TASMANIAN | Land | CONSERVANCY

Implementation Report

Five Rivers Reserve June 2014

www.tasland.org

Five Rivers Reserve Scorecard

Target and Indicator	Status	Viability / Trend
Highland Marshes	**High Priority**	**Very Good**
Floristic diversity	12.5 species/site	Unknown
Structural complexity	9.1 strata/site	Unknown
Miena cider gum recruitment	> 3 age cohorts present	Unknown
Sphagnum peatland extent	100.8 hectares	Unknown
Vertebrate fauna diversity	17 species (total) 0.15 species/trap-night	Unknown
Bird diversity	17 species (total) Mean 9 species per site	Unknown
Streams and wetlands	**High Priority**	**Very Good**
Water quality via aquatic biota diversity	Data to be collected in spring 2014	Unknown
Floristic diversity	12.6 species/site	Unknown
Structural complexity	8.9 strata/site	Unknown
Vertebrate fauna diversity	0.1 species per trap night	Unknown
Bird diversity	11 species (total) 6.4 species per site	Unknown
Drooping pine population size	Present but not fully mapped	Unknown
Clarence galaxid populations	Species detected at 4 sites (IFS data)	population stable
Highland forest and woodland	**Medium**	**Very Good**
Floristic diversity	10.4 species/site	Unknown
Structural complexity	10.3 strata/site	Unknown
Canopy recruitment	2.9 cohorts per site	Unknown
Vertebrate fauna diversity	0.15 species per trap night	Unknown
Bird diversity	20 species (total) 13.5 species per site	Unknown
Wedge-tailed eagle nesting success	2 of 5 nests successful 2 fledged young	Improvement from one successful nest in 2013
Forest cover change in reserve	No data for report period	No change 2000-2010
Forest cover change - 20km	No data for report period	Significant decline 2000-2010
Carnivorous mammals	**High**	**Good**
Spotted-tailed quoll site occupancy Total occurrence No of individuals identified	2/46 = 4.3% site occupancy 2 / 1782 occurrences 2 individuals	Unknown
Eastern quoll site occupancy Total occurrence No of individuals identified	13/46 = 28.3% site occupancy 36 / 1782 occurrences To be determined	Unknown
Tasmanian devil site occupancy Total occurrence No of individuals identified Tasmanian devil facial tumour disease status	35/46 = 76.0% site occupancy 157 / 1782 occurrences To be determined DFTD devils at 6 sites	Unknown DFTD still present on the reserve
Feral cat site occupancy Total occurrence No of individuals identified	14/46 = 30.4% site occupancy 31 / 1782 occurrences 14 individuals + 10 unknown	Unknown
Community connection with landscape	**Medium**	**Good**
# people engaged in cultural activities	25 (Skullbone Experiment)	Increase
# people engaged in scientific activities	25 (Bushblitz, Sphagnum)	Increase
# people engaged in education activities	16 TAFE staff and students	Increase
# people engaged in recreational activities	60 (Riverfly, hunting, general visits)	Slight decrease
# volunteer days on the reserve	357 days in 2013-14	Increase
# people engaged in cultural activities	25 (Skullbone Experiment)	Increase
Cultural heritage	**Medium**	**Not determined**
Intactness of indigeneous heritage sites	Not documented	Unknown
Understanding and interpretation of indigenous knowledge	Not documented	Unknown
Intactness of cultural heritage sites	State of decay	Unknown
Preservation of cultural history sites and knowledge	Being documented	Unknown

Introduction

The Five Rivers Management Plan is the overarching document guiding management of the Five Rivers Reserve from 2014 to 2019. Its development represents the outcomes of the first and second stages of Conservation Action Planning, using the *Open Standards* adaptive management model. The plan identifies four conservation targets that describe broad ecosystem classes or habitat types; and two social targets recognising community and cultural values. These targets are:

- Highland marshes
- Streams and wetlands
- Highland forest and woodland
- Carnivorous mammals
- Community connection with the landscape
- Cultural heritage values

Indicators have been selected for each of the six targets to help monitor changes in their viability or condition. Threats to each of the targets have been identified, along with the factors that contribute to the threats, and these are prioritised depending on the extent, likelihood and severity of their impact on the target. Strategies to minimise and manage these threats have been developed, with consideration given to their environmental, social and economic feasibility. These strategies are:

- Build resilience to climate change
- Access management
- Fire management
- Clarence galaxias protection
- Threatened species protection
- Carnivorous mammal monitoring
- Feral and domestic animal management
- Weed management
- Neighbour relations
- Ecosystem services
- Visitor management
- Protect cultural heritage sites
- Community engagement

Annual work plans have been developed by the TLC to implement the management strategies for the Five Rivers Reserve. Work plans identify specific activities to be undertaken, their timing and the resources required. Work plans also allocate budgets, enabling the TLC to plan ahead to deliver these reserve management activities. Progress against activities is reviewed annually.

Ecological Monitoring

The Tasmanian Land Conservancy (TLC) protects important natural areas as permanent reserves and aims to demonstrate excellence in reserve management for biodiversity conservation. Ecological monitoring gives us a better ecological understanding of the diversity and health of our reserves,

and provides vital information about the condition of species and ecosystems. This information is used by reserve managers to assess the effectiveness of management strategies and make better-informed decisions. By learning from landscapes like the Fiver Rivers we become better at managing these important natural areas into the future.

Monitoring

The TLC implements a monitoring and evaluation strategy across all of its permanent reserves. Monitoring of specific ecological indicators enables the collection of scientifically robust information on the status and trends of the conservation targets. Measuring the success of management actions is also critical for ensuring successful long-term management of the targets. The TLC Ecological Monitoring Framework and Methodologies outlines four types of monitoring conducted at intervals ranging from 1 to 5 years:

- *Long-term ecological monitoring* will establish baseline measures of ecological indicators and subsequently provide early warning of deleterious changes in the conservation targets. The results of this monitoring allow reserve managers to develop mitigation measures and reduce future costs of remedial management.
- *Annual reserve assessments* are undertaken by TLC reserve management staff across all permanent reserves to identify any new or emerging threatening processes that have the potential to reduce the viability of the targets. Early identification of threats allows early management interventions to mitigate a threat.
- *Management effectiveness monitoring* provides land managers with information that is essential to determine the adequacy of management efforts. Data are collected on management inputs and biodiversity outputs, with indicators selected that are specific to measuring the success of management strategies. This information is then used by TLC reserve managers to make better-informed decisions on land management, measure progress towards performance objectives and determine the effectiveness of management strategies.
- *Change detection analysis* of remote sensing data using GIS, is undertaken to assess the impact of management strategies on vegetation cover. The surrounding region is also assessed to identify changes in land cover that could indicate threatening processes that have the potential to impact on a reserve. This wider analysis provides an indication of any 'leakage' – shifting of threatening process from a reserve to surrounding areas. Where this is identified, the TLC works with neighbouring landholders to develop local or regional mitigation strategies.

Methods used

The methods used to undertake each of these monitoring techniques have been described in detail in TLCs Ecological Monitoring: Framework and Methodologies Manual (2014). Appendix A contains a summary of the list of monitoring techniques used to measure the health and condition of the conservation and social targets on the Five Rivers Reserve. In brief:

- 100 long term photo-monitoring points were installed across the reserve to measure vegetation condition (indices of structural complexity, floristic diversity and recruitment of canopy species), and flora species lists were compiled at each site by point intercept transect.
- Satellite imagery is used to measure spatial extent and total area of vegetation communities.

- Fauna diversity is measured at a subset of photo-monitoring sites using motion sensor cameras (unbaited). Motion sensor cameras are also used to measure carnivorous mammal diversity and set along roads and tracks using a meat-based lure as an attractant. Bird diversity is recorded using BirdLife Australia's 2ha bird counts at a subset of monitoring sites.
- Nested targets such as Miena cider gum, Clarence galaxias, wedge-tailed eagle productivity, etc. are determined from species specific field surveys.

Implementing long-term ecological monitoring

Between December 2013 and January 2014 the TLC rolled out its long-term ecological monitoring program across the Five Rivers Reserve. A total of 161 monitoring sites were established to gather long-term information on the flora, fauna and ecological processes of the reserve. The first tranche of baseline data was collected from February to April 2014 and provides reference condition for ecological monitoring in future years.

Spatial extent

Forest loss was assessed using local data and global data. Neither method was very useful in determining forest loss, as error data was higher than actuals. Furthermore, the lack of time series data covering the time period limited the utility of the approach. Better data will emerge over time.

Determining Trends

As 2014 is the first year of ecological monitoring on the Five Rivers Reserve it is not possible to determine trends in target health from some indicators such as floristic diversity, structural complexity and canopy cover etc. However, the data collected on these indicators has now provided a baseline against which future data can be referenced and compared.

Volunteer Contribution

During 2013-14 volunteers made a fantastic contribution to delivering the monitoring and on-site management of the Five Rivers Reserve and improving our knowledge about the reserve's natural values. A small team of volunteers helped TLC staff to install the 100 photo-monitoring sites across Five Rivers and volunteers from BHP-Billiton helped to collect predator scats and install remote cameras to monitor carnivorous mammals. Back in the office a volunteer has assisted in the collation and analysis of photos from remote cameras.

Volunteers contributed time and expertise in assisting TLC staff undertake weed management, manage invasive species, construct on-site infrastructure and distribute gate keys. Specialist volunteers have improved our knowledge about a number of threatened species on the reserve which will assist our management in the future.

During 2013 – 2014, 65 volunteers contributed 357 days of volunteer labour to the reserve.

Ecological Monitoring Program	Volunteer Contribution	Total days
Installation of photo-points	3 volunteers x 4 days	12
Fauna cameras & scat collection	5 volunteers x 4 days	20
Photo monitoring data collection	4 volunteers x 4 days	16
Fauna Camera retrieval	1 volunteers x 3 days	3
Carnivorous mammal photo analysis	1 volunteers x 6 days	6
Miena Cider Gum assessment	2 volunteer x 2 days	4
Clarence galaxias assessment	1 volunteer x 2 day	2
Sub-total	**17 volunteers**	**63 days**
Management Activities		
Weed control	4 volunteers x 20 days	80
Deer hunting and surveillance	15 volunteers x 2 days	30
Bronte store keys and logistics	1 volunteer x 5 days	5
Construction of tent platforms	3 volunteers x 3 days	9
Sub-total	**23 volunteers**	**124 days**
Research Activities		
Bush Blitz 2014	20 scientists x 8 days	160
Sphagnum peat core	4 volunteers x 2 days	8
Ptunarra and wasp assessment	1 volunteers x 2 days	2
Sub-total	**25 volunteers**	**170 days**
Total volunteer effort	**65 volunteers**	**357 days**

Community Engagement

Since late 2012, the TLC has been working on a ground-breaking initiative in nature conservation in Tasmania, made possible through the generous support of the Purves Environmental Fund and Purryburry Trust. In February 2013, eleven high profile Australian artists were invited to explore the wild and remote landscape of Skullbone Plains on a four-day artists retreat, leading to the development of a major body of work that has now been feature in a touring exhibition. An exhibition featuring works developed
by the artists was launched at the Queen Victoria Museum and Art Gallery, Launceston from 15 March - 18 May 2014 attracting over 17,000 visitors over the three month period. The exhibition will now be shown at Galleries UNSW, Sydney from 19 July – 30 August 2014 and similar numbers are expected. 300+ new contacts have been added to the TLC's network as a result of the project.

Organisational Collaboration

The TLC has worked with several organisations to deliver the ecological monitoring program. A population of Miena Cider Gum on Mackenzies Tier was assessed in a joint program with NRM South. Ongoing monitoring by Inland Fisheries scientists has provided TLC with information to support the conservation of the Clarence galaxias at Skullbone Plains. DPIPWE specialists continue to be involved with Sphagnum assessments and our eagle nest activity assessments provides productivity data to the Forest Practices Authority and DPIPWE. Seed has been collected from a number of conservation significant species by staff from the Royal Tasmanian Botanical Gardens for the Millenium Seed Bank project. Staff from the Tasmanian Aboriginal Centre deployed four monitoring cameras on Gowan Brae to compliment TLCs information base.

CONSERVATION TARGETS

Highland Marshes - Viability rating: Very good

Collection of baseline monitoring data in 2013-14 yielded important information about the ecology and condition of highland marshes at Five Rivers Reserve. The floristic diversity of the marshes is significantly higher than that of forested areas. This diversity can be observed in the complex mosaic of vegetation types that have formed in response to local variation in fire history, soil fertility, altitude and drainage. Overall the vegetation is in excellent condition, with little evidence of impacts from human activities, weeds or feral animals.

Goals

- Maintain or improve floristic diversity
- Maintain or improve structural complexity
- Maintain recruitment of Miena cider gum
- Maintain sphagnum peatland extent
- Maintain or improve vertebrate fauna diversity

Ecological indicator	Current status	Trend
Floristic diversity	12.5 species/site	Unknown
Structural complexity	9.1 strata/site	Unknown
Miena cider gum recruitment	> 3 age cohorts present	Unknown
Sphagnum peatland extent	100.8 hectares	Unknown
Vertebrate fauna diversity	17 species (total) 0.15 species/trap-night	Unknown
Bird diversity	17 species (total) Mean 9 species per site	Unknown

Key findings

- A population of Miena Cider Gum on Mackenzie's Tier was assessed in 2013 and found to be in good condition compared to other populations on the Central Plateau. The population contained large mature trees, saplings and many seedlings (> 3 cohorts), which indicates it has been reproducing successfully over a long time period.
- Sphagnum peatland is a threatened ecological community that is especially sensitive to the impacts of fire and climate change. This community was systematically mapped in 2013 and will be a focus of ongoing monitoring.
- 17 species of vertebrate fauna were observed using remote cameras, including two threatened species (spotted-tailed quoll, Tasmanian devil) and two priority species (eastern quoll, bettong). Deer, rabbits and cats were also observed. Deer and rabbits are in low numbers, but the presence of feral cats poses a significant threat to critical weight range mammals.

Recommendations

- Increase monitoring of sphagnum and sedgeland at Skullbone Plains, where there is the potential for the broad-toothed rat to occur. This high altitude species is at risk from climate change. The detection of two native rodent species during this year's monitoring shows the potential for remote cameras to be used as a monitoring tool for this vulnerable species.
- Develop and implement a cat eradication program with an emphasis on Highland Marshes, which are a focus for critical weight range animals including threatened and priority species.
- Continue to monitor the impact of deer and rabbits.

Streams and wetlands - Viability rating: Very good

The freshwater ecosystems of the Five Rivers Reserve are of outstanding conservation value. They comprise the near-pristine catchments of five headwater tributaries of the Derwent River. Monitoring of the riparian zone commenced in 2013-14 and monitoring of aquatic biota and water quality will commence in spring 2014. The riparian vegetation is in excellent condition and is weed-free. Assessment of populations of the threatened Clarence galaxias and drooping pine, show that these species continue to persist at Skullbone Plains.

Goals

- Maintain the diversity of aquatic biota
- Maintain or improve floristic diversity
- Maintain or improve structural complexity
- Maintain or improve vertebrate fauna diversity
- Maintain populations of drooping pine
- Maintain populations of Clarence galaxias

Little Pine River Gorge

Ecological indicator	Current status	Trend
Aquatic biota diversity	Data to be collected in spring 2014	Unknown
Floristic diversity	12.6 species/site	Unknown
Structural complexity	8.9 strata/site	Unknown
Vertebrate fauna diversity	0.1 species per trap night	Unknown
Bird diversity	11 species (total) 6.4 species per site	Unknown
Drooping pine population size	Present but not fully mapped	Unknown
Clarence galaxid populations	Species detected at 4 sites, no trout detected (IFS data)	Population stable

Key findings

- Riparian vegetation is in excellent condition. It is floristically diverse, structurally complex and weed-free.
- A report being prepared by Dr Jean Jackson will provide conservation advice for the Clarence galaxias.
- Long-term monitoring of dwarf conifers established to detect potential impact from climate change.

Recommendations

- Conduct extension surveys for drooping pine in riparian vegetation along the Nive River on the Viormy section of the Reserve.
- Support completion and implementation of the galaxias report
- Train TLC staff in monitoring methods for Clarence galaxias to support and expand the monitoring efforts of IFS
- Train TLC staff in the TRCI methodology so that TLC can monitor aquatic biota, which is currently being undertaken by Dr Peter Davies from the University of Tasmania.

Highland Forest and Woodland - Viability rating: Very good

The highland forests and woodlands of Five Rivers Reserve are in good condition, despite extensive logging having occurred in the past 20 years. Construction of infrastructure such as roads, snig tracks and logging landings has caused significant localised degradation. Weeds are limited to these degraded areas. A detailed comparison of logged and unlogged areas using monitoring data collected in 2013-14 found only minor effects of logging on the natural values of the Reserve. The long term impact of timber harvesting has been low in productive environments, where vigorous recruitment can be observed, but the impact likely to be much longer lasting in unproductive alpine areas, where the harsh environment inhibits regeneration.

Goals

- Maintain or improve floristic diversity
- Maintain or improve structural complexity
- Maintain or improve recruitment of canopy species
- Maintain or improve vertebrate fauna diversity
- Maintain or improve reproductive success of wedge-tailed eagle
- Maintain forest cover within 2% of 2010 baseline

Highland forest typical on the Five Rivers Reserve

Ecological indicator	Current status	Trend
Floristic diversity	10.4 species/site	Unknown
Structural complexity	10.3 strata/site	Unknown
Canopy recruitment	2.9 cohorts per site	Unknown
Vertebrate fauna diversity	0.15 species per trap night	Unknown
Bird diversity	20 species (total) 13.5 species per site	Unknown
Wedge-tailed eagle nesting success	2 of 5 nests successful 2 fledged young	Improvement from one successful nest in 2013
Forest cover change in reserve	No data for report period	No change 2000-2010
Forest cover change - 20km	No data for report period	Significant decline 2000-2010

Key findings

- minimal logging impacts on flora and fauna, especially in productive environments
- Vigorous recruitment in productive lowland areas, less advanced in sub-alpine areas.
- There are five wedge-tailed eagle nests on the Five River Reserve, including a nest that was discovered in 2013. Nest 245 (raptor nest database) was reoccupied in 2013. Two young
- A loss in forest cover of approximately 1ha was investigated and determined to be an error in the GIS analytical technique.

Recommendations

- Establish additional flora and fauna monitoring sites within the Pine Tier bushfire area In 2015 to investigate the impact of a low intensity burn on conservation values
- Maintain monitoring as planned

Carnivorous marsupials - Viability rating: Good

Collection of baseline monitoring data from motion sensor cameras in 2013-14 yielded important information about the relative abundance and extent of Tasmania's three largest carnivorous marsupials. The viability rating of 'very good' refers to the presence of the three dasyurid species on the reserve and their co-occurrence at many of the monitoring sites. The continued persistence of the Tasmanian devil facial tumour disease DFTD prevented a viability score of 'Excellent' despite the species persisting in relatively good numbers. Feral cat numbers were high and the spotted-tail quoll detection rate was very low.

Goals

- Maintain wild, free ranging populations of carnivorous marsupials

Tasmanian devil showing devil facial tumour disease

Ecological indicator	Current status	Trend
Spotted-tailed quoll site occupancy Total occurrence No of individuals identified	2/46 = 4.3% site occupancy 2 / 1782 occurrences 2 individuals	Unknown
Eastern quoll site occupancy Total occurrence No of individuals identified	13/46 = 28.3% site occupancy 36 / 1782 occurrences To be determined	Unknown
Tasmanian devil site occupancy Total occurrence No of individuals identified Tasmanian devil facial tumour disease status	35/46 = 76.0% site occupancy 157 / 1782 occurrences To be determined DFTD in devils at 6 sites	Unknown DFTD present on the reserve
Feral cat site occupancy Total occurrence No of individuals identified	14/46 = 30.4% site occupancy 31 / 1782 occurrences 14 individuals + 10 unknown	Unknown

Key findings

- 46 sites monitored over a total of 1,669 camera trap nights
- 24 species of fauna identified from 4,375 fauna images and 1,782 fauna occurrences
- Four carnivorous species detected at 41 of the 46 total sites (89.1%) using a meat-based lure
- The Tasmanian devil detected at 76% of sites and 85% of predator sites sites)
- The Tasmanian devil was the sole predator recorded at 39% of predator sites (16/41)
- The Tasmanian devil was the most common co-occurring predator species
- 14 individual cats were identified by coat patterning with 10 cats of unknown identity

Recommendations

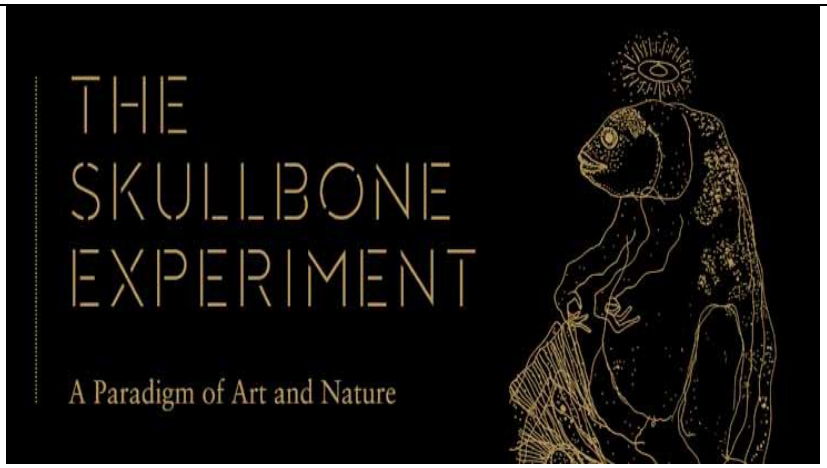
- Continue carnivore monitoring on an annual basis and standardise techniques
- Investigate computer software to determine individual pattern recognition
- Gather more information on feral cat ecology for a feral cat control strategy

Community connection with the landscape - Viability: Good

There is a high degree of public interest in the Five Rivers Reserve, and the TLC continues to encourage community connection with the landscape. While there is still some degree of suspicion and hostility from parts of the local community, overwhelmingly the response to the acquisition and management of the Five Rivers Reserve has been positive. People visit the reserve for a variety of cultural, artistic, recreational and educational reasons. TLCs Artists Retreat leading to the 'Skullbone Experiment' has resulted in national and international acclaim profiling the connection between art and nature. There are a significant number of people who actively participate in the management of the reserve as volunteers in management planning, weeding, and ecological monitoring as well as deer shooting, which contributes to TLCs control feral species. TLC staff support local businesses through purchase of food, fuel and accommodation and hire of local contractors.

Goals

- Foster opportunities for the community to connect with the reserve
- Harness knowledge of the Bronte landscape to enhance management and support healthy communities



'The Skullbone Experiment' major art exhibition

Indicator	Current status	Trend
# people engaged in cultural activities	25 (Skullbone Experiment)	Increase
# people engaged in scientific activities	25 (Bushblitz, Sphagnum)	Increase
# people engaged in education activities	16 TAFE staff and students	Increase
# people engaged in recreational activities	60 (Riverfly, hunting, general visits)	Slight decrease due to eagle gate closure in breeding season
# volunteer days on the reserve	357 days in 2013-14	Increase
Income ecosystem services	$151,877	Increase

Key findings

- Selling ecosystems services, particularly carbon credits, proved lucrative
- The Skullbone Experiment continues to be a huge success in attracting support for TLC
- Bush Blitz 2014 harnessed a significant amount of volunteer effort towards improving scientific knowledge on the reserve
- 10 BHP volunteers have been engaged in on-site management and research activities

Recommendations

- Continue to explore ecosystem service monetization
- Continue to encourage visitation to the Reserve by people in diverse and exciting ways
- Improve opportunities for locals to engage in low-impact recreational uses such as fishing and camping and trail walking.

Cultural heritage - Viability: To be determined

The Five Rivers Reserve in the wider central highland landscape contains a number of important cultural sites for Aboriginal people and also areas where there remains evidence of early European settlement, such as fences, chimneys and ruins. Although a detailed Aboriginal cultural survey has yet to be undertaken, many artefact scatters and traditional campsites are known to occur across the reserve. The remoteness of most sites means that they remain in a relatively undisturbed condition. A range of shepherd huts, boundary fences, cairns and oral histories of the early pioneering days are in various stages of being documented.

Goals

- Protect, enhance and rediscover the cultural heritage values of the reserve

Remains of a shepherd's hut on Roscarborough

Indicator	**Current status**	**Trend**
Intactness of indigeneous heritage sites	Not documented	Unknown
Understanding and interpretation of indigenous knowledge	Not documented	Unknown
Intactness of cultural heritage sites	State of decay	Unknown
Preservation of cultural history sites and knowledge	Being documented	Unknown

Key findings

- There are a large number of European cultural heritage sites scattered across the Reserve. TLC staff member Bruce Hay has an excellent knowledge of these sites and is now systematically documenting and mapping this information.
- The acquisition of the neighbouring property 'Gowan Brae' by the Tasmanian Aboriginal community has created the opportunity for documentation and collaborative management of indigenous heritage sites

Recommendations

- Commission an Aboriginal cultural survey of the reserve
- Continue to systematically map and document European heritage sites
- Support the collection of an oral history of the reserve especially in relation to past use and changes of the landscape

MANAGEMENT STRATEGIES

Build Resilience to Climate Change

What we are doing

The TLC is addressing climate change impacts by undertaking threat abatement on the Five Rivers Reserve to help build resilience in its conservation targets. It is using long-term ecological monitoring to identify changes in target health over time and undertaking a range of specific research programs and assessments to ensure a closer focus on conservation values most at risk.

And why

Climate change is recognised as a key threat to many conservation values on the Five Rivers Reserve, particularly sphagnum peatlands, wetlands and moorlands, due to their narrow environmental niche and particular sensitivities to changes such as fire. Improving the resilience of the conservation targets will help to limit the impacts of other stressors and actively help recruitment and population replacement where appropriate. Long-term monitoring across the reserve is essential to identify any change in extent or condition of conservation targets and if remedial recovery actions are needed.

Key objective(s)

Climate change impacts on all conservation targets are being considered

Outcome 2014

Long-term ecological monitoring commenced and research on two specific targets underway.

Nick Fitzgerald DPIPWE installing a photo-monitoring site for drooping pine *Pherosphaera hookeriana*

Progress in 2013-14

- First year of long term ecological monitoring completed and data analysed.
- Threats to conservation targets are being addressed to help build resilience.
- Long term climate change monitoring of dwarf conifers has commenced.
- Continued involvement in Miena cider gum protection and climate change modelling.
- Five Rivers grasslands selected as monitoring sites for an international study on the impacts of global warming on ecosystem function by M. Hovenden UTAS.
- Three sites selected as benchmark monitoring sites for the National Bush Blitz program.

Key recommendations for future management

- Improve knowledge of climate change impacts over time on grasslands and dwarf conifers.
- Seek opportunities to be involved in climate change adaptation for other targets.

Access Management

What we are doing

TLC is continuing to regulate access to the Five Rivers Reserve to ensure ongoing protection of the conservation targets and security for cultural assets. Access is regulated using infrastructure such as fences and locked gates, road and track closures, information provided in signs, and direct communication with the local community and potential visitors.

And why

Historically, illegal access has been a significant and ongoing problem on the Five Rivers Reserve which has led to serious environmental impacts including hunting, wood-hooking, arson, campfires, dumping of rubbish, damage to infrastructure such as gates and fences, and the use of off-road vehicle leading to new tracks and erosion of existing tracks. People accessing the reserve illegally do not adhere to TLCs biosecurity protocols or reserve conditions of access. These impacts are financially expensive to rectify and can take years to remediate environmental damage.

Key objective(s)

Unauthorised access is reduced by 80% by 2020

Outcome 2014

In 2014 there were 25 known incidences of illegal access on the Reserve. This number is approximately 50% less than recorded in 2013.

Construction of a vehicle barrier at Skullbone Plains

Progress in 2013-14

- Assessment of roads has been completed and maps showing roads to be kept open and those to be closed have been prepared. Road maintenance is ongoing.
- Vehicle barrier installed at the major vehicle access route to Lake Ina
- Signs identifying the property as a reserve and explaining management conditions have been installed at all entrance points and are replaced as required.
- Surveillance cameras installed seasonally on Old Lake Ina track.
- Two parties illegally accessing Lake Ina by 4WD have been questioned and cautioned. They will be denied access in the future.
- Distribution of gate keys by the Bronte General Store continued to be supported

Key recommendations for future management

- Continue the successful program of gate and trench maintenance
- Road maintenance to continue to keep main arterial routes open and safe
- TLCs biosecurity protocols to be updated and installed at major entry points

Fire Management

What we are doing

TLC aims to reduce the impact of unplanned fire on the people and natural environment of the Five Rivers region. This requires the organisation to build capacity internally to ensure staff are adequately trained in fire response and OH&S procedures and acquire the skills needed to plan and undertake ecological burning. TLC works closely with relevant experts, including the Tasmanian Fire Service, fire ecologists, botanists and zoologists, to determine the fire regime prescriptions for hazard reduction and ecological maintenance.

And why

While fire can be a natural process, the threat posed by unplanned fires to human life, property and the environment is a concern for the TLC. The two primary objectives of fire management on TLC land are to protect human life and property from fire and secondly to maintain or enhance the natural diversity of species and communities through appropriate fire regimes, in so far as this is consistent with the first objective. Bronte Park is the largest community in the region and wildfire poses a significant risk to the community. While most of the natural values of the Reserve are relatively resilient to the impacts of fire, sphagnum peatland, Miena cider gum and dwarf conifers such drooping pine *Pherosphaera hookeriana* should be protected from fire as a priority.

Key objective(s)

No unauthorised fires start on the reserve by 2020

All reasonable measures are taken to prevent the spread of any fires originating on the Reserve

Outcomes

TLC staff responded to a fire at Pine Tier Reserve and provided significant assistance to authorities to contain the fire to the Five Rivers Reserve

TLC's Tim Devereux at the Pint Tier fire front Jan 2014

Progress in 2013-14

- Fire management training undertaken and completed by seven TLC staff.
- Fire- fighting equipment was procured and TLC vehicles kitted out.
- An organisational fire policy was developed and fire protocols are being implemented.
- In January 2014 seven TLC staff responded to a fire on the Five Rivers Reserve at Pine Tier.
- Pine Tier fire boundary mapped and monitoring sites established across the fire zone.

Key recommendations for future management

- Work with relevant agencies and neighbouring landholders to develop a fire management response plan for the Reserve.
- Maintain key roads and infrastructure such as dams to facilitate emergency fire response.

Clarence Galaxias Protection

What we are doing

The TLC must provide ongoing protection for the Clarence galaxias on the Five Rivers Reserve by ensuring brown trout do not enter its local waterways and by undertaking additional recovery actions wherever possible. These include investigating the potential to eradicate trout from other local water bodies to expand the species range and identifying potential translocation sites across the reserve. Access control and encouraging responsible fishing practices can also help reduce risks.

And why

The Clarence galaxias is a key conservation asset on the Five Rivers Reserve and ensuring its ongoing protection is critical. Brown trout have the potential to cause local extinction of this nationally endangered freshwater fish so it is imperative to prevent trout expansion and to undertake trout elimination wherever feasible. The reserve is one of only a few key sites for the Clarence galaxias and monitoring has been undertaken by the Inland Fisheries Service for a number of years as part of its recovery program.

Key objective(s)

No introductions or expansion of brown trout on the reserve

Outcomes

No brown trout were detected in waterways where the Clarence galaxias currently occurs

Dr Jean Jackson and TLC volunteer Bruce Champion surveying for Clarence galaxias at Cider Gum Tarn Dec 2013.

Progress in 2013-14

- Annual surveys were undertaken by IFS in 2013 and data provided to TLC.
- Two meetings held with IFS to discuss assistance with habitat surveys and monitoring.
- Preliminary habitat assessment undertaken by Dr Jean Jackson in December 2013
- Dr Jackson is developing a plan identifying potential habitat for future survey, trout free sites for potential galaxias relocation and improving methods for survey.

Key recommendations for future management

- Continue to work with IFS on monitoring and other conservation works
- Continue to progress recovery action planning with Dr Jackson
- Maintain access control and trout barriers

Threatened Species Protection

What we are doing

The TLC is actively improving knowledge on a range of threatened species which are either poorly known or for which additional information will assist their management on the reserve. Extension surveys and habitat assessments are planned for a range of plant and invertebrate species in 2014 / 2015 and seed collection by the Tasmanian Seed Conservation Centre (RTBG) has begun.

And why

The Five Rivers Reserve contains five listed vegetation communities, 17 listed flora and 10 known or suspected threatened fauna. Some of these species / communities are either poorly known or more information is required to improve their conservation management. Improved information will increase the potential for these threatened elements to survive in the wild long-term and further enhance the conservation significance of the Five Rivers Reserve in the Tasmanian landscape.

Key objective(s)

Improve conservation outcomes for threatened species by 2016

Outcomes

Improved knowledge on four poorly known threatened species and new or ongoing monitoring conducted

Dr Jennie Whinam DPIPWE collecting a peat core at Skullbone

Progress in 2013-14

- Bush Blitz survey conducted in Feb 2014 by 20 scientists. The data is still being processed.
- Preliminary habitat assessment for Ptunarra brown butterfly undertaken by Dr Phil Bell in April 2014 with follow up planned for summer 2014/ 2015.
- Annual monitoring of 5 wedge-tailed eagle nests completed in November 2013.
- Grassland cupflower identified by Dr James Wood RTBG in Feb 2014 and seed collected from a number of poorly known plant species.
- Miena jewel beetle survey postponed due to poor *Ozothamnus hookeri* flowering season
- 1 maternal Tasmanian devil den and two devil latrine sites were identified.
- Site information provided for rare *Carex capillacea* by Phil Collier *et al* in Jan 2013
- Two meetings held with DPIPWE to discuss Special Management Zones for Tasmanian devils
- Two reports prepared on Sphagnum peat profile in 2013 [age, invertebrate composition] and additional peat coring planned for November 2014.

Key recommendations for future management

- Undertake Miena jewel beetle and Ptunarra brown butterfly habitat assessment in 2015
- Continue eagle nest monitoring with road closure implemented as required
- Improve knowledge on small mammals especially rodents and the white-footed dunnart
- Complete pollen analysis and carbon dating of second peat core sample due in Nov 2014

Carnivorous Mammal Monitoring

What we are doing

The TLC needs to improve its understanding of the Tasmanian devil, spotted-tail quoll and eastern quoll across the Five Rivers Reserve to ensure populations can be maintained in the wild. By undertaking species focus monitoring using motion sensor cameras and a meat based lure, we can collect presence / absence data, information on site occupancy and relative abundance, map the prevalence and spread of the fatal Tasmanian devil facial tumour disease and collect information on potential predators and competitors.

And why

The presence of three of Australia's largest native carnivorous marsupials, the Tasmanian devil, spotted-tail quoll and eastern quoll, identifies the Five Rivers Reserve as highly significant for the continued existence of these species in the wild. The Tasmanian devil and spotted-tail quoll are nationally threatened and the eastern quoll is now confined to Tasmania and is in decline.

Key objective(s)

Improve management of carnivorous marsupials

Outcomes

Baseline information obtained on distribution and relative abundance of three native carnivorous marsupials.

Tasmanian devil caught on camera investigating a meat bait pod

Progress in 2013-14

- TLCs carnivorous mammal monitoring program established across the reserve
- 46 sites monitored over a total of 1,669 camera trap nights
- 24 species of fauna were identified from 4,375 fauna images and 1,782 fauna occurrences
- Relative abundance of Tasmanian devil, spotted-tail quoll and eastern quoll determined
- DFTD detected from photos of Tasmanian devils at 6 sites
- Monitoring work was supported by grant from UTAS Save the Tasmanian Devil Program
- 521 bags of predator scats were collected for Tas. devils, spotted tail quoll and eastern quoll from 45kms of transects. These scats are now available for DNA and diet analysis.
- Separate DPIPWE devil monitoring program undertaken in May 2014
- Eastern Quoll monitoring in 2013, 2014 by B. Fancourt from UTAS for PhD research

Key recommendations for future management

- Repeat mammal monitoring on a regular basis with revised camera settings and height placement to reduce variability and improve species detectability
- Progress analysis of the predator scats for diet and DNA analysis or make samples available to other related research or management programs e.g. DPIPWEs 'The great poo hunt'

Feral and Domestic Animal Management

What we are doing

The TLC seeks to minimise the impact of feral species and domestic stock on the natural values of the Reserve. Stock fencing and shooting for asset protection have been undertaken and will be ongoing. Targeted monitoring using remote cameras will identify a baseline measure of feral populations that will be used to measure the effectiveness of control measures. This may require the development of DPIPWE property based Game Management Plans. There are occasional incidences of stock breaching fences and straying onto the Five Rivers Reserve. Ongoing fence maintenance and talks with the neighbouring landholder keep this threat at a low level.

And why

Invasive species and domestic livestock have the potential to impact on sensitive vegetation types. Eradication of invasive species is usually impossible to achieve, however, control methods can effectively reduce populations and consequent impacts to an acceptable level. As animals are often widespread and mobile, it is important to work with neighbours to tackle populations at a regional level.

Key objective(s)

By 2016 the distribution of key feral species have been mapped and management strategies identified

Outcomes

Deer management underway and new strategies being developed for deer, wasps and cat management.

A fallow deer caught on camera during monitoring

Progress in 2013-14

- Relative abundance of feral cats determined and scats collected for diet analysis.
- The Bronte Deer stalkers have provided an annual report on the number of fallow deer sighted and the number shot during the recreation deer season.
- A strategy to address feral deer has been discussed by TLCs Science Council
- A new gate installed on the 'Viormy Island Block' to prevent stock access from Pine Tier.
- Met with Dr Phil Bell to develop a European wasp monitoring strategy.

Key recommendations for future management

- Obtain additional deer tags for the 2015 deer season to increase the intensity of shooting effort. Shooting by the Bronte Deer Stalkers has little impact on reducing deer numbers.
- Identify European wasp nest sites and develop a European wasp monitoring program
- Prepare a Feral Animal Management Plan to determine the impact of key invasive species and, identify priority areas for control.
- Inspect and repair fences in the vicinity of Pine Tier Lagoon and around Howards Way gate/cattle grid, because cows have been accessing the property occasionally.

Weed Management

What we are doing

The aim of this strategy is to eradicate existing infestations of weeds on the Five Rivers Reserve. Ragwort and California thistle occur along roads and at logging landings. Weed mapping and control is continuing. Although weed infestations are not extensive, their eradication should be undertaken in a timely and effective manner before they increase in range. A weed action plan has been prepared to ensure the weed work already underway on the reserve are built into works programs and undertaken effectively over the coming a five year period.

And why

Weeds monitoring and control occurs on all TLC reserves. The impact of different weed species varies with environmental conditions so it is important to prioritise species and areas for control. Weed control is usually a long term commitment as soil-stored seed may continue to germinate for decades. Monitoring and follow-up control are therefore essential is weed eradication is to be successful. When tackling weeds it is always beneficial to work with neighbours on regional issues.

Key objective(s)

Existing infestations of weeds are eradicated from the Reserve by 2017

Outcomes

Overall decrease in quantity of three weed species found on the reserve

TLCs Denna Kingdom and a volunteer on ragwort control

Progress in 2013-14

- The Central Highlands weed management plan has been completed and is now being implemented. This plan encompasses several TLC properties including the Five Rivers Reserve.
- TLC staff and volunteers have completed a third round of weed treatment across the Five Rivers Reserve focusing on ragwort *Senecio jacobaea,* great mullein *Verbascum thapsus* and Californian thistle *Cirsium arvense*.
- Weed work was supported by an Australian Government Community Action Grant.
- Overall decrease in quantity of three weed species found, using herbicide volume as a proxy. During 2014 season 86L herbicide used, compared to 101L in 2013 and 124L in 2012

Key recommendations for future management

- Consolidate the GIS components of the weed management program
- Continue with weed control

Ecosystem Services

What we are doing

TLC is exploring a number of avenues for generating revenue from the Five Rivers Reserve to assist with conservation management and provide benefits to the wider community. The TLC has implemented a carbon project over logged forest on the Five Rivers Reserve and successfully sold the first two years of credits. A three year licence to Riverfly Tasmania (http://riverfly.com.au/) has been granted to establish huts and operate their World Heritage Area tours. Other potential developments such as TasTrail, firewood harvesting, camping, nature photographers etc are being implemented and investigated.

And why

Financial stability and security is critical in ensuring management of special conservation areas can be maintained in perpetuity. A range of brand-aligned products and programs that generate revenue can help underpin the costs of conservation management of protected areas without compromising natural values. They can also enable wider community benefits and services to be provided which strengthen the community's connection with the land.

Key objective(s)

Ecosystem service derived income supplements reserve costs by 10% annually

Outcomes

Revenue generated from sale of carbon credits, events, leases and licences is contributing 10% of reserve costs.

Demountable Riverfly huts for accessing fly fishing on Lake Ina

Progress in 2013-14

- The first years carbon vintage (2011) has been sold and generating gross income to the Five Rivers Reserve conservation programs.
- Skullbone Experiment dinner resulted in $14,000 donation with more expected in Aug 2014
- Deer hunters current receipts are $4,320 for FY 14
- Revenue has been received from Riverfly huts licence and gravel licence.

Key recommendations for future management

- Continue to develop and secure ecosystem service programs that support conservation of the reserve and provide wider community benefits

Visitor Management

What we are doing

The TLC is developing a number of strategies to improve general visitation to the reserve and ensure that visitation occurs in a safe and sustainable manner. A brochure is being developed to provide information about natural values, management issues, threats and an access map. In the meantime all visitors are required to sign a waiver and access agreement and TLC staff provide a site map and personal briefing. In the future, biosecurity protocols will be strengthened at all major entry points.

And why

The TLC encourages visitation to its reserves and recognises the importance of natural places to human wellbeing. TLC reserves provide the community with fantastic opportunities for recreation and enjoyment of beautiful and unique natural environments. Recreational activities such as bushwalking, camping, bird-watching, cycling and trout fishing, are generally compatible with conservation, however, in some cases regulations are needed to ensure that the natural values of a reserve are protected. Some activities that pose a threat such as four-wheel driving, hunting and lighting campfires need to be controlled or prohibited and biosecurity measures are needed to ensure that weeds and pathogens such as phytophthora are not introduced to a Reserve.

Key objective(s)

People visit the Reserve every year and visitors comply with TLC policies

Outcomes

A large number of people continue to visit the Five Rivers Reserve, with World Heritage listed Skullbone Plains a major drawcard.

There were only two incidents of non-compliance with TLC policies.

Bushwalkers crossing Skullbone Plains

Progress in 2013-14

- Infrastructure to support reserve visitation has been maintained and a number of significant works projects have been completed, including the construction of tent platforms and a car park at Skullbone Plains.
- Breeding activity was detected in a wedge-tailed eagle nest on the main road into Skullbone Plains this year. The road was closed to restrict access to the nest buffer zone during the breeding season. A less direct access route to Skullbone Plains was used during this period.
- An 'Artist Retreat' held in Feb 2013 accommodated 11 high profile Australian artists for four days for an interpretative experience. Temporary infrastructure, biosecurity protocols and guided walks were implemented to prevent any impacts on the reserve.
- Two guided supporter trips were conducted to the reserve in 2013.

Key recommendations for future management

- Prepare a brochure for visitors to the reserve.
- Track visitor numbers to the reserve using the Bronte Shop diary as a baseline.

Neighbour Relations

What are we doing

The aim of this strategy is to ensure that threats from neighbouring lands don't impact on the values of the reserve, and vice versa, and that wherever possible ensure a collaborative approach can be undertaken to regional or landscape issues such as weeds, deer, fire, livestock, illegal hunting, trespass and wood-hooking. Other management issues include road maintenance and mutual access arrangements with neighbouring landowners and sharing costs and equipment wherever possible.

And why

The TLC recognises the importance of maintaining good relationships with neighbouring landowners and regularly communicates with neighbours about shared management issues. Regular communication between TLC staff and neighbouring landowners facilitates cooperative approaches to regional land management issues such as feral animals, weeds and fire management. Neighbours are informed about any TLC management strategies or issues that have the potential to impact on their land. Similarly, TLC talks to neighbours about activities or management issues on adjoining land that have the potential to impact on the values of TLC Reserves.

Key objective(s)

Regular communications are maintained with all neighbours

Outcomes

TLC staff continue to have positive relations and are working with neighbours on road maintenance, firefighting, weed control and access management

TLC staff and managers of Trawtha Mukaminya discuss cultural sites

Progress in 2013-14

- TLC is actively co-operating on management of bridge replacement, road, fence and gate maintenance and fire management with managers of all neighbouring properties.
- One TLC staff member has joined the local Brady's Lake Volunteer Fire Brigade
- Collaboration with DPIPWE on review of the Tasmanian Wilderness WHA management plan
- Collaboration with PWS Lake St Clair District on access to Lake Ina
- Collaboration with Tasmanian Aboriginal Centre on ‘Gowan Brae’ management planning and carbon assessments
- Collaboration with Forest Practices Authority on wedge-tailed eagle nest assessments

Key recommendations for future management

- Resolve minor issues with Forestry Tasmania regarding negotiation of road maintenance arrangements in mutual rights of way.

Protecting Cultural Heritage Sites

What we are doing

Features of cultural significance on the Five Rivers Reserve include for example Aboriginal stone tool scatters, the remnants of trapper's and shepherd's huts and the remains of old fences. Our knowledge of these sites remains poor. Landscape surveys by cultural heritage officers are needed to increase our understanding of these values and inform future preservation and management strategies. Site information needs to be recorded on our GIS layers.

And why

Cultural heritage values are recognised by TLC as an important feature of the landscapes we manage and are integral to the settlement history of Tasmania. Sites of indigenous cultural significance and structures from early European settlement are widespread on the Five Rivers Reserve. These need to be managed for future generations and in ways which are consistent with the Burra Charter.

Key objective(s)

By 2016, cultural heritage sites and knowledge are documented

Outcomes

A map has been produced that documents the location of known cultural heritage sites.

Remnants of a shepherd's hut on the historic Viormy property

Progress in 2013-14

- TLC staff have a good working relationship with the Aboriginal Land Council of Tasmania and the Tasmanian Aboriginal Centre and are progressing site evaluation opportunities.
- TLC staff member Bruce Hay has begun documenting his knowledge of the European history and heritage sites of the reserve and recording site locations on GIS.

Key recommendations for future management

- Progress heritage assessments of European and Aboriginal cultural heritage sites by Dec 2014
- Commission a historian to interview TLC staff member Bruce Hay and other locals about the history of the reserve and surrounding area to ensure current information is not lost.

Community Engagement

What we are doing

To date the TLC has convened a variety of activities on the Five Rivers Reserve to encourage community engagement, including open days, public consultation, working with stakeholders and neighbours, educational visits, and numerous opportunities for volunteering. This strategy aims to grow these opportunities to strengthen community ownership and protection of the reserve.

And why

The TLC provides opportunities for the community and individuals to achieve conservation. The local community, volunteers, the indigenous community and other stakeholders are encouraged to participate in planning and land management activities and become more involved with the organisation. TLC reserves provide excellent opportunities for education and scientific research as well as natural and recreational activities to engage every level of the community in conservation.

Key objective(s)

Increasing number of people accessing the reserve are engaged in TLC activities

Outcomes

TLC supported four community activities, 65 volunteers contributed 357 days of volunteer labour and the 'Skullbone Experiment' received national acclaim

BHP Billiton volunteers assist TLCs Dan Sprod with cameras

Progress in 2013-14

- During 2013 – 2014 a total of 65 volunteers contributed 357 days of volunteer labour to all aspects of Five Rivers research, monitoring and management programs.
- The Skullbone Experiment Artists Retreat attracted 11 high profile national artists for 5 days and resulted in 300+ new supporters for TLC and national media acclaim
- State and national television, radio, print and online media coverage of *The Skullbone Experiment* occurred as a result of the exhibition opening in Launceston, Tasmania and is anticipated for Sydney.
- 20 scientists and 10 volunteers participated in a Bush Blitz survey during Feb 2014
- 16 TAFE staff and students conducted 5 day orienteering course across the reserve

Key recommendations for future management

- Continue to work with a diverse range of stakeholders to determine the priorities for access to the Five Rivers Reserve and how best they can be accommodated
- Identify further opportunities for volunteers to assist with reserve management and monitoring activities and ensure this information is included in TLCs volunteer policy

Appendix A: Monitoring methods and indicators

Target	Key Environmental Attribute	Indicator	Definition	Objective	Methods	Frequency	Intensity
Highland Marshes	Vegetation condition	Floristic diversity	Mean number of vascular plant species per site	Maintain floristic diversity	Photopoint monitoring	2 years	1 site / 5ha. 3 sites min. 10 sites max
		Structural complexity	Mean number of strata per site	Maintain structural complexity			
		Miena Cider Gum Recruitment	Mean number of cohorts per site	Maintain recruitment			
	Sphagnum peatland spatial extent	Area	Total area of sphagnum ecosystem	Maintain ecosystem extent	Satellite image interpretation / ground truthing	4 years	1 site / 5ha.
	Vertebrate fauna	Mammal diversity	Total number of mammal species per site	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
			Mean number of mammal species per trap night	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
		Bird diversity	Total number of bird species per site	Maintain bird diversity	2ha 20min count (Birdlife Australia)	2 years	2 sites per target
			Mean number of bird species per site	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
Streams and Wetlands	Water quality	Macroinvertebrate abundance vs reference site	Mean mean macroinvertebrate abundance per site	Maintain water quality	Macroinvertebrate survey (TRCI)	2 years	10 sites
	Vegetation condition	Floristic diversity	Mean number of vascular plant species per site	Maintain floristic diversity	Photopoint monitoring	2 years	1 site / 5ha. 3 sites min. 10 sites max
		Structural complexity	Mean number of strata per site	Maintain structural complexity			
		Recruitment of canopy species	Percentage of sites where recruitment of canopy species is present	Maintain recruitment			
	Clarence galaxias presence	galaxias, brown trout	Inland Fisheries Service	Maintain or expand area of occupancy	IFS electrofishing	Annually	Skullbone Plains

Target	Key Environmental Attribute	Indicator	Definition	Objective	Methods	Frequency	Intensity
Highland Forest and Woodland	Vegetation condition	Floristic diversity	Mean number of vascular plant species per site	Maintain floristic diversity	Photopoint monitoring	2 years	1 site / 5ha. 3 sites min. 10 sites max
		Structural complexity	Mean number of strata per site	Improve structural complexity in logged areas,			
			Mean number of plant classes per site	Maintain structural complexity of undisturbed areas			
		Recruitment of canopy species	Number of cohorts per site	Maintain recruitment			
	Vertebrate fauna	Mammal diversity	Total number of mammal species per site	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
			Mean number of mammal species per trap night	Maintain mammal diversity	Surveillance camera	2 years	5 sites per target
		Bird diversity	Mean number of bird species per site	Maintain bird diversity	2ha 20min count (Birdlife Australia)	2 years	2 sites per target
	Wedge-tailed eagle Reproductive Success	Nest activity	Nest maintenance, presence of eggs/chick(s)/juvenile(s)	Maintain nest activity	Nest activity survey	Twice yearly	All eagle nests
	Forest cover change in reserve	Area	Total area having forest cover	Maintain ecosystem extent	Satellite image interpretation / ground truthing	4 years	entire area
	Forest cover change in 20km buffer of reserve	Area	Total area having forest cover	Maintain ecosystem extent	Satellite image interpretation / ground truthing	4 years	entire area
Carnivorous Marsupials	Presence, density and population trends of carnivourous marsupials - Spotted tailed quoll, Eastern quoll and Tasmanian Devil	Site occupancy	Number of sites occupied	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area

Target	Key Environmental Attribute	Indicator	Definition	Objective	Methods	Frequency	Intensity
		Relative abundance	(TBD)	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
		population trends	(TBD)	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
	Tasmanian devil disease status	Percentage of devil sites with DFTD		Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
	Presence, density and population trends of introduced carnivore Cat		No of individuals, cohorts, persistence in the landscape, distribution	Maintain wild populations of carnivorous marsupials	Motion Sensor cameras	Annually or Biennially	Roads, tracks entire project area
Community Connection with Landscape	Community involvement	Number of people engaged in activities: cultural, scientific, educational, recreational		Increase TLC support through community involvement	Engagement opportunities	Annually	Entire project area
	Volunteer activity	Volunteer days		Increase TLC support through community involvement	Engagement opportunities	Annually	Entire project area
	Money generated from ecosystem services	Income	Income attributed directly to sale of ecosystem services form the reserve	Increase TLC support through community involvement	Accounting	Annually	Entire project area
Cultural Heritage values	Site condition	Condition of buildings	Structural integrity of buildings and presence of historical objects	Maintain building condition	Site inspection	2 years	All heritage sites
		Condition of site in surrounding landscape	Intactness / aesthetics / disturbance within viewshed of site	Maintain landscape condition	Photopoint monitoring	2 years	Site specific