2016 - 2023

MTO NORTH ENVIRONMENTAL MONITORING PROGRAM SUMMARY

MTO | lowveld

Version 5 (2023)
Prepared by J. Huyser
Environmental Consultant

INTRODUCTION

To mitigate and manage impacts on the environment, the development and implementation of a holistic monitoring program is an essential management tool of any well managed business. Monitoring is essential to determine base-line information, detect possible change to the environment after a predetermined period and to monitor and implement adequate management changes, should they be required. Monitoring will ensure that standards are being maintained and that constant improvement is taking place, where needed.

This document is the publicly available eight - year strategic monitoring plan for the company from 2016 – 2023. The document covers monitoring as related to the environment and does not include the daily monitoring of forestry, silviculture, or harvesting activities, which are covered by the company's Integrated Management System procedures and policies. This 2023 update is a publicly available document and results of monitoring will be updated at least every two years to keep the document current. Stakeholders wishing to receive an electronic version of this document can contact Jan Huyser, our Environmental Consultant at mailto: huyserjanh@gmail.com in this regard.

STRATEGIC MONITORING PROGRAM

Long term, goal-oriented and systematic trend assessment of natural process is needed as part of a strategic monitoring program. The monitoring of the impact of forestry on the different levels of the ecosystem and on biodiversity is needed in order to monitor trends over time. Monitoring in terms of biodiversity pattern and process and for specific species therefore formed the basis for developing this strategic monitoring program. The different levels at which this program is therefore aimed are shown in Table 1. The monitoring programs initiated for each of these levels is also shown and discussed further in this document.

Table 1. The strategic ecosystem levels to be monitored as part of this monitoring program.

Level of monitoring	Description	Identified and Implemented Monitoring Programs
Biodiversity pattern	Monitoring the extent, intactness and health of identified ecosystems such as forest and wetlands..	❑ Priority Conservation Value Areas Identification. ❑ HCVF monitoring ❑ Habitat Conditions - *Odonata* as indicators
Biodiversity process	Monitoring the potential of the site to function as a biological corridor that will enable the movement of plants and animals over ecological time-scales (e.g. seasonal movement), evolutionary time-scales (population differentiation and diversification) and in response to anticipated anthropogenic climate change.	❑ Water Quality monitoring ❑ Erosion monitoring ❑ Weed eradication monitoring

Species Monitoring	The monitoring of identified rare, threatened and endangered species to determine and manage the impacts of forestry on these species over time.	❑ General Fauna monitoring. ❑ Fish monitoring ❑ Red Data Species Monitoring.
Areas of Special Interest Monitoring	The monitoring of identified cultural and historical sites listed on plantations, to monitor their status over time, and prescribe management actions as necessary.	❑ Areas of Special Interest Program.

The strategic monitoring program is aimed to provide sufficient information to make informative decisions but must also be affordable and general enough to be implemented easily over time. Quantitative and qualitative site monitoring, fixed point photo monitoring and site/habitat/species specific monitoring protocols are all monitoring tools that are considered when developing the strategic monitoring program for MTO North. Cost, the amount of information obtained, and the use of this information were also critical decision-making components.

MONITORING PROJECTS

1. BIODIVERSITY PATTERN

1.1 High Conservation Value Area Identification

1.1.1. Requirements for Monitoring

There has been much workshop discussion and publishing of reports on the history of High Conservation Value thinking and most of these documents are available on the HCV network website (www.hcvnetwork.org). It is however important to note that up to 2009 the HCV concept was restricted to forest ecosystems and made no mention of other ecosystems, such as fynbos. The HCVF concept was initially used by the Forest Stewardship Council® (FSC®) for use in forest management certification and was first published in 1999. Under Principle 9 for forest certification, Forest Managers were required to identify High Conservation Values (of forests) that occurred within their individual management units, to manage them in order to maintain or enhance the values identified and to monitor the success of this management (Jennings & Jarvie 2003).

More recently, guidelines have been developed for undertaking High Conservation Value assessments of other areas or vegetation types (Jennings & Jarvie 2003). Thus the concept is no longer limited to indigenous forests and includes other ecosystems that may be considered threatened

Table 2. Definition of High Conservation Values: To be considered a HCV or HCVF , the forest or area must possess one or more the following attributes:

No.	Current HCVF attribute	Proposed HCV attribute
1	Forest areas containing globally, regionally or nationally significant concentrations of biodiversity values.	Concentrations of biodiversity values that are significant at global, regional or national levels (e.g., endemism, endangered species, and refuges).
2	Forest areas containing globally, regionally or nationally significant large landscape level forests where viable populations of most/all naturally occurring species exist in natural patterns of distribution and abundance	Large landscape-level forests or other ecosystems that are significant at global, regional or national level, in the management unit, containing viable populations of the majority or all the naturally occurring species in natural patterns of distribution and abundance.
3	Forests containing rare, threatened or endangered ecosystems	Rare, threatened, or endangered ecosystems.
4	Forests that provide basic ecological services in critical situations (e.g. water quality or flow, protection against erosion or natural disasters such as cyclones or hurricanes, pollinators);	Basic environmental services in critical situations (e.g. protection of critical water catchments, control of erosion).
5	Forests fundamental to meeting the basic needs of communities.	Areas fundamental for satisfying basic necessities of local communities (e.g. for subsistence, health).
6	Forest areas critical to local community traditional cultural identity.	Areas critical for the traditional cultural identity of local communities (areas of cultural, ecological, economic or religious importance identified in cooperation with these local communities).

1.1.2. Monitoring Protocol

In line with the FSC Indicator 9.1.1, the MTO North Landholdings were assessed by overlaying the shape files of the MTO North non-commercial areas with that of the Mpumalanga Biodiversity Sector Plan, the official conservation plan for the province.

The Mpumalanga Tourism and Parks Agency developed the Mpumalanga biodiversity Sector Plan (MBSP) in 2014.

(https://www.arcgis.com/apps/MapSeries/index.html?appid=c89fe9d818824974b23fbf91b2478479)

The main purpose of biodiversity sector plans is to ensure that the most recent and best quality spatial biodiversity information can be accessed and used to inform land-use and development planning, environmental assessments and authorizations, and natural resource management. A biodiversity sector plan achieves this by providing a CBA map (or maps) of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological processes – these areas are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs).

The CBA map delineates Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Other Natural Areas (ONAs), Protected Areas (PAs) and areas that have been irreversibly modified from their natural state. **Critical Biodiversity Areas (CBAs)** are areas that are required to meet biodiversity targets for species, ecosystems or ecological processes. These include:

- All areas required to meet biodiversity pattern targets and to ensure continued existence and functioning of species and ecosystems, special habitats and species of conservation concern;
- Critically Endangered ecosystems; and
- Critical linkages (corridor 'pinch-points') to maintain connectivity.

CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species. For this reason, where present on MTO land, these areas have been included as Priority Conservation areas.

1.1.3. Summary of Results

The Mpumalanga Biodiversity Sector plan has listed the following CBA attributes for the MTO North plantations:

Farm Name	Terrestrial attributes	Freshwater Attributes	RTE Species
Waterhoutboom		CBA Rivers	
Roodewal		CBA Rivers and CBA wetlands	
Mac Mac		CBA Rivers and CBA Aquatic species	

1.1.4 General Management Recommendations

A precautionary approach is followed whereby weed control for the PCA is prioritised.

Generic and specific recommendations from the annual Dragonfly Index monitoring at Roodewal are reviewed and implemented where feasible.

More specific information can be viewed in the Conservation Management Plans for Ramanas and Hazyview.

1.1.5 Monitoring Frequency

Dragonfly Index Monitoring is conducted annually for the Roodewal/Waterhoutboon Priority Conservation Area.

1.2 High Conservation Value Forests Monitoring

1.2.1 Requirements for monitoring

At this stage there are no identified HCVF's for any of the MTO North Management Areas. This is due to the following:

- The MTO North landholding is made up of numerous small "farms" spread over a wide geographic area. In the absence of a fairly large contiguous area, the scale and intrinsic conservation value of the attributes consistent with High Conservation Value Forests, if present, are negligible when assessing them in terms of the six definitions of HCVF as depicted below and required by the FSC system. In short, indigenous forest pockets that

do occur, are small, isolated and do not meet the definition of HCVF when assessed against the HCVF definitions. Furthermore and as confirmed by DAFF, there are indeed very few true "Indigenous Forests" on MTO land but rather deciduous woodland areas where fire is present and play an important role in the vegetation structure when present or absent.

- MTO North approached the Department of Agriculture/Forestry and Fisheries (DAFF) (the Government Department responsible for the interpretation and implementation of the National Forest Act) with a request to assess the MTO North Plantations against the HCVF definitions and attributes of the FSC system and to provide a professional and scientific opinion on the status of the MTO landholdings in this regard. The Principal Forestry Scientist who did the Assessment concluded that the MTO landholdings do not contain forests that contain any of the six attributes that would qualify them as HCVF.
- Previous owners namely Mondi, Hans Merensky and Bedrock concluded the same as the above finding from DAFF and subsequently no HCVF status was ever afforded to any of the current Forestry Areas, including Ramanas where separate owners Merensky Holdings were not sure what to do in this regard due to conflicting specialist reports that did not assess the forest patches in terms of the HCVF attributes but in terms of general conservation considerations.
- When MTO North requested the Mpumalanga Tourism and Parks Agency to screen the MTO landholdings against the biodiversity attributes in the Mpumalanga Biodiversity Sector Plan, the official biodiversity plan for the province, none of the identified attributes were forest related but were rather wetland and water (aquatic) related.

Given the current definition and the review process mentioned above, no High Conservation Value Forest (HCVF) have been identified and thus there are no monitoring programme in place for HCVF's.

In general the company is committed to conserving and safeguarding the indigenous forest pockets that do occur on MTO's landholding and the widely accepted "Precautionary Approach' is followed in this regard.

The influence of commercial plantations on the indigenous forest should however be monitored in future. The main influence of the plantation on the forest is experienced at the contact zones (forest edge or ecotone) and the influence of alien vegetation and the control thereof on the indigenous forest, should form the basis of the MTO North monitoring system. This will only officially commence once the certification standard for South Africa has been finalized and implemented.

1.2.2 Monitoring protocol

Any future HCVF's that are identified (as new land holdings is purchased), at MTO North, will be selected to detect trends over a long observation period, to assess management operations through monitoring and to keep records of change over time. Formal monitoring will be conducted every five years by a forest specialist and in the interim years by the forestry staff themselves.

The following information will be documented for future identified HCVF's:

- Name of the forest, plantation, compartment
- General description
- List of tree species according to the National Tree Number List
- Regeneration
- Ground cover
- Past utilization
- Present status
- Edge (ecotone) description
- Alien vegetation
- Hydrology
- Fire history
- Fauna
- Social functions
- Fixed-point photo-monitoring sites
- Other monitoring programs
- Management proposals
- General
- Date of forest assessment and name of recorder.

A fixed-point photo-monitoring program, will be considered to create a comparative, visual documentation of vegetation change, may it be due to natural causes or management induced actions.

1.2.4 General Management Recommendations

Scheduled operations will be included into the conservation management plans of the plantation and include:

- Control of alien vegetation: (Eucalyptus, bug-weed, Lantana and other alien vegetation) notably along the edges of HCVF's. In some cases tall mature Eucalyptus trees can be harvested and the timber can be utilized. The felling operations have to be acceptable according to environmental conservation principles.
- Maintenance of ecotone: It is important that during plantation harvesting operations no trees are felled into the forest or even damage the ecotone of the forest. The officially prescribed buffer-zones between the forest and the first row of planted commercial trees must also be maintained at all times. It is essential that the buffer-zone is adequate for the establishment and maintenance of ecologically viable ecotones.
- MTO North does not harvest indigenous trees.

1.3 Habitat Conditions

1.3.1 Requirements for Monitoring

To responsibly manage biodiversity, it is the intention of MTO North to identify areas that contain significant biodiversity attributes and to assess the habitat integrity of such areas in order to gain insights into the current status of these habitats and as well as to identify existing and potential risks that should be addressed.

The wetlands of the Waterhoutboom floodplain at Roodewal (Hazyview Area) have been identified as the first such area due to its biodiversity attributes (Mpumalanga Biodiversity Sector Plan, 2014). Hence the purpose of the assessment was to determine the current condition of the Waterhoutboom floodplain (Roodewal – Hazyview Area), based on a survey of the adult *Odonata* encountered.

1.3.2 Monitoring Protocol

The method makes use of the Dragonfly Biotic Index (DBI), augmented per standard methods to incorporate species abundance (Diedericks, 2016). Eight (8) sampling points were selected within the study area based on habitat type and diversity, and the survey was carried out over a period of three days during December 2016. Most of the sites were located on permanent streams (e.g., Waterhoutboom, Phasaphasa and Motitsi), while one site was located on an ephemeral stream, and one in a seasonal side-channel. It was decided to repeat the DBI monitoring at Roodewal annually as to be able to detect sudden significant changes at an early stage and adjust forest management in accordance. As described in paragraph 1.3.5 this will be replaced by a SASS 5 assessment every fourth year, commencing as from 2024.

1.3.3 Summary of Results

With the 2016 survey, the value of these Waterhoutboom wetlands became apparent in that a total of 37 species of the 54 expected were recorded, which represents 65% of the species expected in the area. To put it into larger context, this represents 36% of the species recorded to date in the Sabie catchment, and 32% of the total species recorded for Mpumalanga. Despite this, all species recorded are locally common, and are listed nationally and globally as least concern (Samways & Simaika 2016). The species recorded correlated very well with their environmental and habitat preferences. The highest diversity of species was recorded in a seasonal side channel of the Waterhoutboom located in the floodplain. This floodplain provided a good diversity of hydrological types (standing/lentic and flowing/lotic water) and open vegetation favoured by many species. In general, more specialised communities were recorded in the stream habitats (lotic or flowing) which were narrower with more closed thicket-type vegetation. Species recorded at the Motitsi wetland-tributary differing almost completely from those recorded at other sites. This is an inundated wetland with open emergent vegetation.

Based on the species encountered compared to the expected, the study area was rated as ***moderately modified*** during the 2016 survey with a loss and change of natural habitat and biota, but with basic ecosystem functioning remaining predominantly unchanged. The vegetation in the area used to be more open canopy woodland, but has become subject to bush encroachment which could exclude some Odonata species.

Since the survey was initiated in December 2016, 56 Odonata species have been recorded during six sampling periods and were used to determine the Habitat Condition Scale (as described in Simaika and Samways (2012). The HCS categories were calculated as percentiles of the site scores within Roodewal plantation. The categories and description of habitat scale categories are included in the table below.

Current habitat scale condition categories for sites based on Roodewal plantation data.

Habitat Condition Scale			
DBI	**Adjusted DBI**	**Category**	**Description**
>31	>2.1	HH	High biotope diversity
31 – 24	1.7 – 2.1	MH	Moderate to high biodiversity
23 - 18	1.6 – 1.7	MM	Moderate biotope diversity
17 – 10	1.3 – 1.6	ML	Moderate to low biotope diversity

<10	Variable	LL	Low biotope diversity

In addition, habitat preference ratings of Odonata species recorded with Odonata abundances were used to determine current available and utilised Odonata habitats. The habitat preference values were obtained from a workshop in November 2014, where African Odonata specialists (international and local) under the guidance of Dr KD Dijkstra (funded by the JRS Biodiversity Foundation) pooled available knowledge by rating the habitat and environmental preferences of all known African species (Dijkstra 2016). These preferences were rated from 0 to 3, with no preference rated as 0 and a high preference as 3.

In this study, the species and their abundances recorded at each sampling location were summarised to determine dominant habitat and environmental preferences based on the community composition. This information serves as a baseline for present habitat conditions and presents a template against which future monitoring can be compared.

To rate the habitat, the DBI score for each species recorded at the site is added. The total DBI score is then divided by the number of species, which provides an average score per site or average DBI (ADBI also termed DBI/Site (Simaika and Samways 2012). As more information in the region is gathered, habitat condition scale categories can be determined to categorise conditions (Samways & Simaika 2016).

The table below provides a summary of the status of habitat conditions from 2018 – 2022. Results from 2016-2017 available upon request.

Habitat Condition Scale results summarised for sites sampled on Roodewal plantation since December 2018.

Site No.	Habitat Type	Jan-18	Dec-18	Dec-19	Dec-20	Dec-21	Dec-22	Change
R01	PS-TP	MM	MH	MM	MM	MH	MM	↘
R02	PS	ML	ML	ML	ML	ML	ML	→
R03	PP-TC	MM	ML	HH	HH	HH	MH	↘
R04	PS	MM	MM	MH	MH	MH	MH	→
R05	ES	LL	LL	LL	LL	LL	LL	→
R06	IW-PS	MH	MH	MH	MH	HH	MH	→
R07	PR	LL	ML	ML	MM	ML	ML	→
R08	PWS	MH	MH	MH	HH	MH	MH	→

PS = permanent stream; PP-TO = permanent pool, temporary oxbow; TP = temporary pool; TC = temporary channel; ES = ephemeral stream; IW-PS = intermediate wetland with permanent stream; PR = permanent river; PWS = permanent wetland-stream.

Diedericks (2022) concludes that habitat conditions are mostly representing stability over time, with a slight decrease in habitat condition scale at the site where the Waterhoutboom enters Roodewal (R01), and the Waterhoutboom wetland-stream tributary (R03). Habitat scale conditions were rated similar to previous years for the other sites.

Species with a preference for shaded conditions are present at the Roodewal 01, 02, and 06 sites. Large trees dominated by River Bush-willow (*Combretum erythrophyllum*) dominate the marginal and lower riparian zones at the stream sites. At the R06 sites, and additional channel fed by overflow from the Phasaphasa is more open, while the stream channel is more closed. All sites are dominated

by an adult Odonatan community with a preference for open habitats. Lotic species were dominant at sites, with lentic species dominant at the R03, R06, and R08 sites, which aligns to the available habitat.

The 2022 survey recommends that attention is given to the following management aspects at Waterhoutboom and Roodewal:

- Road network density.
- Road drainage.
- Vegetative structure and succession.
- Invasive plant control.
- Harvesting Practices.

1.3.4 General Management Recommendations

Recommendations for improvement on a catchment basis include a reduction in the road network densities which will reduce the number of crossings and reduce high sediment inputs into already threatened aquatic ecosystems. Recommendations at a site level basis include weed control of alien invasive plants within the riparian and wetland areas, and clear management goals to attain the proposed climax vegetation types of these areas.

1.3.5 Monitoring Frequency

The objective is to perform the *Odonata assessment* annually for the Roodewal/Waterhoutboom PCA and replace that with SASS 5 every 4 years. At the same time, the SASS 5 will also be repeated for the Crocodile and Sabie River systems to include other MTO plantations. The next SASS 5 monitoring is planned for 2024.

It is important to note that after the initial SASS 5biomonitoring of 2016, the follow up assessment was originally scheduled for 2020. This could however not be done due to COVID-19 and the knock-on effect on the MTO financial situation, and the monitoring cycle is being reset as from 2024 as described in the paragraph above.

2. BIODIVERSITY PROCESS

2.1 Water Quality Monitoring

2.1.1 Requirements for Monitoring

The conservation and wise use of water are priorities in South Africa. For this reason, the maintenance of riparian zones and wetlands is seen as a priority within the South African forestry context. Rivers and riparian zones also form critical habitat and biological corridors within forestry areas and as such should therefore be maintained to improve the overall biodiversity value of a planted area. Detailed monitoring, concentrating on benchmark monitoring and site impact monitoring, to determine change over time, are both important tools used to monitor water quality, and hence, the state of the river system.

2.1.2 Monitoring Protocol

A water quality monitoring program was initiated for the MTO North in 2016. The SASS5 bio monitoring system is used. The monitoring system is essentially a bio-monitoring system of the benthic invertebrates coupled with a habitat assessment and the measurement of certain physical parameters such as temperature, pH, turbidity, dissolved oxygen and conductivity.

Where possible, suitable sites that were previously monitored by MONDI and for which historic data exists, will be included in the SASS5 monitoring programme.

Table 4. SASS5 sampling has been carried out at the following MTO North sites during 2016

Site No.	River	System	Plantation	Latitude	Longitude	(m a.s.l)
X23E-061	Ndlovini	Queens	Jambila	-25.77131	30.86444	940 – 960
X23D-05	Golden Valley	Suid Kaap	Jambila	-25.68321	30.90772	760 – 780
X23D-02	Bosfontein	Suid Kaap	Jambila	-25.70549	30.90772	760 – 780
X31C-13a	Mac Mac	Sabie	Mac Mac	-25.02122	31.00045	540 – 560
X1C-13a	Mac Mac	Sabie	Mac Mac	-25.02950	31.02556	500-560
X31F-01	Waterhoutboom	Motitsi	Waterhoutboom	-24.94833	30.88847	980-1000
X31F-02	Waterhoutboom	Motitisi	Waterhoutboom	-24.95493	30.91038	940-960

2.1.3 Summary of Results

Detailed results of the 2016 SASS5 monitoring are provided in the specific site reports provided by Diedericks & Roux, 2016 (specific individual reports available to Stakeholders upon request). The SASS5 method was applied to generate the appropriate biomonitoring data with ancillary measures of habitat availability generated by the Integrated Habitat Assessment System, (IHAS version 2). A Comprehensive Habitat Integrity Assessment (or Index of Habitat Integrity - IHI) was also applied at each site sampled. The sites were chosen to measure specific impacts at a particular site over time.

In 2016, the Golden Valley monitoring site at Jambila (Barberton Area, (X23DE-05) was restricted to isolated pools with most of the flowing water (trickles) surfaces shaded and covered with reeds. Hence it was not feasible to conduct a proper SASS5 assessment at this site. Thus the site will be removed from the monitoring programme. In order to gain a measure of baseline information, a Dragonfly Biotic Index (DBI) was applied in 2016 at this site.

Table 5. Results of 2016 SASS5 sampling at Jambila, Mac Mac and Waterhoutboom (where available, historic data were included)

	Barberton Area – Jambila section	

Site	River	Data	2016					
X23E-061	Ndlovini (Bothasnek)	SASS	Drought					
		FAM	Drought					
		ASPT	Drought					
		STATE	Drought					
X23D-05	Golden Valley	SASS	135					
		FAM	23					
		ASPT	6.3					
		STATE	C/D					
	River	Data	1998	2001	2005	2008	2016	
X23D-02	Bosfontein	SASS	120	113	107	111	120	
		FAM	23	21	21	22	23	
		ASPT	5.8	4.6	4.4	3.8	5.8	
		STATE	D	E	E	E	D	

Ramanas – Waterhoutboom section										
Site	**River**	**Data**	**2004**	**2006**	**2008**	**2009**	**2011**	**2013**	**2016**	
X31F-01	Waterhoutboom	SASS	193	214	245	248	242	177	182	
		FAM	30	35	36	38	33	27	25	
		ASPT	7.4	5.8	6.3	5.8	6.1	6.6	7.3	
		STATE	A/B	B/C	B	B	B	B/C	B	
		Data	**1998**	**1999**	**2000**	**2013**	**2016**			
X31F-02	Waterhoutboom	SASS	153	220	115	180	149			
		FAM	24	33	19	24	23			
		ASPT	6.4	6.7	6.1	7.5	6.5			
		STATE	C	A/B	D	A/B	C/D			

Hazyview Area – Mac Mac section												
Site	**River**	**Data**	**2016**									
X31C-13a	Mac Mac	SASS	210									
		FAM	30									
		ASPT	6.8									
		STATE	38									

	River	Data	1998	1999	2005	2016					
X1C-13a	Mac Mac	SASS	143	136	167	155					
		FAM	23	21	23	23					
		ASPT	6.2	6.7	6.3	7.3					
		STATE	C/D	C	C	B					

Note: Definitions: SASS - Total SASS5 Sample Score
FAM - Total number of SASS5 families encountered
ASPT - Average score per taxon
STATE - Stream condition classes (see table below for definitions)

Stream condition classes are broadly divided into classes A to F, with an A being unmodified or natural, and F critically to extremely modified. A description of each class is included in the table below:

Table 6. Description of ecological stream conditions as guidelines for allocation of ecological categories.

ECOLOGICAL CATEGORY	GENERIC DESCRIPTION OF ECOLOGICAL CONDITIONS
A	Unmodified/natural, close to natural or close too predevelopment conditions within the natural variability of the system drivers, hydrology, physico-chemical and geomorphology. The habitat template and biological components can be considered close to natural or to pre-development conditions. The resilience of the system has not been compromised.
A/B	The system and its components are in a close to natural condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a B category.
B	Largely natural with few modifications. A small change in the attributes of natural habitats and biota may have taken place in terms of frequencies of occurrence and abundance. Ecosystem functions are essentially unchanged.
B/C	Close to largely natural most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a C category.
C	Moderately modified. Loss and change of natural habitat and biota have occurred in terms of frequencies of occurrence and abundance. Basic ecosystem functions are still predominantly unchanged. The resilience of the system to recover from human impacts has not been lost and it is ability to recover to a moderately modified condition following disturbance has been maintained.
C/D	The system is in a close to moderately modified condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of a D category.
D	Largely modified. A large change or loss of natural habitat, biota and basic ecosystem functions have occurred. The resilience of the system to maintain the category has not been compromised and the ability to deliver ecological goods and services have been maintained.
D/E	The system is in a close to largely modified condition most of the time. Conditions may rarely and temporarily decrease below the upper boundary of an E category. The resilience of the system is often under severe stress and may be lost permanently if adverse impacts continue.
E	Seriously modified. The change in the natural habitat template, biota and basic ecosystem functions are extensive. Only resilient biota may survive and it is highly likely that invasive and problem (pest) species may dominate. The resilience of the system is severely compromised as is the capacity to provide ecological goods and services. However, geomorphological conditions are largely intact but

	extensive restoration may be required to improve the system's hydrology and physico-chemical conditions.
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete change of the natural habitat template, biota and basic ecosystem functions. Ecological goods and services have largely be been lost. This is likely to include severe catchment changes as well as hydrological, physico-chemical and geomorphological changes. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible. Restoration of the system to a synthetic but sustainable condition acceptable for human purposes and to limit downstream impacts is the only option.

2.1.4 Monitoring Frequency

Please refer to paragraph 1.3.5.

2.2 EROSION MONITORING

2.2.1 Requirements for Monitoring

This is a long-term program aimed at improving the ecological status of impacted sites. Eroded and degraded sites are caused as a result of incorrect management practices, such as road construction, firebreak erosion, burning, etc. All sites need to be identified and rehabilitated over time.

2.2.2 Monitoring Protocol

Erosion assessment criteria was developed whereby identified erosion areas are rayed against a set of criteria and a score is noted for each area. The score then prioritises the management of each identified erosion area and the information is summarized on an erosion register for the plantation.

2.2.3 Summary of Results

Individual site records are available for each plantation.

2.2.4 Monitoring Frequency

Two-to-three-year monitoring will be carried out depending on the status of each site (stable or eroding). Monitoring will be recorded in the Degraded sites register. Should sites be actively eroding, rehabilitation will be scheduled.

2.3 WEED ERADICTION MONITORING

2.3.1 Requirements for Monitoring

To improve weeding and develop a holistic plan for the plantation, a programme to determine weed intensity and spread was initiated in 2016 through conducting weed ratings for each open area compartment. Weed Ratings for open area compartments will be carried out at least every two years

and as such Weed Ratings were again conducted during the first part of 2018. The weed ratings for 2020 had to be postponed to 2021 due to the COVID-19 pandemic. By comparing the Weed Ratings of 2016 and 2018, the progress and success of the weed control program becomes evident. Amongst other, the objective of weed ratings are to assist foresters with the prioritisation and scheduling of weed control activities over the medium term.

2.3.2 Monitoring Protocol

To quantify the amount of weed on the plantations, each conservation compartment was rated according to the amount (percentage cover) and size of weed (age), and effort needed to remove the weed (slashing, herbicide, chainsaw, cost). Ratings of 1 had the lowest amount of weed and effort needed, while rating of 6 was the most infested and would cost the largest amount to remove. The classification system used to rate the weed infestations per conservation compartment are shown in Table 6 below.

Table 6. Classification system for weed ratings.

Weed Infestation rating per compartment used to quantify the weed infestations				
Rating	**% weed cover**	**Effort needed to remove**	**Manday and effort required**	**Rating**
0	No weed could occur (dam, graded area).			**0**
1	0-10%	Young and few small patches in an area and easily to remove	Mandays <1. slashing, spraying	**Low light**
2		Older or larger patches, more difficult to remove	Mandays <1 or perhaps greater. Slashing, spraying could include chainsaw.	**Low heavy**
3	11-50%	Young or few small patches in an area and easy to remove	Mandays 1 to 3. Normally not chainsaw.	**Medium light**
4		Older or larger patches, more difficult to remove	Mandays 1 to 3. Chainsaw could be required.	**Medium heavy**
5	51-100%	Young or few small patches in an area and easier to remove	Mandays 1 to 3. Normally not chainsaw.	**High light**
6		Older or larger patches, more difficult to remove	Mandays > 3. Chainsaw required.	**High medium**

Because it is difficult to include a quantification of the weeds species into a rating system, the actual species found within the compartment was merely added as a comment and did not influence the rating system.

2.3.3 Summary of Results

Individual site records are available at each plantation and on Microforest and GIS.

The table below details the percentage of the landholdings that are in a Maintenance phase:

Year	2016	2017	2018	2019	2020	2021	2022	2023
Percentage of commercial area in maintenance phase								
Maintenance %	30%	45%	48%	52%	56%	47%	47%	58%
Percentage of non-commercial area maintenance phase								
Maintenance %	45%	33%	42%	45%	43%	23%	24%	27%

2.3.4 General Management Recommendations

A conservation action plan has been developed for each plantation, which is aimed at identifying and prioritizing a range of environmental management tasks and projects of which the control of weeds are an important element. All actions and completed work are recorded on MicroForest. Weed control continues on an annual basis in order to decrease the weed density over time. The aim is to decrease all weed to a maintenance phase on the plantations. MTO North is also committed to the reduction in the use of chemicals over the long term.

2.3.5 Monitoring Frequency

Monitoring is carried out every two years. Both commercial and open areas are included in the weed rating process as from 2018.

3. SPECIES MONITORING

3.1 General fauna monitoring and the identification of Red data species

3.1.1 Requirement for Monitoring

Vertebrates have been relatively well documented in South Africa (www.sanbi.org). In total 243 mammals are found in South Africa, of which 17 are threatened species. Of the more than 800 bird species, 26 are threatened and 5 are declared as endangered. 370 reptiles and amphibians are known to occur in the region, of which 21 are threatened and 6 are endangered. 220 freshwater fish species occur, of which 21 are threatened.

A baseline database will be developed for all vertebrates (birds, mammals, reptiles, amphibians and fish) known to occur on MTO North plantations. This information will be obtained by reviewing

historical records as well the South African National Biodiversity Institute (SANBI) databases and various species lists (see references in the tables below).

Baseline data is important when management decisions are taken, and when changes to the planted area are contemplated. General fauna monitoring should be seen as a long-term action, and the database will be expanded as more information becomes available.

In addition to this, Red Data species are those species that are known to be rare or threatened with extinction according to IUCN criteria. Species listed in the Red Data List are placed in categories that reflect the scarcity of the species. Species may be classified as Critically Endangered (CE), Endangered (EN), Vulnerable (VU) and Near Threatened (NT). The identification of red date species should be a priority, as where located, these species will need additional management and protection to ensure their survival, if their survival could be impacted by forestry. Using known literature for South Africa (www.sanbi.org) and the IUCN Red list (www.iucnredlist.org) as well as historical information from MONDI, an initial list of potential Red Data Species was compiled.

3.1.2 Monitoring Protocol

From the literature review, an initial database was developed for RTE species that could potentially occur on MTO North plantations. This list includes South African Red Data List ratings and IUCN red list status as well. The lists are to be updated as new information is obtained from visiting scientists or as part of sightings from staff.

From this list, all Red Data Species either positively identified, or potentially known to occur on MTO North plantations has been recorded. Eight fish species (0 positively identified), twelve mammal species (4 positively identified), five reptile species (1 positively identified), sixteen bird species (1 positively identified) and five butterfly (0 positively identified) species were identified during this review.

Table 7. Red Data listed mammal species that could occur on MTO North property.

Common name	Scientific name	IUCN status	SA status	Barberton	White River	Hazyview	Ramanas	Tzaneen	
Robust Golden mole	*Amblysomus robustus*	*VU*	*VU*	*X*	*X*	*X*	*X*		
Highveld Golden mole	*Amblysomus sepentrionalis*	*NT*	*Not Listed*	*X*	*X*	*X*	*X*		
Rough haired Golden mole	*Chrysospalax villosus*	*VU*	*VU*	*X*	*X*	*X*	*X*		
Gunnys Golden mole	*Meamblysomus gunningi*	*E*	E	*X*	*X*	*X*	*X*		
Juliana's Golden mole	*Meamblysomus julianae*	*E*	E	*X*	*X*	*X*	*X*		

Spotted-necked otter	*Lutra maculicolis*	*NT*	*VU*	*X*					
Cape clawless otter	*Aonyx capensis*	*NT*	*Not Listed*	*X*	*X*	*X*	*X*		
Leopard	*Panthera pardus*	*VU*	*VU*	*X*	*X*	*X*	*YES*		
Brown hyaena	*Hyaena brunnae*	VU	Not Listed	X	*X*	*X*	*YES*		
Mountain reedbuck	*Redunca fulvorufula fulvorufula*	LC	E	X			*YES*		
Serval	*Felis Serval*		*NT*	*YES*	*YES*	*YES*	*YES*		
Samango Monkey	*Cercopithecus mitis labiatus*	VU	VU				*X*		

Positively identified species indicated as "YES".

Mammal references:

- Smithers, H.N. 2009. Stuart, C. & Stuart, T
- Friedman, Y & Yolan, B. 2006.
- IUCN red list: **www.iucnredlist.org**

Table 8. Red Data listed bird species that could occur on MTO North property.

Common name	Scientific name	IUCN status	SA status	Barberton	White River	Hazyview	Ramanas	Tzaneen	
Blue crane	Anthropoides paradiseus	*VU*	*VU*	*X*			*X*		
White headed vulture	Trigonoceps occipitalus	*CE*	VU	X			*X*		
Lappet faced vulture	Torgos tracheliotos	*EN*	VU	X			*X*		
Hooded Vulture	Necrosyrtes monachus	*CE*	VU	X			*X*		
White backed Vulture	Gyps africanus	*CE*	VU	X			*X*		
Cape Vulture	Gyps coprotheres	E	VU	X			*X*		
Bateleur	Terathopius ecaudatus	NT	VU	X			*X*		
African Crowned Eagle	Stephanoaetus coronatus	NT	NT	YES	*YES*	*X*	*YES*		

Martial Eagle	Polemaetus bellicosus	VU	VU	X			*X*		
Pallid harrier	Circus macrourus	NT	NT	X			*X*		
White winged flufftail	Sarothrura ayesi	CE	CR	X			*X*		
Southern ground hornbill	Bucorvus leadbeateri	VU	VU	X			*X*		
Southern bald ibis	Geronticus calvus	VU	VU	X			*X*		*X*
Denham's Bustard	Neotis denhami	NT	*VU*	X			*X*		
Black rumped button quaiL	*Turnix hottentottus*	EN	EN	X			X		X
Bush blackcap	Lioptilus nigricapillus	*NT*	NT	X			*X*		

Positively identified species are shown as YES, species not yet identified, but which could potentially occur are shown as X.

Bird references:

- Sinclair, I. & Ryan, P. 2006; Barnes, K.N. 1983.
- SA Red data book birds (www.sanbi.org)
- IUCN red list: www.iucnredlist.org

Table 9. Red Data listed reptile species that could occur on MTO North property.

Common name	Scientific name	IUCN status	SA status	Barberton	White River	Hazyview	Ramanas	TzaneeN	
Coppery Grass Lizard	*Chaemaesaura aenea*	*LC*	*NT*	*X*	*X*	*X*			
Large Scaled Grass Lizard	*Chaemaesaura macrolepis*	*LC*	NT	X	X	X	X		
Breyers long tailed seps	*Tetradactylus breyeri*	*NT*	VU	X	X	X	X		
Striped harlequin snake	*Homoroselaps dorsalis*	*LC*	NT	X	X	X	X		
African Rock Python	*Python sebae*	*Not Listed*	Protected	YES	YES	YES	YES		

Positively identified species are shown as YES, species not yet identified, but which could potentially occur are shown as X.

Reptile references:

- Branch, B. 1990, 1998.
- IUCN red list: www.iucnredlist.org

Table 10. Red Data listed amphibian species that could occur on MTO North property.

Common name	Scientific name	IUCN status	SA status	Barberton	White River	Hazyview	Ramanas	Tzaneen	
	No Known spp at present								

Positively identified species are shown as YES, species not yet identified, but which could potentially occur are shown as X.

Amphibian references:

- Du Preez, L. & Carruthers, V. 2009.
- Minter et. al. 2004
- IUCN red list: www.iucnredlist.org

Table 11. Red Data listed fish species that could occur on MTO North property.

Common name	Scientific name	IUCN status	SA status*	Barberton	White River	Hazyview	Ramanas	Tzaneen	
Incomati rock catlet	*Chiloglanis bifurcus*	*Not Listed*	*R*	*X*	*X*	*X*	*X*		
Rock catfish	*Austroglanis sclateri*	Not Listed	R	X	X	X	X		
Orange fringed largemouth	*Chetia brevis*	*EN*	*R*	*X*	X	X	X		
North largemouth	*Serranochromis meridianus*	*EN*	*R*	*X*	X	X	X		
Pongola rock catlet	*Chiloglanis emarginatus*	*Not Listed*	*R*	*X*	X	X	X		
Southern kneria	*Kneria auriculata*	*Not Listed*	*R*	*X*	X	X	X		
Barred minnow	*Opsaridium zambezense*	*Not Listed*	*R*	*X*	X	X	X		
Incomati chiselmouth	*Varicorhinus nelspruitensis*	*NT*	*Not Listed*	*X*	X	X	X		

* South African status currently under revision.

Positively identified species are shown as YES, species not yet identified, but which could potentially occur are shown as X.

Fish references:

- Skelton, P.H. 1987.
- IUCN red list: www.iucnredlist.org

Table 12. Red Data listed butterfly species that could occur on MTO North property.

Common name	Scientific name	IUCN status	SA status*	Barberton	White River	Hazyview	Ramanas	Tzaneen
Barbara's Copper	*Aloeides barbarae*	*Not Listed*	*EN*	*X*			*X*	
Cloud Copper	*Aloeides nubilus*	EN	EN	X			X	
Irving's Blue	*Lepidochrysops irvingi*	*Not Listed*	*VU*	*X*				
Jeffrey's Blue	*Lepidochrysops jefferyi*	*Not Listed*	*EN*	*X*			X	
Swanepoel's Blue	*Lepidochrysops swanepoeli*	*Not Listed*	*VU*	*X*			X	
Butterfly references: **Henning et. Al. 2009. SA Red Data Book – Butterflies.** **IUCN red list: www.iucnredlist.org**								

3.1.3 Management Requirements

Most of the red data species identified are however difficult to monitor and detect, and therefore only presence and sightings are recorded for most of these species on the plantation.

To protect fauna, the following general precautionary measures have however been identified and will where needed be incorporated into procedures and planning:

- Indigenous forests, woodlands and rocky outcrops will be conserved to create corridors for the movement of animals.
- Wetland areas will be maintained and protected.
- Roads and river crossings will be correctly managed, to prevent soil erosion.
- Procedures will be implemented to minimize impacts on conservation areas.
- Planning will prioritise the provision of interconnection of bio-corridors along rivers that will permit fauna to connect to breeding sites and allow flora dispersal and will provide set aside conservation areas managed for protection of natural fauna and flora.

3.1.4 Monitoring Frequency

A photographic identification key of red data species was developed during 2021. This guide is used to identify the location and presence of red data species on the property, where their location is not already known. Maintenance of the General Fauna Monitoring database and red data species list will be continuous. An initial fish monitoring programme was initiated in 2016, and is discussed in more detail below.

3.3 Fish monitoring

3.3.1 Requirement for Monitoring

Fish are good indicators of long-term effects and broad habitat conditions, and changes in the available habitat conditions (Karr et al. 1986). This is because fish are "top of the food chain", relatively long-lived and mostly highly mobile. Assemblages include a range of species that represent a variety of trophic levels (omnivores, herbivores, insectivores, planktivores, piscivores). They tend to integrate effects of lower trophic levels; thus, fish assemblage structure is reflective of integrated environmental health. In support of the SASS5 assessments of 2016, fish sampling was carried out during March 2016 by a fish ecologist, using electro-fishing. Surveys were conducted at the aquatic bio monitoring sites where macro-invertebrate studies were carried out. The detailed reports are available to Stakeholders upon request.

3.3.2 Monitoring Protocol

Sampling was carried out at Jambila (Barberton Area) and at Waterhoutboom (Ramanas) during March 2016 by a fish ecologist (Diedericks, Roux 2016), using electro-fishing. Results for the fish sampling are listed in terms of species expected and recorded, with the number of each species indicated as well as the catch per unit efforts. The composition of the fish community in terms of indigenous or exotic, hydrological preferences and feeding groups are expressed as a percentage of the individuals recorded. Migration types, spatial ranges and importance of migration are also expressed as a percentage for the community recorded at the sampling point.

3.3.3 Monitoring Results

3.3.3.1 Results of monitoring at Jambila (Barberton Area)

Table 13. Fish species expected and previously recorded in the Ndlovini River is listed below, and the numbers of fish species present during the different surveys are indicated. Fish species expected based on the site location within the PESEIS Reach, are marked with an x.

SPECIES	EXP	DATE 03/2016
ANGUILLIDAE		
Anguilla mossambica	x	
AMPHILIIDAE		
Amphilius uranoscopus	x	2
MOCHOKIDAE		
Chiloglanis pretoriae	x	
CICHLIDAE		
Pseudocrenilabrus philander	x	

SPECIES	EXP	DATE 03/2016
Tilapia sparrmanii	x	
Number of species expected	**5**	
Number of species recorded		**1**
Number of individuals		**2**
Electro-fishing time (minutes)		**17**
Catch/Unit Effort (CPUE)		**0.12**
FRAI		

Five fish species were expected, of which one was recorded in 2016.

Table 14. Fish species expected in the upper Suid Kaap river is listed below and the numbers of those recorded at the Golden Valley in 2016 at the site indicated. Fish species expected based on the site location within the catchment, are marked with an x.

SPECIES	EXP	DATE 03/2016
ANGUILLIDAE		
Anguilla mossambica	x	
CYPRINIDAE		
Enteromius (Barbus) crocodilensis	x	
Enteromius (Barbus) eutaenia	x	2
Enteromius (Barbus) trimaculatus	x	8
Enteromius (Barbus) unitaeniatus	x	3
Labeobarbus marequensis	x	
AMPHILIIDAE		
Amphilius uranoscopus	x	
CLARIIDAE		
Clarias gariepinus	x	
MOCHOKIDAE		
Chiloglanis anoterus	x	
CICHLIDAE		

SPECIES	EXP	DATE 03/2016
Pseudocrenilabrus philander	x	
Tilapia sparrmanii	x	
Number of species expected	**11**	
Number of species recorded		**3**
Number of individuals		**13**
Electro-fishing time (minutes)		**12**
Catch/Unit Effort (CPUE)		**1.08**
FRAI		

Eleven fish species were expected, of which three was recorded in 2016. The species are "trapped" in deeper pools, with movement currently between pools not possible as a result of low flow. There is less surface water available at the Golden Valley than at the Boschfontein site, even though the upstream catchment size is greater (19.75 vs 12.95 km^2). The species present are adapted to harsh conditions, for example low flow and temporary groundwater fed pools. These species also have the ability and need to migrate between reaches to complete life cycles, so it is expected that they will move during high flows.

Table 15. Fish species expected and previously recorded in the upper Suid Kaap region is listed, and the numbers of fish species present at the Bosfontein site during the different 2016 survey is indicated. Fish species expected based on the site location within the PESEIS Reach, are marked with an x.

SPECIES	EXP	DATE 03/2016
ANGUILLIDAE		
Anguilla mossambica	x	
CYPRINIDAE		
Enteromius (Barbus) crocodilensis	x	
Enteromius (Barbus) eutaenia	x	53
Enteromius (Barbus) trimaculatus	x	17
Enteromius (Barbus) unitaeniatus	x	91
Labeobarbus marequensis	x	
AMPHILIIDAE		

SPECIES	EXP	DATE 03/2016
Amphilius uranoscopus	x	
CLARIIDAE		
Clarias gariepinus	x	1
MOCHOKIDAE		
Chiloglanis anoterus	x	
CICHLIDAE		
Pseudocrenilabrus philander	x	3
Tilapia sparrmanii	x	12
Number of species expected	**11**	
Number of species recorded		**5**
Number of individuals		**177**
Electro-fishing time (minutes)		**31**
Catch/Unit Effort (CPUE)		**5.71**
FRAI		

Eleven fish species were expected, of which five was recorded in 2016. The most abundant was *E. unitaeniatus*, followed by *E. eutaenia*. Species adapted to harsh conditions, for example low flow and temporary groundwater fed pools, dominated. These species also have the ability and need to migrate between reaches to complete life cycles.

3.3.3.2 Results of monitoring at Mac Mac (Hazyview Area)

Table 16. Fish species expected and previously recorded in PESEIS Reach Code (X31C-00683) is listed, and the numbers of fish species present at the Mac Mac River (Brandwag) site during the 2016 different survey is indicated. Fish species expected are marked with an x, and in number of individuals provided when actually recorded.

SPECIES	EXP	DATE 03/2016
MORMYRIDAE		
Marcusenius pongolensis	x	5
Petrocephalus wesselsi	x	
ANGUILLIDAE		

SPECIES	EXP	DATE 03/2016
Anguilla mossambica	x	
CYPRINIDAE		
Enteromius (Barbus) brevipinnis	x	
Enteromius (Barbus) eutaenia	x	36
Enteromius (Barbus) trimaculatus	x	
Enteromius (Barbus) unitaeniatus	x	2
Labeo cylindricus	x	
Labeobarbus marequensis	x	18
Labeobarbus polylepis	x	9
Opsaridium peringueyi	x	41
Varicorhinus nelspruitensis	x	4
CHARACIDAE		
Micralestes acutidens	x	
AMPHILIIDAE		
Amphilius uranoscopus	x	27
CLARIIDAE		
Clarias gariepinus	x	1
MOCHOKIDAE		
Chiloglanis anoterus	x	31
CICHLIDAE		
Pseudocrenilabrus philander	x	7
Number of species expected	**17**	
Number of species recorded		**11**
Number of individuals		**181**
Electro-fishing time (minutes)		**33**
Catch/Unit Effort (CPUE)		**5.48**
FRAI		

Fish species listed in Table 16 are those recorded in the Mac Mac River downstream from Mac Mac Falls. Eleven of the expected 17 fish species were recorded in 2016. The most abundant fish species encountered in 2016 was *O. peringueyi*, followed by *E. eutaenia*, both rheophilic species

Table 17. Fish species expected and previously recorded in PESEIS Reach Code (X31C-00683) is listed, and the numbers of fish species present at the Mac Mac river site (Matumi Picnic site) during the 2016 survey is indicated. Fish species expected are marked with an x, and in number of individuals provided when actually recorded.

SPECIES	EXP	DATE 03/2016
MORMYRIDAE		
Marcusenius pongolensis	**x**	1
Petrocephalus wesselsi	*	
ANGUILLIDAE		
Anguilla mossambica	*	
CYPRINIDAE		
Enteromius (Barbus) brevipinnis	**x**	
Enteromius (Barbus) eutaenia	**x**	50
Enteromius (Barbus) trimaculatus	*	
Enteromius (Barbus) unitaeniatus	*	
Labeo cylindricus	*	
Labeobarbus marequensis	x	
Labeobarbus polylepis	**x**	16
Opsaridium peringueyi	**x**	13
Varicorhinus nelspruitensis	**x**	
CHARACIDAE		
Micralestes acutidens	*	
AMPHILIIDAE		
Amphilius uranoscopus	**x**	17
CLARIIDAE		
Clarias gariepinus	*	
MOCHOKIDAE		
Chiloglanis anoterus	**x**	38
CICHLIDAE		
Pseudocrenilabrus philander	**x**	
Number of species expected	**11**	
Number of species recorded		**6**

SPECIES	EXP	DATE 03/2016
Number of individuals		**136**
Electro-fishing time (minutes)		**37**
Catch/Unit Effort (CPUE)		**3.65**
FRAI		

Fish species listed in Table 17 are those recorded in the Mac Mac River downstream from Mac Mac Falls. Fish species only recorded at the confluence of the Mac Mac with the Sabie River but not further upstream included (marked with a "*" in Table 6):

- *P. wesselsi;*
- *A. mossambica;*
- *E. trimaculatus;*
- *E. unitaeniatus;*
- *L. cylindricus;*
- *L. marequensis;*
- *M. acutidens, and;*
- *C. gariepinus.*

This is likely as a result of water temperature, with the Mac Mac River shaded for most of its flow from the Mac Mac Falls to the Sabie confluence. The most abundant fish species encountered in 2016 was *E. eutaenia*, followed by *C. anoterus*, both rheophilic species.

3.3.3.3 Results of monitoring at Waterhoutboom (Ramanas)

Table 18. Fish species expected and previously recorded in PESEIS Reach Code (X31F-00695) is listed, and the numbers of fish species present during the 2016 Waterhoutboom river (site 1 of 2) survey is indicated. Fish species expected based on the site location within the PESEIS Reach, are marked with an x.

SPECIES	EXP	DATE 03/2016
ANGUILLIDAE		
Anguilla mossambica	x	
CYPRINIDAE		
Enteromius[1] (*Barbus*) *anoplus*	x	7

SPECIES	EXP	DATE 03/2016
Enteromius (Barbus) brevipinnis	x	
Enteromius (Barbus) crocodilensis	x	34
Enteromius (Barbus) eutaenia	x	
AMPHILIIDAE		
Amphilius natalensis	x	
Amphilius uranoscopus	x	29
MOCHOKIDAE		
Chiloglanis anoterus	x	18
Number of species expected	**11**	
Number of species recorded		**4**
Number of individuals		**88**
Electro-fishing time (minutes)		**34**
Catch/Unit Effort (CPUE)		**2.59**
FRAI		**B**

Based on historical data for sites in the river from the tar road to this sampling point, 11 fish species were expected, of which four was recorded in 2016. The most abundant was *E. crocodilensis*, followed by *A. uranscopus*, both rheophilic species.

Table 19. Fish species expected and previously recorded in PESEIS Reach Code (X31F-00695) is listed, and the numbers of fish species present during the 2016 survey of the Waterhoutboom river (site 2 of 2) is indicated. Fish species expected based on the site location within the PESEIS Reach, are marked with an x.

SPECIES	EXP	DATE 03/2016
ANGUILLIDAE		
Anguilla mossambica	x	
CYPRINIDAE		
Enteromius[2] (*Barbus*) *anoplus*	x	
Enteromius (Barbus) brevipinnis	x	3
Enteromius (Barbus) crocodilensis	x	23
Enteromius (Barbus) eutaenia	x	

SPECIES	EXP	DATE 03/2016
AMPHILIIDAE		
Amphilius natalensis	x	
Amphilius uranoscopus	x	34
MOCHOKIDAE		
Chiloglanis anoterus	x	56
Number of species expected	**11**	
Number of species recorded		**4**
Number of individuals		**116**
Electro-fishing time (minutes)		**31**
Catch/Unit Effort (CPUE)		**3.74**
FRAI		**C**

Based on historical data for sites in the river from the tar road to this sampling point, 11 fish species were expected, of which four was recorded in 2016. The most abundant was *C. anoterus*, followed by *A. uranscopus*, both rheophilic species.

3.3.4 Management Requirements

The management of siltation and notably the improvement of river crossings have been identified as the primary management requirements. The general road network have been improved over the last 2 years but the stream crossings still require some work and dedication. In this regard, stream crossing assessments were conducted and is assisting management in the prioritisation of maintenance and upgrading projects and work.

3.3.5 Monitoring Frequency

As described in paragraph 1.3.5, SASS 5 Monitoring (including fish monitoring) will be scheduled on four year cycle, with the next monitoring scheduled for 2024 and then again in 2028.

3.4 GENERAL FLORA MONITORING AND IDENTIFICATION OF RED DATA SPECIES

3.4.1 Requirement for Monitoring

It is known that more than 20 300 species of flowering plants occur in South Africa. A review of the MONDI literature and processes, indicates that the only known plant RTE species on the current MTO landholdings (including Ramanas), is *Aloe simii* on the Longmere Farm in the White River Area. MTO

leased Longemere from MONDI until 2017 when the lease was terminated, and the farm taken back by MONDI.

The identification and monitoring of RTE plants are generally considered to be a specialist function performed by an external specialist/consultant. Species lists can be built up through the knowledge of specialists, general spatial overviews where plantation locations are compared to database information from specialists such as SANBI, field surveys and ad hoc records. General flora monitoring should be seen as a long-term action, with databases updated over time to obtain more information on the floral diversity of conservation areas as it becomes available. The identification of rare, threatened and endangered or Red Data species should however be a priority, as where located, these species will need additional management and protection to ensure their survival. Apart from Ramanas, the rest of the MTO North Forest Management Unit have not undergone a baseline survey of vegetation to establish the presence of RTE plant species. Given current constraints in terms of resources and other priorities, such a baseline vegetation survey is not regarded as a priority.

3.4.2 Monitoring Protocol

The concept of Red Data books was introduced in the mid-1960s by Sir Peter Scott and adopted by the South African Ecosystems Programmes of the CSIR in the 1970s. A preliminary Red Data Book on Plants was published in 1980 (Hall *et al* 1980). In 1996, the Red Data list of Southern African Plants (Hilton Taylor 1996) was published. More recent accounts of Red Data plants is the *Southern African Plant Red Data Lists* (Golding 2002) and the *Red List of South African Plans* by Raimondo et. al. 2009. The most up to date source for red data plants in the RSA is however the SANBI Red List that can be accessed at redlist.sanbi.org

3.4.3 Monitoring Results

A search on the SANBI website, provides the picture of potential Red Data plant species that might occur on the MTO North plantations, as detailed in the table below.

Table 20. Identified potential Rare, Threatened, and Endangered flora species on MTO North (from redlist.sanbi.org)

Species	Status	Possible Location
Aloe simii	CR	Longmere
Encephalartos humilis	VU	Numbi Area
Macledium zeyheri	VU	Numbi Area
Ozoroa barbertonensis	VU	Numbi Area
Platycoryne mediocris	EN	Numbi Area
Protea roupelliae	CR	Numbi Area
Warburgia salutaris	EN	Numbi Area
Crinum macowanii	LC	Ramanas
Clivia maniata	DDT	Ramanas

3.4.4 Management Requirements

Where the locality of identified red data species becomes known, the habitat of the species will be protected. This includes the prioritization of weed control and where possible, burning for conservation management.

3.4.5 Monitoring Frequency

Once a red data plant species is positively identified, an initial internal survey will be conducted to determine the extent of further baseline assessments and monitoring. At this stage no positive identification has been made.

4. AREAS OF SPECIAL INTEREST MONITORING

4.1 AREAS OF SPECIAL INTEREST MONITORING

4.1.1 Requirement for Monitoring

MTO North's commitment to people and communities includes a commitment to the management of the artefacts of the cultural and historical past and areas of outstanding natural importance. For this reason MTO North recognizes specific sites and objects with intrinsic value as Areas of Special Interest (ASI). These include specific sites of cultural, historical or archaeological significance such as for example graves, rock painting sites and sites of natural importance, such as waterfalls. These ASI's require specific and sensitive management which should be detailed in the management records for each site. Monitoring of these sites is important to detect changes over time, and to assist with monitoring the impacts on these sites, such as weed infestation. Management could include general maintenance and the establishment of buffers around sites to prevent potential impacts that may damage the site, and the removal of alien vegetation. However, given local cultural considerations, ASI's such as graves, are very often maintained by ancestors/family members and this is the preferred maintenance regime for grave sites on MTO North land.

4.1.2 Monitoring Protocol

To ensure that management is effective, all sites should be monitored on a two to three year rotation and photographed. In this regard, a standardised database with site information and monitoring evidence will be developed for the respective plantations.

4.1.3 Summary of Results

Eighty-five sites are recorded as ASI, and they are listed below.

Table 21. ASI sites on MTO North land.

Code	Plant/Farm	Site Name
1431B 04	Jambila	Ndlovu Graves 1
1431B 05	Jambila	Ndlovu Graves 2
1431B 06	Jambila	Khumalo Grave 1
1431B 07	Jambila	Khumalo Grave 2
1431B 08	Jambila	Phakathi Homestead Graves

1431B 09	Jambila	Phakathi Graves 1
1431B 10	Jambila	Phakathi Graves 2
1431B 11	Jambila	Chief Msibi Grave
1431B 12	Jambila	Msibi Graves
1431B 13	Jambila	Ndlovu Graves
1431B 14	Jambila	Phakathi Grave 3
1431B 15	Jambila	Zulu Graves
1431B 16	Jambila	Ghubu Graves
1431B 17	Jambila	Mos Mavusa Graves
1431B 18	Jambila	John Makagula Graves
1431B 19	Jambila	Communal Grave
1431A 20	De Kaap	Zulu Graves
1431A 21	De Kaap	Lukhele Family Grave
1431A 22	De Kaap	Hlope Grave
1431A 23	De Kaap	Nkosi Grave 1
1431A 24	De Kaap	Khosa Grave 2
1431A 25	De Kaap	Zulu Grave 1
1431A 26	De Kaap	Zulu, Nkosi and Shongwe Grave
1431A 27	De Kaap	Nkosi Grave 2
1431A 28	De Kaap	Zulu Grave 2
1431A 29	De Kaap	Nkosi Grave 3
1431A 30	De Kaap	Nkambule Grave

1431A 31	De Kaap	Zulu (father) grave
1431A 32	De Kaap	Zulu Familiy Grave
1431A 33	De Kaap	Mavimbela Grave
1431A 34	De Kaap	Nzinasa Grave
1431A 35	De Kaap	Maseko Grave
1431A 36	De Kaap	Nzinasa Grave
1431A 37	De Kaap	Nkosi Grave 4
1431A 38	De Kaap	Nkosi Grave 5
1431A 39	De Kaap	Nkosi Grave 6
1431A 40	De Kaap	Lusiba Grave
1431A 41	De Kaap	Mkabhela Grave
1431A 42	De Kaap	Mbokane Grave
1431A 43	De Kaap	Jan Zulu Grave
1431A 44	De Kaap	Nzinasa Grave 2
1431A 46	De Kaap	Duncan Cave
1431A 47	De Kaap	Jambila Cave
1151C 01	Legogote	Unmarked Graves (4)
1151F 01	Bobsloop	Unmarked Graves (5)
1151F 02	Bobsloop	Unmarked Graves
1151G 01	Yaverland	Unmarked Grave
1151P 01	Springfarm	Bens Den Lapa
1152D 01	Geluk	Unmarked Grave

1152D 02	Geluk	Unmarked Grave
1152D 03	Geluk	Unmarked Grave (next to Geluk Village)
1152D 04	Geluk	Mnandwe and Lukuleni Grave
1152D 05	Geluk	Geluk Lapa
	Rutland	Rutland Farm House (now office)
	Rutland	Ben Viviers Arboretum
1	Ramanas	Chief Mogane Grave and 13 other Graves
2	Ramanas	Khalatshe Malele grave and 44 other Graves
3	Ramanas	JM Monyane Grave
4	Ramanas	Poanz Morele Grave and 2 other Graves
5	Ramanas	Lemeisane Morele Grave and 2 others
6	Ramanas	NS Nonyane Grave
7	Ramanas	Two unmarked Graves
8	Ramanas	No Access One Unmarked Grave
10	Ramanas	Marule Grave
11	Ramanas	Mkoena Grave
12	Ramanas	Malele Grave and one other
13	Ramanas	Waterhoutboom Dam
14	Ramanas	Jacarandas – Waterhoutboom Offices
15	Waterhoutboom Kowyns' House	Unmarked Grave
16	Ramanas	5 xUnmarked Graves
17	Hebron	13 x Unmarked Graves
18	Waterhoutboom	Large ol *E. grandis* Trees
1121D 01	WID	Scotsman Mashigo Grave
1121F 01	Mac Mac	Lebombo Graves
1121F 02	Mac Mac	Andries Sivamba Graves
1121F 03	Mac Mac	Matitsi River Picnic Site
1121F 04	Mac Mac	Andrew se swemgat
1121F 05	Mac Mac	Mpunzi Cottage
1121F 06	Mac Mac	Matumi Picnic Site
1121K 01	Niewoudt	Mapange Graves
1122D 01	Burger	Unmarked Graves
1122D 02	Burger	P.D. Burger Grave

4.1.4 Management Requirements

All ASI's should be scheduled for weeding where required. Buildings should receive maintenance as required, while archaeological site should be protected. All ASI's are shown on maps and protected during harvesting or other activities that may impact on them.

4.1.5 Monitoring Frequency

Each site to be photographed and monitored every two to three years.

REFERENCES

- Clark, T. E., & Samways, M. J. (1996). Dragonflies (Odonata) as Indicators of Biotope Quality in the Kruger National Park, South Africa. *Journal of Applied Ecology, 33*(5), 1001-1012.
- Diedericks, G. & Roux, F. 2016. Stream Conditions of rivers and streams on MTO commercial tree plantation in the Crocodile catchment, MTO North. Internal MTO North Report.
- Diedericks, G, 2021. Biomonitoring using *Odonata.* ODONATA AS INDICATORS OF HABITAT CONDITIONS ON MTO'S ROODEWAL PLANTATION, SABIE CATCHMENT, MPUMALANGA PROVINCE, SOUTH AFRICA. MTO monitoring report.
- Kirkman, K, 2013. MTO Cape Environmental Monitoring Program Summary. MTO Cape. Internal MTO Cape publication – 2017 update.
- redlist.sanbi.org.za
- Smithers, H.N. 2009. The Mammals of the Southern African Sub-region.
- www.iucnredlist/apps/redlist/details/18478/0/full