



TASMANIAN
LAND
CONSERVANCY

ENVIRONMENTAL ACCOUNT FIVE RIVERS RESERVE

INFORMATION STATEMENT
AND DETAILED ACCOUNTS

TASLAND.ORG.AU

CONTENTS

This Statement provides support information on the selection of assets, choice of indicators, data sources, analysis and treatment of data, construction of the Econd and account accreditation.

Revised 15 August 2018

Prepared by Dr Sally Bryant, Matthew Taylor and Daniel Sprod.

Accredited 19 June 2018 by TLC's Science and Planning Advisory Council

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Tasmanian Land Conservancy (2018) Five Rivers Environmental Account 2018. Tasmanian Land Conservancy, Sandy Bay TAS 7005

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WENTWORTH GROUP
OF CONCERNED SCIENTISTS



Cover: Aerial of the Serpentine Rivulet, Five Rivers Reserve. Photo: Grant Dixon
Opposite: Kenneth Lagoon, Skullbone Plains. Photo: Rob Blakers

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EXECUTIVE SUMMARY

The Tasmanian Land Conservancy (TLC) is a not-for-profit, apolitical, science and community based organisation that uses innovative approaches to protect Tasmania's unique natural places, world heritage values, and rare ecosystems and habitat for threatened plants and animals, on private land.

In partnership with others, the TLC has facilitated the protection of over 60,000 hectares of Tasmania's private land, including a network of 19 permanent conservation reserves which we own and manage.

The TLC uses Open Standards to produce Management Plans for each of these permanent reserves, and has installed ecological monitoring across our entire permanent reserve estate. Monitoring enables us to track the health and condition of our lands over time and better understand how they respond to major change events including our management work.

In 2015, the TLC adopted the Wentworth Group's 'Accounting for Nature' methodology as a way of recording, presenting and interpreting our monitoring data in a consistent way. In 2016 we determined basal reference condition for our Five Rivers Reserve (total of 11,113 ha) and in 2017 converted our monitoring data for key assets into Econds on a scale of 0 to 100 to show relative change over time.

Environmental accounting allows us to compare the health and condition of all our reserves using a valid reference point for condition. As land managers this enables us to track the effectiveness of our management actions and to identify and prioritise which of our reserves, or which of their conservation assets need more attention, and plan our work accordingly.

We are intending to adopt this methodology for monitoring data collected from other private protected lands in Tasmania as it can be up-scaled to provide regional environmental accounts for consistent and comparable state-wide reporting frameworks in the future.



Opposite: Identifying sub-alpine vegetation, Five Rivers Reserve. Photo: Matthew Newton



ENVIRONMENTAL ACCOUNT

The TLC has adopted the Wentworth Group’s ‘Accounting for Nature’ methodology as a way of recording, presenting and interpreting our ecological monitoring data collected on our permanent reserves in a consistent way. The TLC has determined a basal reference condition for our Five Rivers Reserve, and converted monitoring data for key assets into Econds on a scale of 0 to 100 to show relative change over time. This booklet showcases the methodology and outcomes of this environmental accounting technique.

FIVE RIVERS RESERVE

Class	Asset	Sub-asset	2014	2015	2016	2017
LAND	Native Vegetation	Econd	98		98	
		Highland Forests	95		94	
		Highland Marshes	100		100	
		Riparian Zone	100		100	
	Native Mammals	Econd	85	88	89	89
		Carnivores	65	71	70	71
		Herbivores	100	100	100	100
Omnivores		90	93	98	96	
FRESHWATER	Rivers & Wetlands	Econd		78		
		Clarence River		78		
		Kenneth Lagoon		78		
		Nive River		83		
		Pine River		69		
		Serpentine Rivulet		83		

Opposite: Aerial view of Skullbone Plains, Five Rivers Reserve. Photo: Matthew Newton

INFORMATION STATEMENT

BACKGROUND INFORMATION

The Five Rivers Reserve is located in Tasmania's Central Highlands near the township of Bronte Park, approximately 10 km east of Lake St Clair National Park and 188 km north of Hobart (Fig 1). The Reserve is 11,113 hectares in area and ranges in elevation from 600 m to over 1,100 m. The Reserve receives on average rainfall of 2,500 mm per year and experiences prolonged frost and heavy snowfalls in winter.

The Five Rivers Reserve was acquired by the Tasmanian Land Conservancy (TLC) in 2011 as private freehold land. The Reserve is protected under a statutory conservation covenant and part of it (Skullbone Plains) now has World Heritage status and is included within the Tasmanian Wilderness World Heritage Area. The Reserve has excellent context and shares boundaries with the Walls of Jerusalem National Park, the Central Plateau Conservation Area, Top Marshes Conservation Area, and the Tasmanian Aboriginal owned *trawtha makuminya* also protected by a conservation covenant (Fig 1).

The Reserve has a range of other neighbouring land tenures including State and private conservation reserves, State and privately managed forests, pastoral land, private shacks, and hydro-electricity impoundments and lagoons. It is within close proximity to many well-known fishing and boating lakes and major access routes to the wider Central Highlands area.

The Five Rivers Reserve Management Plan 2014-19 describes the conservation values on the Reserve, their threats and actions proposed for long-term management. The Plan was developed in consultation with stakeholders and project partners including the Commonwealth Government and Conservation International. The Plan and annual progress reports are available on tasland.org.au.

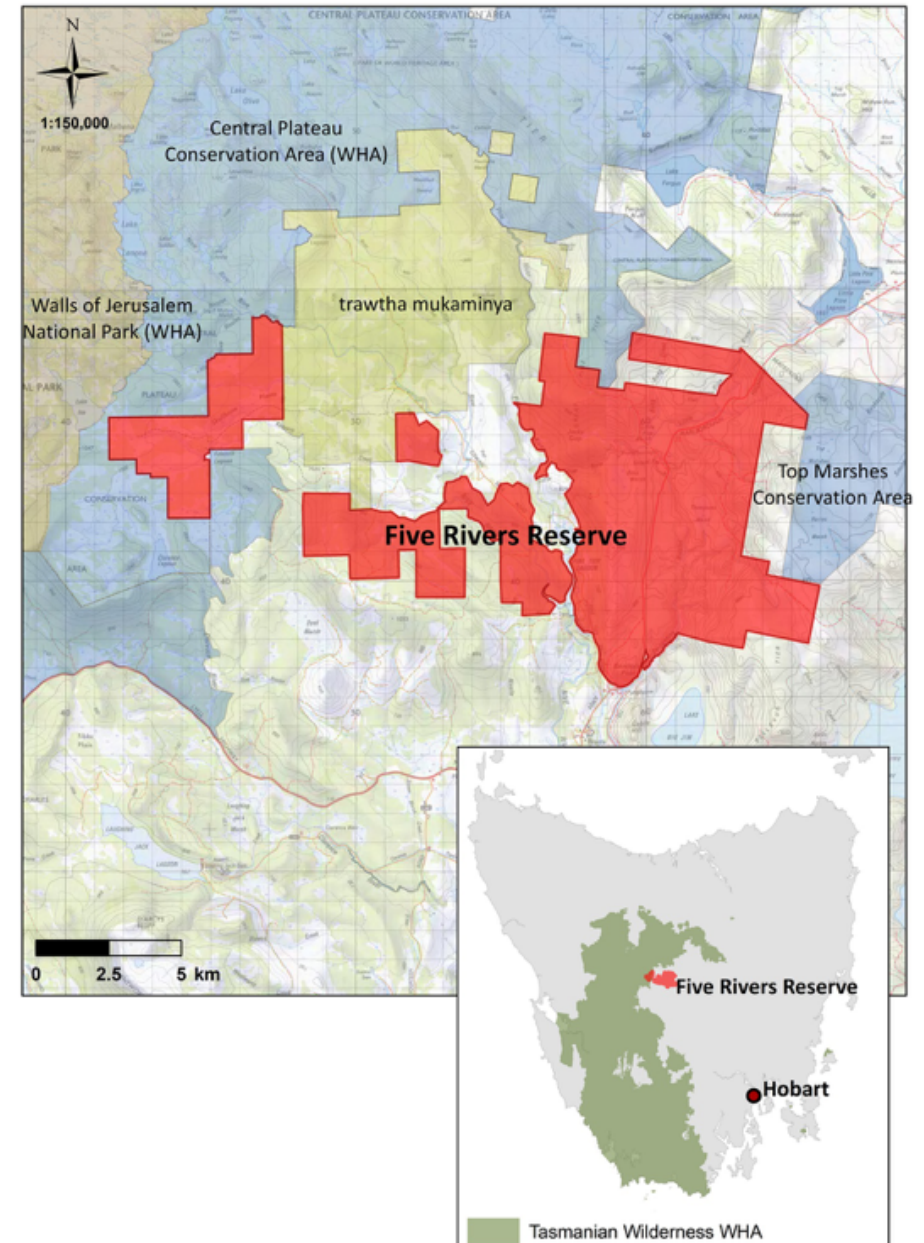


Fig 1: Five Rivers Reserve in Tasmania's Central Highlands



ENVIRONMENTAL ASSETS

WHAT ARE ENVIRONMENTAL ASSETS

Environmental assets are defined as “physical features in the landscape that can be measured in time and space”. The environmental assets presented in this account are: *Native Vegetation, Native Mammals and Rivers and Wetlands*, which are a subset of the conservation values identified in the Five Rivers Reserve Management Plan. These assets were chosen as indicators because of the monitoring data available for the purposes of formulating this environmental account and because they fit within the framework themes determined by the Wentworth Group as common for all regions¹. The data used to determine the condition of the selected environmental assets in this account is the same as those used to measure progress towards meeting management plan objectives.

MEASURING ENVIRONMENTAL ASSETS AND THE ECOND

The TLC monitors a range of ecological indicators across its entire reserve estate and this data is vital for assessing the condition of important ecosystems and species that the TLC seeks to protect. The methods used to gather consistent and reliable data used in this report and other publications is described in detail in the TLC’s Ecological Monitoring Manual, available at tasland.org.au.

An *Econd* describes the biophysical condition of an environmental asset as an index between 0 and 100, where 100 is a measure of the asset in its natural (reference) state.

¹ Wentworth Group of Concerned Scientists, 2016. Accounting for Nature, Wentworth Group of Concerned Scientists, Sydney. wentworthgroup.org

Opposite: Serpentine Rivulet, Five Rivers Reserve. Photo: Grant Dixon

FIVE RIVERS RESERVE ASSETS

The environmental assets selected for this account correspond to the Conservation Targets identified in the Management Plan² and their associated strategies and actions needed to protect or improve their health or condition. These Conservation Targets are broad ecosystem classes or habitat types, often with nested targets that are dependent upon their protection.

Class	Assets	Sub-assets	Indicators
LAND	Native Vegetation	Highland Forests Highland Marshes Riparian Zone	Extent (ha) Diversity Structural complexity Recruitment Carbon storage
	Native Mammals	Carnivores Herbivores Omnivores	Richness Abundance Occupancy
WATER	Rivers and Wetlands	Clarence River Kenneth Creek Nive River Pine River Serpentine Rivulet	Water quality Native fish Hydrology

Table 1: Five Rivers Reserve Assets, Sub-Assets and Indicators

The data used to populate this environmental account is derived from the TLC's ecological monitoring program which was installed on the Reserve in 2014 to measure flora and fauna diversity, structural complexity and changes in special values (species and populations) over time. For flora, 100 permanent photo sites have been established and these were assessed in 2014, 2016 and 2018 with assessment at five yearly intervals thereafter. For fauna, 46 camera trap sites were established in 2014 to measure terrestrial mammals and these have been assessed annually. Native fish are assessed by the Inland Fisheries Service and authorised consultants on a regular basis, and water quality is assessed every 2 to 5 years.

² Tasmanian Land Conservancy (2014). Five Rivers Reserve Management Plan 2014 – 2019. Tasmanian Land Conservancy, Tasmania, Australia.



DATA QUALITY SCORES

Data quality is assessed for its comprehensiveness and accuracy and rated as per Table 2.

Quality Assurance Rating	
5	Comprehensive
4	Substantial
3	Good
2	Reasonable
1	Acceptable
0	Not fit for purpose of regional environmental asset condition accounting

Table 2 Quality assurance rating (Wentworth Group)

Above: Tasmanian Devil (*Sarcophilus harrisii*). Photo: Heath Holden

NATIVE VEGETATION

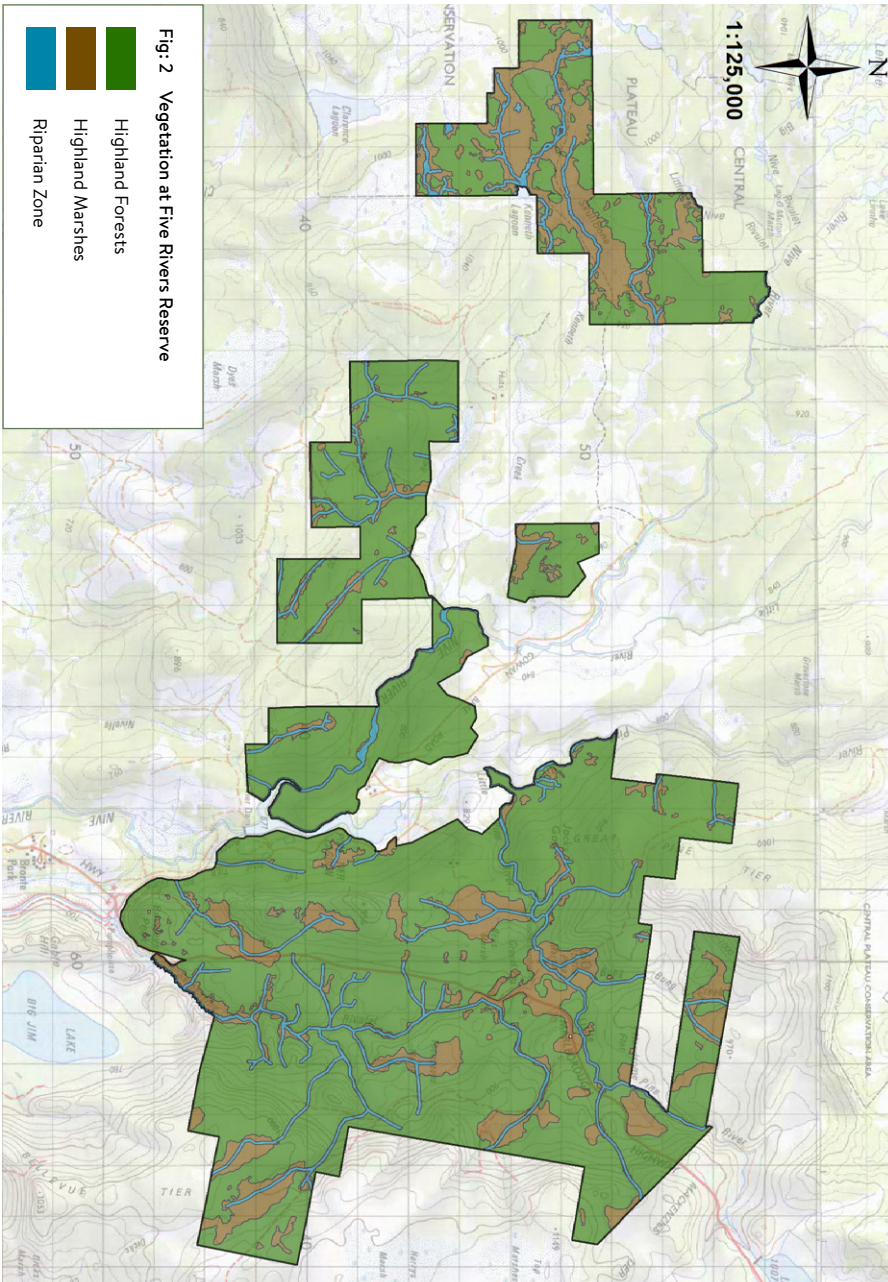


Fig: 2 Vegetation at Five Rivers Reserve

Extensive areas of highland forest occur on the Five Rivers Reserve. The majority of the forested area (98% of the Reserve) is covered by eucalypt dominated forest communities, with species composition determined by changes in geology, altitude and water availability. Small areas of montane rainforest occur in locations that have been protected from fire by topography.

Highland marshes occur in valley areas, where impeded drainage has led to the formation of deep organic soils. Vegetation communities are exceptionally diverse and composition varies from valley to valley. These marsh and grasslands contain nationally endangered values such as Miena cider gum, sphagnum peatlands and are especially important for native wildlife, providing foraging habitat for herbivores and hunting grounds for raptors and marsupial carnivores.

The Five Rivers landscape is interwoven with streams and wetlands. The headwaters of the Nive River are one of the last strongholds for the nationally endangered Clarence galaxias (*Galaxias johnstonii*), while the riparian zone provides fire-protected habitat for endemic conifers and other rare and threatened plant species. Information on these conservation significant species, communities and other natural values can be found in the Five Rivers Reserve Management Plan on the TLC website.

SUB-ASSETS

The following sub-assets are included in this account (Fig 2):

- 1 Highland Forests
- 2 Highland Marshes
- 3 Riparian Zone

INDICATORS

Indicators used to describe the condition of native vegetation are:

- 1 Extent (hectares)
- 2 Diversity
- 3 Structural complexity
- 4 Recruitment
- 5 Carbon storage

Data for each indicator was collected in accordance with the procedures in the Tasmanian Land Conservancy's Ecological Monitoring Field Manual. A copy of this manual is available at www.tasland.org.au/science/.

VEGETATION EXTENT AND CONFIGURATION

Sampling design methodology

Satellite imagery of the Reserve was used as the basis for vegetation extent measures.

Data collection methodology

The spatial extent and configuration of native vegetation across Five Rivers Reserve was mapped using state-wide TASVEG mapping and remote-sensing data and verified in the field by experienced botanists.

Analysis of data

Mapping software (ArcGIS) was used to calculate the extent of native vegetation on the Reserve and within a 10 km radius of its boundary. Extent of clearing due to roads was calculated using a 4 m buffer from mapped road centre lines.

Reference condition data source

Reference condition for 'extent' was calculated as the entire area of Five Rivers Reserve based on the assumption that it was initially completely covered in native vegetation. Similarly, reference condition for configuration assumed that native vegetation was contiguous within 10 km of the Reserve.

Calculation of indicator condition scores

The condition score for each indicator is the measured extent as a percentage of the reference extent.

Data quality score: 5

There is high confidence in the quality of the data as it is derived from quantitative remote sensing data with a high degree of precision and reliability.

VEGETATION COMPOSITION

DIVERSITY, STRUCTURAL COMPLEXITY, RECRUITMENT

Sampling design methodology

Data on vegetation diversity, structural complexity and recruitment were collected from 100 sites across the three vegetation classes in 2014, 2016 and 2018. Sites were initially selected using a random sampling tool on ArcGIS software.

Data collection methodology

Diversity

Diversity was measured by line intercept transect. A tape is stretched between two reference pegs permanently located at each monitoring site and all the plant species that intercept that line are recorded (2 m in grassland, 10 m in other veg types).

Structural complexity and recruitment

Fixed photo-points are used to monitor structural complexity and recruitment. Reference pegs located at each site allow identical repeat photographs to be taken of the vegetation at a standard height. Images are reviewed on a desktop computer and the number of plant types and tree cohorts visible at each site is recorded.

Analysis of data

Floristic diversity is calculated as the average number of species recorded per vegetation type. Structural complexity is the average number of plant types per vegetation type. Recruitment is the average number of cohorts per vegetation type.

Reference condition data source

The Highland Marshes and Riparian Zone sub-asset were assumed to be in reference condition as human impacts in these areas post-settlement has been negligible. Reference was calculated as the average of the two years of data collected. The Highland Forest sub-asset has been extensively impacted by logging so reference condition was determined from surrogate sites elsewhere that have not been impacted. Identification of unimpacted sites is a widely used surrogate for reference in situations where no baseline data on conditions exists (TASVEG community benchmark report: [dipwe.tas.gov.au/conservation/development-planning-conservation-assessment/planning-tools/monitoring-and-mapping-tasmanias-vegetation-\(tasveg\)/vegetation-monitoring-in-tasmania#TASVEGVegetationCommunityBenchmarks](http://dipwe.tas.gov.au/conservation/development-planning-conservation-assessment/planning-tools/monitoring-and-mapping-tasmanias-vegetation-(tasveg)/vegetation-monitoring-in-tasmania#TASVEGVegetationCommunityBenchmarks))

Accounting for natural variability

We applied a factor of 15% to account for natural variability in vegetation condition indicators. This factor was determined by calculating the mean of biannual variation observed across all TLC permanent reserves from monitoring in the years 2013-18. The data from each year of monitoring are reviewed by an expert panel and changes in indicator scores have been found to fall within the range expected in response to weather conditions and other natural processes.

Calculation of indicator condition scores

Condition scores for the Highland Marshes and Riparian Zone subsets are the measured condition as a percentage of the reference condition for each indicator. The measured condition for Highland Forests is the average measure of logged and unlogged areas, weighted by extent. The condition score of Highland Forest is the measured condition as a percentage of the reference condition.

Data quality score: 5

There is a high confidence in the quality of the data as it is derived from direct field measurements from a large number of sites. Data was collected by an experienced team of conservation scientists.

CARBON CONTENT

Sampling design methodology

PI type (Photo Interpretation typing³) was used as the basis for identifying carbon strata, which in turn were the basis for randomly selecting sample plots. PI typing was used because it is an accurate categorisation of carbon content. Strata identified were sampled using 45 m x 45 m plots measured until the variance fell below 5%. For full details see the Verified Carbon Standard methodology VM0010⁴. Only logged forests were sampled: unlogged forests and non-forest communities were assumed to be at carbon carrying capacity.

Data collection methodology

Plots were directly sampled for all trees over 20 cm DBH (diameter at breast height) for both height and DBH. Sampling was carried out in 2012.

Analysis of data

Data were analysed to determine carbon content in tonnes/ hectare for each stratum (for full details see Baseline Carbon Assessment, New Leaf Forest Estate, Forests Alive, 2010). Data were then aggregated for all strata weighted according to contributing area and an overall score given for the entire logged area. Carbon content for both logged and unlogged areas were weighted according to their proportional extent.

Reference condition data source

Reference condition for logged areas was based on modelled FULLCAM⁵ using the above data and past and proposed future harvest events. The maximum carbon content - either past or future - of each stratum was used as reference condition for each stratum. Reference condition for unlogged areas (both forest) was assumed as 100% carbon content.

Calculation of indicator condition scores

Indicator condition scores are the current measured carbon content as a percentage of the reference.

Data quality score: 5

There is very high confidence in the quality of the carbon content scores as they are based on state-wide (forest) PI Type mapping, with extensive field measurements being used as the basis for internationally and nationally accepted statistical and modelling techniques to yield both current and reference condition.

³ Photo interpretation (PI) typing. citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.203.1287&rep=rep1&type=pdf

⁴ Verified Carbon Standard methodology. vcsprojectdatabase.org/#/project_details/1285

⁵ Full Carbon Accounting Model (FullCAM). environment.gov.au/climate-change/greenhouse-gas-measurement/land-sector

NATIVE MAMMALS

Twenty two species of terrestrial mammal have been recorded on the Five Rivers Reserve to date, 19 native and 3 non-native species. Robust numbers of Tasmania's three largest native carnivores – the Tasmanian devil, spotted-tail quoll and eastern quoll occur there together with wombat, brush-tailed possum and two wallaby species particularly around the extensive grassy valleys. Some of Tasmania's critical weight range species such as potoroo, Tasmanian bettong and southern-brown bandicoot are also regularly detected during camera monitoring. A background report on mammal monitoring on this Reserve is available on the TLC web site at tasland.org.au/reserves/five-rivers-reserve/

This account represents the medium to large weight range native mammal species only. It excludes smaller mammals (e.g. rodents) less attracted to roads and tracks or less easily identifiable from camera trap images and non-native mammal species.

SUB-ASSETS

The following sub-assets of mammals are included in this account:

- 1 Carnivores
- 2 Herbivores
- 3 Omnivores (and other)

INDICATORS

Indicators to describe the condition of native terrestrial mammals:

- 1 Richness
- 2 Abundance
- 3 Occupancy

Data for each indicator were collected according to the standard procedures contained in the Tasmanian Land Conservancy's ecological monitoring field manual available at www.tasland.org.au/science/.

These indicators were chosen because they are a relatively standard measure used in wildlife research globally and provide complementary measures of the status of native mammal populations. Richness is a measure of the total number of mammal species observed, abundance measures the status of each species, and occupancy is a measure of the range of each species within the survey area (i.e. Five Rivers Reserve).

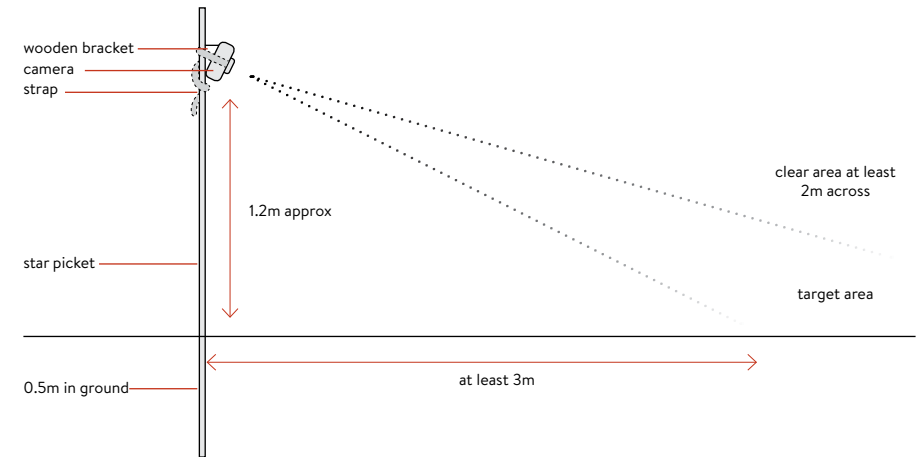


Fig 3: Camera trap placement

MAMMAL RICHNESS, ABUNDANCE, OCCUPANCY

Sampling design methodology

Data was collected annually between 2014 and 2018. Forty-six sites were randomly allocated across the three vegetation types (sub-assets) on the Reserve (see Fig 1) but skewed towards roads and tracks to enhance detection of species especially carnivores that use the road network for movement. These sites were then permanent.

Data collection methodology

Camera traps (Scout Guard SG560Z) were deployed each February for a minimum of 21 days. Cameras were secured on tree trunks or posts approx. 1.2 metres above the ground and a fish-oil lure was used as an attractant (Fig 3). Cameras were retrieved after 21 days and images downloaded with all metadata entered at the time of download including site no, trap nights, number of images etc. Images were scored by trained personnel onto a spreadsheet by recording species identity, date, time and unique photo identifier. A system of expert review cross checked all images assigned 'unsure' and validated a cross section for quality control purposes.

Analysis of data

Species richness for each subset is the total number of species of mammal observed. Relative abundance, calculated for each species, is the total number of observations divided by the number of trap nights. Occupancy, also calculated for each species, is the number of sites, at which each species was detected, as a proportion of the total number of sites surveyed.

Assigning reference condition

Reference condition for richness is the number of species known or predicted to occur in the region from previous studies.^{6,7,8}

Thylacine reference condition was assigned according to historical sources⁷. Reference condition for abundance of the Tasmanian devil is the average from four years of sampling multiplied by 2.5. This species is estimated to have declined in the region by at least 70 - 80% or higher from 1993–1995 to 2001–2003 due to the spread of fatal devil facial tumour disease⁹. The population has now partially recovered to 40% of historic levels so to calculate reference condition a multiplier of 2.5 was applied to our indicator to reflect this. Reference condition for abundance of all other species is the average measure from four consecutive years of sampling on the Reserve, as human impacts have had a negligible impact on populations of native species in the region and feral animal species are in relatively low numbers. Reference condition for occupancy is the likelihood of occupancy predicted from detailed species distribution models in relation to climate change, developed by the University of Tasmania¹⁰.

Accounting for natural variability

Many mammal species are known to fluctuate over time due to a range of conditions which may be unrelated to management (i.e. drought, disease etc.). To account for natural variability we applied a factor to abundance and occupancy of each species based on the data from long-term state-wide mammal monitoring as presented in Tasmania's State of the Environment Report 2009¹¹. The factors vary for each mammal species and are presented in the Reference Table of the environmental account.

Calculation of indicator condition scores

Indicator condition scores were the current measured values as a proportion of the reference condition for each species. These values were averaged to give condition scores for each of the three mammal classes.

Data quality score: 4

The mammal monitoring data is of a high standard as it was collected using well established protocols and assessed by trained personnel. However, the data used to assign reference condition is of variable quality, coming from multiple external sources, only some of which are peer reviewed.

6 DE Rounsevell, R.J Taylor and G.J Hocking (1991) Distribution records of native terrestrial mammals in Tasmania, *Wildlife Research* 18(6) 699 – 717.

7 Royal Society of Tasmania (1972) *The Lake Country of Tasmania*, RST, Hobart.

8 *Natural Values Atlas* (2017), Tasmanian Government database. naturalvaluesatlas.tas.gov.au

9 C.E. Hawkins, C. Baars, H. Hesterman, G.J. Hocking, M.E. Jones, B. Lazenby, D. Mann, N. Mooney, D. Pemberton, S. Pyecroft, M. Restani, J. Wiersma (2006) Emerging disease and population decline of an island endemic, the Tasmanian devil *Sarcophilus harrisii*. *Biological Conservation* 131(2) 307-324.

10 *Climate Niche Modelling* (2017), Landscapes and Policy Hub, lifeatlarge.edu.au/climate-niche-modelling

11 *Tasmanian Planning Commission, State of the Environment Tasmania 2009*, Hobart, Tasmania. soer.justice.tas.gov.au/2009

RIVERS AND WETLANDS

The Five Rivers Reserve is located in the headwaters of the Nive River, which include the sub-catchments of five major streams and numerous scattered wetlands (Fig 4). Much of this upper catchment area remains undisturbed and the waters are near-pristine. Although introduced trout occur throughout much of this area, a few small streams and tarns continue to support the endangered Clarence galaxias, where trout are not present.

SUB-ASSETS

The following sub-assets are included in this account:

Rivers

- 1 Clarence River
- 2 Kenneth Lagoon
- 3 Nive River
- 4 Pine River
- 5 Serpentine Rivulet

INDICATORS

Indicators used to describe the condition of this asset are sub-indices of the Tasmanian River Condition Index (TRCI)¹².

- 1 Water quality
- 2 Native fish
- 3 Hydrology

It should be noted that macro-invertebrate diversity is used here as a proxy indicator for water quality, rather than as a measure of the condition of the macroinvertebrate community itself. Very little data exists on macroinvertebrate communities in Australia prior to the introduction of trout, but it is likely that there has been a significant impact. This area warrants additional work before including in these environmental accounts.

Data for each indicator was collected in accordance with the procedures in the Tasmanian Land Conservancy's Ecological Monitoring Field Manual. A copy of this manual is available at www.tasland.org.au/science/.

12 *Tasmanian River Condition Index* (2016) dpiwwe.tas.gov.au/water/water-monitoring-and-assessment/surface-water-assessment/assessing-river-health-and-condition/tasmanian-river-condition-index

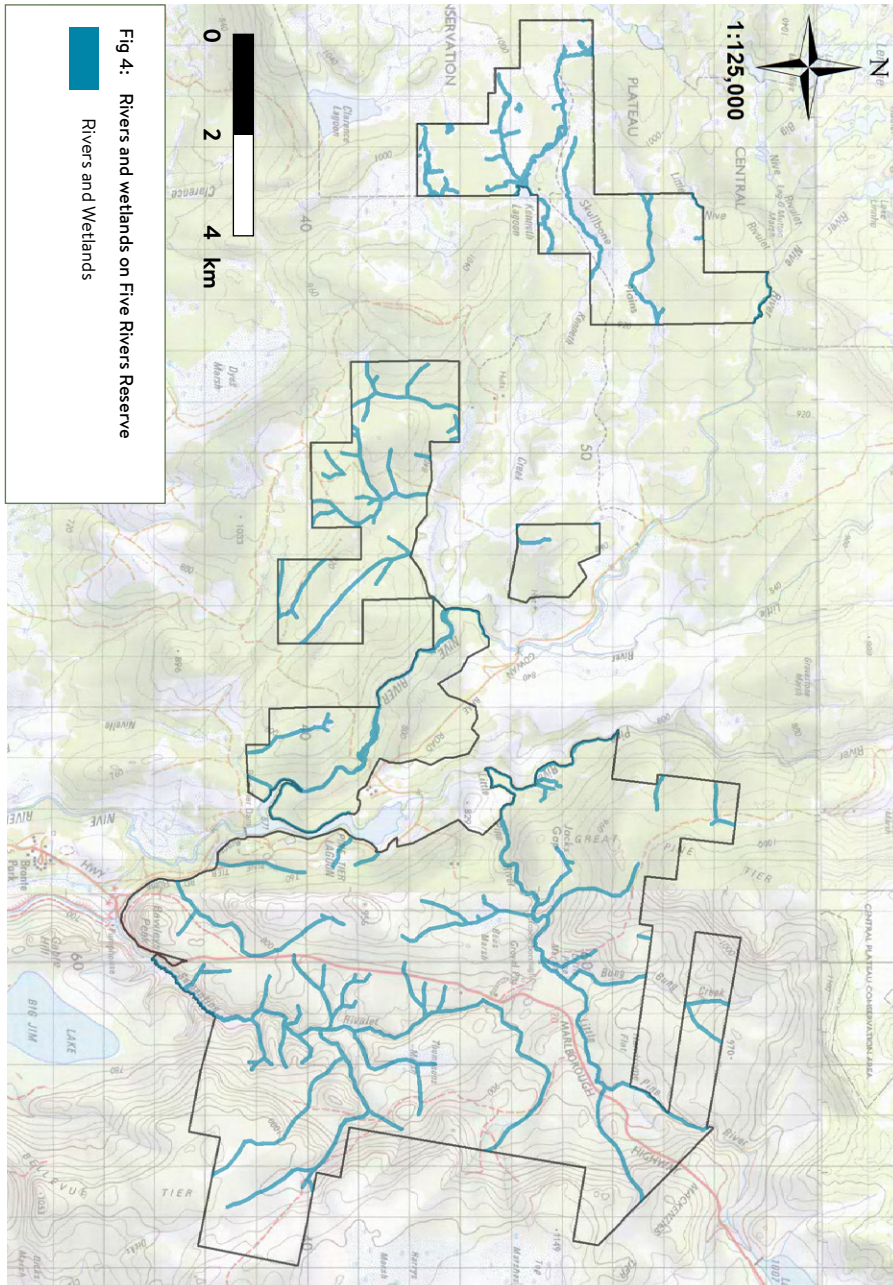


Fig 4: Rivers and wetlands on Five Rivers Reserve

Rivers and Wetlands

WATER QUALITY

Sampling design methodology

Six sample sites were located at three wetlands and three streams spread across the Reserve and were selected for ease of access.

Data collection methodology

Field samples were collected using 10 m Surber sampling in rivers and sweep nets in wetlands. Samples were divided into smaller subsamples (20%) in the lab and macroinvertebrates were then identified by an expert macroinvertebrate zoologist using a stereo microscope.

Analysis of data

Sampled organisms were identified to family level and Simpson's Diversity Index was calculated for each site.

Reference condition data source

Reference condition for this asset is based on the expert opinion of freshwater ecologists at the University of Tasmania and assumes that water quality is relatively pristine due to the position of Five Rivers Reserve in the upper headwaters of the Derwent Catchment, where it borders the Tasmanian Wilderness World Heritage Area.

Calculation of indicator condition scores

The indicator score is the measured condition as a percentage of the reference condition.

Data quality score: 5

The data quality for this indicator is high. Data collection and analysis has been carried out by acknowledged experts in the field of freshwater ecology.

NATIVE FISH

Sampling design methodology

Sample sites are the same as for the macroinvertebrate diversity indicator.

Data collection methodology

Electro-fishing was used to temporarily stun fish so that identification of species could be made.

Analysis of data

Data presented is the number of native fish recorded at each site.

Reference condition data source

A map of the distribution of three native freshwater fish was prepared based on the Conservation of Freshwater Ecosystem Values (CFEV) modelling, observations entered in the Natural Values Atlas, historical records and expert opinion. This map was used to estimate the number of native fish species that would have occurred naturally at each site.

Calculation of indicator condition scores

The indicator condition score for each sub-asset is the observed number of fish species as a percentage of the reference condition.

Data quality score: 3

The data is derived from a small number of samples and expanded sampling would give a more accurate idea of the current distribution of fish on the Reserve. The data used to assign reference condition also represents a 'best-guess' at pre-European fish distributions.

HYDROLOGY

Sampling design methodology

The degree of disturbance was calculated for each sub-asset.

Data collection methodology

For the Pine River sub-asset, data from Hydro Tasmania¹³ was used to quantify the hydrological disruption caused by the damming and diversion of water from the upper catchment of the Little Pine River. For the Nive River sub-asset, the proportion of the catchment area inundated by Pine Tier Lagoon was subtracted from the total catchment area. Remaining sub-assets were assumed to be entirely unmodified.

Analysis of data

Not applicable.

Reference condition data source

Sub-assets were assigned a condition score of 100.

Calculation of indicator condition scores

The indicator condition score for each sub-asset is the measured condition score as a percentage of the reference score.

Data quality score: 5

There is a high degree of confidence in the data provided by Hydro Tasmania as it is based on long-term measurements made by expert engineers. The satellite imagery used to estimate the extent of the Pine River catchment is similarly robust, as it is based on highly accurate measurements made by sophisticated equipment.

¹³ Hydro Tasmania, unpublished data, 2017.
Opposite: Nive River, Five Rivers Reserve. Photo: Grant Dixon



CALCULATION OF ECOND

Calculation of Econds for sub-assets

Native Vegetation

The Econd for each sub-asset is the average condition score for richness, structural complexity and recruitment multiplied by the condition score for extent and divided by 100.

Native Mammals

To calculate the Econd for each sub-asset, the condition score for each indicator is averaged.

Rivers and Wetlands

To calculate the Econd for each sub-asset, the condition score for each indicator is averaged.

Calculation of Econd for the asset

Native Vegetation

The weighted average (by extent) of the three sub-assets.

Native Mammals

The average of the three sub-assets.

Rivers and Wetlands

The weighted average (by extent) of the five sub-assets.

Assessment of Econds

Assessed by the TLC's Science and Planning Advisory Council.

DETAILED ACCOUNTS

VEGETATION ASSET ACCOUNT - FIVE RIVERS RESERVE

Sub-asset	Indicator		Reference Benchmark	2014			2015			2016			2017		
				Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd
						98.3					98.2				
All sub-assets	Extent	% native veg on property	11183	10987	98	98.2			10987	98	98.2				
	Configuration	% native veg within 10 km	113953	112127	98	98.4			112127	98	98.4				
						98.2					98.0				
Highland Forests	Composition	Richness	10.6	11.7	100	94.6			9.4	99	94.3				
		Structural complexity	4.5	4.8	100			4.2	100						
		Recruitment	2.4	2.5	100			2.3	100						
		Carbon content	130	101.4	78			101.4	78						
Highland Marshes	Composition	Richness	10.8	11.5	100	100.0			10.0	100	99.8				
		Structural complexity	3.1	3.4	100			2.8	99						
		Recruitment	100	100	100			100	100						
		Carbon content	100	100	100			100	100						
Riparian Zone	Composition	Richness	10.49	11.6	100	100.0			9.4	100	100.0				
		Recruitment	100	100	100			100	100						
		Carbon content	100	100	100			100	100						
		Structural complexity	3.1	3.4	100			2.9	100						

NATIVE MAMMAL ASSET ACCOUNT - FIVE RIVERS RESERVE

Sub-asset	Indicator	Pre-European Reference Benchmark	Reference Econd	2014			2015			2016			2017		
				Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd
TOTAL			100			85.1			88.2			89.2			88.9
Carnivores			100			65.2			71.5			69.9			71.0
All carnivores	Richness	4.000	100	3.000	75	75.0	3	75	75.0	3	75	75.0	3	75	75.0
eastern quoll	Occupancy	0.370	100	0.326	100	100.0	0.46	100	100.0	0.45	100	100.0	0.39	100	100.0
	Relative abundance	0.037	100	0.025	100		0.041	100		0.024	100		0.057	100	
spotted-tail quoll	Occupancy	0.140	100	0.043	62	81.0	0.14	100	100.0	0.11	100	100.0	0.10	100	100.0
	Relative abundance	0.002	100	0.001	100		0.004	100		0.003	100		0.002	100	
Tasmanian devil	Occupancy	0.750	100	0.761	100	70.0	0.97	100	82.3	0.86	100	74.3	0.80	100	80.2
	Relative abundance	0.348	100	0.104	40		0.169	65		0.127	49		0.158	60	
Tasmanian tiger	Occupancy	0.500	100	0.000	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00	0	0.0
	Relative abundance	0.001	100	0.000	0		0.000	0		0.000	0		0.000	0	
Herbivores			100			99.6			100			100			100
All herbivores	Richness	3.000	100	3.00	100	100.0	3.00	100	100	3.00	100	100	3.00	100	100
Bennetts wallaby	Occupancy	0.433	100	1.00	100	100.0	1.00	100	100	0.95	100	100	0.95	100	100
	Relative abundance	0.433	100	0.433	100		0.366	100		0.428	100		0.554	100	
pademelon	Occupancy	0.380	100	0.67	100	100.0	0.59	100	100	0.73	100	100	0.68	100	100
	Relative abundance	0.162	100	0.162	100		0.054	100		0.116	100		0.090	100	
wombat	Occupancy	0.353	100	0.76	100	98.6	0.92	100	100	0.86	100	100	0.90	100	100
	Relative abundance	0.120	100	0.087	97		0.144	100		0.110	100		0.139	100	
Omnivores			100			90.4			93.1			97.6			96
All Omnivores	Richness	6.00	100	4.00	67	66.67	5.00	83	83.33	5.00	83	83.33	5.00	83	83
bettong	Occupancy	0.27	100	0.02	33	66.30	0.14	100	100.00	0.07	100	100.00	0.05	73	87
	Relative abundance	0.002	100	0.002	100		0.003	100		0.001	100		0.002	100	
brown bandicoot	Occupancy	0.09	100	0.00	100	100.00	0.05	100	100.00	0.11	100	99.91	0.10	100	100
	Relative abundance	0.002	100	0.000	100		0.001	100		0.003	100		0.003	100	
brush-tail possum	Occupancy	0.30	100	0.91	100	100.00	0.97	100	100.00	0.95	100	100.00	0.90	100	100
	Relative abundance	0.339	100	0.349	100		0.331	100		0.288	100		0.388	100	
eastern barred bandicoot	Occupancy	0.22	100	0.00	100	100.00	0.00	100	100.00	0.00	100	100.00	0.00	100	100
	Relative abundance	0.002	100	0.000	100		0.000	100		0.000	100		0.000	100	
echidna	Occupancy	0.42	100	0.20	100	100.00	0.05	51	68.37	0.23	100	100.00	0.15	100	100
	Relative abundance	0.004	100	0.007	100		0.002	86		0.005	100		0.004	100	
potoroo	Occupancy	0.03	100	0.07	100	100.00	0.03	100	100.00	0.02	100	100.00	0.05	100	100
	Relative abundance	0.002	100	0.002	100		0.001	100		0.001	100		0.003	100	

FRESHWATER ASSET ACCOUNT - FIVE RIVERS RESERVE

Sub-asset	Indicator	Reference Benchmark	2014			2015			2016			2017		
			Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd	Measure	Indicator Condition Score	Econd
Total								78.5						
								77.8						
Clarence River	Water quality	0.82				0.82	100							
	Native fish	3				1.0	33							
	Hydrology	100				100	100							
								77.8						
Kenneth Lagoon	Water quality	0.81				0.81	100							
	Native fish	3				1.0	33							
	Hydrology	100				100	100							
								82.8						
Nive River	Water quality	0.85				0.85	100							
	Native fish	2				1.0	50							
	Hydrology	100				98	98							
								69.0						
Pine River	Water quality						100							
	Native fish	2				1.0	50							
	Hydrology	100				57	57							
								83.3						
Serpentine Rivulet	Water quality	0.84				0.84	100							
	Native fish	2				1.0	50							
	Hydrology	100				100	100							

VEGETATION DATA - FIVE RIVERS RESERVE

WEIGHTED AVERAGE CALCULATION

Sub-Asset	Area	Weight	Logging Weight
Rivers and Wetlands	798	0.07	
Highland Marshes	1756	0.16	
Highland Forests	8630	0.77	
Logged	5414	0.48	0.63
Unlogged	3216	0.29	0.37
TOTAL	11184		

RAW DATA

M_ID	Sub-Asset	Logged	2014			2016		
			Richness	Structure	Recruitment	Richness	Structure	Recruitment
Average	Rivers and Wetlands		12	3		9	3	
Average	Highland Forests	Logged	12	5	2	10	4	2
Average	Highland Forests	Unlogged	12	4	3	9	4	2
Average	Highland Marshes		12	3		10	3	

CARBON DATA

Stratum	Stratum Name (PI Code)	Description	Area (ha)	Carbon (tC/ha)	Total Carbon (tC)	Approx carrying capacity (tC/ha)	Total tC @ carrying capacity	% carrying capacity	Weight
		Logged area total	5414	85	458,524	130	701,687	65	0.63
		Unlogged area total	3,216	129.61	416,831	130	416,831	100	0.37
TOTAL			8,630						

NATIVE MAMMAL DATA - FIVE RIVERS RESERVE

	2014		2015		2016		2017	
	Occu-pancy	Abun-dance	Occu-pancy	Abun-dance	Occu-pancy	Abun-dance	Occu-pancy	Abun-dance
eastern quoll	0.33	0.025	0.46	0.041	0.45	0.024	0.39	0.057
spotted-tail quoll	0.04	0.001	0.14	0.004	0.11	0.003	0.10	0.002
Tasmanian devil	0.76	0.104	0.97	0.169	0.86	0.127	0.80	0.158
Bennetts wallaby	1.00	0.433	1.00	0.366	0.95	0.428	0.95	0.554
pademelon	0.67	0.162	0.59	0.054	0.73	0.116	0.68	0.090
wombat	0.76	0.087	0.92	0.144	0.86	0.110	0.90	0.139
bettong	0.02	0.002	0.14	0.003	0.07	0.001	0.05	0.002
brown bandicoot	0.00	0.000	0.05	0.001	0.11	0.003	0.10	0.003
brushtail possum	0.91	0.349	0.97	0.331	0.95	0.288	0.90	0.388
eastern barred bandicoot	0.00	0.000	0.00	0.000	0.00	0.000	0.00	0.000
echidna	0.20	0.007	0.05	0.002	0.23	0.005	0.15	0.004
potoroo	0.07	0.002	0.03	0.001	0.02	0.001	0.05	0.003

FRESHWATER DATA - FIVE RIVERS RESERVE

M_ID	Sub-Asset	Area	Weight	2015		
				Water Quality	Native Fish	Hydrology
FIRI161	Clarence Headwaters	2381	0.18	77	1	100
FIRI162	Kenneth Creek	981	0.07	83	1	100
FIRI163	Nive River	3489	0.26	80	1	98.3
FIRI164	Pine River	3097	0.23		1	57
FIRI165	Serpentine Rivulet	3501	0.26	77	1	100

REFERENCE TABLE - FIVE RIVERS RESERVE

Asset	Sub-asset	Indicator	Reference	Variability	Low Value	
Native Vegetation	Highland Forests	extent	8629	0	8629.0	
		richness	10.6	0.1	9.5	
		structural complexity	4.5	0.1	4.0	
		recruitment	2.4	0.1	2.2	
	Highland Marshes	carbon	129.61	0	129.6	
		extent	1756	0	1756.0	
		richness	10.8	0.1	9.7	
	Riparian Zone	structural complexity	3.1	0.1	2.8	
		extent	798	0	798.0	
		richness	10.49	0.1	9.4	
		structural complexity	3.1	0.1	2.8	
	Native Mammals	Carnivores	richness	4	0	4
			eastern quoll	occupancy	0.37	0.35
spotted-tail quoll				0.14	0.5	0.07
Tasmanian devil				0.75	0.25	0.56
Tasmanian tiger				0.50	0.15	0.43
eastern quoll			abundance	0.037	0.35	0.024
spotted-tail quoll				0.002	0.5	0.001
Tasmanian devil				0.348	0.25	0.261
Tasmanian tiger				0.001	0.15	0.001
Herbivores			richness	3	0	3
		Bennetts wallaby	occupancy	0.43	0.25	0.33
		pademelon		0.38	0.5	0.19
		wombat		0.35	0.25	0.27
		Bennetts wallaby	abundance	0.445	0.25	0.334
		pademelon		0.105	0.5	0.053
Omnivores		wombat		0.120	0.25	0.090
		richness	6	0	6	
		bettong	occupancy	0.27	0.75	0.07
		brown bandicoot		0.09	1	0.00
		brush-tail possum		0.30	0.15	0.26
		eastern barred bandicoot		0.22	1	0.00
		echidna		0.42	0.75	0.11
		potoroo		0.03	1	0.00
		bettong	abundance	0.002	0.75	0.000
		brown bandicoot		0.002	1	0.000
		brush-tail possum		0.339	0.15	0.288
	eastern barred bandicoot		0.002	1	0.000	
	echidna		0.004	0.5	0.002	
	potoroo		0.002	1	0.000	

Asset	Sub-asset	Indicator	Reference	Variability	Low Value
Rivers & Wetlands	Clarence River	water quality	0.82	0.15	0.70
		native fish	3	0	3
		hydrology	100	0	100
	Kenneth Lagoon	water quality	0.81	0.15	0.69
		native fish	3	0	3
		hydrology	100	0	100
	Nive River	water quality	0.85	0.15	0.72
		native fish	3	0	3
		hydrology	100	0	100
	Pine River	water quality			
		native fish	2	0	2
		hydrology	100	0	100
Serpentine Rivulet	water quality	0.84	0.15	0.71	
	native fish	2	0	2	
	hydrology	100	0	100	

Tasmanian Land Conservancy

PO Box 2112 Lower Sandy Bay
Tasmania 7005
Ph +61 3 6225 1399
www.tasland.org.au

ABN 88 743 606 934

 @tas_land

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