



NSW National Parks and Wildlife Service

Kosciuszko offset action plan – Booroolong frog

Kosciuszko Offset Project



Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live.

We pay our respects to Elders past, present and emerging.

This resource may contain images or names of deceased persons in photographs or historical content.

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Artist and designer Nikita Ridgeway from Aboriginal design agency – Boss Lady Creative Designs, created the People and Community symbol.

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Objective

This plan sets out management actions that, when implemented and measured, will deliver biodiversity gains for the Booroolong frog (*Litoria booroolongensis*) within and outside of Kosciuszko National Park – refer to ‘Kosciuszko offset strategy: metrics-based approach’ Step 2 – for further details on why some actions are occurring outside of the park in other areas of the New South Wales national park estate for this species.

The Kosciuszko Offset Strategy 2023 sets out a framework for the development of offset action plans. It is based on a clear objective – to deliver a biodiversity gain in the park equivalent to 120% of the biodiversity loss identified in the Snowy 2.0 environmental assessments.

In the Snowy 2.0 environmental assessments for Exploratory Works, Main Works and Transmission Connection, up to 8.9 hectares of Booroolong frog habitat was identified as being impacted. At an estimated 40 individuals per hectare (see Step 1), the project’s impact on the Booroolong frog is estimated to be a reduction in the population by 356 individuals.

To deliver the 120% biodiversity gain identified under the Kosciuszko Offset Strategy, the objective of this action plan is to **increase the population of Booroolong frogs in Kosciuszko National Park and nearby nature reserves by 428 individuals.**

As this is a Commonwealth-listed species and the potential impacts on it are significant, this action plan has been approved by both the Deputy Secretary, National Parks and Wildlife Service and the Deputy Secretary, Commonwealth Department of Climate Change, Energy, the Environment and Water.

Species overview and key threatening processes

The Booroolong frog is listed as **endangered** under the NSW *Biodiversity Conservation Act 2016* and **endangered** under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Table 1 provides a species summary for the Booroolong frog, including a description of the species, its habitat, its preferred food sources and its distribution within Kosciuszko National Park and nearby nature reserves.

Table 1 Species summary – Booroolong frog

Category	Summary
Description	The Booroolong frog is a medium-sized tree frog, with adults growing to about 5 cm. Their body colour may be grey, olive or brown with indistinct black markings. The abdomen is white. The skin usually has a slightly warty appearance. The fingers and toes have well-developed discs, and the toes are strongly webbed. The call is a soft, purring 'craww craww craww'.
Habitat	The Booroolong frog is associated with permanent streams and rivers in a variety of vegetation types. Primary habitat requirements are extensive rock bank structures with the key feature being rock crevices in relatively shallow, slow to medium-flowing sections of streams and rivers.
Diet	Beetles, flies, spiders and moth larvae are key food sources for the Booroolong frog.
Distribution and population	Suitable habitat for this species was identified along the Yarrangobilly River and Wallace's Creek within Kosciuszko National Park in the Snowy 2.0 project area during the habitat assessment. The presence of Booroolong frog was recorded within the Snowy 2.0 environmental impact statement survey areas for Exploratory Works, Main Works and Transmission Connection. Suitable habitat has also been identified by the NSW Department of Climate Change, Energy, the Environment and Water within National Parks and Wildlife Service nature reserves including Maragle Creek in Clarkes Hill Nature Reserve, Mannus Creek in Bogandyera Nature Reserve, Yaven Yaven Creek in Ellerslie Nature Reserve, and Macphersons Swamp Creek in Black Andrew Nature Reserve.

Source: Saving Our Species and personal communication NSW Department of Climate Change, Energy, the Environment and Water, Biodiversity Conservation Division

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Table 2 provides a list of key threatening processes to Booroolong frogs within Kosciuszko National Park and nearby nature reserves that will be addressed via cost-effective management actions (see Table 3). Actions will also consider relevant Australian Government Threat Abatement Plans to reduce the impacts from key threatening processes on native species.

Table 2 Key threatening processes to Booroolong frog in Kosciuszko National Park and nearby nature reserves

Threat	Description
Anthropogenic climate change	Stream drying caused by severe drought
Pathogens, diseases and microorganisms	Disease such as chytrid fungus
Habitat destruction	Loss of native streamside vegetation Damage to stream margins by feral animals including horses, pigs and deer Stream drying caused by severe drought or water extraction/impoundment Damage and erosion to stream margins
Feral herbivores	Large amounts of sedimentation due to wild horse, pigs and deer activity in the national park, causing filling of breeding crevices
Feral predators	Predation of eggs and tadpoles by introduced fish
Weeds	Weed invasion of streamside habitats, particularly by willows and blackberries

Source: Saving Our Species and personal communication NSW Department of Climate Change, Energy, the Environment and Water, Biodiversity Conservation Division

Kosciuszko offset strategy: metrics-based approach

The Kosciuszko Offset Strategy requires expenditure of Snowy 2.0 offset funds to deliver biodiversity gains for Kosciuszko National Park equivalent to 120% of the loss for threatened species, threatened ecological communities, and ecosystems impacted by the Snowy 2.0 project. The benchmark of 120% has been set because this is considered to be achievable over the life of this action plan and it can be demonstrated as a biodiversity gain.

In setting an objective to exceed the statutory requirements, the strategy recognised the difficulties in measuring biodiversity gains and the inherent fluctuations in biodiversity over time. This benchmark provides a margin that will increase confidence that the minimum statutory requirements are being met. The strategy takes a metrics-based approach that will be applied to the delivery of biodiversity offsets by the NSW National Parks and Wildlife Service (NPWS). This will be achieved by following a 3-step process:

- Step 1: quantifying the impacts and benefits that must be delivered
- Step 2: implementing actions to deliver the offset required
- Step 3: measuring and reporting on the biodiversity benefit.

Step 1: quantifying the impacts on Booroolong frogs and benefits that must be delivered

It is estimated that 356 Booroolong frogs will be impacted by Snowy 2.0 Exploratory Works, Main Works and Transmission Connection. The benefit that must be delivered is the successful and sustainable establishment of an additional 428 Booroolong frogs in Kosciuszko National Park and nearby nature reserves (being 120% of the impact). This calculation is based on impacts to 8.9 hectares of Booroolong frog habitat from Snowy 2.0, with an estimated population density of 40 individuals per hectare.

Step 1 limitations, assumptions and notes

- The methodology outlined in the dot-points below is based on expert departmental species knowledge.
- Previous attempts to estimate actual abundance of Booroolong frogs using mark-recapture methods have demonstrated major limitations for the study of this species. Measures of relative abundance are a reliable indicator of Booroolong frog numbers.
- For this action plan, the estimate of 40 Booroolong frogs per hectare has been derived from spotlight surveys conducted between 2015 to 2019 along 8 stream transects where this species occurs in Kosciuszko National Park and nearby reserves. For each of the 8 transects:
 - a 1:1 sex ratio and 50 metre occupied zone either side of the stream was assumed
 - to estimate population density (the number of individuals per hectare), the recorded relative abundance of breeding male Booroolong frogs was multiplied by 4 to account for detectability

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- the estimated total adult population size was divided by the number of hectares within 50 metres of the stream to provide an estimate of the number of frogs per hectare for that site.
- The average of the estimated frogs per hectare for the 8 local breeding populations was then used as the population density or 'number of Booroolong frogs per hectare' for this action plan.
- This action plan recommends continuing with spotlight surveys and relative abundance to estimate population density as alternative methods such as capture-recapture are not feasible, accurate or necessary (see Step 2).
- Upon actions 1 to 3 (see Table 3 below), and as further studies and information on Booroolong frog populations and densities in Kosciuszko National Park and nearby nature reserves become available over the life of this action plan, the benefit that must be delivered will be refined and adjusted accordingly.

Step 2: implementing the management actions for Booroolong frogs to deliver the required offset

Delivering an offset of at least 428 additional Booroolong frogs in Kosciuszko National Park and nearby nature reserves will involve the following management interventions:

- identifying an area (or areas) of suitable habitat for delivery of the offset (see actions 1 and 2 in Table 3)
- measuring the current density (or other suitable metric such as occupancy) of Booroolong frogs at that location and identifying the target density and thus the required area across which the offset actions are to be delivered (see action 3 in Table 3)
- increasing the density (or other suitable metric) of Booroolong frogs at that location through a targeted series of offset actions such as intensive weed and feral herbivore control above and beyond core management (see actions 5, 6 and 7 in Table 3).
- continue funding contributions for chytrid fungus research, an amphibian disease of international concern, subject to successful progress/outcomes from the research. In 2022, the University of Melbourne commenced a project to increase amphibian survival of chytrid fungus, by identifying resistant genes and increasing their frequency in the population. The project is funded, in part, through an Australian Research Council Linkage Projects grant, with international research partners. If this research is successful, management actions such as genetic screening and/or genetic manipulation can be implemented for the Booroolong frog. This would be expected to result in the recovery and increase of Booroolong frog populations across all of Kosciuszko National Park and nearby nature reserves by many orders of magnitude, above and beyond the required offset delivery (see action 4 in Table 3).

While the focus of the Kosciuszko Offset Strategy is to deliver biodiversity gains for species, threatened ecological communities and ecosystems impacted by Snowy 2.0 in Kosciuszko National Park (Kosciuszko Offset Strategy, page 1), the Snowy 2.0 Main Works and Transmission Connection planning approvals allow for conservation actions to occur outside of Kosciuszko National Park to ultimately benefit the species. For example, Snowy 2.0 Main Works approval Schedule 3, condition 12 Biodiversity Offset Payments states that 'in the limited circumstances where it is not possible to address all of the residual biodiversity impacts of the development within the Kosciuszko National Park, the National Parks and Wildlife Service may use some of these funds to ensure suitable conservation actions are carried out outside the park'.

Offsetting the impacts of Snowy 2.0 on the Booroolong frog is best undertaken where targeted management improves the overall population viability of this species. While options

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for achieving this within Kosciuszko National Park will be maximised under this action plan, there is considerable benefit for the Booroolong frog if actions also focus on streams flowing through nearby nature reserves such as the Black Andrew Nature Reserve, Ellerslie Nature Reserve, and the Bogandyera Nature Reserve, all part of the NSW national park estate.

Since the noticeable decline of Booroolong frogs starting in the late 1980s, there have been considerable target (spotlight) surveys for this species across all known Kosciuszko National Park Booroolong frog sites and on some surrounding National Parks and Wildlife Service managed reserves. Surveys suggest there is considerable scope to protect and enhance habitat in identified areas (Figure 1) to support population growth. Additional surveys are required to confirm assumed population densities (actions 1 and 2).

To provide this action plan with reliable and measurable density estimates for both the initial impact and potential offset areas, the methodology must be applicable across multiple sites in a season and provide consistent and meaningful results that reflect the health of local breeding populations, and actual changes in abundance over time (that is, sources of variation relate to actual variation in abundance rather than sampling error).

Like many frog species, male Booroolong frogs congregate along sections of streams and call for potential mates during the spring and early summer breeding season. Undertaking spotlight surveys during the core breeding period provides an opportunity to assess population size efficiently and reliably.

Capture-recapture techniques to estimate actual Booroolong frog abundance require a minimum of 20 hours per site over 4 separate occasions (5 hours per night). This is not necessary to adequately inform actions under this action plan. Previous studies from the 1980s and spotlight surveys conducted in Kosciuszko National Park between 2015 and 2019, demonstrated that estimates of relative abundance are consistent and adequately reflect actual abundance. Hand capturing large numbers of Booroolong frogs also has ethical implications.

Using biometrical support (action 2, Table 3) to calibrate observer bias, relative abundance is the most appropriate scientific methodology to estimate population density and monitor the Booroolong frog response to management actions going forward. Monitoring via spotlight surveys to calculate relative abundance can be adequately undertaken by field ecologists and staff of differing experience, and with limited licensing complications. Calculating relative abundance by estimating the number of calling males (spotlight surveys) has been used to successfully monitor Booroolong frogs over the past 25 years.

The proposed survey areas in Figure 1 include burnt and unburnt sites, and some sites are now also identified under the Assets of Intergenerational Significance (AIS) program. Actions under this action plan may, where appropriate, occur within AIS sites where offset funds are used to benefit the species, and actions go above and beyond those identified under the AIS program.

Table 3 lists the actions needed to deliver the required biodiversity gains. They include identifying suitable habitat areas, measuring the current species density in those areas, and addressing the identified key threatening processes (Table 2).

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Table 3 Management actions for Booroolong frog to deliver the required offset in Kosciuszko National Park and nearby nature reserves

Action number	Action	Threat addressed	Location	When	Who	Total cost (preliminary estimates)	Comment
1	Complete Booroolong frog spotlight surveys for rivers and streams in identified areas in Figure 1 (shaded blue in the park and yellow in nature reserves)	–	Areas shaded in blue (in the park) and yellow (nature reserves) (Figure 1), plus any additional sites determined by NPWS	2023 to 2027	NPWS	\$100,000	Underway. Identify presence and calculate relative abundance of Booroolong frog. Spotlight surveys require 8 persons per survey event. 2023–24 was the first survey season under the action plan. Implement in collaboration with Saving our Species investment. Part of generating baseline information. Works proposed to be partially undertaken by external sources.
2	Quantify and calibrate the margin of error between observers to provide an index of relative abundance (population density)	–	Areas shaded in blue (in the park) and yellow (nature reserves) (Figure 1), plus any additional sites determined by NPWS	2023 to 2027	Biometrician engaged to calibrate observational margin of error	\$50,000	Underway. Required to calculate certainty around the index of relative abundance and provide current population density figures which are robust and reliable. Staged assessment based on the results of action 1.
3	Undertake a desktop assessment/calculation to determine the required area across which the offset actions are to be delivered	–	Select sites from those identified in Figure 1 plus any other sites identified by NPWS	2026 to 2027	NPWS	\$0	Staged assessment based on the results of actions 1 and 2.
4	Continue funding contributions for chytrid fungus research to identify resistant genes, and ultimately	Pathogens, diseases and microorganisms	All populations	2021 to 2041	NPWS	\$0	Note that this research is funded by contributions from the alpine tree frog action plan (up to \$1 million

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	increase their frequency in the population						over a minimum of 20 years) but will benefit all offset frog species.
5	Additional feral deer, horses and pig control in areas identified in action 3 (designated Booroolong frog offset areas)	Feral herbivores	Designated Booroolong frog offset areas	2025 to 2045	Integrated into existing feral herbivore control programs	Up to \$2 million over a minimum of 20 years	Additional to core feral herbivore management. Horse removal will be consistent with the Kosciuszko National Park Wild Horse Heritage Management Plan.
6	Additional blackberry and willow (and other weeds as appropriate) control in areas identified in action 3 (designated Booroolong frog offset areas)	Weeds	Designated Booroolong frog offset areas	2025 to 2045	Integrate into existing weed control programs	Up to \$3 million over a minimum of 20 years	Additional to core weed management. The area (ha) of land controlled will be recorded.
7	Additional monitoring of feral animal numbers	Feral herbivores	Designated Booroolong frog offset areas	2025 to 2045	Integrate into existing feral animal monitoring	Up to \$600,000 over a minimum of 20 years	As required, implement monitoring to measure and track feral animal densities in the designated Booroolong frog offset areas consistent with NPWS protocols.
					Total cost	\$5.75 million	

Step 2 limitations, assumptions and notes

1. Captive breeding programs and translocation of Booroolong frogs into areas of Kosciuszko National Park and nearby National Parks and Wildlife Service nature reserves will be considered if the measures identified in Table 3 do not deliver increases in Booroolong frog density.
2. Threat control strategies and actions will continue to evolve throughout the life of this action plan. This plan will be updated as new information, knowledge and management techniques become available.
3. Costs identified above will be revised as required, taking into account the relative cost effectiveness of different measures.
4. The success of using an index of relative abundance as an approximation for density will continue to be evaluated through the project.
5. It is expected that designated offset areas for different species will overlap, with resulting management actions being carried out across multiple areas at once. This will maximise biodiversity gains and create cost savings, potentially enabling additional management actions to be undertaken.
6. Actions under this plan will not apply to sites directly impacted by Snowy 2.0 construction activities. Snowy Hydro Limited is required under planning approvals to undertake habitat rehabilitation at these sites. Reintroducing Booroolong frogs into Snowy 2.0 project sites is outside the scope and timeframe of this project and action plan.

Step 3: measuring and reporting on the biodiversity benefit to Booroolong frogs

The Kosciuszko Offset Strategy states that each action plan must describe how the required biodiversity benefit (offset) will be measured. This involves setting out the attributes to be measured and the methodology, timing and other details relevant to monitoring. A hierarchical approach is being taken to measuring the biodiversity benefit.

1. The population density of a species is the desirable measurement attribute.
2. If this is not feasible due to challenges such as difficulty in capturing and detecting populations due to low numbers or species known to be trap shy, then other metrics (such as occupancy) combined with modelling will be considered instead.
3. If the attribute and monitoring design in 1 or 2 above is not working, then the attribute being measured will be revisited with another metric considered.

Any changes to metrics over time will be updated in the action plan and reported on as part of the adaptive management approach under the Kosciuszko Offset Strategy.

Table 4 Measuring biodiversity benefits to Booroolong frogs

Attribute to be measured	Metric	Location	Methodology	Monitoring design	Timing	Cost	Frequency of measurement
Population	Index of relative abundance (used to generate density estimates)	Designated Booroolong frog offset areas	Spotlight surveys (8 persons per survey effort)	Detailed monitoring design to be determined during implementation of actions 1 to 3, and to be integrated with ecological health surveys if required	During breeding season annually (late spring to early summer: November to December)	Up to \$1,000,000 over a minimum of 20 years for ongoing population monitoring to identify the extent of the offset delivered	To be determined as part of the detailed monitoring design

Step 3 limitations, assumptions and notes

- As outlined in Step 2 above, it is difficult to estimate actual abundance (density) for Booroolong frogs due to limitations with mark-recapture methods. An index of relative abundance should be sufficient to be used as a surrogate measure for density and for estimating biodiversity gain or loss.
- Monitoring the Booroolong frog will focus on tracking temporal trends in occupancy and relative abundance of breeding populations.

Governance

Reporting

As required under Snowy 2.0 approvals, NPWS must monitor, evaluate and publicly report on progress of the implementation program and the effectiveness of the specific projects and actions. They will prepare an annual report on the Snowy 2.0 biodiversity offset program for Kosciuszko National Park and its implementation, including progress with achieving the required increase in the population of the Booroolong frog. The report will be provided to the Commonwealth Department of Climate Change, Energy, the Environment and Water, and published on the environment.nsw.gov.au website within 3 months of the end of each financial year.

The annual report will:

- detail the expenditure from the biodiversity offset fund on agreed actions under the Kosciuszko offset action plans
- outline any interest earned and reinvested into the offset program
- provide details about the conservation actions carried out for each approved threatened species, threatened ecological community and threatened ecosystem action plan such as:
 - the type of conservation action implemented - for example, feral animal control, habitat restoration
 - the geographic extent and location of the conservation actions
 - the proportion of the proposed conservation actions achieved, and proportion yet to be achieved
 - an analysis and summary of monitoring data
 - future conservation actions, with key timeframes including intended completion
- include details on progress towards each action plan objective
- document where adaptive management principles have been applied to each action plan to improve their effectiveness.

Adaptive management

Quantifying and measuring the biodiversity benefit for Booroolong frogs may present significant technical challenges. Together with the influence of natural variability, it is anticipated there will be a level of uncertainty to both measuring and interpreting biodiversity benefits relevant to the species. This uncertainty will be addressed by applying an adaptive approach, including reviewing and updating density numbers, monitoring, methodologies and strategies as new information, data or technology becomes available. At a minimum, action plans will be reviewed every 5 years.

Approvals

Date/approval	
Date prepared	May 2025
Date approved - NPWS	22 June 2025
Approved by	Naomi Stephens, Acting Deputy Secretary National Parks and Wildlife Service
Date approved – DCCEEW	10 September 2025
Approved by	Kate Gowland, Branch Head, Commonwealth Department of Climate Change, Energy, the Environment and Water
Date for review	September 2030

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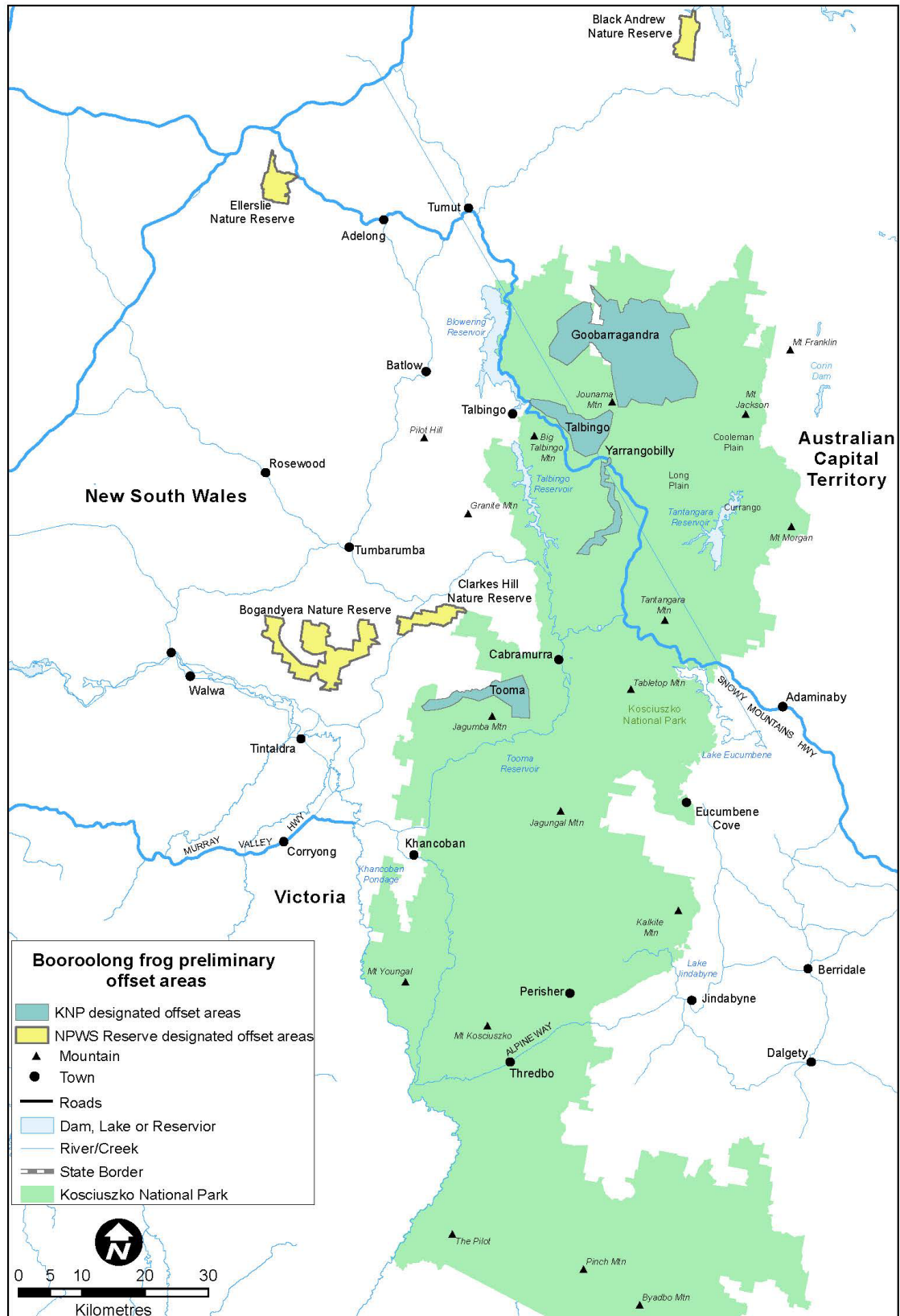


Figure 1 Preliminary Booroolong frog offset areas – Kosciuszko National Park and nearby nature reserves

More information

- [Approved threat abatement plans](#)
- [Assets of Intergenerational Significance](#)