N2 Wild Coast Biodiversity Offset Project

Offset Implementation Management Series

Report 3

Ecosystems and Rehabilitation Implementation Plan

ADVENTURE PROVINCE
Eastern Cape
PARKS & TOURISM AGENCY

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SUBMISSION

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EXECUTIVE SUMMARY

One of the key aspects of the N2 Wild Coast Biodiversity Offset project is land rehabilitation. The majority of land that is under communal land tenure system has not been managed with any conservation standards. This has led to extensive land degradation through inappropriate landuse options. It is therefore necessary that prior the rehabilitation interventions, a reflection on the current extent, condition and rehabilitation options for the major ecosystems of the planning domain be reflected upon. Although some of the work was presented in the Situational Assessment phase of the project, in this report it is presented against the backdrop of quantifying rehabilitation needs. The rehabilitation aspects of the work potentially feed into the SMME and community aspects of implementation in later reports. This report then presents the options that are available for rehabilitation/restoration of these degraded systems.

The ecosystems that the report focuses on are:

- Wetland and riparian ecosystems
- Grassland ecosystems
- Forests and other woody ecosystems
- Coastal and estuarine ecosystems

The report then presents the spatial trends and offset priorities based on the SANBI 2018 ecosystems and an analysis of aerial imagery per offset. It concludes with management suggestions on how to implement all the principles described. These suggestions are NOT an attempt to provide operational-level detail as this requires a vast amount of site-level detail that will only become available once the sites become operational. It is the work of the site managers to operationalise the principles and procedures reported here.

ACRONYMS, ABBREVIATIONS AND TERMINOLOGY

APOs Annual Plan of Operations
CEPF Critical Ecosystem Partnership Fund
DEFF Department of Environment Forestry and Fisheries
DWS Department of Water and Sanitation (National)
ECA Environment Conservation Act (73 of 1989)
ECPTA Eastern Cape Parks and Tourism Agency
EPWP Extended Public Works Programme
ESA Ecological Support Area
FPA Fire Protection Associations
GIS Geographic Information System
IAP Invasive Alien Plant
NEMA National Environmental Management Act (107 of 1998)
NEMBA National Environmental Management: Biodiversity Act (10 of 2004)
NFA National Forest Act (1998)
RoD Record of Decision
SANBI South African National Biodiversity Institute
SANRAL South African National Road Agency Limited
SMME Small, Medium- and Micro-Enterprises
WESSA Wildlife and Environmental Society of South Africa
WFW Working for Water Programme

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INTRODUCTION

The South African Roads Agency SOC Limited (SANRAL) is constructing the "new" N2 Road along the Wild Coast in the Eastern Cape. To mitigate the anticipated environmental impacts as described in the Environmental Impacts Assessment report, the Department of Environmental Affairs Record of Decision (April 2010) required the establishment of biodiversity offsets. In this Wild Coast Biodiversity Offset Project (hereafter the 'Project'), offsets will be sites that are proclaimed as Nature Reserves or Protected Environments in terms of Sections 23 and 28 of the NEM: Protected Areas Act (2003).

SANRAL appointed the Eastern Cape Parks and Tourism Agency (ECPTA) to implement the Project for a period of ten (10) years on the offset sites identified by Botha and Brownlie (2014). The ECPTA's key mandate within the Project is to ensure that these sites are declared in terms of the NEM: Protected Areas Act (2003), with an appropriate implementation plan with spatial management objectives, responsibilities, budgets and timeframes. Sigwela and Associates (S&A) were contracted by the ECPTA to undertake the first phase of the Project with the purpose of developing the various implementation management plans, which is the focus of this report series.

Considerable work was done to assess aspects such as the biodiversity, agricultural, economic and others, of these sites during the initial phases of the Project. This resulted in a variety of reports, such as the Site Assessment Report. During this process, there was considerable engagement with the affected communities living in and around the proposed offset sites and significant changes were made to the original configuration of sites. The now 14 sites are gathered into three loose geographic areas: The Mkambati-Ntentule Complex, the Lambasi-Ntsubane Complex, and the Mount Thesiger-Caguba Complex (see Figure 1).

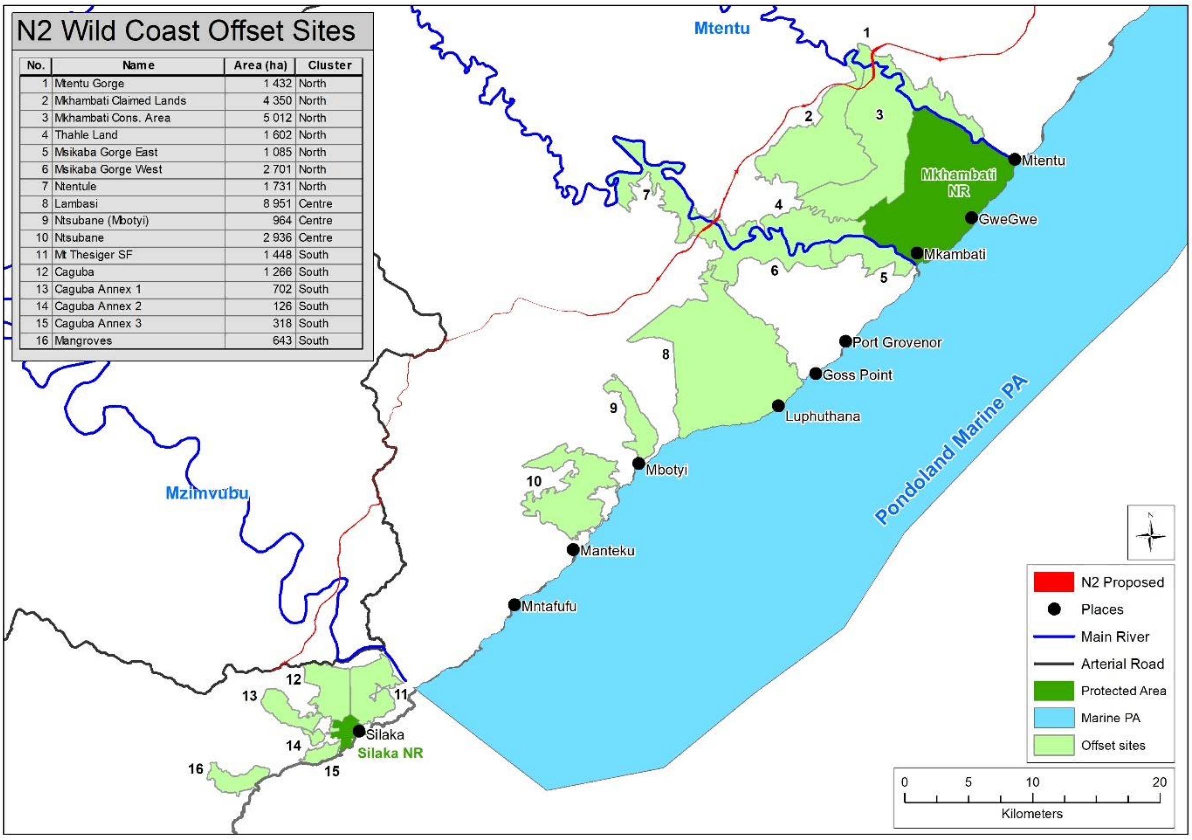


Figure 1. The final configuration of offset sites in the Project after engagement with the communities

This report is the third in a series that describes the implementation of the various aspects of offset development and management, to be used by the ECPTA as the basis for strategic management in the coming eight-year management phase described in their agreement with SANRAL. This report focuses on the natural ecosystems that comprise most of the area, and these ecosystems form the foundation for much of the other aspects of implementation, such as tourism, Small-, Micro- and Medium-sized Enterprises (SMMEs) and IAP control.

REPORT PURPOSE AND STRUCTURE

The purpose of this report is to provide information on the current extent, condition and rehabilitation options for the major ecosystems found across the clusters, building on but not repeating the work already done in the previous reports for the Project. The rehabilitation aspects of the work potentially feed into the SMME and community aspects of implementation in later reports.

This report is structured to provide an analysis of the ecosystems for each of the clusters of offset sites. This is followed by descriptions of the problems faced by the main ecosystems and the options available to rehabilitate degraded or damaged areas.

The aim of ecosystem rehabilitation is not just the restoration of the natural resources/capital (such as environmental goods and services) but, the restoration of a sustainable "man-nature" relationship where both social and financial capital of the rural communities are improved for better livelihoods.

It is not the purpose of this report to copy the extremely good published works on management and rehabilitation of South African ecosystems. These will be referred to as necessary resources and it is vital that the ECPTA staff responsible for any ecosystem management and rehabilitation should familiarise themselves with the relevant best-practices. The purpose of this management series is to highlight the key principles associated with the drivers of degradation, basic rehabilitation and ongoing management. This is done for each of the major ecosystems in the area:

- Wetland and riparian ecosystems
- Grassland ecosystems
- Forests and other woody ecosystems
- Coastal and estuarine ecosystems

Thereafter, the spatial trends and offset priorities are discussed, based on the SANBI 2018 ecosystems and an analysis of aerial imagery per offset.

The report concludes with management suggestions on how to implement all the principles described. These suggestions are NOT an attempt to provide operational-level detail, as this requires a vast amount of site-level detail that will only become available once the sites become operational. It is the work of the site managers to operationalise the principles and procedures reported here.

DEGRADATION, MANAGEMENT AND REHABILITATION PRINCIPLES

Wetland and riparian ecosystems

Ecosystem description

In the past, wetlands were not recognised to have value. So in many areas they were drained or converted to arable lands due to their high soil fertility. More recently, however, wetlands are considered invaluable natural assets that provide a range of products, functions and ecosystem services.

The National Water Act, No. 36 of 1998 defines a wetland as:

> *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".*

Wetlands can be occasionally, seasonally or permanently wet, yet sometimes even staying dry for up to several years. Wetlands on the Wild Coast can occur in a variety of locations across the landscape, even at the top of a hill, and range in size from a few square metres to many hectares.

Wetland ecosystems provide a range of ecological and social services which benefit people, society and the economy at large, including the following:

- Water provision, regulation, purification and groundwater replenishment, which are crucial for water security and water supply for food security.
- Ecosystem health performing many functions that include flood control, water purification, sediment and nutrient retention and export, recharge of groundwater, as well as acting as vital habitats for diverse plant and animal species.
- Ecological infrastructure, replacing the need for municipal infrastructure by providing the same or better benefit at a fraction of the cost.
- Flood control as well as a means of purification. The slow movement of water allows heavier impurities to settle and phreatic vegetation and micro-bacteria the opportunity to remove pollutants and nutrients. For these reasons, artificially created wetlands are often used in newer urban drainage systems to aid both mitigation of flooding and improvement of water quality.
- Valuable open spaces and recreational opportunities for people that include hiking, fishing, boating and bird-watching.
- Cultural and spiritual significance for the communities living nearby. Commercially, products such as reeds and peat are also harvested from wetlands.

Wetlands are thus considered to be critically important ecosystems as they provide both direct and indirect benefits to the environment and society.

There are many types of wetland, separated mostly by their hydro-geomorphic and vegetative characteristics. These details are well-described in the National Biodiversity Assessment reports and will not be repeated here. However, it is important to know what types of wetland are being rehabilitated as the details of the rehabilitation plan will depend on the wetland type.

Drivers of degradation

Wetlands and riparian areas can either be degraded through direct on-site impacts or indirect upstream, in-catchment impacts. Direct impacts are primarily associated with physical damage to the wetland. Although such activities occur in the Project area, they are generally quite small in scale and relatively easily repaired once the driver of the degradation has been identified and removed. Direct drivers include the following:

- Arable use of wetlands during the dry seasons. Many wetlands are ploughed when they are dry enough as they are relatively fertile and have a high moisture content. This seriously damages the flora and fauna of the wetlands and often results in significant erosion problems after the crops are harvested and the land left fallow for years. In some cases, wetlands are deliberately drained to provide more arable land.
- Uncontrolled livestock access, which can form erosion dongas and drainage channels that affect the hydrology of the wetland.
- Sand mining, where sand is mined directly from the wetland or river banks. In some cases, the wetlands downstream of such activities are damaged by sedimentation.
- Poorly planned roads and jeep tracks, and even livestock paths, that which cross sensitive wetlands and riparian areas without consideration of drainage or other factors. These very often lead to erosion dongas and multiple paths and tracks in and around the wetland.
- Injudicious development.

Harder to deal with are the indirect drivers of degradation, which generally occur some distance away from the wetland. Such drivers often occur at a catchment scale and have widespread effects on all the wetlands along a river system. Indirect drivers include the following:

- Stream-flow reducing activities, such as plantation timber or irrigated agriculture, that affect the hydrology of the entire system. Generally, such activities manifest strongly during dry seasons when wetlands will dry up prematurely and remain in a dry state for longer periods. This has a significant effect on the biodiversity of the wetlands. In some cases, the infestation of riparian systems and wetlands by IAPs can lead to massive changes in biotia and hydrology, leading to the destruction of the ecosystem.
- Catchment degradation that results in a loss of basal cover over the soil and increased rates of soil erosion. The soil often ends up as a thick layer of sediment in the wetland systems, chocking the flora and fauna.
- Eutrophication of river systems by point-source injections of nutrients from settlements (mostly sewerage) or more extensive inputs from arable throughflow. The rapid build-up of dead and decaying plant and algal material associated with eutrophication of river and wetland systems leads to a significant change in the water and soil biochemistry, with devastating impacts on the biodiversity.

Rehabilitation

At the onset of planning for wetland rehabilitation, it should be remembered that this is a legislated matter that will need an Environmental Impact Assessment (EIA) permit (issued by the Department of Environment Forestry and Fisheries) and a Water use License (issued by the Department of Water and Sanitation).

The WET-Management Series[1] is a set of integrated tools to guide wetland management and rehabilitation. The tools are designed to be used at different spatial and institutional levels to meet a range of wetland management and rehabilitation needs. Some tools are used to assess wetland health and ecosystem services. Others can be used to foster wise wetland management and develop an understanding of the driving forces behind the formation and degradation of wetlands. The tools offer a sound scientific basis for planning, implementing and evaluating wetland rehabilitation, providing guidelines to:

[1] A product of the Wetland Rehabilitation component of the National Wetlands Research Programme, an initiative of the Water Research Commission (WRC).

- Develop an overall planning framework (WET-Rehab Plan)
- Assess the condition of catchments and individual wetlands (WET-Health)
- Assess the functions and values of individual wetlands (WET-EcoServices)
- Evaluate the need for rehabilitation (WET-Prioritise and WET-Legal)
- Identify why wetlands degrade and what rehabilitation interventions are appropriate (WET-Origins and WET-Methods)
- Guide the selection and implementation of rehabilitation methods (WET-Methods)
- Monitor the success of rehabilitation projects (WET-Rehab-Evaluate and WET-Effective Manage).

Recommendation 7.2 of the RoD for the development of the N2 Road notifies the holder of the RoD that prior to the construction of the road, one of the permits that should be obtained is a water use licence (under Section 21 c & i) of the National Water Act 1998 (NWA). This is in relation to Condition 6.2.11 of this RoD which focuses on 'wetlands and watercourses'. Thus 'wetland rehabilitation' is one of the activities included in the offset sites. The Working for Wetlands programme has established standards and policy objectives for wetland rehabilitation, conservation and management, with an emphasis on the Expanded Public Works Programme (EPWP) and using only local Small-, Medium- and Micro-Enterprises (SMMEs). The EPWP seeks to draw significant numbers of unemployed people into the productive sector of the economy, gaining skills while they work and increasing their capacity to earn an income. This Implementation Plan for the rehabilitation of wetlands is based on the Working for Wetlands Standard Operating Procedures.

To design an appropriate offset for significant residual impacts on wetland ecosystems, it is essential to have a measure of or to quantify these wetlands, and the extent of wetland ecosystems in the biodiversity offset sites is described per cluster below.

The rehabilitation of wetlands obviously depends on the type of wetland and the nature of the problems it is subject to. Although generalisations can be made about the principles of wetland rehabilitation, it is very important that each case be considered individually. Without such due diligence, rehabilitation efforts may cause more damage. We thus advocate that any wetland rehabilitation follows the Standard Operating Procedures of Working for Wetlands, which require that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established (flow is encouraged to disperse rather than to concentrate). Indeed, we recommend that the ECPTA formally partner with Working for Wetlands to conduct any rehabilitation of damaged wetlands in the project area as they have the experience and knowledge already, and their method of operation is entirely congruent with the following offset goals of the ECPTA:

- Restoration of hydrological integrity (e.g. raising the general water table or redistributing the water across the wetland area)
- Rehabilitation of wetland habitat towards the conservation of biodiversity
- Job creation and social upliftment

Methods of wetland rehabilitation may include hard engineering interventions such as the following:

- Earth berms in conjunction with gabion systems to block artificial channels that drain water from or divert polluted water to the wetland
- Concrete and gabion weirs to act as settling ponds, to reduce flow velocity or to re-disperse water across former wetland areas thereby re-establishing natural flow paths
- Earth or gabion structure plugs to raise channel floors and reduce water velocity
- Concrete or gabion structures to stabilise head-cut or other erosion and prevent gullies
- Gabion structures (mattresses, blankets or baskets) to provide a platform for the growth of desired wetland vegetation

They may also include soft engineering interventions such as the following:

- Re-vegetation of stabilised areas with appropriate wetland and riparian plant species
- Fencing of sensitive areas within the wetland to keep grazers out, and to allow for the re-establishment of vegetation
- Use of biodegradable or natural soil retention systems such as eco-logs, plant plugs, grass or hay bales and brush-packing techniques
- Use of appropriate fire management and burning regimes as well as the removal of undesirable plant and animal species
- IAP clearing, which is an important part of wetland rehabilitation (and this is supported by the Working for Water Programme)

Wetland rehabilitation is a relatively complex and medium-term process that requires considerable coordination and commitment. To implement a wetland rehabilitation programme in the Biodiversity Offset Project, wetlands need to be grouped into "Projects", comprising spatially-linked wetland systems within each offset, which are then divided into smaller, more manageable and homogenous wetland units. Each Project is managed in three phases over a two-year cycle (see Figure 2). The first two phases straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase is implementation, which takes place during the second year.

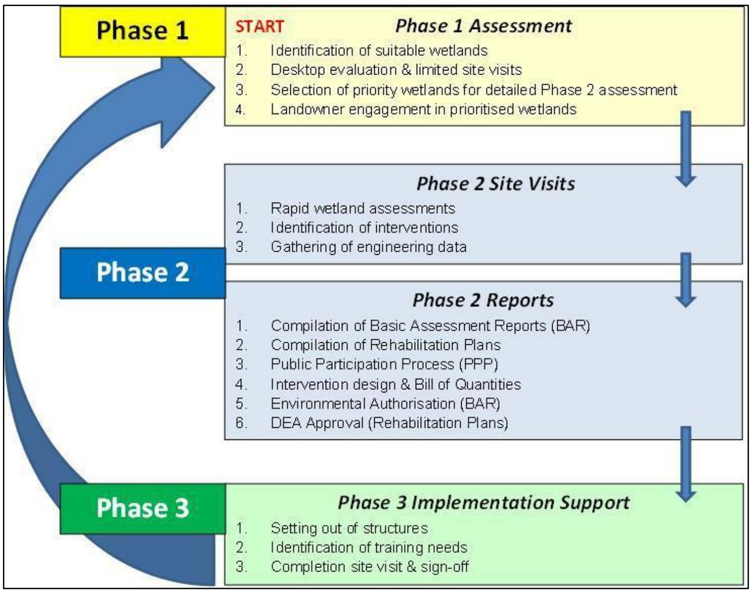


Figure 2. The Working for Wetlands planning process (Phase 1 to Phase 3).

Phase 1 commences with the identification and prioritisation of wetlands which require an intervention, either to prevent degradation or to rehabilitate existing degradation. It is important to involve key stakeholders who will provide meaningful input into the planning phases and wetland selection processes, and who will review and comment on the rehabilitation proposals. Phase 1 also includes initial communication with local communities (landowners) and other Interested and Affected Parties (I&APs) to gauge the social benefits of the work. Once wetlands have been identified and prioritised, and agreed upon by the various parties, specific rehabilitation objectives are determined for each wetland following a rapid wetland status quo assessment undertaken by a wetland ecologist.

Phase 2 requires site visits attended by the fieldwork team comprising a Wetland Ecologist, a Design Engineer, an Environmental Assessment Practitioner, and a SANBI Provincial Coordinator. Other interested stakeholders or authorities, landowners and in some instances the implementing agents may also attend the site visits on some occasions. This allows for a highly collaborative approach, as options are discussed by experts from different scientific disciplines, as well as local inhabitants with deep anecdotal knowledge. While on site, rehabilitation opportunities are investigated. The details of the proposed interventions are discussed, some survey work is undertaken by the engineers, and GPS coordinates and digital photographs are taken for record purposes. Furthermore, appropriate dimensions of the locations are recorded in order to design and calculate quantities for the interventions. At the end of the site visit the rehabilitation objectives together with the location layout of the proposed interventions are agreed upon by the project team.

During Phase 2, monitoring systems are put in place to support the continuous evaluation of the interventions. The systems monitor both the environmental and social benefits of the interventions. As part of the Phase 2 site visit, a maintenance inventory of any existing interventions that are damaged and/or failing and thus requiring maintenance is compiled by the Project Coordinator, in consultation with the Design Engineer.

Based on certain criteria and data measurements (water volumes, flow rates and soil types), the availability of materials such as rock, labour intensive targets, maintenance requirements, etc., the interventions are then designed. Bills of quantity are calculated for the designs and cost estimates made. Maintenance requirements for existing interventions in the assessed wetlands are similarly detailed and the costs calculated. The Design Engineer also reviews and, if necessary, adjusts any previously planned interventions that are included in the historical Rehabilitation Plans.

Phase 2 also comprises a reporting component where Rehabilitation Plans are prepared for each Wetland Project. It should be remembered that Rehabilitation Plans for wetlands cannot be general, each wetland is different from each other. The Rehabilitation Plans should include details of each intervention to be implemented, preliminary construction drawings and all necessary documentation required by applicable legislation. The Rehabilitation Plans are reviewed by various government departments, stakeholders and the general public before a specific subset of interventions are selected for implementation. This also forms part of the EIA process.

Phase 3 requires that certain Environmental Authorisations are obtained before work can commence in the wetlands. Upon approval of the wetland Rehabilitation Plans by DEEF, DWS and the directly-affected landowners is obtained, the work detailed for the Project will be implemented within a year with on-going monitoring being undertaken thereafter. The Rehabilitation Plans are the primary working documents for the implementation of the Project via the construction/undertaking of interventions listed in the Plan.

It is typically at this point in the process when the final construction drawings are issued to the Implementing Agents (IAs). Seventeen Implementing Agents are currently employed in the Working for Wetlands programme and are responsible for employing contractors and their teams (workers) to construct the interventions detailed in each of the Rehabilitation Plans. For all interventions that are based on engineering designs (typically hard engineered interventions), the Design Engineer is required to visit the site before construction commences to ensure that the original design is still appropriate in the dynamic and ever-changing wetland system. The Design Engineer will assist the IAs in pegging and setting-out interventions. The setting-out activities often coincide with the Phase 1 activities for the next planning cycle. Phase 3 concludes with the construction of the interventions, but there is an on-going monitoring and auditing process that ensures the quality of interventions, the rectification of any problems, and the feedback to the Design Team regarding lessons learnt.

The **Project Team** needs to consist of a Programme Manager who oversees the entire rehabilitation programme, supported by a small team based at the ECPTA offices in East London who fulfil various roles such as planning, monitoring and evaluation, implementation, Geographical Information Systems (GIS), and training. Independent Design Engineers and Environmental Assessment Practitioners (EAPs) will undertake the planning, design and authorisation components of the Project. It should be remembered that any activity within a wetland area is legislated in the EIA Legislation. Activity 12 of Listing Notice 1 prescribes what may not happen unless an Environmental Impact Assessment process is first undertaken to evaluate the suitability of the activity within such an area. The Project Team needs to be assisted by Wetland Ecologists who provide scientific insight into the operation of wetlands and bring expert and often local knowledge to the Project Teams. This Wetland Ecologist may also be housed in the ECPTA offices in East London.

The need for the inclusion of Independent Design Engineers in the project team is because, according to the standards, any structure that is constructed within a wetland should be designed by a professional person for that purpose. Ill-designed structures may lead to further wetland degradation.

Ongoing management

If the rehabilitation process has achieved a measure of stability in the ecosystems and removed any drivers of degradation, then wetlands and riparian areas can be managed as part of the surrounding landscape, whether it is grassland or woody or coastal. There are, however, some factors that need to be considered:

1. If the wetland is within a grassland that is regularly being grazed, it is vital that the wetland is monitored to see if the cattle are damaging the hydrology of the wetland by forming channels or erosion dongas. Likewise, the surrounding catchment should be checked to ensure that it is not becoming degraded, with the probability of erosion and sedimentation into the wetland.
2. If there are roads or tracks that cross the wetland, these must be properly planned and stabilised, or else closed.
3. Where there are important wetlands (e.g. those that contribute to the functioning of an estuary), the entire catchment that supports those wetlands must be considered as a management unit. It is often a waste of time to consider just the wetlands in isolation.

Grassland ecosystems

Ecosystem description

The grasslands of the area, mostly associated with the vulnerable Pondoland-Ugu Sandstone Sourveld and transitional coastal grasslands, form a very important part of the ecosystems in the area, sustaining many species of fauna and flora. They also form the foundation of the livestock industry in the area which is a significant economic and cultural part of livelihoods.

The extensive grasslands are, however, not subject to any coherent management.

Drivers of degradation

The drivers of grassland degradation are generally associated with the following:

1. Poor rangeland management for livestock
2. Past arable activities that have led to large areas of grasslands being ploughed and then abandoned
3. Unsustainable harvesting of specific plants or animals
4. Uncontrolled vehicular access across the grasslands, irrespective of slope

Good rangeland management requires control and manipulation of livestock grazing and effective use of fire in a planned and coordinated manner, neither of which are apparent along the Wild Coast.

Currently, fire appears to be applied in a haphazard way with many very small summer burns being used to stimulate a green flush of grass (see, for example, Figure 3). Although effective in the short-term to increase grazing potential, such practice is concerning for plant species diversity in the grasslands.

Figure 3. Photo of small patch burns used to generate a green flush for grazing

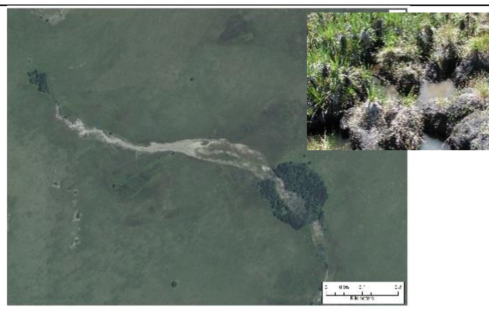
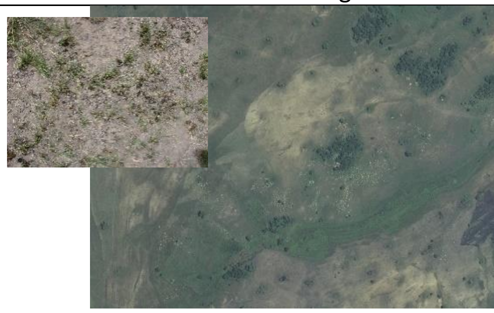
Figure 4. Photo of cattle grazing in a wetland seep in the Mkambati area

Considering that the Wild Coast has a relatively high rainfall, with periods of intense rain, there is a rather high bioclimatic risk that soil erosion will be a significant concern. Along the Wild Coast in general, and in the offset sites in particular, there several types of erosion listed and illustrated in the photographs below:

1. Accelerated rates of erosion from rangelands occur due to slow degradation of the grasslands and forests. Such degradation leads to a gradual loss of vegetation basal cover and exposure of the soil surface. Once exposed, the soil is subject to raindrop impacts and overland flow of water, leading to a marked increase in soil downslope. The loss of the topsoil greatly reduces the suitability of the area to seedling establishment, exacerbating the problem and hampering natural recovery.
2. Accelerated rates of erosion associated with old lands that were planted to crops and then abandoned after a few years. Such areas are left exposed to the elements and there is relatively rapid loss of the topsoil within a few years. Although such areas do become recolonised by grasses or woody plants (and even IAPs), the loss of soil severely reduces the productivity of the area and reduces the ability of the vegetation to recover. Such scars are easily seen from aerial imagery, even decades after the last activity. In some cases, particularly where there are steeper slopes, the loss of vegetation cover leads to massive soil erosion and the formation of gulleys.
3. Erosion of drainage lines and riparian zones leading to the formation of gulleys. Such gulleys mostly form due to overgrazing and livestock accessing the river for drinking water. The repeated hoof action damages the banks and causes them to collapse into the river. In areas where wetlands have been damaged, there are also an increase in hydraulic energy in the river during peak flow events and this causes catastrophic erosion.
4. Erosion due to livestock paths. Livestock are habitual animals and will often walk single file over the same trail every day, especially in areas where they are moved regularly. Very quickly, such trails become natural lines of drainage and quickly become entrenched. Typically, the animals move to a new trail adjacent to the old one and soon there are multiple lane ‘highways’ that lead to massive dongas.
5. Erosion due to irresponsible and unmanaged vehicle tracks. Many areas have a plethora of human-caused trails and tracks as people drive 4x4s and tractors over the grasslands to reach fishing spots and outlier fields. Once a vehicle has driven over the grasslands even a few times it compacts the soil and creates a channel area for water to flow. This quickly leads to erosion dongas.
6. Erosion due to poorly designed and unmaintained roads. There are many roads that have been graded and bull-dozed into the area that have not been properly designed to shed water, so they effectively become drainage lines that erode rapidly, especially on steep slopes. Most of these roads are associated with the tourism infrastructure along the Wild Coast.
7. Erosion due to sand mining. There are a few areas along the Wild Coast where there are informal open-caste mining for building sand. The unplanned and haphazard nature of this activity leads to wide expanses of soil being exposed and left to erode into the nearest stream.

The implications of soil erosion fall into two main categories:

1. Damage to the area being eroded, with an accompanying loss of current and future productivity. Because the majority of local residents of the Wild Coast derive their livelihoods from the natural resource base, any loss of productivity (current or potential) has significant implications for the rural economy.
2. Damage to areas due to sedimentation by the eroded material. Considering the biodiversity value and socio-economic importance of the many rivers, wetlands and estuaries along the Wild Coast, sedimentation has significant potential to impact these values. Rivers from which people derive their potable water, and estuaries that serve as breeding grounds for marine animals are both of high concern.

 Catastrophic erosion in steep old fields	 Subtle sheet erosion from old fields
 Erosion from poor plantation management	 Erosion from a damaged wetland
 Erosion from poor road design and maintenance	 Erosion due to over-grazing of grasslands
 Erosion from multiple cattle paths to a river	 Erosion from unplanned 4x4 tracks
 Erosion due to sand mining	

Rehabilitation

Rehabilitation of grasslands is highly scale dependent.

The rehabilitation of grasslands at a large-scale is generally done slowly in a less intensive manner. The key focus is on ensuring that the original driving forces of degradation – mostly livestock – are well-managed to prevent further degradation. Generally speaking, grasslands may superficially recover to a level where they are stable ecosystems but with a very low level of plant diversity. The interesting elements of plant diversity, mostly the sedges, bulbs, forbs, shrubs and ferns, take many decades before they return.

The huge areas of previously arable lands that were abandoned when the soil fertility declined and have subsequently revegetated naturally with a depauperate form of grassland, are of significance in the Project area. Although there is nothing that can be done to actively rehabilitate them because of their scale, they should enjoy preferential burning and grazing regimes that facilitate the recovery of biodiversity and productive grasses. Typically, this will require relatively intensive management.

Large-scale grassland rehabilitation programmes should aim to allow the less common, more palatable and sub-dominant grasses and forbs (the decreasers) to establish within the grassland. There have been attempts varying in success within the Matatiele region of community-based rangeland management to upscale such rehabilitation using livestock in a highly controlled manner, and such opportunities need to be explored in the current project. The parallel aim of such initiatives is to improve the livelihood of community in the area through integrated veld management programs.

This will include most of the following steps need to be followed when implementing large-scale grassland rehabilitation:

1. Identify and mitigate against any drivers of degradation, including uncontrolled grazing. This may require a long period (>five years) of very low-grazing pressure.
2. Burn the grassland on a 2–3 year rotation in spring, using block burns (i.e. burn half or one-third blocks).
3. Allow high-intensity (controlled) grazing on the burnt areas for a few weeks after the burn, moving the animals around until mid-summer.
4. Allow long periods of rest from grazing until the next burn.

Where a small (c. <1 ha) patch of grassland has been damaged there can be a mixture of interventions depending on the drivers of degradation e.g. by livestock, erosion or some human activity. It is feasible to conduct intensive rehabilitation activities that will focus on re-establishing a grassland cover to stabilise the soil and re-introduce some aspects of diversity and functioning. Such activities are generally highly labour intensive and expensive but can also form the basis of employment opportunities. The process that should be followed is:

1. Identify and mitigate against any drivers of degradation, including uncontrolled grazing.
2. Stabilise the soil to prevent accelerated erosion that removes the topsoil and organic material.
3. Plant a high-density (<0.2 m spacing) stand of mixed indigenous grasses, either from sods or seedlings.
4. Maintain the site with regular follow-up to ensure dead seedlings are replaced and emerging IAPs are killed.
5. Ensure there is no grazing on the site while the seedlings are establishing as they will be pulled out.
6. As soon as the grass sward has established, start burning it on a 2–3 year rotation, aiming for flame heights that can kill any emerging IAPs.

Ongoing management

There are some very good best practice guidelines for the management of grasslands for biodiversity and animal production (SANBI 2014). These provide specific guidance on how to establish sound burning and grazing regimes in both private and communal-landscapes, which will be necessary in the large grasslands of the Central and Northern Clusters.

It is vital for sites with large grasslands that are grazed by livestock, that there is a grazing plan that ensures rotational grazing, burning and rest. Ideally, grazing should be a controlled activity with herders and/or mobile electric fences. Without such control, the long and damaging history of selective grazing will perpetuate.

Each site should have a detailed grazing and burning plan that is agreed upon with the local communities and enforced by the site management.

Woody ecosystems

Ecosystem description

Although the National Forests Act of 1998 (NFA) defines the term "forest" as including natural forest, woodland and plantation timber, only natural systems are being considered here (i.e. excluding commercial plantations). Natural woody ecosystems are defined by having trees as the dominant feature of the landscape, and there are several types defined according to the canopy height and cover of the trees.

- **Natural forest** is defined in the NFA as a group of trees with crowns largely contiguous. However, it is helpful to add to this definition that natural forests are evergreen, fire-free and layered (at least a canopy layer, shrub layer and a non-grassy herbaceous layer). Four types are recognised in the project area (Pondoland Scarp, Transkei Coastal Scarp, Eastern Cape Dune and Mangrove).
- **Woodlands** are poorly defined in the NFA as a group of trees that is not a "natural forest, but whose crowns cover more than five percent of the area bounded by the trees forming the perimeter of the group". It is, therefore, better to subdivide the woodlands into thicket and savanna based on their respective definitions.
  - **Savanna** is a fire-adapted woody ecosystem comprising grassland and scattered trees. It can vary from open savanna with scattered trees, to dense savanna almost resembling a forest, but with differences in species composition and the presence of a grassy understorey that burns regularly. The trees and grass share dominance in a dynamic relationship that responds to grazing, burning and rainfall.
  - **Subtropical thicket** is a dense fire-free ecosystem dominated by woody, spinescent and often succulent shrubs. Thicket shares more characteristics with natural forest than with savanna. Layering is indistinct and tall canopy trees are rare.

Although there are basic similarities between natural forest, savanna and thicket ecosystems, there are significant structural and ecological differences that must be considered as they have an impact on management and rehabilitation. The most significant of these is probably fire. In natural forest and thicket, fire only plays a role along the margins while savanna systems are fire adapted. Also, concepts such as gap dynamics and margin ecotones are applicable to natural forest but not to savanna.

The following section summarises the descriptions of the forest types found in the project area, based on Von Malitz et al. (2003).

Scarp Forests

Two types of Scarp Forests are found in the project area: **Pondoland Scarp Forests** and **Transkei Coastal Scarp Forests**, and they are treated together as they have similar structure, ecological principles and disturbance issues. They differ primarily in terms of their biophysical environment, particularly geology and soils.

Scarp Forests are typically medium–high (15–20 m) with three distinct strata. Under the canopy is relatively open with a well-developed seedling and sapling stratum, and a poorly developed herb layer as the trees are mostly single stemmed. Mature stands comprise 'random' assemblages of shade-tolerant species that are common in the canopy. The dynamics of change are driven by events that create gaps and there is evidence for gap-size niche differentiation by tree species, with only very large gaps (>140 m^2) being colonized by light-demanding species. The primary natural disturbances that create gaps include windthrow, caused by a combination of strong coastal winds and shallow soils, and very infrequent fire penetration. Scarp Forests are considered 'hotspots' of species richness within the Pondoland centre of floral endemism.

Eastern Cape Dune Forests

Although not easily mapped as a separate unit, Eastern Cape Dune Forests are found in small pockets up the coastline, associated with the narrow cordon of barrier dunes adjacent to the predominantly sandy and mixed sandy and rocky beaches. The barrier dune is fixed by vegetation in various stages of succession, including thicket and forest communities. The forests occur typically in landward and sheltered positions and are best developed in inter-dune valleys. The windward slopes of the dunes are covered by floristically similar, but structurally-stunted vegetation called "dune thicket". Eastern Cape Dune Forests are subtropical low-statured and with a dense-canopy dominated by *Mimusops caffra, Sideroxylon inerme* and *Dovyalis rotundifolia*. These forests form a vital biodiversity corridor along the coastal plain. Owing to the inhospitable coastal environment, with low soil nutrients and high salt spray, recovery from disturbances is typically very slow.

Mangroves

Mangroves are an unusual and rare type of forest found only in the Southern Cluster. They are defined by relatively short trees and shrubs associated with tidal, saline wetlands in bays and estuaries. Although they are extremely species poor, with only a few typical species in the southern varieties of Mangroves (*Acrostichum aureum*, *Avicennia marina*, *Bruguiera gymnorrhiza*, *Rhizophora mucronata* and *Xylotheca granatum*), they are of high conservation significance due to a high diversity of associated plants and animals, and because they are integral to the detritus-based food chains in estuaries. It is generally recognized that estuaries are an important breeding and feeding ground for marine species. Mangroves lining waterways also form a river/land barrier which protects the shoreline from erosion.

Mangrove trees are mostly chopped and used as a source of timber for poles and construction.

Thicket

Thicket is a dense formation of evergreen and weakly deciduous shrubs and low trees (2–5 m), often spiny and festooned with vines. It characteristically includes arborescent forms of Aloe and Euphorbia. In wetter climates, thicket becomes transitional to dry forest and the distinction between thicket and dry forest is often difficult to make, since many plants widespread in thicket have a tree habit under better soil moisture conditions (Cowling et al. 2005). Thicket is a fire-free vegetation that seems strongly adapted to heavy browsing pressure.

Thicket is not common in the Project area but is found in the deeper impenetrable warmer valleys and in fire-free coastal pockets that are too dry for forest.

Savanna

Savannas are an unusual ecosystem in the Wild Coast and are possibly the result of long-term transition from more closed woody ecosystems to grassland in response to changes in land use and fire regimes. Forests and thicket patches that become opened due to land use pressures allow penetration by light-loving grasses that create fuel for more regular fires, which rapidly cause the death of any fire-prone species. Over time, the only trees that remain are the fire-tolerant species that then form a low, scattered canopy typical of savanna.

Savanna is often a stable, yet intermediary state between forest and grassland, and its exact nature at any point in time reflects the recent rainfall patterns, grazing history and fire regime. If fire were to be withheld for several years, there is likely to be a strong recruitment of woody plants and a shift towards more closed canopy forest.

Drivers of degradation

The degradation of woody ecosystems in the Wild Coast has been the subject of much discussion and several large interventions already. The drivers of degradation are well-described in literature (e.g. see Table 1), and focus on the following:

- Clearing of woody ecosystems for housing or tourism development.
- Slash-and-burn type clearing for arable activities, including illegal cannabis plantings.
- Deliberate or accidental burning into the forests to expand grazing lands.
- Unsustainable harvesting of timber, poles and firewood.
- Unsustainable harvesting of medicinal plants and animals for meat.
- Harvesting of dead wood for fuel and timber.
- Penetration of woody ecosystems by roads and tracks.
- Infestation of forest edges and disturbed patches by IAPs.

Table 1. Detailed list of threats to woody ecosystems and their causes (based on DWAF 2005)

Biodiversity threat	**Underlying causes**
Unsustainable harvesting of subsistence forest products (firewood, medicinal plants, building materials, bush meat)	Population pressure, poverty. Decentralisation of management without suitable institutional capacity. Historically, lack of participatory management. Breakdown in tribal authority.
Commercial harvesting of medicinal plants	Lack of law enforcement, tribal authority, permit system, primary health care.
Clearing for subsistence agriculture or cattle grazing	Land disputes and forced removals. Unclear land tenure & protected area status. Poor law enforcement. Poverty, accessibility, population pressure.
Commercial agriculture and plantations	Land suitability to commercial cropping & plantations. Lack of systematic protected area planning (historically). Inappropriate application of permitting system, and law enforcement. Corruption.
Urban expansion	Lack of implementation of systematic protected area planning. Lack of biodiversity issues mainstreamed into local planning. Corruption.
Fires	Surrounding land use. Increased alien invasive, population pressure.
Mining	Lack of biodiversity issues mainstreamed into local planning. Corruption.
Disruption of natural hydrological process	Irrigation, competing water demand, floods, salutation. Mangroves & riparian forest.
Land invasions	Land disputes, poverty, population pressure.
Tourism development	Lack of control and management. Ineffective or no regional integrated environmental planning (SEA and EIA.) Lack of biodiversity issues mainstreamed into local planning. Corruption.
Invasive alien plants	Spread of invasive aliens, fires and disturbance.

Although these drivers are evident in all woody ecosystems to some degree, it is the Scarp Forests that are most affected.

Each of these drivers and their underlying causes operate to different degrees in the different sites. Each site is unique in terms of its surrounding socio-economic and biophysical context, and it is not possible in this work to evaluate the detail of each site. This will be the responsibility of the management authority for each site to develop a detailed understanding of what the primary threats are to the major ecosystems in the site, and how best to mitigate these based on the root causes.

Rehabilitation

The rehabilitation of woody ecosystems is well described in the literature, with a range of options including successional approaches (Geldenhuys 2010), selective planting and re-vegetation. Like wetlands, it is necessary that sites undergo detailed assessments to perform due diligence prior to selecting a rehabilitation method. This will include the services of an experienced Ecologist to assist with species selection and ecological interpretation.

The key to successful rehabilitation lies with the removal of whatever was driving the destruction or degradation in the first place. It is thus necessary to understand and mitigate the root causes in the area. The general principle of rehabilitating woodlands is that in the cases where woodlands have been severely degraded and there is no possibility of trees or shrubs to come back on their own, active restoration with planting of seedlings/seeds is needed. During this phase of active re-plantation of trees, alternative land/resource uses should be established to minimise pressure of resource use by the community. In order for the community to see benefits of the restoration activities two things need to be part of the implementation process a) hiring labour from the community and b) sourcing seeds and seedlings from the community. The sourcing of seedlings and seed from the community may even provide opportunities of creating SMMEs and community nurseries that can be income generating for community members. If such SMMEs and nurseries are well supported by the project, they have a potential of growing to support the wider market with greening materials. Since the rehabilitation of ecosystems in the Biodiversity Offset Project is to improve the conservation value of the offset polygons, it is expected that once rehabilitation is successful, it may attract nature-based tourism.

Fire-free Scarp Forests, Dune Forest, Mangroves and thickets

The rehabilitation of woody ecosystems is not easily captured in a set of rules and nor is it quickly achieved. Any rehabilitation effort should be designed around a long-term plan that is funded for at least eight years. Each situation is so unique that it is necessary for an experienced Rehabilitation Ecologist to be employed to design a rehabilitation plan for each area. The key to rehabilitation in the fire-free woody ecosystems is the re-establishment of a closed canopy that stabilises the internal environment of the ecosystem. The closed canopy significantly dampens the day-night temperature and light intensity fluctuations that are strong drivers of IAP seed germination. It also reduces the risk of catastrophic erosion from rainfall. To achieve a closed canopy, a fast-growing pioneer species should be planted that is known to be a good precursor to other species.

However, there are some general principles that will likely apply in all situations:

1. Identify and mitigate any drivers of degradation.
2. Stabilise the soil to prevent accelerated erosion that removes the topsoil and organic material.
3. Establish a good mulch layer that helps prevent erosion and reduces IAP seed germination.
4. Plant a high-density (<2 m spacing) stand of mixed indigenous pioneer and canopy trees and shrubs.
5. If IAP trees are already established in the site, use a thinning and successional approach to facilitate the establishment of indigenous pioneer and canopy trees and shrubs (see Geldenhuys et al. 2017). Avoid clear felling IAPs.

6. Maintain the site with regular follow-up to ensure dead seedlings are replaced and emerging IAPs are killed[2].

Fire-prone Savannas

The fire-prone nature of savannas calls for different rehabilitation approaches. The key decision is to decide what ecosystem is desired after the rehabilitation as savanna could equally be a grassland or a forest, and the potential fire regime will move the ecosystem in one direction or another. If it is impractical to burn regularly, such as where there is commercial timber or housing in the area and the risks are too great, then it is better to aim for forest using the approach above. Where fire is regularly applied to the landscape, or where it is desirable to have a grassland for grazing, then it is best to follow the rehabilitation guidelines for grasslands. In the latter situation, fire-prone trees such as Acacias can be planted in micro-refugia across the grasslands, e.g. in rocky outcrops.

Ongoing management

The management and rehabilitation of woody ecosystems in South Africa has received considerable attention in the literature, and there are many guidelines and approaches available. Most relevant and useful are the approaches described in the CEPF-funded project in the Ntsubane Forests (WESSA 2013). The reality is that most of the threats facing forests are to do with human dynamics in the forests, with extractive resource use, hunting and land clearing being the most important. These generally result in invasion by IAPs.

Other than controlling human access and enforcing the existing laws regarding extraction, hunting and clearing of forests, there isn't any specific management of forests that is required. In areas where disturbance has resulted in IAP infestations, these should be prioritised for clearing and rehabilitation. In this respect, forest management hinges on community engagement and not technical interventions.

Where development is being anticipated that will infringe on a woody ecosystem, it is important to abide by the policies, principles and guidelines proposed in DWAF.

Coastal and Estuarine Ecosystems

Ecosystem description

Many of the offset sites are coastal, with direct frontage onto the seashore, or close proximity to it (see Figure 6). The shore and its immediate dune forest ecosystems form a vital biogeographic corridor from North to South. The shore zone includes a complex matrix of rocky, sandy, grassy and woody with many environmental gradients that separate out different faunal and floral patterns (e.g. see Figure 5). This zone truly is a biodiversity hotspot that deserves a high conservation and tourism value.

[2] The report in this series that covers IAP clearing describes the best practice principles that need to be applied for clearing IAP infestations in forests.

Figure 5. Photographs of the coastal shore zone

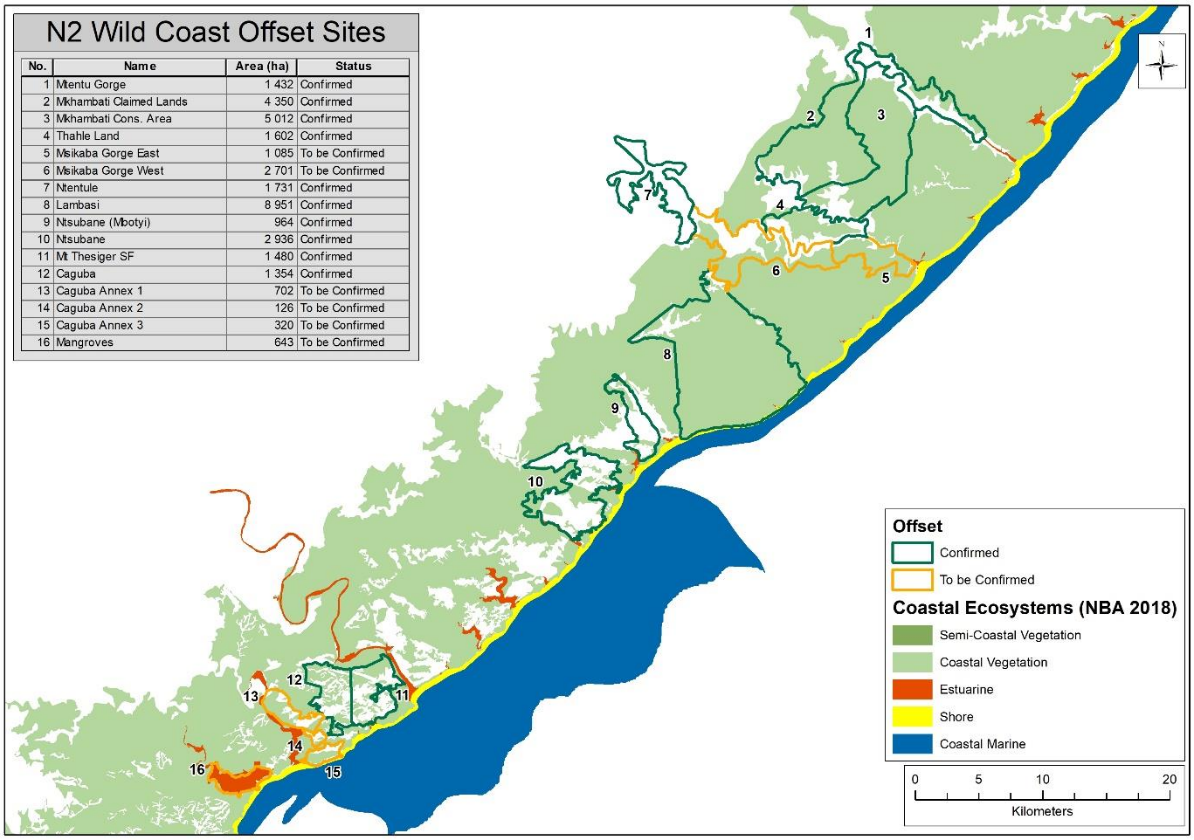


Figure 6. Map showing the NBA 2018 coastal ecosystems of the Project area

The Project area is also home to many estuaries of varying sizes and conditions. Estuaries are considered to be very important for coastal and marine ecology, primarily as the breeding grounds for many marine species. They also are some of the most attractive tourism sites and are often key nodes around which tourism infrastructure is sited (e.g. Figure 7).

Some of the estuaries have conservation-worthy mangrove forests that are relatively rare along the South African coastline.

Figure 7. Example of one of many stunning estuaries along the Wild Coast

Drivers of degradation

Like forests, the coastal ecosystems are primarily threatened by human use, and their management and rehabilitation rely more on community engagement than technical approaches. For example, the primary issues facing estuaries are extractive resource use which require access and harvesting control more than rehabilitation efforts. The primary issues facing estuaries include the following:

- Sedimentation and pollution from upstream catchments that are not being well-managed.
- Uncontrolled development for housing and tourism.
- Uncontrolled resource harvesting of both fauna and flora (timber, fish, shellfish). This extractive resource use, primarily of the rocky and marine animals by communities and tourists is not well controlled despite being subject to detailed legislation.

Another primary threat facing the coastal zone is litter that washes in from the sea and accumulates on the beaches and rocky shores. This is not only very unsightly for tourists and local communities (e.g. Figure 8), but is also thought to have significant implications for the ecology of the coast and sea as the plastics breakdown into tiny pieces that become part of the food chain. Most of this plastic originates from the passing ships at sea, or from the major river systems if there are upstream communities that dump their waste near the river.

Figure 8. Example of plastic litter on a beach

Rehabilitation

There is not much that can be done directly to rehabilitate damaged coastal or estuarine systems. The issues of sedimentation in estuaries are best addressed by good upstream catchment management of the grasslands and forests, to prevent soil erosion.

Where relevant, there could be employment opportunities associated with cleaning the coastal ecosystems from plastic litter.

Ongoing management

There is not much that can be done directly to manage coastal and estuarine ecosystems other than to ensure the harvesting of resources is sustainable. This requires a measure of monitoring of populations and catches, and implementation of existing policies and legislation. Community engagement is the most effective approach to any aspects of controlling the extractive resource use.

SPATIAL TRENDS AND PRIORITISATION

The initial analysis is based on the SANBI vegetation types (2018) which form the basis of all ecosystem analysis in South Africa. The vegetation types found in each offset site were classified into the major ecosystems: grasslands, woody ecosystems, wetland ecosystems and coastal ecosystems. There are overlaps between these ecosystems as they are not static but have the potential for change. For example, wetlands are often a variant of the surrounding vegetation, either grassland or woody; and grasslands can switch to woody ecosystems if fire is withheld.

There are clear patterns of ecosystems across the planning domain (see Figure 6, Figure 9, Figure 10, Figure 12 and Figure 13), with the Northern Cluster sites being dominated by grasslands, with occasional forest patches associated with the naturally fire-free areas such as gorges and cliff-lines. There is a transition in the Central Cluster area towards more woody ecosystems, and the Southern Cluster sites are dominated by woody ecosystems with small patches of grasslands embedded within. The coastal ecosystem unsurprisingly extends along the length of the coastline with subtle variations in degrees of woodiness and grassiness, depending on local conditions. These patterns of grassiness and woodiness are best explained by the transition in climate and topography and their influence on the natural fire-regime, while the Northern Cluster sites have conditions that favour a more frequent natural fire regime.

As the SANBI ecosystems maps were compiled at a relatively large scale, a much more detailed mapping exercise was conducted for the offset sites based on GIS interpretation of aerial imagery. These maps show the true extent of remnant ecosystems and the boundaries are much more accurate than the SANBI maps. This mapping focused on woody ecosystems and wetlands and was also able to identify those wetlands and grasslands that require some form of rehabilitation. These are described below, per cluster and per ecosystem.

Northern Cluster

Grassy ecosystems

The Northern Cluster is dominated by natural grasslands (Table 2, Figure 9) and indeed these are of primary conservation value in the region. There are very few large remnant grasslands in South Africa and this area has one of the most outstanding examples of Pondoland-Ugu Sandstone Sourveld that is considered poorly protected and vulnerable. The Mkambati Nature Reserve is the only protected area for this very restricted vegetation type. It has the highest level of vulnerability of any vegetation type in South Africa. Part of its significance lies with the hygromorphic soils that arise from shallow depressions in the subsurface rock strata which lead to localised endemism within the grassland matrix. That will be a significant addition to the grasslands of Mkambati Nature Reserve.

Table 2. The remaining areas of SANBI ecosystems for the Northern Cluster

Vegetation Type	Mkambati Claimed	Mkambati Cons. Area	Msikaba Gorge E	Msikaba Gorge W	Mtentu Gorge	Ntentule	Thahle Land
East. Valley Bushveld	597	948	116	921	747	1515	585
Moist Coast Hinter. Grass.						175	
Pondo.-Ugu SS. Sourveld	3283	3554	933	1318	431		755
Scarp Forest		43	26	373	232	13	220
TOTAL	3880	4545	1075	2612	1410	1702	1560

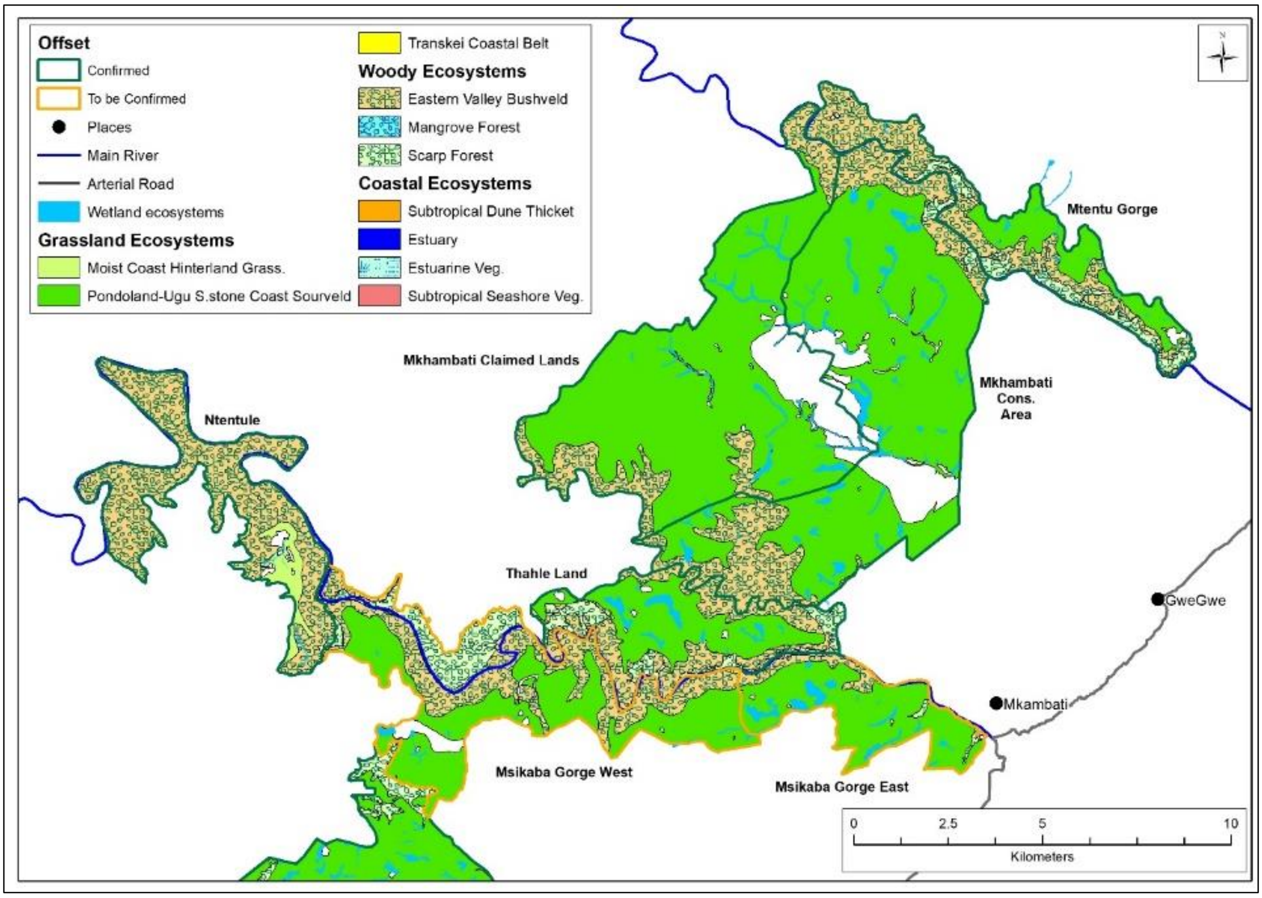


Figure 9. Map of the SANBI ecosystems of the Northern Clusters

Although this Project did not involve any detailed veld condition assessments, previous work in the area (Lechmere-Oertel 2011) highlights the importance of these grasslands from a biodiversity perspective. A more detailed analysis of aerial imagery of the area (Table 3, Figure 10) indicates that not all the grasslands in the area are completely natural. Much of the land adjacent to Mkambati Nature Reserve used to be part of a development area 'managed' by the Transkei Agricultural Corporation (TRACOR). As part of this development, large areas (c. 1 500 ha) were ploughed for sugar cane but have been left fallow for over 15 years and have reverted to a species-poor secondary grassland dominated by ruderal indigenous grasses. These secondary grasslands are in an ecologically functional state to some degree but have almost none of the biodiversity values of the remnant grassland. Such secondary grasslands are found throughout the project area, and are described in more detail below, including rehabilitation options.

Table 3. The areas (ha) associated with the main landcover types and ecosystems in the Northern Cluster

Landcover/ecosystem		Mkambati Claimed	Mkambati Cons. Area	Msikaba Gorge E	Msikaba Gorge W	Mtentu Gorge	Ntentule	Thahle Land
Modified	Arable				4.2		25.4	2.6
	Homesteads			2.3	75.3	15.3	1.2	4.4
	Invasive Alien Plants	26.0	23.6	1.3		2.1		8.2
	Sand mine	18.1				0.6		
	Timber	457.6	443.9					
Natural	Bush		17.5	23.1	66.4	38.1	931.4	79.8
	Erosion	18.8	8.0				4.5	
	Forest	83.8	177.3	40.2	694.2	461.9	255.1	259.2
	Grassland	2,832.5	3,310.5	977.7	1,693.5	843.9	376.5	1,141.8
	Riverine	10.8	16.1	13.7	90.7	38.1	78.5	2.1
	Woodland						3.7	
	Secondary grasslands	900.6	996.5	19.8	67.9	28.6	55.1	77.1
	Wetland woody ecosystems	1.1	14.9					

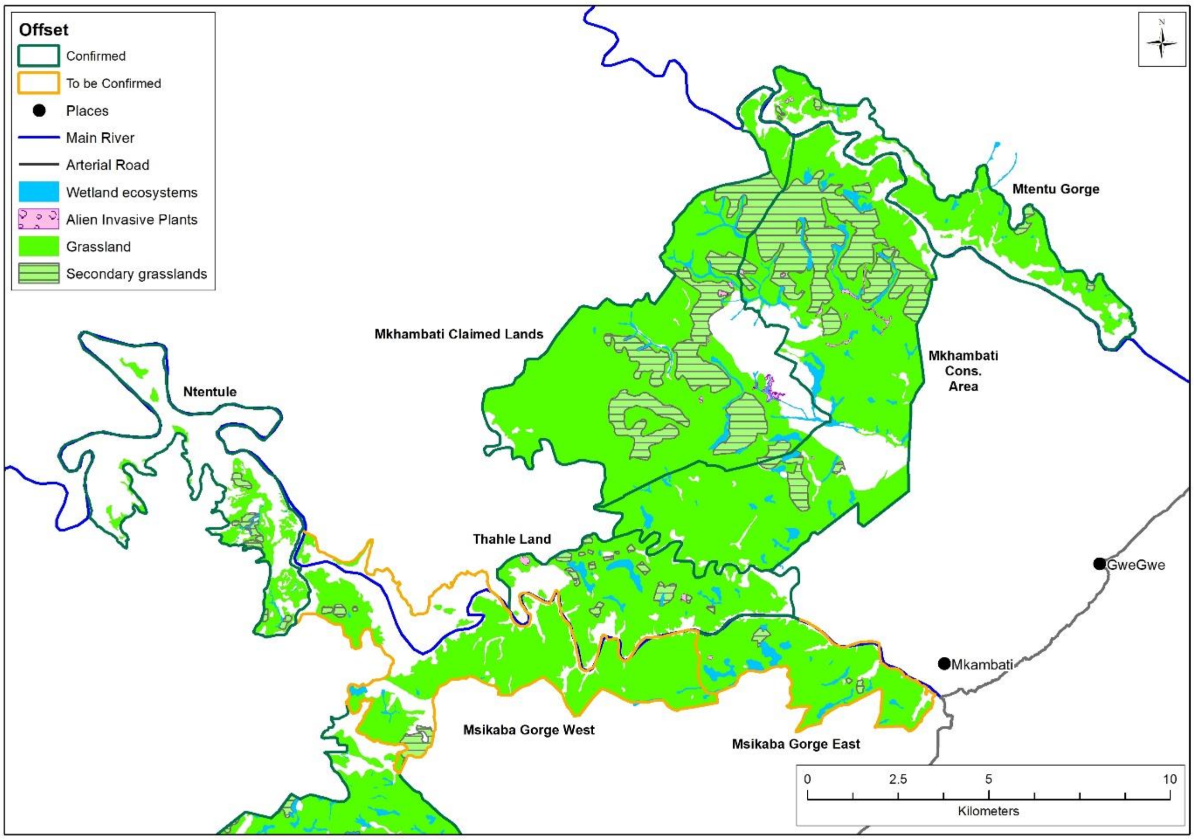


Figure 10. Map showing the grassy ecosystems of the Northern Cluster digitised off aerial imagery

The grasslands of the Northern Cluster are permanently used for grazing by the surrounding communities. Although the number, size and ownership patterns of the herds in the area have not been assessed, this is a vital aspect of future management (see below). There are some areas where grazing is having an obvious impact on the grasslands as seen by reduced basal cover and loss of diversity. The biggest issues regarding rangeland management in the area are the combination of misuse of fire and the continuous selective-grazing regime that is followed by default. These practices result in long-term species losses and degradation of grazing potential of the grasslands. Furthermore, the large areas of secondary grasslands are generally of poor grazing potential, which means the livestock do not graze there voluntarily, and so grazing pressure is increased on the surrounding natural grasslands.

Figure 11. Example of a degraded grassland in the Mkambati area

Woody ecosystems

Embedded within these vast grasslands are patches of forests that are essential components of the biodiversity and ecosystem functioning of the area. Most of these are associated with naturally fire-free areas such as gorges and cliff lines (e.g. the Super Bowl forest in Mkambati NR, Msikaba Gorge and Mtentu Gorge). According to the SANBI classification, most of these are considered Eastern Valley Bushveld, but closer examination in the field suggests they are more akin to Scarp Forest and should be classified as such. However, they do have elements of both vegetation types.

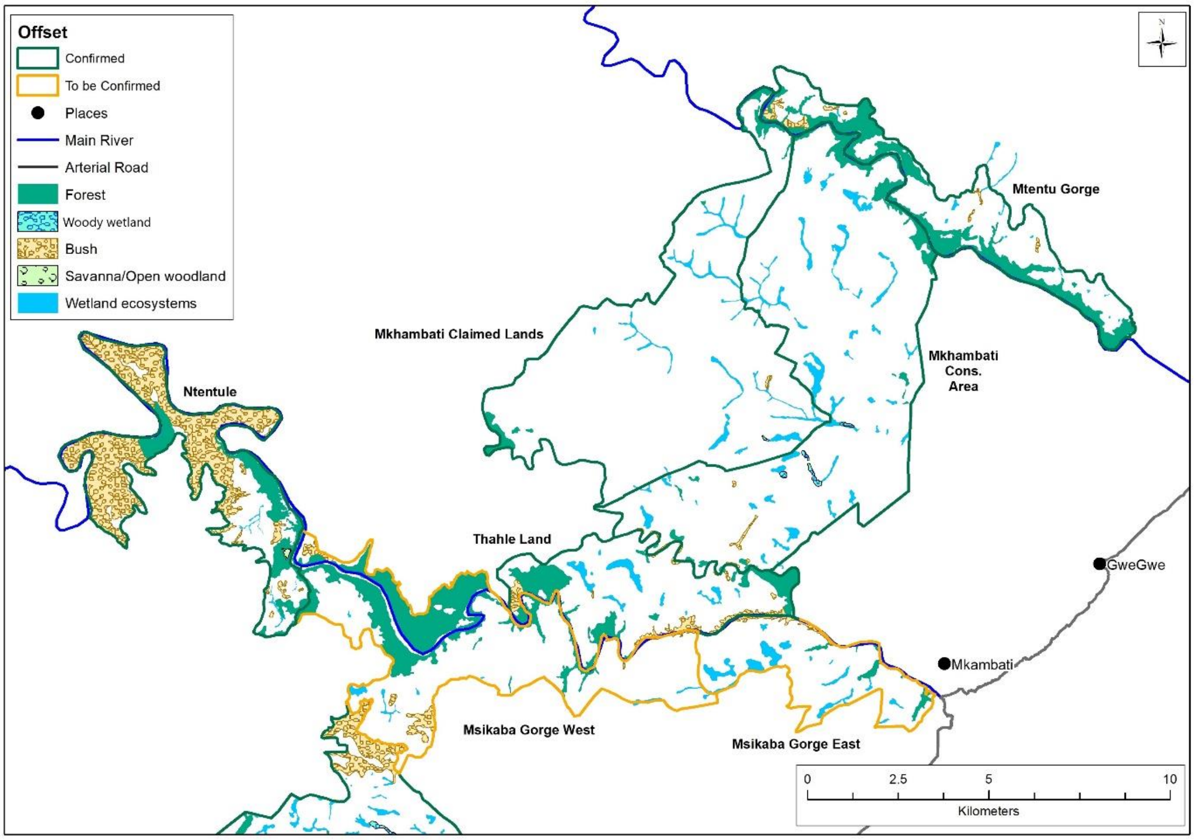


Figure 12. Map of the woody and wetland ecosystems of the Northern Cluster

Of interest are the woody ecosystems associated with slow-flowing rivers and wetlands (e.g. Figure 13), often at the river confluences, where they are integral to the hydrological functioning of the area. Dominated by tree species such as *Syzigium cordatum, Cryptocarya wyliei* and *Strelitzia Nicolai*, these woody ecosystems have outstanding conservation value due to the high incidence of Pondoland endemics such as *Struthiola pondoensis, Plectranthus saccatus, Podolyria velutina, Helichrysum populifolium, Alberta magna, Phylica natalensis, Tarconanthus trilobus var. trilobus, Cryptocarya wyliei, Apodytes abbottii, Putterlickia sp., Psoralea abbottii* and *Centella graminifolia*. Although these woody ecosystems do not occupy a large area, they are great conservation significance.

Figure 13. Example of a small patch of woody ecosystem associated with a wetland

Wetland ecosystems

Also embedded in the landscape are a great number of wetlands that occur wherever the topography flattens and causes ground or river water to accumulate (e.g. Figure 14). The more obvious ones were mapped off aerial imagery to give an estimate of the area, count and density (wetland area/offset area x 100) of wetlands in the cluster (see Table 4). What is striking is the high incidence of wetlands in the cluster; generally associated with the non-perennial streams and seepage zones. These wetlands generally comprise hygrophyllous grasslands dominated by hydrophytic trees, grasses and sedges, including Ar*istida junciformis, Cyperus prolifer, Syzygium cordatum Cliffortia sp., Prionium serratum a*nd *Juncus lomatophyllus*. They also provide habitat for Pondoland endemics such as *Senecio rhyncolaenus, Leucadendron pondoense, L. spissifolium subsp. Natalense, Watsonia bachmannii* and *W. pondoensis*.

Figure 14. Example of a wetland digitised in the Northern Cluster

Table 4. Estimates of wetland area, count and density in the Northern Cluster

Offset	Area (Ha)	Count	Density
Mkambati Claimed Lands	128.0	12	2.94
Mkambati Cons. Area	242.3	37	4.83
Msikaba Gorge East	95.5	16	8.80
Msikaba Gorge West	29.2	13	1.08
Mtentu Gorge	12.8	14	0.90
Ntentule	11.0	5	0.64
Thahle Land	70.0	11	4.37

Although most of these wetlands are in reasonable condition and are just 'managed' as part of the surrounding vegetation, there are some that have been severely damaged by human activities. The primary issue is physical damage associated with the following:

1. Sand mining wherever there are reasonable sand deposits near road access (e.g. Figure 15). This practice is highly damaging and generally totally uncontrolled. The reality is that the exposed soil surface leads to high levels of erosion and considerable downstream deposition, so the impacts are widely felt. Sand mining is mostly found in the Mkambati Claimed Lands (Table 3), with about 18 ha of open mines.
2. Erosion of river banks due to uncontrolled cattle access (e.g. Figure 16). The cattle damage the banks of the river causing them to erode during heavy rain. The effects are not limited to the damaged site as there is considerable deposition downstream, which smothers the wetlands and riverine vegetation. Again, these issues are generally associated with the Mkambati sites (Table 3), with a total of about 26 ha of riverine habitat requiring rehabilitation.

Figure 15. Example of sand mining along a riverine wetland

Figure 16. Example of an eroded upstream riverine wetland and downstream deposition

Central Cluster

The Central Cluster of sites is a transitional area where the primary ecosystem type shifts from grassy to woody. The reasons for this shift are likely to be relatively complex interaction of climatic, topographic, edaphic and anthropogenic factors. It is also the transition from the 'proper' grasslands (Pondoland-Ugu Sandstone Coastal Sourveld) into the complex mosaic of forest and grassland patches of the Transkei Coastal Belt. Such transitional areas are often considered very important in biodiversity planning as they are the interface between major bioclimatic zones and are often associated with high levels of endemism. They are also believed to have potential to allow ecosystems and species to adapt to potential climate change.

Grassy ecosystems

The large grasslands of Lambasi are the southern-most extension of the conservation-important Pondoland-Ugu Sandstone Coastal Sourveld (see Table 5, Figure 17), and it is difficult to over-emphasise the importance of securing this large remnant grassland, which is generally in good condition.

Table 5. The remaining areas of SANBI ecosystems for the Central Cluster

SANBI Vegetation Type	Lambasi	Ntsubane	Ntsubane (Mbotyi)
Estuarine	2	10	0
Pondoland-Ugu Sandstone Coastal Sourveld	8305	20	162
Scarp Forest	446	1958	697
Transkei Coastal Belt		936	78
TOTAL	**8753**	**2924**	**936**

Table 6. The digitised areas (ha) associated with the main landcover types and ecosystems in the Central Cluster

Landcover/ecosystem		Lambasi	Ntsubane	Ntsubane (Mbotyi)
Modified	Arable	29.8		6.0
	Homesteads	10.4	5.7	19.8
	Invasive Alien Plants	10.3		
Natural	Bush	277.7	13.8	75.9
	Erosion	9.5		
	Forest	418.5	2,686.7	814.7
	Grassland	7,060.2	192.9	45.6
	Riverine		20.7	
	Sand Dunes		3.9	
	Savanna/Open woodland		7.8	
	Secondary grasslands	957.9		
	Wetland Woody Ecosystem	42.3		

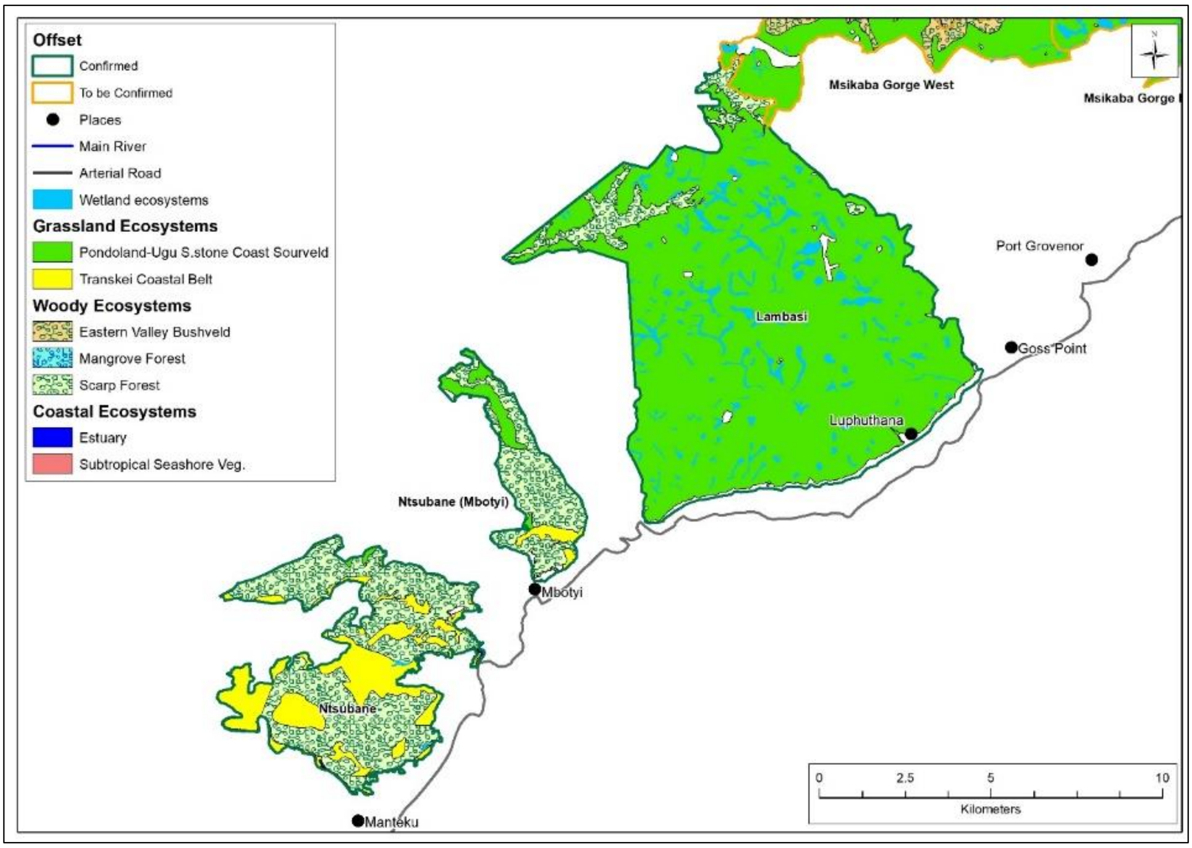


Figure 17. Map of the SANBI ecosystems of the Central Cluster

Similar to the Northern Cluster, the Lambasi grasslands form a matrix in which there are pockets of wetlands and forests. There are also almost 960 ha of secondary grasslands associated with historic attempts to establish arable fields; now abandoned and revegetated with a species-poor grassland.

Although Ntsubane is a short distance to the south (<5 km) it represents a massive biogeographical shift in the Transkei Coastal Belt vegetation, which is dominated by forest and bush, with isolated grassland patches that are believed to be secondary vegetation in response to historic arable clearing. These grassland patches are potentially too small to remain viable as they are probably infrequently burnt and prone to woodiness (e.g. Figure 18). The natural successional pathway in the absence of regular fire is towards bush and forest.

Figure 18. Example of Transkei Coastal Belt grassland patch

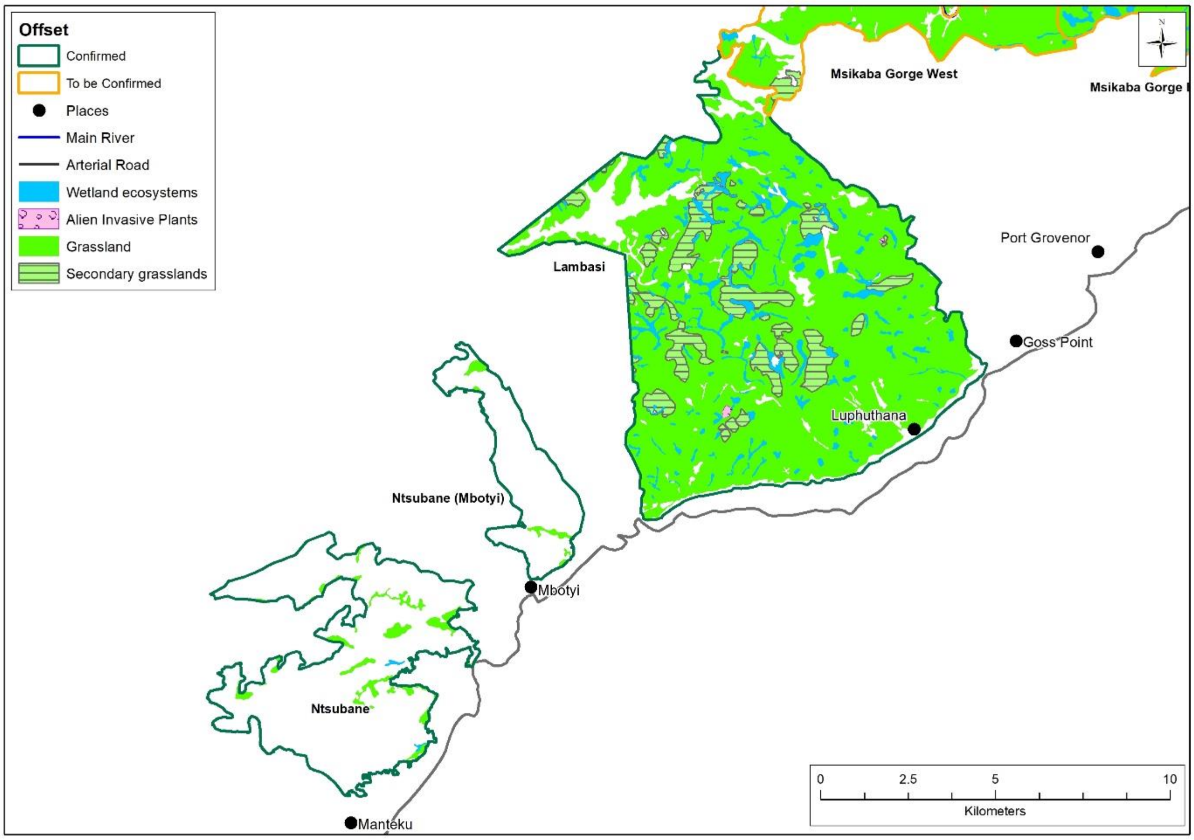


Figure 19. Map showing the grassy ecosystems of the Central Cluster

Woody ecosystems

Although there are only relatively small forest patches embedded in the Lambasi grasslands, they form an important part of the site's biodiversity, including some patches that are associated with the wetlands (see Figure 20).

The importance of the Ntsubane Forests has long been recognised and considerable work has already been done in them, such as the recent WESSA-CEPF funded project. The primary issues that they face are clearing of small patches for slash-and-burn shifting arable farmers and then subsequent infestation by IAPs. Although some patches of IAPs have been digitised, it is not an accurate picture of the extent of the problem due to the inability to distinguish IAPs from indigenous forests from an aerial image.

Wetland ecosystems

The Lambasi grasslands also have a very high occurrence of wetlands (Table 7, Figure 20), although they are generally in much better condition than those in the Northern Cluster due to the absence of sand mining. There are, however, a few wetlands and riparian habitats that have become degraded and eroded, probably due to uncontrolled livestock access.

Table 7. Estimates of wetland area, count and density in the Central Cluster

Offset	Area (Ha)	Count	Density
Lambasi	647.3	144	7.23
Ntsubane	8.3	3	0.28
Ntsubane (Mbotyi)	1.0	1	0.10

There appear to be fewer wetlands in the Ntsubane sites, although this may be due to an inability to see wetlands in forested ecosystems from an aerial image. Without extensive field work it is impossible to make a clear statement on the area or condition of these woody wetland areas.

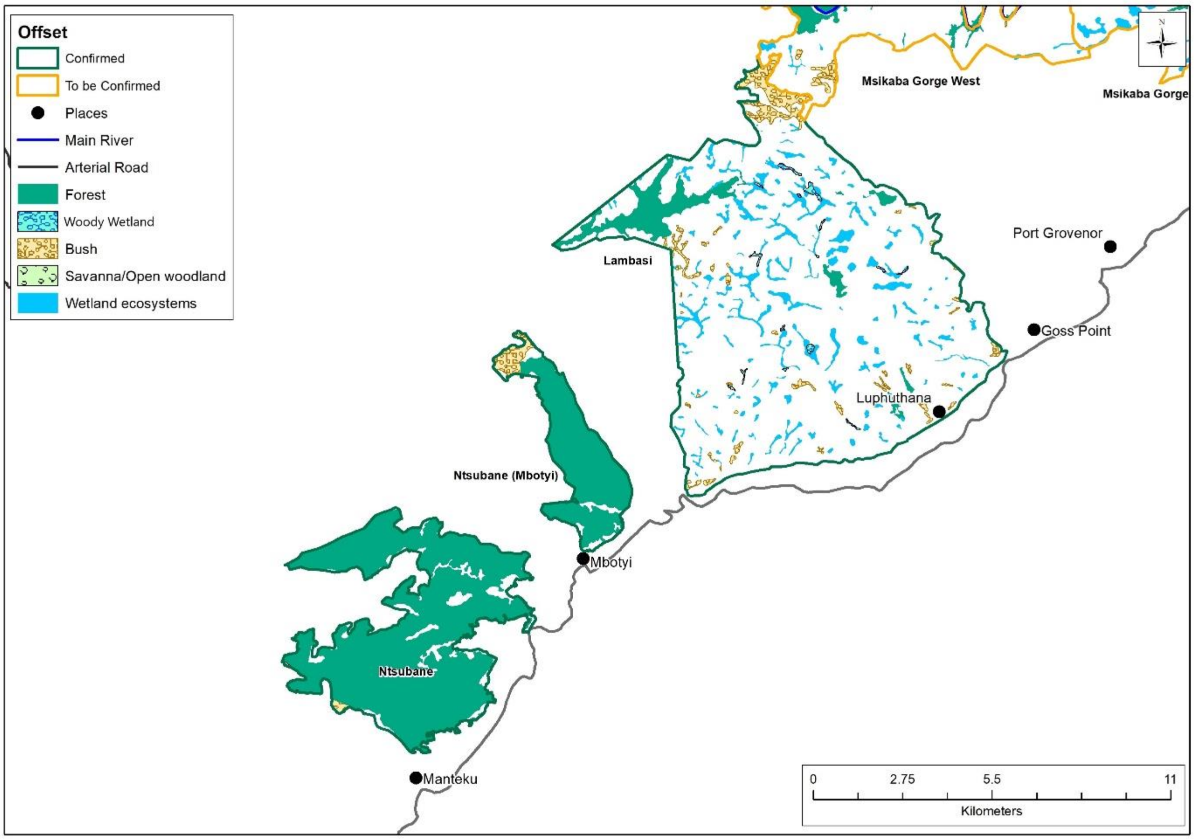


Figure 20. Map of the woody and wetland ecosystems of the Central Cluster

Southern Cluster

Grassy ecosystems

Although the Southern Cluster is dominated by woody ecosystems of the Transkei Coastal Belt and Scarp Forests, there are some small patches of Pondoland-Ugu Sandstone Coastal Sourveld in the Caguba and Mt. Thesiger sites and these are important outliers of this vegetation type (Table 8, Figure 21).

Table 8. The remaining areas of SANBI ecosystems for the Southern Cluster

SANBI Vegetation Type	Caguba	Caguba Annex 1	Caguba Annex 2	Caguba Annex 3	Mangroves	Mt Thesiger
East. Valley Bushveld		11				
Mangrove Forest					135	
Estuarine					83	1
Pondo.-Ugu SS Coast. Sourveld	35					155
Scarp Forest	612	237	75	116	13	823
Transkei Coast. Belt	676	434	41	183	396	397
TOTAL	**1322**	**682**	**115**	**299**	**628**	**1376**

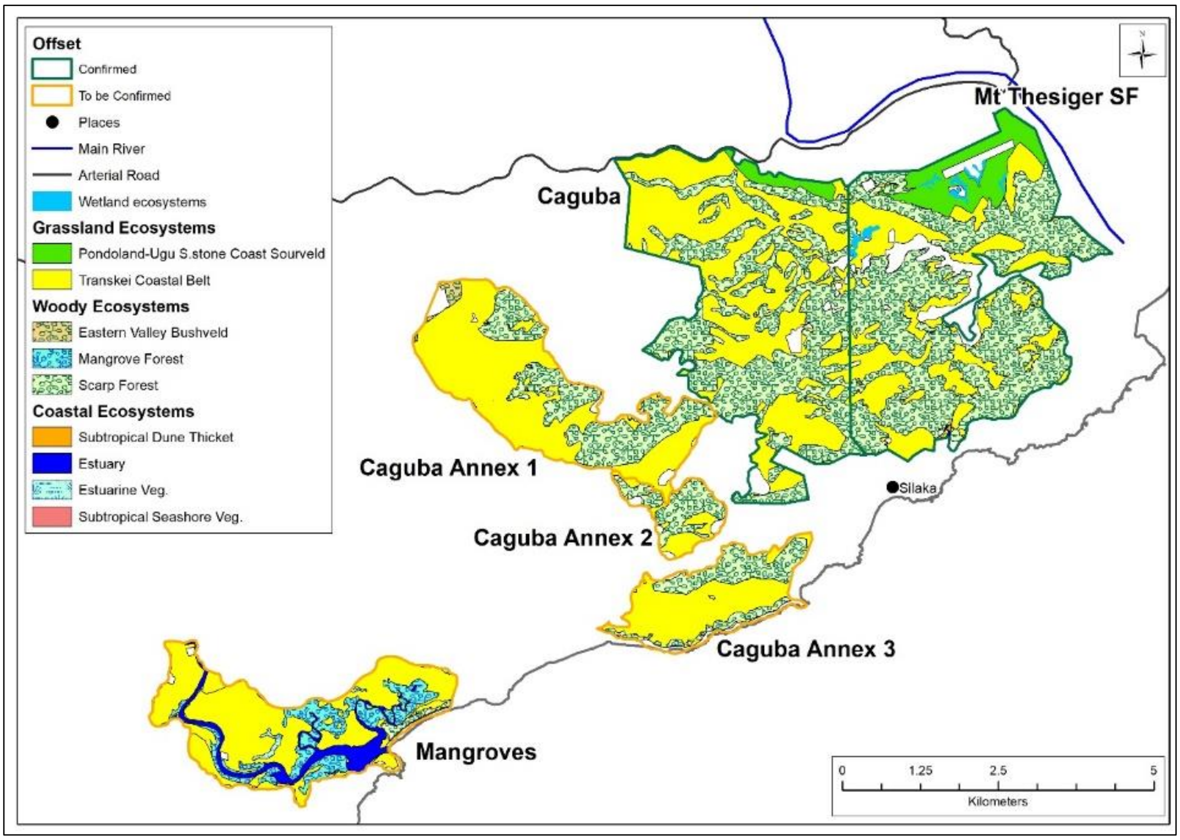


Figure 21. Map of the SANBI ecosystems of the Southern Cluster

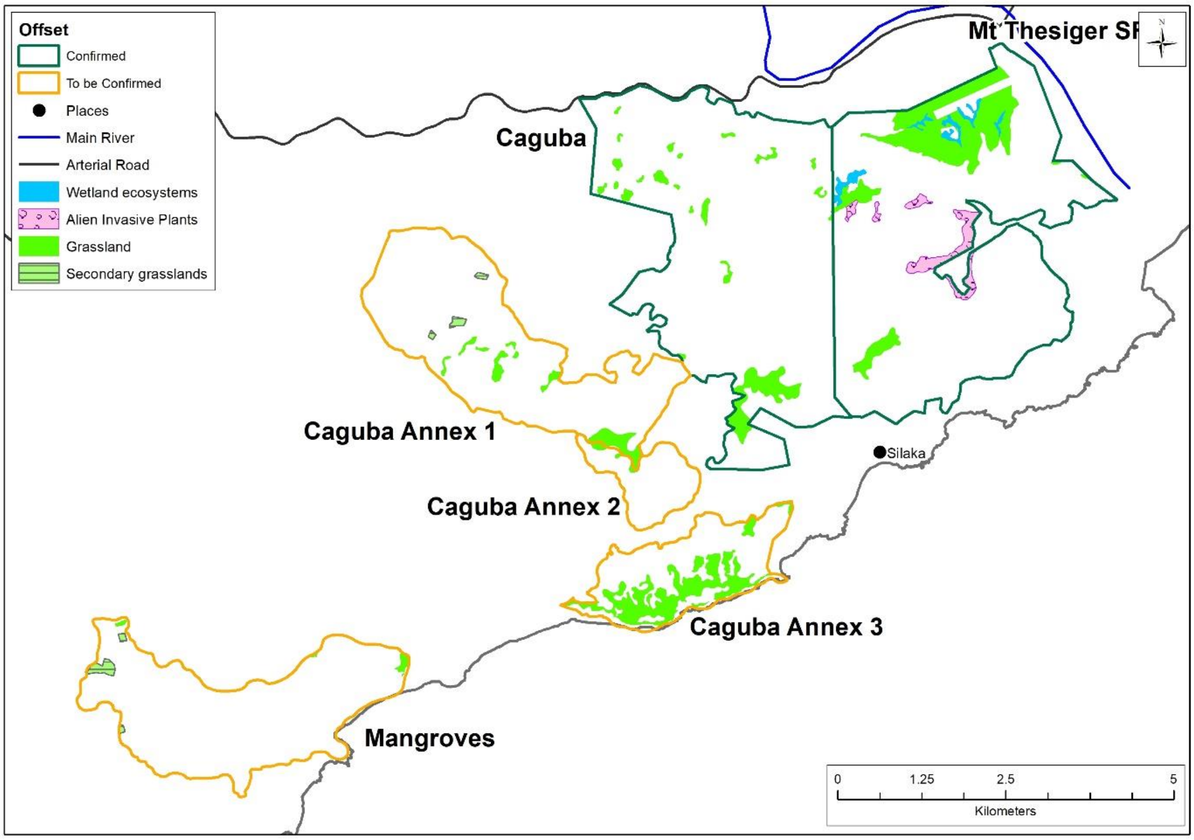


Figure 22. Map showing the grassy ecosystems of the Southern Cluster

Many of the grassland patches of the Caguba complex are Transkei Coastal Belt grasslands and thus may be secondary grasslands associated with revegetation of cleared forest patches. Despite this question of their origins, the interface between forest and grassland, especially in Caguba Annex 3 is significant for conservation.

Table 9. The areas (ha) associated with the main landcover types and ecosystems in the Southern Cluster

Landcover / ecosystem		Caguba	Caguba Annex 1	Caguba Annex 2	Caguba Annex 3	Mangroves	Mt Thesiger
Modified	Arable					4.1	
	Dam	5.9					1.1
	Developed	13.8	7.0				30.2
	Homesteads	11.0	8.6	9.9	1.5		
	Invasive Alien Plants						40.4
	Timber	1.0					28.4
	Bush		1.3	11.2	32.8	124.9	
Natural	Forest	1253.8	644.3	100.2	172.1	140.0	1173.2
	Grassland	66.9	31.8	4.0	96.1	5.0	181.7
	Mangrove Forest					151.4	
	Riverine					82.2	2.1
	Sand Dunes					82.4	
	Woodland	1.4				39.2	19.0
	Secondary grasslands		4.9			8.2	

Woody ecosystems

Unsurprisingly, the sites of the Southern Cluster are dominated by woody ecosystems (Figure 23), primarily Scarp Forest and Eastern Valley Bushveld. These regionally-important forests form important biogeographic corridors linking the Central Cluster forests to those further south.

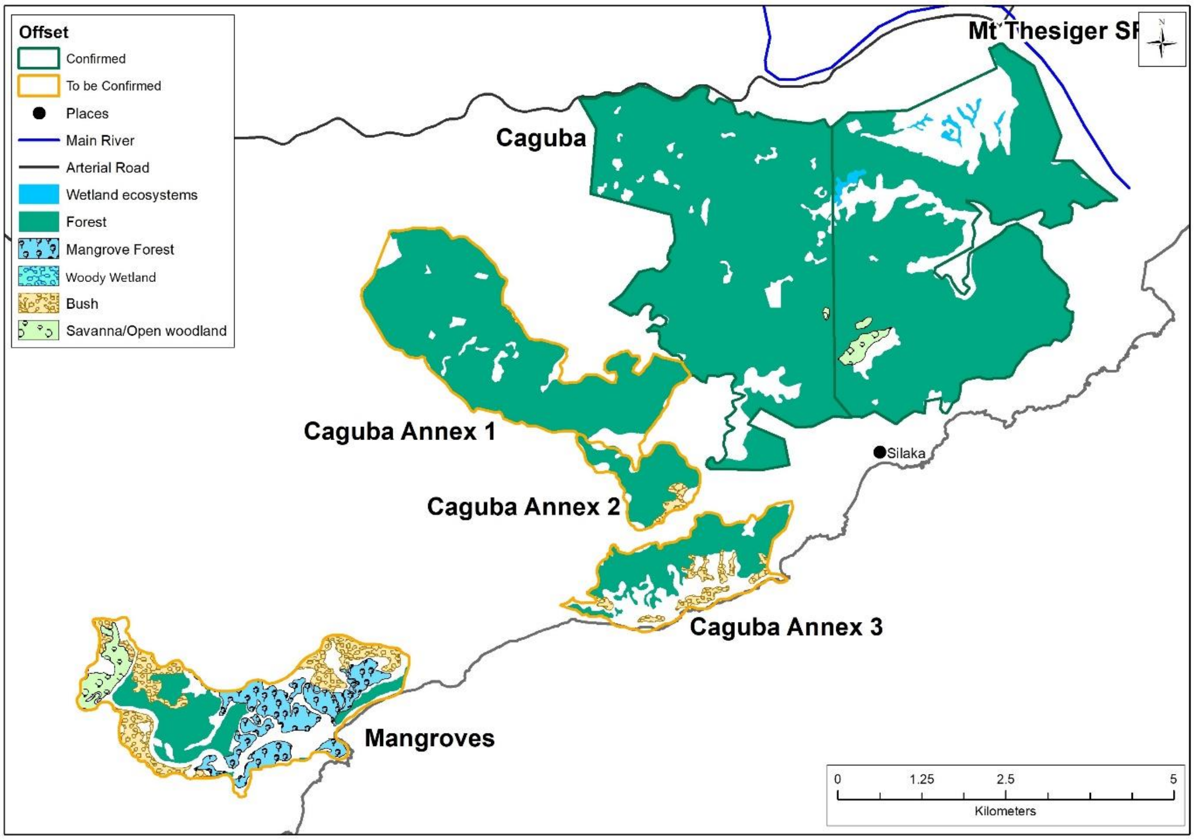


Figure 23. Map of the woody ecosystems of the Southern Cluster

Although no attempt was made to assess the condition of these forests, it is likely that they experience the same threats as those in the Central Cluster, primarily slash-and-burn clearing for arable lands, infestation by IAPs and extractive harvesting. There is no data quantifying these threats.

Wetland ecosystems

The topography of the Southern Cluster is not conducive to the formation of wetlands and most of the area is under woody ecosystems that make it too difficult to map wetlands from aerial images. Thus, there is little accurate data on the extent or condition of wetlands in the area. This does not mean that there are no wetlands in the area, but rather that we do not know. However, wetlands that occur under woody vegetation are generally just managed as part of that ecosystem and, unless they are particularly large and damaged, are unlikely to require specific attention.

IMPLEMENTATION

Once the offset sites have been formalised through signed community agreements or proclamation, and the exact boundaries are finalised, the ecosystem maps should be updated. Considering that threats on the ground are always a shifting target, the threats currently identified may change in the next coming years. The purpose of the updating will be primarily be to assess the condition and threats of the ecosystems in terms of the criteria listed in this section, and to develop mitigation measures to rehabilitate and protect the ecosystems. The goal of the assessment is to have a spatially-complete map of all the ecosystems, with an attribute table describing the current condition and threats. This will underpin the operational management plans that will drive all management actions in a three- or five-year cycle. It will also underpin any monitoring and evaluation at an ecosystem level.

Current condition

Each ecosystem in a site should be assessed by a Field Ecologist with experience in that ecosystem. The assessment must be spatially-linked to the mappable polygons in GIS so that the data can be used as a monitoring baseline and to populate budgets accurately. The assessment should include the following criteria as a minimum using a field sheet adapted from the one provided overleaf:

1. Dominant and/or indicator species, especially those species that come because of degradation.
2. IAP infestations within the ecosystem, including species, areas and age-density classification.
3. Soil stability and potential for erosion.
4. Plant species diversity estimates for the main plant groups (trees, shrubs, ferns, grasses).
5. Functional diversity in the form of decreaser grasses, bulbs and forbs, functional growth forms, tree, grass and forb seedlings, soil animal activity (e.g. worm castes).
6. Estimations of ecosystem services, such as clean water, flood attenuation, food, habitat, etc.

Threats

It is imperative to understand the threats that are resulting in the drivers of degradation. Typically, the threats are the socio-economic or broader environmental changes that drive degradation. It is important to understand the full cause-and-effect chain, using a systematic approach called Root-Cause Analysis (for example, see Figure 24).

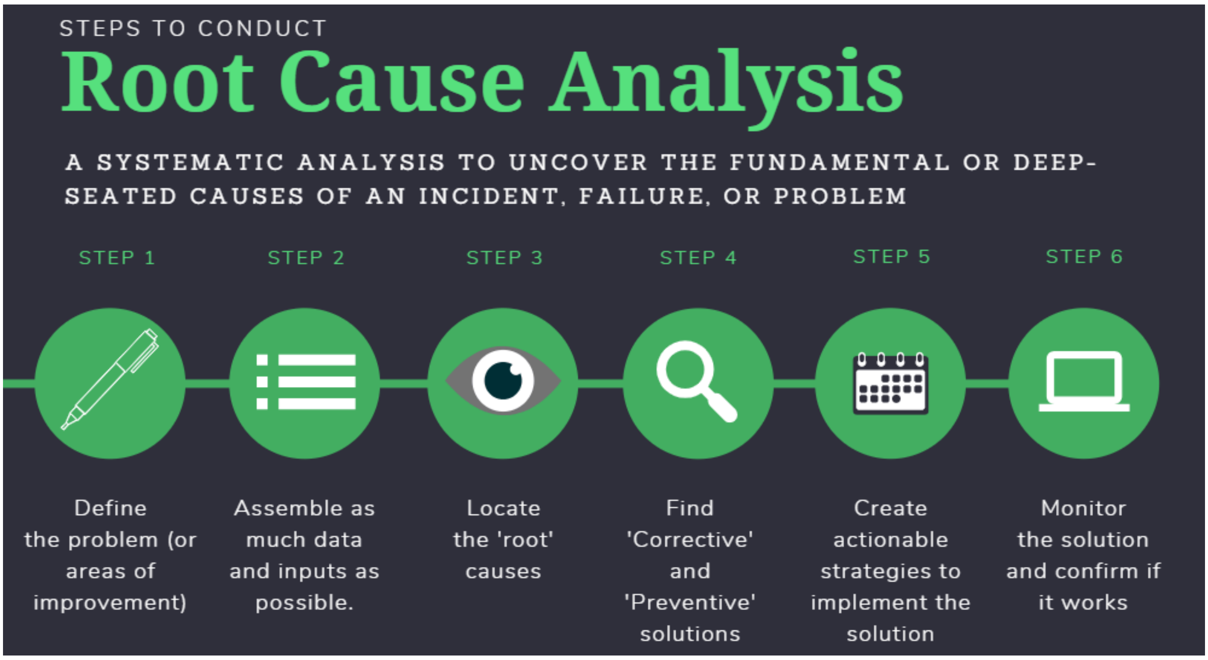


Figure 24. An example of the logic of Root Cause Analysis

For example, unemployment forces more people to derive a living from harvesting medicinal plants from a forest. The threat is unemployment, and the driver is illegal access and harvesting and the result is localised extinction of key species.

Threat mitigation measures

Although the drivers of degradation are relatively well understood (see each ecosystem section for details), the exact underlying reasons and causes are unique to each situation and it is unhelpful to provide a rules-based approach to solutions here. Rather, the site managers should apply themselves to find a creative solution, in collaboration with the local community, with the added goal of finding SMME-type opportunities for local employment.

For example, if there is an issue of over-grazing or selective-grazing that is causing grassland degradation, the solution is to understand the dynamics of cattle ownership and management by the local community, and then to partner with the local community to implement a rotational grazing and burning programme, simultaneously educating them in the mutual benefits to biodiversity and grazing value of healthy grasslands. If there are SMME opportunities associated with employing people as trained herders and rangers to manage the rotational grazing, then these must be pursued.

Site Name:		Estimation of area:	Descriptors
Waypoint:		Photo no's:	
Topographic description:			Slope (Steep, Moderate, Gentle, Flat), Aspect,
Position in the catchment:		Access: Ability to burn:	0 - None, 1 - Some, 2 - Good
Dominant matrix vegetation (what should be there?)			Open G'land, Riv. G'land, Riv. Bush, Rock Outcrop, Bush Clump, Valley Thicket, Forest, Wetland
Current dominant matrix vegetation (what is currently there?)			Open G'land, Riv. G'land, Riv. Bush, Rock Outcrop, Bush Clump, Valley Thicket, Forest, Wetland, IAP Thicket
Soil	Evidence of soil erosion and sedimentation	Type & Score	E.g. gulleys, no organic matter, pedestals, sheet erosion. 0 - Low, 1 - Some, 2 - Medium, 3 - High
Plant diversity:	Grasses		0 - Low 1 - Moderate 2 - High
	Forbs		
	Shrubs		
	Trees		
Functional diversity:	Decreaser grasses, bulbs and forbs		0 - Absent 1 - Low 2 - Moderate 3 - High
	Functional growth forms		
	Grass and forb seedlings		
	Soil animal activity e.g. worm castes		
Top 3 IAPs			0 - Dominant, 1 - Moderate, 2 - Scattered, 3 - None
Description of possible successional future (Where will this area be in 2-5 years time, assuming current management continues?)			
Ecosystem Services	Water quantity		0 - Absent 1 - Low 2 - Moderate 3 - High
	Water quality		
	Biodiversity habitat		
	Ecological corridor		
	Other:		

MONITORING AND EVALUATION

Learning is a critical part of adaptive management. If ECPTA emphasize adaptive management and assessment as a learning vehicle for the efforts described in this implementation plan, the restoration is likely to be more effective than it would otherwise be. Monitoring and evaluation becomes key in this adaptive implementation of rehabilitation techniques. This biodiversity offset is a long-term project, ideas that have been conceptualised for ecosystem rehabilitation may be or may not be as effective as it was envisaged. Learning and adapting will be necessary to ensure that rehabilitation funds are well-spent. This is a major concern given that the time frame of 8 years is very short in the context of ecosystems'. Continuous learning will be a key determinant of rehabilitation successes. This is because one of the areas of support necessary for project implementation is M&E. The Rehabilitation Managers together with their respective support staff can do the best they can in ecosystem rehabilitation, but the scope of work in this biodiversity offset project is so big that it may not very easy for them to identify whether the targeted objectives are achieved or not. M&E therefore needs to be capacitated with both financial resources and human capital.

Also, it is expected that SANRAL will need to know whether their investment has been indeed utilised for the purposes they were intended and whether such an investment is achieving the goals of the 2010 RoD prescripts. M&E will not help ECPTA for just observing the achievement of planned goals, but also will assist in forward planning for the next annual cycles of the project. The M&E therefore aims to provide ECPTA management with context of rehabilitation projects, provide regular feedbacks and early indications of progress or lack thereof in the achievement of intended results and the attainment of goals and objectives. The monitoring process involves reporting on actual performance against what was planned or expected according to pre-determined standards. It will involve collecting and analysing data on implementation processes, strategies and results, and recommending corrective measures.

The M&E programme is proposed to be made up of three components and variables:

a. Monthly M&E Reporting Framework
    i. Areas treated
    ii. Employment
    iii. Training
b. Periodic M&E Surveys
    i. Hectare regenerating
    ii. Habitat recovery
    iii. Improved ecosystem services (e.g. Carbon sequestration)
    iv. Improved biodiversity
    v. Compositional and structural regeneration, recovery and ecosystem functionality
    vi. Water retention and landscape stability (erosion, combating desertification)

Periodic M&E reports will be technical summaries of operational, social and ecological progress and achievements, written for the management review group who are experts in their respective fields. Management will have to take into account that the reviewers, among other things, will be asked to comment on the management/implementation philosophy and methods adopted, the quality of the restoration, the results and outputs of the project, and whether or not ECPTA is receiving 'value for money' in the ecosystem rehabilitation.

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