general, recyclable, and garden/grounds waste, and to prevent pollution from sewage.
Management Actions:	
- All waste generated during the operational phase of the project must be stored in closed, secure bins. - Renovation and maintenance activities must be planned to minimise waste generation. - Educate users on recycling and resource saving initiatives. - Implement an onsite waste separation system for general, recyclable, and garden/grounds waste. - All waste generated must be removed to the Infanta Transfer Station at least once per month. - Removal must be undertaken or arranged by the applicant. - Remove excess vegetation or organic matter to approved disposal sites to prevent build-up and potential fire hazards. - All domestic waste generated onsite must be stored in a secure refuse bin prior to removal. - No burning/burying of waste on the property. - No dumping on property verges - All garden waste/ organic waste to be chipped and responsibly reused or disposed of at a registered offsite facility - Monitor waste removal to landfill – proof of correct disposal - Regularly inspect and service septic tanks to ensure proper functioning. - Conduct monthly visual inspections of septic tanks, to check for leaks, blockages, or overflows - Ensure all sewage systems are appropriately sized for the number of users and designed to prevent leaks, overflows, or groundwater contamination. - If a spillage or leakage event occurs, it should be reported to the relevant authorities and the necessary actions taken to contain the spill and reduce any negative impact. Non-compliance to be reported - Any leaks/ spills should be cleaned and repaired immediately. - Conduct external audits to verify compliance with the EMPr and ensure the site is managed in an environmentally responsible manner. - When the conservancy tank system is full it must be serviced and proof from the Municipality or contractor responsible for pumping the wastewater of the conservancy tank used for the disposal of sewer water must be available on-site.	
Implementation:	
Responsible Party:	Holder of the EA
Timeframe for Implementation:	Throughout the developments lifespan
Monitoring:	

Responsible Party:	The Holder of the EA must ensure that all the management actions above are implemented.
Frequency:	As per the requirements of the competent and/or local authorities.
Evidence of Compliance:	As per the requirements of the competent and/or local authorities.

5.3.6. Implement suitable fire risk management

Management Objective:	To protect the development from wildfire while allowing the natural fire regime to continue in the surrounding area. To ensure that no wildfires start on the proposed development site and spread to adjacent properties.
Management Actions:	
- Join the Greater Overberg Fire Protection Association. - Ensure all alien invasive plants are removed from the site on an ongoing basis. - Plant indigenous fire resistant, fleshy leaved plants around the development footprint. - Ensure that suitable, functional, firefighting equipment is readily available onsite. This should include handheld fire beaters, mobile water units such as a backpack sprayer or bakkie sakkie, spades, protective clothing, and torches. - Firebreaks must be established onsite in accordance with the relevant legislation - National Veld and Forest Fire Act, Act 101 of 1998 and/or local authority by-laws. - All firebreaks must be cut annually in early November and monitored monthly during the fire season. - Handheld brush cutters must be used to develop firebreaks and no soil may be disturbed. - All firefighting equipment must be checked and maintained annually in October, before the start of the fire season. - The fire break must be monitored monthly during the fire season and any potential hazardous biomass removed. - Should a fire occur onsite, firefighting efforts must be mobilised immediately, relevant authorities and adjacent landowners must be notified. - No open fires are permitted unless in designated fireplaces. - No fires may be lit once the Minister has published a warning of a high fire danger (legal punishable offence). - A lit fire may under no circumstances be left unattended (legally punishable offence). - Hot coals should not be left unattended. - Stockpiles of wood are not permitted onsite. - Preserve environmental values by managing fire regimes that are suitable and necessary for conservation purposes. - Smoking shall not be permitted in areas where it is a fire hazard. Such areas shall include any fuel storage areas and areas where the vegetation or other material may promote the rapid spread of an initial flame. - A fire extinguisher of the appropriate type must be present when welding or other "hot" activities are undertaken. Please refer to Section 6 of this EMP for detailed fire management measures as well as Appendix C: What a landowner needs to know about Fire Management (Cape Nature)	
Implementation:	
Responsible Party:	Holder of the EA
Timeframe for Implementation:	Throughout the developments lifespan
Monitoring:	

Responsible Party:	The Holder of the EA must ensure that all the management actions above are implemented.
Frequency:	As per the requirements of the competent and/or local authorities.
Evidence of Compliance:	As per the requirements of the competent and/or local authorities.

SECTION 6: FIRE MANAGEMENT

Legislation dictates that landowners must take adequate steps to prevent or minimise the risk of unscheduled fires on their properties. All accidents and emergency situations are to be reported to the site manager and landowner, and full details included in environmental audits. Emergency contact numbers for fire department to be kept on site.

6.1.1. Responsibilities

The overall responsibility for effective fire management on site rests with the holder of the Environmental Authorisation. It is therefore recommended that the applicant becomes a member of the Greater Overberg Fire Protection Association (GOFPA), which can provide guidance and support in implementing appropriate fire prevention and response measures. Please also refer to Appendix C: What a landowner needs to know about Fire Management (Cape Nature).

During the construction phase, the contractor is responsible for implementing all necessary precautions to prevent accidental fires. Each contractor appointed to the project will be required to formally acknowledge receipt of the final EMPr, including this fire management section, and will be obliged to comply fully with the requirements set out therein.

6.1.2. Firebreaks

In accordance with Chapter 4 of the Veld and Forest Fires Act, firebreaks must be established in early November. Firebreaks must be established along the property boundaries as agreed upon between adjacent landowners. All firebreaks must be cut annually in early November and monitored monthly during the fire season. Boundary line firebreaks must be wide enough to have a reasonable chance of preventing fire from spreading to adjacent land. The width of the firebreak must be mutually agreed upon between adjacent landowners. Along the southern and eastern boundaries of the property it is recommended that the existing roads are suitably maintained to function as firebreaks.

Firebreaks may not cause soil erosion and must be kept free of flammable plants and fuels, as well as bushy and tall vegetation and trees. Firebreaks should be cut and maintained with handheld brush cutters. The cutting of fire breaks should not involve root removal but rather just the cutting of vegetation to the ground. No soil disturbance may be caused during firebreak cutting. No burning may be used to establish fire breaks. Material removed from the firebreaks must be removed from the site.

6.1.3. Firefighting staff, infrastructure & equipment

All site occupants and staff should receive adequate firefighting training and be aware of protocol in terms of a wildfire incident on site. The following firefighting requirements should be implemented and met:

- All firefighting equipment must be checked and maintained annually in October before the start of the fire season.
- In accordance with Chapter 5 of the National Veld and Forest Fire Act the following firefighting equipment and tools should be readily available on site:
 - Hand tools such as rake hoes, fire beaters, spades, long handled slashers, and fire extinguishers
 - Water related tools including backpack sprayers;
 - Spotlights, headlamps, bolt cutter, first aid kit with burn shields,
 - Protective clothing should include fire resistant trousers and shirts, flash resistant hoods, boots, gloves, goggles and breathing masks,
 - Water tanks / pumps, "BakkieSakkie" (a homemade firefighting unit, comprising of a water tank, a water pump and some fire hoses fitted on to the back of a Bakkie).

Please note that if needed, fuels for use in operational machinery are to be stored in suitably equipped storage areas inside the garage. These areas must comply with general fire safety requirements. Impervious materials are to be used in these storage areas to prevent contamination of the ground in the event of spillages or leaks. Quantities of fuels stored on site should be appropriate to the requirement for these substances on site.

6.1.4. Fire detection and reaction strategy

Landowners will have to rely on their staff, neighbours, and visitors as a fire detection system. In the case of a fire occurring on site, the site manager and landowner are to be notified immediately. The site occupant must report fires immediately to the relevant organizations (Municipality, Greater Overberg Fire Protection Agency, CapeNature,

and all direct Neighbours). If localised and posing a threat to humans and infrastructure, effort should be made to extinguish the fire immediately, and if required, the assistance of the local fire department should be sought by the safety steward.

Should the landowner not be present onsite during the fire season they must ensure that there is a responsible person present on or near the property who will assist in extinguishing the fire and take reasonable steps to alert the goFPA and neighboring landowners/their agents. During the fire season (December–April), the site manager must check the daily Fire Danger Rating, inform all personnel and visitors, and ensure that the prescribed rules for each rating are followed.

6.1.5. Design Considerations

Landscaping can be an effective tool to mitigate fire risks. The fuel load around the development must be minimized by ensuring that suitable vegetation is used for all landscaping activities. The following should be implemented:

- Only indigenous species may be used for landscaping purposes.
- Where possible fire-resistant, fleshy-leaved plants should be selected for landscaping purposes.
- During the fire season healthy, green, groundcover must be maintained around the development.
- Avoid the use of plants that develop deciduous bark, dead leaves / branches, or dead undergrowth.
- Ensure that no fuel material is allowed to build up on site.
- Remove any dead leaves, branches etc. from the site.
- Maintain all gutters free of leaf litter.
- Keep any fine vegetation trimmed

6.1.6. Additional Considerations

- Site occupants must take all reasonable precautions to prevent the occurrence of human induced wildfires.
- No open fires are permitted onsite during the construction phase.
- The burning of refuse or vegetation material on site as a means of disposal as well as the collection of firewood or kindling from the site is prohibited.
- No smoking / cooking / heating is permitted onsite outside of the construction site.
- No open fires are permitted during the operational phase unless in designated fireplaces.
- No fires may be lit once the Minister has published a warning of a high fire danger (legal punishable offence).
- A lit fire may under no circumstances be left unattended (legally punishable offence).
- Hot coals should not be left unattended.

- Stockpiles of wood are not permitted onsite.
- Alien invasive vegetation must be removed from the site as outlined within the Alien Invasive Management Plan (Section 8 in this EMPr). All cut vegetation and litter resulting from clearing activities must be removed from the site or responsibly used e.g., chipped.

SECTION 7: WETLAND REHABILITATION PLAN

Development activities already undertaken on site include the unplanned clearance of vegetation and removal of soil from a portion of a Floodplain Saltmarsh Wetland. An aquatic ecosystems impact assessment was conducted as part of the current application. Mitigation measures recommended in the aquatic ecosystems impact assessment include the rehabilitation of the cleared portion of the Floodplain Saltmarsh Wetland through the establishment of locally indigenous wetland and riparian plant species. This section of the report outlines the practical rehabilitation measures to be implemented in order to facilitate the ecological recovery of the affected wetland area.

The area to be rehabilitated in terms of this wetland rehabilitation plan comprises the entire extent of the cleared Footprint 2 area. In addition, certain activities are restricted within the 20 m buffer around the Floodplain Saltmarsh wetland and the 30 m buffer around the Breede River Estuarine Functional Zone. Please refer to **Figure 4** of this EMPr for a map showing the extent of cleared Footprint 2 to be rehabilitated as well as the associated buffer zones.

7.1. Goals and Objectives

The overall goal for Floodplain Saltmarsh wetland rehabilitation onsite is to restore the disturbed wetland area to a stable, vegetated Floodplain Saltmarsh system that is structurally and ecologically similar to the surrounding undisturbed wetland. The aim is to reach 80% indigenous vegetation cover within 18 months after revegetation interventions have been completed.

The specific objectives for the rehabilitation activities are as follows:

- Prevent further soil disturbance and compaction
- Improve soil structure and infiltration through decompaction
- Re-establish indigenous wetland vegetation cover using locally sourced species
- Control and prevent re-infestation by alien invasive plant species
- Maintain existing wetland geomorphology and hydrological patterns;
- Establish a long-term monitoring and management framework to ensure rehabilitation success.

7.2. Roles and Responsibilities

The implementation of this Wetland Rehabilitation Plan shall be the overall responsibility of the applicant. The applicant shall remain responsible for all ongoing monitoring and management actions required to ensure that rehabilitation objectives are achieved. The applicant may appoint a suitably qualified external contractor to assist with the implementation of rehabilitation activities.

7.3. Wetland Rehabilitation

7.3.1. Buffer Zones and Protective Measures

A 20 m buffer zone shall be maintained around the Floodplain Saltmarsh wetland and a 30m buffer shall be maintained around the Breede River Estuarine Functional Zone (refer Figure 4), within which the following restrictions shall apply:

- No further development or construction activities shall be permitted;
- No vehicle access shall be allowed outside existing access roads;
- No soil stockpiling, dumping, or storage of materials shall take place;
- Existing roads located within the delineated Floodplain Saltmarsh wetland that are not required for the ongoing operation of the site may be utilised to facilitate clearance of alien invasive vegetation. Following completion of alien invasive vegetation clearing within the wetland and associated buffer zone, these roads can rehabilitate naturally.

Limit work areas to cleared areas only. No disturbance should occur within the adjacent (uncleared) portions of this wetland system. The only disturbance permitted within these areas is that related to alien invasive vegetation clearance as outlined in Section 8 of the EMPr.

All rehabilitation activities should, as far as reasonably practicable, be undertaken manually without vehicles or heavy machinery. Vehicles or machinery may only be used where absolutely necessary and with prior approval of a Method Statement by the ECO. Existing access roads must be used, and vehicles and machinery are restricted to designated routes, with no entry into the wetland or buffer zone unless authorised in writing by the ECO. Any machinery used must be in good working condition and free of leaks and may only be present in the wetland or buffer zone while actively conducting rehabilitation work, with no parking within 20 m of wetlands when not in use.

7.3.2. Removal of Foreign Material

Any rubbish or building rubble present within the wetland area or 20m buffer thereof must be removed such that the substrate consists of only natural soils. Removed material must be appropriately disposed of at a designated waste facility prior to implementation of additional wetland rehabilitation interventions.

7.3.3. Soil Preparation

Where heavy vehicles or machinery have traversed the cleared wetland area, soil compaction has occurred. Prior to the implementation of revegetation activities, the compacted soil must be loosened. This should be undertaken by light manual ripping of the soil surface to a depth of approximately 300 mm. No deep excavation, reshaping, or re-profiling of the wetland or its associated buffer zone may be undertaken. Soil preparation must be carried out during dry weather conditions to prevent runoff, erosion, sedimentation, and further compaction. It must be undertaken as close as practicable to the planned revegetation to minimise the period during which soils remain exposed and vulnerable.

7.3.4. Revegetation

Revegetation should focus on locally indigenous Floodplain Saltmarsh species, including *Salicornia perennis*, *Atriplex semibaccata* and *Disphyma crassifolium*. Only locally sourced plant material shall be used to ensure genetic compatibility.

Procurement of Plant Material:

Successful rehabilitation requires the use of healthy, genetically sound, and locally appropriate plant material. The remaining wetland areas onsite are dominated by *Salicornia perennis*, *Atriplex semibaccata* and *Disphyma crassifolium*. *Salicornia perennis* and *Atriplex semibaccata* can be propagated via seeds or cuttings while *Disphyma crassifolium* is propagated best by cuttings. As healthy plant material is present onsite it is possible that cuttings can be generated from onsite material by a suitable qualified professional for the purpose of revegetation. Green Intaba, a company specialising in rehabilitation, could assist. Any collection of indigenous material from nearby veld outside the rehabilitation area shall only be done in mature vegetation, in areas identified by the rehabilitation contractor. Harvesting in these areas should be performed in a checker board fashion. Green Intaba also have a healthy indigenous plant nursery from which plants could potentially be obtained.

Planting and Seeding Techniques:

Transplanting of whole plants with well-established roots in a growing medium is one of the most reliable revegetation techniques. Planting of cuttings can also be highly successful and more economical.

The recommended general planting procedures are as follows:

- Planting should be conducted in April to allow plants to establish over the autumn – winter rainfall season. The hot summer months should be avoided. If the plants are not properly established, the mortality will be high over the summer period.
- Use a hand spade to dig a square hole that is 1.5X the depth and 2X the width of the bag containing the plant.
- Remove the plant from its container and carefully loosen the soil by hand, being mindful of not damaging the roots and maintaining as much of the soil as possible.
- Place the plant and associated soil in the hole.
- Replace the soil originally removed and ensure that it forms a slight depression (1-3 cm below the level of the surrounding soil) with the plant in the centre of the depression.
- Compress the soil firmly by hand.

Procedure for planting cuttings:

- Obtain healthy adult plants with sufficient plant material to generate cuttings.
- Neatly cut the stem based on individual species requirements using pruning shears.
- Plant cuttings as per the general planting protocol.
- A 20cm wide by 20cm deep hole should be sufficient for the cutting.
- Ensure that approximately half of the cutting is below ground while the other half is above ground.

Seeding:

Seeding is a useful technique for covering broad areas with hardy, fast growing species and is often the fastest way to achieve adequate coverage. Hand-seeding can be implemented where viable seed material can be obtained for the relevant species required for revegetation. Reseeding should be undertaken in March-April to allow plants to establish over the rainfall season. The seeds can be scattered across the designated areas where after the soils should be raked over. The seeds shouldn't be more than 2.5 times the width of the seed deep yet must not be left on the soil surface.

During indigenous plant transplanting, plants must be protected from excessive sun exposure, with roots and leaves covered using wet hessian to prevent water loss. Adequate topsoil should surround each plant to avoid root desiccation. Plants stored on-site before planting must be kept moist, and all vegetation must be free of weeds or invasive species. Planting should occur within five days of delivery unless otherwise directed by the rehabilitation contractor.

Shrubs can be planted approximately 1m apart, whereas herbaceous species should be planted at densities of up to 12 per 1 m² and no less than 6 per 1 m².

7.4. Maintenance and Monitoring

Following the implementation of revegetation interventions, maintenance and monitoring must be undertaken to determine the relative success of the interventions:

- After revegetation, the rehabilitated area should be inspected once a month by the site manager and photographs should be taken of the seeded and planted areas to document the revegetation process.
- Any alien invasive vegetation noted within the rehabilitation area must be immediately removed through hand pulling. Disturbance of the soil will provide ideal conditions for the establishment of these plants.
- If no rainfall occurs during the rehabilitation phase, manual watering of the area should be considered approximately twice a month during establishment of the plants.
- The landowner must appoint a suitably qualified professional to undertake 6-monthly site visits until such time as the required degree of cover (80%) has been achieved and the rehabilitation objectives are met. All site visits should include an estimate of vegetation cover and species assemblage. Based on these findings, the specialist should provide formal recommendations on how to achieve the required targets. Alternatively, if the required vegetation cover and rehabilitation objectives have been achieved, the contractor may formally sign off on the rehabilitation.
- If the required 80% total vegetation cover is not achieved within 18 months of planting, the applicant must obtain recommendations from a suitably SACNASP-registered specialist and implement the specialist's recommended measures to improve vegetation cover and ensure successful rehabilitation.
- Any significant setbacks or disturbance events resulting in high plant mortality and/or low seedling germination rates during the revegetation plan should be noted.

- If a disturbance event occurs early in the revegetation process, before plants have been fully established or if the disturbance occurs over a large area, reseeding and/or replanting will likely be required.
- If a disturbance occurs once vegetation communities have been successfully established and/or is limited to a small section of the site, it is likely that passive restoration will take place with no intervention required.
- It is recommended that if a significant disturbance occurs, the rehabilitation contractor is consulted to confirm the appropriate cause of action based on the timing and size.

SECTION 8 : ALIEN INVASIVE PLANT MANAGEMENT PLAN

Alien invasive vegetation comprises introduced, non-indigenous plant species that out-compete indigenous vegetation and disrupt natural ecosystem processes. These species also pose a significant fire risk, as they increase fuel loads and fire intensity, which can result in more frequent and severe fire events.

The vegetation on site is predominantly natural, with varying levels of infestation by alien invasive plant species. Woody invasive alien vegetation is dominated by *Acacia cyclops* (Rooikrans) and *Acacia saligna* (Port Jackson). If left unmanaged, these species pose substantial risks to indigenous plant communities and associated faunal habitat.

In order to mitigate the botanical and faunal impacts associated with the development activities undertaken and proposed, the Botanical and Faunal Impact Assessment requires the systematic removal and long-term control of invasive alien vegetation across the affected areas of the property.

8.1. Goals and Objectives

The overall goal for alien invasive vegetation management onsite is to restore and maintain the ecological integrity of the site by systematically removing and controlling alien invasive plant species, thereby promoting the recovery and long-term persistence of indigenous vegetation and associated faunal habitat.

The specific objectives to achieve this goal are as follows:

1. To reduce woody alien invasive vegetation cover across the property to less than 1% through targeted clearing, follow-up control, and ongoing management in accordance with best-practice guidelines.

2. To prevent the re-establishment and spread of invasive alien plant species by implementing regular monitoring, seedling removal, and adaptive management measures over the medium to long term.
3. To enhance habitat quality and ecological functioning by prioritising the protection and recovery of least-invaded areas and supporting the re-establishment of indigenous plant communities.

Please also refer to Appendix D: A Practical Guide to Managing Invasive Alien Plants, WWF.

8.2. Roles and Responsibilities

The implementation of this Alien Invasive Vegetation Management Plan shall be the overall responsibility of the applicant. All practical and financial aspects associated with the initial removal and ongoing monitoring and management actions required to ensure that alien invasive vegetation management objectives are achieved shall be borne by the applicant.

8.2.1. Training and Capacity Building

Where the applicant elects to utilise an internal team rather than appoint a specialised external contractor for alien invasive vegetation management, the applicant must ensure that all personnel involved in clearing and control activities are adequately trained in invasive alien plant management prior to commencement of work.

Training must include, as a minimum:

- Identification of priority alien invasive plant species present on site (including *Acacia cyclops* and *Acacia saligna*);
- Differentiation between indigenous and alien plant species to prevent accidental removal of indigenous vegetation;
- Best-practice methods for mechanical removal and herbicide application in accordance with recognised guidelines;
- Safe handling, storage, and application of herbicides, where applicable;
- Environmental sensitivity awareness, including avoidance of damage to surrounding natural vegetation, soils, and wetland areas;
- Procedures for disposal of cleared plant material to prevent re-establishment or seed spread;
- Health and safety requirements associated with vegetation clearing activities (first aid certification, chainsaw handling and safety training etc.)

Please also refer to Appendix D: A Practical Guide to Managing Invasive Alien Plants, WWF.

Training must be provided by a suitably qualified individual with demonstrated experience in invasive alien plant management and environmental rehabilitation. Records of all training undertaken (including dates, attendees, and training content) must be maintained by the applicant and made available to the ECO or relevant authority upon request. Training must be conducted whenever new personnel are appointed to the team. No clearing activities may be undertaken by untrained personnel.

The applicant remains fully responsible for ensuring that all alien invasive vegetation management activities are implemented in accordance with the approved EMPr and relevant specialist recommendations, irrespective of whether internal staff or external contractors are used.

8.3. Schedule & Timing

8.3.1. Immediate Clearance

Within one year of the date of issue of a valid Environmental Authorisation, all woody invasive alien vegetation within 100 m of all development footprints (refer to Figure 5) must be removed using appropriate best-practice methodology as outlined in Martens et al. 2021 (refer to Appendix D).

The following requirements shall apply:

- No heavy machinery may be used for clearing activities;
- Stems must be cut as close to ground level as possible;
- Cut stumps must be immediately treated by painting (not spraying) with a suitable herbicide (e.g. Garlon), except where herbicide treatment is not required (e.g. for Rooikrans);
- All cleared plant material must be removed from the site and disposed of at an approved facility in a manner that prevents re-rooting or the dispersal of seeds. Alternatively, removed material may be chipped. Chipped material that does not contain viable seeds may be reused on site for landscaping purposes. Material that cannot be safely reused on site must be removed off site for appropriate disposal or further processing. No on-site burning is permitted.

Clearing activities must be audited by an independent external auditor appointed by the to confirm compliance with these requirements.



Figure 5: Initial 100m buffer around cleared footprints to be cleared of AIPs within 1 year from EA

8.3.2. Property Wide Alien Invasive Vegetation Management

Within three (3) years of the date of issue of a valid EA, all woody alien invasive plant species across the Applicant's property must be removed, at an indicative rate of approximately 8 ha per year. This must include the removal of all seedlings of invasive alien *Acacia* species, such that there is less than 1% overall woody alien vegetation cover remaining on the property.

The clearing strategy must prioritise the least densely invaded areas first, as this approach represents the most ecologically effective and cost-efficient method of control. Wherever possible, clearance shall be undertaken manually. When vehicles and/or machinery are required to support clearing activities, their use must be restricted to existing access routes as far as practicable. Such equipment may only leave these routes when actively engaged in clearing operations.

When clearance is undertaken stems must be cut as close to ground level as possible. Cut stumps must be immediately treated by painting (not spraying) with a suitable herbicide (e.g. Garlon), except where herbicide treatment is not required (e.g. for Rooikrans). All cleared plant material must be removed from the site and disposed of at an approved facility in a manner that prevents re-rooting or the dispersal of seeds. Alternatively, removed

material may be chipped. Chipped material that does not contain viable seeds may be reused on site for landscaping purposes. A chipped may only be operated by a trained individual and appropriate protective equipment must be worn. Material that cannot be safely reused on site must be removed off site for appropriate disposal or further processing. No on-site burning is permitted.

Clearance activities must be externally audited to confirm compliance with these requirements. Should clearing not be adequately completed within the prescribed three-year period, the DEA&DP (or an equivalent competent authority) must be tasked with enforcing compliance with the conditions of the Environmental Authorisation and this EMPr.

The only alien trees that may be retained are a limited number of larger Rooikrans (*Acacia cyclops*) individuals in the immediate vicinity of the main house and outbuildings, where they are required for screening or shade. These trees must be clearly identified and mapped and may not be allowed to spread or recruit seedlings.

As far as possible existing tracks and paths should be used to facilitate clearing.

8.4. Control Methods

8.4.1. Mechanical Control

This entails damaging or removing the plant by physical action. The following mechanical techniques could be used:

Hand Pulling:

Use: Seedlings with a stem diameter of <2cm

Hand pulling should be implemented as the preferred clearing technique as far as possible, since the entire plant is removed quickly and there is no chance of resprouting. Seedlings need to be gripped by the stem as close to the ground as possible and pulled out in one smooth motion, taking care to remove the entire root system. Avoid breaking plants off at ground level as they will regrow. When implemented correctly, this method is extremely effective, yet its application is limited to seedlings. Thus, regular monitoring and follow-up treatments are important to ensure successful and economical eradication using this technique. The procedure to be implemented is as follows:

1. Wearing gloves, grip the plant firmly at the base of the stem and pull hard to remove the entire plant, including the rootstocks.
2. If the roots of the plant break off during removal, use a spade to dig them out.

3. Shake the excess sandy material from the plant to ensure a higher mortality rate and make the plant easier to stockpile and lighter to transport.

Tree Popping:

Use: Seedlings/Saplings with a stem diameter of approximately 2-5cm

This technique is used for medium tree specimens and involves the use of an implement commonly marketed as a "Tree-Popper". This tool consists of a base plate and a lever that are joined to form a small pair of jaws. The tree is placed in the jaws of the tool and the lever is used to pull the entire tree, including the roots, out. This tool is extremely useful for trees that are too large to be effectively removed by hand pulling yet are not yet large enough to require felling. The method to be used is similar to that outlined for hand pulling, however, the Tree-Popper is used instead of hands only.

Cutting / Felling:

Use: Trees with a stem diameter of >5cm

Once the stems of trees reach a diameter of greater than 5cm, felling will need to be implemented to remove the individual. Felling can be undertaken using chain saws and/or bow saws. Hand tools can be used where the stump does not exceed 50mm in diameter. With larger plants, moderately sized chain saws (2.5kW) become more cost effective. Only experienced and trained operators may use chain saws and full Personal Protective Equipment (PPE) including ear protection must be worn at all times. All re-fuelling should be done over drip trays outside the 32m regulated area from watercourses. Any spills must be disposed of offsite at a registered waste receiving facility. Fuel must be appropriately stored at all times according to regulatory standards. All provisions of the Health and Safety Act must be complied with at all times.

Trees must be cut with a neat straight cut possible to reduce the chance of resprouting and improve the effectiveness of stump herbicide treatment. Trees must be cut down as close to the ground as possible (between 5cm and 30cm above the ground). Felling must be undertaken by appropriately trained individuals that possess and make use of the required Personal Protective Equipment (PPE) for the task at hand. In the case of resprouting species, felling must be combined with chemical treatment of the cut stumps as detailed below.

Please note, mechanical brush cutting is not acceptable at this often stimulates more vigorous growth of alien invasive. Furthermore, no uprooting of trees should be undertaken where natural vegetation needs to reestablish. The associated soil disturbance will encourage germination of alien invasive seed banks. Cut trees stumps should remain in situ, treated with suitable herbicides for coppicing or re-sprouting species to prevent regrowth.

8.4.2. Chemical Control

No spraying of herbicide is permitted anywhere where there is any natural vegetation. However, use of chemicals is needed for certain species to prevent resprouting as outlined below:

Herbicide Stump Treatment

Use: Resprouting species that have undergone felling treatment

Certain species, such as *Acacia saligna*, are known to resprout from the stump or roots after felling. To prevent this an herbicide treatment needs to be applied post-felling. Once the tree has been cut down to create a smooth surface that exposes the outer rings of the stem where the trunk grows (the cambium) a died 3% Triclopyr herbicide solution (with colorants) must be applied to the freshly cut surface. All side branches should also be removed from the stump and treated with herbicide. The herbicide treatment should be applied as soon as possible after felling (preferably within 3 minutes) to ensure effective treatment. Where trees with a diameter of greater than 10cm are felled, only the outer rings need to be treated with herbicide. When using a product that is mixed with penetrant oil, the entire stump and exposed roots must be treated. Chemical control should not be applied when it is raining. It is important to note that herbicide can also harm many non-target species and must always be used with the greatest care. Herbicide must be applied with a brush or appropriate device ensuring no spillage occurs on surrounding vegetation or ground. The application using a backpack pump or via spray methods is not recommended due to the potential for drift onto adjacent plants.

Large volumes of herbicide should not be transported or carried unnecessarily within the work area. Herbicide containers should be refilled regularly at designated mixing and refilling stations located outside natural vegetated areas and at least 32 m from the edge of any watercourse. Mixed herbicides should not be stored for longer than 24 hours and must be kept in a shaded area until use. A suitable dye (e.g. EcoBlue) should be added to the herbicide mixture prior to application to clearly mark treated stumps and prevent duplicate treatment. Only the recommended herbicide and an approved wetting agent should be used to ensure effective application. Material Safety Data Sheets (MSDSs) for all herbicides used on site must be readily available at all times.

8.5. Monitoring and Follow-up

Effective management of alien invasive vegetation requires not only the initial clearing but also diligent follow-up and maintenance to ensure long-term success. Without consistent follow-up, costs and time required to achieve the ultimate clearing goals will escalate significantly.

8.5.1. Timing and Frequency

Initial Follow-Up: The first follow-up clearing should occur four months after the initial clearing. This period is critical to address seedling emergence and early regrowth of invasive vegetation.

Subsequent Follow-Up: After the four-month follow-up, the next intervention should take place one year after the initial clearing. Thereafter, follow-up treatments should occur on an annual basis to prevent re-establishment.

Continuous Rotational Management: Due to the vast size of the site, follow-up activities will need to be carried out on a rotational basis. This will ensure that all sections of the site are revisited within the required timeframes while maintaining steady progress.

8.5.2. Follow-up Treatments

Seedling and Coppice Control: Follow-up efforts will primarily target seedlings and coppice regrowth from stumps or root systems. Controlling these early-stage regrowth is more cost-effective and efficient compared to dealing with fully re-established vegetation.

Short Intervals for Effectiveness: Close attention must be paid to the intervals between follow-up treatments, especially during the first year after initial clearing. Delays in follow-up will result in increased time and labor required, as the vegetation will have had time to re-establish.

SECTION 9: LANDSCAPING

The cleared areas surrounding the main dwelling (Footprint 1) and the caretaker's cottage (Footprint 3) that are not proposed for development as per the current plans must be landscaped and rehabilitated to restore a degree of ecological function, minimise erosion risk, provide defensible space for fire protection, and maintain the usability and aesthetic value of the property. Please note that a total of 200m² may be retained in Footprint 3, the remainder of the cleared area must be allowed to rehabilitate naturally.

Landscaping and rehabilitation should comprise the establishment of indigenous vegetation representative of the vegetation structure and character of the surrounding natural areas on the property. The use of invasive alien plant species is strictly prohibited. Planting designs should balance ecological rehabilitation objectives with practical land management considerations, including the creation of a low-fuel buffer around buildings to reduce wildfire risk. Vegetation immediately adjacent to structures should therefore be maintained to prevent excessive fuel accumulation while retaining a predominantly indigenous character.

In accordance with the Botanical and Faunal Impact Assessment, no alien invasive Kikuyu grass (*Cenchrus clandestinus*) should be planted anywhere on the property. This species has the potential to spread beyond landscaped areas. Where lawned areas are required for functional or aesthetic purposes, suitable non-invasive and preferably indigenous alternatives shall be utilised (e.g. buffalo grass). The disturbance footprints must further be maintained free from alien invasive vegetation. The only alien trees that could be kept are a few of the larger rooikrans (*Acacia cyclops*) in the vicinity of the main house and outbuildings, which may be needed for screening or shade.

Locally indigenous species should be used as trees, shrubs, and feature plants within landscaped areas. Suitable species include:

- *Aloe ferox* (Bitter Aloe)
- *Olea europaea* subsp. *africana* (African Olive)
- *Euphorbia mauritanica* (Melkbos)
- *Gnidia squarrosa*
- *Polygala myrtifolia* (September Bush)
- *Cotyledon orbiculata* (Plakkies)
- *Sideroxylon inerme* (Milkwood)

Particular attention should be given to the rehabilitation and stabilisation of cleared and exposed slopes. Planting has already been initiated within these areas and must be maintained and supplemented, where necessary, to achieve adequate vegetation cover. The slopes must be revegetated with suitable indigenous groundcover and shrub species to promote soil stabilisation, reduce surface runoff velocities, and minimise the risk of erosion and sediment loss. Where required, temporary erosion-control measures, such as biodegradable erosion-control matting or similar stabilisation measures, may be implemented to support vegetation establishment and protect exposed soils until sufficient vegetative cover has been achieved.

Following planting, landscaped areas must be monitored and maintained to ensure successful establishment of vegetation. Maintenance may include supplementary watering during establishment, replacement of failed plants where necessary, erosion control, and the removal of any invasive alien plant species that emerge within rehabilitated areas.

SECTION 10: STORMWATER MANAGEMENT

Stormwater generated from the developed areas of the property should be managed in a manner that minimises erosion, sedimentation, and pollution, and protects the ecological integrity of surrounding natural areas and watercourses. Rainwater from the majority of the roofs of the dwelling and associated structures will be captured and directed to rainwater storage tanks for reuse on the property, thereby reducing stormwater runoff volumes and promoting sustainable water use.

Overall, stormwater management onsite should align with natural drainage patterns as far as practicable and promote the infiltration of runoff into landscaped areas and surrounding vegetated areas. Where concentrated flows may occur, suitable erosion protection and energy dissipation measures (such as planting) should be implemented.

Measures should be implemented to prevent contamination of stormwater by waste, fuels, chemicals, sewage, wastewater, or any other pollutants. Domestic waste must be stored in suitable closed bins and removed from the site to the Infanta transfer station at least once a month. All sewage systems must be appropriately sized for the number of users and designed to prevent leaks or overflows. No stormwater runoff from any area containing waste, or water containing waste, may be discharged into a water resource. Any polluted stormwater must be appropriately contained and managed to prevent contamination of the surrounding environment.

Stormwater infrastructure and rainwater harvesting systems should be regularly inspected and maintained to ensure their continued functionality. Any erosion, flooding, sediment accumulation, blockages, or stormwater-related impacts identified on the property should be addressed promptly upon detection.

SECTION 11: ONSITE CONSERVATION

The property is located along the Breede River, adjacent to the Breede River Estuarine Functional Zone, with most of the site mapped as a terrestrial CBA and the northern portion as an Aquatic (Estuarine) CBA. The site supports Critically Endangered Potberg Ferricrete Fynbos, and is situated approximately 3.6 km north of De Hoop Nature Reserve. The property is therefore well-positioned to contribute to provincial conservation priorities and to maintain ecological connectivity across the broader terrestrial and estuarine landscape.

As recommended in the Botanical and Faunal Impact Assessment, the applicant intends to enter into a Biodiversity Stewardship Agreement with CapeNature to ensure the sustainable use and management of the site. The natural vegetation in moderate to good condition on the property will be enrolled in the CapeNature Stewardship Program within one year of any valid Environmental Authorisation. The applicant will be responsible for all costs associated with registration and ongoing stewardship site management.

The applicant aims to conserve the majority of the site in its natural state, thereby maintaining both scenic beauty and ecological functionality. The following conservation actions must be implemented onsite:

- Alien Invasive Species Management: Alien vegetation will be managed and cleared from the site on an ongoing basis throughout the operational phase.
- Rehabilitation of Disturbed Areas: The disturbed wetland area will be rehabilitated through the re-establishment of natural vegetation and will continue to be maintained in a health ecological condition.
- Erosion Monitoring and Management: The site will be regularly monitored for signs of erosion, and any identified erosion will be addressed promptly using appropriate remedial measures.
- Integrated Fire Management: Suitable fire management will be implemented, as outlined in Section 6 of this document. All fire management activities will comply with the National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998).

Through the implementation of these actions, the site will contribute to the conservation of biodiversity, ecological connectivity, and the maintenance of ecosystem functionality, while supporting provincial conservation initiatives and stewardship goals.

SECTION 10: MONITORING AND COMPLIANCE

10.1. Monitoring

Monitoring is a critical component of environmental management, ensuring that construction and operational activities are conducted in accordance with the Environmental Management Programme, the Environmental Authorisation, and other applicable permits. Monitoring allows for the early detection of non-compliance or environmental issues and enables the timely implementation of corrective measures to minimise environmental damage. Table 1 summarises the applicable monitoring timeframes, while the sections that follow provide further detail on each monitoring requirement.

Table 1: Summary of Environmental Monitoring Timeframes

Environmental Monitoring Timeframes		
Type	Frequency	Criteria
Site Manager (Internal Monitoring)	Daily visual checks during construction. Monthly monitoring of rehabilitated wetlands until such time as the required degree of vegetation cover is archived.	Identification and management of emerging environmental risks & update site control register
ECO Monitoring	Monthly during construction, less frequent when no works is taking place	EMPr Compliance Monitoring
Independent External Audit	Six months after completion	Independent verification of compliance with the EA and EMPr.
Compliance Monitoring: Wetland Rehabilitation	6-monthly until such time as the required degree of vegetation cover is achieved	Requirements of Wetland Rehabilitation Plan
Compliance Monitoring: AIPs Clearance	One year and again three years after EA is issued	Requirements of the AIPs Management Plan

10.1.1. Internal Monitoring

The applicant and contractor(s) must monitor all construction activities on a day-to-day basis to ensure compliance with the EMPr, EA, and all other applicable authorisations. Internal monitoring shall include:

- Daily visual checks by the site manager;
- Maintenance of the site control register;
- Photographic documentation of activities, progress, and environmental conditions;

- Implementation of corrective actions as needed.

In addition to the above, the site manager must undertake monthly monitoring of the rehabilitated portion of the floodplain saltmarsh wetland and photographic records of monitoring must be maintained until such time as the required vegetation cover is achieved as signed off by a suitably qualified professional.

10.1.2. ECO Monitoring

A suitably qualified ECO must be appointed, at the expense of the landowner, to undertake compliance monitoring and ensure that the EMP is effectively implemented throughout both the construction and operational phases. The ECO's responsibilities include:

- Monthly site visits and reporting during construction;
- All findings and outcomes must be recorded in a ECO Report, which must be submitted to the competent authority at intervals specified in the EA;
- The ECO report should include photographic records of all site visits to support monitoring findings.

Additional site specific compliance monitoring shall include:

- 6-monthly monitoring of rehabilitated wetlands until such time as the required vegetation cover is achieved (ECO or suitably qualified professional e.g. rehabilitation contractor).
- One year after the EA is issued, to verify that alien invasive clearing within 100 m of development footprints has been undertaken (ECO or suitably qualified professional).
- Three years after the EA, to confirm alien invasive clearance across the remainder of the property (ECO or suitably qualified professional)

The ECO is responsible for monitoring and providing guidance but is not responsible for issuing instructions, enforcing compliance, or addressing design requirements.

10.1.3. Audits

A suitably qualified Environmental Auditor must be appointed at the expense of the applicant to undertake audits of compliance with the EA & EMPr. Audits must be conducted six months after completion of construction or the commencement of the operational phase.

Objectives should be to audit compliances with the key components of the EMPr, to identify main areas requiring attention and recommend priority actions. The audit should cover a cross section of issues, including implementation of environmental controls, environmental management, and environmental monitoring.

10.2. Review of the EMPr

The EMPr will be reviewed by the ECO on an ongoing basis. Based on observations during site inspections and issues raised at site meetings, the ECO will determine whether any procedures require modification to improve the efficiency and applicability of the EMPr on site. Any such changes or updates will be registered in the ECO's monthly record, as well as being included as an annexure to this document. Annexures of this nature must be distributed to all relevant parties on site.

10.3. Record Keeping

The Landowner should keep records of all Compliance Monitoring Reports (ECO Reports) and Environmental Audits undertaken for the site. Records should be kept and must be made available for review on request, based on adequate motivation. Minutes of meetings on site must reflect environmental queries, complaints, actions agreed upon, dates of compliance and must form part of the official environmental site record.

10.4. Incident reporting

Environmental incident reporting is a vital part of communication. Employees are required to report all environmental related problems, incidents, and pollution, so that the appropriate mitigation actions can be implemented timeously. See Appendix A for a template that can be used for incident reporting

The landowner and the site manager shall investigate the incident and record the following information:

- How the incident happened,
- The reasons the incident happened,
- How rehabilitation or clean up needs to take place,
- The nature of the impact that occurred,
- The type of work, process or equipment involved; and

- Recommendations to avoid future such incidents and/or occurrences.

The landowner shall also:

- Inform the ECO of all incidents that were reported, and
- consult with the ECO for recommendations on actions to be taken or implemented where appropriate (e.g., clean-ups).

SECTION 8: TRANSGRESSIONS IN TERMS OF EMPR

The Landowner must comply with the requirements of this EMPr on an on-going basis and any failure on his part to do so will entitle the relevant competent authorities to take corrective action against the transgressor.

Transgressions relate to actions by the landowner and operating team members whereby damage or harm is inflicted upon the environment or any feature thereof and where any of the conditions or specifications of the EMPr/ EA/ GA are infringed upon.

In the instance of environmental damage, the damage is, where possible, to be repaired and rehabilitated using appropriate measures, as specified and undertaken by appropriate specialists, for the account of the responsible party.

Issues of non-compliance noted by the ECO are to be communicated to the site manager, who holds the responsibility of ensuring that the relevant parties are made aware of the lack of compliance with EMPr specifications, and that appropriate action is taken to rectify the situation. Issues of non-compliance must be reported in the required ECO site visit report. The ECO will advise on appropriate corrective actions when necessary.



APPENDIX A – SITE CONTROL REGISTER TEMPLATE

Prepared by: PHS Consulting

SITE CONTROL SHEET & ENVIRONMENTAL INSTRUCTIONS TEMPLATE

Project Name:
Contractor:
Site Manager:

Date	Environmental Aspect (e.g. waste management, erosion, dust, general housekeeping etc.)	Problem Encountered	Instruction / Corrective Action	Responsible Person	Due Date	Compliance Date

ENVIRONMENTAL INCIDENT REPORT TEMPLATE

Date:	File reference number:
Name:	
Exact location of incident:	

Section 1: Description of incident

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Section 2: Remedial action required

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Section 3: Relevant Documentation

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Section 4: Steps to prevent recurrence

--

Section 5: Signatures

Site manager:	Date:
.....	
ECO:	Date:
.....	
Landowner:	Date:
.....	

COMPLAINTS REGISTER TEMPLATE

Project Name:
Contractor:
Site Manager:

Complaint No.	Date	Nature of Complaint	Response / Corrective Action	Responsible Person



APPENDIX B – EAP CV

Prepared by: PHS Consulting

CURRICULUM VITAE of PAUL HENDRIK SLABBERT

ENVIRONMENTAL & HERITAGE IMPACT PRACTITIONER

EAPASA Reg 2020 • Ref: 2019/1036

1. PERSONAL DETAILS

Born:	23 May 1973
Nationality:	South African
Drivers License:	Code EB
Languages:	Proficient in English and Afrikaans

2. KEY COMPETENCIES

I've completed my BACCALAUREUS ARTIUM ET SCIENTIAE Honors degree at the Potchefstroom University for CHO in 1995. The degree is primarily focused on qualifying Town and Regional Planners, but due to the SCIENTIAE (Science) component it equipped and stimulated my passion for environmental planning. Geography & Environmental studies, Sociology, Statistics and Mathematics in the first year and Geography & Environmental studies, Sociology in the second year formed the bases of my environmental education and interest. Economics up to 3rd year level and Statistics, Project Management and Planning Legislation at 4th year level provided me with an advance understanding of the development industry. The Town and Regional Planning curriculum from 1st to 4th year covered the entire spectrum of the built, people, heritage, natural and aesthetic environment in relation to the potential impacts on the socio, economic and bio-physical environment.

I started my Environmental Assessment Practitioner (EAP) career in 1998 as a professional practicing initially in the eco-tourism development industry. My passion for environmental, heritage & land-use planning with associated management strategies enable me to facilitate with all role players to find workable solutions in order to implement sustainable development in Greenfield areas. Due to the ECA (Act No. 73 of 1989) Section 21 Activities identified in 1997/8 the projects I was involved with required authorisation into the ECA. As a result I started to practice as an EAP obtaining authorisations for triggered developments. I gained experience in rural and urban development with the emphasis on environmental impact assessments and management. This enabled me to have various publications in leading eco-tourism magazines. I've been witness to the evolution of the EIA industry from ECA to NEMA up to the current EIA Regulations. I've been operating as a Principal EAP and Environmental Practice owner for over 20 years.

During my career to date I have accumulated experience in the following key areas:

Impact Practitioner & Environmental Planner:

- Environmental Impact Assessments [legislative & process],
- Heritage & Visual Impact Assessments [legislative & process],
- Mining; Processing & Industrial [legislative & process],

- Environmental Management [environmental control, management plans, Environmental & Social Management Systems],
- Conservation [management strategies, funding & alien vegetation],
- Power Generation [generation, distribution and powerline alignment]
- Land-Use [forward planning, feasibility study, business plan],
- Eco-tourism [trails, birding, recreation, construction, lodging],
- Community [facilitating, public participation, education],
- Water use authorisation [WULA's, GA's pollution prevention management plans and ELU's];
- Waste Management Licences [legislative & process];
- Air Emission Licences [legislative & process],
- Coastal Water Discharge Permits [legislative & process],
- Organizers [events, strategic, project management].

Business & Corporate Reasonability:

- Information on my Environmental Practice, PHS Consulting please view at www.phsconsulting.co.za
- For overview of my social and community engagement programme visit www.africanvisionfoundation.co.za

Advanced Legislative Knowledge:

Providing specialist services and managing and driving projects related to the following legislation:

- National Environmental Management Act (Act No. 107 of 1998) and 2017 Regulations;
- Environmental Conservation Act (Act No. 73 of 1989);
- National Heritage Resources Act (Act No. 25 of 1999);
- Land Use Planning Ordinance (Ordinance 15 of 1985);
- National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008);
- National Environmental Management: Waste Act (Act No. 59 of 2008);
- National Environmental Management: Air Quality Act (Act No. 39 of 2004);

- Mineral and Petroleum Resources Development Act (Act No. 28 of 2002);
- National Water Act (Act 36 of 1998);
- National Water Services Act (Act 108 of 1997).
- National Environmental Management Act (Act No. 107 of 1998); Public Participation Guideline (10 October 2012)

3. TERTIARY EDUCATION

3.1 Honors Degree in B Art Et Scien (Planning)

Year/s of study: 1992 – 1995 (received 96/03/04)

Institution: University of Potchefstroom (PU for CHO)

Course Modules: Geography and Environmental Studies
Industrial Sociology
Town & Regional Planning
Economics
Mathematics
Philosophy
Sociology
Statistics
Planning Legislation

Honors Thesis: Sustainable Development of Ikageng Township

4. REGISTRATIONS AND AFFILIATIONS

- Certified Member of the Interim Certification Board for Environmental Assessment Practitioners of South Africa – May 2009
- Professional Certified Member of AHAP now the Association of Professional Heritage Practitioners (APHP)
- Professional Member of the International Association for Impact Assessment (IAIA)

5. EMPLOYMENT RECORD

4.1 Current

Designation: Self-Employed
Principal Environmental Assessment Practitioner
Heritage Assessment Practitioner
Environmental Planner

Period: 1998 to current

Key responsibilities: Environmental Practice (PHS Consulting) Owner that conduct, manage and review EIA's, Basic Assessments, Coastal Water Discharge Permit, Air Quality Licenses, Waste Management Licenses, Setback Line applications,

PHS Consulting: Water Use Authorizations, General Authorizations, NEMA S24G Applications, Mining Permit and License applications. Authorisation and License compliance audits, EMP's, ECO work, Social and Labour plan compilations, Alien Eradication Management Plans, Fire Management Plans, Maintenance Management Plans, Wild Life Management Plans. Environmental feasibility planning, event organizing and Corporate Social Investment programmes.

As sole Member of the Close Corporation I currently employ two fulltime EAP's namely Amanda Fritz-Whyte and Nadine Duncan. We make use of various freelance EAP's and specialist consultants depending on the project type.

4.2 Pre PHS Consulting

Designation: Employed by OmniPlan
 Period: 1997 to 1998
 Key responsibilities: Planning Administration, Town Planning Applications, Constraint Analysis, Layout and Design, Community Presentations.

6. COURSE / CONFERENCE PARTICIPATION

5.1 Short courses completed

I attended various DEA&DP, APHP, IAIA, Fynbos & SANBI forum workshops, training programmes and conferences since 1999 to date.

7. LIST OF EIA PROJECTS TO DATE

Please note over the years in practice I conducted many projects and it's impossible to list them all. He is a summary of the most relevant EAP projects that illustrate my competence, knowledge and experience. **Please note that all projects listed below required the need to conduct Public and Authority Participation, the result is 25 years of consultation experience.**

Major project	Tasks	Employer/client	Responsibility
Namaqualand Casino Development 1998	Evaluate and assess various site alternatives for the development of a casino in Namaqualand. Assess bio-physical & socio-economic environments from Garies to Violsdrif to Pella inland environments. Assessment of the entire coastal environment from Groenrivier mouth to Alexander bay. Presented preferred site alternative to be included in national bid for license allocations	Namaqualand District Council	Act as researcher, public participation liaison and site assessment consultant
Barolong Archaeological Eco-tourism Assessment 1999 - 2000	Investigate the feasibility to develop eco-tourism activities amongst the Barolong Tribe kraal systems on the highlands of the North West Province. After survey and mapping, proposed a feasible site close to Hartebeesfontein (NW). Planned hiking and mountain bike trails system in terms of bio-	Hartebeesfontein Farmers Association	Site Analysis, layout development, Heritage Practitioner (HP) and environmental management and ECO work

	physical and heritage constraints. Drafted a management plan for trail system and developed the trail system and product. Launched and operated initial phase until handover to landowners.		
EIA's on 4x4 trails and overnight huts, 2000 - 2001	Completed 3 x EIA's on 4x4 trails in the Du Toit Kloof and Hexriver mountains. Worked according to DECAS guidelines and ECA process at the time.	Private Landowners and conservancies	EAP
Anglo Gold Game Reserves – North West, Gauteng, Free State Provinces 2001	Contracted as Environmental Management Officer for Anglo Gold mining group in Vaal Reefs. I drafted EMP's for all three of the Nature Reserves and Interpretation Centres. This was followed by ecotourism master plans to focus on sustainable use of the Reserves. I acted as ECO, for the building projects (Lodges) in the reserves and on most of the adjacent mining areas. Water Management and monitoring of water samples were part of the duties	Anglo Gold Ashanti	ECO, HP and IEM officer
Contracted by Uluntu Environments for trail planning and assessments 2002	Status quo assessments on all trails and tracks conditions in the Rhodes Memorial, Devils Peak, Sandy Bay, Buffels Bay, Table Mountain and Cape Point areas of the Cape Peninsula National Park. Proposed rehabilitation plans, construction plans and new routes. Assess potential impact on new and disturbed areas. Construction implementation and ECO.	City of Cape Town, Cape Nature	Planning, Environmental Assessment & ECO
Kronendal Estate Residential Development – Houtbay, 2003	Environmental Impact Assessment and EMP's	Dormacorp Pty Ltd & First Plan town and regional Planners	EAP
Community Centre site selection – Pringle Bay 2003	Site Analyses in coastal zone, with comprehensive public participation. This was to determine a feasible site form both an environmental and community perspective	Hangklip Kleinmond Municipality	Site Assessor and Public participation Liaison
Mosaic Farm, Walkerbay Fynbos Conservancy, Stanford, Western Cape 2003 – 2005	Project and Conservation Management contract, responsible for drafting and implementing a major, building restoration and alien clearance program. Planning and implementing the Walkerbay Fynbos Conservancy Hiking trail alignments and management plans. Responsible for assessing development footprints for overnight camps. Implementation of a fire management plan and action plan.	Hermanus Riviera Estates	Environmental Planner, HP, Implementing Agent and Assessor
Chairman Birdlife Walke Bay 2003 - 2005	Established bird club and birding project in the Overberg and the Stanford Bird fair	Birdlife South Africa	Chairman (WB), Event Organiser and Community Liaison
Hoopjiesrivier, Free Range Chicken Farm (Farm 541 Caledon)–	Basic Assessment and EMP's	ITAKANE	EAP

Karwyderskraal, 2006 Heritage Heights (Portion 81 of the Farm 229) residential development – VanWyksdorp, 2006	Visual Impact Assessment (VIA) and Heritage Impact Assessment (HIA)	Andre Snyman	VIA and HP
Kleinberg residential and retirement village development (erf 459) – Riviersonderend 2007 Gansbaai Industrial extension (erf 210) – Gansbaai 2007 Kleinbaai harbour dredging – Gansbaai 2007	Basic Assessment, EMP's and Landscape Planning Basic Assessment, EMP's Basic Assessment, EMP's	Jacob du Toit Overstrand Municipality Overstrand Municipality	EAP EAP EAP & ECO
Langeberg Cheese factory (Portion 69 of Farm no.159) – Buffelsjag 2008 Industrial development (erf 931)- Struisbaai 2008 Shopping Centre Development – Livingstone Zambia 2008 Billboard development (erf 35270) – Milnerton 2008 Fick's Pool Restuarant – Hermanus 2008	Basic Assessment, EMP's Basic Assessment, EMP's, Landscape Planning EIA and EMP's Basic Assessment, EMP's Basic Assessment, VIA and HIA	Langeberg Kaas Pty Ltd Louis Greeff Shoprite Checkers CK Outdoor Advertising Pty Ltd Overstrand Municipality	EAP EAP EAP EAP. VIA & HP Practitioner
Residential Development (erf 1497) – Vermont 2009	Basic Assessment, EMP's, Landscape Planning Basic Assessment, EMP's	CRISTATUS INV 85 CC PJW Terblanche	EAP EAP & ECO

Single Dwelling Development (erf 278) – Malgas 2009	Scoping, EIA and EMP's	Swellendam Municipality	EAP
Petrol Filling Station (erf 1) – Swellendam 2009	Basic Assessment, EMP's	West Point Processing Pty Ltd	EAP & ECO
Fish Processing Plant – St Helena Bay 2009	VIA and HIA	Spirito Trade 82 Pty Ltd	VIA & HP Practitioner
Bloemendal Wine Estate – Durbanville 2009	Environmental Management Programme Reports and Audits	Terblanche Transport	Environmental Auditor
Maandagskop and Airport Quarries – Mosselbay and George 2009			
Matroosberg Reserve (Farm 424) Ceres 2010	Basic Assessment & EMP's	Erfdeel Boerdery	EAP & ECO
Kleinbaai Harbour Expansion (Erf 423) - Gansbaai 2010	Basic Assessment & EMP's	Overstrand Municipality	EAP
Retirement Village Development (Erf 5379 & 5300) – Onrusrivier 2010	Basic Assessment, EMP's & ECO	Tweefonteine Ontwikkelings Trust	EAP & ECO
Industrial Development (Erf 2015) – Riversdale 2010	Basic Assessment, EMP's & ECO	Hessequa Municipality	EAP & ECO
Residential Development (Erf 987) – De Kelders 2011	Basic Assessment & EMP's	Hopefull Trust	EAP
Unlawful Vegetation Removal (Farm 237) - Elim 2011	S 24 G & EMP	Moravian Church of Elim	EAP
Graveyard Development – Springbok, Okiep, Bergsig, Matjieskloof, Kommagas, Nababeep – Northern Cape 2011	Basic Assessments & EMP's	Nama Khoi Local Municipality	EAP
Residential Development (Erf 8704) – Paarl 2011	Basic Assessment & EMP's	Nevensaan Ontwikkelings	EAP

Wetland Rehabilitation – Tesselaarsdal 2011	Basic Assessment & EMP's	Department of Agriculture and Tesselaarsdal Action Group	EAP
Mushroom Farm Development (Farm 436/27) – Botrivier 2011	Basic Assessment & EMP's Waste Licence	Ocean Mushrooms	EAP & ECO
Blouberg Mine Development (Farm 88 & 91) – Melkbosstrand 2012	Visual Impact Assessment	Tip Trans	Visual Assessor
Urban Expansion Residential Estate (Farm 436/5) – Botrivier 2012	Scoping, EIA & EMP's	Crimson Properties	EAP
Cemetery Development (Erf 513 – Napier 2012	Basic Assessment & EMP's	Cape Agulhas Municipality	EAP
Coastal Sidewalks Development (Erf 462) – Franskraal 2012	Basic Assessment & EMP's	Overstrand Municipality	EAP
Riverside Residence Development (Farm 321) – Stanford 2012	Basic Assessment & EMP's	Astrodome Investments	EAP
Eco-Village Development (Farm 483/2) – Caledon 2012	Basic Assessment & EMP's	Theewaterskloof Municipality	EAP
Botrivier Windfarms – Botrivier 2013	Appointed to oppose the development of windfarms outside regional allocated areas as part of the “Wind Rush” period. Scrutinise and evaluate Scoping & EIA Documents on behalf of opposition. Handling of Appeal.	Wildeckrans Wine Estate and Botriver Community	Opposing EAP
Resort Development (Farm 213) – Bonnievale 2013	S24 G & EMP's	De Hoek Trust	EAP
Commercial Development – Chililabombwe Zambia 2013	EIA	Shoprite Checkers	EAP
Birding Route Development – South Africa 2013 to 2016	Environmental Planning to establish and support birding development in all the South African Provinces	E Snell & Co Funder and BirdLife	Environmental Planner

Intensive Feed Farm Development (Farm 728/2) – Grabouw 2013	Basic Assessment & EMP's	SA and SANPARKs Honorary Rangers Babel Trading	EAP & ECO
Uilenvlei Private Nature Reserve, resort development – Uilkraalmond 2013	Basic Assessment & EMP's	Southern Spirit Properties	Compile & Review EAP
Development of five Cemeteries - Uppington 2014	Basic Assessment & EMP's	Khara Hais Local Municipality	EAP & HP
Commercial Development – Mongu Zambia 2014	EIA	Shoprite Checkers	EAP
Establish Hartenbos River Water Users Association – Hartenbos 2014	Draft Constitution, verify ELU's conduct Public Consultation	Hartenbos River Water Users Association	Water Resource Consulting
Commercial Development Cabinda – Angola 2014	EIA	Shoprite Checkers	EAP
Resort Development (Farm 633 & 273) – Swellendam 2014	Basic Assessment & EMP's	Bakkelys Drift Properties	EAP
Natures Path Lifestyle Village - Keurboomstrand 2015	Heritage Impact Assessment guiding the EIA process towards a more aesthetic SDP	Sharples Environmental	Heritage Impact Assessor (HP)
Hazardous Waste Assessment – Castle Mews Woodstock – 2015	Assess hazardous waste contamination in basement of old buildings, establishing the source and report finding the competent authorities. Assist with drafting management actions to clean-up and resolve.	Castle Mews	Waste Assessor
Commercial Development Kuito – Angola 2015	EIA	Shoprite Checkers	EAP
Residential Development (Farm 142/14) – Rheeboek 2015	Basic Assessment & EMP's	Mercedes Trust	EAP & ECO
		Shoprite Checkers	Water Assessor

Water Act and Use Interpretations for Commercial off grid Systems – Western Cape 2015 Coastal Sidewalk and Trail Development – Kleinmond 2015 Wetland Rehabilitation Plan; Operational Environmental Management Plan and Environmental Liaison Committee – Sun Valley Mall Noordhoek – 2015	Site Assessments, Technology Assessment, Legislation Applicability, Interpretation of the Water Act. Basic Assessment & EMP's Rehabilitation Plan, OEMP & ELC	Overstrand Municipality Shoprite Checkers and City of Cape Town	Review EAP EAP & ECO
Air Emissions Licence (2 Neil Hare Rd) - Atlantis 2016 Kenhardt Solar Power Farms and Power Lines – Northern Cape 2016-2018 Jetty Development in Protected Area (Farm 480/136) – Stillbaai 2016 Intensive feed Farm (Farm 226) – Hermanus 2016 Industrial Development (Erf 1) - Caledon 2016 Abalone Farm Development (Farm 421/1) – Doringbaai 2016 Stander Mine (Farm 189/83) – Wilderness 2016	Air Emissions Assessment Appointed to investigate the development of solar farms and powerline distribution lines outside regional allocated areas as part of the “Solar Rush” period. Scrutinise and evaluate Scoping & EIA Documents on behalf of opposition. Handling of Appeal. Basic Assessment & EMP's Basic Assessment & EMP's Basic Assessment & EMP's Basic Assessment & EMP's Basic Assessment & EMP's	Malmesbury Sterilisasie Aanleg Dagab & Rooidam Farms Koringfontein Farm Bapchix Theewaterskloof Municipality Doring Bay Abalone Viadro 127	EAP Analysing EAP Review EAP Review EAP & ECO EAP Review EAP EAP & ECO

ECO Lifestyle Estate & Nature Reserve, Hoek vd Berg (Farm 572) – Hermanus 2017	Scoping EIA & EMP's, HIA	Saddle Path Properties	Review EAP, Heritage Assessor and Water Assessor
Abalone Farm Development (Farm 108) - Jacobsbaai 2017	Basic Assessment & EMP's	Jacobsbaai Sea Products	Compile & Review EAP & ECO
Demolition Waste Management – Cape Peninsula 2017 ongoing	Waste Management Plans for demolition and redevelopments	Shoprite Checkers	Waste Assessor
Resort Development (406/58) – Slanghoek 2017	Basic Assessment & EMP's	Slanghoek Resort	Review EAP & Visual Assessor
Resort Development (Farm 627/1) - Stanford 2017	Basic Assessment & EMP's	Philipskop	Review EAP
Intensive Feed Farm (Farm 541/6) – Karwyderskraal 2017	Basic Assessment & EMP's	Itakane Trading	Review EAP & ECO
Henkershoek Mine (Farm 628) – Albertinia 2017	Basic Assessment & EMP's	Viadro 127	Compile & Review EAP
Heavy Minerals Prospecting (Alexcor Mining Right Area) – Alexanderbaai 2018	Basic Assessment & EMP's	Vast Mineral Sands	EAP
Commercial Development Namibe – Angola 2018	EIA	Shoprite Checkers	EAP
Resort Development (Farm 465) – Elgin 2018	Basic Assessment & EMP's	On The Earth	Review EAP
Residential Development (Erf 1019) - Wilderness 2018	Basic Assessment & EMP's	Costa	Compile & Review EAP
Residential Development (Erf 1156) – Witsand 2018	Basic Assessment & EMP's	Westfield Trust	EAP & ECO
Van Der Stell Liquor Store – Stellenbosch 2019	Heritage Impact Assessment	Shoprite Checkers	HP

Weir and Pipeline Development (Huiskloof River) – Botrivier 2019	S24G & EMP's	Erin de Vigne	EAP
Crocodile Diving Facility (Erf 48) – Birkenhead 2019	Cape Nature Permitting & EMP	Afrikanos	EAP
Abalone Farm Development (Farm 6/453) – Gouritsrivier 2019	Basic Assessment & EMP's	Aqunion	Compile & Review EAP
Heavy Minerals Prospecting (Trans Hex Mining Right Area) – Hondelipbaai 2019	Basic Assessment & EMP's	Saxon	EAP
Intensive Chicken Farm (Farm 487) – Caledon 2019	Basic Assessment & EMP's	Elgin Free Range Chickens	Review EAP
Agricultural Cultivation (Farm 3/497) – Malgas 2019	Scoping, EIA & EMP's	Eksteen Familie Trust	Review EAP
Airport Quarry (Farm 129/208) – George 2019	Scoping, EIA & EMP's	Mercedes Trust	Compile & Review EAP
Constantia Emporium Retail Centre - 2020	Heritage Interpretation Story & Signage	Shoprite Checkers	HP
Commercial Retail Development – City of Cape Town 2017 – 2020	Environmental Management Plans & Environmental Control Officers various projects, Delft, Sun Valley, Constantia, Sitari, Brackenfell, Paarl, Table View and Gordons Bay.	Shoprite Checkers	EMP & ECO
Heavy Mineral Mines – Alexcor Northern Cape 2020 – 2021	Environmental Impact Study	Deep Blue Minerals	EAP
Free Range Chicken Farms – 2020 – 2021	Environmental Impact Assessment	Elgin Free Range Chickens	EAP
Sitari Retail Centre - 2021	Heritage Interpretation Story & Signage	Shoprite Checkers	HP
Hoop Urban Expansion – Overberg 2022	Environmental Impact Study Heritage and Visual Impact Study	Hoop Trust	EAP & HIA

EFRC Abattoir – 2022	Environmental Impact Assessment	Elgin Free Range	EAP
Atlantis Air Quality 2022	Atmospheric Impact Assessment	Atlantis Processors	EAP
Cape Winelands Airport – City of Cape Town 2021 – 2023	Environmental Impact Study	Cape Winelands Airport	EAP
West Point Processors (Fish Meal & Oil) – St Helena Bay 2019 - 2023	Environmental & Atmospheric Impact Study	TerraSan Group	EAP

References:

1. Shoprite Checkers - Leon Myburgh (084 223 4788)
lemyburgh@shoprite.co.za.
2. Cape Winelands Airport - Nick Ferguson (082 374 8769)
nick@capewinelands.aero
3. West Point Processors - Marthin Potgieter (082 551 0217)
marthin@saldanha.co.za



APPENDIX C – WHAT A LANDOWNER NEEDS TO KNOW ABOUT FIRE MANAGEMENT

Prepared by: CapeNature



What a landowner needs to know about **FIRE MANAGEMENT**



Periodic natural fires have always occurred in fynbos and renosterveld ecosystems. In fact, fires are vital to retain fynbos and renosterveld in an ecologically healthy condition. Fire is an important ecological driver required to maintain the species richness in these ecosystems. Many plants actually need fires to reproduce and ensure their longterm survival. The challenge today is how to use fire in a fragmented and highly modified modern landscape to ensure the survival of all plant and animal species. Although fynbos is a fire-adapted system, just one or two inappropriate fires at the wrong time of year, or no fire at all, can cause the local extinction of species. However, local differences in habitat, geology and climate preclude a 'recipe' approach.

The most important use of fire in conservation management is to maintain viable and healthy populations of all plant and animal species present. Other objectives may include: reduction of fuel load to prevent unmanageable wildfires; control of invasive alien plants; promotion of desirable plants for the flower-picking industry; or safeguarding property and infrastructure. Using fire to improve grazing or increase water yield in catchments can be disastrous and may cause local extinction of species. Furthermore, high grazing pressure after a fire can have a worse affect on veld condition than the fire itself.

Principles of Fire Management

Frequency

The interval between fires should largely be determined by the growth rate of natural, existing plants. No fire should be permitted in fynbos until at least 50% of the population of the slowest-maturing species in an area have flowered for at least three successive seasons (or at least 90% of the individuals of the slowest maturing species in the area have flowered and produced seed). Similarly, a fire is probably not necessary unless a third or more of the plants of these slow-maturing species are senescent (i.e. dying or no longer producing flowers and seed).

Research suggests that, under natural conditions the **minimum** fire return interval for moist mountain and lowland fynbos should be between 12 and 20 years and arid mountain fynbos 25 years, whilst that of moist renosterveld (e.g. in coastal plain areas) should be around 10 years and arid renosterveld (e.g. the inland areas) between 15 or more years. The variance in the length of the interval will be dependant on climatic and rainfall cycles, as well as the aspect on which the vegetation occurs. Arid fynbos, from e.g. the Cederberg and Koue Bokkeveld, has a significantly longer fire cycle of up to 50 years. Fire at intervals greater than 25 years may result in fynbos from moist climates becoming senescent but, generally, the greatest challenge is to protect fynbos from fires that are too frequent.

Although not much research has been conducted on the role of fire in renosterveld, it is likely that the above guidelines are a good starting point. Again, regional variances in renosterveld habitats preclude a 'recipe' approach. As renosterveld can contain a high proportion of grasses that are fast growing and highly flammable, it can burn more frequently than fynbos. It should however be noted that there are often individuals of *Protea* species present in some renosterveld

areas, and these species are good indicators for determining fire intervals. However, renosterveld is less dependent on fire than fynbos and too frequent fires could be detrimental for the ecosystem. Fires are nevertheless very important for many species to stimulate seed germination, especially those species that are dependent on ants for seed dispersal. While fire will promote grass regeneration and can temporarily improve grazing, regular burning in renosterveld to promote a 'green flush' can result in the disappearance of a number of plants that require longer fire cycles (e.g. the legumes that fix nitrogen into the soil).

Intensity

Fire intensity is closely associated with season of burn. The intensity of a fire is influenced by the fuel load, fuel moisture, relative humidity and wind speed. The intensity can be manipulated by either reducing the fuel load (i.e. burning more often) or by selecting conditions that will lead to the desired type of fire. Most fynbos species require high intensity fires for survival, however low intensity burns are often favoured for safety reasons. This is however not recommended as such burns could lead to loss of species that do need high intensity fires (e.g. *Leucospermum* (Pincushions), *Mimetes* (Pagoda), etc.) and favour small-seeded, often weedy or pioneer species such as *Helichrysum* spp. (everlastings) and *Stoebe* (slangbos). Repeated, low intensity fires will result in an increase in these weedy species, which will increase the flammability of the veld at an early age. Alien plants impact significantly on intensity (and consequently frequency) due to their flammable oils and the greater biomass created by the density of invasion.

Season

Due to the Mediterranean climate (summer drought) over most of the Fynbos biome, natural fires occur mainly in sum-

mer but can occur at any time under suitable weather conditions. Prescribed burning in the summer months (Dec– Feb) is seldom done due to the risk of runaway fires. Burning is usually only feasible in March and early April. Generally, fire experts consider late summer and early autumn (February to early April) the best time to burn. Seedlings that establish after such fires have the best chance of survival, because they have the generally cooler and wet months during late autumn, winter and spring to manifest themselves, before the following summer.

Proportion of area burned - maintaining a landscape mosaic

On large properties (1000+ ha) it is advisable to maintain a mosaic of different vegetation ages. Block burns are however expensive to implement. Weighing up ecological need, financial implications and practical reality, it is recommended that land managers aim at fire management blocks of 300-500

hectares, if possible. If the property is less than 300 hectares, make the fire management blocks as large as possible – preferably more than 100 hectares each. Any area of less than 50 hectares, should be burnt in one fire event - **do not subdivide the area into smaller blocks**. Small fires of limited extent are problematic because of the significant loss of seeds to seed eaters (e.g. rodents) after the fire. The other problem pertains to the fire intensity – fires take time to build up adequate energy and gain momentum to create a clean burn. If need be (and possible), consider consolidation into larger management units with neighbouring properties.

Authority to burn

In order to undertake a burn during the prescribed season, permission must be obtained from the local Fire Protection Association (if operational) and the District Municipality. CapeNature should also be notified.

Do's and Don'ts of Fire Management

DO

- Burn vegetation at the end of summer or early autumn.
- Ensure you have adequate firebreaks to be able to fight runaway fires – NOTE: firebreaks do not stop/prevent fires – they simply create access points to fight fires from. The Veld and Forest Fire Act states that owners must pay attention to weather, climate, terrain and vegetation in deciding how to prepare a firebreak. If optimal firebreak position is not along a common boundary with neighbours, decide on relocation of fire breaks in collaboration with neighbouring landowners - consider relocating firebreaks to a point where it would be practical to access the area (e.g. existing roads)

A firebreak must:

- be wide enough and long enough to have a reasonable chance of accessing the area to fight the fire (NOTE: Bear in mind that under extreme fire conditions, particularly during strong winds, the widest possible fire breaks will not stop the spread of a fire.)
- not cause soil erosion (it is not advisable to bulldoze firebreaks)
- be reasonably free of inflammable material
- Inform property neighbours of your intention to burn at least two weeks prior to the event.
- Maintain fire fighting equipment and ensure that it is in working order and that people are trained in fire fighting.
- Keep accurate records of fires, using a map of veld age as a basis. Note the date and time of ignition, weather conditions, etc.
- Join a local Fire Protection Association (FPA) or initiate one, as FPA's encourage neighbouring landowners to work together on common fire management issues.

DON'T

- Never burn vegetation in late autumn, winter or spring.
- Don't place livestock onto vegetation during the first 2 years following a fire. Many of the bulbous species need to have adequate time to flower and set seed; small herbaceous species (e.g. buchu, legume, *Erica* species) need adequate time to properly manifest themselves; grass species need to establish and build up their tussocks; many bulbous species that flower after fire are also toxic to domestic animals. After the 2 years, graze veld only during December to March.
- In fynbos, don't burn vegetation unless you can see that at least 90% of the individuals of the slowest-maturing (e.g. non-sprouting *Protea*, *Leucadendron*) species have flowered.
- In renosterveld, don't burn vegetation that is shorter than 50cm and that lacks mature shrubs of a number of different species.
- Don't allow the fuel load to accumulate to dangerous levels.
- Don't leave fires unattended.
- Don't burn on Fridays, weekends and holidays.
- Don't leave an extinguished fire unguarded for at least two days after the burn.

Landowners should devise an appropriate burning strategy, with input from CapeNature on both legal and practical management requirements.

For more information, contact the Fire Management Programme Manager at CapeNature (082 414 6344) or refer to the CapeNature pamphlet 'The Landowner & Fire Protection Associations'.





APPENDIX D – A PRACTICAL GUIDE TO MANAGING ALIEN INVASIVE PLANTS

Prepared by: WWF South Africa



SOUTH AFRICA

A PRACTICAL GUIDE TO MANAGING INVASIVE ALIEN PLANTS

A concise handbook for land users in the Cape Floral Region

This handbook has been produced in collaboration with these partners to guide the management of invasive alien plants in the Cape Floral Region.



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Cover photo: Member of a clearing team stacking biomass in the Vyeboom Wetland near the Theewaterskloof Dam.

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The Afrikaans version is available at www.wwf.org.za/report/invasive_plants_handbook_Afr

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Supporting documents for more information are available as appendices at www.wwf.org.za/report/invasive_plants_appendices

For more information, contact info@wwf.org.za or call 021 657 6600

WWF is one of the world's largest and most experienced independent conservation organisations with over 6 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

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Funders: Corteva Agriscience, the Fynbos Trust, Nedbank, Sanlam and Woolworths.



Corteva Agriscience, through its local subsidiaries, has introduced environmentally accepted herbicides in South Africa since the early 1980s. As global market leader in Green Chemistry Principles, Corteva is committed to new innovations for the control of introduced invader plants that threaten the biodiversity and functioning of our forests, wetlands and especially the species diversity of the Cape Floral Kingdom, without negative impacts to the environment.



The Fynbos Trust is an NGO that promotes and supports landscape-scale conservation (primarily in the Overberg). Conservation leadership and innovation, partnerships with communities, technical support and collaboration with land users, decision-makers and other stakeholders are key areas of focus to ensure that natural diversity and processes persist across the landscape. Integrated invasive alien plant and fire management are key elements of the Fynbos Trust's landscape-scale conservation approach.



Nedbank is proud to fund the production of this guide as part of its support for WWF as we work together to safeguard South Africa's water source areas, improve rural livelihoods and promote land stewardship. WWF and Nedbank have been working together in various forms for almost 30 years – a long-term NGO/business partnership that continues to evolve and innovate to find solutions to complex sustainability challenges in South Africa.



WWF South Africa's partnership with Sanlam works to conserve and ensure the healthy functioning of South Africa's important freshwater ecosystems and, in so doing, the well-being of people that depend on this natural resource. This practical guideline to managing invasive alien plants is one of the tools contributing towards this purpose.



The WWF–Woolworths partnership seeks to improve the stewardship of water resources nationally, explore low-carbon pathways, reduce potential negative impacts of agriculture, improve seafood production and reduce food waste throughout the supply chain. The management of invasive alien plants contributes towards this mission. Therefore, Woolworths is proud to be part of this publication that summarises the lessons and tips for land users who want to join the practice of keeping alien plants at bay.





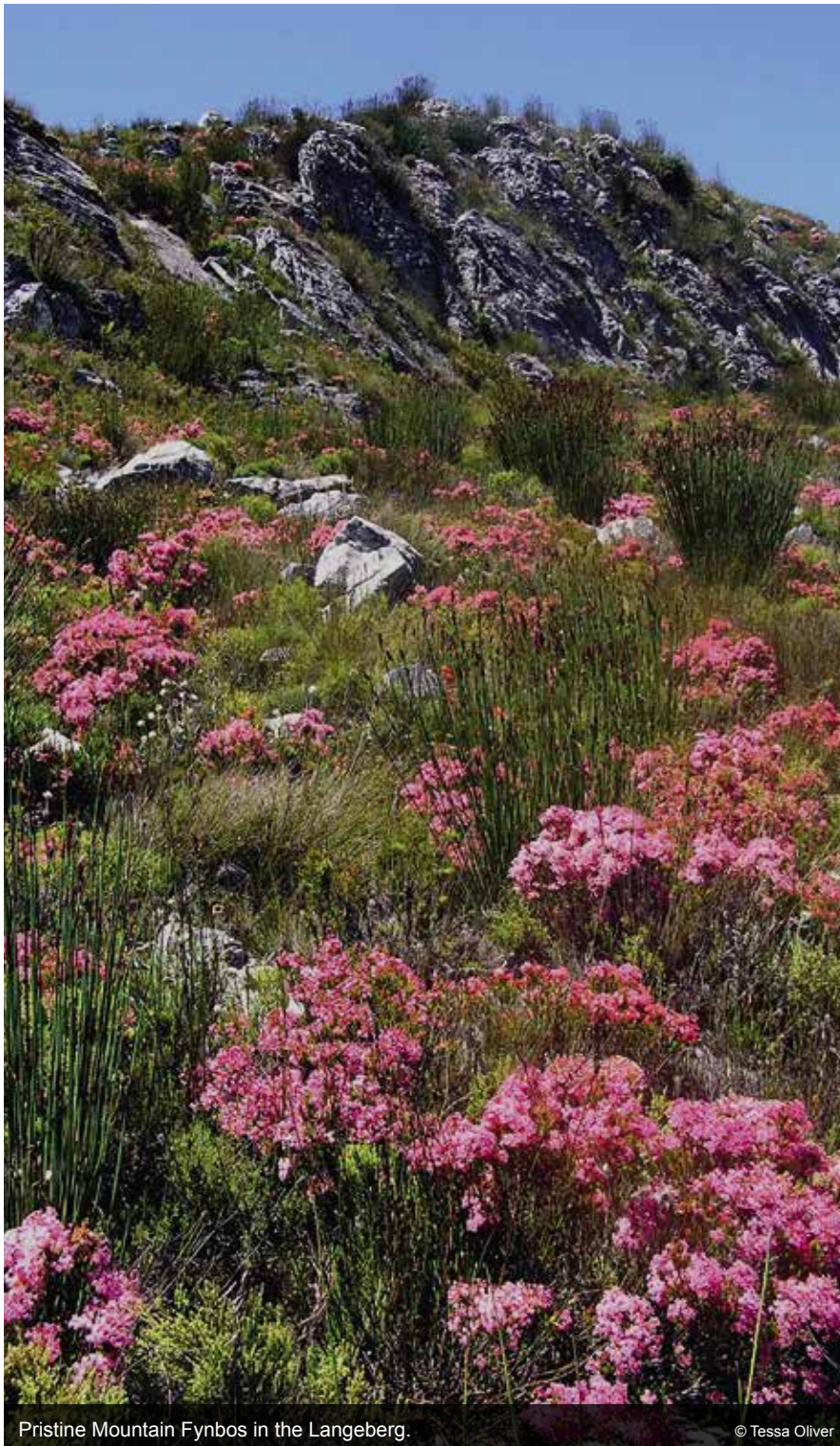
Indigenous common pagoda (*Mimetes spp*) after a fire in Luiiperdskloof, Betty's Bay.
© Tessa Oliver

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INTRODUCTION

This practical guide aims to empower land users (landowners, land managers and contractors) in the Cape Floral Region to understand the threat of invasive alien plants (IAPs) and manage the IAPs on their land.



The guide was developed by WWF South Africa in collaboration with the Agricultural Research Council; the City of Cape Town; Corteva Agriscience; the Department of Environment, Forestry and Fisheries; LANDWORKS; the Fynbos Trust; and NCC Environmental Services. It not only contains a detailed set of instructions on how to proceed when clearing IAPs (this often differs per context) but also aims to be a first-stop resource that can be adapted to local conditions, while giving useful pointers for where to find further information from numerous other sources.

Land users are given an overview of how to approach an IAP management programme: understanding what IAPs are, the relevant legislation, planning, the methods that are available, health and safety considerations, the safe use of herbicides, and successfully rehabilitating the cleared land, if that is the end goal. The authors' intentions are to update the necessary sections on an annual basis, and it is in the reader's best interest to use the latest version of the guide at www.wwf.org.za/report/invasive_plants_handbook and of the supporting Appendices at www.wwf.org.za/invasive_plants_appendices/.

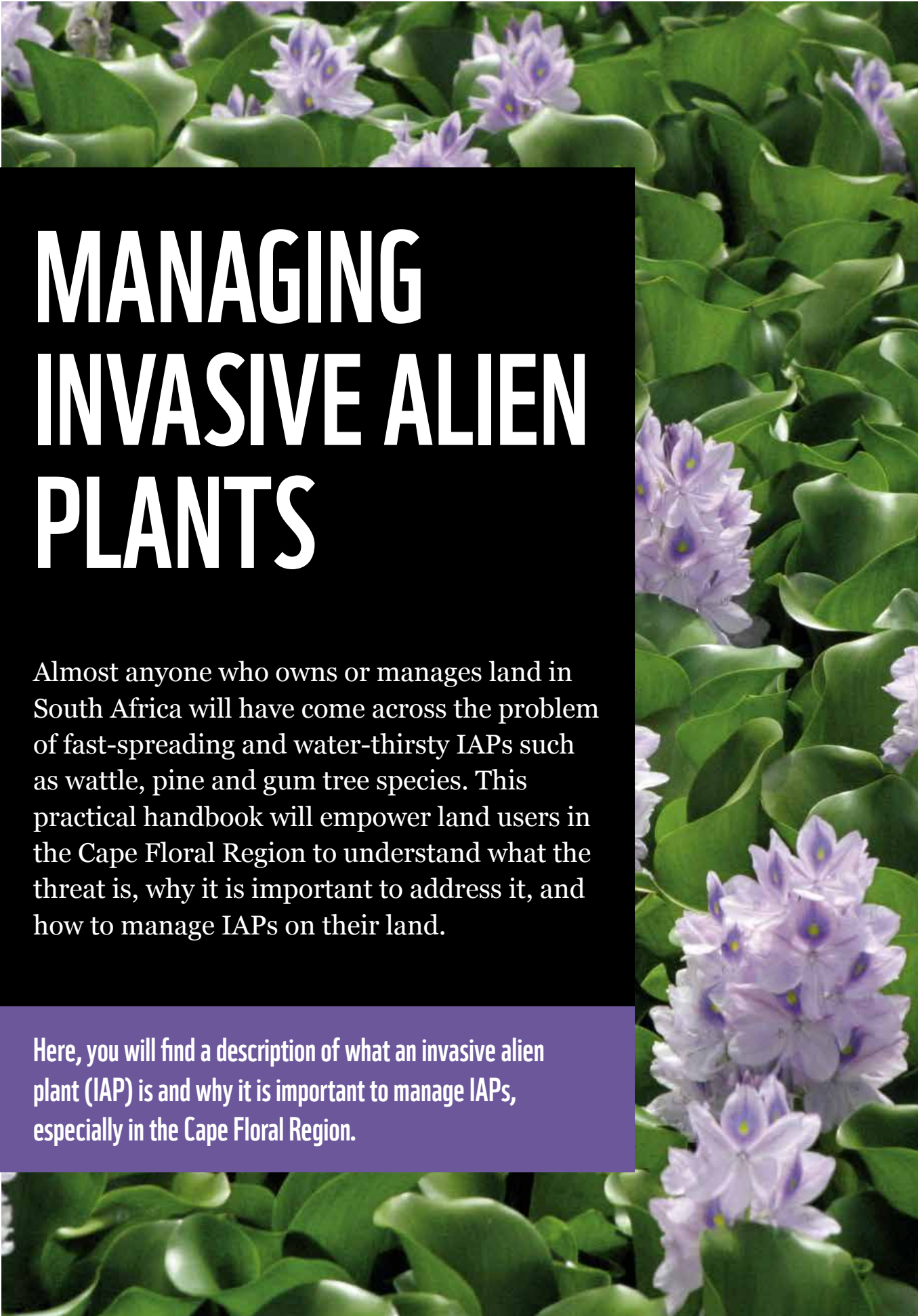
Additional resources are noted throughout the guide in the “[For more information](#) (page xx)” sections, and options to source funding for IAP management are given.

A land user can mean the legal owner of the land, or a land manager, someone leasing land or an IAP contractor.

Pristine Mountain Fynbos in the Langeberg.

© Tessa Oliver

Introduction	In this section, the origin and purpose of this guide is explained.
Managing IAPs	Here, you will find a description of what an invasive alien plant (IAP) is and why it is important to manage IAPs, especially in the Cape Floral Region.
Legal	The legal obligations of landowners with IAPs on their land are summarised in this section. You will find a brief explanation of the relevant laws and regulations relating to IAPs, including what actions are required for different categories of IAPs.
Planning	This section provides the main considerations to think about before beginning an IAP management operation, including steps to develop a management plan, how to prioritise IAP clearing, mapping management units, planning for wildfires, and the labour and budget requirements.
Methods	Here, you will find simple instructions for the four main methods of managing IAPs: manual, mechanical, chemical, and biological control. Further information is given on how to dispose of plant and waste material.
Health and Safety	This section covers the legal background for health and safety, as well as minimum safety requirements. You will also find information on safety in the field, fire preparedness and a list of personal protective equipment.
Herbicide safety	In this section, information is given on herbicide labels and the safe storage, mixing and disposal of herbicides. Following these precautions will help to reduce the risks associated with these dangerous chemicals.
Rehabilitation	Here, you will find an overview of the reasons for rehabilitating cleared land, the types of rehabilitation and the phases in a rehabilitation project. Useful resources with more detailed information on rehabilitation are suggested.
Funding	This section contains information about government and other funding opportunities for IAP management. Options include accessing government programmes, working cost effectively with neighbours, and finding resourceful ways to recoup funds from IAPs.



MANAGING INVASIVE ALIEN PLANTS

Almost anyone who owns or manages land in South Africa will have come across the problem of fast-spreading and water-thirsty IAPs such as wattle, pine and gum tree species. This practical handbook will empower land users in the Cape Floral Region to understand what the threat is, why it is important to address it, and how to manage IAPs on their land.

Here, you will find a description of what an invasive alien plant (IAP) is and why it is important to manage IAPs, especially in the Cape Floral Region.

Water hyacinth (*Eichhornia crassipes*), an aquatic invasive alien plant native to the Amazon basin, is widely spread throughout South Africa and is found in many of our water bodies.

© Debbie Muir / NRM

THE CAPE FLORAL REGION – WHAT ARE WE CONSERVING?

The Cape Floral Region is an area of special and unique biodiversity. It is the smallest of only six floral kingdoms around the world and the only one found within a single country.

The Cape Floral Kingdom extends across the Western Cape and parts of the Northern and Eastern Cape provinces of South Africa, from Gqeberha (formerly Port Elizabeth) to Cape Town and north towards Nieuwoudtville. There are many ways in which the natural ecosystems in this area are recognised as extraordinary.



Cape Floral Region

Biodiversity and endemism

The Cape Floral Region is home to more than 9 000 different species. This is one of the highest concentrations of plant species anywhere in the world. Covering only 0,5% of Africa's area, the Cape Floral Region hosts more than 20% of the continent's plant species. About two-thirds of these plants are endemic, meaning they are not found anywhere else.

Fynbos, Renosterveld and Strandveld

The Fynbos biome comprises various Fynbos, Renosterveld and Strandveld vegetation types. These are the dominant vegetation communities of the Cape Floral Region. Fynbos is a type of shrubland adapted to a mild climate with winter rainfall, poor soils and regular wildfires. It is known for its unique proteas, ericas and restios. Renosterveld is also part of the Fynbos biome but occurs on more fertile soils. It has more grasses, annual plants and bulbs than typical Fynbos. All lowland types of Renosterveld are considered critically endangered, because only small fragments of natural vegetation remain. Strandveld vegetation grows in deep, well-drained alkaline sand along the West Coast and on the Cape Flats. Many Strandveld plants are succulent, so the vegetation does not burn as regularly as Fynbos and Renosterveld.

Biodiversity hotspot

The high biodiversity and endemism of the Cape Floral Region have led to it being considered a biodiversity hotspot. There are 36 recognised biodiversity hotspots around the world. These are areas with very high levels of biodiversity that are also under significant threat from human activities.

World Heritage Site

In 2004, the Cape Floral Region was designated as a World Heritage Site in recognition of its unique biodiversity. The World Heritage Site currently consists of 13 clusters of national parks, nature reserves and wilderness areas, covering more than a million hectares. It is considered of global value because of the unique ecological processes and high biodiversity associated with the Fynbos biome.

Water Source Area

The mountain catchments of the Cape Floral Region are part of South Africa's Strategic Water Source Areas. These are areas that cover only 10% of the country's land but contribute a disproportionate 50% of its water supply. The rainwater that fills the rivers of the Cape Floral Region is a vital water source for millions of people, farms and industries downstream.

Threats

Invasive alien plants are one of the biggest threats to the Cape Floral Region. Fynbos is a shrubland and is vulnerable to invasion by wildfire-adapted tree species. Pines, woody acacia and hakea have the most negative impacts, particularly on water supply, and are the most difficult to deal with. Infestation levels vary from areas that are completely infested to areas free of IAPs. If IAPs are not controlled, they will continue to be an ever-expanding threat to this remarkable biodiversity area and all the benefits provided by a functioning environment. It is therefore critical to maintain IAP-free land and prioritise low infestations for clearing.

INVASIVE ALIEN PLANTS – WHY ARE THEY A PROBLEM?

Invasive alien plants are problem plants. They are plants that are not native to an ecosystem. They spread rapidly and cause harm to the environment, the economy and even to human health.



Purple loosestrife (*Lythrum salicaria*), native to Eurasia, spreads easily and replaces indigenous vegetation, creating its own dense stands.

© Debbie Muir / NRM

4 MAIN CHARACTERISTICS OF INVASIVE ALIEN PLANTS

1 Non-indigenous

Alien species are those that do not occur naturally in an area. They are brought in by people, either on purpose (as garden plants or plantation trees) or by accident (such as seeds in bags of animal feed).

2 From a similar climate

Many IAPs in South Africa come from Australia, Europe or North and South America. They are well adapted in their natural habitat to enjoy similar temperatures, rainfall patterns and fire regimes. This means they can spread easily and thrive in the place to which they have been introduced.

3 No natural enemies

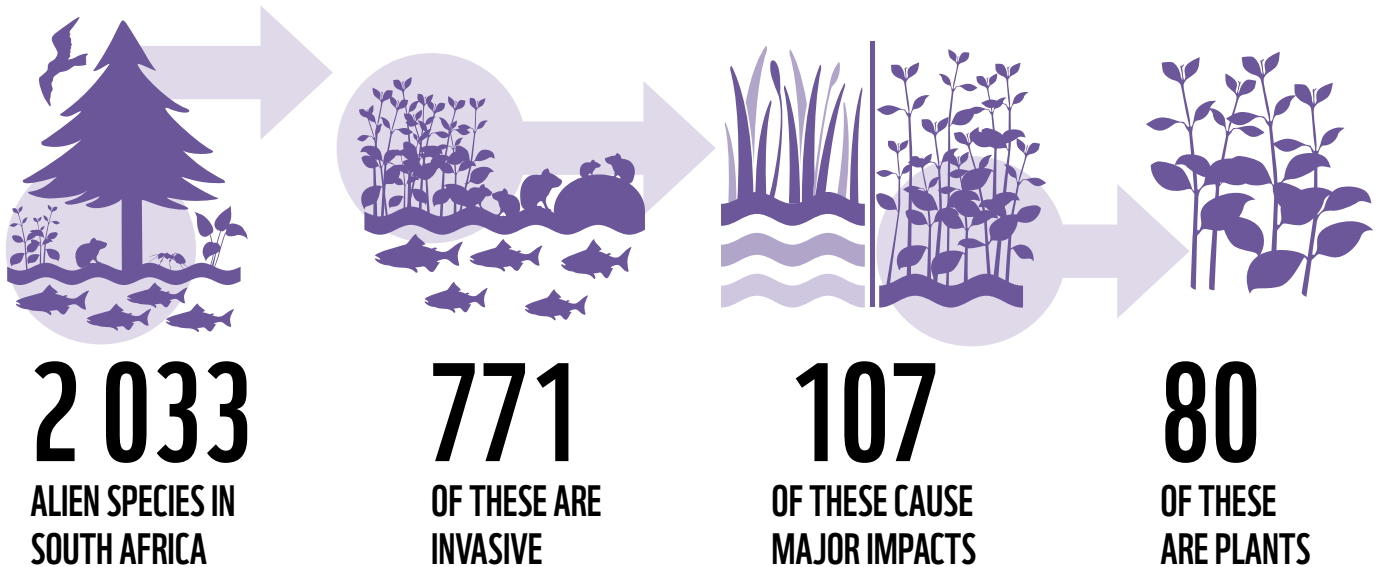
Because IAPs have been artificially introduced to an area by humans, they have not evolved to be a part of the local ecosystem. In their country of origin, they are kept in check by insects, diseases or fungi that feed on them and control their numbers. These natural enemies are often missing in the new environment, which means the IAPs can grow without anything to stop them.

4 Invasive and competitive

Not all alien plants become invaders. But those that find themselves in a suitable climate where there are no natural enemies can quickly become a serious problem. Many IAPs can grow fast, produce large, long-lived seedbanks and disperse easily. IAPs, especially trees, tend to use more water than natural indigenous vegetation. Pines (*Pinus* species), wattle (*Acacia* species) and gum trees (*Eucalyptus* species) invade water courses and can form dense stands.

INVASIVE ALIEN SPECIES IN THE SOUTH AFRICAN CONTEXT

There are currently 2 033 listed alien species in South Africa, consisting of marine organisms, freshwater fish, insects and plants. Altogether 771 of these are invasive, while 107 of them are found to have a major impact on the environment. Of the 107 problem species, 80 of them are plants. This practical guide focuses only on the invasive alien plant species.



European blackberry (*Rubus fruticosus*) originates from the Mediterranean region of Europe. It outcompetes indigenous woody and grassland species.

© Debbie Muir / NRM

MANAGING INVASIVE PLANTS – WHY IS IT NEEDED?

By disrupting natural ecosystems, taking up space and using natural freshwater resources – especially in a water-scarce country like South Africa – IAPs can cause serious damage to the natural environment. Clearing and controlling IAPs can help to prevent some of these negative impacts.

7 NEGATIVE IMPACTS OF INVASIVE ALIEN PLANTS

1 Overuse of water

A single large invasive alien tree can use between 100 and 1 000 litres of water per day, significantly more than the average indigenous plant. They use so much water that they decrease the flow of streams and reduce the amount of water that reaches dams. South Africa loses as much as 2 500 million m³ of water to IAPs every year. This is a significant amount in a country that is already suffering from water shortages. Some of the worst-affected river catchments are in the Western Cape.

2 Decreased agricultural production

IAPs that spread through agricultural land reduce the space available for crops or livestock and this can decrease agricultural production. Managing IAPs is an added expense for farmers. The consequence is that these plants have a negative impact on the agricultural economy and ultimately affect food security.

3 Increased impact of wildfires

IAPs increase the risk of wildfires by increasing the amount of fuel available. Woody IAPs grow in dense stands that increase the biomass available to burn. Some species also contain flammable compounds. Wildfires in IAP-infested areas burn hotter and more intensely than wildfires in natural vegetation, and are more difficult to contain, increasing the danger to lives, livelihoods and the environment.

4 Reduced ecosystem services

IAP-infested habitats have a reduced capacity to deliver ecosystem services – such as providing clean water and healthy soils – that support a healthy living environment for people and animals. They can also cause a decrease in the availability of natural products such as medicinal plants, fodder and building materials.

5 Lower land values

IAP invasions have a significant impact on the sale value of land because the land has lower agricultural production value or the new owner will not want the expense of dealing with the problem.

6 Impacts of climate change

Many IAPs can easily adapt to take advantage of the changing climate and global warming. The Western Cape is predicted to get hotter, drier and have more extreme weather events, leading to significant shifts in biomes like the Fynbos. These changes favour the growth of IAPs. This means that some IAPs will become more aggressive and spread faster. There may also be new and emerging ones that benefit from a changing climate. Some species, like the Acacia, are legumes that can fix nitrogen, changing the chemical composition of the soil. This can make the natural ecosystems less resilient to climate change and more susceptible to secondary invasive species.

7 Biodiversity loss

Biodiversity is the variety of natural species living in an area and the relationship between them. IAPs outcompete and replace indigenous plants, causing a decline or even disappearance of biodiversity. Because IAPs tend to form dense stands where very little else can survive, they can have a devastating impact on local biodiversity. IAPs are one of the biggest causes of biodiversity loss worldwide. This is especially severe in places with unique and rich biodiversity, like the Cape Floral Region (see [The Cape Floral Region – What are we conserving?](#) page 7).

To address these negative impacts of IAPs, the government has put in place laws and regulations. The regulations identify which IAPs need to be eradicated or controlled based on their degree of impact. There are also measures to detect and prevent new invasions (see [Legal requirements](#), page 14).

MANAGING IAPS – WHAT ARE THE KEY PRINCIPLES?

The management of IAPs is driven by two fundamental principles:
acting early and following up.

1 Act early

Taking action to manage IAPs when they first appear is much easier and cheaper than addressing severe infestations. Younger IAPs that cover smaller areas of land can be controlled with less time, labour and equipment. So, making an investment in IAP management at an early stage will save costs over the long term. Monitoring land for new IAP infestations will help to combat them in good time.

2 Follow-up

Follow-up and ongoing maintenance are essential to protect the investment made in IAP management. Regular follow-up treatment will stop any regrowth and prevent secondary infestation.

Any IAP management programme should follow three phases:

Phase 1 – Initial control

Drastically reducing the existing population (potentially including biocontrol)

Phase 2 – Follow-up

Controlling seedlings, root suckers and regrowth

Phase 3 – Maintenance

Sustaining low and decreasing IAP numbers with annual control



A clearing team in the Vyeboom Wetland near Theewaterskloof Dam in the Western Cape stacking cut black wattle.

© WWF

TYPES OF IAPS – HOW DO THEY DIFFER?

Invasive alien plants are often grouped into different types. The management methods for each type can be more or less effective depending on where the IAPs grow, how they grow or how they reproduce. The types of seeds will influence how they need to be managed.



Water hyacinth (*Eichhornia crassipes*) is often labelled as the world's worst aquatic weed because of its invasive potential, negative impact on aquatic ecosystems and the costs involved in controlling it.

© Debbie Muir / NRM

WHERE THEY GROW



In water

These IAPs are known as aquatic IAPs, live mainly in water and can tolerate very wet conditions. Aquatic species invade rivers, dams and wetlands. Water Hyacinth (*Eichhornia crassipes*), for example, is a floating plant that is highly invasive in South Africa.



On land

These IAPs are known as terrestrial IAPs and grow on land. Silky hakea (*Hakea sericea*) is an example. Because so many IAPs fall into this type, they are usually further categorised according to other growth forms.



On riverbanks

These IAPs are plants that grow on the land along the edge of a river, also known as riverbanks or riparian areas. Black wattle (*Acacia mearnsii*) is an example. This can be viewed as a subset of the terrestrial grouping. The interface between land (terrestrial) and water (aquatic) areas are particularly susceptible to severe infestations that cause serious impacts.

HOW THEY GROW



Root systems

Some IAPs have long, deep taproots that make pulling out the plant difficult. Port Jackson (*Acacia saligna*), for example, has a tap root system. If pulled it can break off at the base and the plant will resprout. IAPs with shallow root systems can be pulled out more easily. Some plants grow from root suckers or rhizomes (underground stems) that connect plants below the ground. Saplings of invasive poplars (*Populus* species), for example, are connected to the parent tree. Both need to be treated during clearing operations.



Dormancy

Some IAPs may go through periods of dormancy, which is when growth stops for a while and the plant may lose its leaves. *Populus* species, for example, are widely invasive in South Africa and are deciduous. Some control methods are more effective when the plant is actively growing or has leaves, so it is important to know which IAPs have a dormant period, and when it is.



Bark types

Some IAPs have very thick bark. This will influence the method of control that should be used. The bark of *Eucalyptus*, for example, is thick, so tougher ring-barking methods will be needed.



Climbers

Some climbing plants are particularly serious invaders, like the Madeira vine (*Anredera cordifolia*). Invasive climbers can grow over and overwhelm natural plants. They spread rapidly and can be difficult to control.



An invasive alien weed: pampas grass (*Cortaderia jubata*), which is native to South America.

© Ed February

Other ways of grouping IAPs

Emerging IAPs

Some plants with invasive tendencies are already present outside of their natural distribution, but have not become widely established as yet. They often have horticultural value, but can have a negative impact on natural ecosystems, biodiversity, livelihoods and human health if allowed to continue to expand outside of their natural range. It is important to be on the lookout for new invasive species.

Indigenous invasive plants

A few native species can become invasive due to human-made changes to the environment, such as altered wildfire regimes or pollution. The indigenous bitou (*Osteospermum moniliferum*), for example, can become dominant and cover large areas, reducing the species diversity in smaller isolated remnants in Fynbos systems. Nutrient enrichment (eutrophication) of wetlands also leads to indigenous reeds such as bulrush (*Typha capensis*) becoming dominant.

HOW THEY REPRODUCE



Reseeders

These are plants that reproduce by producing lots of seeds. The parent plant may be killed, but new plants will grow from the seedbank in the soil or from seeds released from cones which had stored the seeds in the canopy. Different species have various methods of spreading their seeds, such as wind or water dispersal. Many species also exhibit fire-activated seed germination. Hakea, for example, is a serious invasive plant in South Africa. It produces seed pods that split open after a wildfire to release winged seeds that disperse in the wind.



Resprouters

These types of plants can grow back after they have been damaged by wildfire or cut down. New shoots grow from the base after the top of the plant has been removed. This is also known as coppicing. Invasive eucalypts in South Africa, for example, will grow new stems if the main trunk is felled. Resprouting may mean that more than one control method, including herbicide, will be required for follow-up treatment.



Vegetative regrowth

Some plants do not only rely on their seeds for survival. Some IAPs can grow from a piece of the parent plant, like a leaf or stem. This is called vegetative regrowth. In some invasive cactus species, for example, each leaf has the potential to grow into a new plant if it comes into contact with the ground.



LEGAL REQUIREMENTS

Landowners have certain legal responsibilities relating to invasive alien plants on their land. These are specified in laws about environmental management, agriculture, water, heritage, health and safety, and the application of herbicides.

The legal obligations of landowners with IAPs on their land are summarised in this section. You will find a brief explanation of the relevant laws and regulations relating to IAPs, including what actions are required for different categories of IAPs.

The headwaters of the Jonkershoek / Eerste River in the Jonkershoek Nature Reserve near Stellenbosch in the Western Cape.

© Helen Stuart / WWF

BIODIVERSITY LAWS – WHAT ARE THE LEGAL OBLIGATIONS?

As invasive alien plants can have a negative impact on biodiversity, laws protecting biodiversity include regulations to control the spread of IAPs. The owner of land where IAPs occur carries responsibilities under these laws.

BIODIVERSITY ACT

The National Environmental Management: Biodiversity Act 10 of 2004 is administered by the Department of Environment, Forestry and Fisheries. Its purpose is to conserve South Africa's biodiversity. The Alien and Invasive Species Regulations are published under the Act. These regulations go together with a national list of invasive species that puts IAPs into categories.

Duty of care

Certain sections of the Biodiversity Act impose a 'duty of care' that applies to landowners. A duty of care means that people must take reasonable action to prevent harm to the environment. A person who owns land where IAPs occur needs to take steps to control them, prevent them from spreading and minimise harm to biodiversity.

Categories

The list of invasive species under the Biodiversity Act has four different categories. Different obligations apply to each of these categories (Table 1).

Table 1: Categories of IAPs under the Biodiversity Act

	Category 1a	Category 1b	Category 2	Category 3
Definition	A species that must be combated or eradicated	A species that must be controlled	A species that requires a permit	A species that is subject to certain prohibitions
Actions required	Take immediate steps to eradicate the invasive species using appropriate methods.	Take steps to control the invasive species using appropriate methods.	Apply for, and comply with, a permit to conduct restricted activities (e.g. import, possess, grow, move, trade, dispose of or spread the species).	- Control the species if it spreads to riverbanks. - Planting, propagating, and trading in the species are not allowed.

Obligations

Landowners are required to do the following:

- Notify the responsible provincial agricultural authority in writing if a Category 1 invasive species occurs on their land.
- Comply with any relevant Invasive Species Management Programme.
- Allow an official onto the land to monitor, assist with, or implement control of a listed invasive species.
- Take measures to control the invasive species, depending on the category it is listed under.
- Conduct control activities cautiously to cause the least harm to biodiversity and the environment.
- Inform the buyer in writing of invasive species on the land, if the land is to be sold.

Offences

If a landowner does not obtain the necessary permit or does not take the required steps to control an invasive species, they can be found guilty of an offence. They may be sentenced to a fine of up to R10 million, or imprisonment for up to 10 years, or both.

AGRICULTURAL LAWS – WHAT ARE THE LEGAL OBLIGATIONS?

Invasive alien plants can have a negative impact on agriculture, so agricultural laws include regulations to prevent their spread. Requirements under agricultural laws may apply to a landowner, or to a land user who has a right to use the land for a certain purpose.

CARA

The Conservation of Agricultural Resources Act 43 of 1983 (CARA) is administered by the Department of Agriculture, Land Reform and Rural Development. Its purpose is to look after South Africa’s agricultural resources. The CARA does not use the term IAPs but refers to “declared weeds” or “declared invader plants”.

Methods

The CARA places a general ban on any conduct that would disperse a declared weed (e.g. selling, advertising, keeping, delivering). It can also require land users to use specific methods to control weeds, depending on what is most appropriate for the species and ecosystem concerned (see [IAP management methods](#), page 32). Methods include:

- Uprooting, felling, cutting or burning
- Any other method of treatment
- Treatment with a registered herbicide
- A combination of one or more methods.
- Biological control

Categories

The actions required depend on which category the plant falls under in the CARA regulations (which might differ from province to province) (Table 2).

Table 2: Categories of IAPs under the CARA

	Category 1	Category 2	Category 3
Definition	Alien plants that are absolutely prohibited and will no longer be tolerated. Their harmfulness outweighs any useful properties they might have.	Alien plants with proven potential to become invasive, but which have some beneficial properties that warrant their continued presence in some circumstances.	Alien plants with proven potential to become invasive but that are popular ornamentals or shade trees that will take a long time to replace.
Actions required	• Take steps to prevent the occurrence of these plants on any land or water surface. • These plants may no longer be planted, and all trade in them is prohibited. • They may not be transported or allowed to disperse.	• Take steps to prevent the occurrence of these plants on any land or water surface. • An exemption can be obtained. • These plants may be kept in special areas, demarcated for that purpose. • Growing these plants is a “water use” in terms of the National Water Act 36 of 1998.	• These plants are allowed to remain where they are, as long as they do not grow in watercourses and steps are taken to prevent them from spreading.

Offences

Failure to comply with any measure in terms of the CARA regulations can attract a fine of up to R5 000 or up to two years in prison (or double for a second conviction).

WHICH OTHER LAWS REFER TO IAPS?

Several other national laws may have some relevance to invasive alien plants. These are listed below. There may also be some regional requirements, like municipal by-laws, but those are not covered here.

Environmental laws

The National Environmental Management Act 107 of 1998 (NEMA) is the main law governing environmental management in South Africa, including environmental impact assessments. It too contains a “duty of care”: every person must take reasonable care to prevent harm to the environment. Importantly for IAP management, it allows employers or company directors to be held responsible for offences under the Biodiversity Act or the CARA. If a person is convicted, the court can also ask them to pay the costs to deal with environmental damage that was caused.

Water laws

The National Water Act 36 of 1998 places all South Africa’s water resources under the ownership and governance of the state. Anyone who wants to use water for certain purposes must apply for authorisation. There are some water uses that may be relevant to IAPs. Planting IAPs is considered a “stream flow reduction activity” that requires a water-use licence. Also, if mechanical removal of IAPs alters the banks of a river, or changes the flow, it can be considered a water use.

Forest laws

The National Forests Act 84 of 1998 can declare some trees, including IAPs, as “champion trees”. The River Red Gum (*Eucalyptus camaldulensis*) that was planted in Bergzicht market square, Stellenbosch, in 1880 is an example of a “champion tree”. These individual trees are protected and it is illegal to cut them down.

Agricultural remedies

The Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947 regulates fertilisers, feeds and remedies used in agriculture. The chemicals used for IAP management are regarded as agricultural remedies. The Farm Feeds Act contains some requirements for the registration, proper use and handling of these chemicals (see [Herbicide safety](#), page 52).

Health and safety laws

The Occupational Health and Safety Act 85 of 1993 promotes the health and safety of workers in the workplace. It contains information on the duties of employers and employees to ensure safe working conditions (see [Health and safety](#), page 46). It also has some provisions that may be relevant for handling IAPs that are dangerous to human health.

Heritage laws

The National Heritage Resources Act 25 of 1999 protects South Africa’s heritage resources. IAPs are sometimes protected under these laws, e.g. trees growing on heritage sites.

Fire management laws

The purpose of the National Veld and Forest Fire Act 101 of 1998 is to prevent and combat wildfires. It requires every owner of land where a fire may start, burn or spread to maintain a firebreak that is free from flammable material (see [Integrated planning for fire and IAPs – Why is it important?](#) page 24).



For more information, see Appendix 1: [Legislation guideline for invasive alien species](#) (page 66).



Houses in Lakeside, Cape Town, coming under threat from a wildfire above Boyes Drive during 2005.

© Bruce Sutherland

PLANNING IAP MANAGEMENT OPERATIONS

Due to the complexity and cost of IAP management, it is important to spend time planning before starting an IAP management operation. IAP control requires a long-term approach. Proper planning will ultimately help to save time and money, ensuring that the best results are achieved.

This section provides the main considerations to think about before beginning an IAP management operation, including steps to develop a management plan, how to prioritise IAP clearing, mapping management units, planning for wildfires, and the labour and budget requirements.



An indigenous broad-leaf watsonia (*Watsonia marginata*) in Kirstenbosch National Botanical Garden.

© Helen Stuart / WWF

IAP MANAGEMENT APPROACH – WHAT SHOULD A LAND USER CONSIDER?

The context within which IAP management is planned will determine the approach taken to the management programme.

CONSIDER THE CONTEXT

Goals

Much depends on your goals for the future management of the invaded area. Clearing IAPs for immediate development of the land, for example, will require different methods compared to managing IAPs to restore functioning of the natural environment.

Environment

The type and condition of natural vegetation in the area may determine the IAP control methods so as to limit a negative impact on the surrounding environment.

Season

The season of the year may influence accessibility to the site, visual identification of species through flowering, the safe and effective use of herbicide and fire, and the ecological impact of IAP management. All these factors will have an impact on the number of available work days for clearing.



A Genadendal community member collecting firewood along the densely invaded Riviersonderend River.

© Helen Stuart / WWF

4 STEPS TO DEVELOPING A LOGICAL IAP MANAGEMENT PLAN

As important as considering the context within which one is planning IAP management, is considering the steps to develop a logical plan and set priorities for the IAP clearing process. By following a few basic steps, it is relatively easy to put together a simple but effective IAP management plan for a property.



1. SURVEY THE AREA

- Walk the area
- Take photographs
- Review aerial photographs
- Identify IAPs



2. IDENTIFY UNITS

- Uniform areas
- Similar IAPs
- Topography
- Manageable size
- Fire history



3. PLAN ACTIONS

- IAP control methods
- Burning schedule
- Optimal sequence
- Seasons



4. CALCULATE COSTS

- Equipment needed
- Labour required
- Areas and norms
- Keep records

1 Survey the area

A suitably experienced person should survey the areas to be cleared and identify the IAPs that occur there. For very large areas, mapping of IAP coverage is essential, but for small sites it may not be necessary. It is best to walk the area to be mapped, and not just to rely on viewing the area from a distance or via an aerial photo. Photographs of the site should be taken to assist the process of monitoring the impact of the IAP management programme (see [Mapping management units – What does this involve?](#) page 23).

2 Identify units

Break the property down into sensible management units. A management unit is a uniform block of land, with similar soil, slope, history, etc. that will respond in a similar way to a management action. For IAP management, a management unit may be an area of uniform species, age classes and densities (and the potential for the use of fire as an IAP management method, if appropriate) (see [Mapping management units – What does this involve?](#) page 23).

Give each management unit a unique identification number. Compile an inventory for each management unit, including the density and age of IAPs.

3 Plan actions

Identify what management actions are needed in each management unit, taking into account the integration of fire and IAP management, if appropriate. Determine the sequence and which methods or combination of methods is best for the site and target species. Consider what field equipment and herbicides are required. Plan the order in which management actions should be implemented, taking into account the effect or advantage of implementing actions in a particular season (see [9 priorities when clearing IAPs](#), page 21).

Check with your local Fire Protection Association (FPA) to ensure that your operation has received approval from the relevant authorities.

4 Calculate costs

Using the information gathered on the size of the management units, the density of IAPs and selected control methods, calculate the labour required and the costs (see [How much labour and budget will a land user need?](#) page 26).

Land users should keep a note of all expenses incurred from IAP management as these are tax deductible.



For more information, see Appendix 5: [Template for a farm-level alien plant control plan](#) (page 66).

9 PRIORITIES WHEN CLEARING IAPs

It is often not possible to tackle all stands of IAPs at once. It is also important not to take on too much at one time, remembering that each area will require follow-up treatments. For this reason, it is useful to plan where to start by setting priorities.

1 Prevent new invasions

Target emerging or new species before they have a chance to set seed and spread.

2 Follow-up first

Areas that require follow-up treatment should be prioritised over areas that still require initial clearing. Follow-up treatment is essential to curb the further growth and spread of IAPs. Follow-up reinforces previous efforts in which you have already invested time and money, so it is important not to waste this investment. This also applies to an area that has recently been burnt: the fire acts as an initial clearing mechanism, so if these areas are prioritised, it will cost less to clear while the growth is young.

3 Limit wildfire risk

Areas of IAPs that pose a wildfire risk to houses or infrastructure should be targeted as a priority. Effective firebreaks should be created where woody or fire-prone IAPs are located in dense stands near settlements, power lines, etc.

4 Start with less dense stands

Treatment of low-density, young invasions should be a priority to halt the invasion and prevent the build-up of IAP seedbanks. This is especially important in fast-maturing, wind-dispersed species such as hakea and pine (*Pinus* species). Less dense areas will also require fewer resources and easier follow-up treatment. Dense mature stands should be left for last, as they probably will not increase in density or pose a greater threat than they do at present. Clearing very dense areas requires a commitment to expensive, long-term follow-up treatments.

5 Start upslope

Consider the natural gradient of the area being cleared. All operations should ideally follow the slope or drainage lines. Clearing needs to start from the highest point and move downstream and downslope. This ensures that potential sources of IAPs – seeds and other regenerative material – are eliminated upstream of the working area to avoid reinfestation.

6 Work from the outside inwards

On gentle gradients, clearing should start from the outside of a work block and move inwards towards the centre, to contain IAPs within a confined area.

7 Follow contours

To avoid the threat of soil erosion when clearing dense infestations of IAPs on steep slopes, work should progress horizontally along the contours. IAPs should be cut in bands of 3 m wide along the slope contour and the cut material should then be rolled back so that it forms a “frill” along the band. Openings between contoured stacks should be staggered to further reduce water run-off.

8 Focus on riparian areas

Rivers, streams and wetlands are a priority when planning the clearing of IAPs. IAPs often use a lot of water and can reduce water flow and quality if water systems are heavily invaded. Waterways also provide a way for IAPs to spread rapidly downstream.

9 Collaborate with neighbours

Collective management and planning with neighbours allow for more cost-effective clearing and maintenance. This reduces reinfestation. It also allows a more integrated approach with respect to fire and fuel-load management.



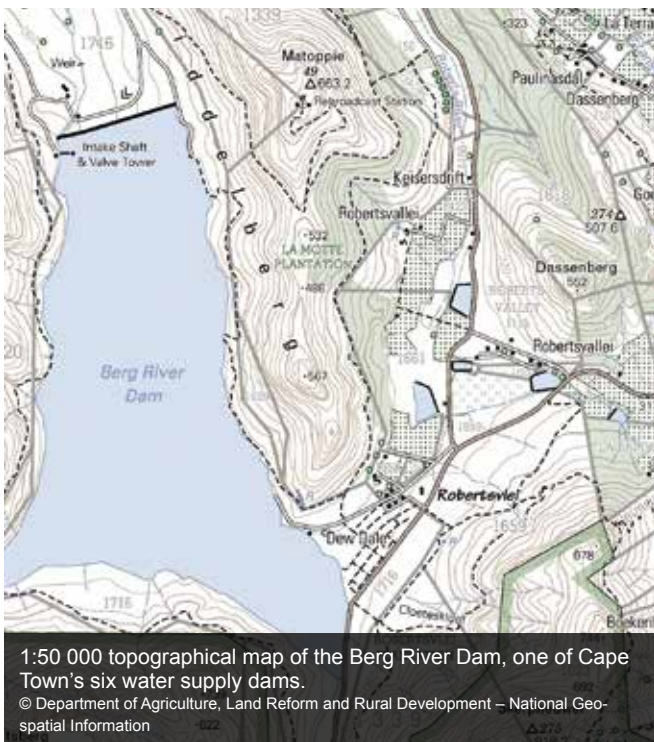
Cleared material stacked along contour lines. © Saskia Fourie / WWF

MAPPING – WHY IS IT ESSENTIAL?

Mapping skills are useful for anyone undertaking the management of IAPs. Maps such as topographical and aerial maps can help land users to understand the location of the area, its boundaries and the layout of the landscape to successfully plan and carry out the IAP management work.

Maps can be used to show where the IAP infestations are, and how management operations should be approached. They can also be used to schedule IAP control treatments and calculate costs.

TYPES OF MAPS NEEDED FOR PLANNING IAP MANAGEMENT



Topographical maps

A topographical map shows the layout (or the topography) of the land. It shows the height above sea level using contour lines, which also gives an indication of the slope of the land. This type of map is useful for assessing accessibility and walking time to an area. Rivers, roads and compass bearings are shown on these maps.¹

It is advisable that a contractor has a topographical map of the area where the work is to be conducted.



Aerial maps

Aerial maps are made from photographs taken from aeroplanes, drones or satellites. These types of maps are easy to understand because they provide a picture and not just a line drawing of the area. But they give less detail than topographical maps. It is important to remember that you need to get the most up-to-date aerial map, as landscapes change over time due to fires, development, etc.

Free open source GIS software is available to anyone to view and manipulate spatial information, e.g. Quantum GIS, Google Earth.



For more information, topographical and aerial maps are available from the [National Geospatial Information \(NGI\) agency](#) (Appendix 9) (page 66).

¹ Deacon, G. and Harding, G. 2007. *Worksite Management Manual*.

MAPPING MANAGEMENT UNITS – WHAT DOES THIS INVOLVE?

Walk the area

Before starting the clearing work, it is essential to walk through the whole area in a set pattern. Walking the area will help to gather information about the IAPs on the land. This information can be used to map out management units.

Information will need to be gathered about:

Species

Managing IAPs cannot be done if the IAP species have not been identified. Only once the species has been identified can the appropriate IAP control methods be selected.

Growth form

How the IAP grows is known as its growth form or habit (see [Types of IAPs – How do they differ?](#) page 12). There are many different growth forms for plants, each with different control strategies.

Age classes

The age, stem thickness and height of the IAPs will determine the type of control method. The age of a plant is usually divided into the following classes:

- Seedling (diameter at ankle height: 0–15 mm)
- Young (diameter at ankle height: 16–50 mm)
- Adult (diameter at ankle height: > 50 mm)

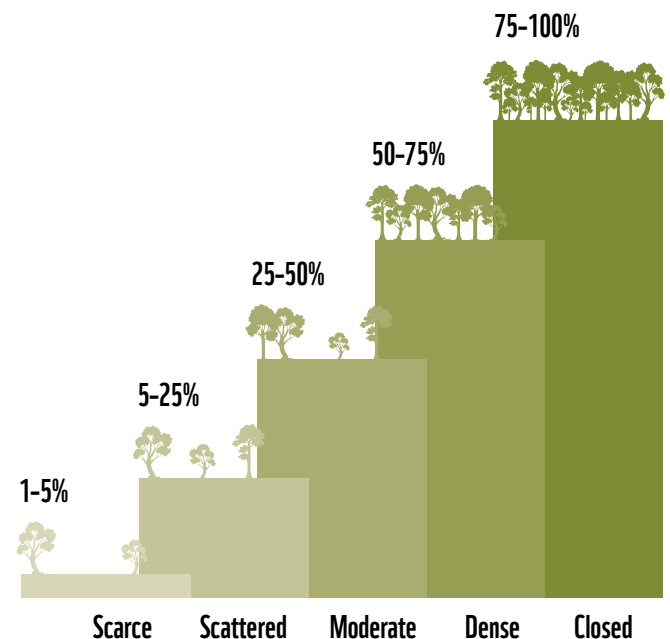
See [IAP management methods](#) (page 32).

Remember, height does not equate to age. Some mature plants do not grow very tall. Generally, anything lower than hip height is classified as a seedling.

Density class

The density of IAPs refers to how closely packed they are. It is measured by estimating the ground cover or the number of stems in an area. Density is usually expressed in percentage, ranging from 0% (no IAPs) to 100% (fully covered with IAPs). It is commonly estimated using simple visual methods to assess the coverage of each IAP species within a set area. The categories generally used are shown in Figure 1. Densities will be a significant determinant of how much time and money it will take to clear the area.

Figure 1: Density class categories for IAPs



Size of area

The size of the area, measured in hectares, will affect the number of working days needed to complete the treatment area. Integrated fire and IAP management may include smaller IAP management units within larger fire management units. In these cases, a fire management unit is an area that can be burnt in a prescribed burn. The rule of thumb is that the unit size is determined by what can be burnt in one day.

Ensure that the boundaries of the area to be cleared are visibly marked to orientate the team.

The information gathered on the species, growth form, age and density across the land will help to decide on management units. A useful management unit is one where the IAPs are of the same species, age and density. Then the most appropriate control treatment can be applied to each unit (see [4 steps to developing an IAP management plan](#), page 20). Also consider appropriate units for [Integrated planning for fire and IAPs – Why is it important?](#) (page 24).



For more information, see Appendix 6: [Basic mapping skills](#) (page 66).

INTEGRATED PLANNING FOR FIRE AND IAPS – WHY IS IT IMPORTANT?

Fire management and the management of IAPs are inextricably linked. The role of wildfire is central to planning IAP control as it presents both a threat to IAP management operations and an opportunity for IAP control.

Threat

Wildfire management is necessary to reduce fire hazards and control unscheduled wildfires that threaten property, crops, infrastructure and IAP management investments already made. In the absence of IAP control, successive wildfires in areas invaded by IAPs lead to densification and further invasion. This in turn increases fuel loads and rate of spread, fuelling a vicious cycle. Uncontrolled wildfires often defeat the purpose of mechanical and biological control. Only once a sound level of wildfire management is in place should alternate IAP control strategies be implemented and integrated.

Opportunity

Fire, with appropriate management, is a cost-effective IAP control method. Fire can be used to control IAPs and maintain optimal water yield in catchments. It is critical to understand the effect of fire as a driver in Fynbos and other fire-driven systems and recognise that fire may be used as an effective management tool.

Integrated planning is required to coordinate the management of fire and IAPs to take advantage of the opportunities and limit the threats. Planning firebreaks (fuel breaks) and

treatment blocks, and being adequately prepared are essential for successful fire management. Land users should devise a joint strategy guided by both legal and practical management requirements. An understanding of fire ecology and the natural processes will further enhance land users' wildfire management capabilities. There are significant benefits to membership of a Fire Protection Association, which promotes and supports fuel-load management.



For more information, see Appendix 7: [Fire Protection Associations in the Western Cape](#) (page 66).

To set up integrated fire and IAP management, it is necessary to identify management units that can be subjected to planned burns. Management actions can then be scheduled in these units to optimise both ecological burning and IAP management at the right time. It is important to note that too frequent or unseasonal fires can have a significant negative ecological impact. It is also crucial to strive for a mosaic of different veld ages across the greater landscape.



For more information, see CapeNature's fact sheet Appendix 10: [What a landowner needs to know about fire management](#) (page 67).



A member of a fire management team in action.

© Tessa Oliver

HOW TO PREPARE FOR AND MANAGE WILDFIRES

Landowners should take measures to prevent wildfires from starting and spreading to neighbouring land. They should be ready to manage any wildfire that occurs on the property.

Legislation

The requirements for fire prevention and preparedness are covered in the National Veld and Forest Fire Act 101 of 1998. There are penalties if landowners fail to follow these provisions (e.g. firebreaks, notification of intention to burn).

Invasive alien plants

Bringing IAP infestations under control is an important step towards preventing wildfires, as these fires burn hotter than Fynbos fires. Wildfires on IAP-infested land are very difficult to control, especially under dry, windy and hot conditions.

Firebreaks

A firebreak (fuel break) should be prepared and maintained around the property, or firebreak exemption should be

sought. It should be wide and long enough to assist in managing a wildfire. It should also be reasonably free of flammable material that might carry a fire across it. The firebreak should not cause soil erosion.

Fire Protection Association (FPA)

The landowner should join the local FPA. Landowners should notify the FPA and neighbouring landowners about fires. Landowners should be ready to fight fires by acquiring equipment and having competent personnel available to fight fires, or appoint an agent to do so. In an emergency, fire services and FPA officials should be given permission to enter the land to fight fires.



For more information, see Appendix 7: [Fire Protection Associations in the Western Cape](#) (page 66).



A member of a fire management team using a drip torch to set fire to the veld.

© Tessa Oliver

HOW MUCH LABOUR AND BUDGET WILL A LAND USER NEED?

The amount of labour (in person days) and the budget a land user will need will depend on the size of the area to be cleared of IAPs, the nature of the terrain, the species present and the age and density of the IAPs.

By mapping out management units, the area can be worked out in hectares (see [Mapping management units – What does this involve?](#) page 23). This information can be used to estimate labour (see [Funding opportunities](#), page 64) and herbicide costs. Also see Figure 2.

Person days

Labour required for IAP management is measured in person days (Pd). A person day is the amount of work that one person can do in one day. The number of person days needed for certain species, ages and densities of IAPs have already been worked out and these norms are available on norm sheets.

Norm sheets are available from the Department of Environment, Forestry and Fisheries Natural Resource Management Programmes offices.

To calculate person days, the area to be cleared (ha) is multiplied by the “norms”. If working in a riparian area, add 50% to the total person days to include time for carrying out the material from the natural flood zone. If cutting and stacking is required, add an additional 20%.

The cost of labour can be calculated by multiplying the total person days by the cost per person per day. Every team's dynamics are different, so it is advisable to eventually work out one's own norms over time. Keep records of production against the norms and adapt the norms to local conditions.

Person days = area (ha) × norm

Cost = total person days × cost per person day

Herbicide cost

Herbicide norms appear on the herbicide norm sheets, which are included when the product is purchased, and are used to calculate herbicide requirements and costs. Herbicide cost is calculated by multiplying the area (ha), the density of IAPs, the litres of herbicide required according to the norm sheet, and the cost per litre.

Herbicide required = area (ha) × density (proportion) × dilution factor (ha/litre)

Cost = total litres required × cost per litre

Figure 2: Aspects that may influence the costing of an IAP management operation



Vegetation

- Species
- Density (coverage % or stems/ha)
- Area (ha)
- Height (m)
- Growth stage



Terrain

- Slope
- Access
- Transport costs



Herbicide

- Herbicide type
- Rate spray volume (per ha or %)
- Knapsacks/sprayers/nozzles
- Herbicide costs



Equipment

- Slashers/brush cutters
- Maintenance
- Equipment costs and depreciation



Labour

- Type (skilled/unskilled)
- Task rate (person days/ha)
- Number of labourers
- Availability
- Salaries/wages
- Benefits/bonuses
- Training costs



Programme

- Duration
- Number of treatments



For more information, see:

Appendix 3: [Work sheet for field verification](#) (page 66).

Appendix 4: [Guidelines for clearing time \(Person days/ha norms\)](#) (page 66).



An indigenous pincushion protea (*Leucospermum* spp.) in Kirstenbosch National Botanical Garden.

© Helen Stuart / WWF

WHAT OTHER FACTORS SHOULD ONE CONSIDER FOR IAP MANAGEMENT?

In addition to the context, methodology and priorities, other factors may influence the methods, extent and location of an initial IAP management operation, and warrant consideration.



A chainsaw operator undertaking alien clearing in the Kouga River in the Eastern Cape, an important catchment for water supply to the Nelson Mandela Metro.

© Rodney February / WWF

Combinations of control methods

An IAP control plan should integrate the various control methods to optimise effectiveness and limit environmental impact. Moderate to low IAP infestations in wetland areas, for example, can be treated by implementing controlled burning at the beginning of autumn, followed by mechanical removal or herbicide application in mid-spring (see [IAP management methods](#), page 32).

Infestations in wetlands

Note that wetlands are protected by the National Water Act 36 of 1998 and the National Environmental Management Act 107 of 1998. No heavy machinery may be used to remove IAPs in wetland areas without prior authorisation from the relevant government departments.

Disposal of material

Disposal of the cut IAP material needs to be carefully considered. Whatever disposal method is selected must meet all the legal requirements and must not create a risk for residents and infrastructure (see [How can one responsibly manage plant material?](#) page 45).

Biomass potential

Dense stands of IAPs may have the potential to be harvested for additional value, e.g. timber, firewood, briquettes or biochar, or even fuel for boilers. Using biomass provides additional benefits, as reducing fuel loads improves fire safety and rehabilitation potential.

Indigenous vegetation

Natural vegetation – including individual indigenous trees located among stands of IAPs – must be protected from damage during the clearing process. Indigenous trees and vegetation can be cordoned off or marked using danger tape to make sure workers know what must be protected. This approach will reduce the long-term cost of managing invasive alien plants by reducing the need for active rehabilitation, and protecting the cleared area from erosion and regrowth. In very sensitive ecosystems, IAP clearing interventions should ideally be done during the dry season when the vegetation is less sensitive to disturbance.

Rehabilitation potential

If the intention is to rehabilitate the area, further restoration methods may be needed. If appropriate in terms of locality and wildfire risk, stands of alien trees can be used to create nursery stands for forest species. This may be managed by selective removal of alien trees to allow indigenous forest to emerge over time (see [Long-term rehabilitation](#), page 58).

Labour considerations

Consider the possible seasonal availability of human resources (e.g. personnel shortage in spring and summer due to irrigation, harvesting and other activities). Also consider the level of skills required.

Practical considerations

Think about the location of the site, the distances to travel and the accessibility for machinery. Plan to use existing access roads.

Threat to pastures and planted crops

Think about how the IAP management operation may enhance the essential economic activity on the property.

Ability to follow up

Follow-up treatments will be needed to maintain the initial investment. Do not start clearing an area if you will be unable to follow up as this can make infestations worse. IAPs are quick to regrow in disturbed areas and often out-compete indigenous vegetation. Different follow-up schedules (e.g. in terms of timing, frequency and approach to follow-up treatments) may be required for different species.

Management history

Previous management actions in the area that you intend to clear could play a role. Understanding the fire and IAP management history of the site will help to choose the appropriate methods and sequence of treatments. Wildfires, for example, may stimulate Acacia seedbanks in areas where seed-limiting biocontrol methods are not yet present. This will determine the appropriate follow-up methodology and costs (see [What is biocontrol?](#) page 41).

Ongoing evaluation

Land users will need to continually evaluate the success of the IAP management operations and potentially adjust the methods used. Other species may invade after initial clearing – this is known as secondary invasion – which may require different management methods.



For more information, see CapeNature's fact file Appendix 8: [A landowner's guide to planning alien control](#) (page 66).



An active restoration site on the Meul River, a tributary of the Riviersonderend near Greyton in the Western Cape.

© Rodney February / WWF

WHAT BASIC TOOLS ARE REQUIRED FOR IAP MANAGEMENT OPERATIONS?

Conducting an IAP management operation will require a basic set of tools and equipment. Further requirements may depend on the specific control methods used.

Table 3: Tools and equipment for IAP management operations

(also see [Personal protective equipment – What does it include?](#), page 50)

Item	Supervisor	Machine operator	General workers	Herbicide applicator
First-aid kit (and maintenance)	✓			
Fire beaters	✓			
Wajax can ²	✓			
Chainsaw		✓		
Chainsaw maintenance items		✓		
Chain lube				
Fuel mix				
Chain				
Bar				
Sprocket				
Sparkplug				
Round files				
Flat files				
Combi-can		✓		
Fire extinguisher ³		✓		
Sharpening kit		✓		
Sharpening kit tool pouch		✓		
Axe			✓	
Axe handles				
Sharpening stones				
Bow-saw/pruning saw			✓	
Blades				
Lopping shears			✓	
Spray can hand-held			✓	
Drip tray or sheet		✓		✓
Measuring jug, bucket, container				✓
Knapsack maintenance				✓
Parts				
Knapsack sprayer				✓
Stopwatch				✓
Tape measure (> 30 m)				✓

² A specially designed, rugged knapsack with a pump action that has been developed to squirt water on a fire. Very effective in extinguishing small fires.

³ A fire extinguisher must be kept at the refuelling area to extinguish fires that can start when petrol lands on the exhaust of a hot chainsaw.

CHECKLIST FOR AN IAP MANAGEMENT OPERATION

When embarking on an IAP clearing programme, land users should bear in mind certain general principles. This will help them to choose the appropriate clearing method, be it manual, mechanical, chemical, biological or a combination thereof.

10 POINTS TO REMEMBER WHEN CONDUCTING AN IAP MANAGEMENT OPERATION

- 1 Always start at the highest point and work downwards, downhill or downstream.
- 2 Start from the edge of the infestation and work towards the centre.
- 3 Take care to prevent the spread of cuttings, which could take root further downstream.
- 4 Once plants have been removed, unstable slopes should be stabilised by erosion protection measures (such as geotextiles or other suitable material).
- 5 Keep accurate records of actions and costs to assist with future planning.
- 6 Control IAPs when the plants are young, rather than waiting until they are woody and difficult to remove by hand.
- 7 Manage IAPs before a wildfire burns the area, as the mechanical control thereafter is substantially more expensive (see [Mapping – Why is it essential?](#) page 22).
- 8 Set up an integrated fire and IAP management plan (see [Integrated planning for fire and IAPs – Why is it important?](#) page 24).
- 9 Take care to distinguish between young invasive species and Fynbos species (this could be difficult). Keurboom seedlings are remarkably similar to that of many acacia species seedlings.
- 10 Select the quickest and most effective way to efficiently kill a plant – time is money.



A Working for Water team undertaking slashing and stacking of the invasive weed lantana (*Lantana camara*).

© LANDWORKS

IAP MANAGEMENT METHODS

A range of methods can be used to manage IAPs. The methods chosen will depend on the species involved, the landscape, the season and the resources available, as discussed in the previous section. Long-term success is best achieved with a combination of various methods, called an integrated IAP control approach.

Here, you will find simple instructions for the four main methods of managing IAPs: manual, mechanical, chemical, and biological control. Further information is given on how to dispose of plant and waste material and the tools needed for IAP clearing.



A chainsaw operator undergoing training on alien clearing along steep slopes.

© Rodney February / WWF

MANUAL CONTROL OF IAPS – WHAT DOES IT ENTAIL?

Manual control is when a worker removes or kills each IAP through hand pulling, cutting, digging out, ring barking or bark stripping. Because it is so labour intensive, it is best used for lighter infestations, seedlings, single plants, plants that have shallow roots, or in very sensitive areas.

Hand pulling

Hand pulling is most effective when plants are small (30 cm), immature or shallow-rooted, and after rain.

- Use a pair of gloves and grip the plant firmly around the stem just above the root.
- Pull hard and remove the plant, roots and all.
- Kicking around the root area of the plant may help to loosen the root system, making it easier to pull out the plant.
- Shake the excess sandy material from the plant to ensure a higher mortality rate and make the plant easier to stockpile and lighter to transport.

Cutting

Chopping or slashing is most effective for young plants that are too large to pull out by hand, or for plants that have woody stems. It is best used on plants that are not resprouters. In the case of resprouters (coppicing), chopping must be combined with chemical treatment of the cut stumps.

- Use implements such as pangas (slashers/machetes), handsaws, bow-saws and axes to cut plants down as low as possible.
- Remember to wear protective clothing and keep team members at least two arm-lengths apart (see [Health and safety](#), page 46).
- Stack removed material into piles of 2 m high and 3 m wide.



A team using the technique of cutting close to the ground combined with bark stripping, which eliminates the use of herbicide. © LANDWORKS

Digging out

Digging out IAPs involves the use of tools like hoes, sticks, tree poppers or spades. The entire plant and root must be removed.

- 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.
- Stack removed material into piles of 2 m high and 3 m wide.

Ring barking

Since this method means the tree is left standing, it is recommended only for single trees or very low-density invasions, not for stands. Ring barking on smaller diameter stems is ineffective and it would be quicker to just cut the tree down. Ring barking should be used on trees with stem diameters greater than 150 mm, where the time taken to fell, de-branch and stack would be excessive. Basal bark treatment could be considered as an alternative in some cases (see [Chemical control of IAPs – What does it involve?](#) page 36).

- Slashers or axes should be used for debarking.
- Remove the bark and cambium (outer rings where the trunk grows) in a continuous band around the trunk of the tree at least 25 cm wide, starting as low as possible.
- Where clean debarking 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.
- For better control of aggressively coppicing species, combine with bark stripping (right).

Bark stripping

Bark stripping is the removal of bark from the trunk between ground level and up to 1 m above ground. A suitable herbicide can be applied along 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 paint brush.

Bark stripping, ring barking and frilling should not be used as methods on any trees located next to rivers or infrastructure. Treated trees that are either dying or dead could fall into rivers and block the flow of water, or cause damage to infrastructure such as roads, fences, buildings and power lines.



Bark stripping removes the phloem layer of the plant, which will cause the tree to die over time.

© Rodney February / WWF



Ring barking is used for larger trees.

© Saskia Fourie / WWF

MECHANICAL CONTROL OF IAPS – WHAT ARE THE OPTIONS?

Mechanical control involves the use of machinery to clear IAPs and is often the most effective for larger individual plants. Cost effectiveness, personnel competency and safety remain important considerations.

Bulldozers

Although machines like bulldozers can bring additional strength to clearing more stubborn infestations, the use of heavy machinery has serious limitations:

- The disturbance to the soil and vegetation will lead to loss of natural biodiversity.
- Bulldozers create a fresh seedbed for germination of more invasive species.
- There are also unforeseen impacts caused by compacting the soil.

Because of these limitations, laws protecting natural veld, riparian areas and wetlands only allow heavy machinery to be used in areas that are already disturbed (e.g. cultivated lands, firebreaks and road verges).

Bulldozers have been used for IAP clearing with varied results.

- Use of machinery for IAP clearing must be compliant with the relevant legislation.
- The blade should be kept 15 to 20 cm above the ground to catch and push plants without gathering too much soil.
- The mix of soil and plants that is created makes disposal of plant material difficult and costly. Stacking into rows is the best option (see [How can one responsibly manage plant material?](#) page 45).

Felling equipment

Felling is appropriate where trees can be cut down and removed using chainsaws, bow-saws, brush cutters or slashers. Where trees cannot be removed (on steep slopes), it is better not to fell trees, but rather to control them where they stand. Where possible, large trees should be felled so that they fall uphill. Cut trees should be debranched.

Take wind direction into account when felling large trees with chainsaws. Always start downwind.

Heavy rollers

Heavy-duty forestry rollers are used to mulch plantation waste after clear-felling. They have been usefully applied to IAP clearing as part of a combined programme where fire is also used. The heavy roller can be used after fires on medium to dense stands of young saplings (saplings up to 2 m in height and < 30 cm in diameter). Fire can also be used to remove the flattened material.

Heavy machinery can be used in various ways to help dispose of plant waste from IAP clearing, such as by chipping or stacking (see [How can one responsibly manage plant material?](#) page 45).



A chainsaw operator felling a pine tree in the Vyeboom Wetland in the Theewaterskloof catchment. © Rodney February / WWF

CHEMICAL CONTROL OF IAPS – WHAT DOES IT INVOLVE?

Chemical control makes use of herbicides to kill target IAPs by foliar application, blanket spraying, aerial application or cut stump treatment. Other chemical methods are chemical frilling, basal bark treatment and stem injection.

A herbicide is a substance that is toxic to plants, either killing the plant or interfering with its growth. Several effective herbicides are available. Herbicides are usually applied to IAPs using special equipment such as knapsacks with spraying nozzles.

Chemical methods are a good choice when the IAPs are still seedlings or young. At this stage of a plant's life it is growing fast, so herbicides will be quickly translocated through the plant to reach the roots. The leaves and stem are young and green with a large surface area, allowing for good absorption of the herbicide.

Chemical control should not be applied when it is raining. It is important to note that herbicide can also harm many non-target species and must always be used with the greatest of care. Wetlands require special care and only herbicide appropriate for wetlands should be used.



Foliar application of herbicide using the correct PPE. © Peter Emsile



Foliar application of herbicide.

© Peter Emsile

Foliar treatment

Foliar treatment is when herbicide is applied to the leaves of the plant, usually by spraying.

- Spray herbicide with a knapsack sprayer, mist-blower or high-pressure sprayer firefighting unit, e.g. a bakkie-sakkie.
- The correct choice of nozzle is important to achieve an even spray cover.
- The best results can be expected in the active growing season (but some species are more susceptible to chemical absorption when they are sprayed in summer).

Blanket spraying

Blanket spraying, or broadcast spraying, is when herbicide is sprayed across an entire area of over 70% infestation. While this method is recognised, it should be used with a high level of caution due to the significant environmental risk. It is the most cost-effective way to eradicate young, dense, uniform stands of IAPs. Some IAPs, like introduced acacias, germinate by the thousands after fire. The first line of attack to reduce these numbers is the use of broadcast spraying. Calibration is crucial to ensure even distribution of herbicide over the target area (see [What you need to know when calibrating your equipment](#), page 40, and [Herbicide safety](#), page 52).



For more information, see Appendix 11: [Choice of nozzles for invader plant control](#) (page 67).

Aerial application

Aerial application is spraying either large-scale infestations or targeted inaccessible plants from an aircraft. While aerial application is a recognised method of IAP control, it is still under development and should be used with a high level of caution due to the significant environmental risk. Aerial spraying can only be done by registered and certified operators according to strict regulations. The pilot must ensure that the spray mixture is distributed evenly over the target area and that the wastage of herbicide, as well as drift onto indigenous species, is kept to a minimum. It is essential that the following criteria be met:

- Inform your neighbours well in advance before spraying commences.
- Use only an aerial registered product. Port Jackson (*Acacia saligna*) and rooikrans (*Acacia cyclops*) have herbicides registered for aerial application.
- Adult Port Jackson and rooikrans must be sprayed in summer (i.e. November–March) for optimum results.



Applying herbicide from a helicopter using the wand method is the most targeted, although it is still under development. © Andrew Turner



Any aerial application of herbicide needs to be certified for in-field use. © Andrew Turner

Cut stump treatment

Applying herbicide to cut stumps is a highly effective method for larger woody IAPs.

- Fell the target tree horizontally and as low as possible to the ground.
- Ensure a smooth cut surface to expose the cambium (outer rings where the trunk grows).
- Clear around the cut stump to expose side branches that also need to be cut and treated.
- Spray the herbicide mixture at a very low pressure on the freshly cut surface.
- Treat only the outside cambium layer for stumps with a diameter larger than 10 cm.
- Apply the herbicide mixture as soon as possible after the tree has been felled.
- When using a product that is mixed with penetrant oil, the entire stump and exposed roots must be treated.



The correct application of herbicide for cut stump treatment.

© Peter Emsile



Basal bark treatment

Basal bark application can only be carried out with an oil miscible product. Oil miscible products are formulated with penetrant oil, which acts as a carrier that moves the herbicide through the bark to the cambium and eventually to the roots. Young trees and shrubs with green bark can be treated while standing with no need for felling.

- Spray the herbicide onto the stem.
- Ensure wetting of the root crown, exposed roots and stem up to a height of 0,5 m.
- Low-pressure spraying or stem paint is required to minimise spillage onto the soil.
- The entire circumference of the trunk must be treated.



Chemical frilling

The frill method can be used to kill standing trees where felling is too difficult. Frilling refers to a series of downward cuts made in the bark around the tree.

- Use an axe to frill trees smaller than 10 cm in diameter. A chainsaw can be used for larger diameter trees, but take care to ensure that the chain is sharp because cauterising the cambium layer can prevent absorption of the herbicide.
- The cut must penetrate the bark and must be deep enough to reach the cambium layer.
- The cuts must be made horizontally and as close to the ground as possible.
- Enough herbicide must be sprayed into the cut to ensure that it runs down to the cambium layer.
- The entire circumference of the tree must be treated.



Stem injection

This treatment, whereby the chemical is directly injected into the base of the plant, is only used for prickly pear (*Opuntia* species), but is still under development. Methods suitable for use on woody species are being investigated.

9 THINGS YOU NEED TO KNOW WHEN APPLYING HERBICIDES

1 Registration

Only herbicide products registered for the particular IAP species being treated must be used.

2 Safety

Appropriate protective clothing must be worn and should be changed and washed regularly. Clothing should be removed immediately if grossly contaminated. Hygiene aids – clean water, soap, towels and eyewash – must always be available to spray operators (see [Herbicide safety](#), page 52).

3 Weather

Application should not be carried out during unfavourable weather such as rain, wind or hot, dry conditions. Weather conditions could affect the ability to control the spread of herbicide and endanger desirable vegetation, water bodies or personnel. Poor results may be achieved if the target plants are not in a suitable condition for treatment – this includes plants that are either water stressed or waterlogged.

4 Drift

Caution must be observed to limit wind drift when using minimum output nozzles.

5 Inspection

Equipment should be inspected regularly between and during applications. Ensure that the correct nozzles are fitted and that pressure settings are checked regularly.

6 Filling

Always ensure that knapsacks are filled to the desired level (generally only 95% of the tank volume). Ensure that there is a sufficient quantity of water on site to prevent operators from running out of spray water.



An example of a herbicide camp in the field. © Rodney February / WWF

7 Spillage

Spillage must be attended to immediately and appropriately disposed of. Where spillage occurs in a storage facility with a hard surface, the following steps should be followed:

- If available, an appropriate spill kit should be used to clear up the spill.
- Alternatively, contain the spillage with lime sand or a suitable material. Never use sawdust, as this could lead to spontaneous combustion.
- Bag and dispose of the material using a reputable hazardous waste disposal company.

If a spill occurs at a clearing site:

- Bag the spill material in thick plastic bags and take it off-site.
- Dispose of the bagged material in the same way as for a spill in the storage facility.

8 Repairs

Leaking sprayers or sprayers not applying correctly should be withdrawn until repairs have been carried out. Spare applicators and parts should always be available so as not to impede operations.

9 Cleaning

Equipment must be emptied and cleaned thoroughly after spraying. The spray mixture must not be left in the apparatus overnight.

Do not under any circumstances use metal objects to clean clogged spray nozzles, as this will cause damage, affecting the flow rate, spray pattern and droplet size. Use a soft bristled brush or compressed air to clean.

Spray water that is left over after cleaning the sprayers can be sprayed out on dense stands of IAPs, but remember to respray the area the next day with the correct concentration.

Important tips to remember

- Herbicide mixing and refuelling must be conducted on a spill blanket.
- A spade must be on-site to deal with any accidental spillage.
- Keep spill kits at hand when working with hydrocarbons.
- Do not decant or mix herbicide near water bodies.
- Do not rinse herbicide equipment in water courses.
- Do not use metal objects to clean clogged spray nozzles.

THE DOS AND DON'TS OF CHEMICAL CONTROL

WHAT TO DO

- ✓ Plan the use of herbicides before the operation starts.
- ✓ Wear the appropriate safety clothing (see [Personal protective equipment – What does it include?](#) page 50).
- ✓ Use only approved herbicides.
- ✓ Only use designated knapsacks or spray bottles.
- ✓ Follow the manufacturer's instructions.
- ✓ Mix herbicide according to the label.
- ✓ For some species, an adjuvant (wetter, spreader, sticker) will be added to the spray mixture to increase the efficacy of the herbicide.
- ✓ Spray when plants are actively growing.
- ✓ Spray when the leaves are dry.
- ✓ Apply spray mixture to the entire leaf surface including green stems and branches.
- ✓ Add dye to the spray mixture to prevent over-spraying.
- ✓ Keep herbicide in a demarcated area at the spraying site, out of direct sunlight.

WHAT YOU NEED TO KNOW WHEN CALIBRATING YOUR EQUIPMENT

Calibration is the adjustment of spray equipment in order to deliver the recommended volumes of water and herbicide, taking into account the operator or machine speed across the terrain to be treated. All spraying equipment must be correctly calibrated to obtain best results and prevent wastage. Calibration is needed for every knapsack since equipment and nozzles differ. The calibration results from one knapsack cannot be used for other knapsacks.

Calibration should be carried out on site and checked frequently during application. The following should be checked:

- Correct spray pressure
- Correct nozzle size and spray pattern
- Correct nozzle output (delivery rate in litres per hectare, suggested in the herbicide label)
- Volume of application over a specific area.

WHAT NOT TO DO

- ✗ Do not spray without the appropriate personal protective clothing and the correct equipment.
- ✗ Do not spray during wind, or when there is a likelihood of spray drift.
- ✗ Do not apply herbicide in the rain or on wet, damp leaves.
- ✗ Do not spray when the temperature exceeds 30 °C.
- ✗ Do not spray plants that have signs of drought stress, frost damage or have not fully developed after winter dormancy.
- ✗ Do not spray plants that are above hip height.



Cut stump herbicide application using the correct PPE.

© Rodney February / WWF



The correct set-up of a herbicide storage camp in the field.

© Guy Deacon

WHAT IS BIOCONTROL?

Biological control, or biocontrol, is bringing in natural enemies of an IAP from their country of origin. The natural enemies will feed on and damage the IAPs, making them easier to manage and reduce the rate of spread.

Biocontrol is a good management option for several reasons:

- It is environmentally responsible as it does not cause pollution and only affects the target plant.
- It does not disturb the soil or create large empty areas where other IAPs could invade.
- Biocontrol can be self-sustaining without the need for ongoing management.
- It is a cost-effective option that is often a key part of an integrated control plan.

BIOCONTROL AGENTS

The natural enemies used in biocontrol are called biocontrol agents. They are usually plant-feeding insects, mites or plant diseases. Biocontrol agents may control an IAP in different ways, e.g. by damaging vegetative growth, or by lowering the number of seeds produced.

More than 700 biocontrol agents have been tested and released around the world. Biocontrol agents are host specific. This means they only feed on the target IAP, and cannot survive by switching to indigenous plants or crops.

If the target IAP population eventually dies out, the introduced biocontrol agents will die out with it. It is sometimes necessary to establish small reserves of healthy, mature IAPs on which the agents can survive and spread to IAPs that may have escaped the clearing process.



Galls formed as a result of *Dasineura rubiformis*, the biological control agent for black wattle (*Acacia mearnsii*). Female midges lay their eggs in the flowers and the flowers become galled rather than going on to produce bunches of seed pods.

© John Hoffman

SAFETY REGARDING THE USE OF BIOCONTROL

The use of living organisms is never entirely risk free, but modern methods of biocontrol are very safe. Biocontrol has been used for over 100 years in South Africa. It has become an accepted and common practice in many countries. There are safety measures in place to ensure that biocontrol does not harm natural ecosystems.

Scientific research

There is a lot of scientific research on biocontrol. Biocontrol scientists are constantly working to expand and build on the current knowledge. They publish their research in reputable scientific journals and share their results at international conferences. Biocontrol scientists are careful to maintain their excellent safety record.

Choice of agents

Biocontrol agents are very carefully selected before release. They are usually chosen to be specific to the target IAP, so they cannot harm any other plants. There have been advances in molecular techniques that have made host-specificity testing more accurate and less time consuming.

Testing

Before any biocontrol is carried out, rigorous scientific safety tests are conducted under strict quarantine. It may take several years to test a single biocontrol agent before it is released.

Regulation

Different countries have different regulatory processes for biocontrol. Regulations are used to decide whether or not a biocontrol agent is safe for release in a particular country. Scientists and regulators are getting better at weighing up the risks and benefits. Usually, approval from the relevant authority is required before biocontrol agents are released.

THE BENEFITS OF BIOCONTROL

Around the world, the benefits of biocontrol are impressive. Biocontrol has been responsible for ending some very damaging IAP invasions. It is also more cost effective than many other IAP control methods. It was estimated in 1998 that biocontrol programmes had already saved South Africa R1,38 billion in IAP control costs. However, biocontrol agents can have varying degrees of effectiveness.

Complete control

Some biocontrol agents have been very successful at suppressing the target IAPs. When biocontrol is successful, it can sustain this benefit for decades, without any further investment or management.

Management aid

Biocontrol agents can help to reduce the density or spread of IAPs to a more easily managed level. These invasions can then be addressed using other control methods. The land user must then consider how best to integrate the use of the biocontrol agents with other control methods.

Limited effect

There are some instances where a biocontrol agent does inflict damage on the IAPs, but it is not enough to bring the invasion under control. In a few cases, biocontrol agents fail to become established in the introduced environment. A suitable biocontrol agent may not be available for some IAPs.

Long term

It is important to understand that biocontrol is often a long-term strategy. It is usual for biocontrol agents to take 10 to 20 years to build up large enough numbers to control the target IAPs. Often, biocontrol has been discounted too early because the IAP problem is not solved within a few months or years.



Dr Alan Wood of the Agricultural Research Council applying the biocontrol stink bean fungus spores to stink bean plants in the field.

© Andrew Turner

EXAMPLES OF BIOCONTROL AGENTS IN SOUTH AFRICA

Over the years, several biocontrol agents have been approved and released for IAPs in South Africa (Table 4 on the next page). Some invasive alien plants are at present under effective biological control. In these instances, further time and money need not be wasted on additional clearing methods. Examples are:

- Silky hakea (*Hakea sericea*) in areas where the climate enhances gummosis disease and other agents;
- Sesbania (*Sesbania punicea*) after the introduction of all three insect agents;
- Red water fern (*Azolla filiculoides*) which has been brought under control by a frond-feeding weevil;
- Harrisia cactus (*Harrisia martinii*) after the establishment of the mealy bug;
- Australian pest pear (*Opuntia stricta*) after the establishment of cochineal.



The gall-forming rust fungus (*Uromycladium tepperianum*), a biocontrol agent for Port Jackson willow (*Acacia saligna*).

© Debbie Muir / NRM

Table 4: Biocontrol agents and their effectiveness

Biocontrol agent	Year introduced	Damage to plant	Comments
Silky hakea (<i>Hakea sericea</i>)			
<i>Erytenna consputa</i> (seed-feeding weevil)	1970	Extensive	
<i>Carposina autologa</i> (seed-feeding moth)	1970	Moderate	
<i>Cydmaea binotata</i> (leaf/shoot-boring weevil)	1979	Trivial	
<i>Aphanasium australe</i> (stem-boring beetle)	2001	Moderate	Limited in distribution and destroyed in areas prone to wildfires
<i>Dicomada rufa</i> (flower bud-feeding weevil)	2006	Moderate	Established only in the southern Cape to date
<i>Colletotrichum acutatum</i> (gummosis fungus)	Indigenous	Considerable	Performs best in wet cold conditions
Rock hakea (<i>Hakea gibbosa</i>)			
<i>Erytenna consputa</i> (seed-feeding weevil)	1979	Trivial	Negligible, but priority species for future biocontrol
<i>Carposina autologa</i> (seed-feeding moth)	1979	Trivial	
Port Jackson willow (<i>Acacia saligna</i>)			
<i>Uromycladium morrisii</i> (gall rust fungus)	1987	Extensive	Control almost complete; around 85% of adult plants killed
<i>Melanterius castaneus</i> (seed-feeding weevil)	2001	Considerable	Seedling regrowth problems
Long-leaved wattle (<i>Acacia longifolia</i>)			
<i>Trichilogaster acaciaelongifoliae</i> (bud-galling wasp)	1982	Extensive	Almost complete control achieved
<i>Melanterius ventralis</i> (seed-feeding weevil)	1985	Extensive	
Golden wattle (<i>Acacia pycnantha</i>)			
<i>Trichilogaster signiventris</i> (bud-galling wasp)	1987	Extensive	Almost complete control achieved
<i>Melanterius maculatus</i> (seed feeding weevil)	2005	Moderate	
Baileys wattle (<i>Acacia baileyana</i>)			
<i>Melanterius maculatus</i> (seed-feeding weevil)	2006	Trivial	<i>D. pilifera</i> first released and established in 2016
<i>Dasineura pilifera</i> (bud-galling midge fly)	2016	Too early to tell	Site destroyed by fire; new releases in 2019
Pearl acacia (<i>Acacia podalyriifolia</i>)			
<i>Melanterius maculatus</i> (seed-feeding weevil)	2008	Trivial	
Black wattle (<i>Acacia mearnsii</i>)			
<i>Melanterius maculatus</i> (seed-feeding weevil)	1995	Moderate	Both agents have most impact in winter rainfall regions
<i>Dasineura rubiformis</i> (flower-galling fly)	2001–06	Extensive	Establishment and impact far less successful in summer rainfall regions
Silver wattle (<i>Acacia dealbata</i>)			
<i>Melanterius maculatus</i> (seed-feeding weevil)	2001	Moderate	Moderate in the Western Cape, trivial elsewhere
<i>Dasineura pilifera</i> (flower-galling fly)	2018	Unknown	The fly is a new introduction
Green wattle (<i>Acacia decurrens</i>)			
<i>Melanterius maculatus</i> (seed-feeding weevil)	2001	Moderate	Moderate in the Western Cape, trivial elsewhere
Australian black wood (<i>Acacia melanoxylon</i>)			
<i>Melanterius maculatus</i> (seed-feeding weevil)	1986	Extensive	Majority of seeds destroyed
Rooikrans (<i>Acacia cyclops</i>)			
<i>Melanterius servulus</i> (seed-feeding weevil)	1994	Extensive	High proportion of seeds destroyed (96% or more at many sites)
<i>Dasineura dielsi</i> (podlet-galling midge fly)	2002	Considerable	
Australian myrtle (<i>Leptospermum laevigatum</i>)			
<i>Aristaea thalassias</i> (leaf-mining moth)	1996	Trivial	Both agents are abundant but control is negligible
<i>Dasineura strobila</i> (bud-galling midge fly)	1994	Trivial	
Red sesbania (<i>Sesbania punicea</i>)			
<i>Trichapion lativentre</i> (bud-feeding weevil)	1970	Extensive	Complete control in most areas Some isolated patches need weevils introduced
<i>Rhyssomatus marginatus</i> (seed-feeding weevil)	1984	Extensive	
<i>Neodiplogrammus quadrivittatus</i> (stem-boring weevil)	1984	Extensive	
Stink bean (<i>Paraserianthes lophantha</i>)			
<i>Melanterius servulus</i> (seed-feeding weevil)	1989	Considerable	High levels of seeds destroyed at many sites
<i>Uromycladium woodii</i> (gall-forming rust fungus)	2016	Unknown	
Mesquite (various hybrids of <i>Prosopis</i> species)			
<i>Algarobius prosopis</i> (seed-feeding weevil)	1987	Considerable	High levels of seeds destroyed by <i>A. prosopis</i> but control is negligible
<i>Neltumius arizonensis</i> (seed-feeding weevil)	1993	Unknown	

HOW CAN ONE RESPONSIBLY MANAGE PLANT MATERIAL?

Invasive alien plant clearing produces large amounts of dead and dying plant material. An excessive amount of plant material can present a fire hazard and, if washed down rivers, can damage infrastructure and riverbanks. This plant waste needs to be responsibly disposed of.

Make use of the waste

Plant material should be used beneficially wherever possible. This includes a wide range of options like charcoal, timber, or even using the cut material to generate electricity where facilities are available. It may be possible to use some material for basket making or animal feed. Wood can be made available to the local community for firewood. This use can offset the costs of IAP management or create a local economic opportunity. However, care must be taken not to distribute seeds or vegetatively growing material (e.g. *Cactus cladodes*) as it could give rise to new infestations.

Chipping and composting

Woody and dry material can be chipped and used as mulch, but beware of the risks of using chips that may contain IAP seed. Wet material and aquatic weeds should be combined with other organic matter and composted. Composting is not appropriate if the material contains seeds. Chipping can also be used to make a range of products, such as pellets for animal feed or fertiliser.

Burning on site

Burning the material on site presents risks that need to be managed appropriately. Burning should only be attempted by suitably (in terms of the relevant legislation) equipped and competent personnel. Material can be stacked in several ways before being burnt (see [Integrated planning for fires and IAPs – Why is it important?](#) page 24).

Landfill

Material that cannot be used, stacked or burnt must be disposed of at a registered and approved disposal site. Plant material can take up valuable space in a landfill, so other disposal options are preferable first. When removing material, take care to remove all debris, including shoots and seeds.

Stacking

Stacking the cut material in heaps or windrows along mountain contours can help to reduce erosion. This also facilitates easy access for follow-up, and assists in containing the fuel load and reducing the risk of uncontrolled wildfires. The stacking method will depend on the IAP species, the clearing methods used, the habitat and the fire history of the invaded area.

- Stack removed material into piles of 2 m high and 3 m wide.
- Keep stacks well apart to prevent fires from crossing, not less than 10 m apart – this is naturally dependent on the size of the stack and the resulting fire intensity when the stacks burn.
- Stack light branches separately from heavy timber (diameter of 150 mm and more) – this helps if communities are dismantling stacks for firewood.
- Preferably remove heavy branches to reduce long-burning fuel loads that can result in soil scars from intensely hot fire, and the need for increased fire surveillance after burning.
- Stack brushwood rows along the contour if on a slope.
- Do not make stacks under trees, power and telephone lines, within 30 m of a firebreak or near water courses, houses and other infrastructure.
- Distribute the team along natural open areas for stacking as productivity will be improved if workers are not working too close to one another. In this way they will not get in one another's way and will be able to stack more freely and safely.

HEALTH AND SAFETY

It is the land user's responsibility to ensure a safe working environment. Work on the property should, at the very least, follow the minimum safety requirements. One way of achieving this can be by employing suitably trained and experienced teams. In this case it is recommended that safety requirements are stated in the work specifications and that the contractor accepts accountability in writing.

This section covers the legal background for health and safety, as well as minimum safety requirements. You will also find information on safety in the field, fire preparedness and a list of personal protective equipment.



Members of a fire management team undertaking a controlled burn.

© Tessa Oliver

WHAT ARE THE MAIN PILLARS OF HEALTH AND SAFETY LEGISLATION?

IAP management involves manual labour with dangerous machinery and hazardous chemicals. It is important that everyone understands the risks and responsibilities. Taking the necessary measures to ensure health and safety makes the difference between a high-risk and a risk-free work environment.

In South Africa, the most important legislation for health and safety is the Occupational Health and Safety Act 85 of 1993 (OHSA). The two main pillars of this Act are:

1 Employer duties and responsibilities

Employers are responsible for making sure that all employees understand the risks and hazards in the workplace. Communication is critical under the OHSA, so workers must be informed of dangers at the workplace. Health and safety information must be communicated to all employees.

2 Employee duties and responsibilities

Employees are responsible for their own health and safety. They should also take reasonable care of those around them. Employees must cooperate with any health and safety rules by obeying all lawful instructions.



A Working for Water clearing team in the field, using the correct PPE.

© Rodney February / WWF

WHAT ARE THE MINIMUM SAFETY REQUIREMENTS?

The landowner should check with the contractor or the contractor's staff to make sure the minimum health and safety requirements are met.

Safety representatives

Due to the risks (or the nature of the work) involved in IAP clearing, the employer should appoint a safety representative. The employer must explain to the workers' organisation what responsibilities the safety representatives will have. The safety representative should be available on site.

Safety committees

In every workplace where there are two or more safety representatives, there must also be a safety committee. This committee must meet at least every three months. The committee must deal with all health and safety issues that affect workers. Safety committees have certain functions and powers. You can find out more about these by contacting the Department of Labour.

Emergency contacts

All teams should be aware of the correct emergency contact details for the ambulance service, South African Police Service, Poisons Information Helpline, COVID-19 public helpline, as well as directions to the nearest hospital, clinic or doctor. Detailed procedures should be drawn up for dealing with emergencies, including fuel, oil and herbicide spills.

Water

Clean water must be available in suitable, clearly marked containers for drinking and mixing herbicides.

Toilet facilities

The contractor or land user should provide a mobile toilet on site for the duration of the work.

Training

Only correctly trained staff can perform quality work. If the land user or contractor is unaware of what training is required, they should consult the local Department of Labour office. It is the employer's duty to give training to workers who use dangerous machinery and materials, and to make sure they know the safety precautions.

Team skills

Chainsaw operators should have valid certificates and members of the team who apply the herbicide should be certified.

Work methods and equipment

Equipment must be suitable for the work and in good working order. All work methods set out in the project specifications should be followed. Dangerous machinery must carry warnings and notices. Workers should be prevented from using dangerous machinery and materials unless all safety rules have been followed.

Compensation for Occupational Injuries and Diseases (COID)

The contractor must have a valid certificate of good standing from the Compensation Commissioner. An indemnity form must be signed stating that the contractor accepts full liability for any COID-related matters and that the land user will not be held liable should the contractor not comply with the minimum health and safety standards.

Accident and incident register

Any incident must be reported to the land user. A register of near misses, incidents and accidents must be kept. If an accident occurs, evidence must not be moved until a Department of Labour inspector has given permission, unless someone has been badly injured and needs treatment.

Insurance

The contractor must be insured for vehicles and equipment, and must provide proof of third-party and liability insurance.

It is important to:

- Ensure that all Covid-19 safety protocols are adhered to.
- Sign an agreement whereby the contractor accepts liability for damages in case of negligence.

HOW CAN A LAND USER ENSURE SAFETY IN THE FIELD?

Safety is all important in the field. There are two areas of safety that the land user must be aware of: staff safety and environmental safety.

Staff safety is only possible if the team has the correct mental attitude and have had appropriate training. Only then is personal protective equipment (see [Personal protective equipment – What does it include?](#), page 50) and first aid effective. Supervision by someone who knows the work will help to ensure the safety of workers.

Environmental safety is achieved through correct choice of IAP control methods and herbicides, proper field storage and waste disposal (in a waste bin or a refuse bag on site for the collection of waste material and to prevent littering), and good team training. It is important to keep the workplace open so that workers can escape from danger if necessary, and to have adequate field-safety measures in place.

Toolbox talks

A “toolbox talk” is a safety meeting that focuses on safety topics related to the specific job. Meetings are short and conducted at the job site before a job or work shift begins. They are an effective way to refresh workers’ knowledge, cover last-minute safety checks, and exchange information with workers. Toolbox talks help to open up discussions about safety at the job site and to promote a culture of safety.

First aid

The regulations state that an employer should take reasonable steps to make sure that someone who is injured at work gets prompt first-aid treatment. If there are more than 10 employees at a workplace, the employer needs to appoint a first aider. This is a compulsory legal appointment, and the first aider should be readily available during normal working hours. The first aider should have a valid first-

aid certificate, issued by a person or organisation approved by the chief inspector. Where pesticides, hazardous chemical substances or hazardous activities are involved, the first-aid worker should also be trained to treat the types of injuries that may result. A fully stocked first-aid kit must be available on site.

Camps

Camps and equipment should not be placed in environmentally sensitive areas, but in a shady spot that has been demarcated before activities commence on site. All rubbish should be collected and disposed of off site. Waste bins should have lids that shut firmly. No waste should be burnt.

Storage of herbicides and fuel

Fuel and herbicides must be left in a shady area, away from the resting/eating area. The area must be clearly marked with danger tape, which must be removed on completion of the job. Herbicide mixing must be conducted on a spill blanket. A spade must be on site to deal with any accidental spillage. Keep spill kits at hand when working with hydrocarbons. Do not decant or mix herbicide near water bodies and do not rinse herbicide equipment in water courses.

Herbicide equipment can be cleaned back at the herbicide store (shed) where there is running water. It should not be cleaned in the field, especially not near water courses. Collect the water still containing herbicide and apply it to dense stands of IAPs, which can be resprayed with the correct concentration later.

No oil, petrol or diesel should be allowed to spill onto the ground or into a stream or river. Drip trays should be used when refuelling, parking overnight or carrying out repairs to machinery. When refuelling on site (e.g. using 200 litre drums), the proper dispensing equipment must be used and the drum should not be tipped in order to dispense fuel.

Transport

The National Road Traffic Act 93 of 1996 is very clear on what is required for safe transport. It is the employer’s responsibility to see that all transport meets these requirements. Some of the basic requirements include the following:

- Vehicles must be roadworthy
- Drivers must be in possession of a valid professional driving permit (PrDP)
- Passengers must be seated and have safety belts
- No hazardous substances should be carried in the same compartments as passengers or food and water
- Tools must be transported in a trailer, separately from the workers.

Preventing fires

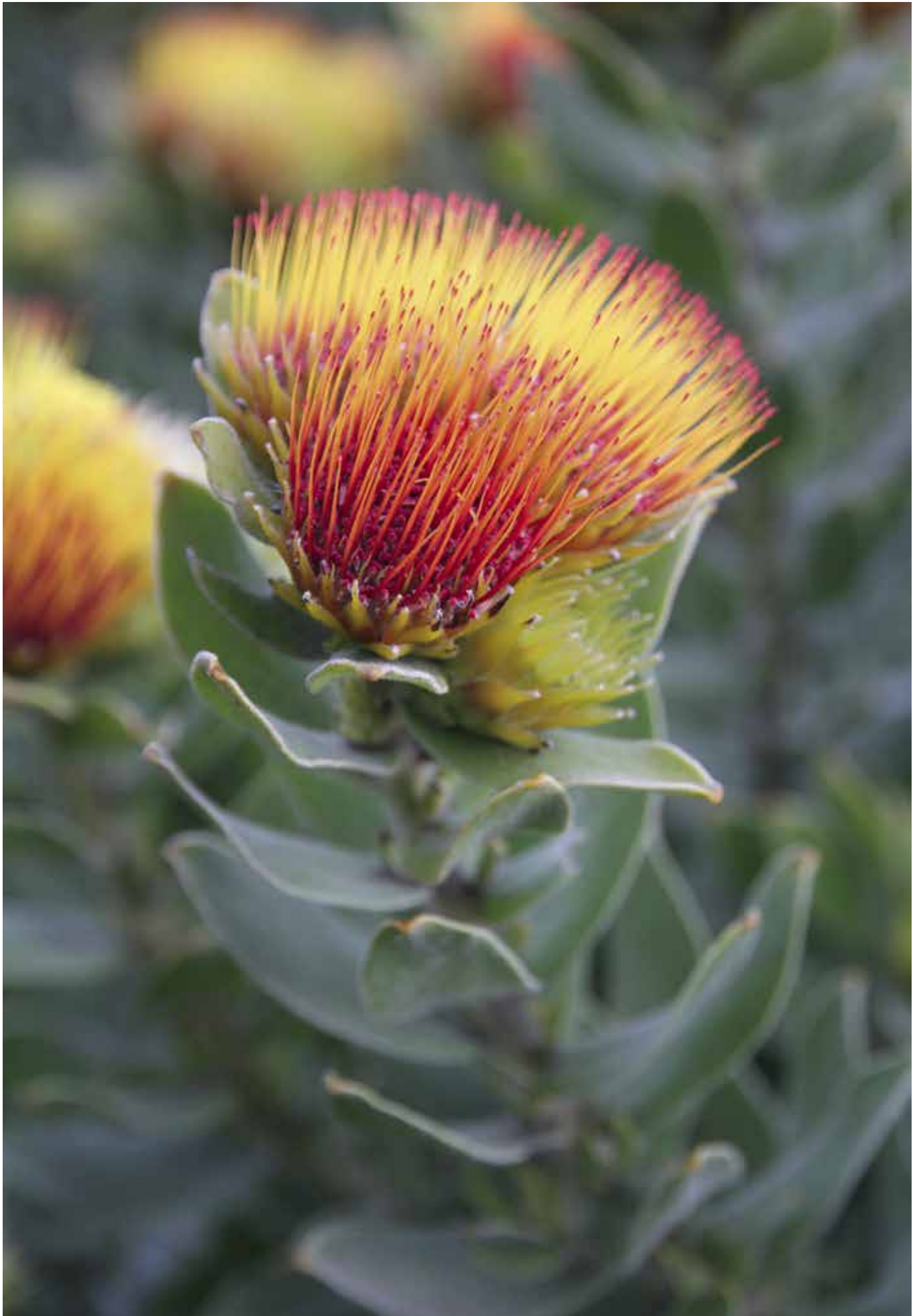
No smoking should be allowed while working. Assign a designated smoking area, remove cigarette butts, and prohibit smoking during windy conditions. No chainsaw work should be done during Code Orange and Red days (Fire Danger Indices are obtainable from the Fire Protection Association). Keep one fire beater for every team member within reach of the workers. A serviced and functional fire extinguisher must be kept at the fuel refilling area (see [How to prepare for and manage wildfires](#), page 25).

PERSONAL PROTECTIVE EQUIPMENT – WHAT DOES IT INCLUDE?

Personal protective equipment (PPE) or personal protective clothing, such as chemical resistant plastic aprons, gloves and eye protection, is worn to protect workers from injury or harm when conducting IAP control. PPE should be of the correct standard (approved by the South African Bureau of Standards) for the task.

Table 5: Examples of personal protective equipment worn during IAP clearing operations

Item	Supervisor	Machine operator	General workers	Herbicide applicator
Conti suit (overall)	✓	✓	✓	✓
Gloves	✓	✓	✓	✓
Gumboots (when working in wet areas)	✓	✓	✓	✓
Rain suit (during rainy conditions)	✓	✓	✓	✓
Safety boots	✓	✓	✓	✓
Safety goggles	✓	✓	✓	✓
Sunhat	✓	✓	✓	✓
T-shirt	✓	✓	✓	✓
Hard hat	✓		✓	✓
Whistle	✓	✓		
Chainsaw operators' gloves		✓		
Chainsaw safety boots		✓		
Chainsaw safety pants (11 layers) with broad belt or braces		✓		
Safety helmet (EU standard)		✓		
Shin-guards for brush cutters		✓		
Cape (when using a knapsack)				✓
Mask (when applying herbicides)				✓
Rubber apron (for mixing herbicides)				✓
Rubber gloves (for mixing herbicides)				✓



Indigenous Overberg pincushion (*Leucospermum oleifolium*) in Kirstenbosch National Botanical Garden.

© Helen Stuart / WWF



HERBICIDE SAFETY

Herbicides are chemicals used to kill unwanted plants. Herbicides can be very effective for controlling some types of IAPs. However, they can be hazardous or toxic, and cause harm to people, animals, other plants and the environment.

In this section, information is given on herbicide labels and the safe storage, mixing and disposal of herbicides. Following these precautions will help to reduce the risks associated with these chemicals.

A blue dye mixed with herbicide (which is often colourless) clearly identifies stumps that had been treated.

© Rodney February / WWF

WHAT IS ON THE HERBICIDE LABEL?

The herbicide label will give details about how the herbicide should be prepared and applied. The Material Safety Data Sheet (MSDS) gives information on the hazardous ingredients, health risks, fire risk, emergency procedures, and more. MSDSs can be found on the Internet or from the dealer.

Concentration

The concentration gives the amount of herbicide that should be diluted in water for use in foliar spray. It is expressed as a percentage (%) or as a volume per volume (v/v). For example: 0,75% in 100 litres of water means you need 75 ml in 10 l of water, or 7,5 ml in 1 l.

Dosage

Dosage tells you the volume of herbicide that needs to be used per area for blanket spraying, e.g. 1,5 l per hectare.

Rate of application

The rate of application gives the volume of mixture that needs to be used per area for blanket spraying, e.g. 1,5 l of product to be applied in 400 l of water per hectare.



For more information, see Appendix 12: [Example of a herbicide mixing rate table](#) (page 67).



An in-field herbicide mixing station with the correct safety precautions in place.

© Carlo de Kock / SANParks

HOW TO STORE HERBICIDES

Herbicides should be stored correctly to prevent leakage and contamination.

Isolation

The herbicide store (shed) should be a separate building, more than 5 m from the dwelling house, livestock buildings or where fodder, fuel or flammable materials are stored. The store must be totally sealed off, with no free movement of air between the storage area and other areas. The location of the store must minimise possible pollution risk from spilt chemicals. It should be situated away from water sources, rivers, dams, boreholes and areas likely to be flooded. It should be in a location that can be supervised.

Accessibility

The store should have easy access for delivery and dispatch. In an emergency, it should be possible to approach the building from all sides.

Floor

Smooth, screeded concrete is the ideal flooring. Sealed steel-container floors are also acceptable. Earth, timber, bitumen, PVC, linoleum and coarse unscreeded or disintegrating concrete is not acceptable. The floor surrounding the doorway should be bunded (a ridge to contain spillage) to a height of 200 mm. The bunded area should be able to store 110% of the liquids kept in the store. All floor joints and doorways should be watertight.

Walls

Walls should be made of bricks or concrete blocks with vents 200 mm from the floor and near roof level. Repurposed shipping containers are acceptable if there is adequate ventilation. The container should be placed in a shaded area.

Roof

The roof should be leak-free and insulated to keep temperatures at a reasonable level. A vent in the roof will allow hot air to escape during the summer months. If possible, an extractor fan should be installed.

Doors

Steel doors with an effective locking system are preferred. Wooden doors should have security gates to reduce the risk of forced entry. Containers with fitted security gates can be left open to cool the contents during the heat of the day. Only authorised personnel should have access to keys and be allowed in the store.

Windows

Windows should allow enough light into the store to be able to read product labels. All windows should be weather proof, burglar barred and preferably at head height for security reasons.

Lighting

There should be sufficient lighting to allow for the reading of product labels. If electric lighting is required, it must be secure to reduce the risk of fire. The mains control should be outside the store itself.

Sanitation

Staff should have immediate access to washing facilities with running water, soap and towels. They should be encouraged to use these facilities frequently. An eyewash bottle or similar must always be available for the flushing of contamination from the eyes, should it occur. A shower facility is also recommended.

Equipment

The room should be equipped with a suitable table for the reading of labels and decanting and measuring of herbicides. Measuring jugs, funnels, pumps and buckets must be kept on hand. These items must be kept specifically for use with herbicides – do not use household items. Have on hand a broom, spade and a supply of dry, fine soil or spill-absorbing material (not sawdust) that is fire resistant to contain and absorb spills.

Fire extinguisher

A fire extinguisher should be mounted on the outside of the storage facility.

Emergency numbers

The store should have well-displayed emergency contact numbers, e.g. ambulance, medical doctor, Poisons Information Helpline, fire brigade, etc.

Labels

All containers should be labelled accordingly. The Material Safety Data Sheets should be placed on the wall behind the product.



For more information, see Appendix 13: [AVCASA's Storing agrochemicals and stock remedies](#) (page 67).

HOW TO MIX HERBICIDES

Many herbicides require mixing with water to dilute them, or with other additives to improve their effectiveness. Products should be mixed according to instructions on the label.

Water

Only clean water should be used for spray mixtures. The product label should be consulted regarding the quality of water suitable for a particular herbicide. Where particulate matter occurs in water (e.g. water from rivers), the water must be filtered to avoid nozzle blockages. When large volumes of water are transported over rough or uneven terrain, which causes the water to move from side to side, tanks should be fitted with tank baffles because the vehicle can be easily overturned by the pure weight of the water.

Adjuvants

There are several types of surfactants⁴ that may need to be added to spray mixtures to increase the efficacy of the herbicide. Each product label will specify which adjuvant/surfactant is recommended with the product to optimise its performance. Contact the manufacturer or distributor for advice on the use of these agents. The contact numbers will be printed on the product label.

- Wetting and spreading agents should be mixed in accordance with label recommendations.
- Dye must be added where the product has no built-in dye. Dye helps to show where target species may have been missed or herbicide spilled.
- In areas where water is alkaline, a buffering agent may be necessary. Buffers should be added to water before the herbicide.
- In sensitive areas where drift must be controlled, the use of drift-control agents may be necessary.

Containers

All containers into which herbicides are decanted must be clearly marked with the contents and the dilution. A copy of the original label must be secured to the container. Mixtures should never be decanted into drinking bottles or food containers, as this is a serious safety risk. Suitable equipment must be available to prepare spray mixtures. These include plastic measuring cylinders and beakers, mixing containers (buckets) and funnels.

See [What is on the herbicide label?](#) (page 53) for more information.

Safety

The person responsible for mixing must take extra precaution since they are working with an undiluted product that can burn or irritate the skin and eyes.

- Wear suitable protective clothing when handling concentrates (see [Personal protective equipment – What does it include?](#) page 50).
- Mix the herbicide according to the label instructions, on a spill blanket.
- Add liquid concentrates to a half-full tank, and then top up the tank.
- Do not mix concentrates together before adding them to the tank.
- Follow the label instruction about when to add adjuvants – before or after mixing the herbicide.
- When a buffer is needed to stabilise the water at the desired pH, first add the buffer, measure the pH of the water to ensure that the correct pH has been reached, and only then add the herbicide to the spray water.
- Proper mixing in knapsacks and hand-held applicators is difficult; mix spray mixtures in bulk containers before pouring into the knapsacks or applicators.
- Agitate spray mixtures continuously, especially after they have been standing for a while.
- Do not wash or rinse spray equipment or containers in or near natural water systems, but take them back to the herbicide store (shed) where wash water can be safely stored in drums for future use as mixing water, without the risk of contaminating the natural environment.

⁴ Surfactants lower the surface tension between substances and may act as wetting agents, emulsifiers, foaming agents or dispersants.

PRECAUTIONARY MEASURES WHEN HANDLING HERBICIDES

The handling of herbicides requires strict precautions to protect people, animals, non-target plants and the environment.

Clothing

Suitable protective clothing should be worn. These include chemical resistant plastic aprons, gloves and eye protection (see [Personal protective equipment – What does it include?](#) page 50).

In the field

Special care must be taken when handling herbicides in the field.

- Herbicides should only be kept on site in appropriate, clearly demarcated storage areas (see [How can a land user ensure safety in the field?](#) page 49).
- Care must be taken to prevent damage to desirable vegetation.
- Application equipment and containers should not be cleaned on site.
- Spray mixtures and equipment must not be left unattended where there is a danger of theft or misuse.
- Products should not be left uncovered in the sun.
- Plans must be in place to prevent spillage, and clean up and dispose of any spilled material.

Spillage

In the case of accidental spillage, the spill must be contained immediately. Suitable absorbent material, such as fine, dry soil, must be available to clean up spillage. Contaminated material should then be disposed of at an approved hazardous waste site. Adequate hygiene aids such as plentiful clean water, soap, towels and eyewash must be readily available.

Transporting

Herbicides and application equipment must be transported separately from people, food and clothing. Herbicides and equipment must be secured to prevent spillage and damage. Vehicles should carry absorbent material to absorb any spillage (see [How can a land user ensure safety in the field?](#) page 49).

Since herbicides are hazardous to people and the environment, precautions must be taken to limit risks.

Public safety

Bystanders in the vicinity of herbicide storage and application areas must be well informed and protected from harm.

- The public should be kept out of operational areas where hazards exist.
- The public should be informed of control operations in their area by means of verbal communication, notices, pamphlets, the press, etc.
- Warning notices should be displayed where necessary.
- Product and spray mixtures should be stored so that they are inaccessible to the public.
- Treatment of areas within 50 m of homes and public areas (e.g. parks) should be avoided or only carried out in consultation with the parties affected.

Environmental safety

Steps must be taken to minimise the impact of herbicide use in IAP clearing operations on the natural environment.

- Area contamination must be minimised by careful, accurate application with the lowest amount of herbicide to achieve control of IAPs.
- To avoid damage to indigenous or other desirable vegetation (like crops), herbicides should be selected that will have the least effect on non-target vegetation.
- Coarse-droplet nozzles should be fitted to avoid drift onto neighbouring vegetation and crops.
- All care must be taken to prevent contamination of water bodies. This includes due care in storage, application, cleaning of equipment and disposal of containers, products and spray mixtures (see [Safely disposing of empty containers and leftover spray mixtures](#), page 57).



For more information, see Appendix 14: [CropLife International's Responsible Use Manual](#) (page 67).

SAFELY DISPOSING OF EMPTY CONTAINERS AND LEFTOVER SPRAY MIXTURES

In addition to taking care that the cleaning of equipment does not contaminate the environment, used containers and leftover spray mixtures should be disposed of with great care.

Used containers

Used herbicide containers must not be used for any other purpose and must be destroyed after use.

- A designated person should be responsible for safely disposing of used containers.
- Under no circumstances should containers be taken home for personal use.
- Empty herbicide containers will not be accepted back by the supplier. It is the purchaser of the product's responsibility to deal with empty herbicide containers according to the CropLife regulations.
- All empty containers must be returned to the herbicide store (shed) from where they were issued. The designated storeman will then triple rinse the containers, puncture and flatten them and send them away for recycling or destruction by an authorised organisation.

Leftover spray mixture

Only sufficient herbicide spray mixture that can be used in a day should be prepared. However, if it starts to rain and spraying cannot continue, leftover spray mixtures must be handled appropriately.

- Leftover mixed herbicide should be returned to the herbicide store (shed) for safe storage and reuse, if appropriate. Containers must be clearly labelled with the herbicide name and dilution.
- The spray mixture (or washings) can be kept in drums and used for 'spray water' when the same herbicide is required for the same species. In this case, the herbicide needs to be added to the spray mix again to compensate for chemical breakdown.
- Certain spray mixtures should not be left standing overnight and should be safely disposed of. Consult the product label.



Refilling herbicide spray bottles at a herbicide camp.

© Carlo de Kock / SANParks



For more information, see Appendix 15: [CropLife's Resources on Container Management](#) (page 67).



LONG-TERM REHABILITATION

Clearing IAPs is an important part of rehabilitating infested land, and often a first step in any rehabilitation project. Rehabilitation work needs to be carried out by people with adequate skills to avoid damage to the remaining natural ecosystems.

Here, you will find an overview of the reasons for rehabilitating cleared land, the types of rehabilitation and the phases in a rehabilitation project. Useful resources with more detailed information on rehabilitation are suggested.



Regrowth of indigenous vegetation at an active restoration site in the Kouga catchment in the Eastern Cape.

© Saskia Fourie / WWF

WHY REHABILITATE?

The need to tackle the threat of IAPs has been recognised for many years. But it is only more recently that we have started to realise what an important role rehabilitation can and should play in the process.

The removal of IAPs is the first step in addressing their negative impacts, but in some situations the natural area, such as rivers, have degraded to such a degree that they are not able to self-restore and their ability to deliver basic functions, e.g. flow and filtration, has been compromised. In these cases, additional interventions in the form of active restoration, such as seeding or planting, are required to return the area’s natural functions and prevent further degradation. The establishment of an indigenous vegetation cover also suppresses alien regrowth and is a prerequisite for the long-term control of IAPs.

Intact, functioning natural ecosystems, which are called our “natural infrastructure”, provide society with a number of goods and services (Figure 3).

Figure 3: Ecosystem services

	CLEAN AIR	Ecosystems produce oxygen and also purify and detoxify the air
	CLEAN WATER	Ecosystems provide us with clean water and store and cycle fresh water
	CLIMATE	Ecosystems regulate the climate and provide resilience against the impacts of climate change
	HEALTHY SOIL	Ecosystems form topsoil and prevent erosion and flood damage
	RAW MATERIALS	Ecosystems produce raw materials, foods and medicines

Rehabilitating the cleared land will ensure that natural infrastructure can keep producing the benefits that people derive from nature. By planting back lost or endangered species, we can prevent extinction, maintain biodiversity, reverse the loss of species and help restore the way the natural environment functions.

WHAT ARE THE BASIC PRINCIPLES OF REHABILITATION?

Although one should always strive to avoid degradation in the first place, this is not always possible and rehabilitation might be necessary. Rehabilitation can differ from area to area, depending on the situation. However, all rehabilitation projects follow the same four basic principles.

4 BASIC PRINCIPLES OF REHABILITATION

1 Halt degradation

Identify what is causing degradation to the natural ecosystem and take measures to stop it. IAPs can be very damaging to natural ecosystems, so managing IAPs can help to prevent further destruction. Be careful not to inadvertently increase degradation through rehabilitation actions, either on or off site.

2 Address missing ecosystem processes

Ecosystem processes are processes that link organisms to their environment. These processes include things like nutrient cycles and food webs. Often, degraded systems are missing key ecosystem processes. Identifying and addressing these missing processes can help with rehabilitation. Local conservation offices or rehabilitation specialists could be consulted in this regard.

3 Conserve what remains

It is important to prevent the loss of remaining natural ecosystems, including seedbanks and soils. In this way, rehabilitation costs may be kept to a minimum.

4 Prioritise

Resources are usually limited, so it is important to carefully prioritise which areas should be rehabilitated. Studies in Brazil have shown that a well-prioritised approach is five times more effective than an unplanned approach. After clearing IAPs, areas most prone to further degradation should be prioritised for rehabilitation.



Cleared material at a restoration site that has been stacked along the contours to prevent erosion.

© Saskia Fourie / WWF

WHAT METHODS CAN BE USED FOR REHABILITATION?

The type of rehabilitation will depend on the setting and the IAP management methods that were used. The extent, density, age and species of IAPs cleared will affect what type of rehabilitation – passive, active or manipulated succession – should be implemented.

Passive rehabilitation

After IAPs have been cleared or activities damaging the ecosystem stopped, the area is left to recover naturally. The causes of degradation are removed from the system and the system can repair itself over time. If the IAP infestation was minimal or if plenty of indigenous vegetation still exists around the IAP infestation and was not damaged during the clearing process, then one may rely on passive rehabilitation taking place. This will provide adequate ground cover to suppress the regrowth of IAPs and prevent erosion.

Active rehabilitation

When IAP clearing has resulted in large exposed areas, active rehabilitation activities may be required. These may include activities that stabilise the soil, the planting of seedlings or the sowing of seeds to reintroduce natural species. Obtain indigenous seed and seedlings from as nearby as possible to ensure correctly adapted plant populations. If IAP management is implemented properly, it can reduce the need for any active rehabilitation, thus reducing the long-term costs involved.

Manipulated succession

Complete clearing of an area can cause the growth of secondary IAPs (weedy species). Many IAPs fall into this category and will take advantage of newly cleared ground. To prevent this, IAPs can be thinned in stages to support the gradual regrowth of natural vegetation (Figure 4).

It is useful to plan IAP clearing and rehabilitation at the same time. There may be different rehabilitation methodologies for riparian or terrestrial areas. It should be noted that full restoration cannot always be achieved. This is often due to the severity of the degradation, or a lack of resources.

For more information, see:

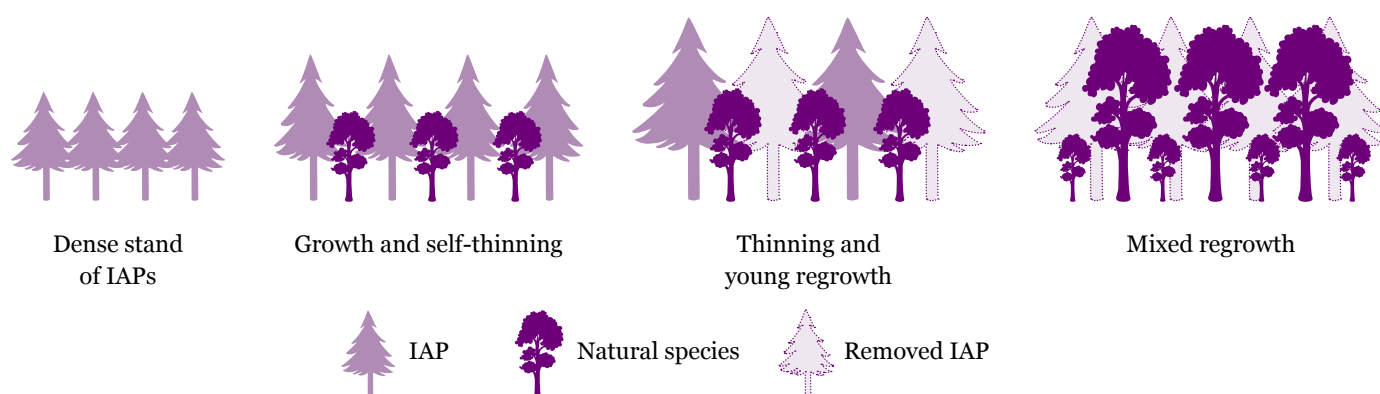


Appendix 16: [WWF: A practical guide for community-run nurseries](#) (page 67).

Appendix 17: [WWF: Restoration of alien-invaded riparian systems](#) (page 67).

Appendix 18: [Alien weeds and invasive plants](#) (page 67).

Figure 4: Removing selected IAPs over time can support natural forest succession for rehabilitation⁵



⁵ Geldenhuys, C.J. 2011. Most invasive plants facilitate natural forest recovery – how is that possible? *SAPIA News* 18: 2–5.

WHAT ARE THE PHASES OF A REHABILITATION PROJECT?

Rehabilitation projects invariably follow four distinct phases – a site assessment (getting an understanding of the site); planning (drawing up a detailed and cost-effective plan for the necessary interventions); executing the planned interventions; and monitoring the work (surveillance of the site and indicators of recovery, and identifying further interventions, as appropriate).

4 PHASES OF A REHABILITATION PROJECT

1 Site assessment

Before rehabilitation is even planned, a good background understanding of the site is needed. One should record the history of the site, look at its existing condition, and find out what has caused the degradation. They should collect baseline information over a period of time. Physical conditions such as slope, water quality, local climate and soils should be noted. A nearby natural ecosystem should be identified to understand what comprises the natural system, thus determining what rehabilitation efforts may be required. Information on plants and animals that make up the natural ecosystem should be gathered, including information about the reproduction and life cycles of key species. It may be necessary for a land user to consult experts on the above if they require additional assistance.

2 Planning

A rehabilitation management plan should be drawn up, building on the background information collected during the site assessment. Planning is essential to decide how feasible it is to carry out rehabilitation. The plan should clearly state the goal of the rehabilitation project. It should specify what rehabilitation activities will need to be undertaken over the course of the project. If necessary, trials should be carried out to test the rehabilitation methods. The plan should also identify the physical, human and financial resources that will be needed. It is also mandatory to get all the necessary approvals or permits, and to liaise with relevant organisations or government departments.

3 Implementation

Once planning is completed, staff can be hired to supervise and carry out the rehabilitation. Rehabilitation methods will vary depending on the situation. They will probably include the reintroduction of plants or animals, e.g. through collecting flower heads and mulch from surrounding areas to spread over the site. Beware of commercially available seed as it may contain other undesirable seed (especially alien species), which may compete with Fynbos seedlings or threaten the genetics of local plants. Other rehabilitation activities may include putting in place landscape restrictions, such as stopping land uses that reduce water quality.

4 Monitoring

Once active rehabilitation is complete, there are several follow-up tasks that should be done. These include protecting the site from vandals, pests or livestock, and performing ongoing maintenance, such as erosion repair and continued IAP control. Records should be kept of all rehabilitation sites. These records should include IAP management methods, dates, the results of IAP clearing and rehabilitation actions. Regular site inspections should be undertaken to address any threats to the recovering area.



For more information, see the resources listed under [Rehabilitation and restoration](#) (page 67).



Indigenous daisy (*S. elegans*) in Kirstenbosch National Botanical Garden.

© Helen Stuart / WWF



FUNDING OPPORTUNITIES

Managing IAPs can be costly, but failing to manage IAPs before they get out of control can be even more costly. Land users do not need to wait until they have enough funds before starting with IAP management activities. There are many resources available to help them with their IAP management efforts.

This section contains information about government and other funding opportunities for IAP management. Options include accessing government programmes, working cost effectively with neighbours, and finding resourceful ways to recoup funds from IAPs.

An indigenous pincushion protea (*Leucospermum spp.*).

© Tessa Oliver

AVAILABLE RESOURCES FOR IAP MANAGEMENT

To make the most of funding opportunities, it is vital that land users show that they are taking responsibility for the IAP problem that exists on their land. Funders often want to see what efforts the land user is already making towards IAP control.

Even if only limited funds are available, the management of IAPs still needs to be well planned (see [Planning IAP management operations](#), page 18), with careful consideration of how activities can be sustained with the resources available.

The best way of finding potential co-funders is to think about where the property is situated in the landscape. Understanding who stands to gain from IAP clearing will help to determine who might be willing to provide funds. Is the area important for conservation, water production, or of high agricultural value? Linking up with other initiatives in the landscape can help to access funds from a variety of sources.

Neighbourhood initiatives and conservation stewardships

Often, extra resources can be found when IAP management is combined across neighbouring properties. It is best for land users to work together and develop a landscape or catchment approach to IAP management. This can be achieved by working through a Farmers' Association, Fire Protection Association or Water User Association, or by creating a new initiative like a conservancy, or by signing up with a conservation stewardship (see capenature.co.za/care-for-nature/stewardship). Conducting IAP management in this way is more cost effective because resources such as herbicide can be shared. A collaborative approach is also more likely to attract funding from outside sources.

LandCare Programme

Provincial departments of Agriculture sometimes fund IAP management through their LandCare Programme. If LandCare is active in an area, they may be willing to assist private land users by co-funding IAP clearing. However, in most instances they prefer to tackle large projects with many land users in priority areas.

Natural Resource Management (NRM) Programme

The Department of Environment, Forestry and Fisheries is another potential source of resources through its NRM provincial offices. Through the NRM Programme, a land user

can get access to herbicide and IAP eradication assistance. Assistance will depend on various factors, including budget, the IAP management strategy in the catchment, and existing IAP control efforts. The land user and provincial office will negotiate contributions (financial and non-financial), and the land user will have to display a willingness to do their part. Due to the necessary checks and balances for disbursement of government funds, applying for and managing these resources may require a lot of administration.

Beneficiation

Additional funds can be gained by making use of the IAP biomass that is cut down (see [What other factors should one consider for IAP management?](#) page 28 and [How can one responsibly manage plant material?](#) page 45). The land user can get financial benefit if wood is processed into saleable products like charcoal, activated carbon, pellets, pallets, poles and many other wood products. The investment in these production processes can help to offset the costs of IAP management. However, this approach should always follow best practice for IAP management, as clearing only some IAPs may have no environmental benefit and could make the IAP problem worse.

Several green economy initiatives are emerging across the landscape, so it is wise to approach the government programmes mentioned above, local non-government organisations or local businesses to get involved.

FOR MORE INFORMATION

Supporting documentation and additional information have been compiled into a set of appendices, which are available at www.wwf.org.za/invasive_plants_appendices. All the documents are in PDF format, but the templates can be converted to MS Word using free PDF to MS Word conversion programs available on the internet.

LEGAL REQUIREMENTS

APPENDIX 1: LEGISLATION GUIDELINE FOR INVASIVE ALIEN SPECIES

A detailed guideline on the legislation relevant to landowners with invasive alien species on their land.

PLANNING IAP MANAGEMENT OPERATIONS

APPENDIX 2: GUIDELINES FOR THE PREPARATION OF AN IAP CONTROL PLAN

Guidelines for drawing up an IAP control plan for a farm, giving basic pointers on drawing up a plan, completing a field verification and determining working days for costing. A field verification worksheet (Appendix 3) and guidelines for clearing times (Appendix 4) are also included.

APPENDIX 3: WORK SHEET FOR FIELD VERIFICATION

A blank worksheet to fill in the species, age and density classes of IAPs and then calculate person days. The work sheet can be converted to MS Word using free PDF to Word conversion programs available on the internet. It is also available from the Department of Environment, Forestry and Fisheries Natural Resource Management (NRM) offices.

APPENDIX 4: GUIDELINES FOR CLEARING TIME (person days/ha NORMS)

The “norms” for person days required for different IAP types, ages and density classes. It is also available from Department of Environment, Forestry and Fisheries Natural Resource Management (NRM) offices.

APPENDIX 5: TEMPLATE FOR A FARM-LEVEL ALIEN CONTROL PLAN

A template to record listed alien species, distribution, objectives and actions, monitoring actions, planning and budget and a clearing schedule. It also provides a herbicide control sheet and useful checklists for landowners. The template can be converted to MS Word using free PDF to Word conversion programs available on the internet.

APPENDIX 6: BASIC MAPPING SKILLS

Some basics of map reading and mapping aids necessary to understand maps.

APPENDIX 7: FIRE PROTECTION ASSOCIATIONS IN THE WESTERN CAPE

Information about Fire Protection Associations are specific to the reader's location and can be found online. An example for the Western Cape is included here.

APPENDIX 8: CAPENATURE'S FACT FILE: A LANDOWNER'S GUIDE TO PLANNING ALIEN CONTROL

This two-page information sheet giving brief information on prioritisation, budget, clearing methods and common invasive alien species, in English and Afrikaans, is also available on CapeNature's website at www.capenature.co.za.

APPENDIX 9: NATIONAL GEOSPATIAL INFORMATION (NGI)

Topographical maps and aerial photos are available from the NGI at www.ngi.gov.za.

APPENDIX 10: CAPENATURE'S FACT SHEET: WHAT A LANDOWNER NEEDS TO KNOW ABOUT FIRE MANAGEMENT

A two-page information sheet on fire management for landowners, including principles of burning (frequency, intensity, season) and dos and don'ts, available in English at <https://www.capenature.co.za/wp-content/uploads/2013/09/Landowners-Guide-to-Fire-Management-Fact-Sheet-English.pdf>, and in Afrikaans at <https://www.capenature.co.za/wp-content/uploads/2013/09/Landowners-Guide-to-Fire-Management-Fact-Sheet-Afrikaans.pdf>.

IAP MANAGEMENT METHODS

APPENDIX 11: CHOICE OF NOZZLES FOR INVADER PLANT CONTROL

An introduction to the types of nozzles available and their uses. This information can be sourced from your herbicide provider.

HERBICIDE SAFETY

APPENDIX 12: EXAMPLE OF A HERBICIDE MIXING RATE TABLE

Most herbicide manufacturers supply a table of quantities for mixing common herbicides online. Additional information can be found on CropLife's website: <https://croplife.co.za>.

APPENDIX 13: AVCASA'S STORING AGROCHEMICALS AND STOCK REMEDIES

Guidance on the proper storage of chemicals to prevent the risk of agrochemicals being used to poison livestock, people and even to destroy crops is available at www.nda.agric.za/docs/peststore/storing.htm.

APPENDIX 14: CROPLIFE INTERNATIONAL'S RESPONSIBLE USE MANUAL

Comprehensive course material on the concepts and principles of the responsible use of pesticides is available at <https://croplife.org/wp-content/uploads/2016/04/Responsible-Use-Manual.pdf>.

APPENDIX 15: CROPLIFE'S RESOURCES ON CONTAINER MANAGEMENT

A set of resources on proper disposal of used herbicide containers is available at <https://croplife.co.za/container-management>.

REHABILITATION AND RESTORATION

APPENDIX 16: WWF: A PRACTICAL GUIDE FOR COMMUNITY-RUN NURSERIES

Wilman, V. 2019. *A Practical Guide for Community-run Nurseries: Growing Indigenous Plants for Restoration*. WWF South Africa, Cape Town, South Africa. This practical guide is available at https://www.wwf.org.za/our_research/publications/?29601/a-practical-guide-for-community-run-nurseries.

APPENDIX 17: WWF: RESTORATION OF ALIEN-INVADDED RIPARIAN SYSTEMS

Fourie, S. and Wilman, V. n.d. *Restoration of Alien Invaded Riparian Systems*. Report ISBN 978-2-940443-06-2, WWF, Cape Town, South Africa.

APPENDIX 18: ALIEN WEEDS AND INVASIVE PLANTS

Henderson, L. 2001. *Alien weeds and invasive plants*. Plant Protection Research Institute Handbook No. 12. Plant Protection Research Institute, Agricultural Research Council, Pretoria, South Africa.

A complete guide to declared weeds and invaders in South Africa, including another 36 species invasive in that region, compiled by the Agricultural Research Council. This guide is available at www.wfw.org.za.

REFERENCES

Conservation of Agricultural Resources Act 43 of 1983

National Environmental Management: Biodiversity Act 10 of 2004

National Forest Act 84 of 1998

National Heritage Resources Act 25 of 1999

National Road Traffic Act 93 of 1996

National Veld and Forest Fire Act 101 of 1998

National Water Act 36 of 1998

Occupational Health and Safety Act 85 of 1993

CLEARING INVASIVE ALIEN PLANTS IS THE FIRST STEP TOWARDS RESTORING THE NATURAL ECOSYSTEMS THAT SUPPORT ALL LIFE ON EARTH



To champion the earth's capacity to provide a source of inspiration, sustainable food, water and clean energy for all.

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