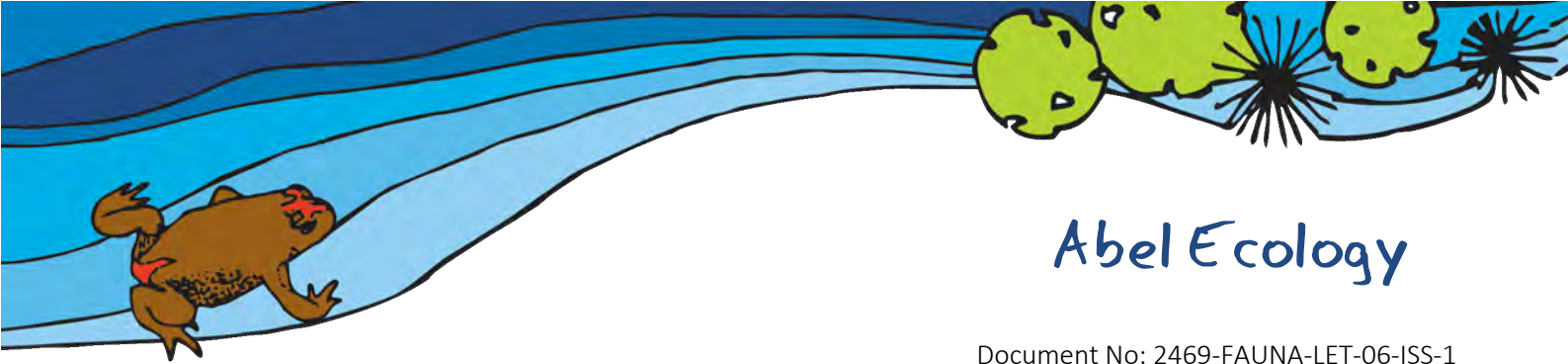




Abel Ecology

Document No: 2469-FAUNA-LET-06-ISS-1

24 July 2024

Chris Buscall
Snowy Hydro Ltd
PO Box 332
Cooma, NSW 2630

Attention: Chris Buscall

Dear Chris,

RE: Review of Lobs Hole Road fauna underpass remote camera monitoring for the period of 11 September 2023 to 16 March 2024.

This letter presents the results of a review of remote camera photos of fauna detected using purpose-built road underpasses along Lobs Hole Ravine Road, Cabramurra NSW. Fauna underpasses along Lobs Hole Ravine Road were installed in response to potential direct impact on threatened small mammal populations through actions of vehicle strike in relation to Snowy Hydro 2.0 construction works, utilisation of the road. Monitoring of the fauna underpasses is guided by procedures outlined by Snowy 2.0 Main Works – Biodiversity Management Plan (BMP) (Revision I, dated 12 Oct 2020), Table 5-1 - BM02, BM03, BM04 and BM22, Appendix B and Appendix G.

There are six (6) fauna underpasses along Lobs Hole Ravine Road, each with two (2) remote Reconyx cameras, one at each entrance to the underpass. This is a total of twelve (12) cameras. There is one (1) monitoring period presented here and this period is based on when the camera SD cards were retrieved and downloaded by Snowy Hydro Limited (SHL) staff.

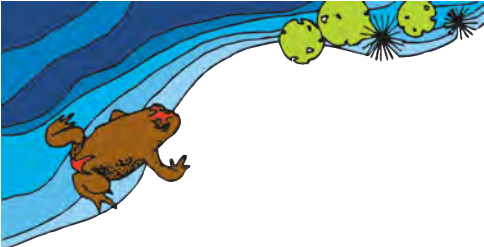
Monitoring period:

- 11 September 2023 to 16 March 2024.

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1.1 BioNet Atlas of NSW Wildlife website search

Because direct trapping of fauna is not scheduled to occur to identify animals in the hand through accurate morphometric measurement, and also because views of lateral and ventral angles of animals is limited, records from the BioNet Atlas of NSW Wildlife website were accessed using the following search criteria to cross-reference local species records and locations:

Licensed Report of all Valid Records of Exotic listed or Native listed fauna for a 20 x 22 km square centred on the site (selected area [North: -35.74°, West: 148.32°, East: 148.54°, South: -35.94°]). Records since 1 January 1990 until 17 July 2024 returned a total of 6,642 individual records from 250 fauna species. Of these records, species unlikely to use the fauna underpasses or not of interest were eliminated from the results. The cleaned results are presented in Table 1 and Table 2.

Data from the BioNet Atlas website holds records from a number of custodians. The data are indicative only and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°). Copyright the State of NSW through the Office of Environment and Heritage.

The species in Table 1 and Table 2 have been considered in analysis of underpass photos.

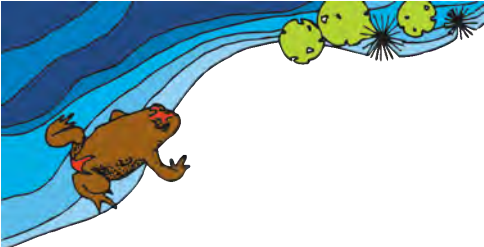


Table 1. BioNet records search results of relevant small mammals likely to use fauna underpasses in the locality.

<i>Scientific Name</i>	Common Name	Bionet records for locality since 1 Jan 1990	NSW status	CommWlth. status
<i>Pseudomys fumeus</i>	Smoky Mouse	35	E4A, P	E
<i>Mastacomys fuscus</i>	Broad-toothed Rat	111	E1, P	E
<i>Cercartetus nanus</i>	Eastern Pygmy-Possum	61	V, P	-
<i>Rattus fuscipes</i>	Bush Rat	157	P	-
<i>Antechinus mimetes</i>	Mainland Dusky Antechinus	29	P	-
<i>Antechinus agilis</i>	Agile Antechinus	198	P	-
<i>Antechinus stuartii</i>	Brown Antechinus	1	P	-
<i>Perameles nasuta</i>	Long-nosed Bandicoot	6	P	-
<i>Mus musculus</i> *	House Mouse	45	I	I
<i>Rattus rattus</i> *	Black Rat	11	I	I
<i>Oryctolagus cuniculus</i> *	Rabbit	428	I	I
<i>Vulpes vulpes</i> *	Red Fox	134	I	I
<i>Felis catus</i> *	Feral Cat	49	I	I

Key

P = Protected
 V = Vulnerable
 E = Endangered
 E1 = Endangered Species
 E4A = Critically Endangered
 CE = Critically Endangered
 I = Introduced*

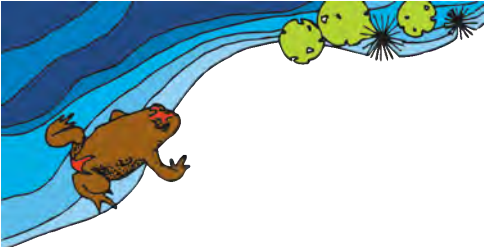
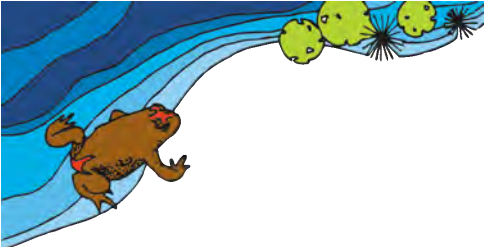


Table 2. BioNet records search results of relevant amphibian and reptile species likely to use fauna underpasses in the locality.

<i>Scientific Name</i>	Common Name	Bionet records for locality since 1 Jan 1990	NSW status	CommWlth. status
<i>Crinia signifera</i>	Common Eastern Froglet	44	P	
<i>Pseudophryne bibronii</i>	Bibron's Toadlet	5	P	
<i>Limnodynastes dumerilii</i>	Eastern Banjo Frog	16	P	
<i>Litoria booroolongensis</i>	Booroolong Frog	60	E1,P	E
<i>Litoria verreauxii</i>	Verreaux's Frog	8	P	
<i>Litoria verreauxii alpina</i>	Alpine Tree Frog	34	E1,P	V
<i>Acritoscincus duperreyi</i>	Eastern Three-lined Skink	17	P	
<i>Anepischetosia maccoyi</i>	Highlands Forest-skink	5	P	
<i>Ctenotus robustus</i>	Robust Ctenotus	10	P	
<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	3	P	
<i>Cyclodomorphus praealtus</i>	Alpine She-oak Skink	38	E1,P,2	E
<i>Egernia cunninghami</i>	Cunningham's Skink	1	P	
<i>Egernia saxatilis</i>	Black Rock Skink	6	P	
<i>Eulamprus heatwolei</i>	Yellow-bellied Water-skink	2	P	
<i>Eulamprus kosciuskoi</i>	Alpine Water Skink	9	P	
<i>Eulamprus sp.</i>	Unidentified Eulamprus	1	P	
<i>Eulamprus tympanum</i>	Southern Water-skink	12	P	
<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	4	P	
<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink	15	P	



<i>Scientific Name</i>	Common Name	Bionet records for locality since 1 Jan 1990	NSW status	CommWlth. status
<i>Pseudemoia entrecasteauxii</i>	Tussock Cool-skink	21	P	
<i>Pseudemoia pagenstecheri</i>	Tussock Skink	137	P	
<i>Pseudemoia spenceri</i>	Trunk-climbing Cool-skink	2	P	
<i>Tiliqua nigrolutea</i>	Blotched Blue-tongue	10	P	
<i>Amphibolurus muricatus</i>	Jacky Lizard	5	P	
<i>Intellagama lesueurii</i>	Eastern Water Dragon	5	P	
<i>Austrelaps ramsayi</i>	Highland Copperhead	12	P	
<i>Austrelaps superbus</i>	Lowland Copperhead	1	P	
<i>Drysdalia coronoides</i>	White-lipped Snake	18	P	
<i>Notechis scutatus</i>	Tiger Snake	2	P	
<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	1	P	
<i>Pseudonaja textilis</i>	Eastern Brown Snake	2	P	

Key

P = Protected

V = Vulnerable

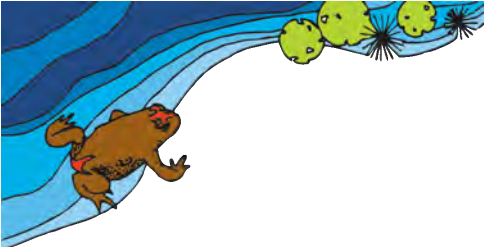
E = Endangered

E1 = Endangered Species

E4A = Critically Endangered

CE = Critically Endangered

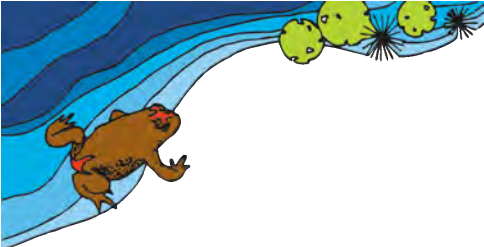
I = Introduced*



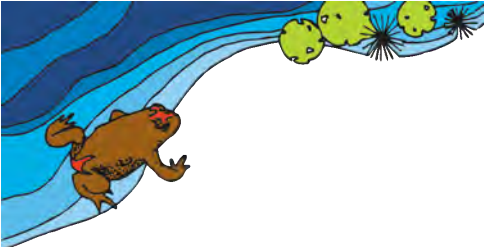
The presence / absence results of the 11 September 2023 to 16 March 2024 monitoring period are illustrated below in Table 3.

Table 3. Results from reporting period 11 September 2023 to 16 March 2024.

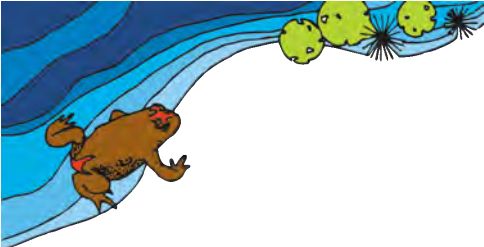
Underpass Location	Species detected	East	West
1	Smoky Mouse	No data	-
	Broad-toothed Rat	No data	-
	Bush Rat	No data	•
	Agile Antechinus	No data	•
	House Mouse	No data	•
	<i>Austrelaps ramsayi</i> Highlands Copperhead	No data	•
	<i>Notechis scutatus</i> Tiger Snake	No data	•
	<i>Eulamprus tympanum</i> Southern Water-skink	No data	•
	<i>Lampropholis delicata</i> Garden Skink	No data	•
	<i>Lampropholis guichenoti</i> Grass Skink	No data	•
	<i>Acritoscincus duperreyi</i> Eastern Three-lined Skink	No data	•
	<i>Acritoscincus platynotum</i> Red-throated Skink	No data	•
	White-browed Scrubwren <i>Sericornis frontalis</i>	No data	•



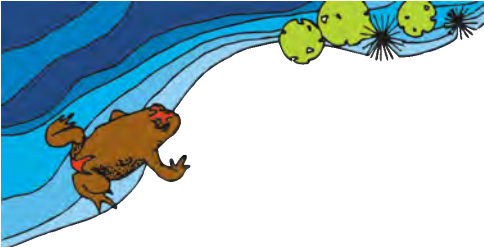
Underpass Location	Species detected	East	West
2	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Eastern-Pygmy Possum <i>Cercartetus nanus</i>	•	•
	Agile Antechinus	•	•
	Bush Rat	•	•
	House Mouse	•	•
	<i>Lampropholis delicata</i> Garden Skink	•	•
	<i>Lampropholis guichenoti</i> Grass Skink	•	•
	<i>Acritoscincus platynotum</i> Red-throated Skink	-	•
	<i>Acritoscincus duperreyi</i> Eastern Three-lined Skink	-	•
	<i>Eulamprus tympanum</i> Southern Water-skink	•	•
	<i>Tiliqua nigrolutea</i> Blotched Blue-tongue	•	•
	<i>Austrelaps ramsayi</i> Highlands Copperhead	•	•
	<i>Austrelaps superbus</i> Lowland Copperhead	•	-
	<i>Notechis scutatus</i> Tiger Snake	•	•
	<i>Pseudonaja textilis</i> Eastern Brown Snake	•	•
	White-browed Scrubwren <i>Sericornis frontalis</i>	•	•



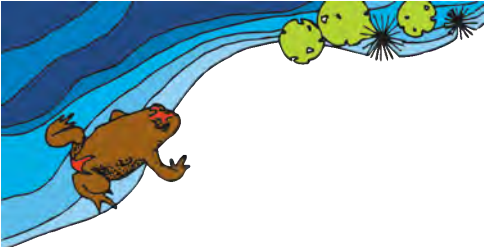
Underpass Location	Species detected	East	West
3	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Eastern-Pygmy Possum <i>Cercartetus nanus</i>	•	•
	Agile Antechinus	•	•
	Bush Rat	•	•
	House Mouse	•	•
	<i>Lampropholis delicata</i> Garden Skink	•	•
	<i>Lampropholis guichenoti</i> Grass Skink	•	•
	<i>Acritoscincus platynotum</i> Red-throated Skink	-	•
	<i>Acritoscincus duperreyi</i> Eastern Three-lined Skink	-	•
	<i>Egernia saxatilis</i> Black Rock Skink	-	•
	<i>Egernia whitii</i> White's Skink	-	•
	<i>Amphibolurus muricatus</i> Jacky Lizard	-	•
	<i>Austrelaps ramsayi</i> Highlands Copperhead	•	•
	<i>Austrelaps superbus</i> Lowland Copperhead	•	-
	White-browed Scrubwren <i>Sericornis frontalis</i>	•	•



Underpass Location	Species detected	East	West
4	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Eastern-Pygmy Possum <i>Cercartetus nanus</i>	•	•
	Bush Rat	•	•
	Agile Antechinus	•	•
	House Mouse	•	•
	<i>Lampropholis guichenoti</i> Grass Skink	•	•
	<i>Lampropholis delicata</i> Garden Skink	-	•
	<i>Egernia whitii</i> White's Skink	-	•
	<i>Egernia saxatilis</i> Black Rock Skink	-	•
	<i>Acritoscincus duperreyi</i> Eastern Three-lined Skink	-	•
	<i>Crinia signifera</i> Common Eastern Froglet	-	•
	<i>Acritoscincus platynotum</i> Red-throated Skink	•	•
	<i>Austrelaps ramsayi</i> Highlands Copperhead	•	•
	<i>Austrelaps superbis</i> Lowland Copperhead	-	•
	<i>Notechis scutatus</i> Tiger Snake	•	•
	White-browed Scrubwren <i>Sericornis frontalis</i>	•	•
	White-throated Treecreeper <i>Cormobates leucophaea</i>	-	•



Underpass Location	Species detected	East	West
5	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Eastern-Pygmy Possum <i>Cercartetus nanus</i>	•	•
	Bush Rat	•	•
	Agile Antechinus	•	•
	House Mouse	•	•
	<i>Lampropholis guichenoti</i> Grass Skink	•	•
	<i>Acritoscincus platynotum</i> Red-throated Skink	-	•
	<i>Acritoscincus duperreyi</i> Eastern Three-lined Skink	•	•
	<i>Eulamprus tympanum</i> Southern Water-skink	•	•
	<i>Egernia saxatilis</i> Black Rock Skink	•	•
	<i>Austrelaps ramsayi</i> Highlands Copperhead	-	•
	White-browed Scrubwren <i>Sericornis frontalis</i>	-	•



Underpass Location	Species detected	East	West
6	Smoky Mouse	-	-
	Broad-toothed Rat	-	-
	Bush Rat	•	•
	Agile Antechinus	•	•
	House Mouse	-	•
	<i>Lampropholis delicata</i> Garden Skink	-	•
	<i>Lampropholis guichenoti</i> Grass Skink	-	•
	<i>Acritoscincus platynotum</i> Red-throated Skink	-	•
	<i>Acritoscincus duperreyi</i> Eastern Three-lined Skink	•	•
	<i>Eulamprus tympanum</i> Southern Water-skink	-	•
	<i>Egernia saxatilis</i> Black Rock Skink	•	•
	<i>Austrelaps superbis</i> Lowland Copperhead	•	•
	<i>Austrelaps ramsayi</i> Highlands Copperhead	•	•
	White-browed Scrubwren <i>Sericornis frontalis</i>	•	•



2 Discussion

With a reasonable level of confidence, no presences of Smoky Mouse or Broad-toothed Rat were recorded using the underpasses during the 11 September 2023 to 16 March 2024 reporting period. Species recorded that are similar in size and shape were Agile Antechinus, House Mouse and Bush Rat. All mouse sized individuals recorded were brown to light-brown in colour (Figure 21 and Figure 22), no image recorded provided the diagnostic features to confirm the present of Smoky Mouse. Similarly, the Bush Rats (Figure 6, Figure 7 and Figure 8) caught on camera were quite dark brown as opposed to descriptions of lighter coloured individuals from reference text. All views of rat feet were pink or white in colour, and no views of dark coloured rat feet were captured to indicate a different *Mastacomys* / *Rattus* species. Juvenile Bush Rats have been detected (Figure 8), and these individuals are similar in size and colourisation to Broad-toothed Rat. The body size difference between the smallest and largest rat recorded is significant, however not diagnostic. No image recorded provided the diagnostic features to confirm the present of Broad-toothed Rat. This conclusion also reflects the spatial distribution of public species records for Broad-toothed Rat and Bush Rat within the Snowy Hydro 2.0 project area.

Broad-toothed Rat and its preferred habitat has not previously been recorded along Lobs Holes Ravine Road (EMM 2020; BMP 2020). Reference text supports the argument for sharp habitat and distribution boundaries between the Bush Rat and Broad-toothed Rat indicating there could be very little distribution overlap between the two species. The main driver for this observation is argued by reference text to be distinct habitat features favoured by Broad-toothed Rat being absent from the immediate surroundings of Lobs Holes Ravine Road. Testing this hypothesis through live trap survey and habitat mapping would benefit Snowy Hydro's understanding of the Broad-toothed Rat use of the project site.

As could be expected, species richness increased within the underpasses as the average air temperature at the site during the day increased, being the natural transition from Spring into Summer. This was particularly noticeable in reptile species. The level of fauna activity, from species that previously used the underpasses regularly (e.g. Bush Rat and Agile Antechinus) was again similar to other reporting periods. Eastern Pygmy-Possum (Figure 1 and Figure 2) was detected regularly (25 separate occasions) during this reporting period from underpasses #2 - #5, with 13/25 recordings coming from underpasses #4. The most frequently detected species using the underpasses during the reporting period was Agile Antechinus (Figure 3, Figure 4 and Figure 5) and there was a noticeable detection (frequency) drop in Bush Rats (Figure 6 and Figure 7).



This reporting period resulted in the detection of twenty (20) species:

- Eastern Pygmy-Possum (Figure 1 and Figure 2),
- Agile Antechinus (Figure 3, Figure 4 and Figure 5),
- Bush Rat (Figure 6, Figure 7 and Figure 8),
- House Mouse *Mus musculus* (Figure 21 and Figure 22)
- *Lampropholis delicata* Garden Skink,
- *Lampropholis guichenoti* Grass Skink ,
- *Tiliqua nigrolutea* Blotched Blue-tongue (Figure 9),
- *Egernia whitii* White's Skink (Figure 10),
- *Egernia saxatilis* Black Rock Skink (Figure 11),
- *Eulamprus tympanum* Southern Water-skink (Figure 12),
- *Acritoscincus platynotum* Red-throated Skink,
- *Acritoscincus duperreyi* Eastern Three-lined Skink (Figure 13),
- *Amphibolurus muricatus* Jacky Lizard (Figure 14),
- *Austrelaps ramsayi* Highlands Copperhead (Figure 15 and Figure 16),
- *Austrelaps superbus* Lowland Copperhead (Figure 17),
- *Notechis scutatus* Tiger Snake (Figure 18 and Figure 19).
- *Pseudonaja textilis* Eastern Brown Snake (Figure 20),
- *Crinia signifera* Common Eastern Froglet,
- White-browed Scrubwren (*Sericornis frontalis*) (Figure 23) and;
- White-throated Treecreeper (*Cormobates leucophaea*) (Figure 24).

Use of the underpasses by these species is a positive outcome and is an event that SHL should strive to maintain and improve. Records of reptile species make a significant contribution to the species richness of the species list. *Lampropholis guichenoti*, *Lampropholis delicata* are the most frequently recorded skink species. Highlands Copperhead is the most frequently recorded snake species.

Incidental records of White-browed Scrubwren and White-throated Treecreeper within the underpass entrances are unexpected, however sightings of small bird species are becoming regular. Small birds are not expected to forage or to go beyond the entrance to pass through the underpass. *Acritoscincus platynotum* Red-throated Skink and *Egernia whitii* White's Skink were recorded for the first time during reporting period. All other reptile species have been recorded previously as users of the underpasses during the warmer months; the skinks and snakes are using the underpass as habitat. The *Lampropholis* skinks and Copperheads appear to be among the most cool-climate-tolerant of the reptile species recorded to-date, the Grass Skink has previously been detected at ambient air temperature of 11°C and the Highlands Copperhead has previously been detected at ambient air temperature of 9°C. Both reptiles would use the underpass as shelter and the snake species would also use the underpass for hunting the skinks. Snakes preying on mice could not be ruled out.



Rabbits (Figure 23) were not recorded from any underpass during the monitoring period reported on here. Rabbit was previously recorded at underpass #4 and #6. The fauna underpasses would offer temporary shelter to rabbits.

We are pleased to report no feral predators (red fox and cats) were detected 'within' the underpass entrances during the monitoring period reported on here, however House Mouse (exotic now a naturalised species) was detected in all underpasses, however less frequently than previously detected (Figure 21 and Figure 22). It is unclear if introduced predators are able to move freely through the underpasses. The presence of a grill (shadow) was detected previously in photos from Underpass 3 East, Underpass 4 East and Underpass 6 West. The presence of foxes and cats appears to be linked to the presence of House Mouse, as no foxes or cats have been recorded in the underpasses since 21 June 2022, as previously reported. The design of the underpasses was to have obstructive habitat within the underpasses to facilitate threatened fauna movement through the underpasses and to exclude feral predators. This design feature is currently being real-world tested by onsite feral predators. Previously we recommended that a site inspection is made to determine if improvements can be made to deny predator entry into the underpasses past the camera positions. It would appear the addition of a grill on the outside of the fauna underpass entrances has helped to deter feral predators, as the detection frequency of potential prey species has not decreased during the monitoring period reported on here.

Previous detection of a significant amount of water from some of the fauna underpasses (Underpass 1 West, Underpass 4 West, Underpass 5 West, and Underpass 6 West), has now been downgraded as an issue. Good drainage is evident at present, and all underpasses are drying out within three or four days after a significant rain event. The water while present is not likely to be a significant deterrence to Smoky Mouse and Broad-toothed Rat from using the underpasses for any significant length of time. Management of run-off water may be needed in the future at mentioned underpasses, we recommend monitoring of this issue to determine if management action is required. Underpass #6 East is the only underpass with a significant amount of loose gravel inside the entrance that could be removed.

This monitoring period, included in this letter, is the 3rd data set reported on where a measuring tape has been placed in each of the underpass photo frames. The placement of measuring tape within the photo frames of the underpass cameras has been an ongoing recommendation to capture a scale on the fauna being observed within the underpasses. We provide the following comments for improvement.

Ideally, we want the animals measured against the measuring tape as opposed to a measurement against the rock holding the tape. This previous issue (however always current) appears to have been rectified by SHL staff. One benefit we see from a rock obstacle within the photo frame is that it gives the animals opportunity to reach out with their limbs to climb the obstacle, providing more clear views of feet for the observer. However, the obstacle cannot be too tall, as this places the animal outside the focal range of the camera, meaning the photos generated will not be in focus. We continue to recommend providing a small holding rock or moving the existing holding rock, outside the photo frame, or securing / gluing the measuring tape against the surface of the culvert.



Current Issues:

The following cameras failed to produce data:

Underpass 1 East.

The measuring tape has been covered in stormwater silt obscuring the legibility of the tape for:

- Underpass 1 West,
- Underpass 3 East,
- Underpass 3 West,
- Underpass 4 East,
- Underpass 4 West,
- Underpass 5 East (heavy silt), and
- Underpass 6 East.

We believe the measuring tape to be outside the photo frame on these cameras:

- Underpass 5 East, and
- Underpass 6 East.

The placement of rock and measuring tape is acceptable on:

- Underpass 1 East,
- Underpass 1 West,
- Underpass 2 East,
- Underpass 2 West,
- Underpass 3 East,
- Underpass 3 West,
- Underpass 4 West,
- Underpass 5 West, and
- Underpass 6 West.

We acknowledge the placement of a free-standing measurement tape held down by a rock, as a first step towards fulfilling previous recommendations towards gaining a scale of animals. We would be happy to discuss with SHL adaptive measures if the wording of our recommendations cannot be achieved fully in practice. Based on the measuring tapes that are easily observable, the photo frame of each camera is approximately 18 cm long by 27 cm wide (the length and width measurement to be the same corresponding parallel measurements to the underpass, same orientation). It is discernible that the width of the photo frame does not capture the entire width of each underpass, as on many occasions, animals hugging the wall of the underpass, can squeeze past the camera without being (clearly) observed in the photos. The motion sensor of the camera is still sensitive enough to detect the movement of the animals past the camera, but delivering photos that appear to be false triggers, when actually the animals are just out of frame. Creative ‘funnelling’ of animals into the middle of the



underpass, could be achieved through careful placement of high rock obstacles down either sidewall of the underpass, just outside the photo frame of the cameras. This adaptive measure hopes to reduce the level of false triggers. Noting a House Mouse can squeeze through a gap larger than a 20-cent piece; the rock obstacle would have to be tight fitting against the culvert wall.

It is essential that the area of the underpass within the photo frame of the cameras be cleared of debris (e.g., habitat rocks and silt) so the animals and measuring tape are 'in-focus' when the photo/s are taken. The previous removal of habitat rocks within the photo frame of the cameras has meant in this reporting period the cameras generated many in-focus images of fauna. We would maintain our recommendation that >90% of the photo frame of the cameras be cleared of debris. Underpass 5 & 6 have washed-in silt and crushed rock, that we would recommend removing, particularly if rulers and tags are to be installed for reference. It is essential that cover (e.g., habitat rocks) are maintained or increased to strongly inhibit predator movement through the underpasses and provide habitat connectivity for native fauna.

To improve the success of the fauna underpass monitoring program the installation of plastic measuring tape or metal rulers (30cm) is again recommended and maintained within the photo frame of the cameras. This is to ensure we capture a reliable scale of the animals using the underpasses. A marking (paint or tag) to indicate the direction of the underpass entrance within the photo frame of the remote cameras is again recommended. Additionally, a marking (paint or tag) within the photo frame of the cameras to indicate which underpass camera the photo was taken at is also again recommended. These recommendations have been made previously, and from what we can determine have not yet been fully implemented.

A successful movement through a fauna underpass (use of a fauna underpass) will be determined through an animal being detected on both cameras at around the same time period. The success of this performance criteria has not been analysed or reported here. Target species have not been detected during this reporting period.



3 Conclusion

The six (6) fauna underpasses are functioning as a corridor for small mammal and reptile movement. The target species - Smoky Mouse and Broad-toothed Rat have not yet been recorded utilising the underpasses. Eastern-Pygmy Possum *Cercartetus nanus* was recorded on twenty five (25) separate occasions during this reporting period.

Broad-toothed Rat and its preferred habitat has not previously been recorded along Lobs Holes Ravine Road. Reference text supports the argument for sharp habitat and distribution boundaries between the Bush Rat and Broad-toothed Rat indicating there could be very little distribution overlap between the two species. The main driver for this observation is argued by reference text to be distinct habitat features favoured by Broad-toothed Rat being absent from the immediate surroundings of Lobs Holes Ravine Road. Testing this hypothesis through live trap survey and habitat mapping would benefit Snowy Hydro's understanding of the Broad-toothed Rat use of the project site.

Through anecdotal evidence (separate Snowy 2.0 fauna monitoring work), there would appear to be a trend developing that detection of Smoky Mouse across the project site has significantly decreased in recent years. Testing this hypothesis through live trap survey and habitat mapping would benefit Snowy Hydro's understanding of Smoky Mouse use of the project site surrounding Lobs Holes Ravine Road.

The detection of nineteen (19) native species, and one naturalised exotic species using the underpasses is a positive outcome, and this is an event that SHL should strive to maintain and improve.

No items of significant concern were detected during the monitoring period reported here. The presence of feral predators, which appear to be focusing on the underpasses during periods of a high or dispersing House Mouse population have not been detected since 21 June 2022. We do encourage adaptive management to address issues raised in regard to placement of measurement tape and holding rocks.



4 Recommendations

For the continued monitoring of six (6) fauna underpasses along Lobs Hole Ravine Road, Cabramurra NSW, the following recommendations are made in accordance with the Snowy Hydro Limited document Snowy 2.0 Main Works – Biodiversity Management Plan (BMP), Biodiversity Monitoring Program and Fauna Strike Mitigation Strategy:

1. Presence and pressure from feral predators has not been detected at any fauna underpass since 21 June 2022. We continue to recommend a site inspection is made to determine if improvements can be made to deny predator entry into the underpasses past the camera positions. It would appear the addition of a grill on the outside of the fauna underpass entrances has helped to deter feral predators.
2. The installation of plastic measurement tape or metal rulers (30 cm) is again recommended within the photo frame of the remote cameras. This is to ensure we capture a reliable scale of the animals using the underpasses. We recommend two (2) rulers running parallel to the underpass, one on either side of the photo frame. Please note issues raised in the discussion of this report on the execution of this recommendation. Adaptive management is required on most underpass cameras to fulfil the recommendation (see discussion). We recommend providing a small holding rock, or moving the existing rock outside the photo frame, or securing / gluing the tape against the surface of the culvert. The measurement tape on all cameras will require regular cleaning of washed-in silt and dust.
3. A marking (paint stencil or tag) to indicate the direction of the underpass entrance within the photo frame of the remote cameras. Additionally, a marking (paint stencil or tag) within the photo frame of the remote cameras to indicate which underpass camera the photo was taken at. It is unclear if this recommendation has been implemented.
4. Continue small terrestrial mammal presence/absence monitoring as per Table 5-2 of site BMP (2020) in the vicinity of the fauna underpasses.
5. Continue feral animal presence/absence monitoring as per Table 8-1 of site BMP (2020).
6. Implement Smoky Mouse and Broad-toothed Rat pest animal mitigation strategies as per Table 5-3 of site BMP (2020).
7. Creative 'funnelling' of animals into the middle of the underpass at the point where fauna will enter the photo frame of all underpass cameras is required. This could be achieved through careful placement of high rock obstacles down either sidewall of the underpass, outside the photo frame of the cameras. This adaptive measure hopes to reduce the level of false triggers caused by animals 'hugging the walls' of the underpass as they pass the monitoring cameras. The review and processing of excessive false triggers (photos) by staff and contractors, caused by the current lack of a funnel within the fauna underpasses, in association with the monitoring cameras, has been identified as an inefficient use of project funds. Creative 'funnelling' of animals into the middle of the underpass is an adaptive recommendation to improve efficient use of project funds.



8. Fauna Underpass camera settings. Reduce the number of photos taken per trigger event to five (5) photos, per trigger event. This is an adaptive recommendation to improve efficient use of project funds.
9. We recommend in future, a graphical analysis to be reported here for the 'frequency of underpass use', illustrating:
 - a) triggers per camera per reporting period, and
 - b) frequency that each species is detected per reporting period.

This new data being in addition to the presence / absence data already reported in the monitoring of the six (6) fauna underpasses along Lobs Hole Ravine Road.

10. Corrective management of holding rock and measuring tape is required at:
 - Underpass 1 West,
 - Underpass 3 East,
 - Underpass 3 West,
 - Underpass 4 West,
 - Underpass 4 East,
 - Underpass 5 East, and
 - Underpass 6 East.

Yours faithfully,

Mark Mackinnon

Abel Ecology

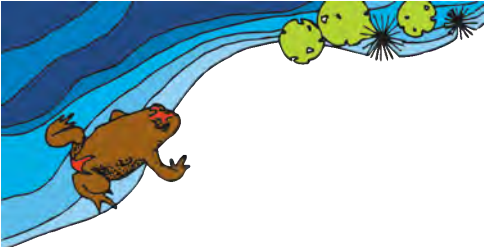


Figure 1. Remote camera image of Eastern-Pygmy Possum *Cercartetus nanus* recorded using a fauna underpass (#4 West) along Lobs Hole Ravine Road, Cabramurra NSW during January 2024.



Figure 2. Remote camera image of Eastern-Pygmy Possum *Cercartetus nanus* recorded using a fauna underpass (#2 East) along Lobs Hole Ravine Road, Cabramurra NSW during September 2023.

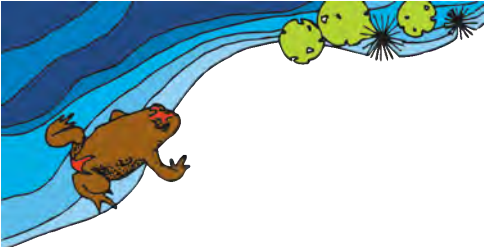


Figure 3. Remote camera image of Agile Antechinus *Antechinus agilis* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during February 2024. Note the Tick on the head of this individual.



Figure 4. Remote camera image of Agile Antechinus *Antechinus agilis* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during February 2024.

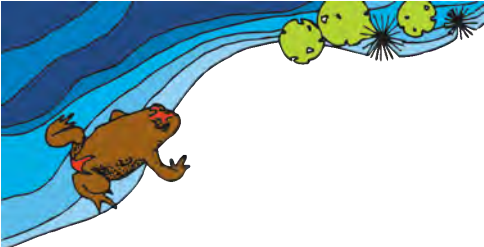


Figure 5. Remote camera image of Agile Antechinus *Antechinus agilis* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during January 2024.



Figure 6. A regular user of the fauna underpasses along Lobs Hole Ravine Road, Cabramurra NSW is the Bush Rat *Rattus fuscipes*.

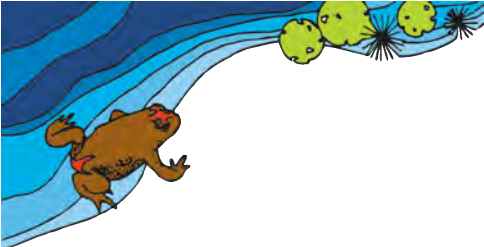


Figure 7. A regular user of the fauna underpasses along Lobs Hole Ravine Road, Cabramurra NSW is the Bush Rat *Rattus fuscipes*.



Figure 8. Is this a Broad-toothed Rat or a juvenile Bush Rat? We think it is a juvenile Bush Rat but we could be wrong without a different angle of view.

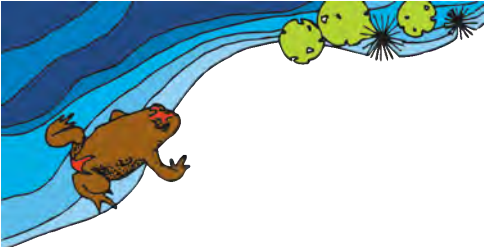


Figure 9. Remote camera image of *Tiliqua nigrolutea* Blotched Blue-tongue recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during December 2023.



Figure 10. Remote camera image of *Egernia whitii* White's Skink recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during February 2024.

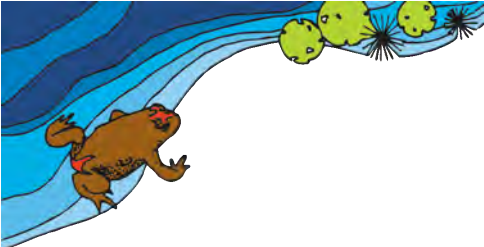


Figure 11. Remote camera image of *Egernia saxatilis* Black Rock Skink recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during March 2023.



Figure 12. Remote camera image of *Eulamprus tympanum* Southern Water-skink recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during January 2024.

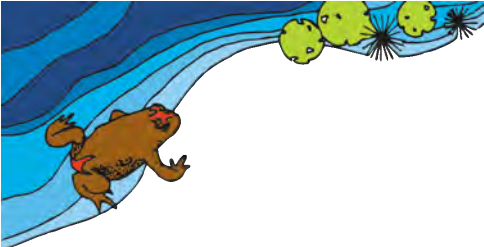


Figure 13. Remote camera image of *Acritoscincus duperreyi* Eastern Three-lined Skink recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during January 2023.



Figure 14. Remote camera image of *Amphibolurus muricatus* Jacky Lizard recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during February 2024.

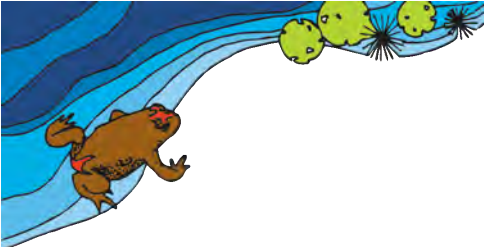


Figure 15. Remote camera image of Highlands Copperhead *Austrelaps ramsayi* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during February 2023.



Figure 16. Remote camera image of Highlands Copperhead *Austrelaps ramsayi* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during March 2023.

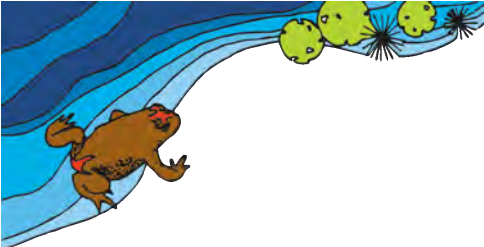


Figure 17. Remote camera image of *Austrelaps superbus* Lowland Copperhead recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during March 2023.



Figure 18. Remote camera image of *Notechis scutatus* Tiger Snake recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during February 2023.

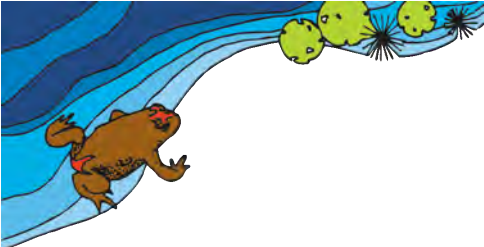


Figure 19. Remote camera image of *Notechis scutatus* Tiger Snake recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during January 2023.



Figure 20. Remote camera image of *Pseudonaja textilis* Eastern Brown Snake recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during December 2023.

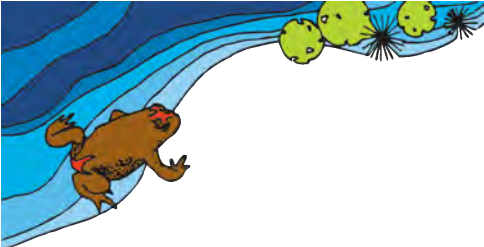


Figure 21. Remote camera image of House Mouse *Mus musculus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during May 2022.



Figure 22. Remote camera image of House Mouse *Mus musculus* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during April 2022.

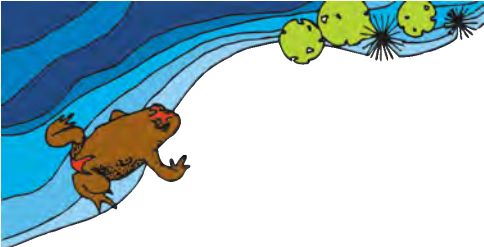


Figure 23. Remote camera image of White-throated Treecreeper *Cormobates leucophaea* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during September 2023.



Figure 24. Remote camera image of White-browed Scrubwren *Sericornis frontalis* recorded using a fauna underpass along Lobs Hole Ravine Road, Cabramurra NSW during September 2023.