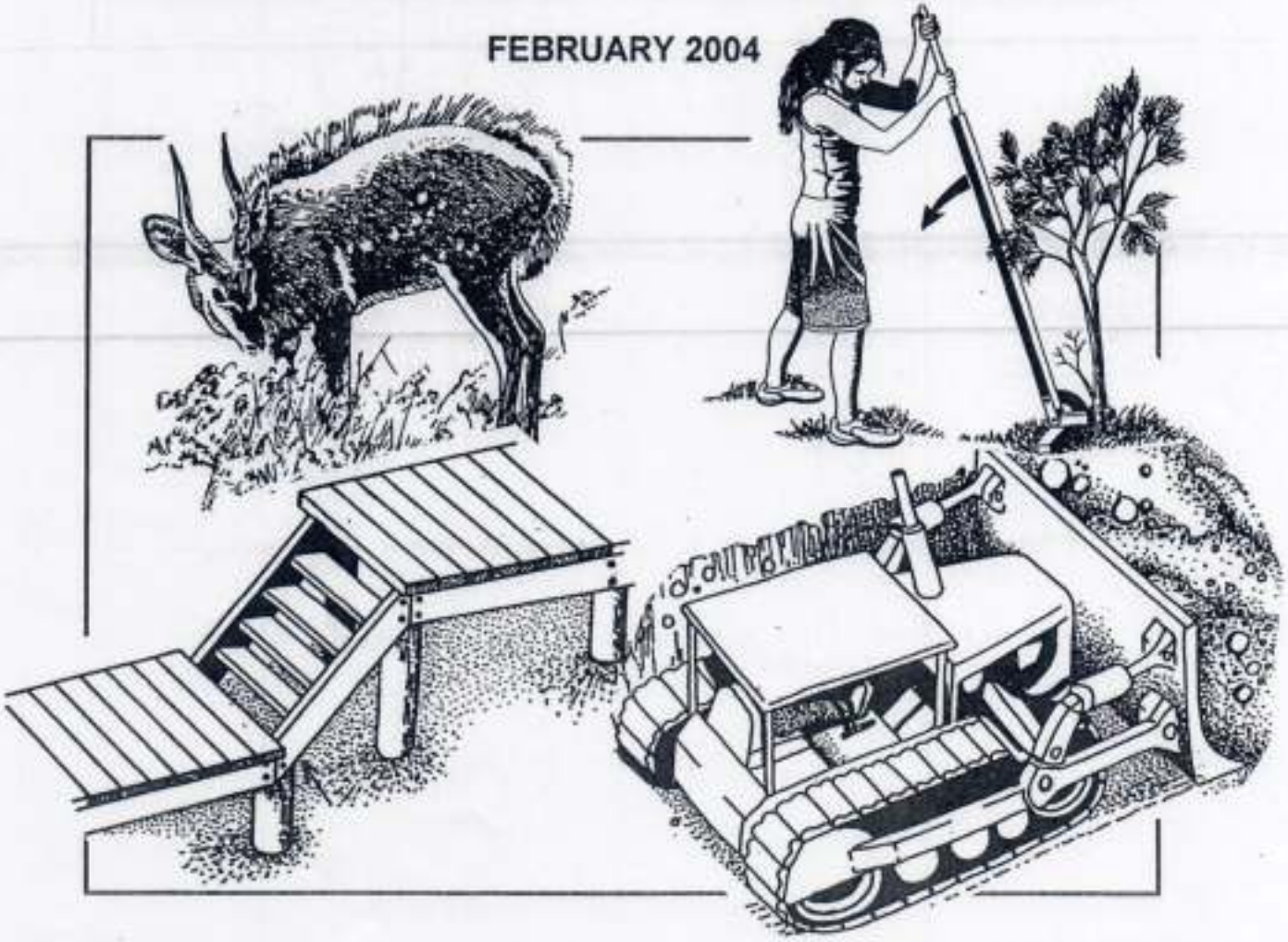
VYFBRAKKEFONTEIN

RESIDENTIAL DEVELOPMENT

ENVIRONMENTAL MANAGEMENT PLANS:
- CONSTRUCTION PHASE
- OPERATIONAL PHASE

PREPARED FOR Messrs F JOHNSTON & M FERREIRA

FEBRUARY 2004



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1. INTRODUCTION AND OBJECTIVES

1.1 INTRODUCTION

Ken Coetzee of *Conservation Management Services* was contracted by clients, Mr F Johnston and Mr M Ferreira to draw up Environmental Management Plans (EMP) for both the construction and operational phases of the Vyfbrakkefontein residential development project. The EMPs are based on Record Of Decision (ROD) furnished by the Department of Environmental Affairs and Development Planning (DEA & DP). The ROD specified that the mitigatory measures that were proposed in the Environmental Sensitivity Analysis Report (Ken Coetzee, June 2003) must be implemented as conditions of the approval of the application to develop. Consequently, the construction phase EMP is based on these mitigatory measures and the other specified issues indicated in the ROD.

1.2 THE OBJECTIVES OF THE CONSTRUCTION AND OPERATIONAL PHASE EMP'S ARE AS FOLLOWS:

- Provide guidelines for the management and mitigation of the environmental impact that occurs, or can occur, as a result of the development.
- Outline the appointment and function of an Environmental Control Officer (ECO) that must ensure that all development is in compliance with the EMP.
- Minimise or avoid significant environmental impacts by instituting a pro-active approach to environmental control and construction impact management.
- Provide a basis or format which can be used as a guide to environmental auditing.
- Provide guidelines for post-construction phase environmental management.

2. COMPETENCE, APPOINTMENT AND FUNCTIONS OF THE ENVIRONMENTAL CONTROL OFFICER (ECO)

A competent and independent Environmental Control Officer (ECO), or Environmental Consultant, must be appointed by the developer to ensure the effective environmental control of the development. The ECO must ensure that the environmental management guidelines provided in this environmental management plan are adequately implemented, as is required in the ROD document of 30/01/2004 in Sections 6 & 7.

2.1 COMPETENCE

The person appointed must be suitably qualified in a relevant environmental discipline, must have sufficient experience as a Project ECO and must be committed to the degree of hands-on involvement that will be required for effective control. This implies that the ECO should preferably be resident in the South Cape (Mossel Bay/George) area, so that he will be able to act quickly when required to do so. Local knowledge is also be a highly recommended qualification.

2.2 APPOINTMENT

The ECO must be appointed before construction commences on site and must be fully aware of what is required of him and what approved references must be used to guide his function. The developer will be responsible for the appointment and remuneration of the ECO. The Department of Environment Affairs and Development Planning (DEA & DP) must approve the appointment of the ECO before commencement with his/her duties. It is thus the responsibility of the developer to furnish details of the nominated ECO to DEA& DP for approval.

2.3 FUNCTIONS

The functions of the ECO will be as follows:

- Ensure the implementation of every part of this construction phase EMP.
- Ensure compliance with all of the mitigatory measures referred to in the conditions of authorization contained in the ROD document.
- Inspect the construction site at least once a week, with particular reference to the guidelines contained in this EMP.
- Establish liaison with the site contractors and engineers in respect of the EMP requirements.
- Stop any construction or contractor or related activity that is in opposition to or in contradiction to the EMP or the conditions of authorization. The suspension will be enforced until the offence is corrected to the satisfaction of the ECO.
- Request site meetings with the developer, resident engineer, environmental consultant and contractors as required in terms of the EMP whenever it is considered necessary.
- Report at key phases or when required, in writing, to the DEA & DP, with copies to the developer and the environmental consultant.
- Smooth the way for environmentally compatible construction practice, thereby avoiding the unpleasant necessity of written warnings and fines. The ECO must thus ensure that all relevant persons are fully aware of what is required in terms of the EMP, ie: ensure environmental awareness. (See Figure 1).
- With the approval of the developer, furnish contractors with verbal warnings in case of any contraventions of the EMP or conditions of authorization.
- Furnish errant contractors with pre-determined written fines, approved by the developer, when verbal and written warnings are ignored. DEA&DP may request the implementation of fines. A rate of between R500-00 and R800-00 per contravention is recommended.

- Assist with finding environmentally acceptable solutions to construction problems.

- Recommend additional environmental protection measures whenever required.

- The ECO should introduce and interpret environmentally sensitive development practice to both the contractors and the workers. (See Figure 1). Aspects that should be covered are the norms and regulations that are designed to mitigate impact and examples are as follows:

    - Strict use of toilets and thus no bush visits.
    - Why demarcation of the construction area is necessary and how they are affected by it.
    - What the pollution threat is and how to avoid it.
    - Explain regulation in terms of wood collection, making of fires, damaging trees, disturbing animals and littering.
    - Explain regulations about road use, path use and no-go areas.
    - Explain the context of the development area as part of a much bigger nature conservation area.

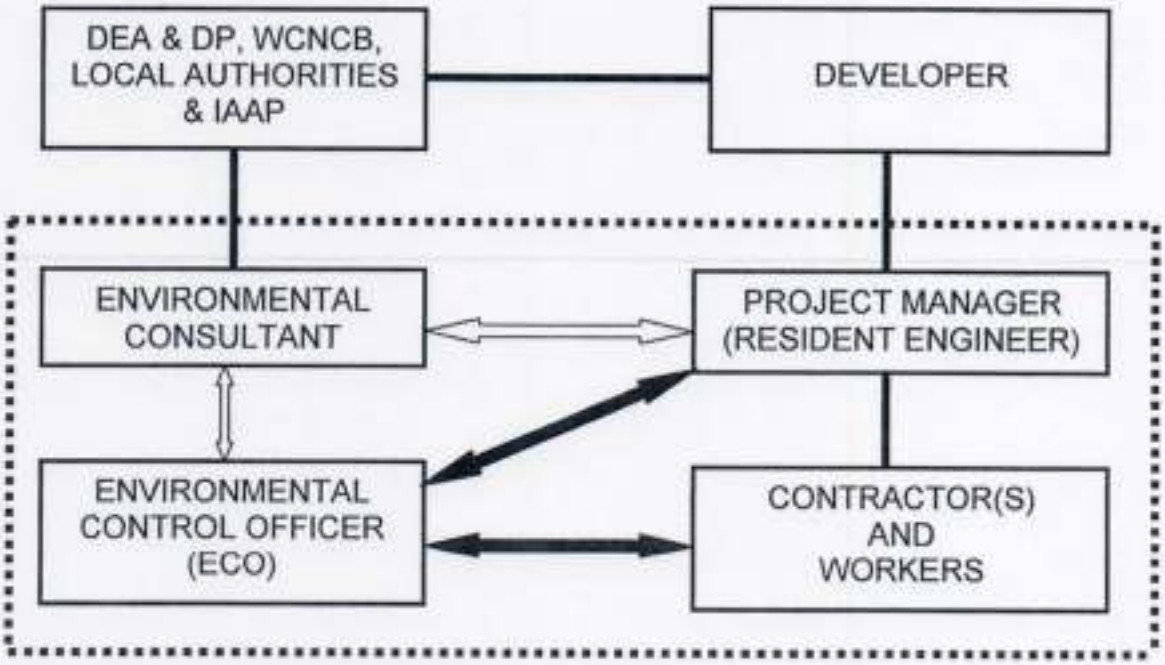

FIGURE 1: Primary lines of communication for the ECO. Regular communication with the contractor(s) and project manager(s) are critical for hitch-free development progress.

3. MITIGATORY MEASURES - CONDITIONS OF APPROVAL

The following methods were recommended in mitigation of the expected impacts of the proposed developments and have been included as conditions of approval by DEA & DP in the ROD: These measures form the bulk of the EMP and also serve as the chief guideline for the effective functioning of the ECO on site. Many of the measures are dealt with in greater detail further in the construction phase EMP, while others are more fully specified in the operation phase EMP. Figure 2 illustrates the approved layout of the development area.

a) The development will be confined to areas of lower vegetation sensitivity, most of which was or is still covered by invasive alien *Acacia cyclops* infestations. (Construction Phase).

b) The areas of higher vegetation sensitivity occur within the drainage system which must not be impacted by the proposed development. (Construction Phase).

c) The undeveloped balance (±600m²) of each of the individual plots, ie: area not required for the residential development footprint will be available for the rehabilitation of Renosterveld and Thicket. (Operational Phase).

d) The undeveloped parts of the affected area, together with the undeveloped part of each individual plot can be managed together as a natural vegetation area, in which Thicket and Renosterveld can be established. (Operational Phase).

The following mitigatory measures have become conditional to the approval for development:

e) All invasive alien *Acacia cyclops* should be removed and permanently controlled on the property, particularly from the more sensitive Thicket vegetation. (Operational Phase).

f) A nursery should be established on site for the propagation of locally indigenous Renosterveld and Thicket plants for use in the rehabilitation of formerly rooikrans-infested areas. (Operational Phase).

g) No indigenous Thicket may be removed from the affected area. Small clumps of Thicket within development areas should be retained intact outside the residential footprint area. (Construction Phase).

h) A garden planning list should be provided to guide each resident. No alien plants should be permitted for gardening and a priority list of locally indigenous plants that will be obtainable from the nursery should be provided. (Operational Phase).

i) Only locally indigenous trees, shrubs, grasses and herbaceous plants should be planted within the undeveloped public open space (nature reserve) area. (Operational Phase).

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FIGURE 2: LAYOUT OF THE APPROVED DEVELOPMENT

j) Domestic pet dogs will have to be banned or confined to avoid the disturbance of small antelope (bushbuck, grysbok) and birds within the public open space (nature reserve) area. (Operational Phase).

k) All areas of disturbance that occur as a result of building and road construction, clearing, service installation, building refuse storage and any type of contamination (ie: imported sand, gravel) must be rehabilitated using the indigenous vegetation of the area. The procedure for rehabilitation must be determined in a management guideline. (Construction Phase).

l) An environmental management guideline document should be prepared to guide the rehabilitation process. This guide should outline species, planting method, planting locality, planting times, alien vegetation control procedures and wild and domestic animal management aspects. (Construction and Operational Phases).

m) Walking access into and throughout the public open space (nature reserve) area should be formalized by means of a specially designated path network. Details of layout and design should be contained within the environmental management guideline document. (Operational Phase).

n) An independent environmental management expert should be appointed to carry out regular inspections on site to ensure that the provisions of the environmental management guidelines are satisfactorily implemented. (Construction and Operational Phases).

4. CONSTRUCTION PHASE MANAGEMENT GUIDELINES

The following section provides guidelines for the effective management, or prevention of environmental impacts that will result from the proposed development. Only environmental management guidelines that are relevant to the proposal and the site have been included in this EMP. The following sections should be seen and managed as individual projects and are summarized as such in the last section of the EMP.

4.1 CONTRACTOR'S CAMP

The contractor's camp must include areas for building material storage, offices, vehicle cleaning, vehicle parking and maintenance, machinery storage and maintenance, temporary accommodation, cooking and ablution facilities. The camp must not be positioned within any environmentally sensitive area and should preferably be located within an area that will become part of the development layout. The final positioning of the contractor's camp must be approved by the ECO prior to its establishment.

The contractor's camp must be clearly demarcated and fenced all along its outer boundary.

The bathroom water, kitchen water and sewerage disposal systems of the contractor's camp must be discussed with and approved by the ECO before establishment.

This action will ensure that no more than the minimum absolutely necessary disturbance area will be impacted (cleared, compacted, surfaced) at the contractor's camp.

4.2 TOILETS

The contractor is responsible for the provision of adequate sanitary arrangements for construction and supervisory staff on the site. Chemical toilets should be provided at a rate of one per 10 persons and must be located within the contractor's camp and within the demarcated building areas in a manner that will provide reasonably easy access for use. The chemical toilets must be regularly serviced by the supply company and must thus be positioned to facilitate servicing. The actual positioning of the toilets must obviate any chances of downslope spillage should this occur accidentally. The positioning of each chemical toilet must be approved by the ECO prior to their final installation. Excess of sewerage waste that may result from cleaning or servicing may not be dumped anywhere on the site. The servicing agency must dispose thereof in approved facilities off the construction site.

The ECO should regularly inspect the toilets to ensure compliance.

This action will ensure that no harmful pollution of the soil or groundwater occurs as a result of sewerage contamination.

4.3 CONSTRUCTION AREA DEMARCATION

The construction areas must be clearly marked with well secured and visible pegs to the satisfaction of the ECO. This demarcation must be maintained for the full duration of the construction phase. Access outside of this demarcated area by any of the contractor's staff is prohibited, similarly, no storage or dumping may take place outside of the demarcated construction area and no vehicles may turn, traverse or be stored outside of the construction area. It follows that an adequate area must be earmarked for construction activities. All areas outside of the demarcated area must be strictly treated as no-go areas.

The ECO must ensure compliance and also ensure that the construction area boundary remains intact and fully visible throughout the construction phase. The recommended construction area demarcation is indicated in Figure 3.

This action will ensure that no more than an absolutely necessary area will be negatively impacted (cleared, compacted, covered) during the construction period.

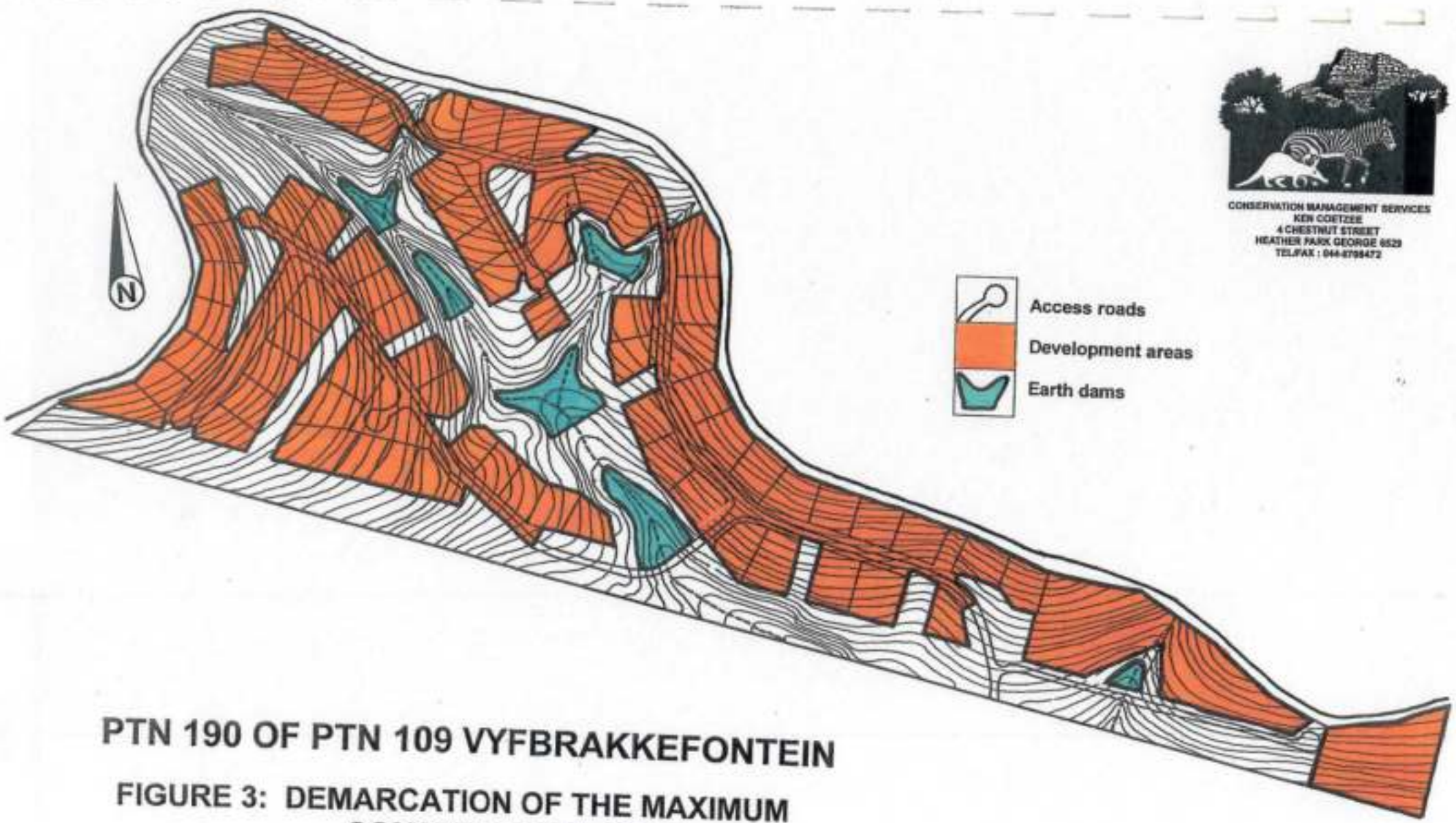

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FIGURE 3: DEMARCATION OF THE MAXIMUM CONSTRUCTION AREA

4.4 INSTALLATION OF SERVICES: (WATER, ELECTRICITY, SEWER PIPES)

The guiding principle for the installation of services should be that all excavations required for burying water pipelines, storm water pipes, sewerage pipelines and power lines must be within or directly alongside the main access roads as far as is possible. Excavations alongside of road surfaces, rather than within the road or path itself, must be carefully filled in, compacted, and rehabilitated with the prescribed vegetation cover establishment. Excavations within roads need only be filled and recompacted. Figure 4 shows the recommended service supply routes.

Any excavated rock, blasted chips or spoil that is not required for excavation fill, must be stockpiled at a site approved by the ECO and then later removed from the site completely, or used for fill elsewhere on the site. Any necessary deviation from this principle must be discussed with the ECO before any contravention or alternative action takes place.

This action will ensure that environmental disturbances such as excavations are consolidated with other necessary disturbances such as roads, thereby reducing the need to further damage to undisturbed areas, resulting in extra unnecessary and costly rehabilitation.

4.5 POLLUTION AND DUST CONTROL

DUST: The contractor must implement reasonable and effective measures to minimize dust during construction activities, particularly during earth-moving operations, road building and surfacing. Dust can be reduced by wetting the affected substrate during the critical work periods. This applies to the construction of residences, as well as to the installation of the services and roads. The ECO must be present during these critical "dust generation" activities and must ensure that reasonable dust control is achieved.

If windblown dust and sand proves to be a problem, then control will have to be applied by installing vertical dust/sand particle traps (fences) using fine geotextile materials to prevent particle transport. These traps can be constructed at intervals across the dust transport route. These should be designed and installed in consultation with the ECO.

These actions will ensure that excessive wind-blown sand and dust is not transported and deposited on the natural vegetation or in the dams or on the nearby neighbouring pastures and croplands.

POLLUTION: The pollution of the substrate and the network of dams must be prevented. Sources of pollution may include the purposeful or accidental release of chemicals, oils, fuel, sewerage, waste water, concrete or cement water, contaminated water and vehicle cleaning water. All staff must be coached in terms of the correct storage and disposal of all potential pollutants. Oils, chemicals, fuel, herbicides and insecticides must be stored in a sealed structure or container that

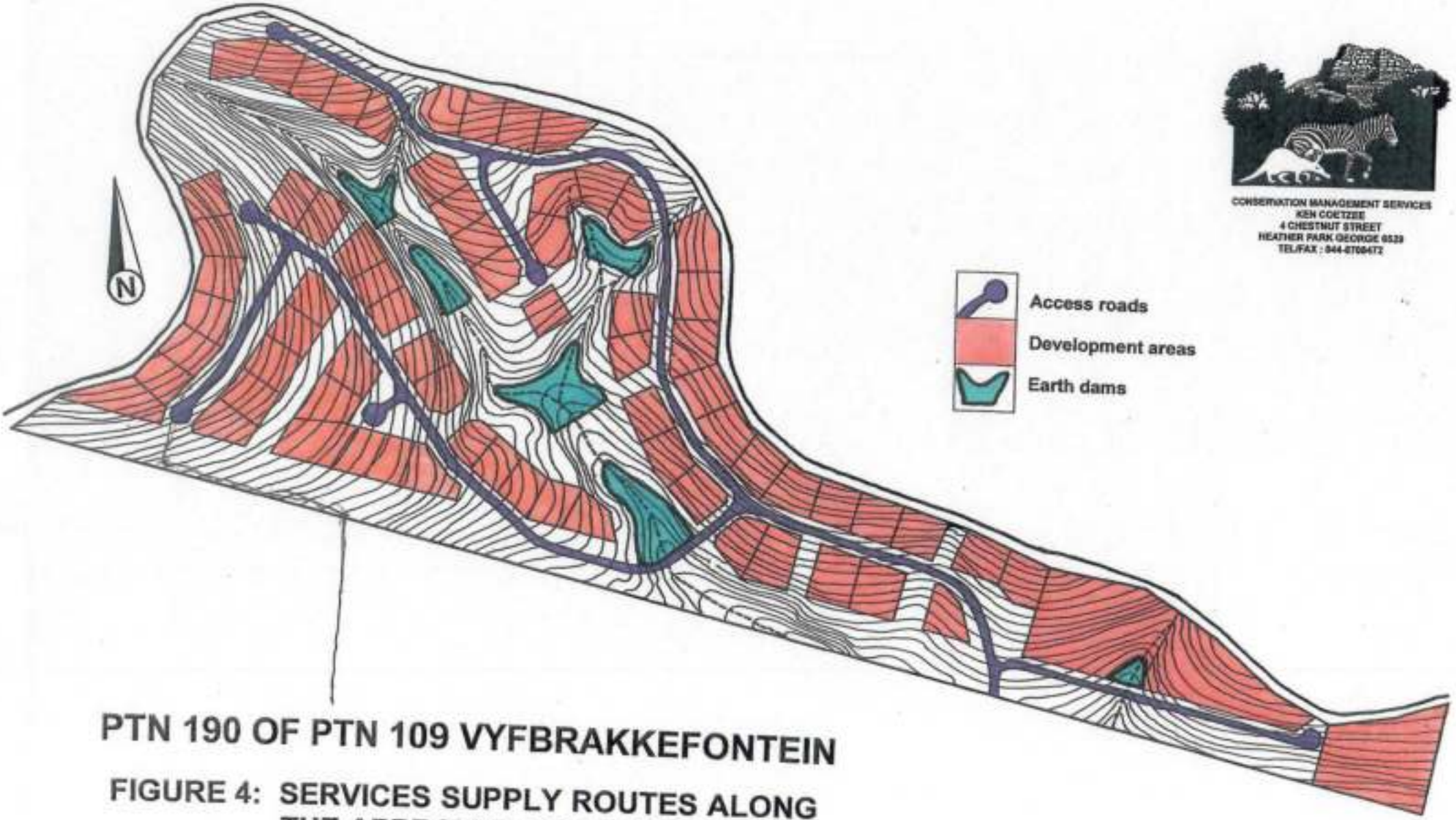

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FIGURE 4: SERVICES SUPPLY ROUTES ALONG THE APPROVED ROAD NETWORK

must be approved by the ECO. Waste water must be stored for disposal or adequately filtered in a sealed wetland system in order to remove harmful elements before release. This disposal or filtering process must also be approved by the ECO before its implementation. The contractor must also have an emergency contingency plan in case of spillage and this must also be approved by the ECO prior to implementation.

Approved emergency methods that can be used include the following:

1. Containment of the spillage in a sealed leak-proof facility (concrete floor with berm) and removal to an approved disposal site.
2. Absorbing the spillage (fuel, oil, chemicals) with sawdust, wood shavings or clean building sand (if not contained) prior to removal to an approved disposal site.
3. Application of dry building sand to cement or concrete water spill and removal of the mixture once the spill is contained.
4. Immediate transfer (by flow) of the contaminant (fuel, oil, chemicals, cement water, waste water, paint) from the substrate surface into an emergency plastic-lined pond from where it can be safely removed. Use can be made of a large single dampcourse sheet or a buried water storage portapool.
5. The complete removal of the contaminated substrate layers (soil, sand and gravel) to an approved disposal site. Remove as deep as is necessary and refill with uncontaminated spoil or excavated excess material.
6. Drip trays should be used wherever machinery or plant is stored or refueled to help contain polluting spill.

These actions will ensure that (a) the risk of pollution is reduced and (b) that contingency plans are in place in case of an accidental spills or contamination.

4.6 WASTE MANAGEMENT

The guiding principle for waste management should be to reduce and reuse. A waste minimization approach must be implemented, and if at all practical, all reusable waste should be recycled. The contractor will be responsible for the establishment of an effective refuse storage and removal system that will prevent the spread and accumulation of unsightly refuse and litter in the construction area and beyond it. This can be achieved by means of the following:

- Provide sufficient wind-proof, animal-proof and water-proof refuse disposal bins or containers at strategic points (construction camp, kitchen, construction site). The ECO should assist with the selection of these sites and must approve the number of refuse bins.
- Inform all staff about the refuse disposal requirements to obviate littering.
- Paint refuse bins a bright yellow or orange as an aid to location and use.
- Refuse must be regularly disposed of at an approved municipal site. Bins must not be allowed to overflow, as this undermines the principle of effective refuse management.

- Set up a recycling plant with individual containers for metals, glass, paper and cardboard and plastics. This will require some training of the workers and diligent removal to recycling plants or pickup points. The recycling plant can be located within the construction camp storage area.
- Building site refuse such as cardboard and plastic packaging, paint tins, broken materials (tiles, bricks, wood off-cuts, pipe off-cuts, cement bags) must also be disposed of in the refuse bin or container system and must also be timeously removed for disposal at the approved site.
- Solid, heavy building rubble such as waste cement, bricks, sand and crushed stone should be stockpiled for later use as construction fill, raised path or road fill and terracing. The ECO must approve these stockpiling sites before they are used.
- The ECO should make regular checks of the refuse management system to ensure effective functioning and a litter- and pollution-free environment.

These actions will help to reduce rubbish build-up that will need to be cleared when construction is completed, will reduce the risks of pollution, will prevent unsightly visual contamination of the nature reserve and will help to reuse and recycle certain materials.

4.7 STORMWATER AND SOIL EROSION

The development area is highly susceptible to soil erosion and past agricultural land management practices have resulted in some erosion of the soil surface both on- and off-site. The management of storm water during the construction phase is the responsibility of the contractor and entails the following:

- All storm water can be channeled into the network of dams, provided that it does not transport pollutants or silt.
- The flow of storm water must not result in erosion of the soil surface en route to the dam.
- It may be necessary to construct storm water collection and filtration ponds en route to the dams.
- The concentrated flow of storm water must be checked and dissipated wherever necessary (steeper slopes) to avoid soil erosion. Earth berms, channel gutters, cross-road drainage, stone gabions, reno mattresses, geotextile filters, filtration ponds and vegetation establishment are all methods that can be used alone or in combination, to dissipate the force of water flow. The methods proposed for use must first be approved by the ECO before implementation.
- Storm water collection dams (or wetlands) planted densely with aquatic reeds, sedges and bulrushes are ideal both for water force dissipation and the filtration of silt-laden runoff water. Outflow into the dam will thus be clean and gentle.

These actions will help to prevent soil erosion of the site or the contamination of the dams with water-transported silt.

4.8 ACCESS TO CONTRUCTION SITES

All access to construction sites of heavy machinery for earth-moving or to transport and offload building materials must be via the road network that has been approved as part of the development layout. (See Figure 5). There may thus be no movement of any type of vehicle outside of the road network and individual construction sites. Any need or emergency that may develop and that may require movement outside of the approved access areas must first be approved by the ECO.

This approach will help to maintain an unspoilt character in the natural veld between the various groups of units of the development. The approach will reduce impact and the need for rehabilitation will consequently be reduced.

4.9 PREPARATION OF INDIVIDUAL CONSTRUCTION SITES

A policy of minimum disturbance of each construction site is necessary. Only an approved footprint area for each unit within each plot should be cleared prior to construction. The balance of the stand should be undisturbed. A width of an additional 2m around the total floor area is proposed, but this should be flexible and must be finally planned with the ECO. The garden area should not be impacted in any way by the construction activities. Although within the demarcated development area, the natural veld beyond the footprint should not be impacted at all, if possible. Deviations from this approach must be cleared with the ECO before any action is taken. The principle for maximum construction area for each site is illustrated in Figure 6.

It is recommended that all mature indigenous trees and shrubs within the development area must be retained in the layout of the development if at all possible. This is critical to the natural character of the site and any problems in this regard must be discussed with the ECO, who will determine what (if any) deviations are permissible.

This approach will ensure that much of the natural character of the area is retained and that there is little or no unnecessary additional rehabilitation costs.

4.10 STOCKPILING TOPSOIL

Wherever construction sites are to be cleared, the ± 300mm topsoil layer should be carefully pushed aside and stored alongside the cleared construction site in a long, low heap, no higher than 600 mm.

Topsoil storage need not be done in areas where the alien rooikrans was formerly dominant, but rather on sites where natural vegetation still occurred.

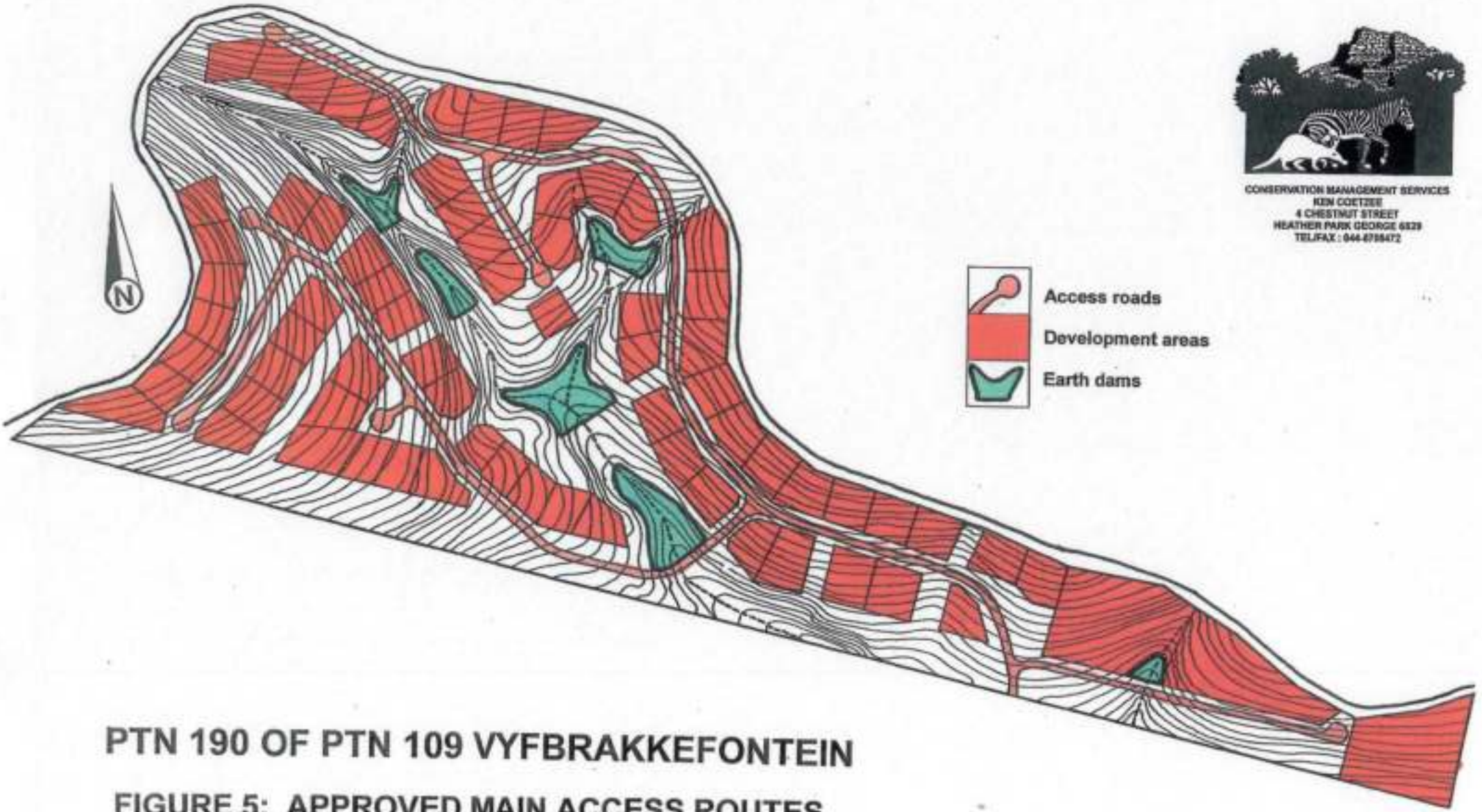

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FIGURE 5: APPROVED MAIN ACCESS ROUTES FOR CONSTRUCTION

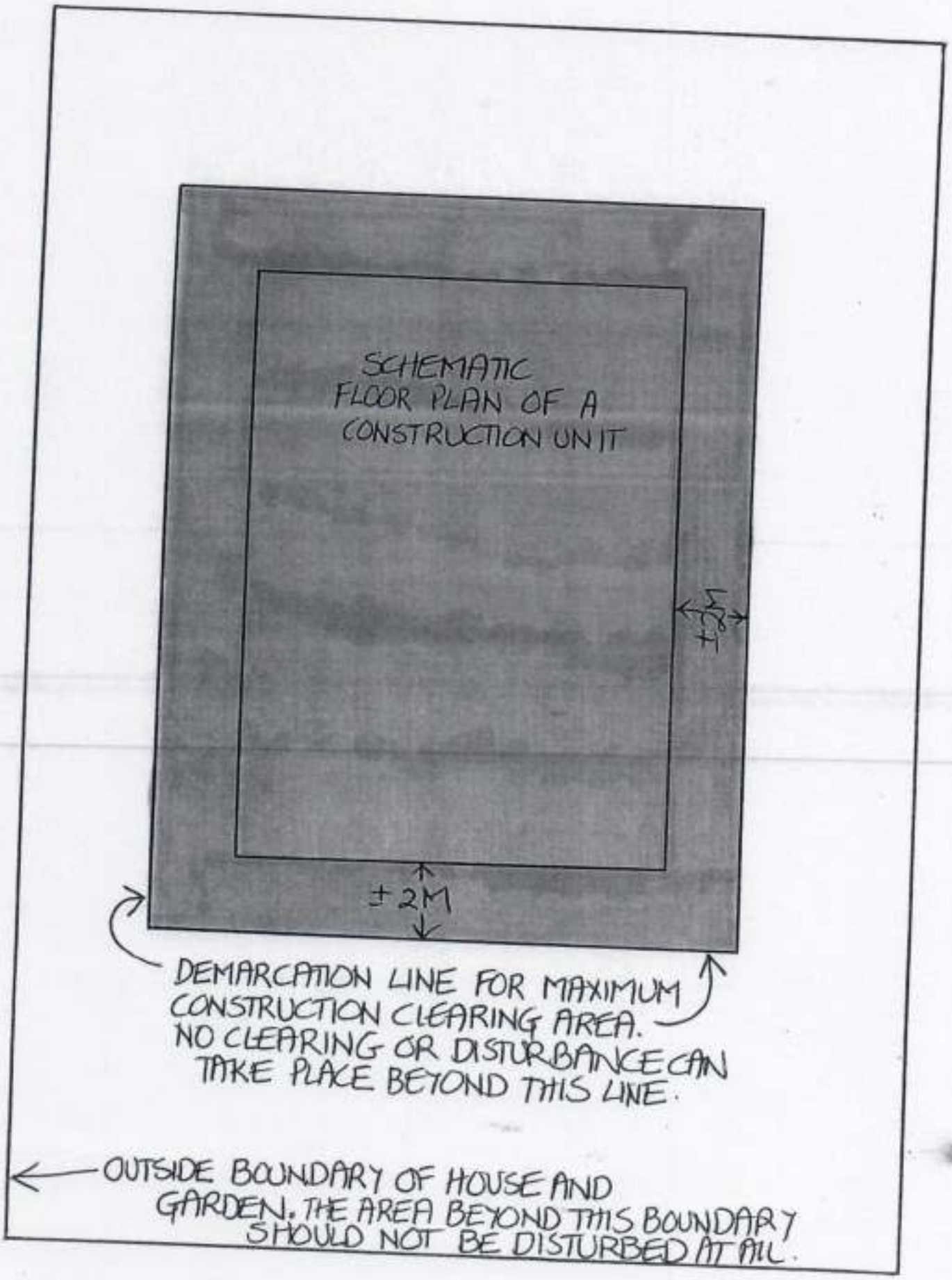


FIGURE 6 : SCHEMATIC ILLUSTRATION OF THE RECOMMENDED DEMARCATION FOR A MAXIMUM CONSTRUCTION FOOTPRINT AT EACH UNIT

This topsoil can later be used to help rehabilitate areas disturbed by construction as it will still be rich with organic material, soil organisms and seed. The ECO can help determine whether topsoil should be stockpiled or not and he can simply mark the sites where topsoil stockpiling should take place.

4.11 REHABILITATION

All areas that are unavoidably disturbed during construction must be rehabilitated with a suitable, locally indigenous vegetation cover. In terms of the construction phase, the objective of the rehabilitation action is to establish a vegetation cover that will protect the soil surface from water and wind erosion. Other objectives include biodiversity conservation and visual aesthetic considerations. Rehabilitation should consist of the following procedure:

a) Stabilize the soil surface by means of brush packing, mulch, geotextile covering or even stone packing at intervals. This will help to prevent soil erosion. Any organic material like reeds, crop residue, wood chips will also be suitable for soil covering. Converting alien rooikrans branches into mulch with a heavy-duty chipper machine can be considered.

b) Loosen the soil of primary plant establishment sites. This will be between the above stabilization treatments or it will be the entire soil surface under the stabilization treatments, in which case soil surface loosening must be done before the surface stabilization is done.

c) Establish a pioneer plant cover. The plants used must be able to establish under typical local arid conditions. Species that should be used are as follows:

Agathosma ovata	(shrub)
Chironia baccifera	(shrub)
Chrysanthemoides monilifera	(shrub)
Cynodon dactylon	(creeping grass)
Digitaria eriantha	(grass)
Diospyros dichropylla	(shrub)
Elytropappus rhinocerotis	(shrub)
Eragrostis curvula	(grass)
Eriocephalus africanus	(shrub)
Melini's repens	(grass)
Polygala myrtifolia	(shrub)
Rhus glauca	(shrub).

Further Renosterveld species will germinate from soil -stored seed.

As the Vyfbrakkefontein area receives much of its rain during the winter months, it is advised that seeding/planting should be done during April. Rehabilitation details are also provided in the Operational Management Plan as well.

4.12 RARE PLANT RESCUE

Rare plants such as *Bobartia robusta*, where threatened by development construction, must be removed and planted into nursery bags for later rehabilitation planting. Individual *Bobartia* plants could be planted directly into areas that will not be affected by the development, but there is the risk that they may be accidentally damaged. It is thus advisable to plant rescued plants into nursery bags for later transfer to safe sites.

The rescued plants must, however, be cared for during the construction phase. The ECO must control the plant rescue project and ensure that rescued plants are adequately cared for and planted out into safe sites with the minimum possible delay.

This action will ensure that rare plants are not lost as a result of the development.

4.13 PROTECTION OF WILDLIFE

It is the responsibility of the development contractor(s) to ensure that the wildlife that occurs within the development areas are not unnecessarily harmed or disturbed in any way. Wildlife beyond the boundaries of the demarcated construction area (see Figure 3) should be adequately protected as this is a "no-go" environmental protection area. Wildlife found within the construction area must be transferred (if possible) into the "no-go" area (eg: tortoises, frogs, snakes, etc). The ECO can be consulted regarding collection, containment and transporting methods.

All contract staff and workers must be briefed when moving onto site. The briefing must give out a message that no animal of any kind may be intentionally harmed or disturbed. The ECO can assist with such a briefing and can also outline the procedure to follow when animals are accidentally disturbed.

Purposeful hunting of larger animals such as bushbuck and porcupines on the site by contract workers is illegal and perpetrators must be charged in terms of the Nature Conservation Ordinance.

ECO site visits should inspect typical animal snaring sites such as along fence lines.

4.14 AUDITING

An external, independent audit in terms of the EMP must be carried six months after commencement of the construction phase of the project. In the interim, the full-time ECO will closely control all environmental requirements in terms of the construction phase EMP on a continuous basis until all construction is completed. An audit will again be required on completion of the construction phase and again six months after completion of the last house.

The audits should be done by a competent person who is completely independent of the project. The audits can be simply administered by dealing with each project of the EMP and commenting on progress or compliance on the environmental management evaluation form shown in Figure 7.

The list of projects to be audited is as follows:

1. Compliance with the conditional mitigatory measures.
2. Efficiency of the ECO control function.
3. Rehabilitation of:
   - Contractor's campsite.
   - Construction sites.
   - Services installation sites.
   - Road verges.
4. Effectivity of waste management actions.
5. Effective management of storm water.
6. Condition of "no-go" protected areas.
7. Application of the minimum footprint development principle within each stand.
8. Progress with alien vegetation control within the development areas.

Completed audits reports should then be submitted by the applicant to DEA & DP and any other relevant authority if required.

FIGURE 7: ENVIRONMENTAL MANAGEMENT EVALUATION

PROJECT:

OBJECTIVE	PROJECT STATUS		COMMENT AND RECOMMENDATION
	NEEDS ATTENTION		
	PARTLY UNDERTAKEN		
	SIGNIFICANT PROGRESS		
	COMPLETED		
	NEEDS FOLLOW-UP		

PROJECT:

OBJECTIVE	PROJECT STATUS		COMMENT AND RECOMMENDATION
	NEEDS ATTENTION		
	PARTLY UNDERTAKEN		
	SIGNIFICANT PROGRESS		
	COMPLETED		
	NEEDS FOLLOW-UP		

PROJECT:

OBJECTIVE	PROJECT STATUS		COMMENT AND RECOMMENDATION
	NEEDS ATTENTION		
	PARTLY UNDERTAKEN		
	SIGNIFICANT PROGRESS		
	COMPLETED		
	NEEDS FOLLOW-UP		

5. EMP SUMMARY

The following tabular summary of the construction phase EMP provides an easy reference (section number and page number), project description, objectives, responsibilities and time frames.

EMP REFERENCE	PROJECT / ACTIVITY DESCRIPTION	OBJECTIVE	RESPONSIBILITY	TIME FRAME
2. Page 1	Appointment of ECO	Ensure compliance with EMP and ROD.	Developer.	Prior to construction phase
2.2 Page 2	Approval of ECO	Ensure competence of appointee.	DEA & DP with referral by developer.	Before commencement of construction phase.
2.3 Page 2	Ensure compliance with EMP. Ensure compliance with ROD. Inspect construction site minimum once per week. Establish liaison with contractors and engineers. Request site meetings when necessary. Report at key phases in writing to DEA & DP. Ensure environmental awareness in contractors and workers. Issue verbal and written warnings when necessary. Furnish contractors with fines if a contravention penalty system is used. Help find environmentally-friendly acceptable solutions. Recommend additional environmental protection measures where needed.	Ensure an environmentally compatible development. Ensure compliance with ROD & EMP.	ECO.	Entire construction phase.

EMP REFERENCE	PROJECT / ACTIVITY DESCRIPTION	OBJECTIVE	RESPONSIBILITY	TIME FRAME
4.1 Page 5	Select site for use as a contractor's camp.	Limit related disturbance to a single area.	Contractor and ECO.	At commencement of construction phase.
4.2 Page 6	Provision of adequate toilets.	Ensure healthy sanitary arrangement and prevent pollution.	Contractor. ECO to approve siting and general hygiene.	At commencement of construction phase.
4.3 Page 6	Demarcation of maximum construction areas.	Prevent unnecessary veld degradation.	Contractor to demarcate. ECO to control.	Prior to commencement of construction.
4.4 Page 7	Restrict the installation of water, electricity & sewerage pipes to the approved road routes.	Ensure the minimum disturbance of inter-structure areas.	Architect. Contractor. ECO to control.	Commencement of the construction phase.
4.4 Page 7	Rehabilitation of services installations along roads/paths.	Prevent soil erosion. Improve visual aesthetics.	Contactor. ECO to control.	When installations are complete.
4.5 Page 7	Implement dust control measures during excavations and earth moving.	Prevent excessive siltation of dams. Prevent dust damage to vegetation. Minimalise visual & environmental impact (dust clouds).	Contractor. ECO to control.	Whenever dust generation can occur.
4.5 Page 7	Prevention of substrate and water pollution.	Store contaminants safely. Manage all effluent. Reduce effluent. Contingency plans for spills.	Contractor. ECO to control.	Ongoing during the construction phase.
4.6 Page 8	Effective waste management.	Prevent litter & rubbish buildup. Removal of refuse to approved tip site. Recycle glass, cardboard & plastics. Re-use building rubble.	Contractor. ECO to control.	Ongoing during the construction phase.
4.7 Page 9	Management of storm water.	Prevent erosion of the surface by storm water. Dissipate the destructive force of storm water. Channel excess water into the dam.	Engineer. Contractor. ECO to control.	Ongoing during the construction phase.

EMP REFERENCE	PROJECT / ACTIVITY DESCRIPTION	OBJECTIVE	RESPONSIBILITY	TIME FRAME
4.8 Page 10	Construction site access.	Restrict all vehicular movement to approved roads. Minimise vehicular damage in veld.	Contractor. ECO to control.	Ongoing during the construction phase.
4.9 Page 10	Construction site preparation.	Limit construction impact at each site. Demarcate construction footprint at each site. Retain all mature trees and shrubs in layout as far as possible.	Contractor. ECO to assist with final unit placement. ECO to control.	With the onset of each construction site preparation.
4.10 Page 10	Stockpiling topsoil.	Availability of organic seed-bearing soil for rehabilitation of disturbed areas.	Contractor. ECO to advise.	Ongoing during construction phase.
4.11 Page 11	Rehabilitation of all areas disturbed by construction activities.	Establish a plant cover that will prevent soil erosion. Improve visual aesthetic. Restore biodiversity (locally indigenous species).	Contractor. ECO to control.	Ongoing during the construction phase whenever possible.
4.12 Page 12	Rare plant rescue.	Transplant rare *Bobartia* to safe sites.	Contractor. ECO to assist and control.	Ongoing during the construction phase.
4.13 Page 12	Wildlife protection.	Prevent unnecessary harm or disturbance of animals. Eliminate poaching. Improve environmental awareness.	Contractor. ECO to assist and control.	Before commencement of construction work and ongoing during construction phase.
4.14 Page 13	External auditing.	Assess the effectiveness of the EMP. Outline its strengths and weaknesses and evaluate compliance.	Developer. Independent auditor.	At 6 months after commencement and again on completion of the construction phase.

6. OPERATIONAL PHASE MANAGEMENT GUIDELINES

6.1 THE CONTROL OF INVASIVE ALIEN VEGETATION

A requirement in the ROD (Condition of Approval for the Development) is that all invasive alien plant species must be controlled.

The effective control of invasive alien vegetation is urgently necessary in order to retain the aesthetic and nature conservation integrity of the development area. Similarly, it has also been shown that the uncontrolled spread if invasive alien trees will impact on the sustained availability of browsing and grazing for wildlife and will also alter the capacity of the natural Renosterveld and Thicket vegetation to withstand and survive fires.

The control of alien vegetation should thus be a primary management concern for the undeveloped parts of the property. The time to control is thus as soon as possible to prevent the imminent rapid spread into the undeveloped natural parts of the site. ***The longer the delay to deal with this problem, the more expensive and unattainable a solution becomes.*** Consequently, this part of the management guideline is devoted to the alien species, control methods and priority action areas for alien vegetation control. The long-term objective for this programme should be:

> ***To eradicate all alien vegetation infestations in the longer term and prevent any further spread of the infestations into the natural Thicket and Renosterveld vegetation in the short term.***

6.1.1 THE EXTENT OF THE PROBLEM

Although the invasive vegetation consists only of *Acacia Cyclops* (rooikrans), infestations of this species in some areas can be described as extremely dense. In order to fully appreciate and understand this problem, the following description of rooikrans provides clues to the ecology of the plant:

ROOIKRANS
Acacia cyclops
(Legume family - Fabaceae)

Rooikrans is an evergreen shrub or small tree up to 6 m tall, and has a dense tangled, clumpy appearance. It has no true leaves, but flattened leaf-stalks, phyllodes, that resemble true leaves. They are 3 - 9 cm long and up to 1,5 cm wide, fairly straight, and have 3 - 5 prominent longitudinal veins with more or less longitudinal veinlets anastomosing between them. The first few leaves, resembling those of black wattle, are feathery but are soon superseded by phyllodes. The bright yellow flowers are borne in rounded inflorescences in the axils of phyllodes,

usually from October to May, with a peak in December to January, but also sporadically throughout the year. As only a few inflorescences are produced at any one time, this plant does *not* provide a spectacular show like the other species of wattle. The pods of rooikrans (some are always present on mature trees) are a distinctive feature. They are twisted, flattened, lack constrictions between the seeds and are retained on the plant for several months after releasing the seeds. The seeds are dark brown to black, and are encircled by a bright red or orange seed-stalk much relished by birds.

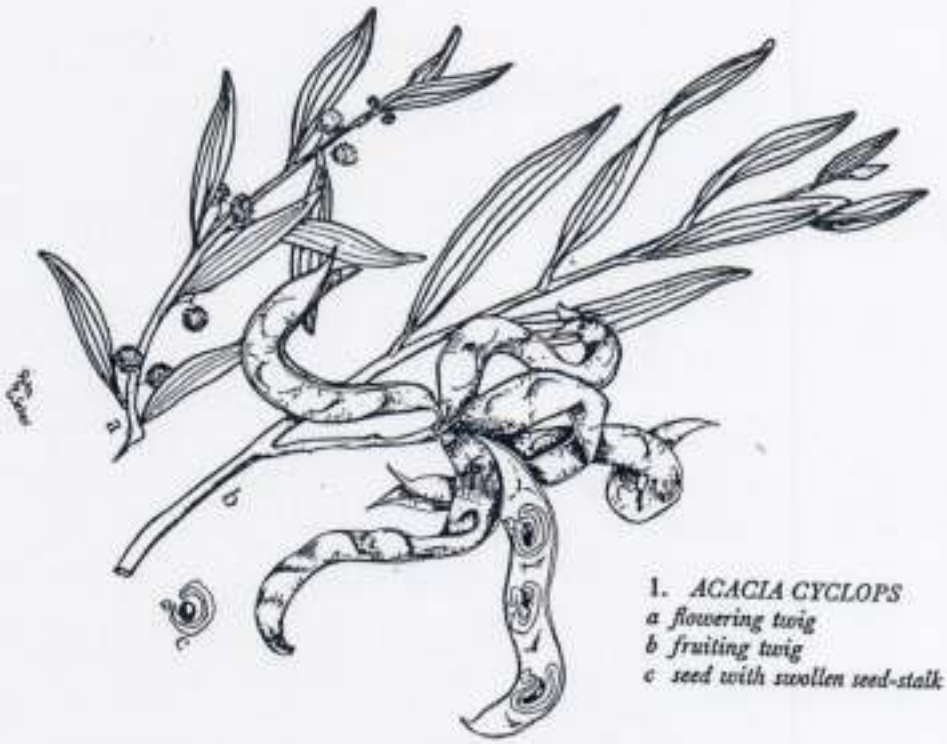
Origin: Rooikrans is a plant native to south-western Australia and extends southwards from Dongara in Western Australia to the eastern parts of South Australia. This coastal plant favours calcareous dune-sands and a rainfall of at least 250 mm per annum. In its natural habitat it usually grows singly or scattered, rarely forming dense stands.

Spread: Rooikrans is the most widespread Australian wattle in the Cape Province and occurs mainly in the lowlands. This is not surprising, because seed has been actively distributed for dune binding from Port Nolloth to Port Elizabeth. Today rooikrans can be found in natural veld from Kommagas, just south of Port Nolloth, to East London. This wattle is well established in the Mountain Fynbos and Lowland Fynbos vegetation groups. It has begun to invade Southern Forest, Eastern Cape Forest and Succulent Karoo and may be expected to spread further in karroid areas along rivers and streams and other moist areas. Rooikrans readily invades disturbed areas such as roadsides and dunes whereas its spread into established vegetation is especially rapid after fires.

Seed dispersal agents include man and his implements; mammals such as the striped field mouse (*Rhabdomys pumilio*) and the chacma baboon (*Papio ursinus*), and birds such as francolin (*Francolinus spp*), crowned guinea fowl (*Numida meleagris*), moorhen (*Gallinula chloropus*), red-eyed turtle dove (*Streptopelia semitorquata*), mourning dove (*Streptopelia decipens*), Cape turtle dove (*Streptopelia capicola*), Namaqua dove (*Oena Capensis*), Cape bulbul (*Pycnonotus capensis*), pied starling (*Spreo bicolor*) and red-wing starling (*Onychognathus morio*).

Danger: Rooikrans forms dense, impenetrable stands of tall shrubs or short trees with interlocking crowns. The shrub form is prevalent and is a serious problem in the Lowland Fynbos. Because the germination and growth of the indigenous vegetation in these areas is suppressed, the natural flora soon disappears. Boucher & Stirton, 1978).

On Vyfbrakkefontein, most of the infested areas are fairly dense and continuous and the infestation is widespread. Strips have already been cleared along the road routes and parts of the drainage area.



1. *ACACIA CYCLOPS*
a flowering twig
b fruiting twig
c seed with swollen seed-stalk

6.1.2 ALIEN VEGETATION AND INDIGENOUS BROWSERS

Although invasive alien plants are often utilized by indigenous browsing herbivores, the impact of the browsing is seldom sufficient to eradicate or control the infestations. Most browsers utilize succulent young shoots and growing tips, selecting them and then moving on to another plant to do the same before utilizing older growth. Even in areas where the browsing pressure is high, only the reachable branch tips are utilized and the rest of the plant continues to flower and produce seed.

Even with a range of browser species all feeding at different heights, not enough of the plant is damaged to impair it permanently. Browsing can, however, have an impact seedling growth. The small common duiker, for example, selects for seedlings and saplings, continuously removing the new growth and preventing the plants from producing seed and growing any bigger. Eland, kudu and elephant damage trees by breaking off the branches that they feed on. Despite this, browser impact is generally not enough to control the spread of palatable alien plants because of the typically rapid rate of spread of these plants due to lack of the normal controls that restrict them at their place of origin.

It will not be practical to stock high numbers of browsers in an effort to eradicate alien plants, because after all of the preferred browse has been removed, browsers tend to die before any permanent damage to the trees occurs. Similarly, the implications of obtaining, introducing and containing high densities of large indigenous browsers makes this option too impractical and too costly.

It is, therefore, unavoidable that the alien rooikrans infestation will have to be manually controlled in the interests of Renosterveld and Thicket conservation.

6.1.3 PRINCIPLES FOR CONTROL

According to Kluge and Erasmus (1991), despite good progress made in recent times with the development of effective control techniques, the progress with actual control of invasive plants has been generally disappointing because of:

a) **Poor Planning** – Treatments are done occasionally when some spare time or workers are available. Control is thus a low priority and receives little attention.

b) **Impractical Approach** – Starting clearing operations in densely infested areas rather than working from light to dense.

c) **Inflexible Approach** – Not adapting control methods to local conditions, the response of the plants to treatment is not monitored with a view to adaptation and there is a lack of improvisation.

d) **Incorrect Use of Control Methods** – Plants are treated, but not killed, insufficient herbicide is used or ineffectively applied, control is attempted in the wrong season and many more similar practical problems.

e) **Control Work is not Followed-Up** – Treated areas are not diligently and timeously revisited to treat resprouting stems and new plants that germinate from seed. The great expense of initial control is wasted if follow-up control, which is considerably cheaper, is not done.

f) **Lack of Guidance** – People who attempt to rid their land of alien plants receive little guidance from experts. Similarly, the workers who must carry out the control are seldom trained and receive little guidance.

g) **Lack of Information About the Costs of Control** – Inexperience with alien plant control often results in poor financial planning, which stems from a lack of appreciation for the complexities of the field work.

Any of the above, or any combination of them, can result in a landowner or manager becoming completely discouraged with the effectivity of alien vegetation control. Control projects are often discontinued and the money invested in the project is lost due to the failure to control the alien plants.

Planning must thus ensure that these points are sufficiently considered and that the most efficient use of the available funding is guaranteed and that the alien plants are effectively controlled on the study area.

There are a number of basic planning principles that can be used to guide the alien plant control programme on the study area and ultimately, to ensure success. Much has been learnt from the mistakes of the past, which now become the guidelines for future action.

- To succeed in controlling and eradicating problem plants, a well thought out and practical plan of action is absolutely critical. A haphazard approach always fails.

- A land owner, or land manager, needs a long-term alien plant control programme for his property and this must include a budget of estimated costs of labour, equipment, transport and chemicals.

- Alien plant control can be expensive, labour-intensive and time-consuming. It is thus imperative that the planning and cost estimates are correctly done to ensure that limited funding is effectively used.

- Alien vegetation control must be viewed as a long-term programme and must also be fully incorporated into the other management practices on the property.

- The goals that the land owner, or land manager, has for the property must be clear so that the alien plant control programme can be shaped around them and help to achieve them.

- The land owner, or land manager, must be sufficiently motivated to sustain the control programme in the long-term to ensure success. This is particularly applicable to the follow-up stages of control.

- It is almost impossible to totally eradicate invasive alien plants from a property – it is more practical to rather think in terms of effective control.

- The ultimate goal must be to reach a level of control where the annual input is low and the impact of the alien plants on the environment is low or negligible. This is known as the maintenance level of control.

- There are two levels of control, namely initial control and follow-up control. Initial control is usually the most costly, with costs reducing progressively through the follow-up controls until a minimal cost is reached at the maintenance level of control.

- To make any real progress with alien plant control, the follow-up operations must be seen as all-important. If the follow-up control phases are neglected, it is certain that the invasive situation will revert back to the original, and sometimes worse, condition.

6.1.4 CONTROL IN NATURAL VELD (UNDEVELOPED ZONES)

To aim, in the short and medium term, for the complete eradication of alien plants is unrealistic. The objective should rather be to prevent the further spread of rooikrans into unaffected areas and to isolate the dense infestations within a landscape that is otherwise maintained free of it.

The pro-active establishment of ***realistic goals*** entails matching the available or potentially available management resources of funds and manpower with the defined goals to be achieved.

In order to attain these realistic goals, it is essential that a practical strategy be established and pursued. The following stages, in order of priority, outline an effective approach for control in the natural and undeveloped areas:

STAGES FOR AN EFFECTIVE APPROACH FOR CONTROL:

A. ***Eradicate plants in sparsely invaded areas first and apply follow up within 3-6 months, then ...***
B. ***Clear small isolated infestations and apply follow-up within 3-6 months, then ...***
C. ***Stop the edges of dense infestations spreading and apply follow-up within 3-6 months, then ...***
D. ***Reduce the area of dense infestations working from the edges inwards and apply follow-up within 3-6 months, then ...***
E. ***Follow-up on A to D as required.***

The aim must thus be to prevent light or small infestations from becoming mature and producing a seed reserve. In this way, small infestations are controlled before they infest the area with a long-term seed reserve and immature infestations are controlled before they can flower and produce seed. Mature, dense stands are thus ***isolated*** and left for later treatment. **The mature, dense infestations can't get any worse, whereas the light infestations can spread and become dense mature thickets, and this is exactly what must be prevented.**

With these guidelines in mind, the following control strategy (Table 1) is suggested. It is, unfortunately, not always possible to follow the effective approach (A - E), to the letter, because of practical considerations. The suggested strategy does, however, follow the approach, in principle, as closely as possible.

Figure 8 shows the proposed alien vegetation control blocks. Using a block/unit system such as this compartmentalizes the alien invasion problem. A block thus becomes the goal area which has fixed boundaries. It is easier to return to a block for follow-up at a later date if the boundaries are fixed and the history of control in the block is known.

Within each control block, the approach should be to clear all rooikrans from the block using the 5 stages for effective control already discussed.

In the undeveloped natural area, the Renosterveld blocks are considered the priority for clearing. This is an important vegetation type, it probably contains rare and interesting plants. Initial clearing has been done in some blocks and rooikrans regrowth should be removed at this stage to prevent a new seed reserve from being built up in the soil. Only once these areas are completely clear of rooikrans should efforts be invested elsewhere.

After the Renosterveld, the dense infestations in the Thicket areas of the drainages can be controlled. There is still a lot of indigenous Thicket cover in these areas that should be protected.

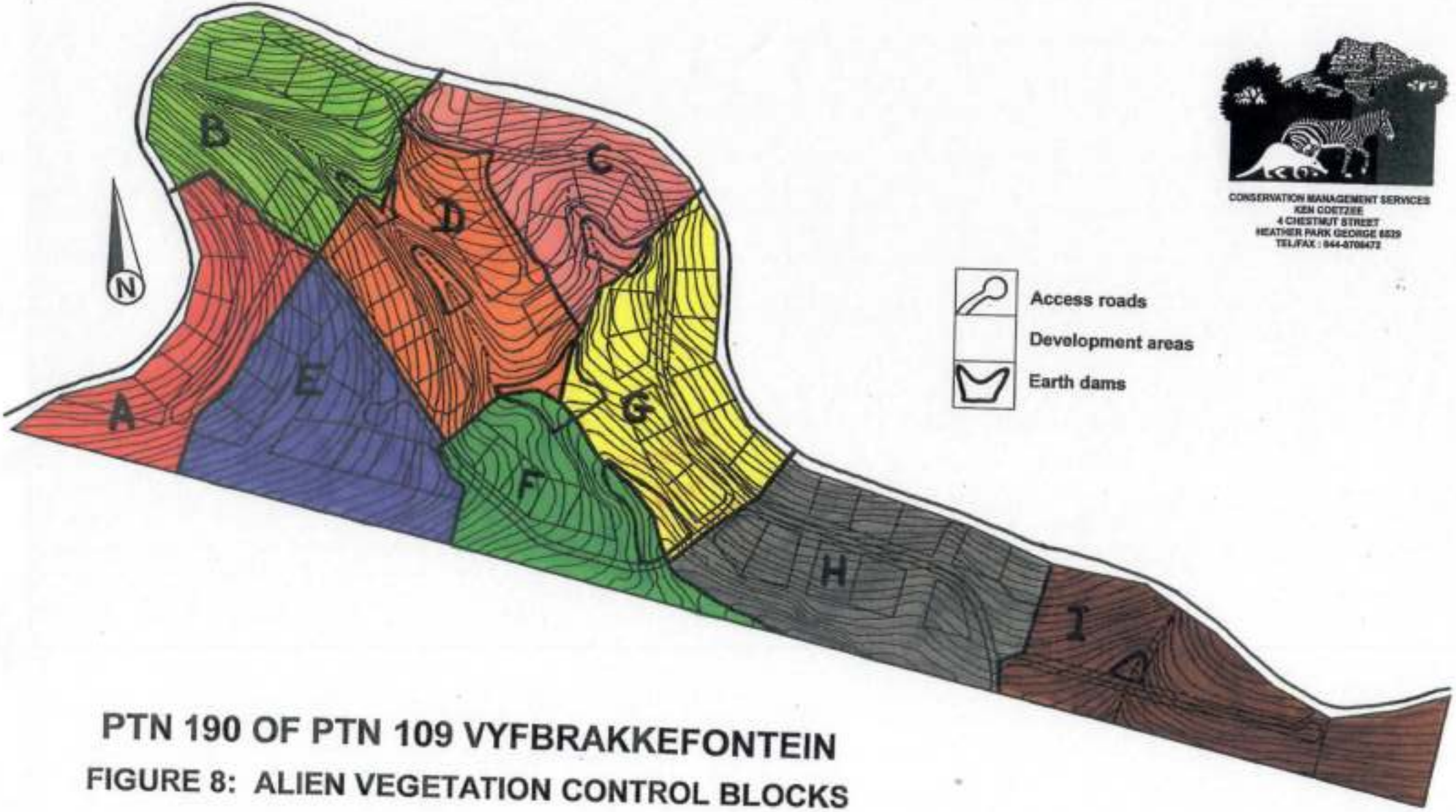


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FIGURE 8: ALIEN VEGETATION CONTROL BLOCKS

A practical approach will be to get a private contractor in to remove the very dense infestations and to employ and train casual workers to deal with the control of light and moderate infestations such as in the Renosterveld areas. It cannot be over-emphasized that very close follow-up control is essential if success and cost-effective investment is to be achieved.

As an alternative, a specialist alien vegetation control contractor can be appointed to deal with all alien vegetation infestations. Cape Eco-Contracting, based in George, has a forestry background, can remove usable wood and will be able to deal with all levels of control in a professional manner. Contact Geert de Decker at telephone: 044 – 873 3751 or cell: 082 5602 613.

PRIORITY RATING	BLOCK NO (FIG 8)	INFEST-ATION RATING	FOLLOW UP CONTROL	TIME FRAME*
1	A	Dense	3 months, 6 months & again 12 months after clearing	Year 1 – 2005
2	B	Dense	3 months, 6 months & again 12 months after clearing	Year 1 – 2005
3	C	Dense	3 months, 6 months & again 12 months after clearing	Year 1 – 2005
4	D	Dense	3 months, 6 months & again 12 months after clearing	Year 2 – 2006
5	E	Dense	3 months, 6 months & again 12 months after clearing	Year 2 – 2006
6	F	Dense	3 months, 6 months & again 12 months after clearing	Year 2 – 2006
7	G	Dense	3 months, 6 months & again 12 months after clearing	Year 3 – 2007
8	H	Dense	3 months, 6 months & again 12 months after clearing	Year 3 – 2007
9	I	Dense	3 months, 6 months & again 12 months after clearing	Year 3 – 2007

TABLE 1: Preliminary alien vegetation control programme with control block priority ratings and suggested time frames.

*The time frame can be modified to fit in with development planning and progress and the achievable input/progress level.

6.1.5 CONTROL IN THE DEVELOPMENT ZONES

Clearing within these areas can be determined in terms of progress with the development of building sites. Development areas can either be cleared as building progresses or infestations can be cleared along with the balance of the natural areas as already outlined.

6.1.6 METHODS FOR CLEARING AND CONTROLLING THE ROOIKRANS

Mechanical eradication is an effective method of control for rooikrans. Rooikrans rarely coppices after effective cutting, but care must be taken to cut the stem as close to the ground as possible, thereby ensuring that no buds will resprout.

Young plants can be pulled by hand and intermediate sized saplings should be cut off below the root/stem junction, or be pulled out of the ground with a tree puller. (See Figure 9 for details of the puller).

It is suggested that mature trees simply be cut off as close to the ground as possible, all useable wood can then be removed and the rest stacked in rows about 20m apart. The stacked material will eventually rot, although experience is that these stacked rows persist for as long as 25 years. Initially, the stacks will reduce the impact of wind, retain moisture and even provide cover for small wildlife in the rehabilitation area. The problem with this method (cut and stack in rows) is that with the extremely dense infestations on the study area, the rows of stacked branches occupy a large proportion of the area. It would be better, for veld rehabilitation purposes, to get rid of the cut material.

This can be done by feeding the branches and foliage through a heavy-duty chipper machine. The material is reduced to a fine wood chip mulch which can then be used to cover the newly exposed soil surface and thereby protect it from wind and water erosion. The rooikrans can be cleared in blocks or strips and immediately treated with a chip mulch layer, approximately 100 - 200 m deep. Grass seed can then be sown directly into this mulch to help stabilize the sand. Strips of rooikrans should be retained in between cleared areas to help prevent wind-erosion of exposed sand. These rows can be removed when the cleared areas have a protective vegetation cover.

As with all alien vegetation control, follow-up action after the initial control is possibly more important than the initial control. This is because once a mature tree is removed, much of the seed reserve in the soil under the parent tree germinates, which means that if no follow-up takes place, one mature tree can be replaced with hundreds of small trees.

The mulch layer, and the speedy establishment of a grass sward, will help to suppress the germination of rooikrans seeds. The seeds are then dormant and are exposed to predation and rotting for longer periods.

FIG 9 **TREE PULLERS**

BOTH PULLER TYPES HAVE JAWS WHICH CLAMP FIRMLY ON THE TREE STEM WHEN THE HANDLE IS PULLED DOWNWARDS. THE FOOTPLATE PROVIDES A FULCRUM FOR LEVERAGE

6.2 REHABILITATION OF AREAS CLEARED OF ROOIKRANS AND UNDEVELOPED AREAS

The rehabilitation of undeveloped areas and areas cleared of alien vegetation will be necessary, particularly in the case of dense rooikrans infestations where there is little or no ground cover. This guideline is geared towards the rehabilitation of areas in which all, or most, of the protective indigenous vegetation cover has been lost. (Figure 10 illustrates the typical stages of rehabilitation.

6.2.1 STABILIZATION OF CLEARED OR OTHERWISE UNVEGETATED AREAS

The areas cleared of alien tree infestation are eventually to be rehabilitated to Fynbos or Coastal Thicket, or as near to these vegetation types as is possible. It will, however, take some time for Fynbos or thicket to develop the necessary protective ground cover, so it is suggested that a first stage interim stabilisation of the cleared areas be implemented as follows:

a) **MULCHING:** All of the branches and leaves of the rooikrans that are cut down should be fed through a chip-mulch machine to produce a fine wood chip mulch that must be applied as a soil surface layer to the entire cleared area.

This mulch layer will protect the soil from wind and water erosion, will preserve moisture in the soil and will eventually break down and be incorporated into the organic component of the topsoil. It will also protect germinating seedlings from larger herbivores.

If such a machine is not available, the brush can be hacked up into short bits (no more than 300 mm long) and packed over the soil surface to a depth of about 100 – 150 mm. (See Figure 10).

If a chipper machine is used, it will leave behind a 100 - 200mm thick layer of fairly fine mulch, which is acceptable. Excess mulch can be raked into heaps and removed if required.

b) **SOWING OF GRASS:** All denuded, cleared areas should be stabilised with grass. The roots of fast growing grass will assist with soil protection from wind and water erosion and, most importantly, will compete with the alien tree seedlings that can be expected to germinate in great numbers from the considerable soil-stored seed reserve. The species suggested for establishment are *Eragrostis curvula, Cynodon dactylon, Digitaria eriantha, Ehrharta calycina* and *Chloris gayana*, all of which are commercially available. A mixture of grass seed can be broadcast directly into the wood chip mulch, preferably during spring (September to November). Blue buffalo grass (*Stenotaphrum secundatum*) can, unfortunately, only be established from root runners in wetter areas. Seed can be sown at a rate of approximately 3 – 6 kg per hectare.

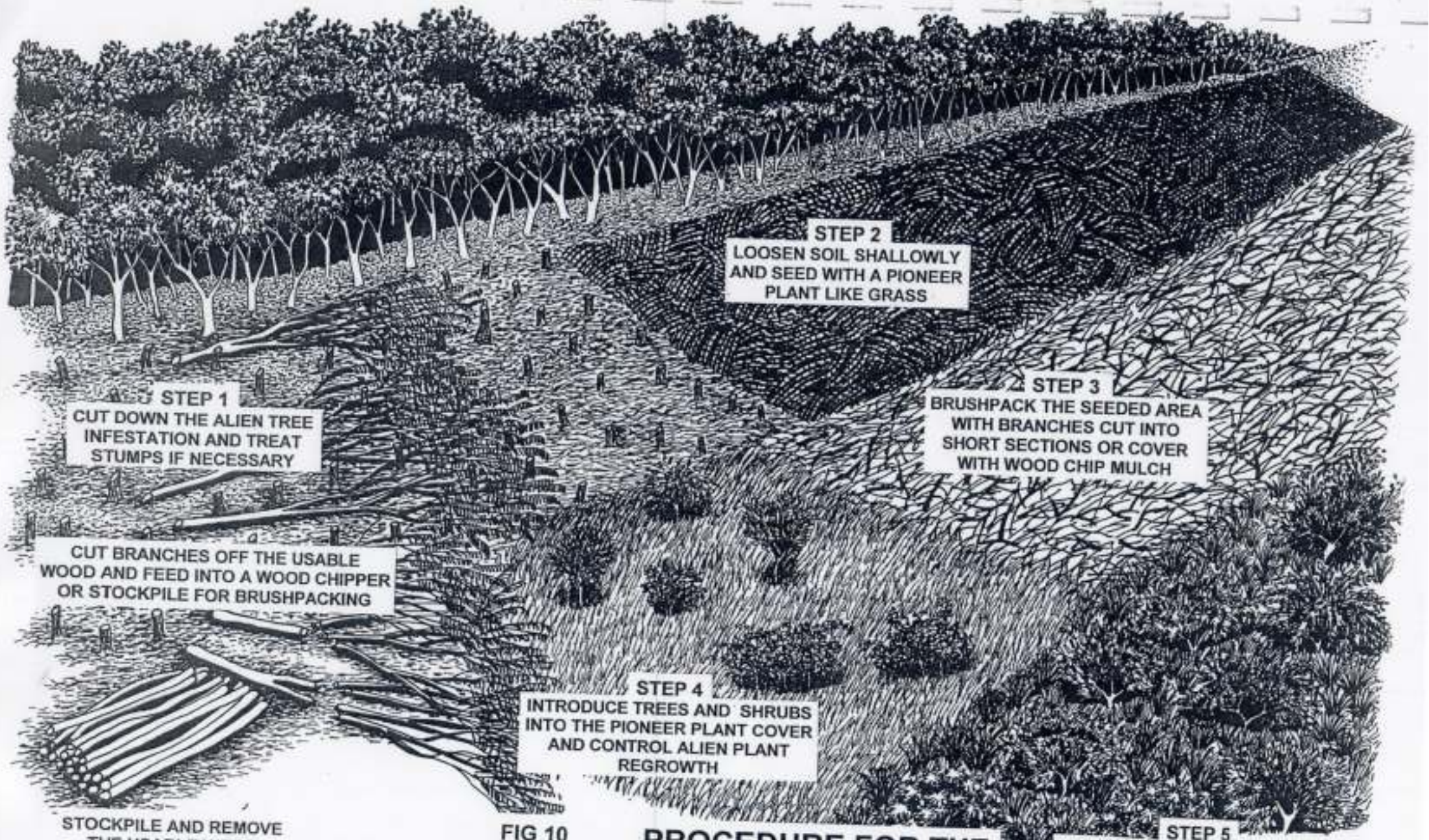


FIG 10

PROCEDURE FOR THE REHABILITATION OF ALIEN TREE AND SHRUB INFESTED AREAS

Alternatively, before the mulch is applied, the soil surface can be lightly raked and the grass seed mixture hand-sown into the raked area. Grass seed must not be buried too deeply (no more than 2 – 5mm), so that after sowing, no more than a light tamping down of the loose soil with the rake is needed. The mulch can then be spread over the sown area to a depth of about 100mm.

It is suggested that careful records be kept as to which species work best, when sown and which treatments (eg mulch thickness) work best. Perhaps a good practice will be to treat the first sowings as experimental and to sow individual grass species in clearly identifiable strips.

6.2.2 THE ESTABLISHMENT OF THICKET PATCHES

The restoration of some of the alien-infested areas to indigenous Thicket vegetation is one of the goals by means of which the primary objective of nature conservation can be achieved. Restoring Thicket will increase habitat diversity for a wide range of wildlife species (in terms of cover and food) and will also improve the aesthetic visual appeal of the rehabilitated habitat.

The restoration of the vegetation to a condition closer to its original natural state, a Thicket/Renosterveld vegetation mosaic, can be achieved by means of a combination of planting and exclusion. To successfully establish and promote Thicket species, it will be necessary to establish a suitable "microclimate" for Thicket development. The approach should thus be to establish protected patches of Thicket, that can develop their own microclimate, rather than to plant individual trees and plants. Establishing protected patches will also encourage natural germination of seeds dropped by birds and permit an indigenous understory vegetation to develop in the absence of grazing and browsing wild herbivores.

EXCLUSION SITES

The protected exclusion sites for Thicket species planting can be created by constructing a number of fenced exclosures of varying size throughout the area to be rehabilitated. The area closed off can vary in size and shape is unimportant. (Anything larger than $3m^2$ will be suitable). A protected site for planting Thicket species will thus be possible at numerous sites widely spread over the cleared and stabilized area, which will ultimately result in a pleasing mix of Thicket patches and Grassy Renosterveld in the long term. By protecting plantings in these exclosures, browsers like duiker and bushbuck will be excluded until the shrubs and trees are well established after which the fences can be removed. The exclosure should be 1,8m high.

SUITABLE SPECIES FOR PLANTING

In keeping with the nature conservation objectives for the management of the area, only indigenous species which occur naturally in the area should be considered for planting. It is strongly advised that no other species foreign to the area be introduced in the planting programme.
Special care has been taken to include the important pioneer Thicket species. These plants are generally fast growing and will quickly establish the necessary cover and microclimate per exclusion site.

The primary stabilization species of the area are *Rhus glauca, Rhus lucida, Buddleja saligna, Grewia occidentalis* and *Chrysanthemoides monilifera*. Unfortunately, these species are not always available commercially and it is thus suggested that a small nursery be established to grow these important plants from seed. Use the following procedure:

- Collect berries when ripe;
- Crush them to break up the fruit pulp, without damaging the seed inside;
- Use a weak (5 – 10%) solution of hydrochloric acid to wash the seeds. The acid will remove all of the fruit pulp (keep hands out!);
- Wash the seeds with water a couple of times;
- There is no need to keep seeds separate, mixing them per planting site is a good idea;
- Plant into nursery bags and give TLC;
- Plant out into exclosure when ±15 cm tall;
- Plant out at a rate of ±5 plants per m^2.

Other tree and shrubs species suggested for planting are:

Azima tetracantha	- beestings
Buddleja saligna	- witolienhout / false olive
Carissa bispinosa	- noem-noem / num-num
Cassine peragua	- bastersaffraan / cape saffron
Cussonia thrysiflora	- dune cabbage tree
Diospyros dichrophylla	- gewone sterappel / common star apple
Euclea undulata	- gwarrie
Grewia occidentalis	- kruisbessie / cross-berry
Gymnosporia buxifolia	- common spike thorn
Mystroxylon aethiopicum	- Kooboo berry
Olea exasperata	-
Pterocelastrus tricuspidatus	- kershout
Rhoicissus tridentata	- baboon grape
Rhus glauca	- bloutaaibos
Rhus longispina	- taaibos
Rhus lucida	- blink taaibos / glossy currant
Sideroxylon inerme	- witmelkhout / white milkwood.

Some of the above trees and shrubs are obtainable from the Diepwalle and other Forest Station Nurseries at very reasonable prices. Many of the local private nurseries also stock indigenous trees. The nurseries do not, however, always have all species available, so it is proposed that whatever is available on the list, be bought and that the other species be bought when available. The nursery will sometimes take an order and plant specially for a specific project by prior arrangement.

Of particular importance to the establishment of thicket patches is the natural role that fruit-eating birds and mammals can play. Attracting these animals to planted exclosures will further promote the establishment of indigenous plants, the seeds of which pass through the animals or are carried and dropped by them, and are deposited within the exclosures where they germinate.

Important fruiting plants on the proposed list are:

Carissa bispinosa
Cassine peragua
Chrysanthemoides monilifera
Diospyros dichrophyllum
Grewia occidentalis
Gymnosporia species
Rhus species
Sideroxylon inerme.

Care should be taken to include these fruiting species in Thicket establishment sites to take full advantage of the natural germination that will occur as a result of attracting birds.

TREE AND SHRUB PLANTING METHOD

The planting method is simple and is graphically illustrated in Figure 11. It is important to note that the best time to plant trees and shrubs is during the mid-winter months when plants are dormant. This will enable them to take full advantage of the new, more resourceful site when spring approaches and stimulates the plants to sprout and grow.

After planting, any bare soil should be covered with a suitable protective mulch. Alien tree branches (without seed) are ideal for this task, but it is important that branches are cut up into short lengths (no more than 30 cm long) so that all of the material lies in close contact with the soil surface (mulched/chipped branches can also be used). This mulch will also provide a protected site for seed germination and will also trap wind-blown seed. Alternantively, wood chip mulch can be used.

Trees and shrubs should be planted in groups or clumps rather than in rows, the objective being to create dense bushclumps which serve as cover and nesting habitat for wildlife. Trees can be planted in clumps of about 5-10 plants, each spaced 500cm - 1 000m apart from each other. A number of these clumps can be planted relatively close together (2-3) within a particular Thicket establishment patch. The number of clumps per area depends on the size of the demarcated rehabilitation area, but as a general guide, one can never have too many Thicket establishment patches.

1. Dig a hole that is twice as wide, and as deep, as the roots of your plant.

2. Push or hammer a pole into the hole, slightly to the side. The pole will help to support the young plant.

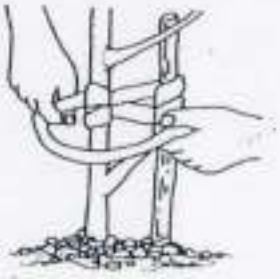
3. Place the plant in the hole, and check that the hole is the right size.

4. Spread the roots out in the hole. Take care not to damage the roots.

5. Fill the hole with soil, then press down firmly with your hand or foot.

6. Water the plant well.

7. Sprinkle a layer of mulch (dead leaves, twigs, bark, old newspaper) around the plant.



8. Tie the plant stem to the pole with a piece of hessian or strong material.

STRIPS OF TYRE INNER TUBE ALSO WORKS WELL

SOIL MIX PER HOLE

1/3 COMPOST
2/3 SOIL FROM HOLE
1 CUP 2:3:2 FERTILIZER
1 CUP BONE PHOSPHATE

FIG 11

TREE AND SHRUB PLANTING GUIDE

6.3 LAYOUT AND DESIGN OF A FOOTPATH NETWORK

The natural or undeveloped open space areas of the development should be accessible to residents and visitors. Excessive trampling of the natural, and rehabilitated vegetation, must be avoided by the provision of a network of formalized footpaths. This footpath network should link all of the different parts of the development with the central drainage Thicket feature that lies along the length of much of the property. The layout of the path network can link with sections of the road access within the development to form a series of circuit walks. The proposed path network is illustrated in Figure 12. Key features of the proposed footpath network are as follows:

a) The bulk of the path network should consist of a well graded impervious non-slip surface. The paths should be preferably brick-paved or gravel surfaced.

b) In wet areas and where the route is through Thicket, the path should be on a raised wooden boardwalk. (See Figure 13).

c) The drainage crossings should be over wooden foot bridges which will not hinder the flow of water or impact on wetland vegetation. (See Figure 13).

d) Where the pathway is hard surfaced with gravel, adequate drainage off the path must be ensured and steeper sections should be provided with level pole steps to ensure slope stability on the path. (See Figure 14).

6.4 NON-INVASIVE PLANTS FOR PRIVATE GARDEN PLANTING

OBJECTIVE:
To eliminate the chance of alien vegetation invasion by providing residents with guidelines for acceptable garden plant establishment.

Residents on the estate should be requested to use only non-invasive plants for their private gardens. It would be an excellent policy to encourage residents to only plant indigenous plants, and preferably locally indigenous species. This may, however, meet with some opposition. It is thus suggested that only trees indigenous to the South Cape coastal area be permitted, but that any South African indigenous shrubs, bulbs, flowers, climbers or reeds and grasses be permitted. Residents should, however, be encouraged to plant local fynbos species.

Alien trees that should not be permitted, either because they are invasive in natural vegetation, or because they will not "fit in" aesthetically at the estate are as follows: (* indicates highly invasive species).

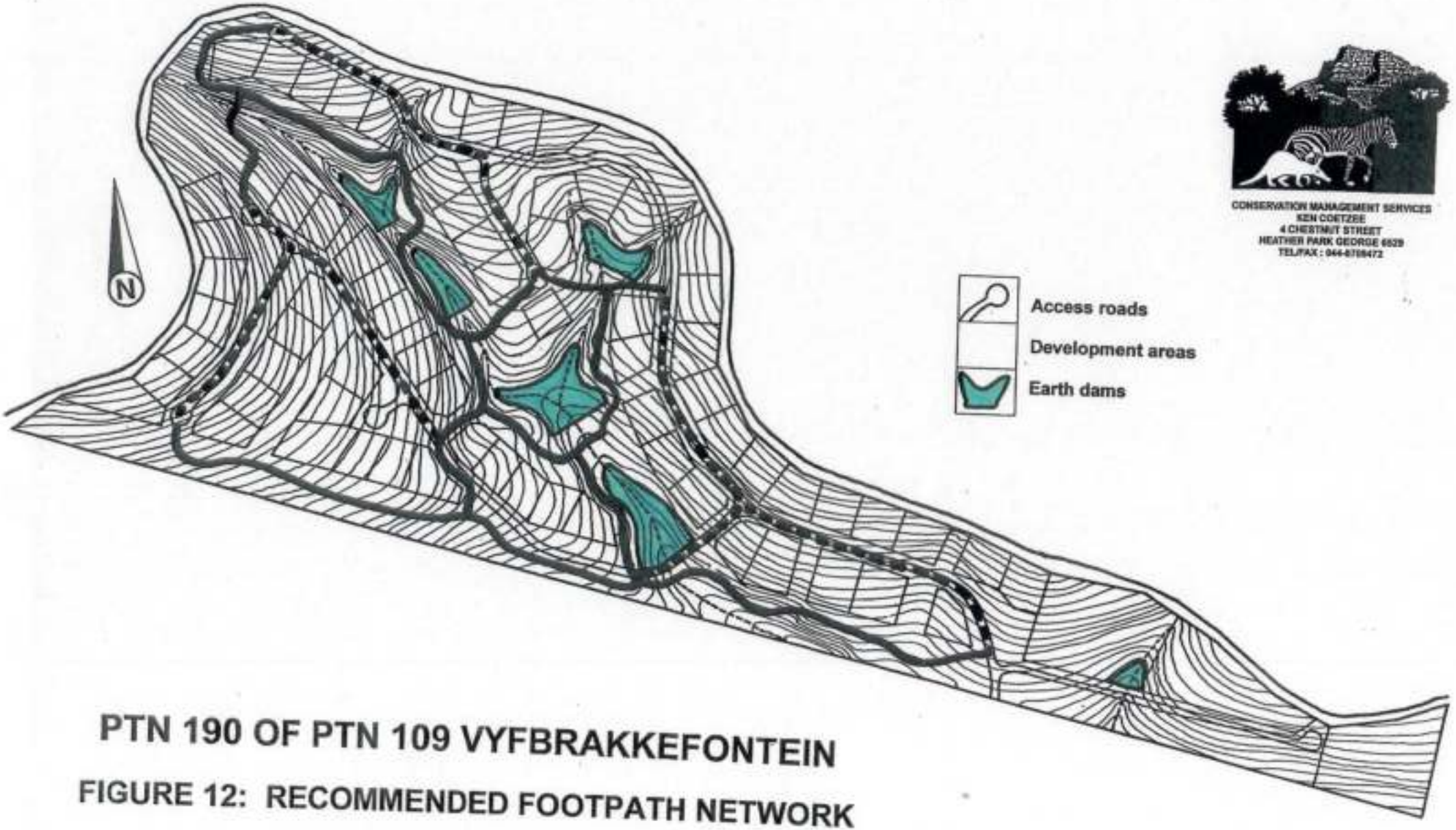


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FIGURE 12: RECOMMENDED FOOTPATH NETWORK

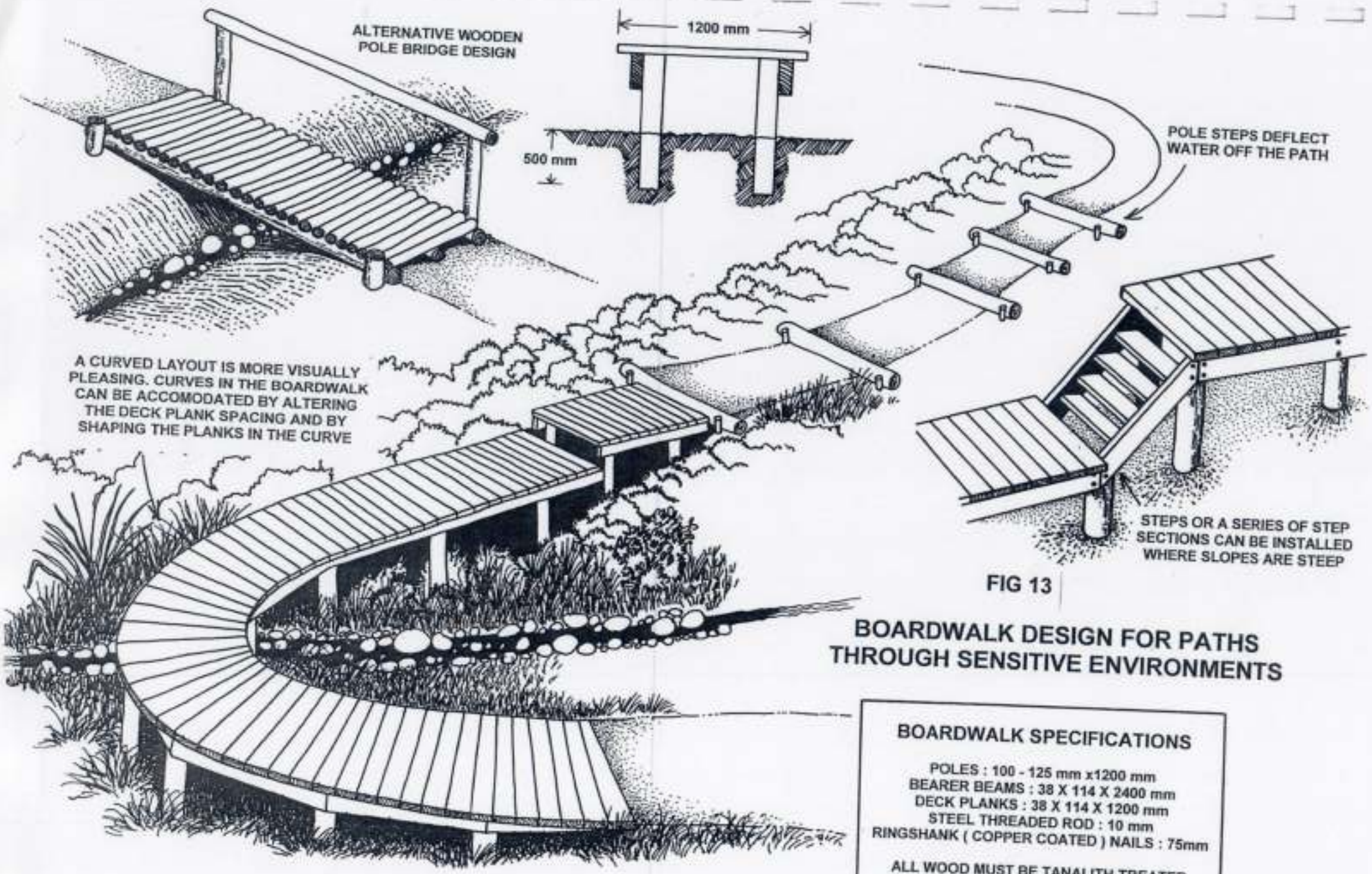

FIG 13

BOARDWALK DESIGN FOR PATHS THROUGH SENSITIVE ENVIRONMENTS

BOARDWALK SPECIFICATIONS

POLES : 100 - 125 mm x1200 mm
BEARER BEAMS : 38 X 114 X 2400 mm
DECK PLANKS : 38 X 114 X 1200 mm
STEEL THREADED ROD : 10 mm
RINGSHANK (COPPER COATED) NAILS : 75mm

ALL WOOD MUST BE TANALITH TREATED
DECK PLANKS SPACED 15 - 20 mm APART
EACH PLANK FIXED WITH 4 NAILS

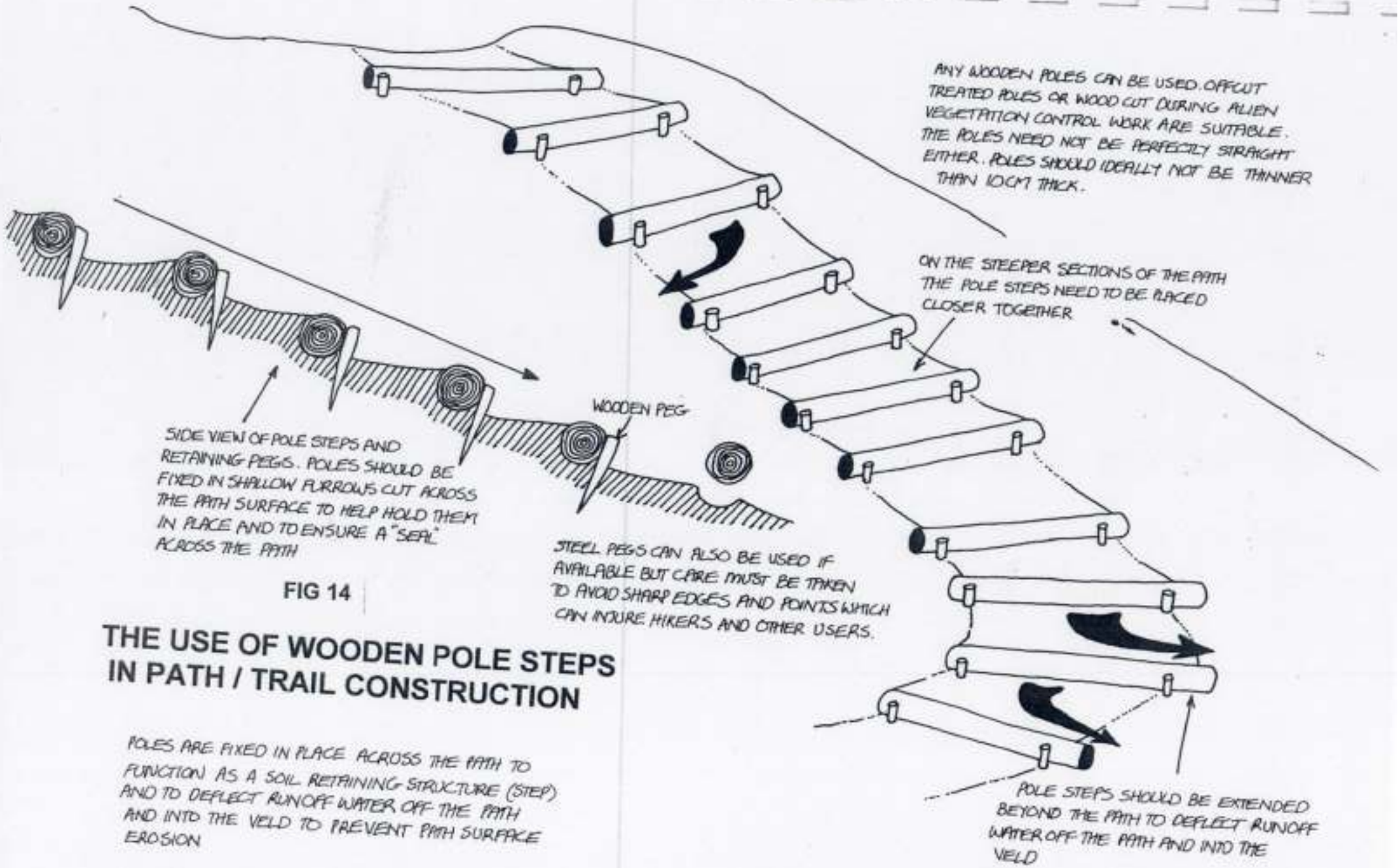

FIG 14

THE USE OF WOODEN POLE STEPS IN PATH / TRAIL CONSTRUCTION

POLES ARE FIXED IN PLACE ACROSS THE PATH TO FUNCTION AS A SOIL RETAINING STRUCTURE (STEP) AND TO DEFLECT RUNOFF WATER OFF THE PATH AND INTO THE VELD TO PREVENT PATH SURFACE EROSION

Acacia cyclops	- rooikrans *
Acacia dealbata	- silver wattle
Acacia decurrens	- green wattle
Acacia elata	- pepper tree wattle*
Acacia longifolia	- long-leafed wattle *
Acacia mearnsii	- black wattle *
Acacia melanoxylon	- blackwood *
Acacia podalyriifolia	- pearl acacia
Acacia pycnantha	- golden wattle
Acacia saligna	- Port Jackson wattle *
Ailanthus altissima	- tree of Heaven *
Caesalpinia decapetala	- Mauritius thorn *
Casuarina species (all)	- beefwood *
Cinnamomum camphora	- camphor tree
Cottoneaster franchetti	- cottoneaster *
Cystsus species (all)	- broom *
Eucalyptus species (all)	- gum trees *
Grevillea robusta	- Australian silky oak *
Hakea species (all)	- hakea *
Jacaranda mimosifolia	- jacaranda *
Leucaena leucocephala	- Australian myrtle
Ligustrum species (all)	- privets *
Melia azedarach	- syringa *
Metrosideros excelsa	- New Zealand bottlebrush *
Myoporum tenuifolium	- manatoka *
Nerium oleander	- oleander *
Paraserianthes lophantha	- stink bean *
Pinus species (all)	- pine trees *
Pittisporum undulatum	- Australian cheesewood
Populus species (all)	- poplars *
Prosopis species (all)	- mesquite *
Psidium species (all)	- guava *
Quercus robur	- English oak *
Schinus molle	- pepper tree *
Schinus terebinthifolius	- Brazilian pepper tree *
Spartium junceum	- Spanish broom *
Tamarix ramosissima	- pink tamarisk *.

Shrubs and herbaceous plants that should definitely not be planted are:

Agave species (all)	- agave/sisal
Cereus species (all)	- cacti
Cestrum species (all)	- inkberry
Cortaderia species (all)	- pampas grass
Echinopsis species (all)	- cacti
Harrisia species (all)	- cacti
Hedychium species (all)	- ginger lilies
Hypericum perforatum	- St John's wort
Lantana camara	- lantana *

Opuntia species (all)	- cacti
Passiflora species (all)	- granadilla/passion flower
Pyracantha angustifolia	- yellow fire thorn *
Pyracantha crenulata	- Himalayan firethorn *
Ricinis communis	- caster-oil plant *
Robinia pseudoacacia	- black locust
Rubus species (all)	- brambles *
Senna didymobottrya	- peanut butter cassia
Sesbania punicea	- red sesbania *
Solanum mauritianum	- bugweed *
Tithonia species (all)	- Mexican sunflower.

Locally indigenous tree and shrub species that are particularly well suited to conditions in the estate area are:

Acacia karoo	- soetdoring / sweet thorn
Buddleja saligna	- witoelienhout / false olive
Carissa bispinosa	- bosnoemnoem / forest num-num
Chrysanthemoides monolifera	- bietou / bush-tick berry
Diospyros dichrophylla	- gewone sterappel / common star apple
Grewia occidentalis	- kruisbessie / cross-berry
Gymnosporia buxifolia	- common spike thorn
Leonotis leonurus	- wildedagga / wild dagga
Leucadendron salignum	- geelbos / sunshine protea
Ochna serrulata	- rooihoutbos / plane bush
Olea europaea var *africana*	- olienhout / wild olive
Osyris compressa	- pruimbas / Cape sumach
Polygala myrtifolia	- septemberbossie
Protea neriifolia	- black-bearded protea
Pterocelastrus tricuspidatus	- candlewood / kershout
Rhamnus prinoides	- blinkblaar / dogwood
Rhus laevigata	- duinetaaibos / dune currant
Rhus lucida	- blink taaibos / glossy currant
Salvia africana lutea	- geelblomsalie /dune salvia
Sideroxylon inerme	- witmelkhout / white milkwood
Sutherlandia michrophylla	- kankerbos / cancer bush
Tarchonanthus camphoratus	- wildekanferbos / wild camphor bush
Virgilia oroboides	- keurboom / blossom tree.

In addition to these plants, residents should be encouraged to plant any of the species that are recorded in the ESA checklist. (See Appendix 1).

The acquisition of locally indigenous bulb plants, dwarf shrubs, ground covers, creepers, annuals and flowering shrubs will depend on the availability of these plants at local nurseries in Mossel Bay and George and are thus not be specifically listed here.

Residents should be given copies of these planting guidelines prior to the commencement of construction, so that they can begin to plan garden landscaping in advance.

6.5 WILDLIFE PROTECTION AND MANAGEMENT

Larger wildlife like the Cape francolin (*Francolinus capensis*), the guinea fowl (*Numidia meleagris*), bushbuck (*Tragelaphus scriptus*) and grysbok (*Raphiceros melanotis*) and porcupine (*Hystrix africeaustralis*) still occur in the general area. These species and a diversity of other locally indigenous rodents, insectivores, bats, small carnivores, reptiles, amphibians and birds all add up to an interesting and conservation-worthy fauna on the estate.

A generally protective policy should be adopted for the estate and the requirements of this policy, in the form of a sheet of do's and don'ts, should be incorporated into the homeowners' association constitution. This information should be conveyed to each existing and new landowner and it should also be interpreted at focal points on the property.

A policy of tolerance and specialist intervention only, should be adopted for all interactions with wildlife, as is generally required by the provincial nature conservation legislation. This policy should be established in conjunction with the establishment of wildlife species checklists for the estate area. This will help to identify whether any rare or endangered species require specialist management.

6.6 MANAGEMENT OF DOMESTIC PETS

Due to the disturbance and destruction that can be caused by domestic dogs and cats within a nature area, the following restrictions should be applied to domestic pets:

DOGS: If a resident wishes to keep a dog (or dogs), the homestead footprint area of 600m² (or less) should be completely and adequately fenced to contain the dogs. Dog-proof fencing (for bigger breeds) should be no less than 1,5m high.

Preferably, dogs should not be taken into the nature area, even if on a leash. The continued presence and scent of dogs along the nature trail and dog faeces in the area may keep the smaller game wild and may even force them to move out of the area, or may restrict their normal behaviour and breeding. This would not be desirable from a nature enjoyment point of view and the opportunity to establish relatively tame and often seen small game will be lost.

The homeowners association should have the right to decide on the fate of problematic dogs – this must, however, be a condition of purchase into the development. The Association should also have the right to decide on whether dogs should be permitted into the nature area. If a decision is taken to permit dogs on the path network, they should be kept on a leash.

CATS: Cats are highly successful and active predators of small wildlife such as mice, reptiles and birds. They also freely interbreed with the African wildcat, which occurs naturally in the area, and eventually resulting in a population of wild semi-domestic cats. This is very bad for African wildcat conservation and as a result, the

species is now classed as "vulnerable" in the Red Data Book for South African mammals. It is impossible to fence cats in to contain them within the residence gardens, this leads to the following recommendation:

- All male cats must be neutered.
- All female cats must be spayed.
- All cats should be fitted with bells on collars to warn small potential prey of their presence.

6.7 AUDITING

Compliance, or progress, with the Operational Phase EMP should ideally be audited on an annual basis. The results of these audits can then be used to help with project and financial planning for the following operational or financial year. The audit can thus become an important management tool for the property.

The audits should be done by a competent person who is completely independent of the development project. The audits can be simply administered by dealing with each project of the EMP and commenting on progress or compliance on the environmental audit form illustrated in Figure 7.

The list of projects that should be audited include the following:

i. Progress per prescribed alien vegetation control block.
ii. Progress with the rehabilitation of areas cleared of alien vegetation. Subprojects to audit are:
    - *mulching;
    - * pioneer grass establishment;
    - * establishment of Thicket patches;
    - * species used for rehabilitation;
    - * species used for gardening;
    - * rehabilitation/greening of dams.
iii. Management of domestic pets.
iv. Progress with the footpath network.
v. General wildlife protection and management.
vi. Other environmental management initiatives.

Completed audit reports should then be submitted to the Homeowners' Association and the relevant nature conservation authority (WCNCB) and also to DEA & DP if so required.

APPENDIX 1

INDIGENOUS PLANT SPECIES CHECKLIST FOR VYFBRAKKEFONTEIN

The following checklist indicates species that were located on the site during the fieldwork. 24 of the plants were identified by Jan Vlok of *Regalis Environmental Services*. (19/06/2003).

PLANT SPECIES CHECKLIST – RENOSTERVELD

Agathosma ovata
Athanasia trifurcata
Bobartia robusta
Brunsvigia orientalis
Carpobrotus edulis
Chironia baccifera
Chrysanthemoides monilifera
Crassula sp
Cynodon dactylon
Digitaria eriantha
Diospyros dichrophylla
Drosanthemum sp
Ehrharta sp
Elytropappus rhinocerotis
Eragrostis capensis
Eragrostis chloromelas
Eragrostis curvula
Eragrostis obtusa
Eragrostis plana
Eriocephalus africanus
Euclea racemosa
Euclea unulata
Gnidia squarrosa
Helichrysum cymosum
Hermannia flamula
Hermannia holosericea
Hermannia saccifera
Hibiscus trionium
Hyparrhenia hirta
Indigofera denudata
Indigofera heterophylla
Jamesbrittenia tenuifolia
Lycium cinereum
Melinis repens
Montina caryophyllacaea
Muraltia ericifolia
Oedera genistifolia
Osteopermum glabrum
Oxalis confertifolia
Oxalis polyfilla
Oxalis psilopoda
Panicum maximum
Pelargonium suburbanum
Phylica axillaris
Phyllopodium rustii
Polygala myrtifolia
Rhus glauca
Rhus lucida
Selago albida
Senecio sp
Sporobolus africanus
Sporobolus africanus
Themeda triandra
Ursinia anatoides.

PLANT SPECIES CHECKLIST – THICKET

Acokanthera oppositifolia
Aloe ferox
Asparagus asparagoides
Asparagus striatus
Azima tetracantha
Buddleja saligna
Carissa bispinosa
Carpobrotus edulis
Cassine peragua
Cussonia thrysiflora
Diospyros dichrophylla
Euclea undulata
Grewia occidentalis
Gymnosporia buxifolia
Gymnosporia nemorosa
Mystroxylon aethiopicum
Olea exasperata
Panicum maximum
Pterocelastrus tricuspidatus
Putterlickia pyracantha
Rhoicissus tridentata
Rhus glauca
Rhus longispina
Rhus lucida
Sarcstemma viminale
Schotia afra var *afra*
Scutia myrtina
Sideroxylon inerme.