

Devils Pulpit Pacific Highway Upgrade

Compliance Report

Transport for NSW | March 2021 to February 2022



1 Introduction

1.1 The Project

The Devils Pulpit Upgrade is part of the Pacific Highway Upgrade Program, a joint commitment by the Australian and NSW governments to improve the standard of the Pacific Highway between Hexham and the Queensland border. The Upgrade is 7.36 kilometres in length, located between 65.64 and 73 kilometres north of Grafton.

1.2 Project approval

The Project was approved under Part 9 of the *Environment Protection and Biodiversity Conservation Act 1999* on 14 February 2011.

1.3 Purpose of this report

This is the tenth report reporting on compliance with the Department of Agriculture, Water and the Environment conditions of approval for the project (EPBC 2010/5586). As required by condition 10, this report will report on compliance against each condition in the conditions of approval, including implementation of any management plans that have been approved by the Minister.

Condition 10. Within three months of every 12 month anniversary after the substantial commencement of the action, the person taking the action must submit to the department an annual report addressing compliance with each of the conditions of this approval, including implementation of any management plans that have been approved by the Minister. Annual reports must be provided until the Minister is satisfied that the person taking the action has complied with all conditions of this approval.

1.4 Activities and progress during the reporting period

Offset Plan

The revised Offset Plan was submitted to the Department of Environment and Energy for approval on 15 December 2017. Transport for NSW (TfNSW) received comments on the plan from the Department on 5 October 2018 and re-submitted in November 2019. Further comments were received in February 2020. The Plan was re-submitted for approval on 27 May 2020 and approved on 14 August 2020.

Vegetation rehabilitation

The landscape maintenance contract was completed at the end of June 2016. TfNSW Regional Maintenance Delivery now maintains the vegetation under the routine maintenance contract for TfNSW roads.

Vegetation across the study area was significantly burnt in the late 2019 bush fires. Some areas (eg. Impact Site 4 and the swamp forest west of the Tabbimoble bridges) experienced particularly high intensity canopy fires. The vegetation connectivity corridor was also burnt, however recruitment and growth of native species has been recorded across the corridor. The bushfire impacted (reduced) native species diversity and cover in some areas, and increased weed cover mainly in the ground stratum. Exotic groundcovers (including weeds) are present and reducing native species recruitment in the southern half of the corridor. As recommended, TfNSW will undertake bush regeneration and tree plantings works in localised areas with dense exotic groundcovers to assist the regeneration process where the density of understorey/ canopy tree recruits is low.

Ecological Monitoring Program

In June 2017, monitoring under the EMP commenced. The EMP requires monitoring in Year 3 (2017/2018), Year 4 (2018/2019) and Year 6 (2020/2021) following completion of construction. The final Year 6 report is attached.

Road kill and monitoring of fauna fence for maintenance is undertaken regularly as part of TfNSW regular asset maintenance activities.

Fauna Connectivity

Transport for NSW have continued to investigate fauna connectivity structure repairs to improve dry passage following significant flood events in 2017. These works have been added to the TfNSW Road Maintenance works schedule.

1.5 Non-compliance

There were no non-compliances during the reporting period.

Compliance with approvals

| Condition | Status | Comment |
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| Condition 1. <i>The person taking the action must carry out the action in accordance with the conditions of this approval and as described in the referral documentation received 23 July 2010 and the variation information submitted 8 November 2010. Where the referral or variation information and these conditions are inconsistent, these conditions shall prevail to the extent of the inconsistency.</i> | Compliant | Noted. |
| Condition 2 <i>The person proposing to take the action must not clear more than 58 hectares of vegetation within the footprint of the action.</i> | Compliant | All clearing and grubbing for the project was completed. A total of 46.47 hectares was cleared. |
| Condition 3 <i>To minimise impacts on listed threatened species and migratory species, if the person taking the action intends to undertake preparatory works as part of the Pacific Highway Upgrade, a plan must be submitted to the Minister for approval outlining all preparatory works to be undertaken. This plan must be approved by the Minister prior to any preparatory works being undertaken. The plan must include, but not be limited to:</i> <i>a) the location of all preparatory works to be undertaken;</i> <i>b) the area (in hectares) to be impacted;</i> <i>c) an assessment of the quality vegetation to be impacted by the preparatory works; and</i> <i>d) an assessment of the likely impacts of the preparatory works on habitat for threatened species and migratory species.</i> | Compliant | The Preparatory Works Plan was approved on 13 December 2011. |

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| <p>FLORA AND FAUNA MANAGEMENT PLAN</p> <p>Condition 4 <i>To mitigate impacts on listed threatened species and migratory species, the person taking the action must submit a detailed Flora and Fauna Management Plan to the Minister for approval prior to substantial commencement of the action. This plan must be approved by the Minister prior to substantial commencement of the action. The approved plan must be implemented. The Flora and Fauna Management Plan must include, but not be limited to, the following requirements:</i></p> <ul style="list-style-type: none"> a) <i>Measures to be implemented to avoid, suppress and control the spread of weeds, plant pathogens and invasive species and to measure other indirect impacts that may result from the proposal during construction;</i> b) <i>Measures to manage aquatic habitat on-site to at least maintain habitat values for the Oxleyan Pygmy Perch;</i> c) <i>An Ecological Restoration Plan detailing the rehabilitation of vegetation to occur within the footprint of the action;</i> d) <i>Engagement of a suitably qualified expert to undertake pre-clearing fauna searches within the footprint of the action, including searches of nests, hollow bearing trees, logs, existing culverts and existing bridges to ensure that the area is free of Spotted-tail Quoll, Grey-headed Flying-fox, Regent Honeyeater, Swift Parrot and any other EPBC Act listed species.</i> e) <i>Measures to relocate an/or ensure the appropriate care of individuals of EPBC Act listed fauna species that are located during searches referred to in Condition 4(d), in</i> | Compliant | <p>The Flora and Fauna Management Plan was approved 9 February 2012.</p> <p>During the reporting period monitoring and maintenance of vegetation rehabilitation occurred.</p> |
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| <p><i>accordance with the RTA's Fauna Rescue Framework;</i></p> <p>f) <i>The Flora and Fauna Management Plan must include clear key milestones, monitoring, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the plan.</i></p> | | |
| <p>SPOTTED-TAIL QUOLL MANAGEMENT PLAN</p> <p>Condition 5. <i>The person taking the action must submit a management plan for the Spotted-tail Quoll to the Minister for approval prior to the substantial commencement of the action. This plan must be approved by the Minister prior to substantial commencement of the action. The approved plan must be implemented. The management plan must include, but not be limited to, the following requirements:</i></p> <p>a. <i>The construction, ongoing monitoring, maintenance and repair of permanent fauna crossings, fauna exclusion fencing and associated infrastructure that will ensure safe and effective movement of the Spotted-tail Quoll across the Pacific Highway Upgrade;</i></p> <p>b. <i>An independent, suitably qualified expert is to verify that the design, location and number of fauna crossings are appropriate;</i></p> <p>c. <i>The construction, ongoing monitoring, maintenance and repair of permanent fauna exclusion fencing that will restrict Spotted-tail Quoll from crossing the Pacific Highway Upgrade and facilitate the use of fauna crossings;</i></p> <p>d. <i>Conduct research that:</i></p> <p>i. <i>Determines the effectiveness of various</i></p> | Compliant | <p>The Spotted-tail Quoll Management Plan was approved 9 February 2012.</p> <p>As per Section 1.4, the final Year of the Ecological Monitoring Program was completed during the reporting period.</p> |

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| <p><i>designs of fauna crossing structures to facilitate the effective movement of the Spotted-tailed Quoll across various types of linear infrastructure and avoid injury or death due to crossing;</i></p> <p><i>ii. determines the effectiveness of the fauna crossings constructed for the Pacific Highway Upgrade to maintain the viability of the Spotted-tail Quoll population affected by the Pacific Highway Upgrade;</i></p> <p><i>iii. determines the effectiveness of the existing culverts, to be repaired and maintained consistent with Conditions 5(a) to 5(c), to maintain the viability of the Spotted-tail Quoll population affected by the highway;</i></p> <p><i>iv. . identifies potential and actual threats to the viability of Spotted-tail Quoll populations affected by the Pacific Highway Upgrade;</i></p> <p><i>v. Have the research reviewed by a suitably qualified expert. Documentation of the review must be submitted to the Minister with documentation of research outcomes;</i></p> <p><i>vi. Implement recommendations made as a result of the research.</i></p> <p><i>e. The plan must include clear key milestones, performance indicators, corrective actions and timeframes for the completion of all commitments and actions outlined in the plan.</i></p> <p><i>f. If it is determined the fauna crossings and culverts monitored, consistent with condition 5(a), are not effective to maintain the viability of the Spotted-tailed Quoll population</i></p> | | |
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| <p><i>affected by the Pacific Highway Upgrade, the person taking the action must submit an amended Management Plan for the Spotted-tailed Quoll to the Minister for approval. The amended strategy must include appropriate measures to ameliorate impacts on the affected Spotted-tailed Quoll population;</i></p> <p><i>g. All actions must be developed in consultation with a suitably qualified expert.</i></p> <p><i>h. The plan must integrate with and build on management plans for other nearby highway upgrade projects for the Spotted-tail Quoll.</i></p> | | |
| <p>SOIL AND WATER MANAGEMENT PLAN</p> <p><i>Condition 6. To mitigate impacts on listed threatened species, the person taking the action must submit a detailed Soil and Water Management Plan, to be developed in consultation with I&I NSW (Fisheries), to the Minister for approval prior to substantial commencement of the action. This plan must be approved by the Minister prior to substantial commencement of the action. The approved plan must be implemented. The Soil and Water Management Plan must include, but not be limited to:</i></p> <p><i>a) Details of the water monitoring program to be implemented before, during and after construction to determine baseline water conditions, water quality objectives for the site as they relate to the Oxleyan Pygmy Perch, as well as the performance and effectiveness of mitigation measures to be used to mitigate water quality and hydrologic impacts. The program must include but not be limited to:</i></p> <p><i>i. A minimum of two (2) baseline data sites in</i></p> | Compliant | The Soil and Water Management Plan was approved 9 February 2012 and implemented. |

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| <p><i>Tabbimoble Floodway No. 2 and a minimum of two(2) in Tabbimoble Floodway No. 3, determined in consultation with I&I NSW (Fisheries);</i></p> <p><i>ii. Baseline water conditions must include data describing water quality, pH levels and hydrological parameters such as stream flows and velocity;</i></p> <p><i>iii. Water conditions must be monitored at monthly intervals before, during and after construction for a length of time to be determined in consultation with I&I NSW (Fisheries);</i></p> <p><i>iv. The identification of thresholds that will trigger corrective actions and the actions that will be implemented within 24 hours if a threshold is reached or exceeded. If such an event occurs, this is to be reported to the department within 2 weeks of the event occurring;</i></p> <p><i>v. Monitoring of the effectiveness of mitigation measures, which should include samples during and post rainfall events. Contaminant concentrations and flow volumes entering and discharging from treatment systems on-site must be quantified and contaminant loads calculated;</i></p> <p><i>vi. Reporting arrangements to the department, including procedures and time frames for reporting any non compliance; and</i></p> <p><i>vii. Results of the Monitoring Program (including data and its interpretation) is to be made publicly available on the website of the person taking the action including data and its interpretation within three</i></p> | | |
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| <p><i>months of every 12 month anniversary of the substantial commencement of the action.</i></p> <p><i>b) Details and location of all permanent erosion and sediment control, as well as pollution control measures, to be implemented during construction and operation of the Pacific Highway Upgrade. All erosion and sediment control measures must be best practice based on industry guidelines and must be certified, in consultation with I&I NSW (Fisheries) and approved by the department. These measures must include, but not be limited to:</i></p> <p><i>i. All waterway crossings within the footprint of the Pacific Highway Upgrade to be in accordance with the fish classification for each waterway based on state guidelines, unless otherwise agreed to by I&I NSW (Fisheries) and the department.</i></p> <p><i>ii. Any in-stream works in Class 1 waterway (as defined in the state guidelines) to be conducted outside the spawning season of the Oxleyan Pygmy Perch (October to December inclusive);</i></p> <p><i>iii. In-stream works in Class 1 waterways (as defined in the state guidelines) must not be undertaken on a day when a rainfall event is forecast. If a rainfall event occurs, in-stream work must only recommence once dry weather is forecast and Tabbimoble No. 2 and No. 3 have returned to a non-flowing state;</i></p> <p><i>iv. No stockpiles to occur in the floodplain zone between Tabbimoble Floodway No. 2</i></p> | | |
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| <p><i>and Tabbimoble Floodway No. 3;</i></p> <p>v. <i>Chemicals and fuels to be stored and bunded so that the floor of the bund is above the 1 in 20 year flood event and the top of the bund above the 1 in 100 year flood event. No chemicals and fuels to be stored in the floodplain zone between Tabbimoble Floodway No. 2 and Tabbimoble Floodway No. 3;</i></p> <p>vi. <i>The area within 50 meters of Tabbimoble No. 2 and Tabbimoble Floodway No. 3 to be fully stabilised before the commencement of the next spawning season of the Oxleyan Pygmy Perch;</i></p> <p>vii. <i>Measures to ensure that any waters treated on site will be suitable for the Oxleyan Pygmy Perch (based on best available knowledge on the Oxleyan Pygmy Perch and results of monitoring outlined in Condition 6(a)) prior to release from water treatment areas implemented as part of the Pacific Highway Upgrade;</i></p> <p>viii. <i>Measures to be implemented for events such as rainfall events and fuel and chemical spills;</i></p> <p>ix. <i>Measures to be implemented to monitor, review and update the effectiveness of the sediment and erosion control measures implemented.</i></p> | | |
| <p>OFFSET PLAN</p> <p><i>Condition 7. The person taking the action must submit an Offset Plan for approval by the Minister within 12 months of the date of this approval to provide for the conservation and management in perpetuity of a minimum of 152 hectares of habitat for the Grey-headed Flying-</i></p> | Compliant | <p>The revised Offset Plan was submitted to the Department of Environment and Energy for approval on 15 December 2017. Transport for NSW (TfNSW) received comments on the plan from the Department on 5 October 2018 and re-submitted in November 2019. Further comments were received in February 2020. The Plan was re-submitted for approval on 27 May 2020 and approved on 14 August</p> |

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| <p><i>fox, the Spotted-tail Quoll, the Regent Honeyeater and the Swift Parrot. The approved plan must be implemented. The Offset Plan must include, but not be limited to:</i></p> <ul style="list-style-type: none"> <i>a. The acquisition and conservation of land containing a minimum of 152 hectares of habitat for the Grey-headed Flying-fox, the Spotted-tail Quoll, the Regent Honeyeater and the Swift Parrot that is of equal or greater quality to that to be removed for the Pacific Highway Upgrade;</i> <i>b. The land referred to at condition 7(a) must be located within 50km of the Pacific Highway upgrade at Devil's Pulpit, unless otherwise agreed to by the department.</i> <i>c. The land referred to at condition 7(a) must be protected by a legal instrument under relevant nature conservation legislation on the title of the area within 18 months of the date of this approval.</i> <i>d. The instrument referred to in Condition 7(c) must provide for:</i> <ul style="list-style-type: none"> <i>i. The protection of the land in perpetuity</i> <i>ii. Prevent any future development activities</i> <i>iii. Ensure the active management of the land;</i> <i>e. The land referred to at Condition 7(a) must provide linkages to existing habitat for the species of concern.</i> <i>f. The Offset Plan must include a clear commitment to ongoing management of</i> | | 2020. |
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| <p><i>the land at Condition 7(a). Management works must be consistent with advice from a suitably qualified expert. These measures must commence within 3 months of the legal protection of the land.</i></p> <p><i>g. The Plan must include key milestones, performance indicators, corrective actions and timeframes for the completion of all actions outlined in the Plan.</i></p> <p><i>h. The Plan must include clear outline of funding for the management in perpetuity of the land at Condition 7(a).</i></p> <p><i>i. The Plan must be developed in consultation with the department.</i></p> | | |
| <p>STANDARD ADMINISTRATIVE CONDITIONS</p> <p><i>Condition 8. Within 10 business days of the substantial commencement of the action, the person taking the action must advise the department in writing of the actual date of substantial commencement.</i></p> | Compliant | The action was substantially commenced on 13 February 2012. The Department was advised of substantial commencement of the action on 21 September 2017. |
| <p><i>Condition 9. If, after 3 years from the date of this approval, the person taking the action has not substantially commenced the action to the satisfaction of the Minister, the person taking the action must obtain the written agreement of the Minister to commence or continue taking the action.</i></p> | Compliant | The action was substantially commenced on 13 February 2012. |
| <p><i>Condition 10. Within three months of every 12 month anniversary after the substantial commencement of the action, the person taking the action must submit to the department an annual report addressing compliance with each</i></p> | Compliant | <p>The first annual compliance report for the period February 2012 to February 2013 was submitted on 10 July 2013.</p> <p>The second annual compliance report for the period March 2013 to February 2014 was submitted on 30 May 2014 (with a revised version</p> |

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| <i>of the conditions of this approval, including implementation of any management plans that have been approved by the Minister. Annual reports must be provided until the Minister is satisfied that the person taking the action has complied with all conditions of this approval.</i> | | <p>being sent on 11 August 2014).</p> <p>A third annual compliance report for the period March 2014 – February 2015 was not submitted within three months of the third 12 month anniversary and was therefore a non-compliance.</p> <p>A fourth annual compliance report for the period March 2015 – February 2016 was not submitted within three months of the fourth 12 month anniversary and was therefore a non-compliance.</p> <p>These reports were submitted in March 2017 addressing those non-compliances. All reports following 2017 have been submitted within three of every 12 month anniversary.</p> |
| <i>Condition 11. Upon the direction of the Minister, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the Minister. The independent auditor must be approved by the Minister prior to the commencement of the audit. Audit criteria must be agreed to by the Minister and the audit report must address the criteria to the satisfaction.</i> | Compliant | <p>No direction from the Minister has been received to undertake an independent audit of compliance with the conditions of approval during the reporting period.</p> <p>Independent audits of the project have been undertaken and results of these are available on request.</p> |
| <i>Condition 12. If the person taking the action wishes to carry out any activity otherwise than in accordance with the plans, reports or strategies referred to in this approval, the person taking the action must submit for the Minister's approval a revised version of any such plan, report or strategy. The varied activity shall not commence until the Minister has approved the varied plan, report or strategy in writing. If the Minister approves such a revised plan, report or strategy, that plan, report or strategy must be implemented in place of the plan, report or strategy originally approved.</i> | Compliant | <p>No activities have been carried out otherwise than in accordance with the Conditions of Approval during the reporting period.</p> |
| <i>Condition 13. If the Minister believes that it is necessary or desirable for the better protection of listed migratory species and listed threatened</i> | Compliant | <p>No requests for revisions to approved plans have been received from the Minister to date.</p> |

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| <p><i>species and ecological communities to do so, the Minister may request that the person taking the action make specified revisions to the plans, report or strategies approved pursuant to the conditions of this approval and submit the revised plan, report or strategy for the Minister's approval. The person taking the action must comply with any such request. The revised approved plan, report or strategy must be implemented. Unless the Minister has approved the revised plan, report or strategy, then the person taking the action must continue to implement the plan, report or strategy originally approved under this approval.</i></p> | | |
| <p><i>Condition 14. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of this approval, including measures taken to implement the management plans required by this approval, and make them available upon request to the department. Such records may be subject to audit by the Department or an independent auditor in accordance with section 458 of the EPBC Act, or used to verify compliance with the conditions of approval. Summaries of audits may also be publicised through the general media.</i></p> | Compliant | Noted. All records are available upon request by the Department. |

Attachment A - Ecological Monitoring Program Third and Final Report.

Third (Final) Annual Report for Post Construction Year 3, 4 and 6 Ecological Monitoring Devils Pulpit Pacific Highway Upgrade



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Table of Contents

| | | |
|-----------|---|-----------|
| 1. | Introduction | 1 |
| 1.1 | Background | 1 |
| 1.1.1 | Introduction | 1 |
| 1.1.2 | Changes to Site Conditions | 7 |
| 2. | Methodology | 9 |
| 2.1 | Monitoring Target Terrestrial Species | 9 |
| 2.1.1 | Monitoring Sites | 9 |
| 2.1.2 | Methodology | 14 |
| 2.1.3 | Rufous Bettong | 14 |
| 2.1.4 | Spotted-tailed Quoll | 19 |
| 2.1.5 | Green-thighed Frog and Wallum Froglet | 19 |
| 2.1.6 | Yellow-bellied Glider | 20 |
| 2.1.7 | Squirrel Glider | 20 |
| 2.1.8 | Brush-tailed Phascogale | 21 |
| 2.1.9 | Koala | 21 |
| 2.2 | Monitoring Crossing Structures | 22 |
| 2.2.1 | Fauna Underpasses | 22 |
| 2.2.2 | Rope Bridge | 26 |
| 2.2.3 | Vegetated Median | 28 |
| 2.2.4 | Restoration of Vegetated Connectivity Corridor | 28 |
| 2.3 | Other Monitoring Activities | 31 |
| 2.3.1 | Roadkill Monitoring | 31 |
| 2.4 | Survey Limitations | 31 |
| 3. | Results | 32 |
| 3.1 | Results | 32 |
| 3.2 | Rufous Bettong/ Brush-tailed Phascogale Camera Trap Results | 37 |
| 3.2.1 | Year 3, 4 and 6 Comparison | 38 |
| 3.3 | Spotlighting and Call Playback Results | 42 |
| 3.3.1 | Year 3, 4 and 6 Comparison | 43 |
| 3.4 | Threatened Frog Survey Results | 46 |
| 3.4.1 | Year 3, 4 and 6 Comparison | 48 |
| 3.5 | Nest Box Monitoring Results | 49 |
| 3.6 | Fauna Underpass Monitoring Results | 51 |
| 3.6.1 | Underpass Cameras | 51 |
| 3.6.2 | Scat and Track Searches | 54 |

| | | |
|-------------|---|-----------|
| 3.7 | Rope Bridge Results | 55 |
| 3.7.1 | Year 3, 4 and 6 Comparison | 57 |
| 3.8 | Vegetated Median Results | 58 |
| 3.9 | Restoration of Vegetated Connectivity Corridor Results | 58 |
| 3.9.1 | Year 6 Spring | 59 |
| 3.9.2 | Year 3, 4 and 6 Comparison | 59 |
| 3.10 | Roadkill Monitoring Results | 63 |
| 3.10.1 | Year 6 | 63 |
| 3.10.2 | Year 3, 4 and 6 Comparison | 63 |
| 4. | Discussion | 66 |
| 4.1 | Target Threatened Species | 66 |
| 4.1.1 | Rufous Bettong | 66 |
| 4.1.2 | Wallum Froglet | 67 |
| 4.1.3 | Green-thighed Frog | 67 |
| 4.1.4 | Yellow-bellied Glider | 69 |
| 4.1.5 | Squirrel Glider | 72 |
| 4.1.6 | Brush-tailed Phascogale | 76 |
| 4.1.7 | Koala | 78 |
| 4.1.8 | Long-nosed Potoroo | 80 |
| 4.1.9 | Greater Glider | 82 |
| 4.1.10 | Spotted-tailed Quoll | 85 |
| 4.1.11 | Pest Fauna Observations | 85 |
| 4.2 | Effectiveness of Mitigation Measures (Connectivity Structures) | 86 |
| 4.2.1 | Fauna Underpass | 86 |
| 4.2.2 | Rope Bridge | 87 |
| 4.2.3 | Vegetated Medians | 88 |
| 4.2.4 | Vegetation Connectivity Corridor | 88 |
| 5. | Recommendations and Conclusion | 94 |
| 5.1 | Recommendations | 94 |
| 5.2 | Conclusion | 95 |

Illustrations

| | | |
|-------------------------|--|-----------|
| Illustration 1.1 | Site Locality | 5 |
| Illustration 1.2 | Mitigation Measures Being Monitored | 6 |
| Illustration 1.3 | DPIE Fire Extent and Severity Mapping | 8 |
| Illustration 2.1 | Monitoring Site Locations | 13 |
| Illustration 2.2 | Target Terrestrial Species Monitoring Locations | 16 |
| Illustration 2.3 | Vegetation Connectivity Corridor Monitoring Sites | 30 |
| Illustration 3.1 | Recorded Threatened Species | 33 |
| Illustration 3.2 | Roadkill Monitoring Results | 65 |
| Illustration 4.1 | Green-thighed Frog Study Area Distribution | 68 |
| Illustration 4.2 | Yellow-bellied Glider Study Area Distribution | 70 |

| | | |
|-------------------------|--|-----------|
| <u>Illustration 4.3</u> | <u>Squirrel Glider Study Area Distribution</u> | <u>74</u> |
| <u>Illustration 4.4</u> | <u>Brush-tailed Phascogale Study Area Distribution</u> | <u>77</u> |
| <u>Illustration 4.5</u> | <u>Koala Study Area Distribution</u> | <u>79</u> |
| <u>Illustration 4.6</u> | <u>Long-nosed Potoroo Study Area Distribution</u> | <u>81</u> |
| <u>Illustration 4.7</u> | <u>Greater Glider Study Area Distribution</u> | <u>83</u> |

Tables

| | | |
|------------------|---|-----------|
| <u>Table 1.1</u> | <u>Relevant Mitigation Measures Being Monitored</u> | <u>3</u> |
| <u>Table 2.1</u> | <u>Target Terrestrial Species Monitoring Sites and Target Species</u> | <u>10</u> |
| <u>Table 2.2</u> | <u>Spotlighting Survey Effort During Year 6 Monitoring</u> | <u>18</u> |
| <u>Table 2.3</u> | <u>Threatened Frog Monitoring Survey Dates During Year 6 Monitoring</u> | <u>20</u> |
| <u>Table 2.4</u> | <u>Nest Box Configuration</u> | <u>21</u> |
| <u>Table 2.5</u> | <u>Underpass Camera Trap Configuration and Effort During Year 6 Reporting Period</u> | <u>24</u> |
| <u>Table 2.7</u> | <u>Underpass Substitution and Fauna Furniture Camera Trap Installation and Retrieval Dates, and Effort during Year 6 Monitoring</u> | <u>25</u> |
| <u>Table 2.8</u> | <u>Rope Bridge Camera Inspection Dates and Effort for Year 6 Reporting Period</u> | <u>27</u> |
| <u>Table 2.9</u> | <u>Modified Braun-Blanquet Cover Classes</u> | <u>29</u> |
| <u>Table 3.1</u> | <u>Activity Levels for the Brush-tailed Phascogale and Long-nosed Potoroo for Year 6 Monitoring</u> | <u>38</u> |
| <u>Table 3.2</u> | <u>Summary of Recorded Target Species Spotlighting/ Call Playback Results for Year 6 Monitoring</u> | <u>44</u> |
| <u>Table 3.3</u> | <u>Summary of Squirrel Glider Nest Box Site Occupancy for Year 3, Year 4 and Year 6 Monitoring</u> | <u>50</u> |
| <u>Table 3.4</u> | <u>Species Recorded by Rope Bridge Camera Traps During the Year 6 Reporting Period</u> | <u>55</u> |
| <u>Table 3.5</u> | <u>Direction of Movement of Species on Rope Bridge During the Year 6 Reporting Period</u> | <u>56</u> |
| <u>Table 3.6</u> | <u>Potential complete crossings during Year 3, Year 4 and Year 6 monitoring</u> | <u>58</u> |
| <u>Table 3.7</u> | <u>Summary of Year 6 Spring Vegetation Quadrat Data</u> | <u>60</u> |
| <u>Table 3.8</u> | <u>Summary of Year 6 Roadkill Monitoring Results</u> | <u>63</u> |
| <u>Table 3.9</u> | <u>Terrestrial Mammal Roadkill Results During Year 3, Year 4 and Year 6 monitoring</u> | <u>64</u> |
| <u>Table 4.1</u> | <u>EMP Performance Measures</u> | <u>89</u> |

Plates

| | | |
|-------------------|---|-----------|
| <u>Plate 3.1</u> | <u>Brush-tailed Phascogale image from Control 3 during Year 6 summer monitoring.</u> | <u>40</u> |
| <u>Plate 3.2</u> | <u>Long-nosed Potoroo image from Control 2 during Year 6 summer monitoring.</u> | <u>40</u> |
| <u>Plate 3.3</u> | <u>Two Long-nosed Potoroos in image from Control 2 during Year 6 spring monitoring.</u> | <u>41</u> |
| <u>Plate 3.4</u> | <u>Three House Mice at Impact Site 3 (west) during Year 6 summer monitoring.</u> | <u>41</u> |
| <u>Plate 3.5</u> | <u>Wild Pig image from Control 5 during Year 6 spring monitoring.</u> | <u>42</u> |
| <u>Plate 3.6</u> | <u>Eastern Grey Kangaroos grazing while moving west (northern bank) at SBT3.</u> | <u>52</u> |
| <u>Plate 3.7</u> | <u>Lace Monitor moving east-west at fauna underpass C7.</u> | <u>52</u> |
| <u>Plate 3.8</u> | <u>Feral cat moving east-west at fauna underpass C7.</u> | <u>53</u> |
| <u>Plate 3.9</u> | <u>Short-beaked Echidna moving east-west at fauna underpass C7.</u> | <u>53</u> |
| <u>Plate 3.10</u> | <u>Brown Goshawk using fauna furniture at SBT3.</u> | <u>53</u> |
| <u>Plate 3.11</u> | <u>Swamp Wallaby moving west-east at fauna underpass C9.</u> | <u>53</u> |
| <u>Plate 3.12</u> | <u>Eastern Grey Kangaroo crossing west-east at SBT3 (southern span)</u> | <u>54</u> |
| <u>Plate 3.13</u> | <u>Common Brushtail Possum crossing west-east at fauna underpass C7.</u> | <u>54</u> |
| <u>Plate 3.14</u> | <u>Squirrel Glider at the western rope bridge pole.</u> | <u>56</u> |
| <u>Plate 3.15</u> | <u>Brush-tailed Phascogale at the eastern rope bridge pole.</u> | <u>56</u> |
| <u>Plate 3.16</u> | <u>Sugar Glider at the eastern rope bridge pole.</u> | <u>57</u> |

| | | |
|-------------------|---|-----------|
| <u>Plate 3.17</u> | <u>Ringtail Possum at the western rope bridge pole.</u> | <u>57</u> |
| <u>Plate 4.1</u> | <u>Typical water height at the outlet of C3.</u> | <u>86</u> |
| <u>Plate 4.2</u> | <u>Scouring and pooled water at the outlet of C8.</u> | <u>86</u> |
| <u>Plate 4.3</u> | <u>Northern bank at SBT2 with rock scour protection that crossing fauna need to navigate.</u> | <u>87</u> |
| <u>Plate 4.4</u> | <u>Southern bank at SBT2 with rock scour protection and no obvious path that crossing fauna need to navigate.</u> | <u>87</u> |
| <u>Plate 4.5</u> | <u>Northern bank at NBT3 showing obvious passage for crossing fauna (flat regular ground).</u> | <u>87</u> |
| <u>Plate 4.6</u> | <u>Southern bank at NBT3.</u> | <u>87</u> |

Figures

| | | |
|--------------------|---|-----------|
| <u>Figure 3.1</u> | <u>Average Activity Levels of Brush-tailed Phascogale and Long-nosed Potoroo at Impact and Control Sites During Year 3, Year 4 and Year 6.</u> | <u>39</u> |
| <u>Figure 3.2</u> | <u>Number of Target Species Recorded via Spotlighting/ Call Playback during Year 6 Monitoring</u> | <u>45</u> |
| <u>Figure 3.3</u> | <u>Mean Activity Levels of Target Species Recorded via Spotlighting/ Call Playback Survey during Year 3, Year 4 and 6 Monitoring</u> | <u>46</u> |
| <u>Figure 3.4</u> | <u>Threatened Frog Survey Results During Year 6 Monitoring</u> | <u>47</u> |
| <u>Figure 3.5</u> | <u>Threatened Frog Survey Results During Year 3, Year 4 and Year 6 Monitoring</u> | <u>48</u> |
| <u>Figure 3.6</u> | <u>Number of Sites With Threatened Frogs During Year 3, Year 4 and Year 6 Monitoring</u> | <u>49</u> |
| <u>Figure 3.7</u> | <u>Squirrel Glider Results During Year 3, Year 4 and Year 6 Monitoring</u> | <u>50</u> |
| <u>Figure 3.8</u> | <u>Nest Box Occupancy Rates During Year 3, Year 4 and Year 6 Monitoring</u> | <u>51</u> |
| <u>Figure 3.9</u> | <u>Visitation rates (visits/ week) of target species at each rope bridge pole during Year 3, Year 4 and Year 6 monitoring</u> | <u>58</u> |
| <u>Figure 3.10</u> | <u>Cover of native and exotic species, number of native species and mean height of tree (T1) layer – Year 3, Year 4 and Year 6 monitoring</u> | <u>62</u> |
| <u>Figure 3.11</u> | <u>Cover of native and exotic species, number of native species and mean height of shrub (T2) layer – Year 3, Year 4 and Year 6 monitoring</u> | <u>62</u> |
| <u>Figure 3.12</u> | <u>Cover of native and exotic species, number of native species and mean height of groundcover (G) layer – Year 3, Year 4 and Year 6 monitoring</u> | <u>62</u> |

Appendices

| |
|---|
| <u>Appendix A Target Terrestrial Species Monitoring Survey Methodology and Weather Data</u> |
| <u>Appendix B Nest Box Monitoring Locations and Results</u> |
| <u>Appendix C Fauna Underpass Monitoring Results</u> |
| <u>Appendix D Restoration of Vegetation Connectivity Corridor Results</u> |
| <u>Appendix E Roadkill Monitoring Results</u> |
| <u>Appendix F Rufous Bettong/ Brush-tailed Phascogale Camera Trap Results</u> |
| <u>Appendix G Spotlighting and Call Playback Results</u> |
| <u>Appendix H Threatened Frog Survey Results</u> |



Executive Summary

Transport for NSW (Transport, formerly Roads and Maritime Services) upgraded a 7.3 kilometre section of the Pacific Highway at Devils Pulpit, between Grafton and Ballina on the NSW north coast. Conditions of Approval for the Project included the development and implementation of an Ecological Monitoring Program (EMP). GeoLINK has been engaged to implement the post construction terrestrial species monitoring program for the Project. The broad objective is to monitor the effectiveness of the following mitigation measures: fauna crossing structures, vegetated medians and vegetated connectivity corridor.

This report presents the results of the final year of post construction monitoring undertaken from January 2020 to February 2021 (referred to as Year 6). Permanent underpass camera and rope bridge camera results from January 2019 until August 2020 that were not reported in the Year 4 monitoring report (GeoLINK 2019) are also included. Woolgoolga to Ballina Pacific Highway upgrade (W2B) works and the 2019/ 2020 drought and bushfire impacted site conditions since the previous Year 4 monitoring.

The monitoring completed for the reporting period included:


- Targeted threatened species monitoring for the Rufous Bettong, Wallum Froglet, Green-thighed Frog, Yellow-bellied Glider, Squirrel Glider, Brush-tailed Phascogale, Koala and Spotted-tailed Quoll. The Greater Glider and Long-nosed Potoroo are also included as target threatened species as per recommendations made after Year 3 monitoring in the First Annual Report (GeoLINK 2018).
- Fauna underpass monitoring (motion detection cameras and scat/ track searches at ten structures).
- Rope bridge monitoring with motion detection cameras (one rope bridge).
- Vegetated median monitoring (spotlighting/call playback and nest box monitoring at two medians)
- Restoration of vegetated connectivity corridor (vegetation) monitoring.
- Roadkill monitoring.

All target species were recorded during the Year 6 reporting period except for the Rufous Bettong and Spotted-tailed Quoll.

Assessment of the monitoring results against the performance measures of mitigation measures being monitored found:

Fauna Underpasses: No complete crossings of target threatened species has been detected during the three years of post construction monitoring, although crossings by a number of native non-threatened species have been recorded. Varying levels of fauna activity between structures and limited results at a number of structures (including no complete crossings at underpass structure C3) indicate varying suitability or quality of each in providing fauna connectivity. Damage from the 2017 floods and 2019 bushfire has affected fauna underpass usage. Transport have upgraded one of the underpass structures (C6) during W2B works and are investigating repair works for the other structures. Other factors that have influenced the underpass monitoring results and/or lack of records of target threatened species relate to ecological factors (e.g. target species abundance and distribution), Project design features (e.g. culvert length, presence or absence of fauna furniture) and the 2019/ 2020 drought and bushfire.

With repair of the fauna underpass structures, the potential for fauna crossings would be expected to increase, particularly now that upgraded/ additional fauna fencing is in place (due to the W2B works).



Rope Bridge: Three target threatened species (Squirrel Glider, Brush-tailed Phascogale and Yellow-bellied Glider) and four other native species (Sugar Glider, Feathertail Glider, Common Ringtail Possum and Yellow-footed Antechinus) have been recorded on the rope bridge. Visitation by Feathertail Glider and Squirrel Gliders has been occasional to irregular, and rare for the other species. Directional movements have been recorded by six of these species, although likely complete crossings have only been recorded for the Feathertail Glider and Squirrel Glider. The vegetated medians provide better crossing opportunities for the target threatened gliders at Devils Pulpit compared to the rope bridge.

Vegetated Medians: Clearing phase surveys and post construction monitoring have indicated Yellow-bellied Glider and Greater Glider movements at the southern median, and Squirrel Glider movements across the northbound lane at both medians. The frequency of Squirrel Glider movement across the northbound lane during radio tracking was higher than the frequency of rope bridge crossings. Both vegetated medians provide opportunities for two way crossing for these threatened species across both lanes of the highway. The Greater Glider roadkill detected during Year 6 demonstrates that traffic collision remains a risk for crossing fauna.

Vegetation Connectivity Corridor: Recruitment and growth of native species has been recorded across the corridor, however exotic groundcovers (including weeds) are present and reducing native species recruitment in the southern half of the corridor. The 2019 bushfire impacted (reduced) native species diversity and cover in some areas, and increased weed cover mainly in the ground stratum. Compared to the former managed pastoral land, the corridor is regenerating and has vegetation characteristic of Subtropical Coastal Floodplain Forest, although exotic grass cover is hindering regeneration in the central to southern portion of the corridor.

Two recommendations were provided based on assessment of the EMP performance indicators and contingency measures:

- Underpasses: Maintain/ rectify underpass structures to be consistent with the EMP design intent.
- Vegetation Connectivity Corridor: Undertake bush regeneration and tree plantings works in localised areas with dense exotic groundcovers to assist the regeneration process where the density of understorey/ canopy tree recruits is low.

Fauna fencing at the site was updated as part of the W2B project between Years 4 and 6 of the post construction monitoring and no further fauna fencing contingency measures are triggered. Several other recommendations are provided for Transport consideration on future projects and relate to monitoring program design or connectivity structure design.

The findings of this project contribute to the expanding knowledge and dataset associated with road impacts and wildlife mitigation developed from research and other monitoring programs in Australia. It can be used to inform future road projects, road retrofit projects with a conservation objective, and as a reference for other projects with an interest in the threatened species that were monitored.



1. Introduction

1.1 Background

1.1.1 Introduction

Transport for NSW (Transport, formerly Roads and Maritime Services) upgraded a 7.3 kilometre section of the Pacific Highway at Devils Pulpit, between Grafton and Ballina on the NSW north coast (the Project – refer to **Illustration 1.1**). The Project involved widening the Pacific Highway from the existing single lane to a four-lane dual lane, with a wide median to allow for future upgrade to six lanes (Hyder 2012). Construction was completed in March 2014.

The Project was approved by the NSW Minister of Planning on 1 February 2011, subject to a number of conditions. Condition B6 stated:

‘Prior to the commencement of construction, the Proponent shall develop and implement an Ecological Monitoring Program to monitor the effectiveness of the mitigation measure identified in condition B4 for threatened species directly impacted by the project...’.

The *Devils Pulpit Upgrade Ecological Monitoring Program* (EMP) was developed by Hyder Consulting Pty Ltd (Hyder 2012) on behalf of Transport to address this condition. The broad objective of the EMP is to monitor the effectiveness of the mitigation measures identified in the Biodiversity Offset Strategy for threatened species directly impacted by the Project.


Project approval from the Commonwealth Minister for the Department of Sustainability, Environment, Water, Populations and Communities (now Department of Agriculture, Water and Environment; DoAWE) was received on 14 February 2011, also subject to a number of conditions. The *Spotted-tailed Quoll Management Plan* (SKM 2012) was prepared to address conditions 5(a)-(h) of the Commonwealth Conditions of Approval. This included the implementation of a program to monitor the effectiveness of the fauna crossings constructed for the Project for Spotted-tailed Quoll using surveillance cameras (which correlated to the EMP fauna underpass monitoring) and population monitoring. Post construction Spotted-tailed Quoll population monitoring was completed in 2015 as part of a separate monitoring program (Sandpiper 2016a).

GeoLINK has been engaged by Transport to implement the post construction terrestrial species monitoring program for the Project in accordance with the EMP (Hyder 2012), *Spotted-tailed Quoll Management Plan* (SKM 2012) and the *Pre-construction Threatened Fauna Monitoring Results* (GeoLINK 2012a). Specifically, the monitoring covers the following sections of the EMP:

- Section 6: Monitoring Target Terrestrial Species
- Section 7: Monitoring Crossing Structures (excluding *Section 7.4 Fauna Fencing*)
- Section 8: Monitoring Changes to Habitat Use
- Section 9: Other Monitoring Activities (excluding *Section 9.1 Weed Monitoring*).

The mitigation measures monitored for effectiveness under this program and their objective as stated in the EMP are provided in **Table 1.1** and shown in **Illustration 1.2**, and include:

- fauna crossing and structures
- vegetated medians
- vegetated connectivity corridor (Hyder 2012).



The effectiveness of these mitigation measures would be assessed by:

- monitoring threatened species adjacent to the Project footprint
- identifying changes to habitat usage and assess whether changes can be attributed to the Project (Hyder 2012).

Eight target terrestrial species were identified in the EMP including:

- Rufous Bettong (*Aepyprymnus rufescens*)
- Wallum Froglet (*Crinia tinnula*)
- Spotted-tailed Quoll (*Dasyurus maculatus*)
- Green-thighed Frog (*Litoria brevipalmata*)
- Yellow-bellied Glider (*Petaurus australis*)
- Squirrel Glider (*Petaurus norfolcensis*)
- Brush-tailed Phascogale (*Phascogale tapoatafa*)
- Koala (*Phascolarctos cinereus*) (Hyder 2012).

All of these species are listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). The Spotted-tailed Quoll and Koala are dually listed as threatened species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Post construction monitoring in Year 3 (2017/ 2018 – GeoLINK 2018) identified the Long-nosed Potoroo (*Potorous tridactylus*) and Greater Glider (*Petauroides volans*) as additional threatened species at the site to monitor as part of the Project. Both species are listed under the EPBC Act, while the Long-nosed Potoroo is also listed under the BC Act.


The Oxleyan Pygmy Perch (*Nannoperca oxleyana*) comprises the target aquatic species of the EMP. Post construction monitoring requirements of the EMP for this species have been completed and are documented in the *Devils Pulpit Pacific Highway Upgrade Post-Construction Monitoring of Oxleyan Pygmy Perch and Surface Water* (GeoLINK 2015).

Post construction monitoring is required in Year 3 (2017/ 2018), Year 4 (2018/ 2019) and Year 6 (2020/ 2021) following completion of construction. This report presents the results of Year 6 (2020/ 2021) post construction monitoring completed from January 2020 to February 2021 (referred to as Year 6). Permanent underpass camera and rope bridge camera results from January 2019 until August 2020 that were not reported in the Year 4 monitoring report (GeoLINK 2019) are also discussed. Refer to GeoLINK (2018) for the study area description and a summary of the baseline (pre-construction) monitoring results.

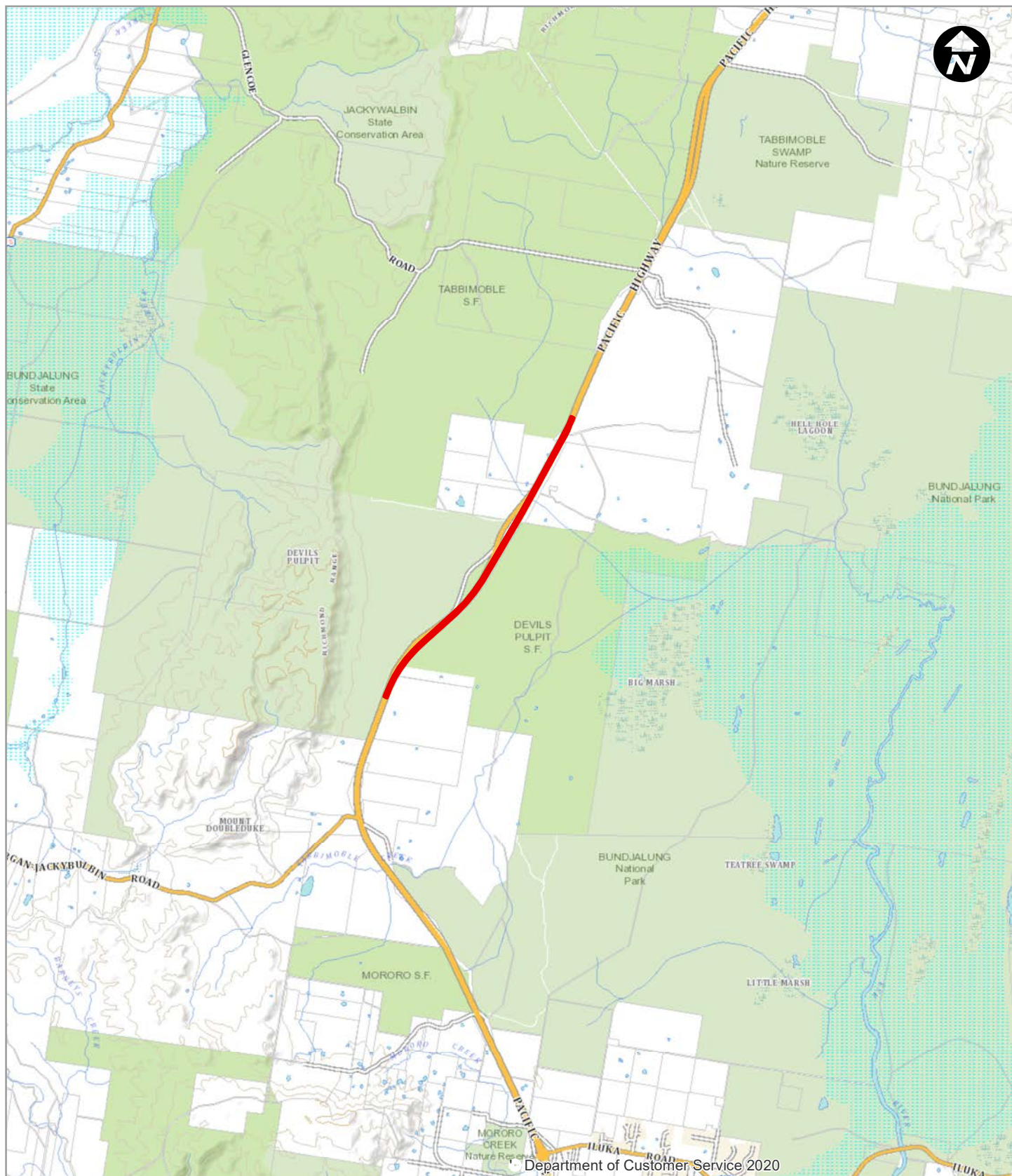
The Year 6 post construction monitoring is the final year for the EMP and this report includes an analysis of the monitoring results between years (including pre and post construction where possible), as well as an assessment of the Project against the EMP performance measures.

Table 1.1 Relevant Mitigation Measures Being Monitored

| Mitigation Measure | Objective | Target Species | Features Being Monitoring |
|---------------------------|--|---|---|
| Fauna underpasses | <ul style="list-style-type: none"> ■ Maintain fauna movements and habitat connectivity for terrestrial and aquatic species. ■ Reduce roadkill. | <ul style="list-style-type: none"> ■ Frogs ■ Reptiles ■ Terrestrial mammals | <p>Six Culverts:</p> <ul style="list-style-type: none"> ■ C3, C6, C7, C8, C9, C10. <p>Four Bridges:</p> <ul style="list-style-type: none"> ■ Southbound bridge over Tabbimoble Floodway No. 2 (SBT2). ■ Northbound bridge over Tabbimoble Floodway No. 2 (NBT2). ■ Southbound bridge over Tabbimoble Floodway No. 3 (SBT3). ■ Northbound bridge over Tabbimoble Floodway No. 3 (NBT3). |
| Rope bridges | <ul style="list-style-type: none"> ■ Maintain fauna movements and habitat connectivity for arboreal mammals. ■ Reduce roadkill. | <ul style="list-style-type: none"> ■ Sugar Glider (<i>Petaurus breviceps</i>) ■ Greater Glider ■ Common Brushtail Possum (<i>Trichosurus vulpecular</i>) ■ Common Ringtail Possum (<i>Pseudocheirus peregrines</i>) ■ Squirrel Glider ■ Yellow-bellied Glider | <ul style="list-style-type: none"> ■ 1 x rope bridge extending over both lanes linking Devils Pulpit State Forest and Bundjalung National Park (chainage 68.500). |
| Vegetated medians | <ul style="list-style-type: none"> ■ Maintain fauna movements and habitat connectivity for arboreal mammals. ■ Reduce gap crossing distance for gliding mammals. ■ Reduce roadkill. | <ul style="list-style-type: none"> ■ Sugar Glider ■ Greater Glider ■ Squirrel Glider ■ Yellow-bellied Glider | <ul style="list-style-type: none"> ■ 2 x vegetated medians at chainage 66.300-67.800 and 69.300-70.700. ■ Gliders will be able to use vegetated median to move between Devils Pulpit State Forest and Bundjalung National Park due to short glide distances. ■ Supports Dry Sclerophyll Forest and Floodplain Forest vegetation communities. |



| Mitigation Measure | Objective | Target Species | Features Being Monitoring |
|---------------------------------|--|---|--|
| Vegetated connectivity corridor | <ul style="list-style-type: none"> The vegetated connectivity corridor will improve connectivity in the vicinity of Tabbimoble Floodways 2 and 3, facilitating the movement of cover-dependent and less mobile fauna species. | <ul style="list-style-type: none"> Frogs Reptiles Terrestrial mammals Arboreal mammals Cover-dependent birds | <ul style="list-style-type: none"> 1 x corridor at chainage 70.200 - 71.900 (east of the highway alignment). Vegetated connectivity corridor will be at least 60m wide will involve rehabilitation of Subtropical Coastal Floodplain Forest. |



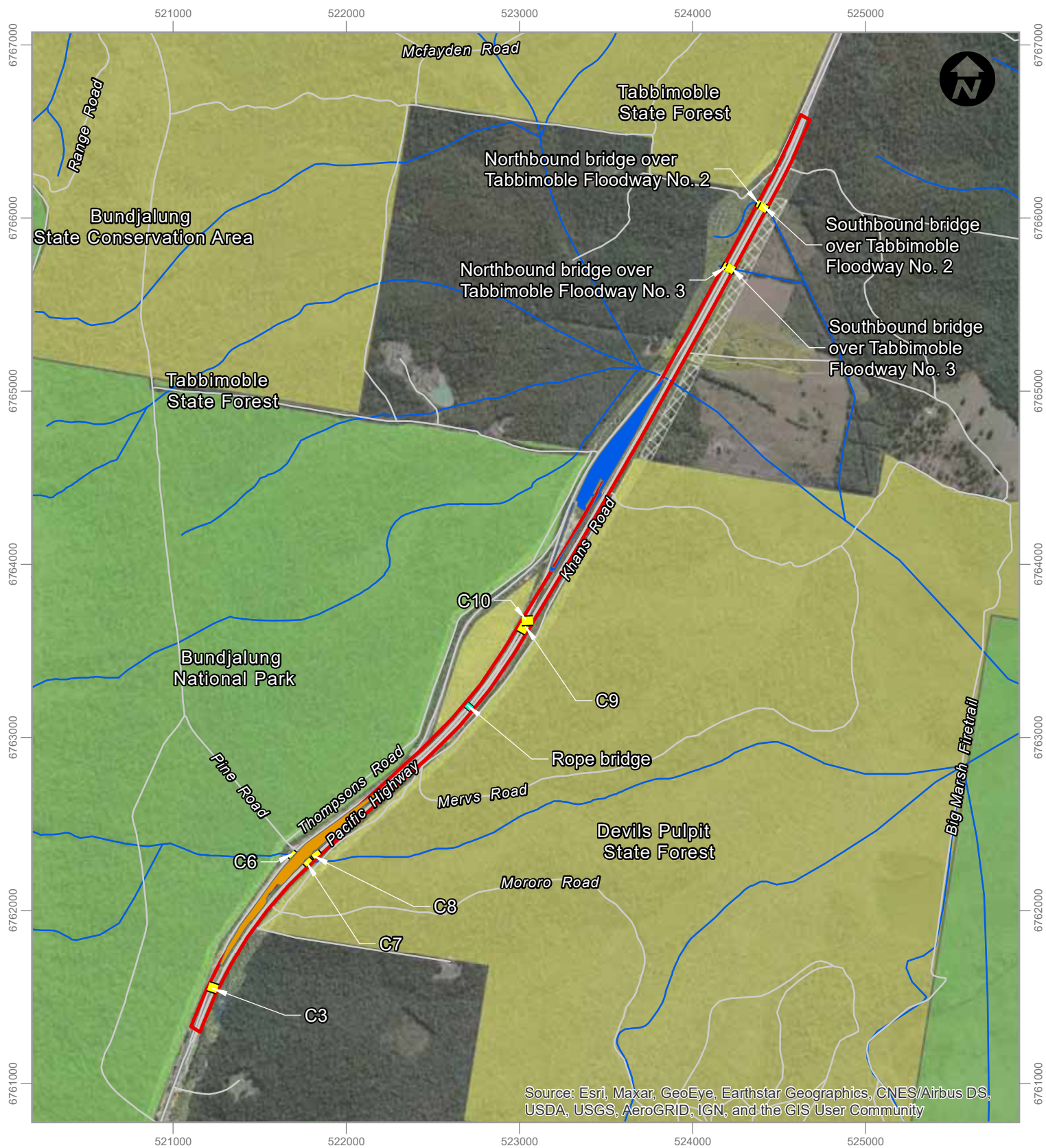
LEGEND

█ The project

GDA 1994 MGA Zone 56

0 2 Km

Site Locality - Illustration 1.1



LEGEND

- | | | |
|--|--|--|
| Devil's Pulpit concept clearing limit | Northern median | Combined fauna underpass |
| State Forest | Southern median | Rope bridge |
| National Park reserve | Vegetated connectivity corridor | Watercourse |

0 600 Metres

Mitigation Measures Being Monitored - Illustration 1.2



1.1.2 Changes to Site Conditions

Since commencement of the post construction monitoring, site conditions have changed due to Woolgoolga to Ballina Pacific Highway upgrade (W2B) construction between November 2017-October 2021; and a bushfire in November 2019. W2B construction included:

- clearing along the northbound lane at both medians to facilitate construction works
- clearing along fence lines (both lanes)
- pavement and drainage works along the northbound lane, including minor realigning of the northbound lane at the southern median (Impact Site 2)
- installing/ upgrading fauna fencing along both lanes
- installation of 'Koala/ fauna grids' where access roads intersect the northbound lane
- replacement of the pipe culvert south of the C6 fauna underpass (Impact Site 2)
- upgrades to the C6 fauna underpass, including an extension, raising the dry bench height approximately 0.3 m inside the culvert; modifying the fauna furniture and creating an approximately 1m wide dry passage at the inlet and outlet
- various temporary lane closures and diversions. The Devils Pulpit subject section of the Pacific Highway reopened to two lanes of traffic in both directions in August 2020, with localised works continuing until approximately October 2021.

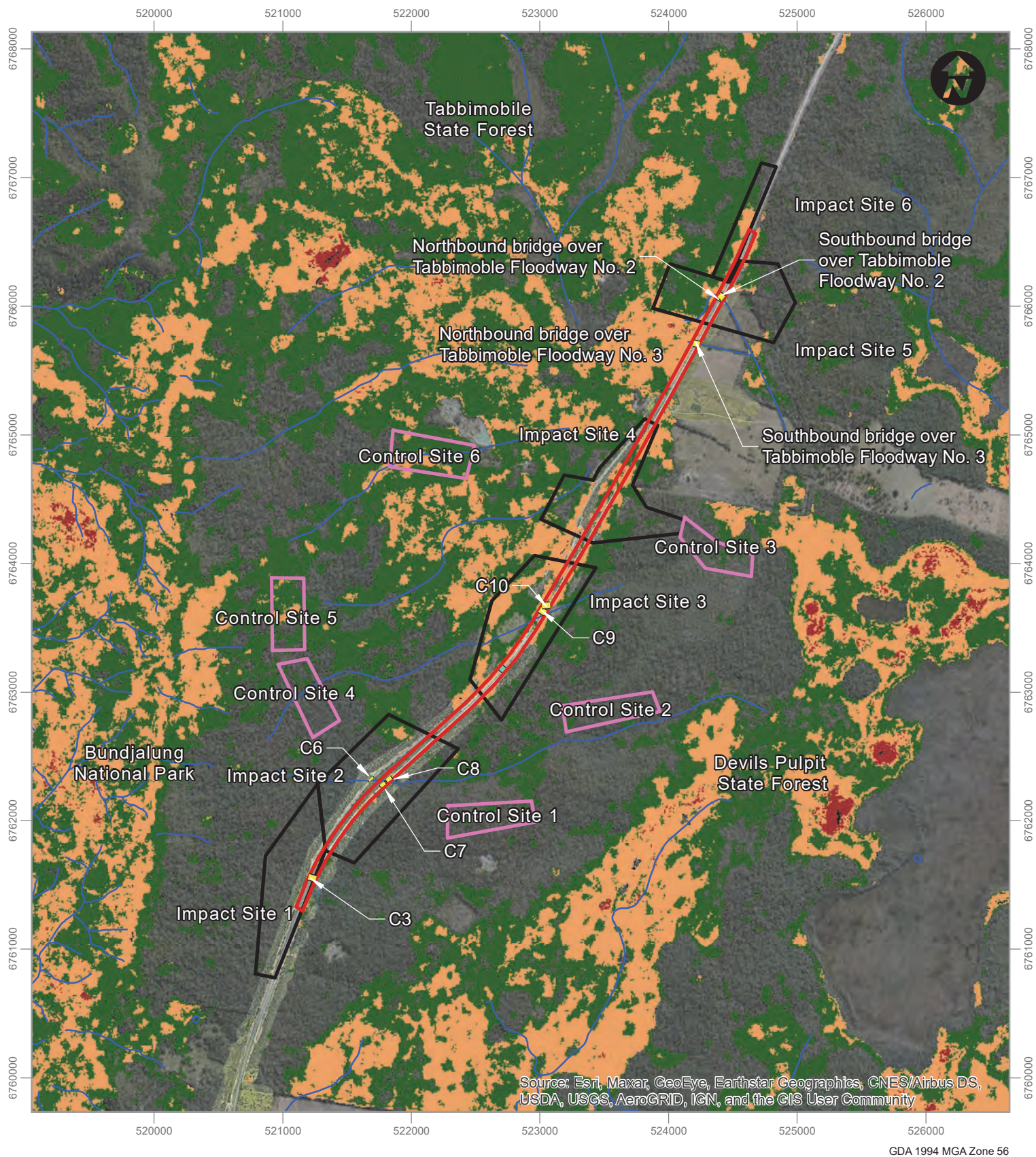
The entire study area was burnt during a bushfire in November 2019, excluding a localised area at the southern end of the southern median. The bushfire occurred during a period regional drought. Fire intensity ranged from low to moderate understorey burns to high intensity canopy burns, particularly on the western side of the highway. The bushfire moved across the study area in a north-west to south-east direction.

Department of Planning, Industry and Environment (DPIE) Fire Extent and Severity Mapping (FESM) for the study area is shown in **Illustration 1.3**. There are discrepancies with this mapping to what was observed on site (e.g. large portions of the study area are shown as unburnt), however is useful as a relative scale of fire intensity.

After the fires, vegetation and trees in proximity to the highway was assessment and additional hazardous tree were removed. Damage to infrastructure and resources from the fire included loss of 21 Devils Pulpit monitoring nest boxes and damage to fauna furniture at the Tabbimoble Floodway No. 2 and No.3 bridges.

These events have resulted in the following habitat changes along the Devils Pulpit section of the Pacific Highway:

- localised vegetation and habitat removal
- removal of 45 hollow-bearing trees from clearing and hazardous tree removal activities and
- increased vegetation fragmentation associated with the highway corridor.



LEGEND

- | | | |
|--|---|--|
| Devil's Pulpit concept clearing limit | Rope bridge | Unburnt |
| Control site | Combined fauna underpass | Reserved class for future development |
| Impact site | Watercourse | Low - burnt understory with unburnt canopy |
| | | Medium - partial canopy scorch |
| | | High - full canopy scorch/partial consumption |
| | | Extreme - full canopy consumption |
| | | No data |

0 800 Metres

DPIE Fire Extent and Severity Mapping - Illustration 1.3



2. Methodology

2.1 Monitoring Target Terrestrial Species

2.1.1 Monitoring Sites

Six monitoring 'Impact' sites and six monitoring 'Control' sites were monitored as part of the target terrestrial species monitoring component of the Project. The impact sites (numbered 1-6) were originally paired (east and west of the new upgraded highway alignment), with Impact Sites 2 and 4 encompassing the vegetated medians. The following modifications were made as part of post construction monitoring due to access constraints or insufficient habitat remaining in the road reserve:

- Impact Site 1 (east) was relocated to the western side of the highway due to insufficient habitat remaining within road reserve and access limitations on adjacent land to the east
- Impact Site 6 (east) was removed. The survey effort at other impact sites was increased to offset the reduced effort at Impact Site 6.

Six monitoring 'Control' sites were established as part of the post construction monitoring (GeoLINK 2018) and located a minimum of 0.5 km from the Pacific Highway (refer to **Illustration 2.2**), with:


- three control sites (Control Site 1-3) located in Devils Pulpit State Forest to the east of the Project
- three control sites (Control Site 4-6) located in Bundjalung National Park to the west of the Project.

Table 2.1 details the habitat and target species for each site.

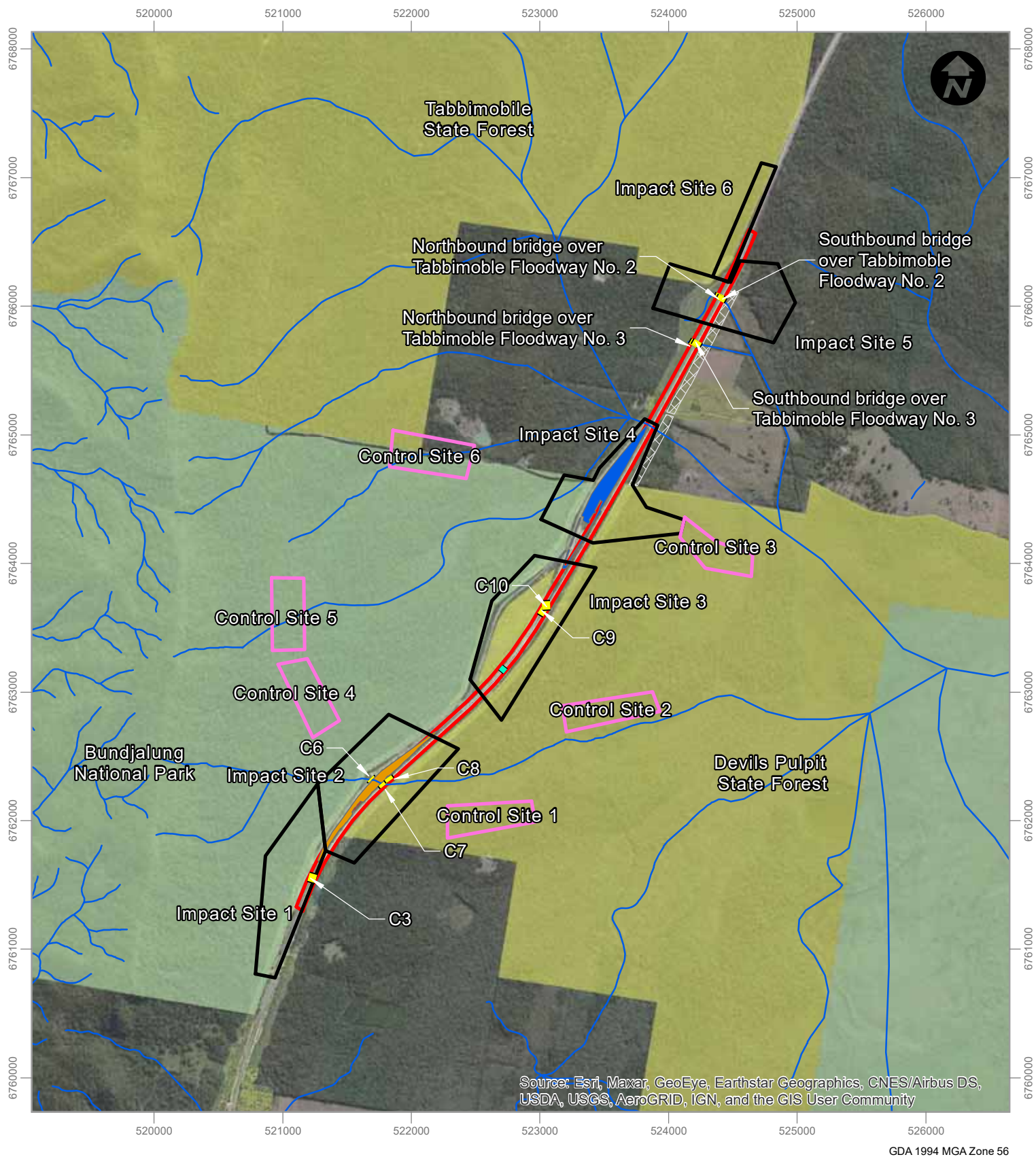
Table 2.1 Target Terrestrial Species Monitoring Sites and Target Species

| Site | Location (central chainage for impact sites) | Target Species | Design Mitigation Measure (impact sites only) | Vegetation Form and Class (Hyder 2011) |
|---------------|---|--|---|--|
| Impact Site 1 | CH 66.270 | <ul style="list-style-type: none"> ■ Brush-tailed Phascogale ■ Koala ■ Rufous Bettong ■ Long-nosed Potoroo | <ul style="list-style-type: none"> ■ Combined fauna underpass (C3). ■ Fauna fencing. | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> – Spotted Gum Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> – Eastern Red Gum Floodplain Forest. – Forest Red Gum Floodplain Forest. |
| Impact Site 2 | CH 67.170 | <ul style="list-style-type: none"> ■ Brush-tailed Phascogale ■ Green-thighed Frog ■ Koala ■ Rufous Bettong ■ Squirrel Glider ■ Yellow-bellied Glider ■ Long-nosed Potoroo ■ Greater Glider | <ul style="list-style-type: none"> ■ Combined fauna underpass (C6, C7 and C8). ■ Vegetated median. ■ Fauna fencing. | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> – Blackbutt Dry Sclerophyll Forest. – Spotted Gum Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> – Forest Red Gum Floodplain Forest. |
| Impact Site 3 | CH 69.000 | <ul style="list-style-type: none"> ■ Brush-tailed Phascogale ■ Green-thighed Frog ■ Koala ■ Squirrel Glider ■ Yellow-bellied Glider ■ Long-nosed Potoroo | <ul style="list-style-type: none"> ■ Combined fauna underpass (C9 and C10). ■ Fauna fencing. ■ Rope bridge. | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> – Scribbly Gum Dry Sclerophyll Forest. – Blackbutt Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> – Eastern Red Gum Floodplain Forest. |
| Impact Site 4 | CH 70.100 | <ul style="list-style-type: none"> ■ Brush-tailed Phascogale ■ Rufous Bettong ■ Squirrel Glider ■ Yellow-bellied Glider ■ Long-nosed Potoroo ■ Greater Glider | <ul style="list-style-type: none"> ■ Vegetated median | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> – Scribbly Gum Dry Sclerophyll Forest. – Blackbutt Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> – Forest Red Gum Floodplain Forest. |
| Impact Site 5 | CH 71.845 (Tabbimoble 2) | <ul style="list-style-type: none"> ■ Brush-tailed Phascogale ■ Green-thighed Frog ■ Koala ■ Rufous Bettong ■ Wallum Froglet | <ul style="list-style-type: none"> ■ Restoration of vegetation connectivity corridor. ■ Combined fauna underpass Tabbimoble Floodway No 2 and 3 | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> – Scribbly Gum Dry Sclerophyll Forest. – Blackbutt Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> – Eastern Red Gum Floodplain Forest. |

| Site | Location (central chainage for impact sites) | Target Species | Design Mitigation Measure (impact sites only) | Vegetation Form and Class (Hyder 2011) |
|----------------|---|--|---|--|
| | | <ul style="list-style-type: none"> Long-nosed Potoroo | <ul style="list-style-type: none"> bridges). Fauna fencing. | <ul style="list-style-type: none"> Forested Wetland: <ul style="list-style-type: none"> Paperbark Swamp Forest on coastal lowlands of the North Coast (note: this community is outside the Hyder 2011 study area footprint). |
| Impact Site 6 | CH 72.300 | <ul style="list-style-type: none"> Squirrel Glider Yellow-bellied Glider Greater Glider | <ul style="list-style-type: none"> No mitigation measures. | <ul style="list-style-type: none"> Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> Scribbly Gum Dry Sclerophyll Forest. Blackbutt Dry Sclerophyll Forest. Grassy Woodlands: <ul style="list-style-type: none"> Eastern Red Gum Floodplain Forest. |
| Control Site 1 | Devils Pulpit State Forest | <ul style="list-style-type: none"> Brush-tailed Phascogale Rufous Bettong Squirrel Glider Yellow-bellied Glider | - | <ul style="list-style-type: none"> Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> Spotted Gum Dry Sclerophyll Forest. Blackbutt Dry Sclerophyll Forest. |
| Control Site 2 | Devils Pulpit State Forest | <ul style="list-style-type: none"> Brush-tailed Phascogale Koala Rufous Bettong Squirrel Glider Yellow-bellied Glider | - | <ul style="list-style-type: none"> Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> Blackbutt Dry Sclerophyll Forest. Scribbly Gum Dry Sclerophyll Forest. |
| Control Site 3 | Devils Pulpit State Forest | <ul style="list-style-type: none"> Brush-tailed Phascogale Green-thighed Frog Koala Rufous Bettong Wallum Froglet | - | <ul style="list-style-type: none"> Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> Blackbutt Dry Sclerophyll Forest. Grassy Woodlands: <ul style="list-style-type: none"> Eastern Red Gum Floodplain Forest. |
| Control Site 4 | Bundjalung National Park | <ul style="list-style-type: none"> Brush-tailed Phascogale Green-thighed Frog Koala Rufous Bettong Squirrel Glider Yellow-bellied Glider | - | <ul style="list-style-type: none"> Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> Spotted Gum Dry Sclerophyll Forest Grassy Woodlands: <ul style="list-style-type: none"> Forest Red Gum Floodplain Forest. |
| Control Site 5 | Bundjalung National Park | <ul style="list-style-type: none"> Brush-tailed Phascogale Green-thighed Frog | - | <ul style="list-style-type: none"> Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> Spotted Gum Dry Sclerophyll Forest |



| Site | Location (central chainage for impact sites) | Target Species | Design Mitigation Measure (impact sites only) | Vegetation Form and Class (Hyder 2011) |
|----------------|---|--|--|--|
| | | <ul style="list-style-type: none"> ■ Rufous Bettong ■ Squirrel Glider ■ Yellow-bellied Glider | | <ul style="list-style-type: none"> ■ Grassy Woodlands: <ul style="list-style-type: none"> – Forest Red Gum Floodplain Forest. |
| Control Site 6 | Bundjalung National Park | <ul style="list-style-type: none"> ■ Koala | - | <ul style="list-style-type: none"> ■ Grassy Woodlands: <ul style="list-style-type: none"> – Eastern Red Gum Floodplain Forest. ■ Forested Wetland: <ul style="list-style-type: none"> – Paperbark Swamp Forest on coastal lowlands of the North Coast (note: this community is outside the Hyder 2011 study area footprint). |



LEGEND

| | | | | | |
|--|---------------------------------------|--|---------------------------------|--|--------------------------|
| | Devil's Pulpit concept clearing limit | | State forest | | Rope bridge |
| | Control site | | National park reserve | | Combined fauna underpass |
| | Impact site | | Northern median | | Watercourse |
| | | | Southern median | | |
| | | | Vegetated connectivity corridor | | |

0 800 Metres

Monitoring Site Locations - Illustration 2.1

2.1.2 Methodology

This section provides the 'Target Terrestrial Species' monitoring methodology used during post construction monitoring. Survey techniques are generally in accordance with the EMP (Hyder 2012) and GeoLINK (2012a), with the following modifications:

- Camera traps targeting the Rufous Bettong and Brush-tailed Phascogale were used in substitution of hair tubes. The survey methodology was revised so that data collected was comparable to the data collected as part of the *Woolgoolga to Ballina Pacific Highway Upgrade Rufous Bettong & Brush-tailed Phascogale Preconstruction Baseline Monitoring Survey* (Lewis 2014).
- Nest box monitoring was undertaken in substitution of arboreal Elliott B trapping.
- Mammal spotlighting transects use one person per spotlighting transect rather than two people.

These modifications were developed in consultation with Transport and NSW Environment Protection Authority (EPA) and approved by the NSW Department of Planning and Environment (DoPE) on 22 June 2017.

Additionally, Koala Spot Assessment Technique (SAT) monitoring was terminated from the monitoring program and was not undertaken as part of the Year 4 or 6 monitoring. Year 3 post construction monitoring found that *'Due to the recorded low density and activity levels of Koalas in the study area and EMP design, the EMP will not be able to identify changes in Koala relative abundance nor determine if any changes are attributed to the Devils Pulpit Pacific Highway upgrade'* (GeoLINK 2018). Cessation of Koala SAT monitoring was endorsed by the NSW Environmental Protection Agency (EPA – Peter Higgs – Senior Threatened Species Officer; email correspondence dated 12 July 2018).

All other survey techniques adopted during Year 6 monitoring were consistent with the methods used during the Year 3 and 4 monitoring (GeoLINK 2018, 2019a).

2.1.3 Rufous Bettong


Rufous Bettong monitoring included camera traps at five impact and five control sites and spotlighting at six impact and six control sites in winter, spring and summer of 2020/ 2021.

2.1.3.1 Camera Traps

Camera traps were established at each site in two lines of three (six cameras in a grid) spaced 100 m apart, with a trap density of one camera per hectare. The cameras were primarily Titley Scientific Trail Camera 0.35 sec Fast Trigger 12MP No-Glow Infra-red LED (Trail Cameras). Up to three Bushnell NatureView Cam HD Max cameras and three X-Trail 3CW HD cameras were used when the Trail Cameras were being maintained. The cameras were set in a horizontal orientation following the methodology in *Taylor et al.* (2014). This included:

- Removing vegetation and leaf litter at the site. Existing clearings were selected to minimise vegetation disturbance.
- Use of a bait station (110 mm x 35 mm PVC pipe pegged to the ground). Bait stations were positioned 1.2-1.5 m* from the camera for Trail Cameras and 2 m for the other cameras.
- Positioning the camera approximately 0.4 m above the ground on a tree, with the camera angled down at the bait station.

**Bait stations were moved closer to the cameras (from 2 m in Year 3 monitoring) for the Trail Cameras as this was found to produce better quality images for identification with the wide-angle camera lens.*



Cameras were set for 14 continuous trap nights each season (winter, spring and summer), with the following recording parameters for the Trail Cameras:

- Camera mode: Photo.
- Resolution: 12MP.
- Night mode: Balanced.
- Multi-shot: three with 20 second delay.
- Sensitivity: High.
- Timer mode set from 5.00 pm to 7.00 am (14 hours) each day, with the time adjusted for changes in daylight saving.

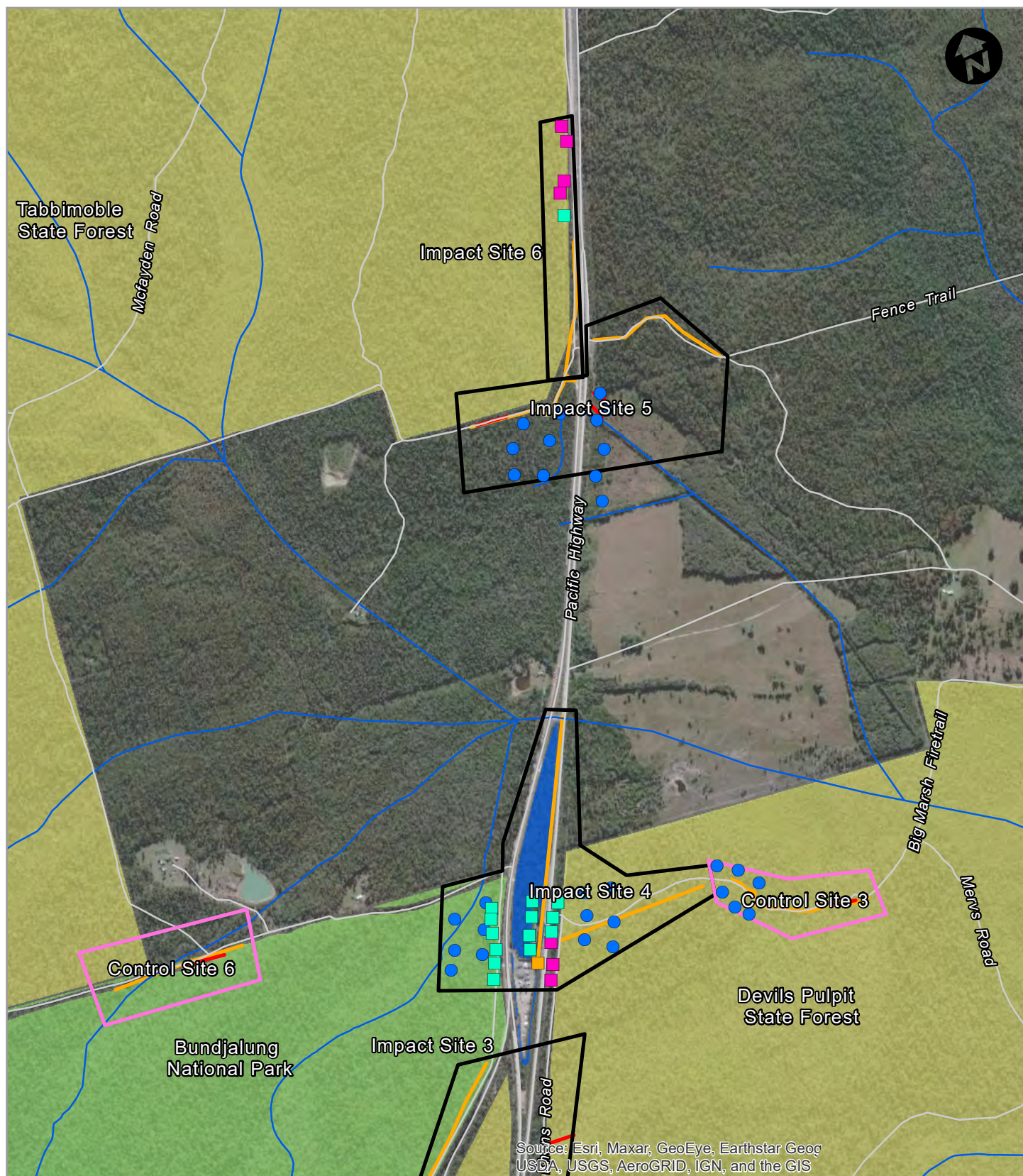
Equivalent settings were used with the other camera types.

Bait stations were baited with a peanut butter, honey, oats, vanilla essence and sesame oil mix. Camera trap locations are provided in **Appendix A** and shown in **Illustration 2.2**. All camera trap locations were the same as those used during Year 3 monitoring, except at Impact Site 5 (east) which was relocated after the Year 4 winter surveys to Transport land to avoid conflicts with activities on the private land. A summary of the installation and retrieval dates, and survey effort is provided in **Appendix A**.

All images were downloaded onto a computer and reviewed by a senior ecologist. All mammals detected were recorded, with the following data collected: identification accuracy (possible, probable, definite) and number of individuals (>1 only if >1 in the photo/ s or defined features were observed). Where traps were collected after 14 nights, records of target species only recorded from night 15 onwards were recorded as opportunistic records and not included in the analysis.

'Activity levels' of target species at each site were calculated as a function of the number of cameras that detected the relevant target species for each season. It is used as a surrogate for relative density. The mean and standard errors were derived from the percentage activity values for the three survey periods (seasons) to provide an overall activity level for each site for Year 6 monitoring. This methodology allows for comparison with data collected for the W2B project (e.g. Lewis 2014).

Additionally, Year 3 and 4 results have been re-analysed to allow for comparison of activity levels between years.



GDA 1994 MGA Zone 56

LEGEND

- Control site
- Impact site
- State Forest
- National Park reserve

Northern median

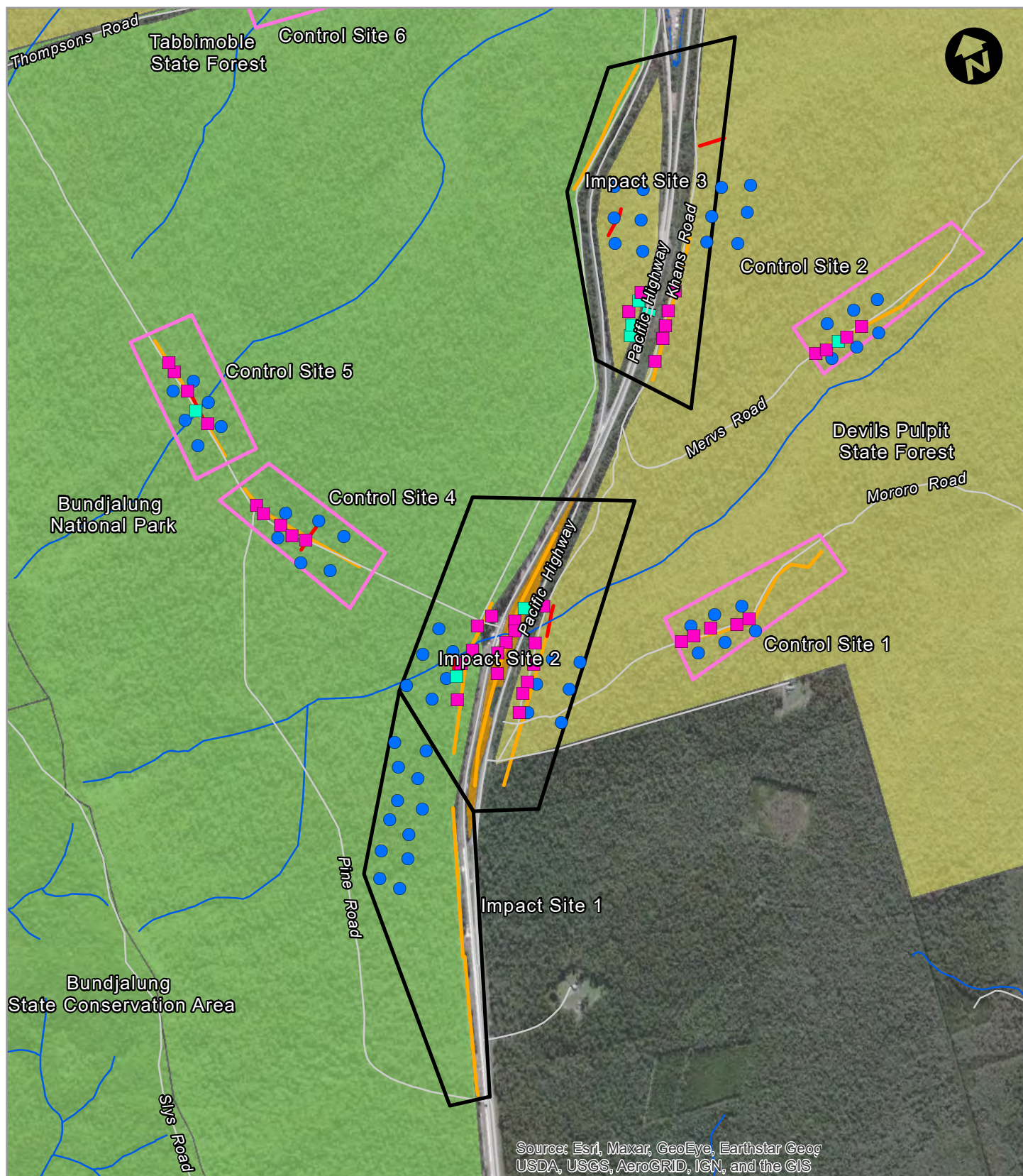
- Frog survey
- Mammal spotlighting survey
- Watercourse
- Rufous Bettong/ Brush-tailed Phascogale camera trap

Nest Box

- Nest box (burnt)
- Nest box (not burnt)
- Nest box (not burnt; not accessible in spring/summer)

0 400 Metres

Target Terrestrial Species Monitoring Locations Illustration 2.2 - Sheet 1 of 2



GDA 1994 MGA Zone 56

LEGEND

- Control site
- Impact site
- State Forest
- National Park reserve

- Northern median
- Southern median

- Frog survey
- Mammal spotlighting survey
- Rope bridge
- Watercourse
- Rufous Bettong/ Brush-tailed Phascogale camera trap

Nest Box

- Nest box (burnt)
- Nest box (not burnt)

0 400 Metres

Target Terrestrial Species Monitoring Locations Illustration 2.2 - Sheet 2 of 2

2.1.3.2 Spotlighting

While five impact sites (1, 2, 3, 4 and 5) and five control sites (1, 2, 3, 4 and 5) were nominated as target sites for the Rufous Bettong, spotlighting was undertaken at all six impact and six control sites, targeting all target mammal species. Spotlighting was undertaken along 500 m transects with one observer spotlighting at a rate of 1 km/ hour. This included ten impact site transects and six control site transects. Two additional 1 km transects were undertaken at the vegetated medians at Impact Sites 2 and 4 and were spotlighted at the same rate. Refer to **Illustration 2.2** for spotlighting survey locations.

Spotlighting surveys were undertaken over three non-consecutive nights per season (winter, spring and summer).

Threatened nocturnal avifauna and reptiles were also recorded when encountered.


Table 2.2 **Table 2.2** summarises spotlighting survey sites and effort. Survey dates and weather conditions are provided in **Appendix A**.

All mammals (excluding flying-foxes) detected (observed and/ or call identified) were recorded, with the following data collected: species; number of individuals; sex; age; presence and number of dependant young; behaviour.

Threatened nocturnal avifauna and reptiles were also recorded when encountered.

Table 2.2 Spotlighting Survey Effort During Year 6 Monitoring

| Site | No. Spotlighting Surveys | | | |
|---------------------------|--------------------------|--------|--------|-------|
| | Winter | Spring | Summer | Total |
| Impact Site 1 (east) | 3 | 3 | 3 | 9 |
| Impact Site 1 (west) | 3 | 3 | 3 | 9 |
| Impact Site 2 (east) | 3 | 3 | 3 | 9 |
| Impact Site 2 (median) | 3 | 3 | 3 | 9 |
| Impact Site 2 (west) | 3 | 3 | 3 | 9 |
| Impact Site 3 (east) | 3 | 3 | 3 | 9 |
| Impact Site 3 (west) | 3 | 3 | 3 | 9 |
| Impact Site 4 (east) | 3 | 3 | 3 | 9 |
| Impact Site 4 (median) | 3 | 3 | 3 | 9 |
| Impact Site 5 (east) | 3 | 3 | 3 | 9 |
| Impact Site 5 (west) | 3 | 3 | 3 | 9 |
| Impact Site 6 (west) | 3 | 3 | 3 | 9 |
| Control site 1 | 3 | 3 | 3 | 9 |
| Control site 2 | 3 | 3 | 3 | 9 |
| Control site 3 | 3 | 3 | 3 | 9 |
| Control site 4 | 3 | 3 | 3 | 9 |
| Control site 5 | 3 | 3 | 3 | 9 |
| Control site 6 | 3 | 3 | 3 | 9 |
| Total Impact Sites | 36 | 36 | 36 | 108 |



| Site | No. Spotlighting Surveys | | | |
|----------------------------|--------------------------|-----------|-----------|------------|
| | Winter | Spring | Summer | Total |
| Total Control Sites | 18 | 18 | 18 | 54 |
| Total All Sites | 54 | 54 | 54 | 162 |

2.1.4 Spotted-tailed Quoll

The Spotted-tailed Quoll monitoring component covered under this monitoring program is detailed in the *Spotted-tailed Quoll Management Plan* (SKM 2012) and relates to monitoring fauna underpass structures. The survey methodology is discussed in **Section 2.2.1**, noting that the monitoring is being undertaken in post construction years 3, 4 and 6 as per the EMP, rather than years 1, 3 and 5 as stated in some sections of SKM (2012).

2.1.5 Green-thighed Frog and Wallum Froglet

Threatened frog monitoring was undertaken targeting the Green-thighed Frog and Wallum Froglet. Target sites are shown in **Illustration 2.2**. Three impact sites (2, 3 and 5) and three control sites (3, 4 and 5) were surveyed targeting the Green-thighed Frog. One impact site (5) and one control site (3) was also surveyed targeting the Wallum Froglet.

The surveys included:

- **Spotlighting:** 100 m spotlighting transects with two observers 20 m apart, on two non-consecutive nights per season (spring and summer). Spotlighting was undertaken at a rate of 200 m/ hour.
- **Call Playback:** Green-thighed Frog and/ or Wallum Froglet call playback was undertaken near the centre of each spotlighting transect or within appropriate habitat. The methodology included five minutes listening, two minutes call playback, five minutes listening, two minutes call playback, then five minutes listening.

The EMP required two threatened frog surveys following suitable separate rainfall events in both spring and summer (four surveys in total). Due to insufficient rain in Year 6 spring, four survey events were undertaken in Year 6 summer; and summer surveys 1 and 2 were undertaken on consecutive days which formed part of the same rainfall event to ensure sufficient surveys were undertaken.

Specific survey dates are provided in **Table 2.3**.

The survey rainfall event criteria outlined in EMP (Hyder 2012) were met for each survey (i.e. when between 30-50 mm of rain was recorded within a 24 hour period, or when soil saturation levels are high and 20-30 mm of rain was recorded within a 24 hour period). Most frog survey events were also in line with the triggers recommended in GeoLINK (2018) (i.e. '*a rainfall event which exceeded 50 mm within a 24 hour period with a preference given to rainfall events which exceeded 75 mm in 24 hours or an accumulated total of 150 mm over a 72 hour period*'). Weather conditions during the surveys are provided in **Appendix A**.

Table 2.3 Threatened Frog Monitoring Survey Dates During Year 6 Monitoring

| Survey Event | Date |
|------------------------|-------------|
| Year 6 Summer Survey 1 | 14/12/2020 |
| Year 6 Summer Survey 2 | 15/12/2020 |
| Year 6 Summer Survey 3 | 7/01/2021 |
| Year 6 Summer Survey 4 | 18/02/2021 |

2.1.6 Yellow-bellied Glider

Targeted Yellow-bellied Glider surveys were undertaken at four impact sites (2, 3, 4 and 6) and four control sites (1, 2, 4 and 5) in winter, spring and summer for three non-consecutive nights per season. Spotlighting was also undertaken at Impact Sites 1 and 5, and Control Sites 3 and 6. The surveys included:

- **Spotlighting:** As for **Section 2.1.3.2**. Spotlighting was undertaken along ten 500 m impact site transects; two 1 km impact site transects and six 500 m control site transects with one observer spotlighting at a rate of 1km/ hour.
- **Call-playback:** Yellow-bellied Glider call-playback was undertaken at one point along the seven impact sites (2 east, 2 median, 2 west, 3 east, 3 west, 4 east, 4 median and 6 west) and four control site (1, 2, 4 and 5) spotlighting transects that targeted the Yellow-bellied Glider. The methodology comprised five minutes listening, five minutes Yellow-bellied Glider call playback, two minutes listening, five minutes playback, two minutes listening. A Faunatech modified Toa megaphone (or equivalent) was used to broadcast recorded Yellow-bellied Glider call recordings.

Yellow-bellied Glider survey dates are provided in **Appendix A**.

2.1.7 Squirrel Glider

Target Squirrel Glider surveys were undertaken at four impact sites (2, 3, 4 and 6) and four control sites (1, 2, 4 and 5). Spotlighting was also undertaken at Impact Sites 1 and 5, and Control Sites 3 and 6. The surveys included:

- **Spotlighting:** As for **Section 2.1.3.2**. Spotlighting was undertaken along ten 500 m impact site transects; two 1 km impact site transects and six 500 m control site transects with one observer spotlighting at a rate of 1 km/ hr. Spotlighting surveys were conducted for three non-consecutive nights each season (winter, spring and summer).
- **Nest Box Monitoring:** Forty-nine (31 impact and 18 control) unburnt Squirrel Glider nest boxes (Hollow-Log Home – rear entry timber design) of the 70 installed in winter 2017 were surveyed in Year 6 winter, spring and summer. One nest box (Impact 4 (median)) was not inspected in spring and summer as access to the median was removed as part of W2B completion works. Nest box locations are shown in **Illustration 2.2** and detailed in **Appendix B**. **Table 2.4** details the nest box configuration at relevant sites. The nest boxes were checked by a tree climber under ecologist supervision. When fauna were present, either:
 - the nest box entrance was blocked and the nest box was lowered for direct ecologist inspection and species identification. The nest boxes were subsequently re-instated
 - a camera with a remote screen was used by the arborist and inspected by the ecologist.

Table 2.4 Nest Box Configuration

| Site | No. of Nest Boxes | |
|----------------------------|----------------------------|-------------------------|
| | Year 3 & Year 4 | Year 6 (unburnt) |
| Impact Site 2 (west) | 6 | 5 |
| Impact Site 2 (median) | 6 | 5 |
| Impact Site 2 (east) | 6 | 6 |
| Impact Site 3 (west) | 5 | 2 |
| Impact Site 3 (east) | 6 | 6 |
| Impact Site 4 (west) | 6 | 0 |
| Impact Site 4 (median) | 5 | 1 |
| Impact Site 4 (east) | 5 | 2 |
| Impact Site 6 (west) | 5 | 4 |
| Control site 1 | 5 | 5 |
| Control site 2 | 5 | 4 |
| Control site 4 | 5 | 5 |
| Control site 5 | 5 | 4 |
| Total Impact Sites | 50 | 31 |
| Total Control Sites | 20 | 18 |
| Total All Sites | 70 | 49 |

2.1.8 Brush-tailed Phascogale

Brush-tailed Phascogale monitoring was undertaken in winter, spring and summer, and included:

- Camera Traps: Refer to **Section 2.1.3.1**.
- Spotlighting: Refer to **Section 2.1.3.2**.
- Nest Box Monitoring: Refer to **Section 2.1.7**.

2.1.9 Koala

Koala monitoring surveys included:

- **Spotlighting:** Refer to **Section 2.1.3.2**.
- **Call-playback:** Koala call-playback was undertaken at one point along the eight impact sites (1 east, 1 west, 2 east, 2 west, 3 east, 3 west, 5 east, 5 west) and four control sites (2, 3, 4, 6) spotlighting transects that targeted the Koala for three non-consecutive nights in winter, spring and summer. The methodology comprised five minutes listening, five minutes Koala call playback, two minutes listening, five minutes playback, two minutes listening. A Faunatech modified Toa megaphone (or equivalent) was used to broadcast the Koala call recording. Survey dates are provided in **Appendix A**.

2.2 Monitoring Crossing Structures

2.2.1 Fauna Underpasses

2.2.1.1 Monitoring Sites

The EMP and *Spotted-tailed Quoll Management Plan* (SKM 2012) identified 10 combined fauna underpass structures that require monitoring. These structures are shown in **Illustration 1.2** and are described in GeoLINK (2018).

2.2.1.2 Methodology

Underpass monitoring undertaken as part of Year 6 monitoring included:

- **Underpass camera traps:** Motion-detecting cameras were installed at each of the ten combined fauna underpass structures. The camera configurations and installation/ retrieval dates are provided in **Table 2.5**. The cameras are operating for the full year and checked each season (roughly two to three monthly), including replacing sd cards and batteries. This reporting period covers monitoring undertaken in Year 4 between 18/02/2019 and 20/08/2019 (outside of the Year 4 reporting period) and all of Year 6.
- **Substitution camera traps:** Two camera traps (substituting sand-plots) were established 0.4 m above the ground at the ends of each fauna underpass culvert or in locations complementing underpass cameras at the bridges for a minimum of four weeks each season (winter, spring and summer); excluding at C3. As there is limited potential for the two substitution cameras previously designated to this structure to enhance camera coverage/ fauna detectability above the underpass camera detection rate, these substitution cameras were installed on the northern wingwall at both ends of the pipe culverts located south of the C6 fauna underpass (referred to as C6 pipes). Installation and retrieval dates are detailed in **Table 2.6**.
- **Fauna furniture camera traps:** Camera traps (substituting hair-tubes) were installed at the six underpass structures with timber rail fauna furniture (11 cameras in total). Two cameras were installed at five of the underpasses, located at each end of the fauna furniture within the underpass and facing towards the centre of the structure. Only one camera trap was installed on the fauna furniture at NBT2 (eastern end, facing west) as the western portion of the fauna furniture was destroyed in the 2019 bushfire. The camera traps were set for a minimum of four weeks per season. Installation and retrieval dates are provided in **Table 2.6**.
- **Scat and track searches:** Scat and track searches were undertaken at each of the ten fauna underpass structures twice per season (0.5 hours per structure per event) in winter, spring and summer. Triggs (2004) was used for fauna identification. Survey dates are provided with the results in **Appendix C**.

The underpass camera traps comprised Reconyx HC500 HyperFire cameras, housed in security casings. At culverts, they were installed on the wall in the centre of each culvert cell between 0.4 to 1 m high (depending on inundation risk); while locations at bridges varied to maximise field of view. The cameras were set with the following recording parameters, consistent with those used for the Glenugie Pacific Highway Upgrade monitoring (Sandpiper 2017):

- Motion Sensor: On.
- Sensitivity: High.
- Time Lapse: Off.
- Pictures/ Trigger: 10

- Picture interval: Rapidfire.
- Image resolution: 1080p.
- Quiet Period: No delay.

The substitution camera traps and fauna furniture camera traps comprised Titley Scientific Trail Camera 0.35 sec Fast Trigger 12MP No-Glow Infra-red LED. The cameras were set with the following recording parameters:

- Camera mode: Photo.
- Resolution: 12MP.
- Night mode: Balanced.
- Multi-shot: 5 with 0 second delay.
- Sensitivity: High (except during Year 6 Summer at some Tabbimoble Floodway cameras that were being falsely triggered by vehicle movements. The sensitivity at these cameras were reduced to low).
- Timer: off.

All images were downloaded onto a computer and reviewed by an ecologist. Data recorded included species, date, time, location, direction of movement (east, west, N/ A, returned), and outcome. 'Complete crossings' were defined as follows:

- Bridges:
 - image sequence shows a complete crossing
 - directional movement indicative of a complete crossing
 - image sequence shows a complete crossing when comparing cameras, fauna species and recording times at other cameras on the subject bridge or the adjacent opposite lane bridge.
- Underpasses:
 - image sequence shows a complete crossing when comparing cameras at each end of the structure, or
 - image sequence from camera in the centre (middle) of a culvert shows movement in one direction and the fauna does not return.

Unique complete crossings were identified by comparing the species, times and dates of recordings on the different cameras at each structure (and adjacent bridge in the case of the Tabbimoble Floodway bridges).



Table 2.5 Underpass Camera Trap Configuration and Effort During Year 6 Reporting Period

| Underpass | Underpass Camera Trap | Year 4 | | | | | | Year 6 | | | | | | | | | | | | Total Days Active (Y4&6) |
|--------------------|---|-----------|-----------------------|--------------------------|----------|---------------------------|---------------------------|----------|-----------------------|-------------|-----------------------|-------------|---|-------------|-----------------------|-------------|----------|-------------|-------------------|--------------------------|
| | | Start | 1 st Check | | End | | Total Active Days | Start | 1 st Check | | 2 nd Check | | 3 rd Check | | 5 th Check | | End | | Total Days Active | |
| | | | Date | Days Active | Date | Days Active | | | Date | Days Active | Date | Days Active | Date | Days Active | Date | Days Active | Date | Days Active | | |
| C3 (3 cell RBC | 2 x cameras (attached to northern wingwall at inlet and outlet). | 18/02/19* | 29/04/19 | 71 (eastern camera only) | 20/08/19 | 113 (eastern camera only) | 184 (eastern camera only) | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| C6 (1 cell RCBC) | 1 x camera (in centre of culvert) | 18/02/19* | 29/04/19 | 0 | 20/08/19 | 0 | 0 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | ^Temporary removal 18/09/20. Reinstalled 8/10/20. | 63 | 04/12/20 | 63 | 15/02/21 | 73 | 368 | 368 |
| C7 (2 cell RCBC): | 2 x camera (in centre of each culvert cell) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| C8 (2 cell RCBC): | 2 x camera (in centre of each culvert cell) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| C9 (2 cell RCBC): | 2 x camera (in centre of each culvert cell) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| C10 (2 cell RCBC): | 2 x camera (in centre of each culvert cell) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| NBT3 | 2 x camera (1 at northern bank; 1 at southern bank) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| NBT2 | 2 x camera (1 at northern bank; 1 at southern bank) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| SBT3 | 3 x camera (1 at northern bank; 1 at southern bank central span; 1 at southern abutment span) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |
| SBT2 | 2 x camera (1 at northern bank; 1 at southern bank) | 18/02/19 | 29/04/19 | 71 | 20/08/19 | 113 | 184 | 24/01/20 | 20/04/20 | 88 | 10/07/20 | 81 | 2/10/20 | 84 | 04/12/20 | 63 | 15/02/21 | 73 | 389 | 573 |

*C3 west and C6 underpass camera traps were not operational during the subject Year 4 period due to W2B construction works.

^ C6 underpass camera trap was temporarily removed between 18/09/2020 and 8/10/2020 due to W2B construction works.

Table 2.6 Underpass Substitution and Fauna Furniture Camera Trap Installation and Retrieval Dates, and Effort during Year 6 Monitoring

| Id. | No. Substitution Cameras | No. Fauna Furniture Cameras | Winter | | | Spring | | | Summer | | | Total Active Days | |
|--------------------|--------------------------|-----------------------------|----------------|----------------|-------------|----------------|----------------|-------------|----------------|----------------|-------------|---------------------|------------------------|
| | | | Date Installed | Date Retrieved | Active Days | Date Installed | Date Retrieved | Active Days | Date Installed | Date Retrieved | Active Days | Substitution Camera | Fauna Furniture Camera |
| C3 (3 cell RCBC) | 0 | 0 | - | - | - | - | - | - | - | - | - | - | - |
| C6 (1 cell RCBC)* | 2 | 2 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 18/09/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | 121 (242) |
| | | | | | | 8/10/2020 | 22/10/2020 | | | | | | |
| C6 (pipes) | 2 | 0 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60)^ | 121 (242)^ | N/A |
| C7 (2 cell RCBC): | 2 | 0 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | N/A |
| C8 (2 cell RCBC): | 2 | 2 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | 92 (184) |
| C9 (2 cell RCBC): | 2 | 0 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | N/A |
| C10 (2 cell RCBC): | 2 | 0 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | N/A |
| NBT3 | 2 | 2 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | 121 (242) |
| NBT2 | 2 | 1* | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | 121 (242) |
| SBT3 | 2 | 2 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | 121 (242) |
| SBT2 | 2 | 2 | 3/08/2020 | 31/08/2020 | 29 (58) | 1/09/2020 | 2/10/2020 | 32 (64) | 22/12/2020 | 20/01/2020 | 30 (60) | 121 (242) | 121 (242) |

Effective trap nights are provided in brackets behind 'Active Days'.

* Year 6 spring surveys were staggered due to W2B construction works.

^ denotes camera with potential battery failure reducing trap nights of one of the cameras by 14 days in summer.

2.2.2 Rope Bridge

2.2.2.1 Description

The Devils Pulpit rope bridge is located at approximate chainage 68.500 over both the north and southbound lanes at a cutting (refer to **Illustration 1.2**). Original design features of the rope bridge are described in GeoLINK (2018), while modifications (release point and 30mm diameter silver rope) is described in GeoLINK (2019).

2.2.2.2 Methodology

Monitoring of the rope bridge is required continuously in post construction monitoring years 3, 4 and 6. This reporting period covers monitoring undertaken in Year 4 between 15/01/2019 and 16/08/2019 and all of Year 6 (31/01/2020 to 1/02/2021). Two Reconyx cameras were installed on the rope bridge at each pole (one camera at each end). The cameras were positioned on the main rope bridge approximately 2 m from the poles, facing towards the respective pole. They are checked each season (every three months) and SD cards and batteries are replaced during each inspection. Camera setup, inspection and removal dates during the reporting period are provided in **Table 2.7**. A malfunction of the camera on the western pole resulted in 91 days of no data between 28/05/2020 and 27/08/2020.

Reconyx SC950 cameras were used during the Year 4 monitoring period and on the western pole during Year 6. A HC600 Hyperfire camera was used on the eastern pole during Year 6. This camera has the same specifications as the SC950, except it is not time programmable so the camera was always on.

Recording parameters set include:

- Motion Sensor: On.
- Sensitivity: High.
- Time Lapse: Off.
- Pictures/ Trigger: 10
- Picture interval: Rapidfire (up to two per second).
- Image resolution: 3.1MP.
- Quiet Period: 6.00 am to 6.00 pm (SC950 cameras only in Year 4 and January to August of Year 6. The quiet period was turned off on the SC950 camera [western pole] between August 2020 and February 2021).
- Night mode: Balanced.

All images were downloaded onto a computer and reviewed by a senior ecologist. Data recorded included species, date, time, location (eastern rope bridge pole or western rope bridge pole) and direction of movement (east, west, N/ A, returned). Complete crossings were noted where an individual was recorded at both ends of the structure, moving in one direction and the time and sequence of images corresponding to indicate the individual crossed the entire structure. Where cameras were always on, only images captured between 6.00 pm and 6.00 am were analysed as part of the main analysis. Other images captured outside this period were inspected and noted as opportunistic records.



Table 2.7 Rope Bridge Camera Inspection Dates and Effort for Year 6 Reporting Period

| Underpass Camera Trap | Year 4 | | | | | | Year 6 | | | | | | | | | | | | Total Days Active (Y4&6) |
|-----------------------|----------|-----------------------|-------------|----------|-------------|-------------------|----------|-----------------------|-------------|-----------------------|-------------|-----------------------|-------------|-----------------------|-------------|---------|-------------|-------------------|--------------------------|
| | Start | 1 st Check | | End | | Total Active Days | Start | 1 st Check | | 2 nd Check | | 3 rd Check | | 5 th Check | | End | | Total Days Active | |
| | | Date | Days Active | Date | Days Active | | | Date | Days Active | Date | Days Active | Date | Days Active | Date | Days Active | Date | Days Active | | |
| Rope Bridge Pole East | 15/01/19 | 10/05/19 | 116 | 16/08/19 | 98 | 214 | 31/01/20 | 28/05/20 | 119 | 19/08/20 | 83 | 27/08/20 | 8 | 22/10/20 | 56 | 1/02/21 | 101 | 367 | 581 |
| Rope Bridge Pole West | 15/01/19 | 10/05/19 | 116 | 16/08/19 | 98 | 214 | 31/01/20 | 28/05/20 | 119 | 19/08/20 | 0* | 27/08/20 | 0* | 22/10/20 | 56 | 1/02/21 | 101 | 276 | 490 |

* denote period of camera malfunction.

2.2.3 Vegetated Median

2.2.3.1 Description

The Project encompasses two vegetated medians that are surveyed as part of the EMP. Locations of the medians are shown in **Illustration 1.2**. The southern median corresponds with Impact Site 2 and the northern median corresponds with Impact Site 4. A description of each median is provided in GeoLINK (2018).

2.2.3.2 Methodology

Vegetated median monitoring activities undertaken during the Year 6 monitoring included:

- **Spotlighting:** As for **Section 2.1.3.2**. Spotlighting was undertaken along one one-kilometre transect at each median with one observer spotlighting at a rate of one kilometre/ hour. Spotlighting surveys were conducted for three non-consecutive nights each season (winter, spring and summer). **Table 2.2** lists spotlighting survey sites and effort. Survey dates and weather conditions are provided in **Appendix A**.
- **Nest Box Monitoring:** As for **Section 2.1.7**. Squirrel Glider nest boxes were monitored once per season in winter, spring and summer. The five nest boxes located at Impact Site 2 (median) and one nest box located at Impact Site 4 (median) that remained post the 2019 bushfire were inspected as part of the Year 6 monitoring. The nest box at Impact Site 4 (median) was not inspected in spring and summer as access to the median was removed as part of W2B works. Nest box locations are shown in **Illustration 2.2** and detailed in **Appendix B**.

2.2.4 Restoration of Vegetated Connectivity Corridor

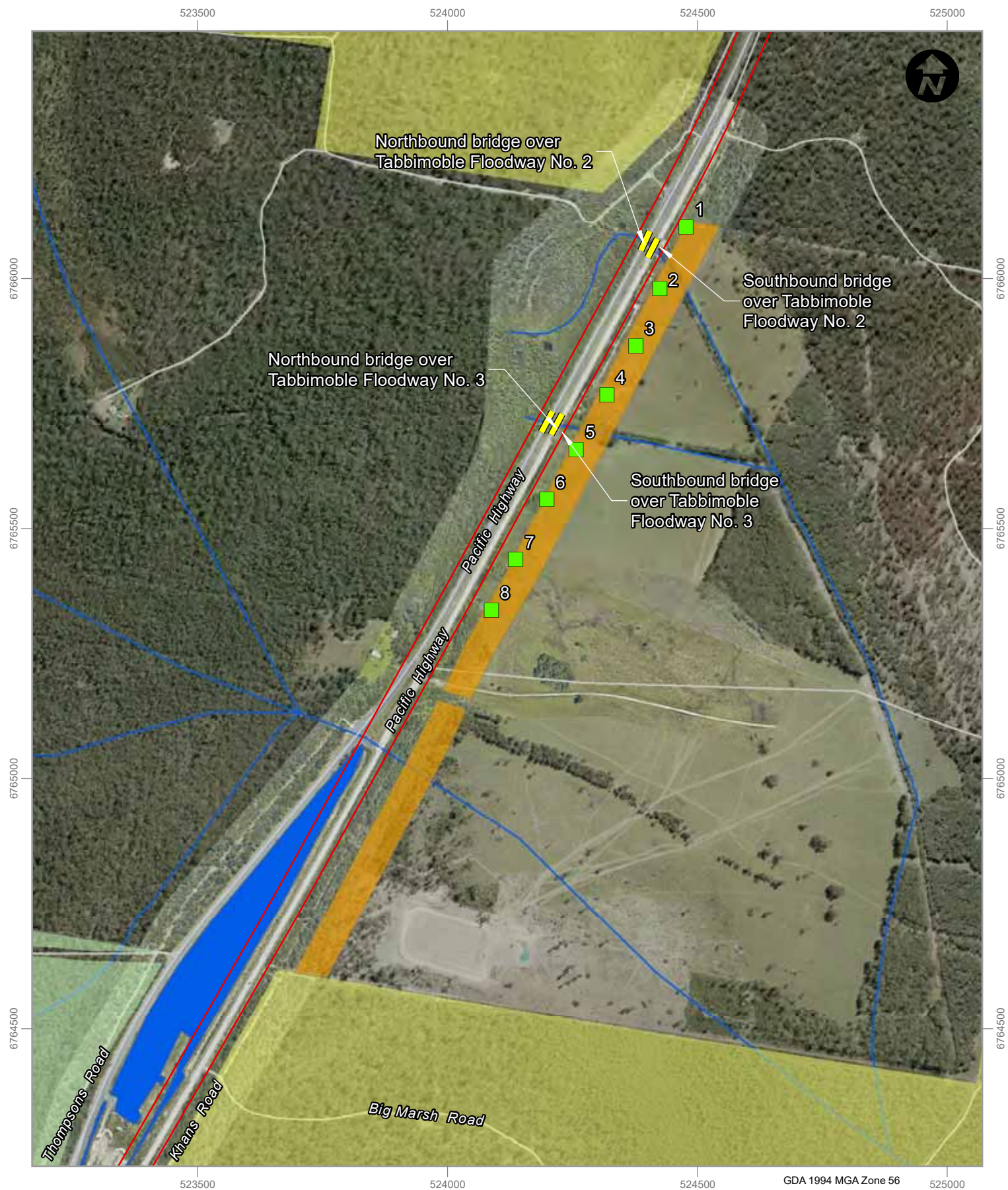
The 'vegetation connectivity corridor' is located between chainage 70.200-71.900 on the eastern side of the highway. It has a width of approximately 60 m (refer to **Illustration 1.2**).

Vegetation monitoring at the connectivity corridor during the reporting period comprised the Year 6 spring post construction monitoring event undertaken on 29/10/2020. The monitoring included:

- **Vegetation quadrats:** The eight 20x20 m quadrats established in winter Year 3 within the corridor were monitored (refer to **Illustration 2.3** and **Appendix D**). Within each quadrat, the following attributes were recorded:
 - diversity of species (i.e. species inventory of all native and exotic species, including noxious weeds)
 - per cent cover of native and exotic species (modified Braun-Blanquet scale; refer to **Table 2.8**)
 - height of plants in each stratum
 - general condition of the quadrat
 - whether any second generation or subsequent generations have been naturally recruited
 - any evidence of disturbance (e.g. fire, litter, disease, herbivory).
- **Photo point monitoring:** A photo was undertaken of the quadrat during each monitoring event, from the north-east corner facing the south-east corner.

Table 2.8 Modified Braun-Blanquet Cover Classes

| <i>Class</i> | <i>Percentage Cover</i> |
|---------------------|--------------------------------|
| 1 | <5 % sparse |
| 2 | <5 % common |
| 3 | 5-25 % |
| 4 | 26-50 % |
| 5 | 51-75 % |
| 6 | 76-100 % |



LEGEND

- | | | | |
|---------------------------------------|-----------------|-------------|--------------------------------|
| Devil's Pulpit concept clearing limit | State forest | Watercourse | Vegetation monitoring location |
| Vegetated connectivity corridor | Northern median | | |
| Combined fauna underpass | | | |

0 200 Metres

Vegetation Connectivity Corridor Monitoring Sites - Illustration 2.3

2.3 Other Monitoring Activities

2.3.1 Roadkill Monitoring

Roadkill monitoring was undertaken once per week for four weeks per season (winter, spring and summer), totalling 12 events. It involved a vehicle being driven for the length of the upgrade (approximately 15.5 km of road encompassing both highway lanes and the Bundjalung rest area) mapping and identifying roadkill. The following data was recorded at each roadkill: species, GPS location, lane and presence/ absence of fauna fence. Roadkill monitoring dates are provided in **Appendix E**. Opportunistic roadkill detected when undertaking other activities were also recorded.

2.4 Survey Limitations

The EMP provides a list of typical survey limitations. The following specific limitations were also noted during Year 6 monitoring:

- Call playback and call identification: Highway traffic noise was considered a key limitation for call playback broadcast, and response detection and identification at impact sites. The range to which call playback was effective and the ability to hear and identify fauna calls was reduced.
- Spotlighting:
 - The effectiveness of spotlighting was affected (reduced) by highway vehicle lighting in some sections of Impact Site 1 (east), Impact Site 1 (west), Impact Site 2 (median) and Impact Site 6 (west).
 - Spotlighting transects have been established along cleared tracks/ easements at all sites except Impact Site 2 (median) and Impact Site 4 (median). The ability to observe in the canopy is reduced along some sections of these transects.
 - The effectiveness of spotlighting was impacted by the post fire regrowth structure in areas with dense epicormic growth on canopy trees.
- Nest box monitoring: refer to **Section 1.1.2**.
- Fauna underpass monitoring:
 - impacted where fauna furniture was damaged by the fires (refer to **Section 1.1.2**)
 - W2B construction works were undertaken along the northbound land and affected monitoring at underpass C3 and C6 (refer to **Section 2.2.1**).
- Camera traps: There are limitations with camera trap detectability which has been well documented in scientific literature (e.g. Meek 2015).



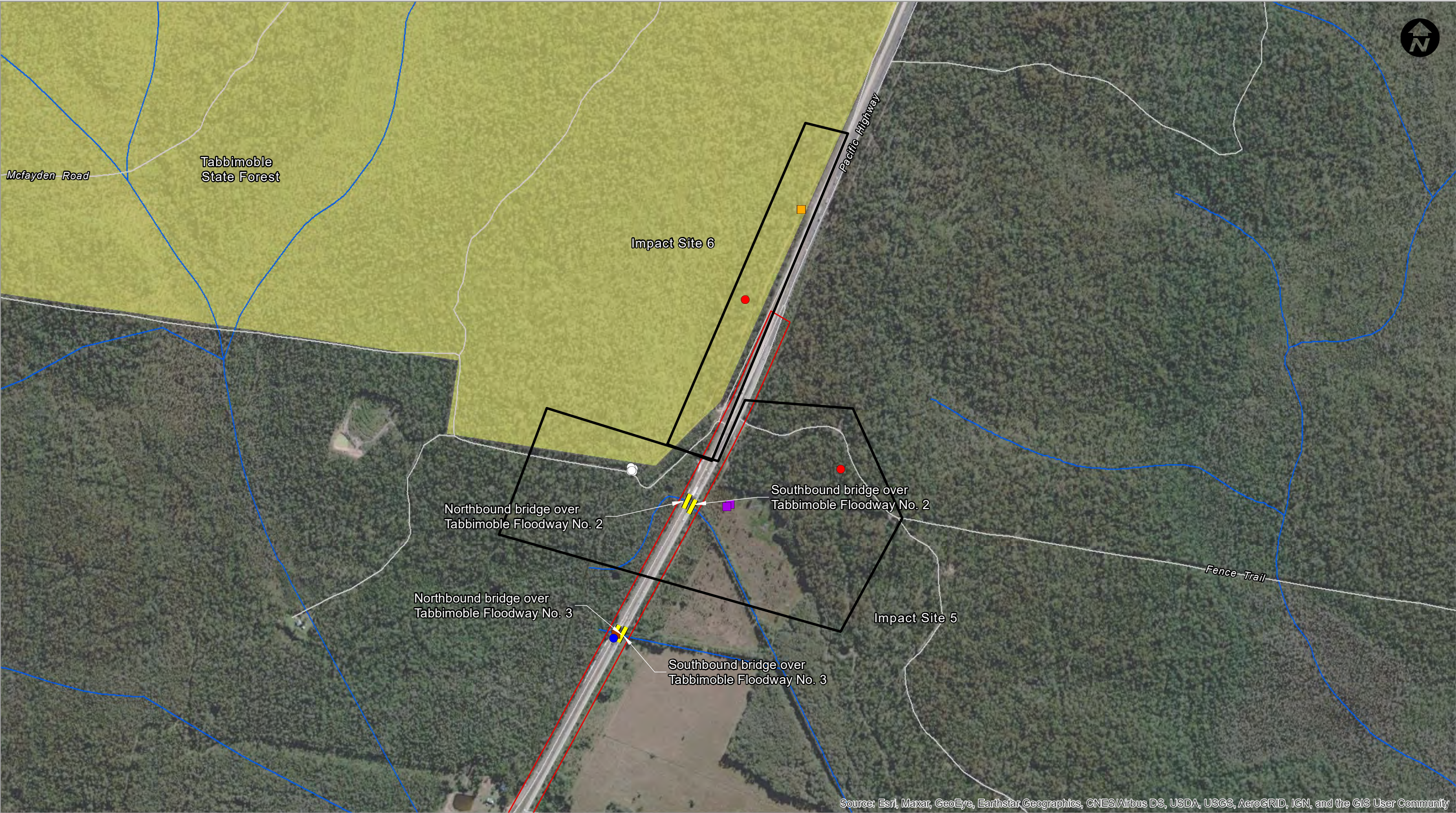
3. Results

3.1 Results

Monitoring results are provided below per survey method and target mitigation measure. Raw monitoring results are provided in **Appendix B** to **Appendix H** as follows:

- Appendix B: Nest Box Monitoring Locations and Results
- Appendix C: Fauna Underpass Monitoring Results
- Appendix D: Restoration of Vegetation Connectivity Corridor Results
- Appendix E: Roadkill Monitoring Results
- Appendix F: Rufous Bettong/ Brush-tailed Phascogale Camera Trap Results
- Appendix G: Spotlighting and Call Playback Results
- Appendix H: Threatened Frog Survey Results

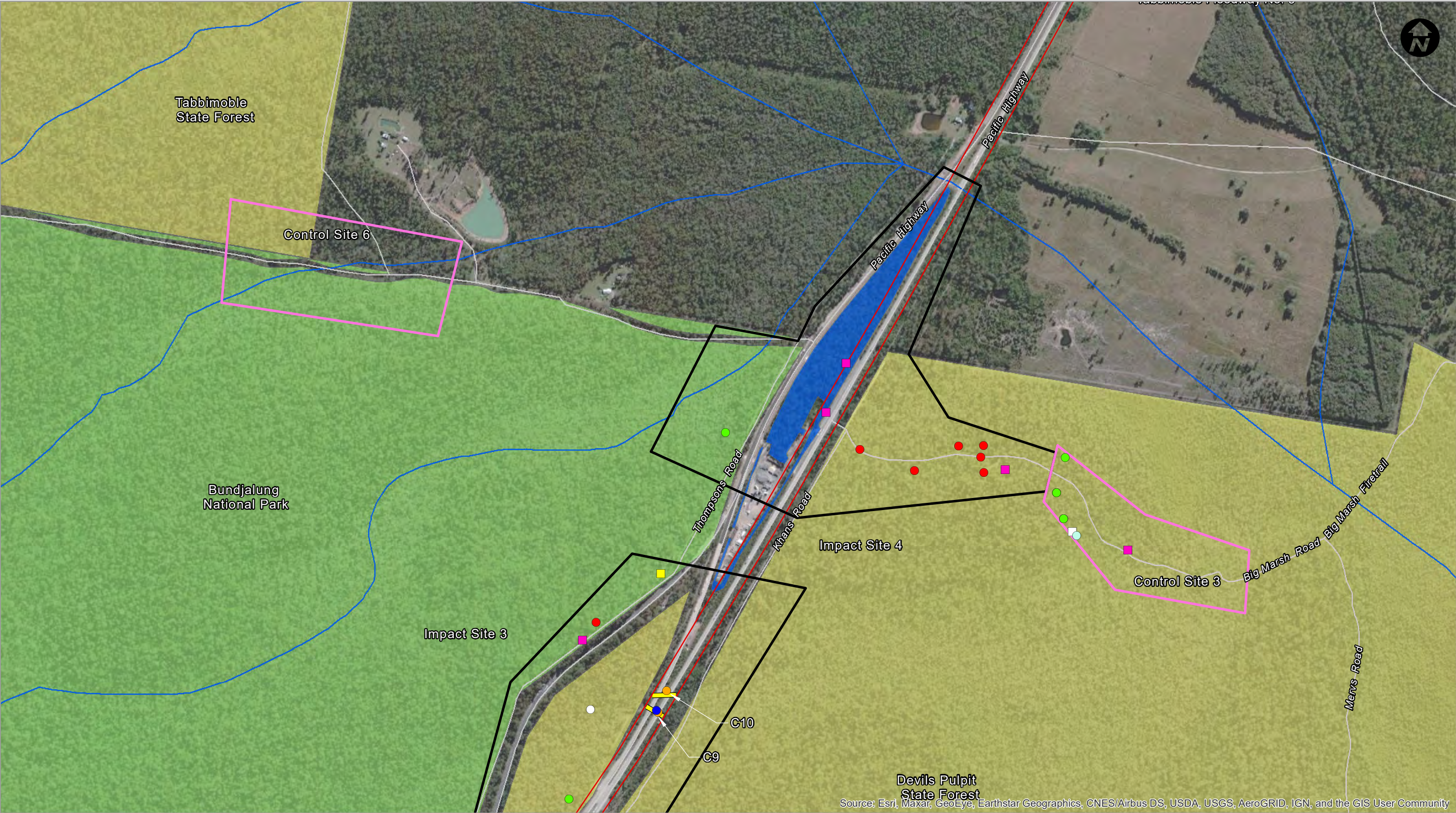
Locations of recorded threatened species are shown in **Illustration 3.1**.



LEGEND

- | | | | |
|---------------------------------------|--------------------------|---------------------------|-------------------------|
| Devil's Pulpit concept clearing limit | State Forest | Threatened Species | Southern Myotis |
| Impact site | Combined fauna underpass | Eastern Bent-winged Bat | Squirrel Glider |
| | Watercourse | Greater Glider | Squirrel Glider (Pr/Po) |
| | | Green-thighed Frog | Wallum Froglet |

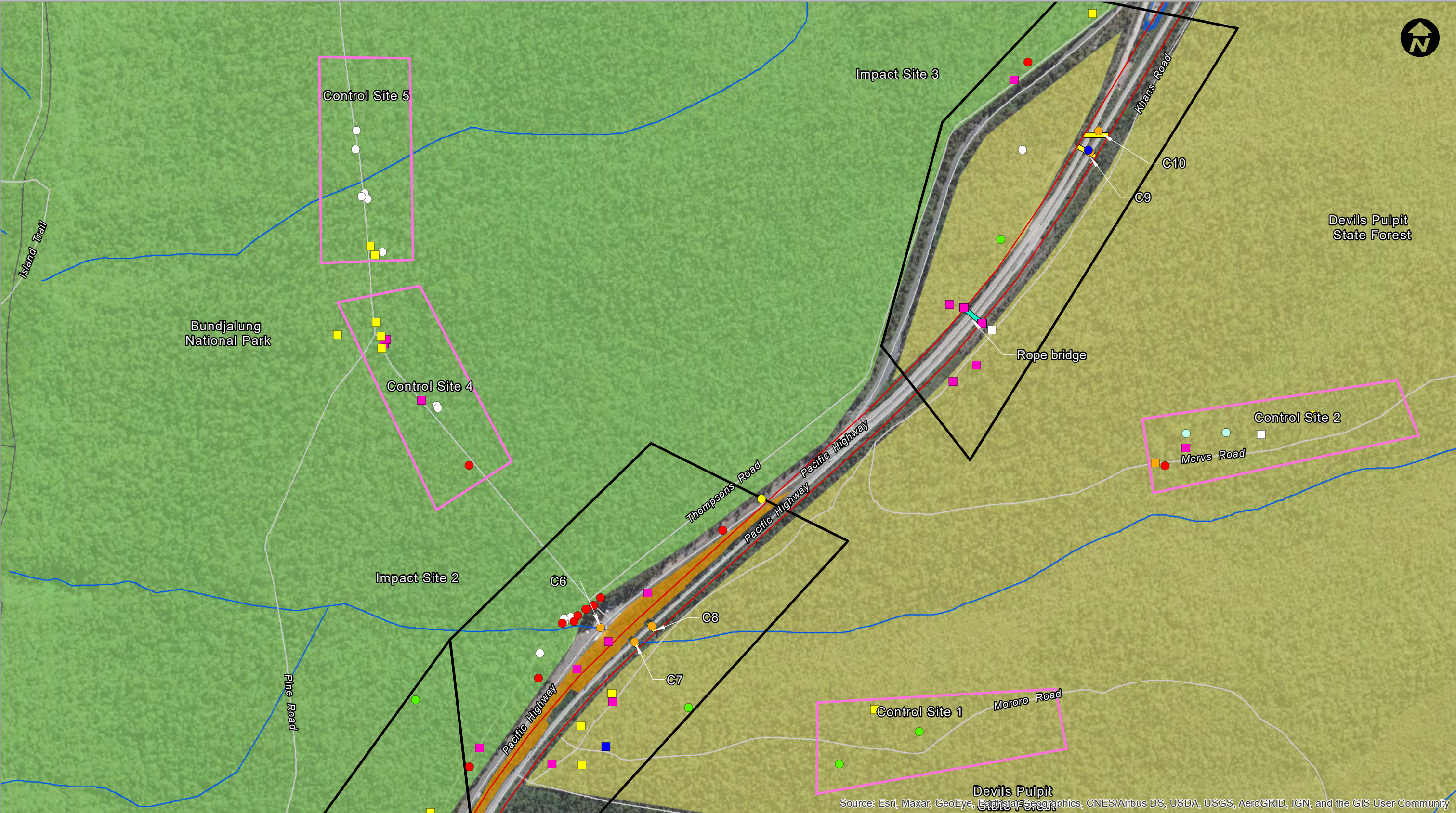
0 200 Metres



LEGEND

- | | | | |
|---------------------------------------|--------------------------|---------------------------|------------------------|
| Devil's Pulpit concept clearing limit | State Forest | Threatened Species | Little Bent-winged Bat |
| Control site | National Park reserve | Brush-tailed Phascogale | Long-nosed Potoroo |
| Impact site | Combined fauna underpass | Eastern Bent-winged Bat | Masked Owl |
| Northern median | Watercourse | Greater Glider | Squirrel Glider |
| | | Green-thighed Frog | Yellow-bellied Glider |

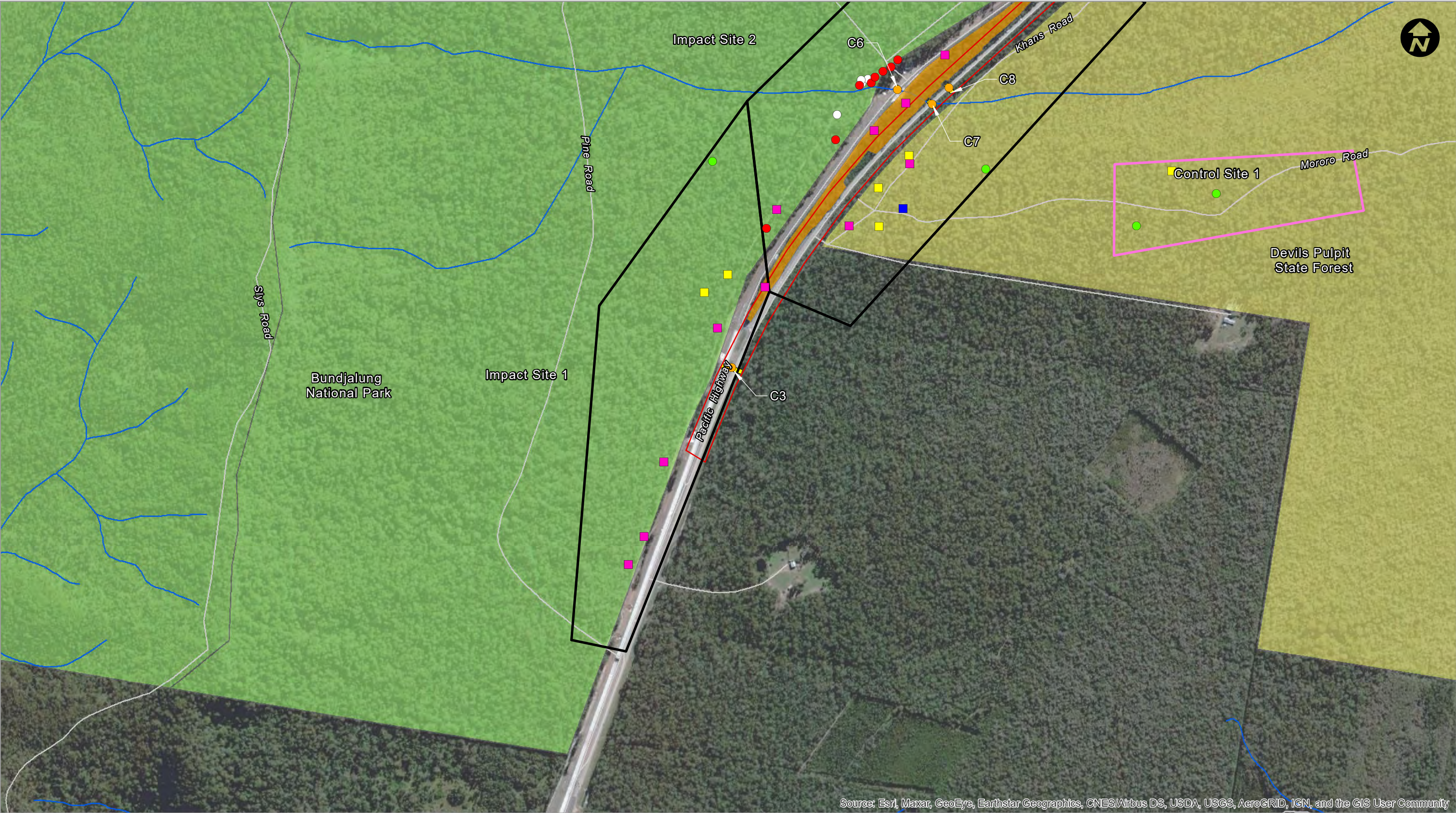
0 200 Metres



LEGEND

- | | | | |
|---------------------------------------|--------------------------|-------------------------|-------------------------|
| Devil's Pulpit concept clearing limit | State Forest | Brush-tailed Phascogale | Long-nosed Potoroo |
| Control site | National Park reserve | Eastern Bent-winged Bat | Masked Owl |
| Impact site | Combined fauna underpass | Greater Glider | Powerful Owl |
| Northern median | Rope bridge | Green-thighed Frog | Squirrel Glider |
| Southern median | Watercourse | Koala | Squirrel Glider (Pr/Po) |
| | | Little Bent-winged Bat | Yellow-bellied Glider |

0 200 Metres



LEGEND

- | | | | |
|---------------------------------------|--------------------------|---------------------------|------------------------|
| Devil's Pulpit concept clearing limit | State Forest | Threatened Species | Little Bent-winged Bat |
| Control site | National Park reserve | Brush-tailed Phascogale | Powerful Owl |
| Impact site | Combined fauna underpass | Greater Glider | Squirrel Glider |
| Southern median | Watercourse | Green-thighed Frog | Yellow-bellied Glider |



3.2 Rufous Bettong/ Brush-tailed Phascogale Camera Trap Results

Rufous Bettong/ Brush-tailed Phascogale (RB/ BTP) camera trap results for Year 3, Year 4 and Year 6 monitoring are provided in **Appendix F**. Year 6 results are discussed in this section and comparison between years is provided in **Section 3.2.1** below.

A total of 26 species/ species groups were recorded, an average of 9.5 species (SD: 2.17) per site for each survey event. The average diversity was similar during winter, spring and summer (9.4 [SD: 1.76], 10.1 [SD: 1.92] and 9.7 [SD: 1.16] species/ species groups respectively). The average diversity was also similar when comparing impact and control sites (9.8 [SD: 1.53] and 9.6 [SD: 1.88] species/ species groups, respectively).

The species that were recorded at the most sites were the House Mouse (*Mus musculus*), Swamp Wallaby (*Wallabia bicolor*) (both species at all sites), Black Rat (*Rattus rattus*), Bush Rat (*Rattus fuscipes*), Eastern Grey Kangaroo (*Macropus giganteus*), Northern Brown Bandicoot (*Isodon macrourus*), Short-beaked Echidna (*Tachyglossus aculeatus*) and Yellow-footed Antechinus (*Antechinus flavipes*) (each species at 14 sites). The mean number of sites that each species was recorded at was 8.3 (SD: 5.16), with impact sites (5.4, SD: 3.55) higher than control sites (2.9, SD: 1.84).

Two target threatened species were recorded via the RB/ BTP camera traps:

- Brush-tailed Phascogale: six grid sites (four impact sites and two control sites).
- Long-nosed Potoroo: at two grid sites (two control sites).

No Rufous Bettongs or other threatened fauna species were recorded.

Images of recorded threatened species are shown from **Plate 3.1** to **Plate 3.3**. Images of a possible native mouse (*Pseudomys* sp.) were recorded at Impact Site 3 (west), Impact Site 5 (west) and Control Site 5. In each case the animal was unable to be identified to species level from the images and the records are considered a tentative 'possible' identification. The *Pseudomys* genus includes a number of threatened species.

Activity levels of the Brush-tailed Phascogale and Long-nosed Potoroo for each site are provided in **Table 3.1**. Average activity levels were lower at impact sites than at control sites for both species. There were an additional two opportunistic records of the Brush-tailed Phascogale at Control Site 3 and one opportunistic record of the Long-nosed Potoroo at Control Site 2 from images captured outside of the 14 day monitoring period. These records were not included in the activity level analysis.

Table 3.1 Activity Levels for the Brush-tailed Phascogale and Long-nosed Potoroo for Year 6 Monitoring

| Site | Brush-tailed Phascogale | | Long-nosed Potoroo | |
|------------------------------|-------------------------|----------|--------------------|----------|
| | Activity Level | SE | Activity Level | SE |
| Impact Site 1 (west) | 6 % | 6 | 0 % | 0 |
| Impact Site 1 (east) | 0 % | 0 | 0 % | 0 |
| Impact Site 2 (west) | 0 % | 0 | 0 % | 0 |
| Impact Site 2 (east) | 6 % | 6 | 0 % | 0 |
| Impact Site 3 (west) | 6 % | 6 | 0 % | 0 |
| Impact Site 3 (east) | 0 % | 0 | 0 % | 0 |
| Impact Site 4 (west) | 6 % | 6 | 0 % | 0 |
| Impact Site 4 (east) | 0 % | 0 | 0 % | 0 |
| Impact Site 5 (west) | 0 % | 0 | 0 % | 0 |
| Impact Site 5 (east) | 0 % | 0 | 0 % | 0 |
| Average Impact Sites | 2 % | 1 | 0 % | 0 |
| Control Site 1 | 12 % | 8 | 0 % | 0 |
| Control Site 2 | 0 % | 0 | 12 % | 8 |
| Control Site 3 | 12 % | 8 | 12 % | 8 |
| Control Site 4 | 0 % | 0 | 0 % | 0 |
| Control Site 5 | 0 % | 0 | 0 % | 0 |
| Average Control Sites | 5 % | 2 | 5 % | 2 |
| All Sites | 3 % | 1 | 2 % | 1 |

3.2.1 Year 3, 4 and 6 Comparison

Species diversity during Year 3, Year 4 and Year 6 monitoring was comparable (mean number of species/ site: 9.0 [SD: 2.60], 10.5 [SD: 2.66], 9.5 [SD: 2.17] respectively).

Generally, the species that were recorded at the most sites also remained consistent throughout Year 3, Year 4 and Year 6 monitoring. An exception is an increase in the number of sites with House Mouse records during Year 6 monitoring (all 15 sites) compared with five sites in Year 3 (33 % of sites; all impact sites) and eight sites in Year 4 (53 % of sites; six impact sites and two control sites) (refer to **Plate 3.4**). Also of note were records of Wild Pig (*Sus scrofa*) at three sites (two impact and one control site) during Year 6 monitoring (refer to **Plate 3.5**). Wild Pigs had not previously been recorded during Year 3 or Year 4 monitoring.

A comparison of the activity level of target species at impact and control sites for Year 3, Year 4 and Year 6 monitoring is provided in **Figure 3.1**. The following trends can be observed:

■ Brush-tailed Phascogale:

- activity levels generally decreased at both impact and control sites between each monitoring period. An exception was an increase in activity levels at control sites between Year 4 and Year 6
- activity levels were generally higher at impact sites compared with control sites, except during Year 6.

■ Long-nosed Potoroo:

- activity levels decreased at both impact and control sites between each monitoring period
- activity levels were lower at impact sites compared with control sites during Year 3 and Year 6 and equal in Year 4.

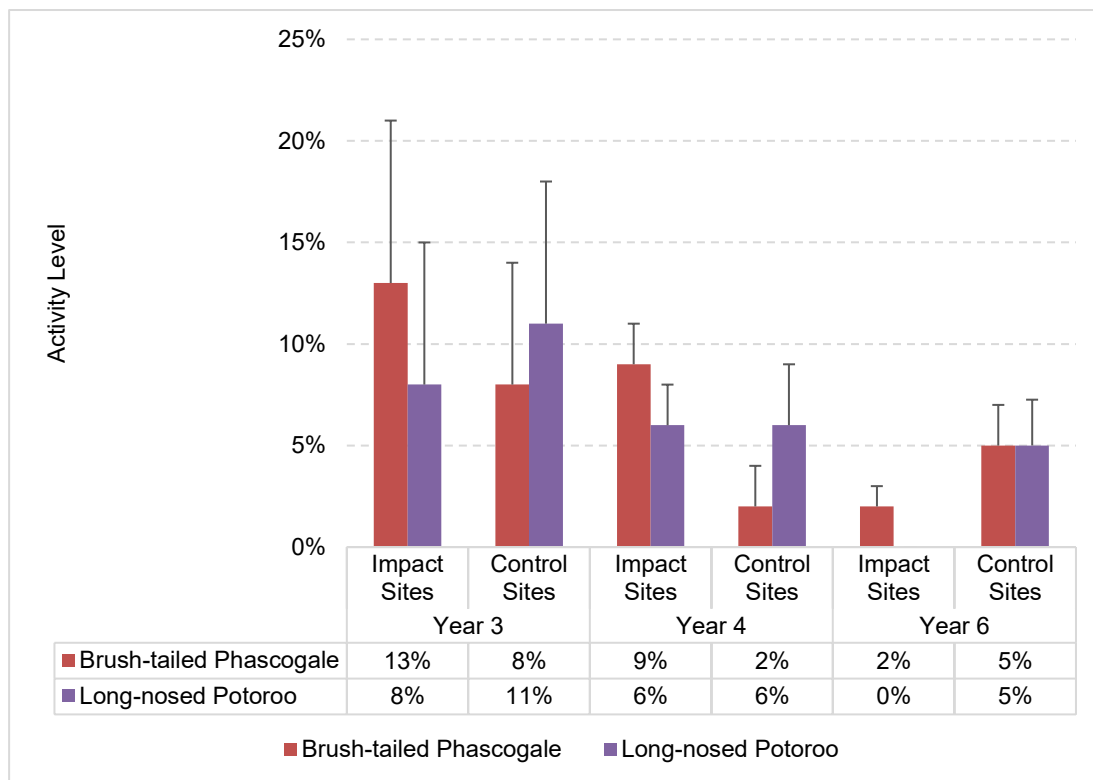


Figure 3.1 Average Activity Levels of Brush-tailed Phascogale and Long-nosed Potoroo at Impact and Control Sites During Year 3, Year 4 and Year 6.



Plate 3.1 Brush-tailed Phascogale image from Control 3 during Year 6 summer monitoring.



Plate 3.2 Long-nosed Potoroo image from Control 2 during Year 6 summer monitoring.



Plate 3.3 Two Long-nosed Potoroos in image from Control 2 during Year 6 spring monitoring.



Plate 3.4 Three House Mice at Impact Site 3 (west) during Year 6 summer monitoring.



Plate 3.5 Wild Pig image from Control 5 during Year 6 spring monitoring.


3.3 Spotlighting and Call Playback Results

Spotlighting and call playback results are provided in **Appendix G** and summarised in **Table 3.2**. A total of 99 records of 13 species/ species groups were obtained. The average number of records (abundance) per species was 6.6 (SD: 6.70). The Greater Glider (20 records; 7 sites), Squirrel Glider (17 records; 11 sites), Sugar Glider (16 records; 10 sites) and Yellow-bellied Glider (14 records; 7 sites) were the most commonly recorded species and were recorded at the highest number of sites (mean number of sites per species: 4.2, SD 3.47). The highest percentage of records were obtained in spring (43 %), followed by summer (33 %) and winter (23 %).

The average number of species recorded at each site (species diversity) was 3.5 (SD: 1.69), which was slightly lower at impact sites (mean: 3.3, SD: 1.42) compared to control sites (mean: 4.0, SD: 2.19). The highest species diversity was recorded at Control site 2 (eight species). The lowest species diversity was recorded at Impact Site 1 (west) where there were no records, and Impact Site 5 (west), Impact Site 6 (west), and Control Site 5, which each had two species recorded.

Three target threatened species were recorded during spotlighting/ call playback surveys:

- Squirrel Glider: 17 records from 11 transect sites (eight impact sites and three control sites). This species was recorded on both sides of the highway and within both vegetated medians.
- Yellow-bellied Glider: 14 records from seven transect sites (three impact sites and four control sites). This species was recorded on both sides of the highway, but not within the medians.
- Greater Glider: 20 records from seven transect sites (five impact sites and two control sites). This species was recorded on both sides of the highway, but not within the medians.



Target threatened species not recorded included the Koala, Rufous Bettong, Long-nosed Potoroo and Brush-tailed Phascogale. Other non-target threatened species recorded were the Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*Ninox strenua*). Both of these species are listed under the BC Act.

The number of records for each target threatened species at each site is displayed in **Figure 3.2**. Three *Petaurus* spp. (*P. breviceps* or *P. norfolcensis*) records that could not be identified to species level have not been included with this data.

3.3.1 Year 3, 4 and 6 Comparison

A comparison of activity levels of threatened species during Year 3, Year 4 and Year 6 monitoring is provided in **Figure 3.3**. The average activity level for the Yellow-bellied Glider was lower at impact sites compared to control sites during Year 6. In contrast, the average activity levels for the Greater Glider and Squirrel Glider were higher at impact sites compared to control sites. These trends were similar in both Year 3 and Year 4 monitoring for the Yellow-bellied Glider and Greater Glider, and the opposite for the Squirrel Glider in Year 6 compared to Years 3 and 4 (i.e. Squirrel Glider records were higher at control sites compared to impact sites during Years 3 and 4). Average activity levels were lower for the recorded target species at both impact and control sites in Year 6 compared to Years 3 and 4, with the exception of the Squirrel Glider at impacts sites where increased activities levels were recorded.

Table 3.2 Summary of Recorded Target Species Spotlighting/ Call Playback Results for Year 6 Monitoring

| <i>Site</i> | <i>Greater Glider</i> | <i>Squirrel Glider</i> | <i>Yellow-bellied Glider</i> | <i>Other Arboreal Mammals</i> | <i>Other Terrestrial Mammals</i> | <i>Total</i> |
|------------------------|-----------------------|------------------------|------------------------------|-------------------------------|----------------------------------|--------------|
| Impact Site 1 (west) | 0 | 0 | 0 | 0 | 0 | 0 |
| Impact Site 1 (east) | 0 | 4 | 2 | 1 | 0 | 7 |
| Impact Site 2 (west) | 8 | 1 | 0 | 4 | 0 | 13 |
| Impact Site 2 (median) | 0 | 2 | 0 | 3 | 0 | 5 |
| Impact Site 2 (east) | 0 | 1 | 3 | 0 | 1 | 5 |
| Impact Site 3 (west) | 1 | 1 | 1 | 1 | 1 | 5 |
| Impact Site 3 (east) | 0 | 1 | 0 | 1 | 0 | 2 |
| Impact Site 4 (median) | 0 | 3 | 0 | 4 | 1 | 8 |
| Impact Site 4 (east) | 6 | 1 | 0 | 2 | 2 | 11 |
| Impact Site 5 (west) | 0 | 0 | 0 | 1 | 3 | 4 |
| Impact Site 5 (east) | 1 | 0 | 0 | 3 | 0 | 4 |
| Impact Site 6 (west) | 1 | 0 | 0 | 1 | 0 | 2 |
| Impact Total | 17 | 14 | 6 | 21 | 8 | 66 |
| Activity Level* | 1.21 | 1.00 | 0.43 | 1.50 | 0.57 | - |
| ST Dev | 2.68 | 1.27 | 1.00 | 1.42 | 0.98 | - |
| ST Error | 0.72 | 0.34 | 0.27 | 0.38 | 0.26 | - |
| Control Site 1 | 0 | 0 | 1 | 1 | 1 | 3 |
| Control Site 2 | 1 | 1 | 1 | 3 | 2 | 8 |
| Control Site 3 | 0 | 1 | 0 | 1 | 0 | 2 |
| Control Site 4 | 2 | 1 | 5 | 2 | 0 | 10 |
| Control Site 5 | 0 | 0 | 1 | 2 | 0 | 3 |
| Control Site 6 | 0 | 0 | 0 | 3 | 0 | 3 |
| Control Total | 3 | 3 | 8 | 12 | 3 | 29 |
| Activity Level* | 0.50 | 0.50 | 1.33 | 2.00 | 0.50 | - |
| ST Dev | 0.84 | 0.55 | 1.86 | 0.89 | 0.84 | - |
| ST Error | 0.34 | 0.22 | 0.76 | 0.37 | 0.34 | - |
| Total All Sites | 20 | 17 | 14 | 33 | 11 | 95 |

* Activity level refer to the no. of records/ 500 m spotlight transect

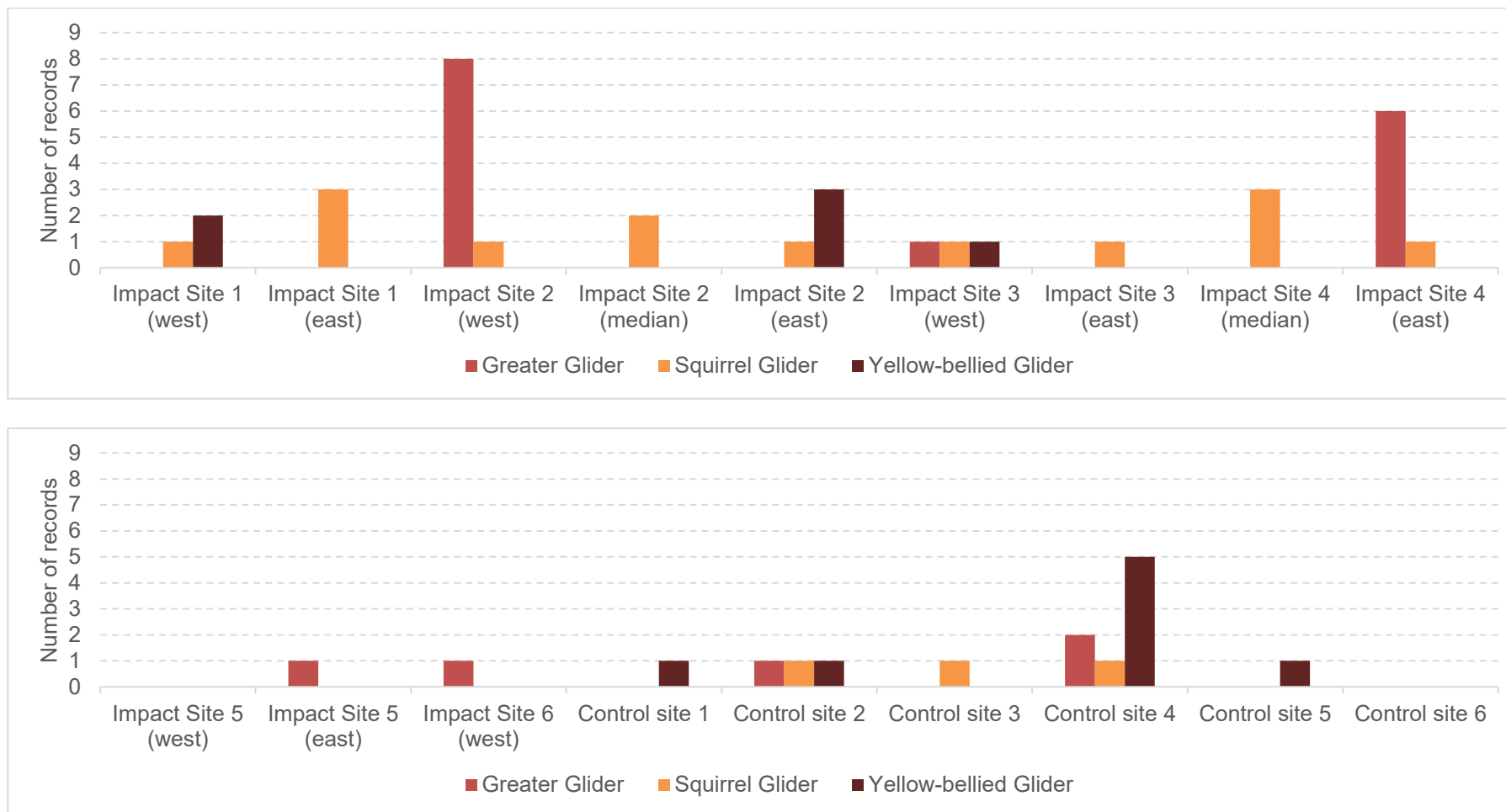


Figure 3.2 Number of Target Species Recorded via Spotlighting/ Call Playback during Year 6 Monitoring

Note: Spotlighting transects are 1 km long at Impact Site 2 (median) and Impact Site 4 (median); and 500 m long at all other sites.

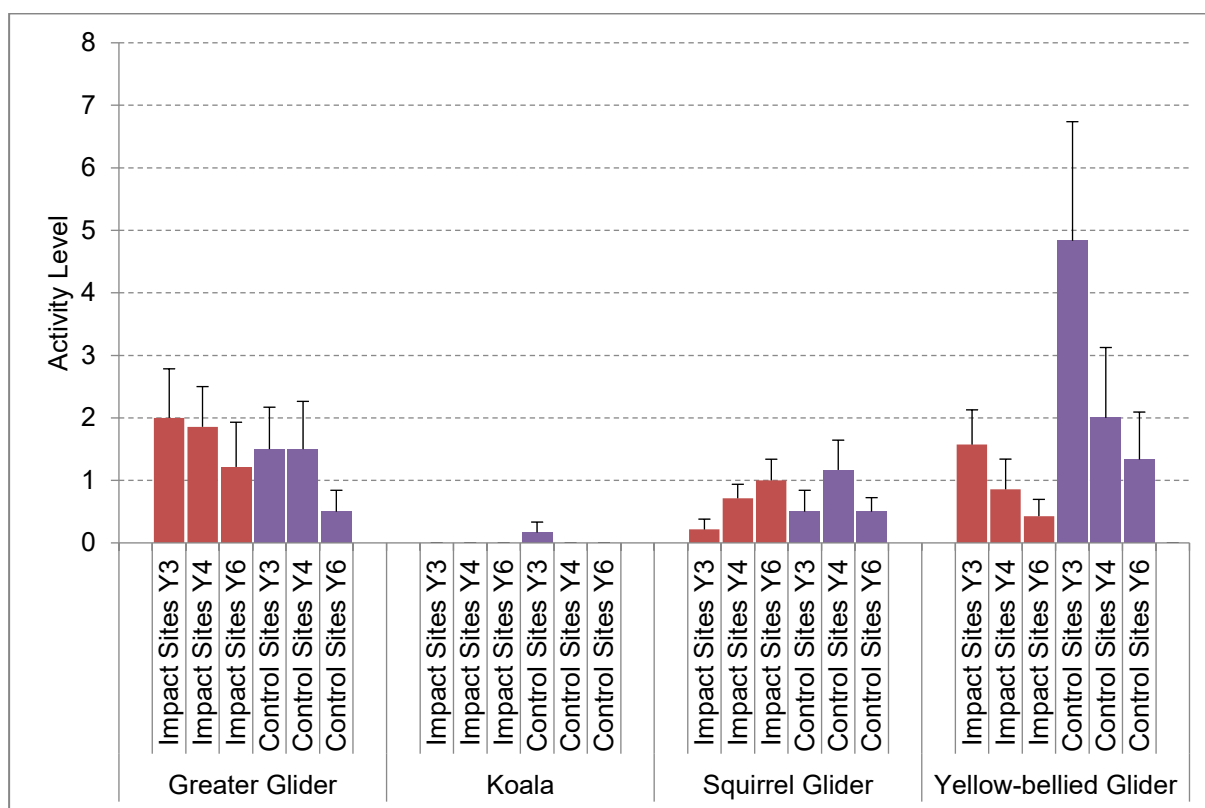


Figure 3.3 Mean Activity Levels of Target Species Recorded via Spotlighting/ Call Playback Survey during Year 3, Year 4 and 6 Monitoring

3.4 Threatened Frog Survey Results

Year 6 frog survey results are shown in **Appendix H**. Twenty-three frog species were recorded in total, averaging 13.3 species per site (range: 10-16; SD: 2.00). The highest diversity (number) of species was recorded at Control site 5 (16), Impact Site 3 (west) (15) and Impact Site 5 (west) (12).

The average number of species at each transect site per monitoring event was 8.6 (SD: 2.27). The most commonly recorded species (i.e. species recorded at the most number of transect sites) were the Striped Marsh Frog (*Limnodynastes peronii*), Green Tree Frog (*Litoria caerulea*), Striped Rocket Frog (*Litoria nasuta*), Tyler's Tree Frog (*Litoria taylori*) and Cane Toad (*Rhinella marina*), each of which were recorded at all nine sites.

The Green-thighed Frog was recorded at five sites, including both impact and control sites, all located on the western side of the highway (Impact Sites 2, 3 and 5 (west), Control Sites 4 and 5). It was recorded during all four survey events. The Wallum Froglet was recorded at one site (Impact Site 5 (east)) during summer surveys 3 and 4.

The number of individuals and location of threatened frog species recorded during each survey event is provided in **Figure 3.4**. Green-thighed Frog numbers ranged from 0-10 (mean: 1.6; SD: 2.66). Wallum Froglet numbers also ranged from 0-10 (mean: 0.4; SD: 1.84).

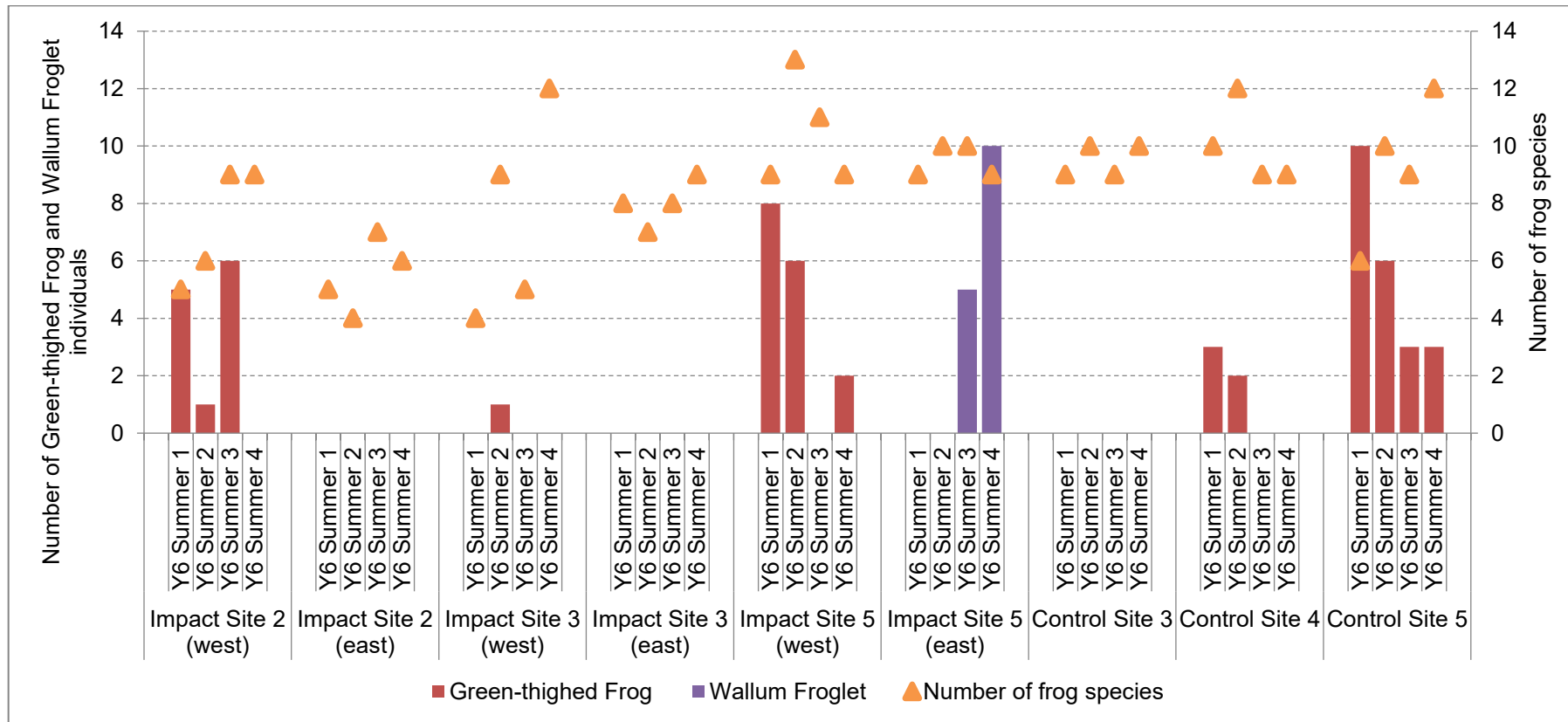


Figure 3.4 Threatened Frog Survey Results During Year 6 Monitoring

3.4.1 Year 3, 4 and 6 Comparison

Figure 3.5 shows a comparison between the number of target threatened frog species individuals and the number of frog species recorded at impact and control sites in Year 3, Year 4 and Year 6 monitoring. Higher species diversity (number of species) was recorded at both impact and control sites in Year 6 compared to Years 3 and 4. Higher numbers of threatened frogs were recorded at impact sites in Year 6 compared to Years 3 and 4; while numbers were variable at control sites between years.

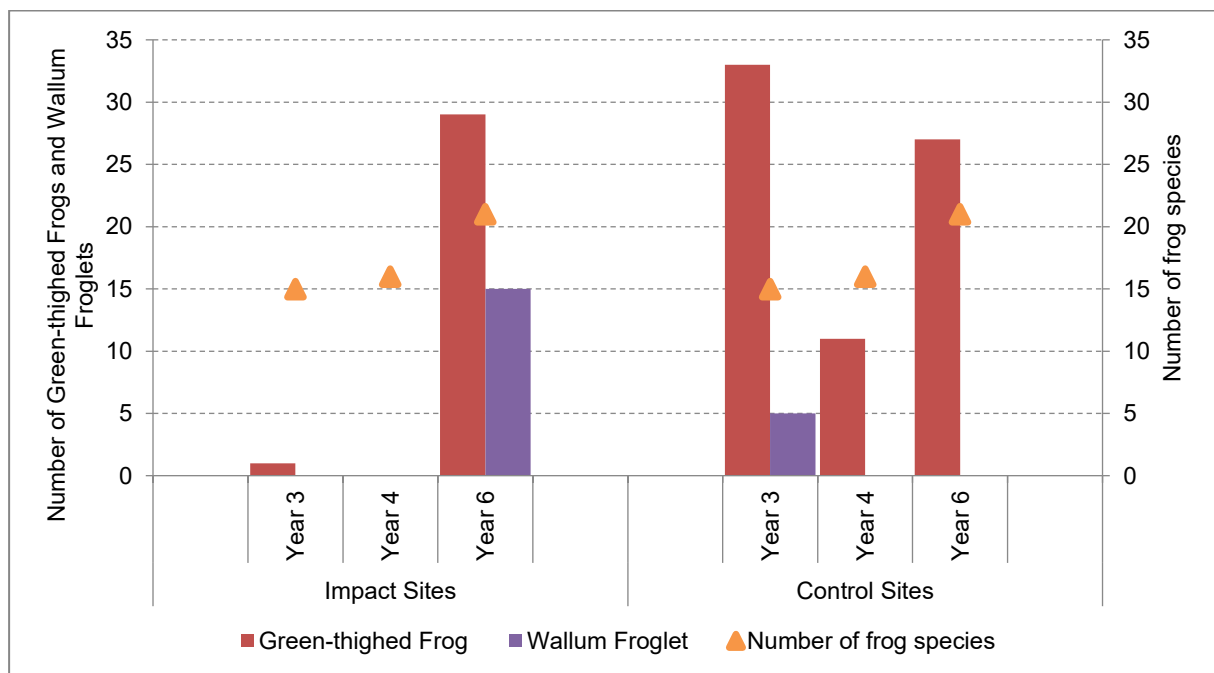


Figure 3.5 Threatened Frog Survey Results During Year 3, Year 4 and Year 6 Monitoring

Figure 3.6 shows a comparison between the number of sites where threatened frog species were recorded in Year 3, Year 4 and Year 6 monitoring. Green-thighed Frogs were recorded at more impact sites in Year 6 compared to Years 3 and 4, and the same number of control sites each year. Wallum Froglets were not frequently recorded and detected only at one impact site in Year 6 and one control site in Year 3.

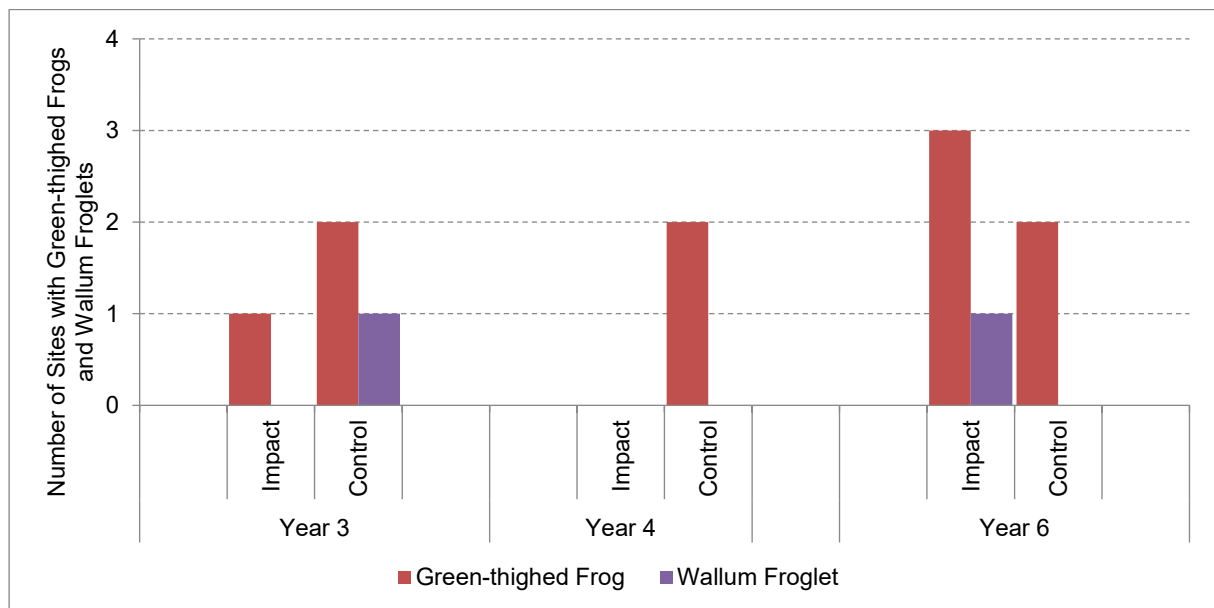


Figure 3.6 Number of Sites With Threatened Frogs During Year 3, Year 4 and Year 6 Monitoring

3.5 Nest Box Monitoring Results

The nest box monitoring results are provided in **Appendix B**. The Squirrel Glider was the only target species recorded occupying nest boxes, with a total of 19 individuals (including subadults; excluding dependant pouched young) recorded occupying eight nest boxes (16 %). A summary of sites with nest boxes occupied by Squirrel Glider is provided in **Table 3.3**. Other vertebrate fauna recorded occupying the nest boxes included reptiles (a Lace Monitor and a gecko [likely Robust Velvet Gecko *Oedura robusta*] which dispersed during the inspection) and a frog (*Litoria sp.* which also dispersed during the inspection).

A further 34 nest boxes (69 %) were not occupied, however showed evidence of glider (*Petaurus sp.*) activity through leaf nesting material deposits. No Brush-tailed Phascogales or evidence of nest box usage by this species was recorded. No active European Bee (*Apis mellifera*) hives were present.

During Year 6 monitoring six gliders dispersed before identification to the species level could be made and were recorded as being either Squirrel Gliders or Sugar Gliders. For analysis purposes, these gliders have been categorised as Squirrel Gliders based on the previous nest box monitoring results.

Table 3.3 Summary of Squirrel Glider Nest Box Site Occupancy for Year 3, Year 4 and Year 6 Monitoring

| <i>Site</i> | <i>Nest Boxes Occupied During Year 3</i> | <i>Nest Boxes Occupied During Year 4</i> | <i>Nest Boxes Occupied During Year 6</i> |
|------------------------|--|--|--|
| Impact Site 2 (west) | - | Y | - |
| Impact Site 2 (median) | - | Y | Y |
| Impact Site 2 (east) | Y | Y | Y |
| Impact Site 3 (west) | Y | - | Y |
| Impact Site 3 (east) | Y | Y | Y |
| Impact Site 4 (west) | Y | - | - |
| Impact Site 4 (median) | - | Y | - |
| Impact Site 4 (east) | - | Y | - |
| Impact Site 6 (west) | Y | Y | Y |
| Control Site 1 | - | Y | - |
| Control site 2 | - | - | Y |
| Control Site 4 | - | Y | Y |
| Control Site 5 | - | Y | - |

Figure 3.7 shows the number of Squirrel Glider individuals recorded over time at the site while **Figure 3.8** shows nest box occupancy rates. The nest box monitoring observed a peak in Squirrel Glider numbers in Year 4 winter (22). Five to eight Squirrel Gliders were recorded during the five subsequent monitoring events, despite a 30-31 % reduction in nest box numbers monitored during the three Year 6 monitoring events (refer to **Section 2.1.7**). The proportion of gliders at impact and control sites has fluctuated. The number of nest boxes showing evidence of glider occupancy has increased overtime.

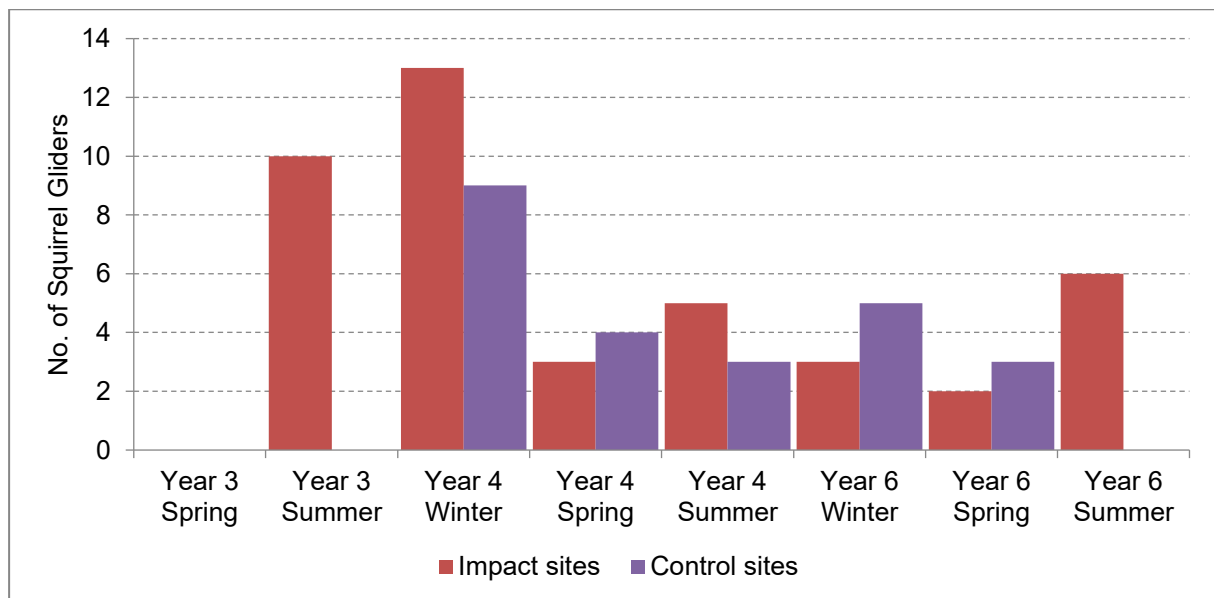


Figure 3.7 Squirrel Glider Results During Year 3, Year 4 and Year 6 Monitoring



Figure 3.8 Nest Box Occupancy Rates During Year 3, Year 4 and Year 6 Monitoring

Evidence of glider use = nest boxes occupied by gliders or containing leaf litter.

* For Year 6 the calculation for percent occupation excludes nest boxes that had been burnt or could not be accessed.

3.6 Fauna Underpass Monitoring Results

3.6.1 Underpass Cameras

Fauna underpass camera monitoring results are summarised in **Appendix C**. Camera monitoring (including underpass cameras, substitution cameras and fauna furniture cameras) recorded a total of 1820 records of 31 fauna species/ species groups (excluding birds). On average native species contributed to the majority of records (73 %). The most recorded species were the Black Rat (352), Eastern Water Dragon (*Intellagama lesueurii* - 257), Swamp Wallaby (257) and Lace Monitor (*Varanus varius* – 201). Several species (e.g. Eastern Water Dragon, Black Rat, Cane Toads, Antechinus sp., and Water Rat *Hydromys chrysogaster*) regularly displayed habitation behaviour within or adjacent to the structures (such as foraging, basking, etc) rather than dispersing through the underpasses. A sample of images from are provided in **Plate 3.6** to **Plate 3.13**.

The majority of records were obtained from SBT3 (421), C6 (298), C7 (265) and NBT3 (228). Fauna underpasses with the least number of records included C3 (30), C9 (54), C10 (58) and NBT2 (89).

A total of 992 unique complete crossings of 26 species/ species groups were recorded. Most unique complete crossings recorded were of Black Rats (199, mostly at C6), Swamp Wallabies (189, mostly at SBT3), Eastern Grey Kangaroos (148 mostly from SBT3) and Lace Monitors (139 – mostly at C7). SBT3, C7, NBT3 and C6 recorded the most unique complete crossings, numbering 287, 166 139 and 131 respectively. Although the number of unique complete crossings at C6 was high, most were made by Black Rats. The proportion of unique complete crossings made by native species at C6 was relatively low (26 %). No unique complete crossings were recorded at C3, while low numbers of unique complete crossings were recorded at C10 (21), C9 (30), NBT2 (49) and SBT2 (68). The overall weekly rate of unique complete crossings for all species was 12.12.

No records of any threatened species were obtained during underpass camera monitoring.

Comparison of fauna records and complete crossings between similar structures shows the following trends:

- Substantially higher numbers of records and unique complete crossings were recorded at the Tabbimoble Floodway No.3 bridges (NBT3 and SBT3) compared to the Tabbimoble Floodway No.2 bridges. The main difference between the bridges at these waterways are:
 - Tabbimoble Floodway No.3 bridges are longer (3 and 4 spans) and include areas with flat ground on both sides of the waterway and groundcover vegetation.
 - Tabbimoble Floodway No.2 bridges are shorter (2 spans), have limited vegetation, and SBT2 has irregular rock scour protection that would require negotiating for fauna to cross.

All bridges are a similar width (10 m to 12.04 m).

- Substantially higher numbers of unique complete crossings were recorded at C7 compared to C8 (166 to 96), despite both culverts being a similar length (19.67 m and 22.13 m respectively) and located along the same drainage line; and C8 supporting fauna furniture (thereby would be expected to have recorded more small mammal crossings [Goldingay et al 2019]). The main difference between these structures is the damaged scour protection at the outlet of C8 which creating pooled water at the eastern end of the culvert (GeoLINK 2018).
- Substantially higher numbers of records and unique complete crossings were recorded at short culverts below one lane (C6, C7 and C8; ~16 - 22 m) compared to longer culverts below two lanes (C3, C9 and C10; ~49 - 59 m). C3, C9 and C10 have semi-permanent pooled water at the outlet (eastern end) which is likely to also be impacting fauna use of these structures. Comparisons between C8 and C9/ C10 however demonstrate the length trend as they all have semi-permanent pooled water at the outlet, and were monitored for the same duration and with the same camera configuration.
- Macropods and bandicoots were generally recorded at higher numbers at the bridge structures compared to culverts; except for the Swamp Wallaby at C7.



Plate 3.6 Eastern Grey Kangaroos grazing while moving west (northern bank) at SBT3.
A complete crossing was recorded.



Plate 3.7 Lace Monitor moving east-west at fauna underpass C7.
A complete crossing was recorded.



Plate 3.8 Feral cat moving east-west at fauna underpass C7.
A complete crossing was recorded



Plate 3.9 Short-beaked Echidna moving east-west at fauna underpass C7.
A complete crossing was recorded.



Plate 3.10 Brown Goshawk using fauna furniture at SBT3.
This was a regular observation, mainly at underpasses with fauna furniture.



Plate 3.11 Swamp Wallaby moving west-east at fauna underpass C9.
A complete crossing was not recorded on this occasion.



Plate 3.12 Eastern Grey Kangaroo crossing west-east at SBT3 (southern span)

A complete crossing was recorded. Note that the animal is crossing in an area with no rock. Macropods were frequently observed to avoid the irregular rock when crossing.



Plate 3.13 Common Brushtail Possum crossing west-east at fauna underpass C7.

A complete crossing was not recorded on this occasion.

3.6.2 Scat and Track Searches

Underpass scat and track search results are provided in **Appendix C**. A total of twenty-three species/ species groups (excluding avifauna) were identified through direct observation or detection of scats and/ or tracks, including:

- Thirteen mammals: Eastern Bent-winged Bat (*Miniopterus orianae oceanensis*), Little Bent-winged Bats (*Miniopterus australis*), Antechinus sp., Cat (*Felis catus*), Common Brushtail Possum, Eastern Grey Kangaroo, European Fox (*Vulpes vulpes*), *Rattus* sp., Ringtail Possum (*Pseudocheirus peregrinus*), Short-beaked Echidna, Southern Myotis (*Myotis macropus*), Swamp Wallaby and Water Rat.
- Three amphibians: Cane Toad, Green Tree Frog and Striped Marsh Frog.
- Seven reptiles: Lace Monitor, Eastern Water Dragon, Sun-skink (*Lampropholis delicata*), Eastern Crevice Skink (*Egernia mcpheei*), *Egernia* sp., *Elapid* sp. and Martin's Bar-sided Skink (*Eulamprus martini*).

Most of the underpass usage observed/ detected by amphibians, reptiles and small terrestrial mammals (i.e. Antechinus sp., *Rattus* sp. and Water Rats) was associated with habitation of the structure. Results indicative of complete crossing fauna crossings were of:

- Cat at C7.
- Eastern Grey Kangaroos at NBT3.
- Lace Monitor at C7, C8, C9 and C10.
- *Macropod* sp. at SBT3.
- *Rattus* sp. at C6 (pipe culverts south of fauna underpass).
- Short-beaked Echidna at C10.
- Swamp Wallaby at C7, C8, C9, SBT3 and NBT3.
- Water Dragon at C6 (observed crossing).

No scats or tracks of target threatened species were detected at the underpass structures.

Fauna underpass structures C3, C7, C8, C9 and C10 were observed to support small to large roosting colonies of Little Bent-winged Bats during winter (range of individuals per structure: 2 to approx. 1800), with C3, C9 and C10 also used by small to medium sized colonies in early spring (range of individuals per structure: 3 to approx. 55). Individual Eastern Bent-winged Bats were observed roosting in C9 and NBT3 in winter. An individual Southern Myotis was observed roosting in NBT3 in winter. These three microbat species are listed as threatened species under the BC Act.

3.7 Rope Bridge Results

Rope bridge cameras recorded a total of 103 records of six species (refer to **Table 3.4**). The Feathertail Glider (*Acrobates pygmaeus* – 42 records) was the most commonly recorded species followed by the Squirrel Glider (39 records) and Sugar Glider (10 records) (plus seven *Petaurus sp.* records of either of these species that could not be identified to species levels). Other species recorded included the Brush-tailed Phascogale (2 records) and the Common Ringtail Possum (3 records). A sample of photos from the reporting period are provided in **Plates 3.14 to 3.17**.

The Feathertail Glider, Squirrel Glider and Sugar Glider were recorded on both the eastern and western sides of the rope bridge. The Brush-tailed Phascogale was recorded on the eastern side of the rope bridge only, while the Common Ringtail Possum was recorded at the western end of the rope bridge only. Overall, the total number of records was slightly higher at the western side (53) than the eastern site (50), despite the camera at the western pole malfunctioning for 16 per cent of the recording days. No images of fauna slipping on metal element were captured during Year 6.

No Yellow-bellied Glider or Greater Glider activity on the rope bridge was recorded in Year 6.

Table 3.4 Species Recorded by Rope Bridge Camera Traps During the Year 6 Reporting Period

| Species | Eastern Pole | | Western Pole | | TOTAL Visits |
|-------------------------|---------------|--------------|---------------|--------------|--------------|
| | No. of Visits | Visits/ Week | No. of Visits | Visits/ Week | |
| Brush-tailed Phascogale | 2 | 0.02 | 0 | 0.00 | 2 |
| Common Ringtail Possum | 0 | 0.00 | 3 | 0.04 | 3 |
| Feathertail Glider | 13 | 0.16 | 29 | 0.42 | 42 |
| Glider sp.* | 3 | 0.04 | 4 | 0.06 | 7 |
| Squirrel Glider | 25 | 0.30 | 14 | 0.20 | 39 |
| Sugar Glider | 7 | 0.08 | 3 | 0.04 | 10 |
| TOTAL | 50 | 0.60 | 53 | 0.76 | 103 |

Directional movement of the Feathertail Glider, Squirrel Glider and Sugar Glider occurred on both the eastern and western sides of the rope bridge (refer to **Table 3.5**). There were 12 occasions when gliders were recorded on both sides of the rope bridge on the same night (6 Feathertail Gliders, 5 Squirrel Gliders, 1 *Petaurus sp.*). These are potentially indicative of rope bridge crossings, with:

- Feathertail: five east-west and one west-east movements
- Glider sp.: one west-east movement
- Squirrel Glider: three east-west movements and two west-east movements.

However, directional movements were not consistent at each end of the rope bridge. It is also plausible that gliders were present at each end of the rope bridge on the same night and did not cross.

During the time of the western pole camera malfunction, only one potential crossing could have occurred during this period. There were only three visits to the eastern pole during this period, including two returns (Brush-tailed Phascogale and Squirrel Glider) and one directional record (Squirrel Glider moving east-west).

Squirrel Gliders were recorded moving east, west and making return movements on both sides of the rope bridge. Directional movement of Squirrel Gliders was recorded most often in a western direction (19 records).

Brush-tailed Phascogales were recorded twice on the eastern side of the rope bridge moving in a western direction. A return movement was observed on one of the occasions.

Some records (27 %) did not involve directional movement. This was partly attributed to Feathertail Glider habitation activity (i.e. foraging) at the rope bridge poles. Other instances were associated with animal's non-directional sequences or a low quality or number of images.

Table 3.5 Direction of Movement of Species on Rope Bridge During the Year 6 Reporting Period

| <i>Species</i> | <i>Eastern Pole</i> | | | | <i>Western Pole</i> | | | | <i>TOTAL</i> |
|-------------------------|---------------------|-------------|---------------|------------|---------------------|-------------|---------------|------------|--------------|
| | <i>East</i> | <i>West</i> | <i>Return</i> | <i>N/A</i> | <i>East</i> | <i>West</i> | <i>Return</i> | <i>N/A</i> | |
| Brush-tailed Phascogale | - | 1 | 1 | - | - | - | - | - | 2 |
| Common Ringtail Possum | - | - | - | - | 2 | - | - | 1 | 3 |
| Feathertail Glider | 5 | 4 | - | 4 | 7 | 12 | - | 10 | 42 |
| Glider sp.* | - | 3 | - | - | - | - | - | 4 | 7 |
| Squirrel Glider | 3 | 13 | 5 | 4 | 5 | 7 | 1 | 1 | 39 |
| Sugar Glider | - | 5 | - | 2 | 1 | | - | 2 | 10 |
| Grand Total | 8 | 26 | 6 | 10 | 15 | 19 | 1 | 18 | 103 |



Plate 3.14 Squirrel Glider at the western rope bridge pole.



Plate 3.15 Brush-tailed Phascogale at the eastern rope bridge pole.



Plate 3.16 Sugar Glider at the eastern rope bridge pole.



Plate 3.17 Ringtail Possum at the western rope bridge pole.

3.7.1 Year 3, 4 and 6 Comparison

A comparison of the visitation rate (number of visits per week) of target species at the eastern and western glider pole for Year 3, Year 4 and Year 6 monitoring is provided in **Figure 3.11**. The following trends can be observed:

- overall visitation rates (combined species) increased during Year 3 and Year 4, however decline during Year 6
- overall visitation rates were higher at the western pole compared with the eastern pole in Years 3 and 4, however during Year 6 visitation at the western pole decreased to lower levels than at the eastern pole
- during Year 3 and Year 4 Feathertail Gliders had the highest visitation rates, followed by Squirrel Gliders. During Year 6 Feathertail Glider visitation dropped significantly, which was the main contributor to the decrease in overall visitation in Year 6. In contrast, Squirrel Glider visitation remained relatively constant.

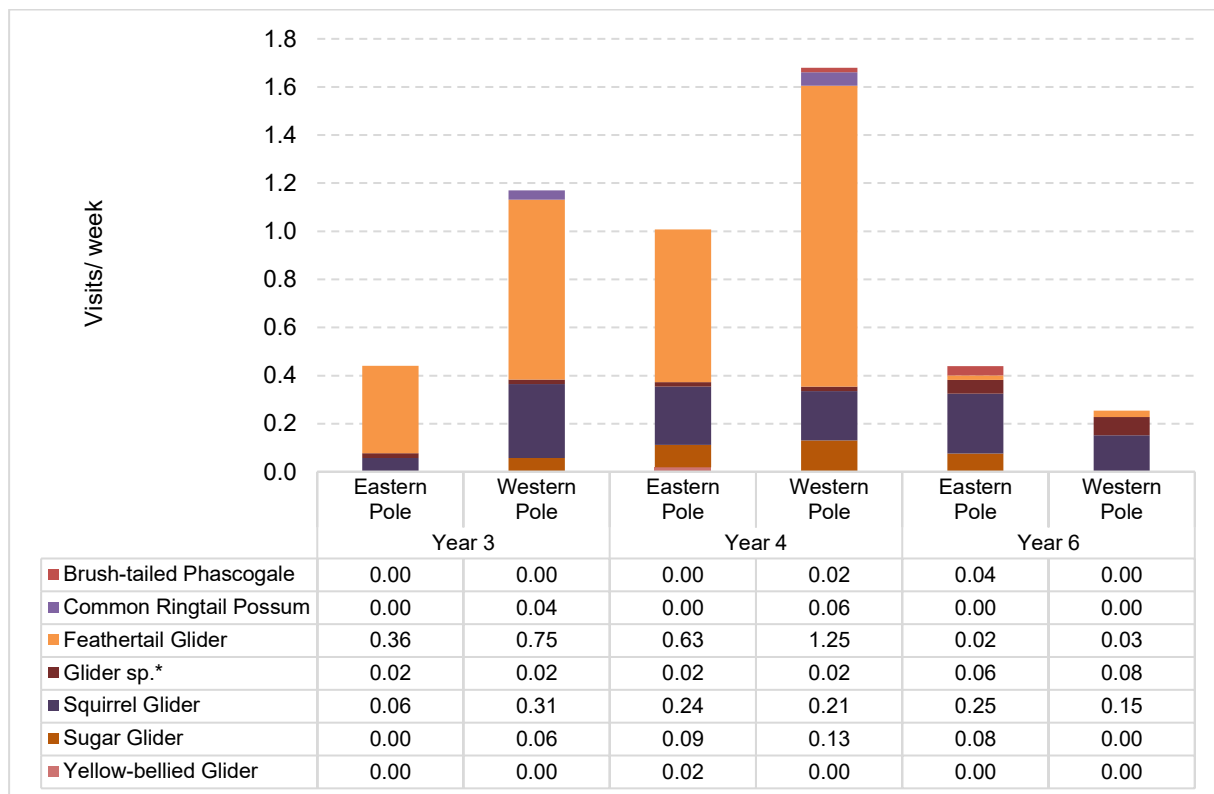


Figure 3.9 Visitation rates (visits/ week) of target species at each rope bridge pole during Year 3, Year 4 and Year 6 monitoring

Note: This data relates to monitoring years rather than reporting periods.

Table 3.6 shows the number of potential crossing recorded each year during the post construction monitoring. Recorded potential crossings were highest in Year 4 and mainly associated with Feathertail Glider activity.

Table 3.6 Potential complete crossings during Year 3, Year 4 and Year 6 monitoring

| Species | Year 3 | Year 4 | Year 6 |
|--------------------|--------|--------|--------|
| Feathertail Glider | 5 | 21 | 0 |
| Glider sp* | 0 | 0 | 1 |
| Squirrel Glider | 0 | 4 | 1 |

3.8 Vegetated Median Results

The results for spotlighting and call playback surveys, and nest box monitoring at the vegetated medians is included in **Sections 3.3 and 0** respectively.

3.9 Restoration of Vegetated Connectivity Corridor Results

Vegetation quadrats and photo point results are provided in **Appendix D** and summarised in **Table 3.7**. Vegetation structure at each site was divided into three categories:

- Trees (T1) = 3 m tall
- Shrubs (T2) = woody species <3 m tall
- Groundcovers (G) = non-woody species (e.g. herbs, grasses, sedges and rushes)

3.9.1 Year 6 Spring

A total of four tree species (all native) were recorded in the tree layer, with Swamp Box and Broad-leaved Paperbark being the dominant species at most sites. Upper tree height ranged between seven and 10 metres at each quadrat. Total cover scores at each site varied from 2 to 7 for native trees.

Thirteen 'shrub' species were recorded, including both native and weed species. Commonly recorded species included Swamp Box saplings, Forest Red Gum saplings, and Paperbarks (*Melaleuca linariifolia*, *M. nodosa*, *M. quinquenervia* and *M. sieberi*, *M. thymifolia*). The only weed species recorded was Groundsel Bush, which was uncommon. Total shrub cover scores at each site ranged from 2 to 4 for native species and 0 to 1 for weed species.

Fifty-five species were recorded in the groundcover layer, including 36 native and 19 exotic species. Dominant species included Pennywort (*Centella asiatica*), Blady Grass (*Imperata cylindrica*), Bluegrass (*Ischaemum australe*), Milkwort (*Polygala paniculata**) and Pigeon Grass (*Setaria sphacelata**). Total cover scores of groundcovers at each site ranged from 2 to 6 for native species and 2 to 6 for exotic species.

Condition varied from good at three quadrats (Q1, Q2, Q3), moderate at one site (Q4) and poor at four sites (Q5, Q6, Q7 and Q8). Disturbance from fire was recorded at all sites.

3.9.2 Year 3, 4 and 6 Comparison

A comparison of cover, number of native species and mean height cover for the tree, shrub and ground layer at each quadrat recorded in Year 3, Year 4 and Year 6 spring is provided in **Figure 3.10**, **Figure 3.11** and **Figure 3.12** respectively. Results varied both spatially (between quadrats) and temporally (between monitoring events). The following overall trends can be observed:

- a reduction in the number of native species in the tree and shrub layer at most sites
- an increase in tree height in the tree layer at all sites
- generally, at each quadrat the native cover scores remained stable and where variations occurred, they were minor
- for native species cover there was an increase in the tree layer at Q3 and Q4; a decrease in the tree layer at Q7; a decrease in the shrub layer at Q7, and a decrease in the ground layer at Q4, Q7 and Q8
- for exotic species cover there was an increase in the shrub layer at Q2 and Q4, a decrease in the ground layer at Q1, and an increase in the ground layer at Q4, Q7 and Q8.

Table 3.7 Summary of Year 6 Spring Vegetation Quadrat Data

| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|-----------------------------|-------------------------|-------------------------|-------------------------|----------|------|------|------|------|
| Trees (T1) > 3 m | | | | | | | | |
| Number of native species | 2 | 3 | 2 | 4 | 2 | 3 | 2 | 2 |
| Number of exotic species | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mean height (m) | 7 | 8 | 10 | 8 | 7 | 8 | 7 | 8 |
| Cover of native species* | 6 | 3 | 5 | 4 | 2 | 3 | 2 | 3 |
| Cover of exotic species* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shrubs (T2) < 3 m | | | | | | | | |
| Number of native species | 5 | 7 | 7 | 4 | 4 | 4 | 6 | 3 |
| Number of exotic species | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Mean height (m) | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 |
| Cover of native species* | 3 | 3 | 4 | 3 | 2 | 3 | 2 | 2 |
| Cover of exotic species* | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| Groundcovers (G) | | | | | | | | |
| Number of native species | 21 | 23 | 23 | 6 | 3 | 5 | 6 | 11 |
| Number of exotic species | 8 | 12 | 7 | 5 | 4 | 7 | 4 | 6 |
| Mean height (m) | 0.5 | 1 | 0.5 | 0.5 | 1.2 | 1.2 | 1.2 | 1.2 |
| Cover of native species* | 6 | 5 | 5 | 4 | 2 | 3 | 3 | 3 |
| Cover of exotic species* | 2 | 3 | 3 | 6 | 6 | 6 | 6 | 6 |
| Condition | Good recovery from fire | Good recovery from fire | Good recovery from fire | Moderate | Poor | Poor | Poor | Poor |



| | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|----------|----------|-----------------|-------------------------------------|----------|----------|----------|----------|
| Evidence of recruitment | Low | Low | Good (herbs) | Very low (Due to groundcover) | Very low | Low | Low | Low |
| Evidence of disturbance (e.g. fire, litter, disease, herbivory) | Y – fire | Y - fire | Y - fire | Y - fire | Y - fire | Y - fire | Y - fire | Y - fire |

* modified Braun-Blanquet score

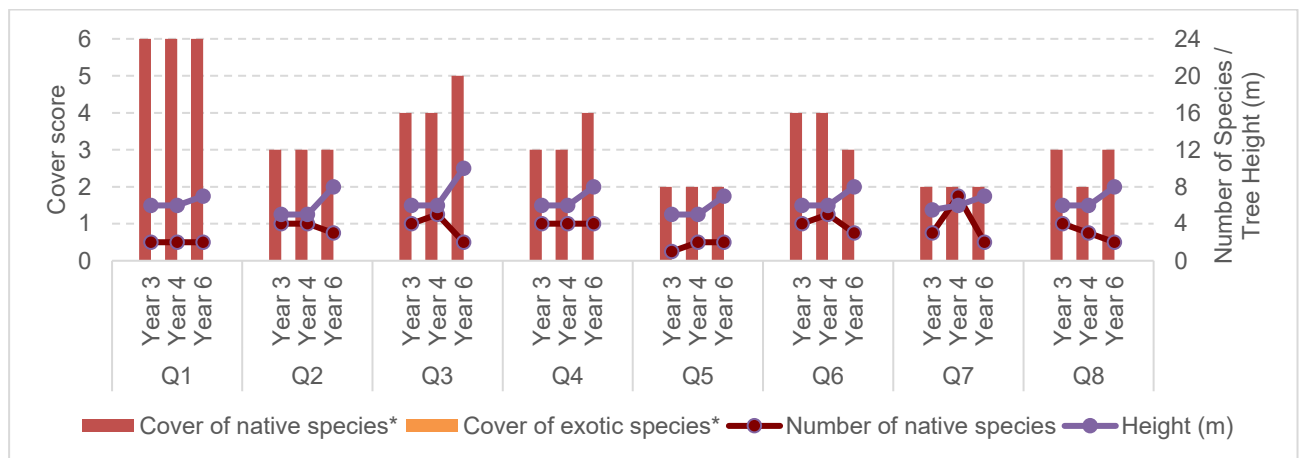


Figure 3.10 Cover of native and exotic species, number of native species and mean height of tree (T1) layer – Year 3, Year 4 and Year 6 monitoring

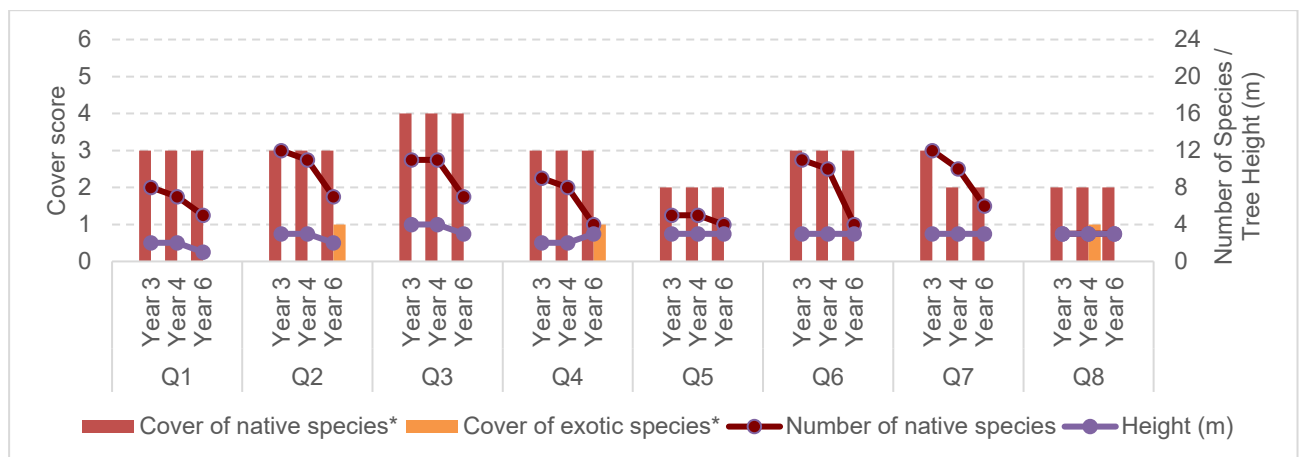


Figure 3.11 Cover of native and exotic species, number of native species and mean height of shrub (T2) layer – Year 3, Year 4 and Year 6 monitoring

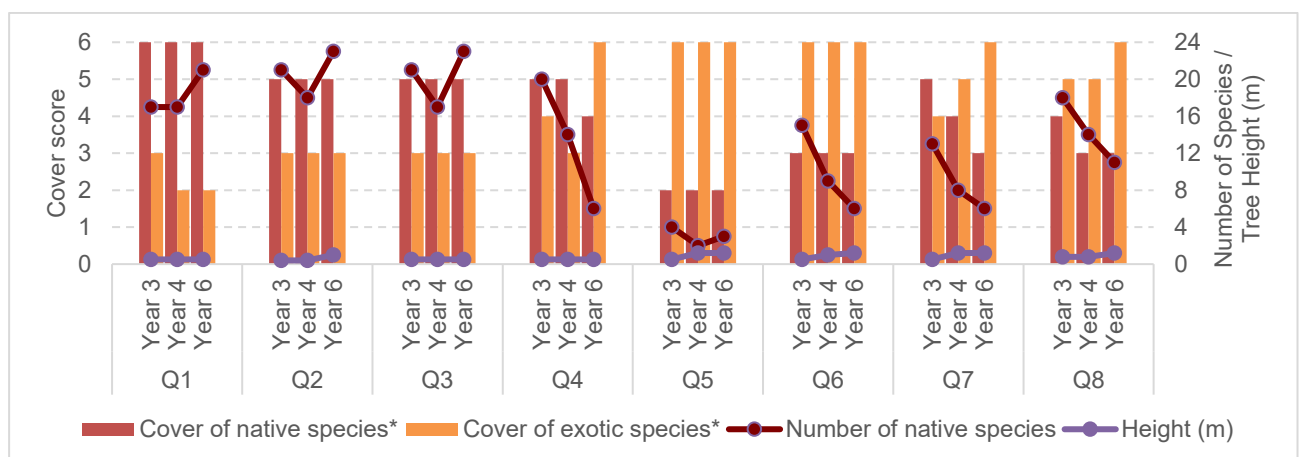


Figure 3.12 Cover of native and exotic species, number of native species and mean height of groundcover (G) layer – Year 3, Year 4 and Year 6 monitoring

*Braun-Blanquet score

3.10 Roadkill Monitoring Results

3.10.1 Year 6

Roadkill monitoring results are provided in **Appendix E** and summarised in **Table 3.8**. A total of 23 roadkills were recorded during surveys or opportunistically, comprising 14 species/ species groups. The most commonly recorded roadkills were birds (9 records), followed by Little Red Flying-foxes (*Pteropus scapulatus*), reptiles (Carpet Python *Morelia spilota*, Lace Monitor) and terrestrial mammals (Northern Brown Bandicoot, Red-necked Wallaby *Macropus rufogriseus*, Short-beaked Echidna), 3 records each. Roadkill numbers were highest in summer (15) and relatively equal in winter (5) and spring (3).

Two threatened species roadkills were confirmed, an opportunistic record of a Greater Glider during winter (26/08/2020) and a Koala during summer (1/12/2020). Both were recorded from the northbound lane at Impact Site 2 where fauna fencing was present, however is not a barrier to the Greater Glider and not of a design specific to Koalas.

Terrestrial mammals are the main fauna group that the fauna fencing at Devils Pulpit provides a barrier for. Of the three terrestrial mammal roadkills recorded, two were located along a section of road with fauna fencing (Northern Brown Bandicoot and Short-beaked Echidna) and the other was located within the Bundjalung rest area in a location without fauna fencing (Red-necked Wallaby). It is unclear how the roadkill terrestrial mammals within the fauna fencing area accessed the roadway.

Table 3.8 Summary of Year 6 Roadkill Monitoring Results

| Species | Winter | Spring | Summer | Total | In Area with Fauna Fencing | In Area without Fauna Fencing |
|---------------------------|---------------|---------------|---------------|--------------|-----------------------------------|--------------------------------------|
| Amphibians | - | - | 3 | 3 | 3 | - |
| Arboreal mammals * | 1 (1) | - | 1 | 2 | 2 | - |
| Birds * | 3 (1) | - | 6 | 9 | 9 | - |
| Little Red Flying-foxes * | - | 1 (1) | 2 | 3 | 2 | 1 |
| Reptiles | - | 1 | 2 | 3 | 3 | - |
| Terrestrial mammals | 1 | 1 | 1 | 3 | 2 | 1 |
| All species | 5 | 3 | 15 | 23 | 21 | 2 |

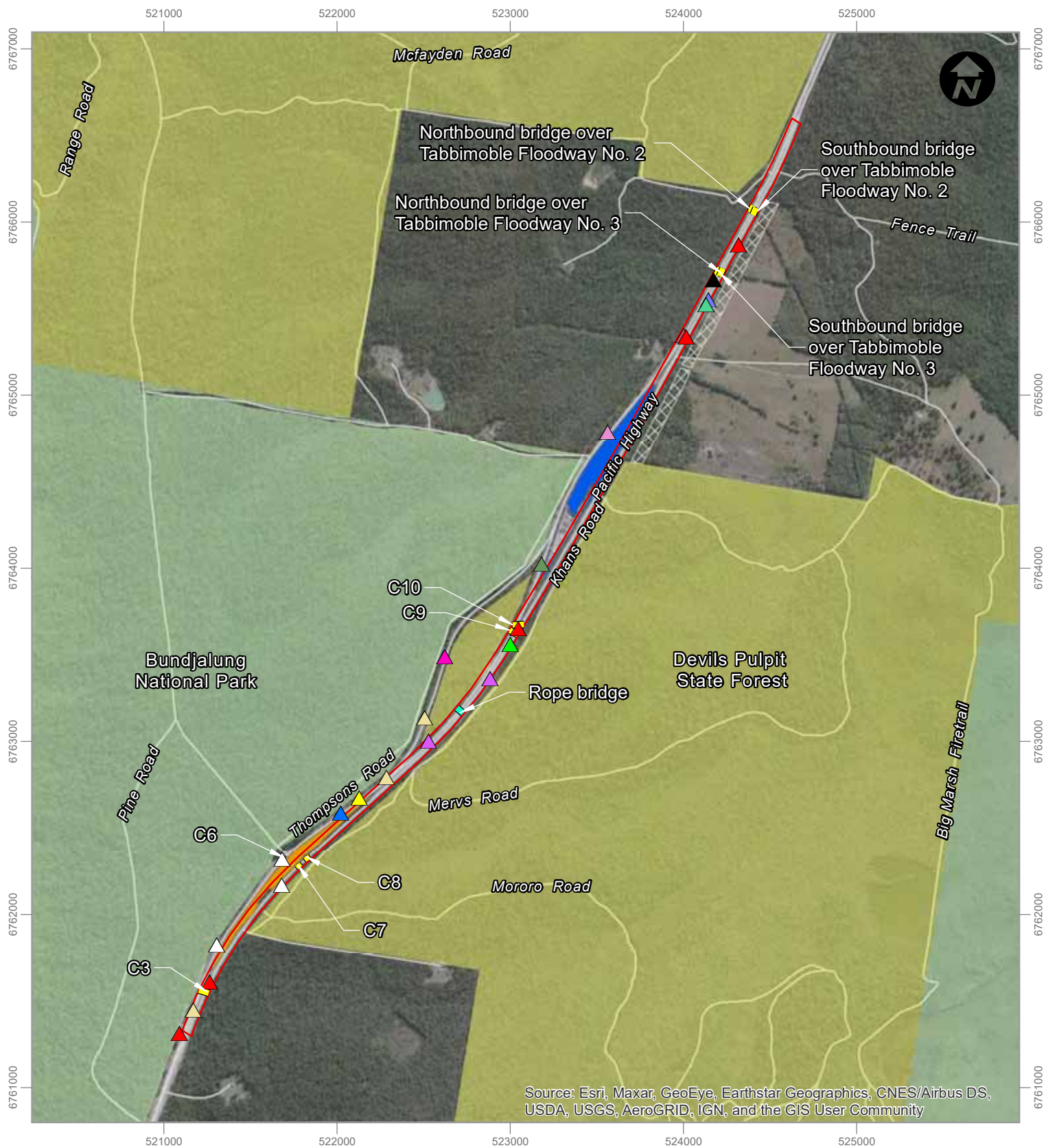
* Numbers in brackets are the portion of the records that were opportunistic; recorded outside of spring, winter, or summer survey dates.

3.10.2 Year 3, 4 and 6 Comparison

Due to the limited roadkill survey effort and low numbers of roadkills recorded during the post construction monitoring, it is not possible to describe trends in roadkill records at the site over time or the effectiveness of the fauna fencing. This is despite the fauna fencing being substantially upgraded between Year 4 and Year 6. This is demonstrated in **Table 3.9** which provides a summary of terrestrial mammal records each year of post construction monitoring and the presence of fauna fencing at each roadkill site.

Table 3.9 Terrestrial Mammal Roadkill Results During Year 3, Year 4 and Year 6 monitoring

| <i>Fauna Fencing</i> | <i>Year 3</i> | <i>Year 4</i> | <i>Year 6</i> |
|-----------------------------|----------------------|----------------------|----------------------|
| Present | 0 | 0 | 2 |
| Absent | 4 | 10 | 1 |
| Total | 4 | 10 | 3 |



GDA 1994 MGA Zone 56

LEGEND

- Devil's Pulpit concept clearing limit
- State forest
- National park reserve
- Northern median
- Southern median
- Vegetated connectivity corridor
- Combined fauna underpass
- Rope bridge

Roadkill

- Cane Toad
- Carpet Python
- Crow
- Dove
- Greater Glider
- Koala
- Kookaburra

- Lace Monitor
- Little Red Flying-fox
- Magpie
- Northern Bandicoot
- Red-necked Wallaby
- Short-beaked Echidna
- Unidentifiable Bird

0 590 Metres

Road Kill Monitoring Results - Illustration 3.2



4. Discussion

4.1 Target Threatened Species

The following target threatened species were recorded during the Year 6 monitoring reporting period:

- Green-thighed Frog
- Wallum Froglet
- Yellow-bellied Glider
- Squirrel Glider
- Brush-tailed Phascogale
- Koala
- Long-nosed Potoroo
- Greater Glider.

The Rufous Bettong and Spotted-tailed Quoll were target species not recorded which is discussed further in **Sections 4.1.1** and **4.1.10** respectively.

Two non-target threatened species were opportunistically recorded during Year 6 monitoring: Masked Owl and Powerful Owl (BC Act listed). Both species were assessed in the Project EA (Hyder 2011).


Tentative possible native mouse (*Pseudomys sp.*) records were observed again this year during RB/ BTP camera trap image analysis. The *Pseudomys* genus includes several threatened species. It is plausible that some of the tentative records would be of animals from the *Rattus* or *Melomys* genus, especially where records are irregular and not consecutive between years. Possible (*Pseudomys sp.*) have been recorded each year at Impact Site 3 (west). Target Elliott A trapping at this site would be required for the species identification to be confirmed.

4.1.1 Rufous Bettong

The Rufous Bettong was not recorded during Year 6 monitoring, nor during Year 4 monitoring. Images of the possible RB/ BTP records from Year 3 were subsequently reviewed against the larger image dataset gathered for the Project and it was confirmed that they were not of Rufous Bettong (one was a probable juvenile Red-necked Pademelon and the other a probable Long-nosed Potoroo). With this amendment, no Rufous Bettongs have been recorded during the post construction monitoring.

Project EA surveys (Hyder 2011) did not record the Rufous Bettong and the species was only an unconfirmed record during baseline monitoring (GeoLINK 2012a). The results collectively indicate that a resident Rufous Bettong population does not occur in the study area.

The potential suitability of the fauna underpass structures at Devils Pulpit for the Rufous Bettong is unclear. Sandpiper (2017) recorded numerous Rufous Bettong crossings at a comparable sized fauna underpass structure at Glenugie, although with natural material on the floor. AMBS (2001, cited in Bond and Jones 2013) reported bettongs (species not defined) using structures at least 52 m in length. In relation to other medium sized mammals known to occur within the study area, Northern Brown and Long-nosed Bandicoots were recorded using the underpass structures (both culvert and bridge structures), whereas Long-nosed Potoroos and Red-necked Pademelons were not (noting that the abundance of bandicoots in the study area is significantly higher than potoroos and pademelons; refer to **Section 3.2**). The limited fauna fencing along the highway during Years 3 to 4 may have



contributed to this result, although fauna fencing suitable as a barrier/ funnel for terrestrial mammals was functional along large portions of the site in Year 6.

4.1.2 Wallum Froglet

There is insufficient data to discuss changes in Wallum Froglet habitat use with relevance to the Project. It has been recorded at a very low frequency (25 % of surveys) and limited distribution (two sites: Impact Site 5 (east) in Year 6 and Control Site 3 in Year 3) during post construction monitoring. All records are located on the eastern side of the highway, despite similar habitat occurring on both sides of the highway. The Wallum Froglet was not recorded during the baseline (pre-construction) monitoring (GeoLINK 2012) or during surveys associated with the EIS.

There are numerous occurrences of Wallum Froglet populations in habitat adjacent to roads. The record of this species adjacent to the highway during Year 6 post construction indicates the habitat suitability of the study area has not been compromised by the Project. The EMP has not been designed to assess connectivity impacts on the Wallum Froglet or the effectiveness of the frog fencing or fauna underpass structures for this species.

The Year 6 Wallum Froglet records were located within a vegetated connectivity corridor. The regeneration of this area from former grazing land as part of the Project offset is beneficial for this species.

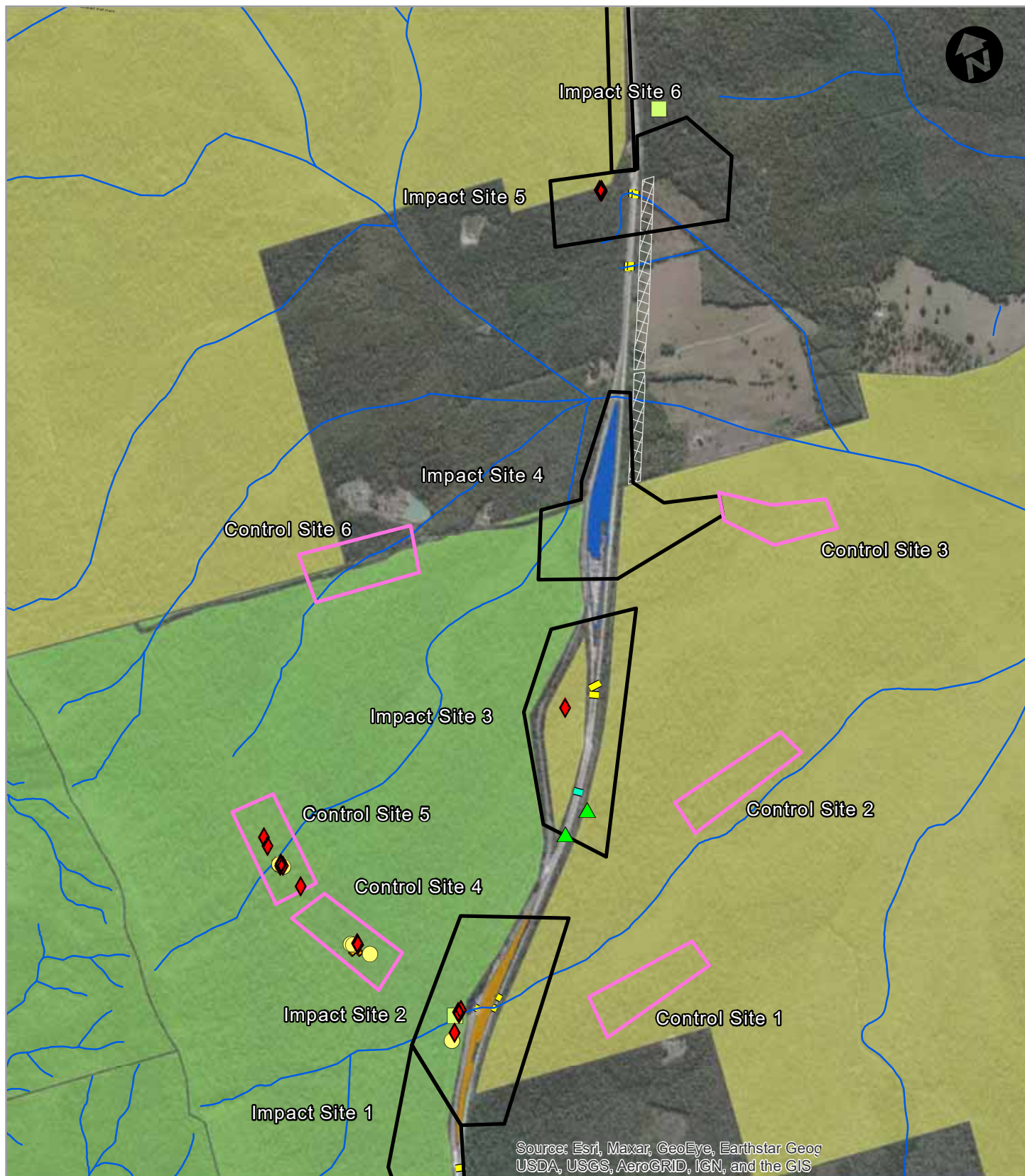
4.1.3 Green-thighed Frog

There is insufficient data to discuss changes in Green-thighed Frog habitat use and whether it is attributed to the highway upgrade. This is due to limited pre-construction records and no post-construction records on the eastern side of the highway; and made complex by the species' cryptic nature (Lemckert et al., 2006).

The post construction monitoring has frequently recorded Green-thighed Frog activity at three monitoring sites (33 % of sites, recorded from at least one of these sites during 67 % of surveys), with the known distribution increasing in Year 6 to two additional sites, all located on the western side of the highway (refer to **Illustration 4.1**). Although not demonstrated through the EMP, it is likely that a Green-thighed Frog subpopulation located on the eastern side of the highway would persist post construction based on:

- the presence of suitable habitat
- the diversity of other frog species recorded pre and post construction.

The EMP has not been designed to assess connectivity impacts on the Green-thighed Frog or the effectiveness of the frog fencing or fauna underpass structures for this species.



GDA 1994 MGA Zone 56

LEGEND

- | | |
|--|--|
| Control site | Northern median |
| Impact site | Southern median |
| State Forest | Vegetated connectivity corridor |
| National Park reserve | Rope bridge |
| | Combined fauna underpass |
| | Watercourse |

Green-thighed Frog

- | | |
|---------------------------------------|-------------------------|
| ▲ | 2012 - Construction |
| ■ | 2012 - Pre-construction |
| ● | Year 3 |
| × | Year 4 |
| ◆ | Year 6 |

0 600 Metres

Green-thighed Frog Study Area Distribution Mapping - Illustration 4.1

4.1.4 Yellow-bellied Glider

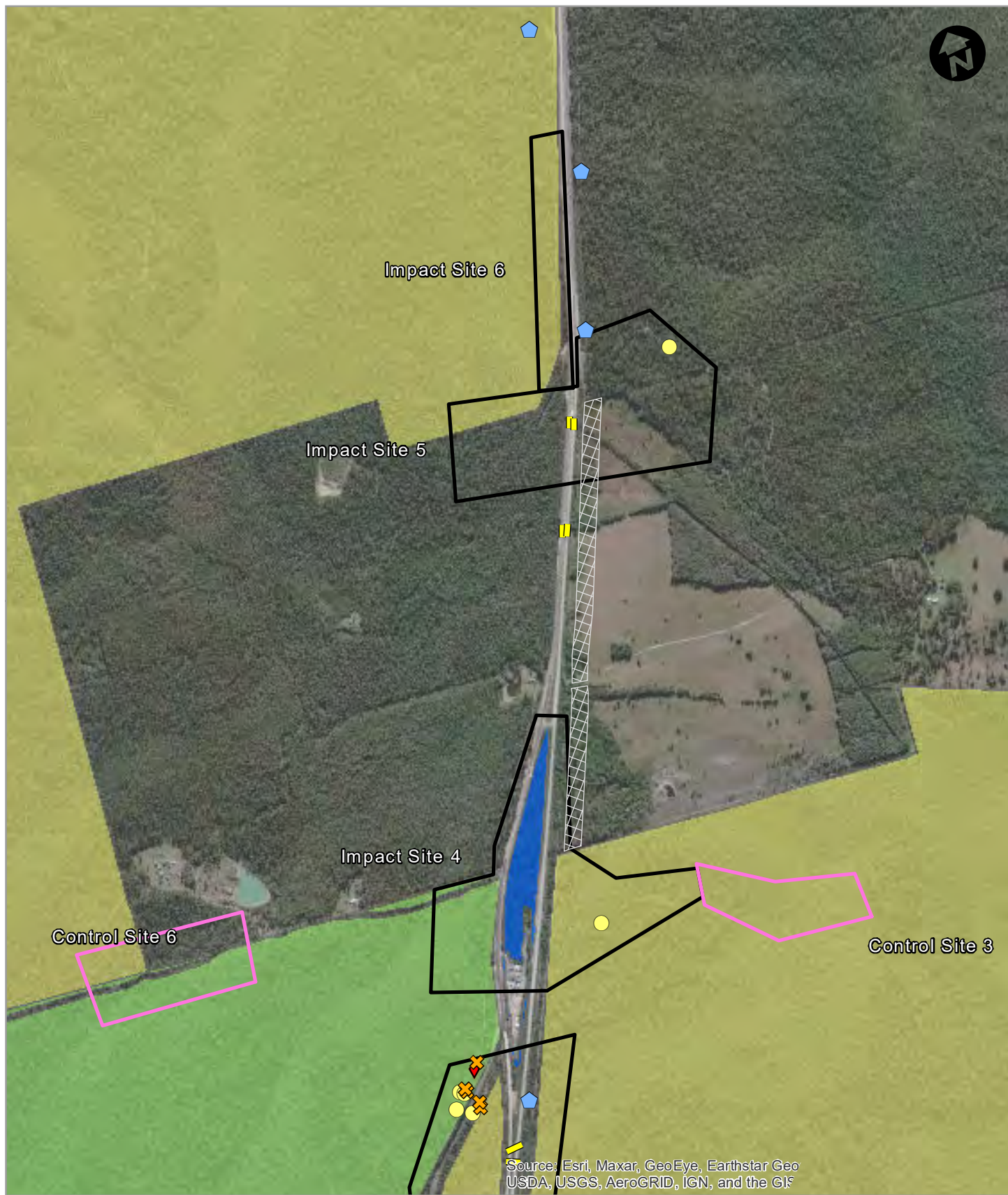
There is insufficient baseline/ pre-construction data to determine if there has been a change in Yellow-bellied Glider habitat use as a result of the Project. Post construction monitoring has however recorded the Yellow-bellied Glider at the same locations where the species was recorded pre/ during construction (Hyder 2011; GeoLINK 2012a; GeoLINK 2012b) as well as additional sites (refer to **Illustration 4.2**), demonstrating continued occupation of the study area post construction.

Yellow-bellied Glider activity levels and the number of occupied sites reduced at both impact and control sites in Year 6 compared to the Years 3 and 4 post construction monitoring. Similar trends have been observed over the same period during Yellow-bellied Glider monitoring on other regional highway monitoring projects (i.e. W2B Pacific Highway upgrade and Warrell Creek to Nambucca Heads Pacific Highway upgrade; Sandpiper 2020a). The 2019/ 2020 drought and 2019 bushfire are likely to have impacted the local Yellow-bellied Glider population through population declines or shifts in distribution, which have been recorded during other studies (Goldingay and Kavanagh 1991; Lunney 1987 in NPWS 2003).

No Yellow-bellied Glider rope bridge visits were recorded during the Year 6 monitoring and records in proximity of the rope bridge were limited to a single record on the western side of the highway during this period. During the five years of rope bridge camera monitoring undertaken at Devils Pulpit (GeoLINK 2018, 2019; Sandpiper 2016b), only a single Yellow-bellied Glider rope bridge visit has been recorded (Year 4; eastern side). While a complete crossing was not confirmed, this record was significant as it is the first known record of the species on a rope bridge. The Yellow-bellied Glider has previously been recorded on glider poles (Goldingay *et al.* 2018; Taylor and Rohweder 2020) with one study observing repeated pole use and detecting highway crossings on three occasions (Taylor and Rohweder 2020).

The Yellow-bellied Glider has not been recorded within either vegetated median during the post construction monitoring, although has been recorded on both sides of the southern median each year. Records in proximity to the northern median have been limited to a single record east of the highway during Year 3 and suggesting this area is not within a family groups' core territory. Calculations from a 2019 (post W2B clearing; before post bushfire hazardous tree removal) glide crossing assessment indicated that Yellow-bellied Glider should be able to cross the highway at both medians in both directions, although an above average glide performance would be required to cross east-west over the southbound lane at the northern median (GeoLINK 2019). The Taylor and Rohweder (2020) highway Yellow-bellied Glider pole crossing records suggest that traffic may not inhibit glider movement across the highway at the medians.

Although not demonstrated, it is likely that the Yellow-bellied Glider can move across the highway at Devils Pulpit via the vegetated medians and that these provide better potential crossing opportunities for this species than the rope bridge. The Yellow-bellied Glider has recently been recorded in a vegetated median along the Pacific Highway at Wells Crossing (Simon Wilson, Transport for NSW pers. comms. 3/08/2021), supporting this suggestion. Future projects should consider different approaches to record Yellow-bellied Glider highway crossings such as radio/GPS tracking or baited camera traps within medians.

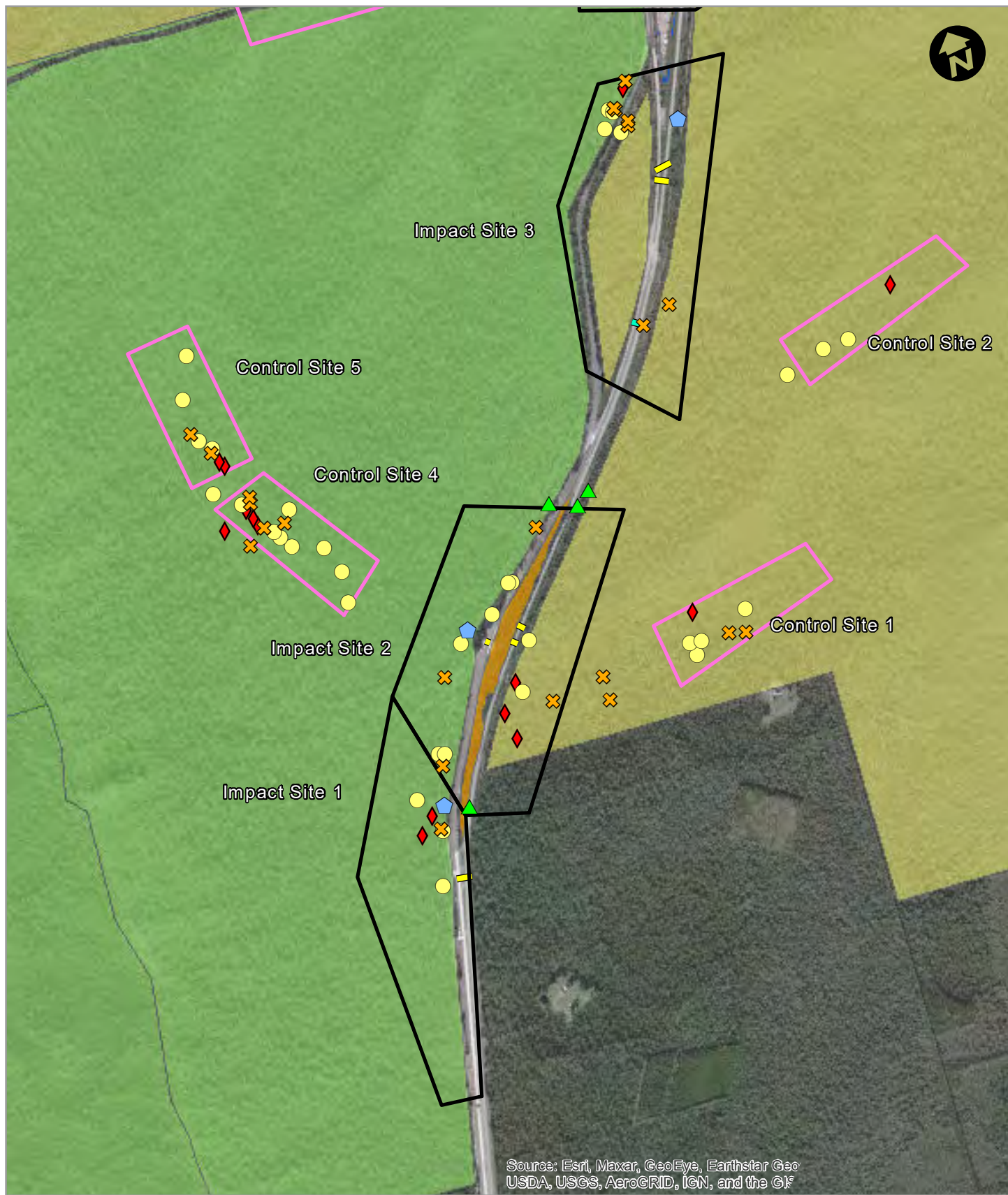


LEGEND

| | | | |
|---|---|--|--|
| Control site | Northern median | Yellow-bellied Glider | ✕ Year 4 |
| Impact site | Vegetated connectivity corridor | ⬠ 2011 - Hyder EIS | ♦ Year 6 |
| State Forest | Combined fauna underpass | ● Year 3 | |
| National Park reserve | | | |

0 400 Metres

Yellow-bellied Glider Study Area Distribution Mapping Illustration 4.2 - Sheet 1 of 2



LEGEND

| | | |
|---|---|---|
| Control site | Northern median | ● Yellow-bellied Glider |
| Impact site | Southern median | ● 2011 - Hyder EIS |
| State Forest | Rope bridge | ● 2012 - Construction |
| National Park reserve | Combined fauna underpass | × Year 4 |
| | | ◆ Year 6 |

0 400 Metres

Yellow-bellied Glider Study Area Distribution Mapping Illustration 4.2 - Sheet 2 of 2

4.1.5 Squirrel Glider

The Squirrel Glider was recorded by spotlighting, rope bridge monitoring and nest box monitoring during the Year 6 reporting period at:

- Eleven (61 %) of the spotlighting transect sites. Activity levels were higher at impact sites in Year 6 compared to Years 3 and 4; and lower at control sites in Year 6 compared to Year 4, although the same as Year 3 activity levels at control sites.
- Seven (approximately 61 %) of the remaining nest box transects.
- Both sides of the rope bridge with directional movement recorded at both ends; five potential complete crossings were recorded.

Similar observations of increased activity levels at impact sites have been recorded over a comparable period for the W2B project (Sandpiper 2020a).


There is insufficient baseline/ pre-construction data to determine if there has been a change in Squirrel Glider habitat use as a result of the Devil Pulpit project. However the Squirrel Glider has been recorded at all target impact sites (four sites) and control sites (four sites) during the post construction monitoring, which replicates the locations that Squirrel Gliders were recorded during preconstruction surveys (Hyder 2011 and GeoLINK 2012a) (refer to **Illustration 4.3**). These results indicate that resident Squirrel Glider groups continue to occupy both sides of the highway at these sites.

Visitation rates by Squirrel Gliders to the rope bridge have overall been relatively consistent during Years 3, 4 and 6 post construction monitoring (average 0.41 visits/week) and higher than the rates recorded during the initial trial monitoring (0.02 visits/week; Sandpiper 2016a). Similar temporal increases in visitation rates have been observed on other projects (e.g. Sandpiper 2020a; Soanes 2015). Sandpiper (2020a) suggested that this trend may be associated with a lag in resident gliders' discovery and familiarity with the crossing structure. The overall EMP visitation rate is also higher than visitation rates recorded during rope bridge monitoring at the Glenugie Pacific Highway upgrade site (mode: 0.21 visits per week; Sandpiper 2017).

Some recent studies have classified visitation and crossing rates differently (e.g. Golding *et al.*, 2018; Soanes *et al.*, 2015; Sandpiper 2020a). This report has presented the findings in a way that enable the results to be expressed differently to enable comparisons to these studies or future projects.

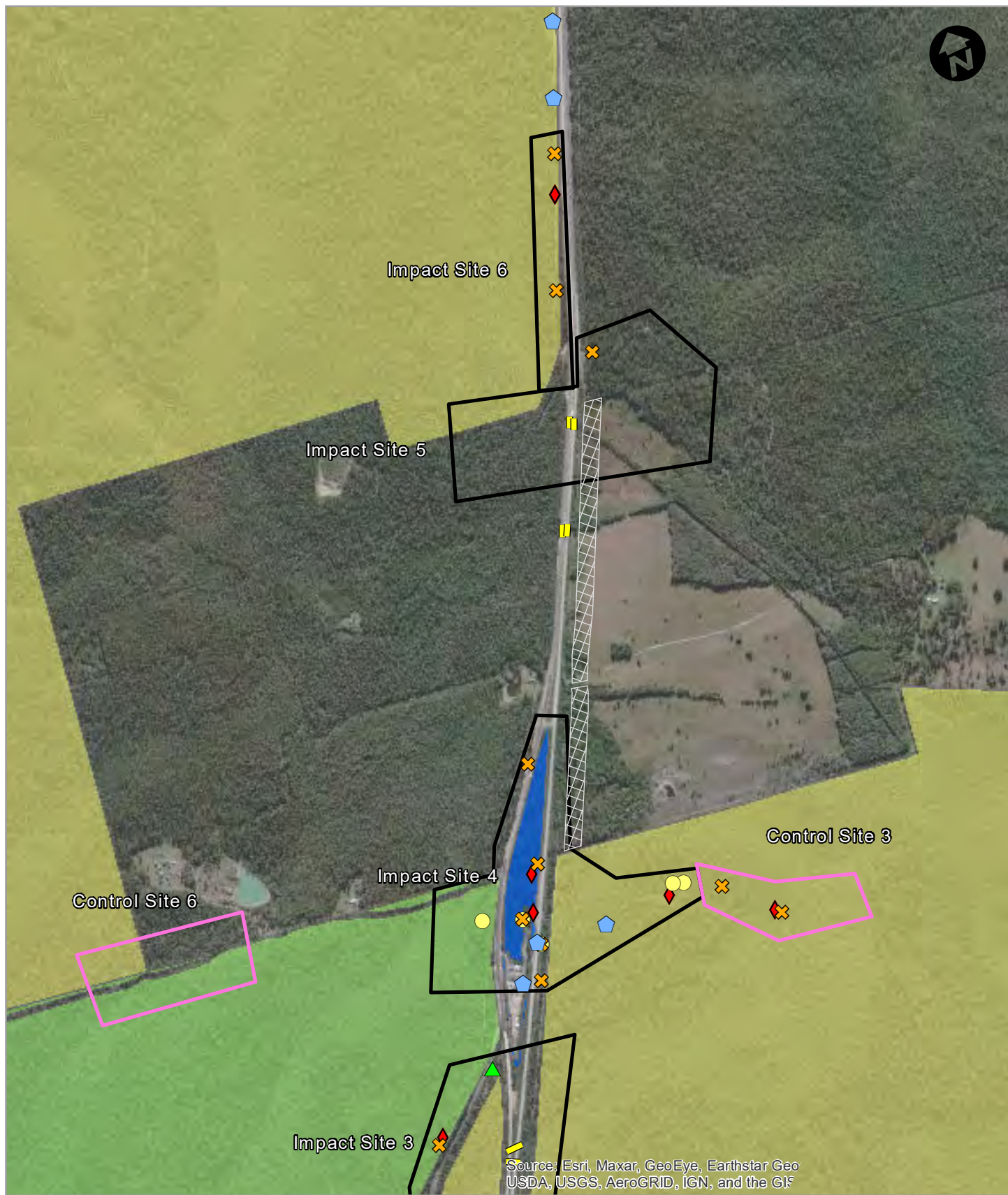
The Squirrel Glider has been recorded within and on both sides of the highway at the northern and southern median. The Squirrel Glider radio tracking in Year 5 (GeoLINK 2021) demonstrate that both male and female Squirrel Gliders were able to cross the northbound lane of the Pacific Highway at both medians at the Devils Pulpit site under no night traffic conditions. No crossings of the southbound lane were recorded, therefore the maintenance of Squirrel Glider movement across this newly constructed lane has not been demonstrated. It is expected that Squirrel Gliders could cross both the northbound and southbound lanes of the Pacific Highway at the vegetated medians when both lanes are open to traffic (GeoLINK 2021).

The Squirrel Glider radio tracking recorded frequency of glider movement across the northbound lane into the median was greater than Squirrel Glider visits to the rope bridge. This suggests that the vegetated medians provide greater opportunities for Squirrel Glider movement across the highway at Devils Pulpit. Part of the reason for this could be that there are many more crossing opportunities when numerous potential launch trees are available compared to a singular location when artificial crossing structures are used. However, given accumulating evidence of the use of arboreal crossing structures by the Squirrel Glider and other gliding species (e.g. Ball and Goldingay 2008; Soanes *et al.*



2015, 2018; Goldingay et al. 2018), the use of rope bridges and gliding poles is warranted where clearing gaps exceed gliding ability.

Numerous studies have looked at Squirrel Glider use of vegetated medians, rope bridges and poles to cross roads (e.g. Soanes et al. 2014; Soanes et al. 2015; Taylor and Goldingay 2013). The frequency of use of these crossing structures varies depending on specific site conditions and glider home range configurations. The objective of any glider crossing structure and target frequency of fauna movement should be considered when determining the appropriate glider connectivity structure for a particular site. Site topography, maintenance requirements and clearing impacts should also be considered.



LEGEND

- Control site
- Impact site
- State Forest
- National Park reserve

- Northern median
- Vegetated connectivity corridor
- Combined fauna underpass

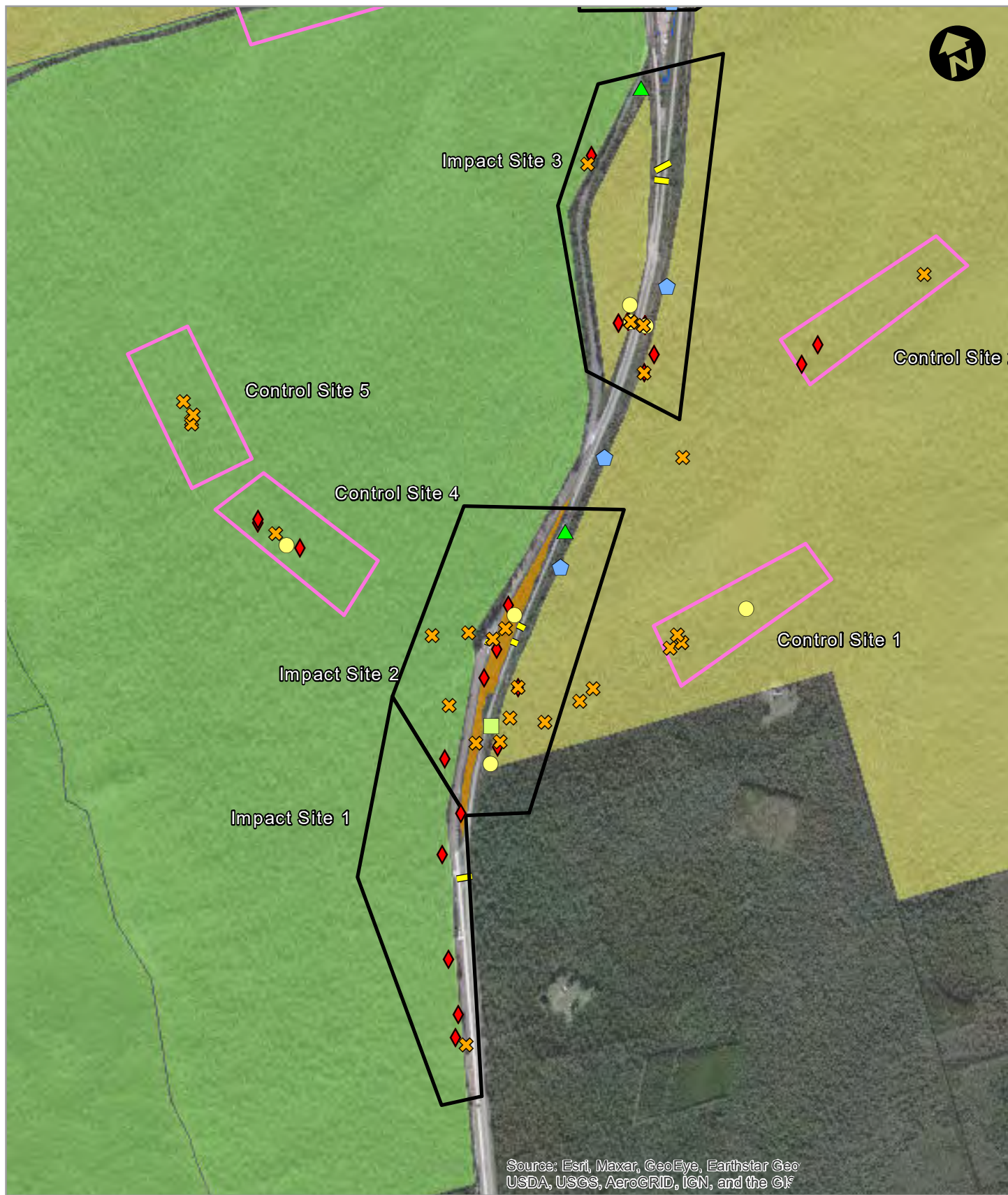
Squirrel Glider

- ◆ 2011 - Hyder EIS
- ▲ 2012 - Construction

- Year 3
- ✕ Year 4
- ◆ Year 6

0 400 Metres

Squirrel Glider Study Area Distribution Mapping Illustration 4.3 - Sheet 1 of 2



LEGEND

| | | | |
|--|---|--|---|
| Control site | Northern median | ◆ Squirrel Glider | Year 3 |
| Impact site | Southern median | ◆ 2011 - Hyder EIS | ✕ Year 4 |
| State Forest | Rope bridge | ▲ 2012 - Construction | ◆ Year 6 |
| National Park reserve | Combined fauna underpass | 2012 - Pre-construction | |

0 400 Metres

Squirrel Glider Study Area Distribution Mapping Illustration 4.3 - Sheet 2 of 2

4.1.6 Brush-tailed Phascogale

The Brush-tailed Phascogale was recorded by camera traps at six (40 %) of the RB/ BTP camera trap grid sites and on the eastern rope bridge camera on two occasions during Year 6. The number of sites where the Brush-tailed Phascogale was recorded in Year 6 is lower and has shifted in terms of distribution when compared to the Years 3 and 4 results (refer to **Illustration 4.4**). Overall activity levels have also decreased over the post construction monitoring period. Mansfield *et al.* 2017 found that '*phascogale abundance is highly spatially and temporally variable, most likely as a response to heterogeneity in habitat and foraging resources operating at a range of spatial scales*'. The 2019/ 2020 drought and bushfire are likely to be the primary factors contributing to the observed Brush-tailed Phascogale distribution and abundance changes during the post construction monitoring.

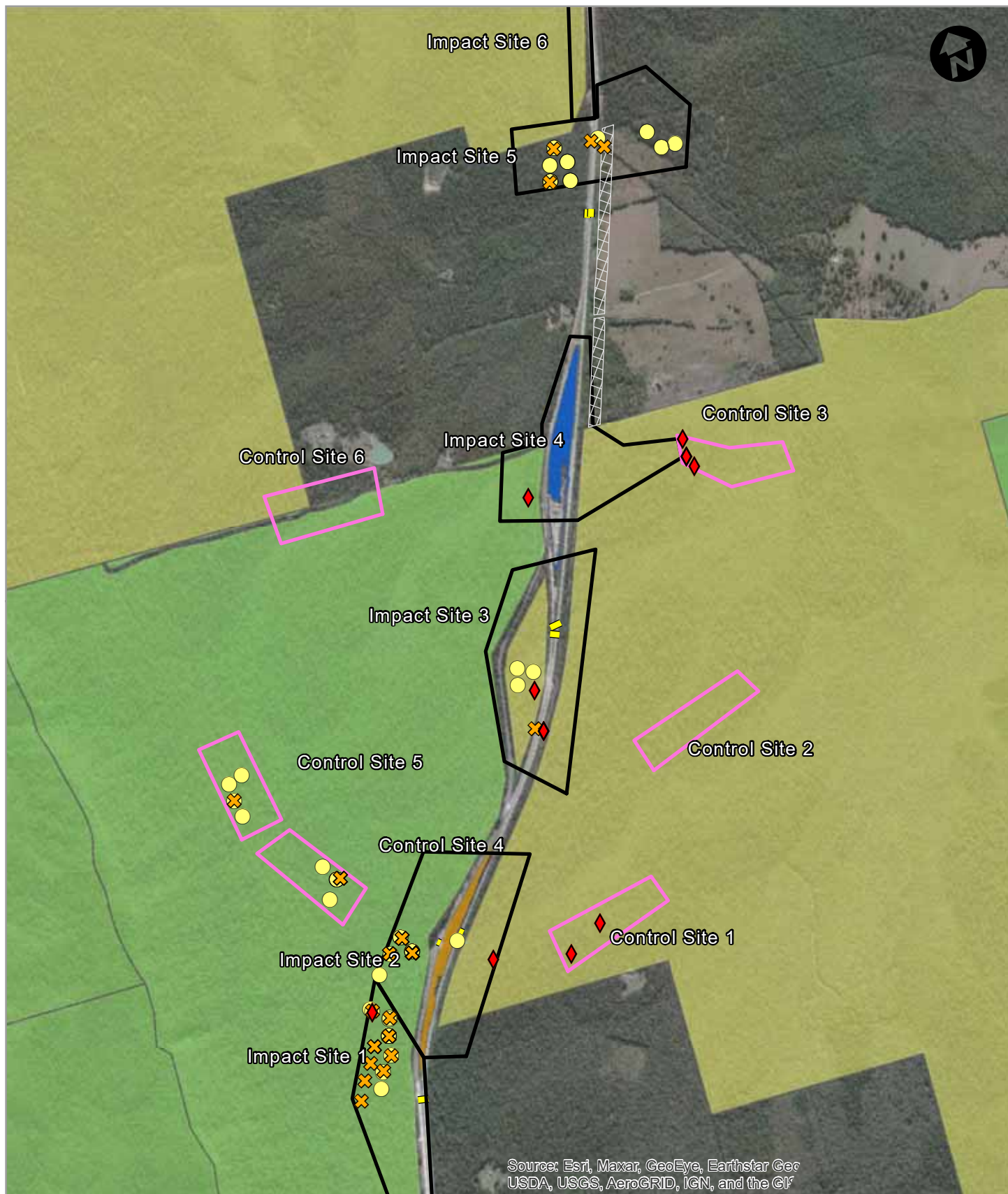
Pre/ during construction surveys (Hyder 2011; GeoLINK 2012a; GeoLINK 2012b) did not record any Brush-tailed Phascogales. Therefore, distribution and abundance comparisons cannot be made pre/ post construction, nor any statements regarding the impacts of the Devils Pulpit project.

Brush-tailed Phascogale visitation at the rope bridge has only been recorded on three occasions during the five years of rope bridge camera monitoring undertaken at Devils Pulpit (GeoLINK 2018, 2019; Sandpiper 2016a). No complete crossings have been recorded, with two of the three records being return visits and the other being a directional crossing movement with no camera record on the other side of the rope bridge. Similar observations have been recorded during previous studies (Soanes *et al.*, 2015; Sandpiper 2017), which also failed to record images of directional movement on both ends of the rope bridge to confirm a complete crossing.

No underpass crossings were recorded during the post construction monitoring, despite the species being recorded using similar structures on other highway upgrade projects (e.g. Sandpiper 2017; Niche 2020). In relation to the fauna underpass structures, the Year 6 Brush-tailed Phascogale records were located:

- Within 500 m on the western side of the highway at C9 and 10.
- Within 500 m on the eastern side of the highway at C6, C7 and C8.
- Not within 500 m of C3, SBT2, NBT2, SBT3, NBT3.

During Years 3 and 4, fauna fencing in the study area was limited and not of a design that would create a barrier/ funnel for the highly agile Brush-tailed Phascogale. Large sections of Brush-tailed Phascogale designed fauna fencing was in place during Year 6, however reduced activity levels (an indicator of relative abundance) was observed during this period. These factors along with camera trap limitations are overall likely to have reduce the ability of the EMP to record Brush-tailed Phascogale activity at the underpasses.



LEGEND

- Control site
- Impact site
- State Forest
- National Park reserve

- Northern median
- Southern median
- Vegetated connectivity corridor

- Rope bridge
- Combined fauna underpass

Brush-tailed Phascogale

- Year 3
- ✕ Year 4
- ◆ Year 6

0 600 Metres

Brush-tailed Phascogale Study Area Distribution Mapping - Illustration 4.4

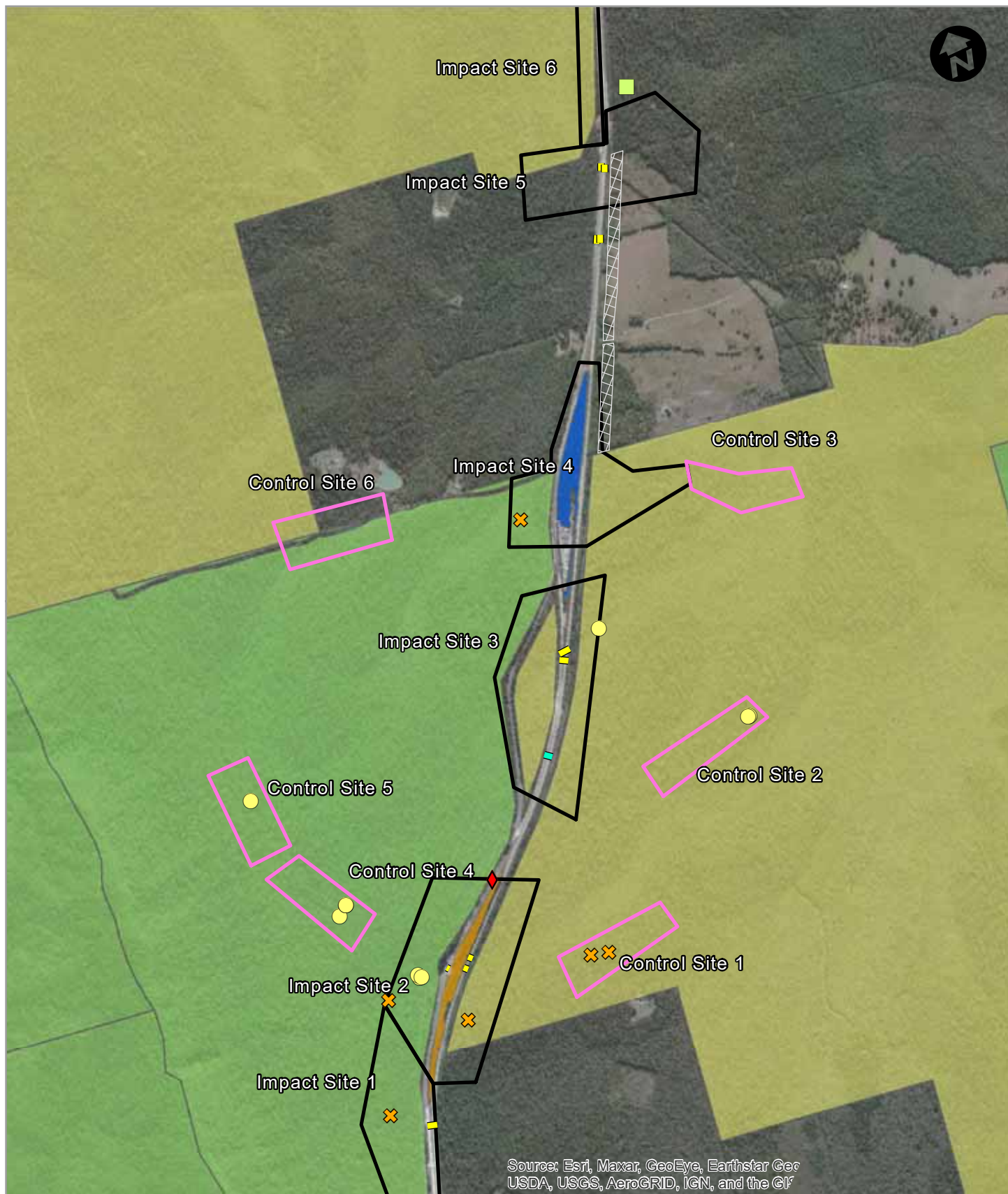


4.1.7 Koala

The only Koala record during Year 6 was a roadkill on the northbound lane at Impact Site 2 during summer. The record is located in the vicinity of the previous post construction records associated with Bundjalung National Park (refer to **Illustration 4.5**). Fauna fencing was present in this area, along with a fauna/ Koala grid at the Pine Road entrance, however, is not of a design specific to Koalas. It is unclear how the Koala entered the roadway, although potential options include climbing the fence and going around the end of the fence at the Bundjalung rest area. Transport/ Pacific Complete (W2B principal contractor) were notified of the roadkill and conducted a fauna fence inspection as a contingency response (in accordance with Section 10 of the EMP).

The post construction monitoring results are indicative of a low density Koala population in the study area. Koala surveys undertaken as part of W2B project in the general locality recorded similar findings (RMS 2016; GeoLINK unpublished). No Koala underpass or rope bridge crossings were recorded. This is not unexpected given the low density of records and limited fauna fencing (Years 3 and 4) or Koala fencing (Year 6) along the Project site to direct Koalas moving east or west across the study area to underpass structures.

There are insufficient records to determine pre/ post construction changes to Koala activity within the study area and attribute any changes to the Devils Pulpit project. The Koala roadkill demonstrates that the roadkill risk remains within the study area for the Koala and that fauna fencing should be holistic and specific to the target fauna.



LEGEND

- Control site
- Impact site
- State Forest
- National Park reserve

- Northern median
- Southern median
- Vegetated connectivity corridor

- Rope bridge
- Combined fauna underpass

Koala

- 2012 - Pre-construction
- Year 3
- ✕ Year 4
- ◆ Year 6

0 600 Metres

Koala Study Area Distribution Mapping - Illustration 4.5



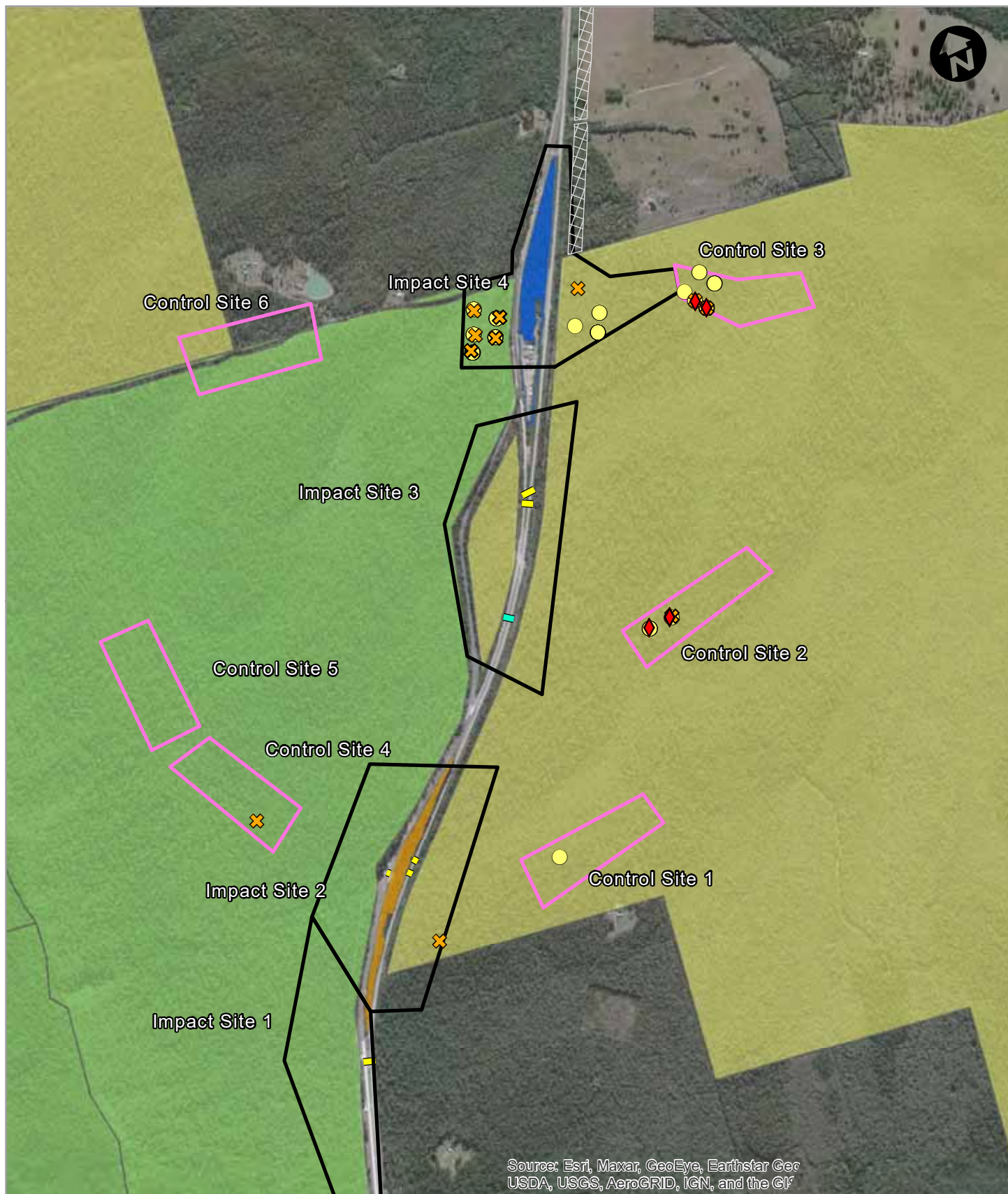
4.1.8 Long-nosed Potoroo

Pre/ during construction surveys (Hyder 2011; GeoLINK 2012a; GeoLINK 2012b) did not record any Long-nosed Potoroos. Therefore, distribution and abundance comparisons cannot be made pre/ post construction, nor any statements regarding the impacts of the Devils Pulpit project.

The Long-nosed Potoroo was recorded by camera traps at two (13%) of the RB/ BTP camera trap grid sites during Year 6, comprising two (40%) of the five control grid sites and none of the 10 impact sites. Overall activity levels and distribution reduced in Year 6 compared to Years 3 and 4 and there were no Long-nosed Potoroo records on the western side of the highway. This decline is attributed to the 2019 bushfire and similar declines have been observed during other studies post fire (Catling et al. 2001; cited in DEPI 2013).

No Long-nosed Potoroo activity was recorded at any of the underpass crossing structures during Year 6 or the entire EMP. In Year 6, this was not unexpected given the absence of Long-nosed Potoroos records in proximity to the underpass structures (all records were >500 m east of the highway). During Years 3 and 4, Long-nosed Potoroo activity primarily occurred in locations without fauna underpass structures and there was limited fauna fencing along the Project site at the time to direct Long-nosed Potoroos to the underpass structures (GeoLINK 2019).

The potential suitability of the fauna underpass structures at Devils Pulpit for the Long-nosed Potoroo is unclear. Lewis (2015) recorded one adult Long-nosed Potoroo using a comparable sized culvert (2.4 m width x 1.8 m high and 31 m long) as part of the Tungan Bypass project. The record was made after culvert modifications were made (i.e. mulch layer, increased shelter logs and the creation of a dirt bund to direct water flows away from the culvert inlet). AMBS (2002, cited in Bond and Jones, 2013) reported Long-nosed Potoroos using 3 m x 3 m underpass structures 40 to 52 m long as part of the Bulahdelah to Coolongolook highway upgrade monitoring. Long-nosed Potoroo underpass activity was also recorded as part of the Coopernook to Herons Creek highway upgrade monitoring (Sandpiper 2015; cited in Sandpiper 2020). In relation to other medium sized mammals known to occur within the study area, Northern Brown and Long-nosed Bandicoots were recorded using the underpass structures (both culvert and bridge structures), whereas Red-necked Pademelons were not, although this is not unexpected given that the abundance of the latter species was substantially lower than bandicoots in the study area (refer to Section 3.2). Overall, it is plausible that underpass structures at Devils Pulpit are suitable for Long-nosed Potoroo use, however this has not been demonstrated during the EMP.



LEGEND

| | | | |
|---|---|---|--|
| Control site | Northern median | Rope bridge | Long-nosed Potoroo |
| Impact site | Southern median | Combined fauna underpass | |
| State Forest | Vegetated connectivity corridor | Year 3 | |
| National Park reserve | | Year 4 | |
| | | | Year 6 |

0 500 Metres

Long-nosed Potoroo Study Area Distribution Mapping - Illustration 4.6

4.1.9 Greater Glider

There is insufficient data to discuss changes in Greater Glider habitat use and whether it is attributed to the highway upgrade due to the limited pre-construction records (GeoLINK 2012a; GeoLINK 2012b). However, the species has been recorded at all pre-construction record sites and at additional sites during the post construction monitoring (refer to **Illustration 4.7**), which demonstrates continued occupation.

Greater Glider activity levels and the number of occupied sites reduced at both impact and control sites in Year 6 compared to the Years 3 and 4 post construction monitoring (where similar results were recorded). This reduction can be attributed to the 2019 bushfire because the species is known to be sensitive to wildfire (Lunney, 1987, Andrews et al., 1994, Lindenmayer et al., 2011; cited in DoE undated).

No Greater Glider activity has been recorded on the rope bridge during the five years of camera monitoring undertaken at Devils Pulpit (this EMP and Sandpiper 2016b). The species has been recorded on both sides of the highway in the general vicinity of the rope bridge (Impact Site 3), although only in very low numbers to the east (one record) and to the west post the 2019 bushfire (refer to **Illustration 4.7**).

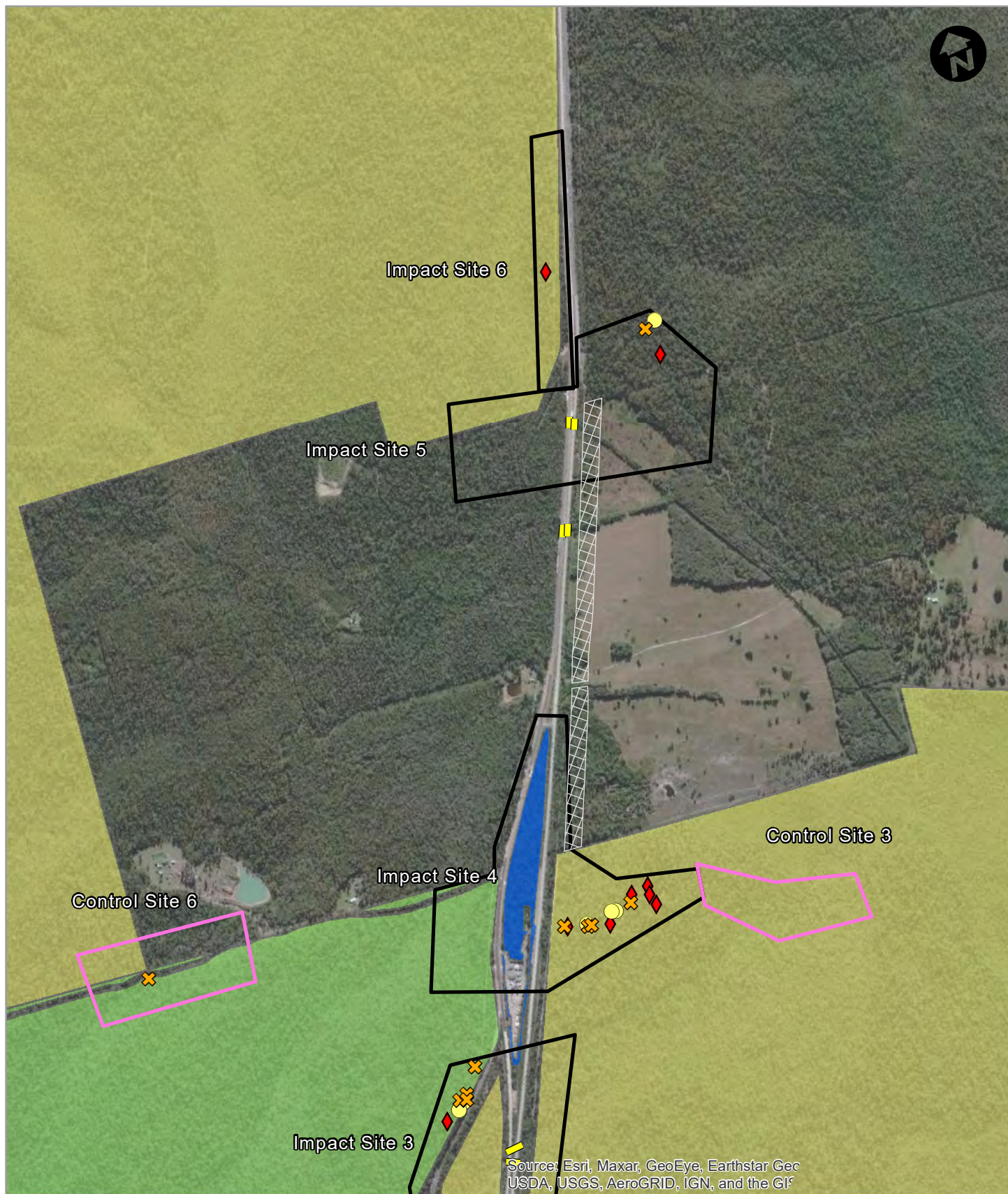
At the southern vegetated median, the Greater Glider was only recorded on the western side during Year 6. This contrasts to Years 3 and 4 where the Greater Glider was recorded within and on both sides of the highway at this site (Impact Site 2 (east, median and west)). Results indicative of Greater Glider movements across the highway between the southern median and adjacent habitat were recorded during Years 3 and 4, although it was not determined which lane, or if both were traversed. Movement across both lanes is plausible based on the highway clearing distance, the height of adjacent trees (GeoLINK 2019) and the species glide performance (Taylor and Goldingay 2009; WPSQ undated), despite the additional clearing undertaken as part of W2B between Years 4 and 6 which increased the clearing width.

A Greater Glider roadkill recorded on the northbound lane at the southern median during Year 6 demonstrates that:

- Gliders have a willingness to cross the highway at the median at a location with an approximately 44 m clearing distance.
- Gliders crossing the highway are susceptible to traffic collision.

The increased canopy gap at the northbound lane in the vicinity of the roadkill from the recent W2B works (from approximately 25 m to 44 m) is likely to have increased the roadkill risk for crossing gliders.

No Greater Gliders have been recorded within the northern median as part of the EMP spotlighting surveys, although an opportunistic record was made during Squirrel Glider radio tracking in Year 5. The Greater Glider was recorded east of the northern median each year during post construction monitoring. Although not confirmed, Greater Glider movement across the both lanes at the northern median is plausible based on the highway clearing distance, the height of adjacent trees (GeoLINK 2019) and the species glide performance (Taylor and Goldingay 2009; WPSQ undated).

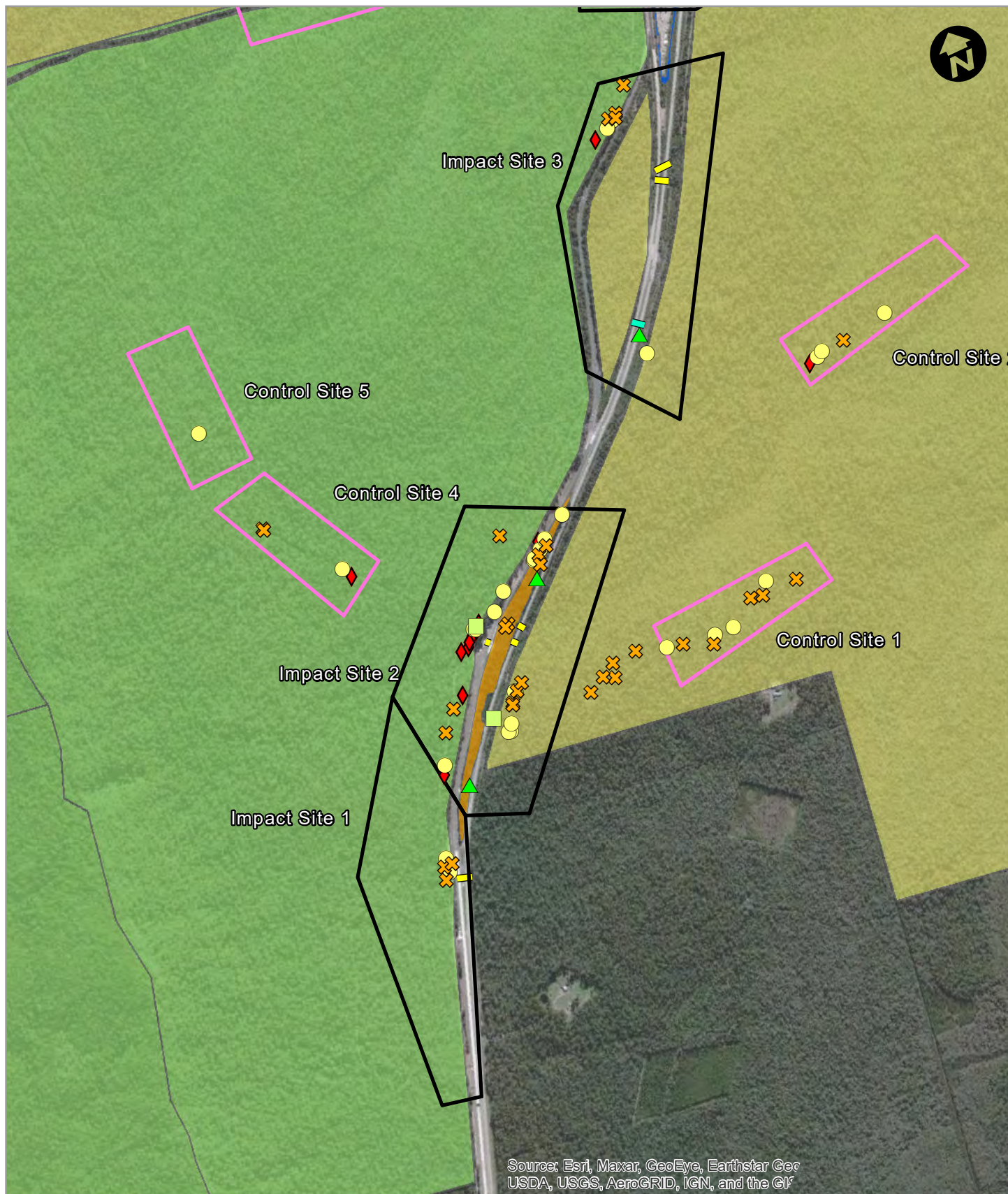


LEGEND

| | | | |
|--|---|--|--|
| Control site | Northern median | Greater Glider | ✕ Year 4 |
| Impact site | Vegetated connectivity corridor | ● Year 3 | ◆ Year 6 |
| State Forest | Combined fauna underpass | | |
| National Park reserve | | | |

0 400 Metres

Greater Glider Study Area Distribution Mapping Illustration 4.7 - Sheet 1 of 2



LEGEND

| | | | |
|---|---|--|--|
| Control site | Northern median | ▲ Greater Glider 2012 - Construction | ● Year 3 |
| Impact site | Southern median | ■ Greater Glider 2012 - Pre-construction | ✕ Year 4 |
| State Forest | Rope bridge | ◆ Year 6 | |
| National Park reserve | Combined fauna underpass | | |

0 400 Metres

Greater Glider Study Area Distribution Mapping Illustration 4.7 - Sheet 2 of 2

4.1.10 Spotted-tailed Quoll

The Spotted-tailed Quoll was not recorded during any post construction monitoring events undertaken as part of this monitoring program or during target surveys in 2014 and 2015 (Sandpiper 2016a). Sandpiper (2016a) found:

'Quolls are likely to move through forest in the vicinity of the upgrade and, at times, cross the Pacific Highway in vicinity of the upgrade, although use would primarily be limited to male quolls roaming in search of mates during the breeding season and dispersing juveniles. The roadkilled male quoll recorded in May 2013 is evidence that individuals occur in the area and the timing of that record supports the idea of occasional visitation during the breeding season.... the area does not support a resident population of quolls. Therefore, the probability of detecting quolls within the Devils Pulpit study area is low.'

The results of this monitoring program support these statements. The likelihood of the Spotted-tailed Quoll using the underpasses during Years 3 and 4 was low due to the limited fauna fencing. Most of the additional fauna fencing present during Year 6 was a design unlikely to create a barrier/ funnel for a highly agile species such as Spotted-tailed Quoll, although it would be expected to funnel ground dwelling prey (e.g. bandicoots) which may lead quolls to the underpass (e.g. when following tracks and scent trails).

No corrective actions of the Spotted-tailed Quoll Management Plan have been triggered to date.

4.1.11 Pest Fauna Observations

The EMP has observed an increase in some pest fauna within the study area. This includes:

- Cane Toads which have established and progressively increased in abundance throughout the study area. No Cane Toads were recorded in the study area during surveys undertaken for the EIS (Hyder 2011) or pre/ during construction activities (GeoLINK 2012a; 2012b). They have been recorded during each year of the post construction monitoring, originally only at impact sites adjacent to the highway (GeoLINK 2018), then at all sites in Year 6. The 2019 bushfire and subsequent rain appears to have been advantageous for the species, enabling Cane Toads to establish further into the forest away from the highway and access tracks.
- Wild pigs, particularly in Bundjalung National Park, where tracks and diggings are frequent. Their movement into the area occurred between Years 4 and 6, corresponding with the 2019/ 2020 drought, bushfire and subsequent rain.
- House Mouse across the study area (refer to **Section 3.2**).

Feral predators (feral cats, wild dogs/dingo and foxes) have also been observed throughout the post construction monitoring, including at underpass structures. Analysis of pest fauna abundance and interaction with threatened fauna (particularly in relation to crossing structures) has not been undertaken as part of this study, however this is worth investigating on future projects. Observations of European Hare (*Lepus europaeus*) have been occasional and in low numbers throughout the post construction monitoring.

4.2 Effectiveness of Mitigation Measures (Connectivity Structures)

Monitoring of crossing structures and roadkill monitoring is discussed in **Table 4.1** in relation to the performance measures specified in the EMP. Key findings are summarised below.

4.2.1 Fauna Underpass

No complete crossings of target threatened species have been detected, although crossings by a number of native non-threatened species have been recorded. Varying levels of fauna activity between structures and limited results at a number of structures (including no complete crossings at C3) indicate varying suitability or quality of each in providing fauna connectivity. As discussed in GeoLINK (2018, 2019), significant rainfall events in early 2017 resulted in damage at some structures, including:

- Scouring at the inlet and/ or outlet of five culvert structures (C3, C6, C8, C9 and C10; refer to **Plate 4.1** and **4.2**), causing pooling of water within or at the entrance to the subject culverts. C6 has since been upgraded (refer to **Section 1.1.2**), although pools of water remain across most of the entrances and dense aquatic vegetation (Bulrush, *Typha sp.*) occurs at the inlet.
- Damage to the fauna furniture.

The 2019 bushfire further damaged the fauna furniture at the Tabbimoble floodway bridges.

This damage has affected fauna underpass usage which is demonstrated during the Year 6 reporting period by the substantially greater number of unique fauna crossings at structures without pooled water at the entrance compared to structures with pooled water (refer to **Section 3.6.1**). Transport are currently investigating repair works for these structures.



Plate 4.1 Typical water height at the outlet of C3.



Plate 4.2 Scouring and pooled water at the outlet of C8.

The bridge underpass monitoring results suggest that fauna are more likely to use bridge underpasses with an obvious passage for fauna to traverse, compared to those with less defined or irregular (rocky) routes. For example, the absence of a clear passage at SBT2 (refer to **Plates 4.3** and **4.4**) is likely to have reduced the number of fauna records and complete crossings recorded for this structure and the adjoining NBT2. In contrast, the Tabbimoble Floodway No.3 bridges have defined passages (refer to **Plates 4.5** and **4.6**) and recorded higher numbers of fauna records and complete crossings.

Other key factors that have influenced the underpass monitoring results and lack of records of target threatened species include:

- absence of a resident population (e.g. Rufous Bettong and Spotted-tailed Quoll)
- low density populations (i.e. Koala)

- absence of crossing structures in proximity to target threatened species population (i.e. Long-nosed Potoroo)
- limited fauna fencing during Years 3 and 4 of the EMP
- fauna fence designs not being a barrier for target species (e.g. Koala)
- the 2019/ 2020 drought and bushfire impacting fauna abundance.

With repair of the fauna underpass structures, an increase in the potential for fauna crossings would be expected. Particularly because upgraded/ additional fauna fencing is now installed (due to the W2B works) and as fauna populations recover from the 2019 bushfire.

The EMP has not been designed to assess the effectiveness of the frog fencing or fauna underpass structures for target threatened frog species. This should be considered on future projects.



Plate 4.3 Northern bank at SBT2 with rock scour protection that crossing fauna need to navigate.

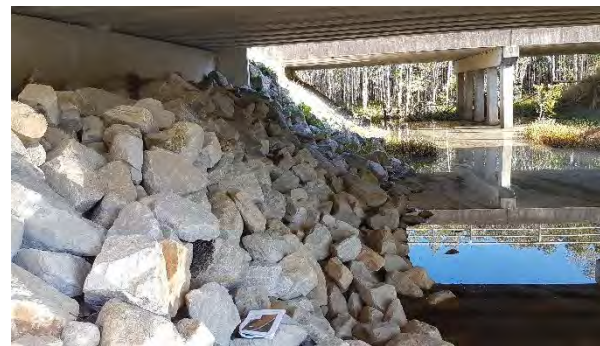


Plate 4.4 Southern bank at SBT2 with rock scour protection and no obvious path that crossing fauna need to navigate.




Plate 4.5 Northern bank at NBT3 showing obvious passage for crossing fauna (flat regular ground).



Plate 4.6 Southern bank at NBT3.
The vegetation has been trimmed in this photo to prevent obstruction of camera traps. The image shows that the passage for crossing fauna consists of regular flat ground.

4.2.2 Rope Bridge

Three target threatened species (Squirrel Glider, Brush-tailed Phascogale and Yellow-bellied Glider) and four other native species (Sugar Glider, Feathertail Glider, Common Ringtail Possum and Yellow-footed Antechinus) have been recorded on the rope bridge. Visitation by Feathertail Gliders and



Squirrel Gliders has been occasional to irregular, and rare for the other species. Directional movements have been recorded by six of these species, through likely complete crossings have only been recorded for the Feathertail Glider and Squirrel Glider. The vegetated medians appear to provide better crossing opportunities for the target threatened gliders at Devils Pulpit compared to the rope bridge.

4.2.3 Vegetated Medians


Clearing phase surveys and post construction monitoring have indicated Yellow-bellied Glider and Greater Glider movements at the southern median, and Squirrel Glider movements across the northbound lane at both medians. The frequency of Squirrel Glider movement across the northbound lane during radio tracking was higher than the frequency of rope bridge crossings. Both vegetated medians provide opportunities for two way crossing for these threatened species across both lanes of the highway. The Greater Glider roadkill demonstrates that traffic collision remains a risk for crossing fauna.

4.2.4 Vegetation Connectivity Corridor

Recruitment and growth of native species has been recorded across the corridor, however exotic groundcovers (including weeds) are present and reducing native species recruitment in the southern half of the corridor. The 2019 bushfire impacted (reduced) native species diversity and cover in some areas, and increased weed cover mainly in the ground stratum. Compared to the former managed pastoral land, the corridor is regenerating and has vegetation characteristic of Subtropical Coastal Floodplain Forest, although exotic grass cover is hindering regeneration in the central to southern portion of the corridor.

Table 4.1 EMP Performance Measures


| Mitigation | Performance Measure | Findings to Date |
|-----------------------|--|--|
| 7.2 Fauna Underpasses | A completed passage from one side of the Project to the other by native fauna species previously recorded from the Project area. Completed passage/ s to be made by species from each native fauna group; reptile, frog, terrestrial mammal. | <p>The monitoring program targets listed threatened species, none of which have been recorded crossing any of the fauna underpass structures during the three years of post construction monitoring. Complete crossings have however been recorded for a range of non-threatened native species. The Year 6 reporting period recorded complete crossings by:</p> <ul style="list-style-type: none"> ■ small mammals terrestrial and scansorial mammals: <ul style="list-style-type: none"> - Antechinus at C6 and SBT3 (two crossings). - Bush Rat at NBT2 (one crossing) - Water Rat at C9 and C9 (two crossings) ■ medium terrestrial mammals: <ul style="list-style-type: none"> - Bandicoot sp. at SBT3 (15 crossings) - Long-nosed Bandicoot at C6 and C7 (four crossings) - Northern Brown Bandicoot at NBT3 and SBT3 (15 crossings) - Short-beaked Echidna at C7 and C8 (six crossings) ■ arboreal mammals: <ul style="list-style-type: none"> - Common Brushtail Possum at C7 (two crossings) - Common Ringtail Possum at C10 (one crossing) ■ macropods: <ul style="list-style-type: none"> - Eastern Grey Kangaroo at C9, NBT3, SBT3, NBT2 and SBT2 (148 crossings) - Macropod sp. at C7, C8, C9, NBT3 and SBT3 (44 crossings) - Red-necked Wallaby at NBT2, SBT3, NBT2 and SBT2 (75 crossings) - Swamp Wallaby at C7, C8, C9, C10, NBT3, SBT3, NBT3 and SBT2 (189 crossings) ■ reptiles: <ul style="list-style-type: none"> - Eastern Water Dragon at C6, C7, C8, C9, C10, NBT3, SBT3, NBT2 and SBT2 (82 crossings) - Lace Monitors at C6, C7, C8, C9, C10, NBT3, SBT3, NBT2 and SBT2 (139 crossings). - Land Mullet at C7 (two crossings) - a skink at NBT2 and SBT2 (two crossings) ■ amphibian: <ul style="list-style-type: none"> - Green Tree Frog at SBT2 (one crossing). |




| Mitigation | Performance Measure | Findings to Date |
|-------------------|--|---|
| | | <p>Several other reptiles and an amphibian were detected using the structures as habitat (refer to Section 3.6).</p> <p>This adds to the results from Years 3 and 4 (GeoLINK 2018; 2019). Results varied between structures and limited results at a number of structures (including no unique complete crossings at C3) indicate varying suitability or quality of each in providing fauna connectivity.</p> <p>Variations with EMP underpass design requirements and/ or construction/ condition issues (GeoLINK, unpublished) are likely to be affecting the functionality of the structures in providing fauna passage across the highway (refer to Section 4.2.1).</p> |
| | If Spotted-tailed Quolls are detected via camera surveys, underpass monitoring or roadkill monitoring a completed passage/ s by spotted-tailed quoll. | No Spotted-tailed Quolls have been recorded to date. |
| | No threatened species roadkill. | A Koala roadkill was recorded during Year 6 (refer to Section 4.1.7). This is a target threatened species for the fauna underpass management measure. The fauna fence in the vicinity of the roadkill comprised a 'Phascogale' fence design (1,200 mm high fence, with fine mesh [0 to 300 mm from the ground] and a 600 mm metal sheet [300 to 900 mm from the ground]) and not a specific Koala exclusion fence design. A Greater Glider roadkill was also recorded however this species is not relevant to the fauna underpasses. |
| 7.3 Rope Bridge | Complete crossing of the rope bridge by a diversity of native arboreal fauna species known to occur in the Project area, such as Brushtail Possum or Sugar Glider. | Rope bridge monitoring has recorded four non-threatened target species visiting the rope bridge (Feathertail Glider, Yellow-footed Antechinus, Ringtail Possum and Sugar Glider). Of these, complete crossings have only been recorded for the Feathertail Glider, although directional movements have been recorded for the other species. The Feathertail Glider was a frequent visitor to the rope bridge prior to the 2019 bushfire. Visitation by other non-threatened native species is rare. |
| | Complete crossing of the rope bridge by arboreal target species (Brush-tailed Phascogale, Squirrel Glider, Yellow-bellied Glider). | The Brush-tailed Phascogale, Squirrel Glider and Yellow-bellied Glider have all been recorded at the rope bridge. The Squirrel Glider has been recorded making directional movement in both directions, and likely complete crossings have been detected. |



| Mitigation | Performance Measure | Findings to Date |
|----------------------------|--|--|
| | | Directional movement at the eastern end of the rope bridge was been recorded for the Yellow-bellied Glider and Brush-tailed Phascogale on one occasion each, although no complete crossings have been confirmed. Rope bridge visits by these species are rare. The Greater Glider has not been recorded on the rope bridge. |
| | Lower rates of roadkill in proximity to rope bridge than in sections of the upgrade away from crossing structures. | There is insufficient data to compare arboreal animal roadkill rates in relation to the rope bridge. Three arboreal mammal roadkills were recorded during the post construction monitoring, including two in Year 6 within 1km of the road bridge (Koala and Greater Glider). The factors associated with these roadkills (e.g. fauna fencing for the Koala) do not relate to the presence of the rope bridge. |
| 7.5 Vegetated Median | Identification of arboreal fauna species within vegetated medians. | <p>Arboreal fauna recorded at the vegetated medians during post construction monitoring include:</p> <ul style="list-style-type: none"> ■ Northern median: four species including the Squirrel Glider, Feathertail Glider, Sugar Glider and Greater Glider. ■ Southern median: six species including Squirrel Glider, Feathertail Glider, Greater Glider, Common Ringtail Possum, Small-eared Possum and Sugar Glider. The Yellow-bellied Glider has been recorded on both sides of the highway in the vicinity of the median, however not within the actual median during post construction monitoring. <p>Of these species, the medians are designed to facilitate connectivity for gliders across both lanes. The Squirrel Glider has been recorded crossing the northbound lane in both directions at both medians (GeoLINK 2021). Other results indicative of glider movements have been recorded at the southern median:</p> <ul style="list-style-type: none"> ■ Pre-clearing surveys recorded three Yellow-bellied Gliders crossing the southbound lane at the southern median where clearing had been completed (GeoLINK 2012b). While the highway was not open to traffic at this stage, this recording demonstrates the ability of the Yellow-bellied Glider to cross the southbound lane, as well as the northbound lanes which has a similar clearing width and adjacent trees of similar height. ■ Greater Gliders records in Years 3 and 4 were indicative of Greater Glider movements across the highway between the southern median and adjacent habitat (GeoLINK 2019; 2020), although it was not determined which lane, or if both were traversed. <p>Due to the size of the vegetated medians, they provide habitat for both gliding and non-gliding fauna in their own right; as well as provide refuge for fauna crossing the highway.</p> |
| | Identification of other fauna species within vegetated medians. | See comments above. |



| Mitigation | Performance Measure | Findings to Date |
|--|--|--|
| 7.6 Restoration of Vegetated Connectivity Corridor | Increase in height of native plants over time. | This performance measure has been realised. During the Project construction phase the corridor primarily comprised former managed pastoral land, with saplings around 2-3m tall (David Andrighetto, pers. obs. 2012). All quadrats recorded recruitment and growth of native species to varying extents with the mean tree heights observed at 7-10 m during Year 6. Native plant height in the shrub layer has either been stable or reduced due to the 2019 bushfire; while the height of the ground stratum has been consistent. |
| | Increase of per cent cover in native plant species and a reduction of per cent cover of exotic species over time. | There is no comprehensive pre-construction/ baseline data for comparison and the post construction monitoring has found native cover scores have remained stable or varied to a minor extent. Cover of exotic groundcover increased in some locations during post construction monitoring. Dense Pigeon Grass in the central to southern sections (quadrats 5 to 8) is likely to reduce recruitment rates of native species in this area. Notwithstanding, the transformation of the corridor from managed pastoral land to a corridor with regrowth vegetation including native species in three stratum suggests that this performance measure is being realised. |
| | Weed cover (including noxious and invasive weed species) not to exceed 20 per cent. In the event that weed cover exceeds 20 per cent, a regular weeding program will be implemented. | Exotic species (including weeds and invasive grasses) exceed 20 % cover in the southern quadrats (particularly around quadrats 5 and 6), triggering the provision for 'a regular weeding program'. This is primarily triggered by dense occurrences of Pigeon Grass. In the long-term, recruitment and growth of native trees and shrubs is likely to 'shade out' and reduce exotic species cover in most relevant areas. Bush regeneration and tree plantings works in localised areas with dense exotic groundcovers would however assist the regeneration process where the density of understorey/ canopy tree recruits is low. |
| | Prompt management of noxious weeds identified within the corridor. Any noxious weeds identified during monitoring of the corridor should be managed in accordance with <i>Noxious and Environmental Weed Control Handbook (DPI 2007)</i> . | <i>Noxious Weed Act 1993</i> (repealed) listed species for the Clarence Valley Council LGA species at the site including: Annual Ragweed (<i>Ambrosia artemisiifolia</i>), Groundsel Bush (<i>Baccharis halimifolia</i>), Camphor Laurel (<i>Cinnamomum camphora</i>) and Fireweed (<i>Senecio madagascariensis</i>). Cover of these species is <5 %. Groundsel Bush and Fireweed are listed under the <i>Biosecurity Act 2015</i> which replaces the <i>Noxious Weed Act 1993</i> . |
| | A minimum seedling density of 0.5 tree, 1 shrub and 2 groundcover seedlings per square metre within each quadrat. | This performance measure relates to planting densities. The Trans brief for the establishment of fauna connectivity corridor stipulates planting density of 1.75 x 1.75 m spacing, except at in specific locations around Tabbimoble Floodway 2 and 3 bridges which required 0.75 m centres. The current corridor comprises a mix of plantings and natural recruitment. |
| | Seedling survival of 60 %. If seedling | It is not possible to determine if this performance measure has been met due to the time between the |



| Mitigation | Performance Measure | Findings to Date |
|-------------------------|---|--|
| | survival falls below this percentage, a qualified and experienced expert in bush regeneration will assess the requirement for additional seedling planting. | plantings and the monitoring. |
| | A qualified and experienced expert in bush regeneration to assess whether the regenerating vegetation within the corridor is self-sustaining by spring of Year 6. | The vegetation within the corridor is self-sustaining and showing recovery post the 2019 bushfire. Dense Pigeon Grass in the central to southern sections (quadrats 4 to 8) is likely to reduce recruitment rates of native species in this area. This is primarily triggered by dense occurrences of Pigeon Grass. In the long-term, recruitment and growth of native trees and shrubs is likely to 'shade out' and reduce exotic species cover in most relevant areas. Bush regeneration and tree plantings works in localised areas with dense exotic groundcovers would however assist the regeneration process where the density of understorey/ canopy tree recruits is low. |
| 9.2 Roadkill Monitoring | Lower rates of roadkill in proximity to fauna fencing, rope bridges and fauna underpasses than in sections of the upgrade not near fauna crossing structures. | There is insufficient roadkill data to confirm the effectiveness of the structures in reducing this risk. Furthermore, the fence configuration has changed during the post construction monitoring associated with the W2B works. It is likely that the current updated/ additional fauna fence arrangement will reduce the risk of roadkill for relevant species (e.g. medium sized terrestrial mammals). |
| | No threatened species recorded as roadkill throughout the length of the Project. | A Koala and Greater Glider roadkills were recorded during Year 6 (refer to Sections 4.1.7 and 4.1.9 respectively). |
| | <p>If these performance measures are not met, the following contingency measures would be implemented:</p> <ul style="list-style-type: none"> ■ Review/ modify fauna furniture associated with underpass. ■ Review/ modify habitat (i.e. vegetation composition and structure; type and abundance of natural habitat features) adjoining the underpass. | Transport has reviewed and updated the fauna fencing at Devils Pulpit as part of the W2B project. Remediating scours and preventing the pooling of water at underpass structures is also recommended to improve the function of these structures (refer to Section 4.2.1). |



5. Recommendations and Conclusion

5.1 Recommendations

The following recommendations are provided based on assessment of the EMP performance indicators and contingency measures:

- Underpasses: Maintain/ rectify fauna underpasses so they are consistent with EMP design intent, including prevention of scouring/ pooled water C3, C8, C9 and C10; and repairing fauna furniture at all Tabbimoble floodway No.2 and 3 bridges. Transport are currently investigating repair works for these structures.
- Vegetated connectivity corridor: Weed management is triggered by recorded weed cover classes and species occurrences, particularly in the southern half of the corridor. This is primarily triggered by dense occurrences of Pigeon Grass. In the long-term, recruitment and growth of native trees and shrubs is likely to 'shade out' and reduce exotic species cover in most relevant areas. Bush regeneration and tree plantings works in localised areas with dense exotic groundcovers would however assist the regeneration process where the density of understorey/ canopy tree recruits is low. This is currently (October 2021) being investigated.

The following recommendations are provided for Transports consideration:

- Future monitoring programs should be developed with:
 - clear specific aims, performance measures and contingency triggers
 - specific objectives of the mitigation measure being monitored outlined based on the site's characteristics and target species. For example, the frequency of crossings at connectivity structures should be defined (such as dispersal or inter-range movements) for each target species
 - the objective of expanding on existing knowledge from research and other road monitoring projects and avoid replicating well studied parameters
 - consideration of upcoming works which may conflict with the monitoring program or create additional variables that would impact results
 - a program then enables sufficient baseline data to be collected. Trial monitoring programs should be used during the baseline phase to ensure sufficient and meaningful data can be captured by proposed monitoring methods.
- Rope bridge designs should ensure rope material completely extends from pole to pole providing a clear passage and there are no sections with only metal elements.
- Sufficient ecological surveys are undertaken during the design phase of the Project so that the most appropriate fauna connectivity structures for the environment can be selected and located in areas occupied by target species.
- Fauna underpass structures have clear passages at the entrances and within the structure.

GeoLINK (2021) includes additional recommendations specific to Squirrel Glider monitoring.




5.2 Conclusion

The post construction terrestrial species monitoring program for the Project has been completed in accordance with the EMP (Hyder 2012) and *Spotted-tailed Quoll Management Plan* (SKM 2012). The monitoring has demonstrated variable success of the mitigation measures monitored relative to the Project objectives. The findings of this project contribute to the expanding knowledge and dataset associated with road impacts and wildlife mitigation developed from research and other monitoring programs in Australia. It can be used to inform future road projects, road retrofit projects with a conservation objective, and as a reference for other projects with an interest with the threatened species that were monitored.



References

- Bond, A. R. F. and Jones, D. N. (2013). Roads and macropods: interactions and implications, in *Australian Mammalogy* <http://dx.doi.org/10.1071/AM13005>
- DPIE (2013). *Action Statement No. 254 Long-nosed Potoroo Potorous tridactylus Flora and Fauna Guarantee Act 1988*. Victorian Government Department of Environment and Primary Industries.
- DoE (undated). *Consultation Document on the Listing Eligibility and Conservation Actions: Petauroides volans (greater glider)*. Australian Government Department of the Environment.
- GeoLINK (2021). *Squirrel Glider Radio Tracking for Post Construction Ecological Monitoring, Devils Pulpit Pacific Highway Upgrade*. Unpublished report prepared for Transport for NSW. GeoLINK Consulting, Lennox Head.
- GeoLINK (2019a). *Second Annual Report for Post Construction Year 3, 4 and 6 Ecological Monitoring Devils Pulpit Pacific Highway Upgrade*. Unpublished report prepared for NSW Roads and Maritime Services. GeoLINK Consulting, Lennox Head.
- GeoLINK (2019). *W2B Devils Pulpit Widened Median Glider Crossing Ability Assessment*. Unpublished report prepared for BMD Construction. GeoLINK Consulting, Lennox Head.
- GeoLINK (2018). *First Annual Report for Post Construction Year 3, 4 and 6 Ecological Monitoring Devils Pulpit Pacific Highway Upgrade*. Unpublished report prepared for NSW Roads and Maritime Services. GeoLINK Consulting, Lennox Head.
- GeoLINK (2015). *Devils Pulpit Pacific Highway Upgrade - Post-construction Monitoring of Oxleyan Pygmy Perch and Surface Water*. Unpublished report prepared for NSW Roads and Maritime Services. GeoLINK Consulting, Coffs Harbour.
- GeoLINK (2012a). *Devils Pulpit Pacific Highway Upgrade - Pre-construction Threatened Fauna Monitoring Results*. Unpublished report prepared for NSW Roads and Maritime Services. GeoLINK Consulting, Lennox Head.
- GeoLINK (2012b). *Devils Pulpit Highway Upgrade – Post Clearing Report*. Unpublished report prepared for John Holland Group. GeoLINK Consulting, Lennox Head.
- Goldingay, R. L. and Taylor, B. D. (2009). Gliding performance and its relevance to gap crossings by the squirrel glider (*Petaurus norfolcensis*), in *Australian Journal of Zoology*, 2009, 57, 99-104, CSIRO Publishing.
- Goldingay, R. L., Taylor, B. D. and Parkyn, J. L. (2019). Movement of small mammals through a road-underpass facilitated by a wildlife rail, in *Australian Mammalogy*, 41(1) 142-146.
- Goldingay, R. L., Taylor, B. D. and Parkyn, J. L. (2018). Use of tall wooden poles by four species of gliding mammal provides further proof of concept for habitat restoration, in *Australian Mammalogy*, 41, 255–261.
- Hyder (2012). *Devils Pulpit Upgrade – Ecological Monitoring Program*. Unpublished report prepared for NSW Roads and Maritime Services. Hyder Consulting Pty, Ltd, North Sydney.



Hyder (2011). *Pacific Highway Upgrade – Devils Pulpit Project – Appendix D. Technical Working Paper – Ecology*. Unpublished report prepared for NSW Roads and Traffic Authority. Hyder Consulting Pty, Ltd, North Sydney.

Lewis, B.D (2015). *Tugun Bypass Project: Long-nosed Potoroo Management: Five Year Review*. Report prepared for Queensland Department of Transport and Main Roads (TMR).

Lewis, B. D. (2014). *Woolgoolga to Ballina Pacific Highway Upgrade Rufous Bettong & Brush-tailed Phascogale Preconstruction Baseline Monitoring Survey*. Unpublished report for NSW Roads and Maritime Services.

Lemckert, F., Mahony, M., Brassil, T. and Slatyer, C. (2006). The biology of the threatened Green-thighed frog *Litoria brevipalmata* (Anura: Hylidae) in the central and mid-north coastal areas of New South Wales, in *Australian Zoologist*: 2006, Vol. 33, No. 3, pp. 337-344.

Mansfield, C. Arnold, A. H., Bell, T. L., and York, A (2017). Habitat characteristics of a threatened arboreal marsupial and its resource use in a degraded landscape: the brush-tailed phascogale (*Phascogale tapoatafa tapoatafa*) in central Victoria, Australia, in *Wildlife Research* 44(2) 153-164.

Meek, P. (2015). *Constraints of Using Camera Traps for Wildlife Monitoring and Ecological Research*. School of Environmental and Rural Science, University of New England.

Niche (2020). *Fauna Underpass and Associated Fauna Fence Monitoring 2018/2019*, Frederickton to Eungai Pacific Highway Upgrade. Unpublished report to Transport for NSW.

NSW National Parks and Wildlife Service (2003). *Recovery Plan for the Yellow-bellied Glider (Petaurus australis)*. NSW National Parks and Wildlife Service, Hurstville.

RMS (2016). *Woolgoolga to Ballina Pacific Highway Upgrade Koala Management Plan*. NSW Roads and Maritime Services.

Sandpiper Ecological (2020a). *Pacific Highway Upgrade – Threatened Gliders Monitoring Program, Annual Report (Year 3)*. Unpublished report to NSW Transport for NSW. Sandpiper Ecological Surveys.


Sandpiper Ecological (2020b). *Nambucca Heads to Urunga Pacific Highway Upgrade: Operational Phase, Year Three; Operational Phase Biodiversity Monitoring – Year Three 2019*. Unpublished report to Transport for NSW.

Sandpiper Ecological (2017). *Pacific Highway Upgrade – Glenugie Operational Phase Fauna Crossing Monitoring Program (years 1 to 3)*. Unpublished report to NSW Roads and Maritime Services. Sandpiper Ecological Surveys.

Sandpiper Ecological (2016a). *Pacific Highway Upgrade – Devils Pulpit: Spotted-tailed quoll (Dasyurus maculatus) status assessment - year 2*. Unpublished report prepared for NSW Roads and Maritime Services.

Sandpiper Ecological (2016b). *Devils Pulpit rope bridge monitoring*. Unpublished report to NSW Roads and Maritime Services. Sandpiper Ecological Surveys.

SKM (2012). *Pacific Highway Upgrade Devils Pulpit – EPBC Act Condition of Approval Spotted-Tailed Quoll Management Plan*. Unpublished report for NSW Roads and Maritime Services.



Soanes, K., Vesk, P. A. and van der Ree, R. (2015). Monitoring the use of road-crossing structures by arboreal marsupials: insights gained from motion-triggered cameras and passive integrated transponder (PIT) tags. *Wildlife Research*: 10.107

Soanes K., Carmody Lobo M., Vesk P. A., McCarthy M. A., Moore J. L. and van der Ree R. (2013). Movement re-established but not restored: inferring the effectiveness of road-crossing mitigation for a gliding mammal by monitoring use, in *Biological Conservation* **159**, 434–441

Taylor, B. D., Goldingay, R. L. and Lindsay, J. M., (2014). Horizontal or vertical? Camera trap orientations and recording modes for detecting potoroos, bandicoots and pademelons in *Australian Mammalogy*, Vol 36, 60-66.

Taylor, B. D. and Goldingay, R. L. (2013). Squirrel glider use of roadside glide poles to cross a road gap, in *Australian Mammalogy* **35**;119.

Triggs, B. (2004). *Tracks, scats and other traces: a field guide to Australian mammals*. Oxford University Press, Melbourne.

WPSQ (undated). Wildlife Preservation Society of Queensland Species Profile.



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Appendix A

Target Terrestrial Species Monitoring Survey Methodology and Weather Data

Table A1 Rufous Bettong/ Brush-tailed Phascogale Camera Trap Survey Dates and Effort During Year 6 Post Construction Monitoring

| <i>Site</i> | <i>Survey Season</i> | <i>Installation Date</i> | <i>Survey Completion Date</i> | <i>No. Trap Nights</i> | <i>No. Camera Traps</i> | <i>Effort (effective trap nights)</i> |
|----------------------|----------------------|--------------------------|-------------------------------|------------------------|-------------------------|---------------------------------------|
| Impact Site 1 (west) | Winter | 12/08/2020 | 26/08/2020 | 14 | 6 | 84 |
| Impact Site 1 (west) | Spring | 14/10/2020 | 28/10/2020 | 14 | 6 | 84 |
| Impact Site 1 (west) | Summer | 20/01/2021 | 13/02/2021 | 14 | 6* | 70 |
| Impact Site 1 (east) | Winter | 12/08/2020 | 26/08/2020 | 14 | 6 | 84 |
| Impact Site 1 (east) | Spring | 14/10/2020 | 28/10/2020 | 14 | 6 | 84 |
| Impact Site 1 (east) | Summer | 20/01/2021 | 13/02/2021 | 14 | 6 | 84 |
| Impact Site 2 (west) | Winter | 12/08/2020 | 26/08/2020 | 14 | 6^ | 70 |
| Impact Site 2 (west) | Spring | 14/10/2020 | 28/10/2020 | 14 | 6 | 84 |
| Impact Site 2 (west) | Summer | 20/01/2021 | 13/02/2021 | 14 | 6 | 84 |
| Impact Site 2 (east) | Winter | 9/07/2020 | 23/07/2020 | 14 | 6 | 84 |
| Impact Site 2 (east) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Impact Site 2 (east) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Impact Site 3 (west) | Winter | 10/07/2020 | 24/07/2020 | 14 | 6 | 84 |
| Impact Site 3 (west) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Impact Site 3 (west) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Impact Site 3 (east) | Winter | 9/07/2020 | 23/07/2020 | 14 | 6 | 84 |
| Impact Site 3 (east) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Impact Site 3 (east) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Impact Site 4 (west) | Winter | 10/07/2020 | 24/07/2020 | 14 | 6^ | 70 |
| Impact Site 4 (west) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Impact Site 4 (west) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Impact Site 4 (east) | Winter | 9/07/2020 | 23/07/2020 | 14 | 6 | 84 |
| Impact Site 4 (east) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Impact Site 4 (east) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Impact Site 5 (west) | Winter | 12/08/2020 | 26/08/2020 | 14 | 6 | 84 |
| Impact Site 5 (west) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6^ | 70 |
| Impact Site 5 (west) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6^ | 70 |
| Impact Site 5 (east) | Winter | 12/08/2020 | 26/08/2020 | 14 | 6 | 84 |
| Impact Site 5 (east) | Spring | 12/11/2020 | 26/12/2020 | 14 | 6^ | 70 |
| Impact Site 5 (east) | Summer | 1/12/2020 | 15/12/2020 | 14 | 6^ | 70 |
| Control site 1 | Winter | 9/07/2020 | 23/07/2020 | 14 | 6^ | 70 |
| Control site 1 | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Control site 1 | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Control site 2 | Winter | 9/07/2020 | 23/07/2020 | 14 | 6^ | 70 |
| Control site 2 | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Control site 2 | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Control site 3 | Winter | 9/07/2020 | 23/07/2020 | 14 | 6^ | 70 |
| Control site 3 | Spring | 12/11/2020 | 26/12/2020 | 14 | 6 | 84 |
| Control site 3 | Summer | 1/12/2020 | 15/12/2020 | 14 | 6 | 84 |
| Control site 4 | Winter | 10/07/2020 | 24/07/2020 | 14 | 6 | 84 |
| Control site 4 | Spring | 14/10/2020 | 28/10/2020 | 14 | 6 | 84 |
| Control site 4 | Summer | 20/01/2021 | 13/02/2021 | 14 | 6 | 84 |
| Control site 5 | Winter | 10/07/2020 | 24/07/2020 | 14 | 6 | 84 |
| Control site 5 | Spring | 14/10/2020 | 28/10/2020 | 14 | 6 | 84 |
| Control site 5 | Summer | 20/01/2021 | 13/02/2021 | 14 | 6 | 84 |
| All Sites | Winter | - | - | - | - | 1190 |
| All Sites | Spring | - | - | - | - | 1232 |




| <i>Site</i> | <i>Survey Season</i> | <i>Installation Date</i> | <i>Survey Completion Date</i> | <i>No. Trap Nights</i> | <i>No. Camera Traps</i> | <i>Effort (effective trap nights)</i> |
|-------------------|----------------------|--------------------------|-------------------------------|------------------------|-------------------------|---------------------------------------|
| All Sites | Summer | - | - | - | - | 1218 |
| All Impact Sites | All seasons | - | - | - | - | 2422 |
| All Control Sites | All seasons | - | - | - | - | 1218 |
| Total All Seasons | All seasons | - | - | - | - | 3640 |

^ denotes sites where camera or SD card errors reduced the number of effective traps or trap nights.

* denotes sites where camera theft reduced the number of trap nights.


Table A2 Spotlighting Survey Dates During Year 6 Post Construction Monitoring

| Site | Survey | Date | Transect Length (m) | Call Playback Species |
|------------------------|------------------------|-------------|----------------------------|---------------------------------|
| Impact Site 1 (west) | Year 6 Winter Survey 1 | 14/07/2020 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Winter Survey 2 | 12/08/2020 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Winter Survey 3 | 20/08/2020 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Spring Survey 2 | 11/11/2020 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Summer Survey 1 | 12/01/2021 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Koala |
| Impact Site 1 (west) | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Winter Survey 1 | 14/07/2020 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Winter Survey 2 | 12/08/2020 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Winter Survey 3 | 20/08/2020 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Spring Survey 2 | 11/11/2020 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Summer Survey 1 | 12/01/2021 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Koala |
| Impact Site 1 (east) | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Koala |
| Impact Site 2 (west) | Year 6 Winter Survey 3 | 20/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Winter Survey 1 | 14/07/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Winter Survey 2 | 12/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Spring Survey 2 | 23/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Summer Survey 1 | 12/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (west) | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Winter Survey 1 | 14/07/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Winter Survey 2 | 13/08/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Winter Survey 3 | 20/08/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Spring Survey 1 | 13/10/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Spring Survey 2 | 23/10/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Spring Survey 3 | 12/11/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Summer Survey 1 | 12/01/2021 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Summer Survey 2 | 4/02/2021 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (median) | Year 6 Summer Survey 3 | 11/02/2021 | 1000 | Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Winter Survey 1 | 12/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Winter Survey 2 | 18/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Winter Survey 3 | 20/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Spring Survey 1 | 13/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Spring Survey 2 | 10/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Summer Survey 1 | 14/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Summer Survey 2 | 4/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 2 (east) | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 3 Winter Survey 1 | 14/07/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Winter Survey 2 | 12/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Spring Survey 1 | 22/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Spring Survey 2 | 9/11/2020 | 500 | Koala and Yellow-bellied Glider |



| Site | Survey | Date | Transect Length (m) | Call Playback Species |
|------------------------|------------------------|-------------|----------------------------|---------------------------------|
| Impact Site 3 (west) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Summer Survey 1 | 4/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Summer Survey 2 | 11/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (west) | Year 6 Summer Survey 3 | 22/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Winter Survey 1 | 12/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Winter Survey 2 | 18/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Spring Survey 1 | 23/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Spring Survey 2 | 9/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Summer Survey 1 | 20/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Summer Survey 2 | 4/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 3 (east) | Year 6 Summer Survey 3 | 22/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Winter Survey 1 | 9/08/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Winter Survey 2 | 13/08/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Winter Survey 3 | 18/08/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Spring Survey 2 | 9/11/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Spring Survey 1 | 13/10/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Spring Survey 3 | 12/11/2020 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Summer Survey 1 | 14/01/2021 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Summer Survey 2 | 4/02/2021 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (median) | Year 6 Summer Survey 3 | 8/02/2021 | 1000 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Winter Survey 1 | 9/08/2020 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Winter Survey 2 | 13/08/2020 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Winter Survey 3 | 18/08/2020 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Spring Survey 1 | 13/10/2020 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Spring Survey 2 | 9/11/2020 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Summer Survey 1 | 14/01/2021 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Summer Survey 2 | 14/01/2021 | 500 | Yellow-bellied Glider |
| Impact Site 4 (east) | Year 6 Summer Survey 3 | 8/02/2021 | 500 | Yellow-bellied Glider |
| Impact Site 5 (west) | Year 6 Winter Survey 1 | 15/07/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Winter Survey 2 | 13/08/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Spring Survey 2 | 10/11/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Summer Survey 1 | 10/12/2020 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Koala |
| Impact Site 5 (west) | Year 6 Summer Survey 3 | 8/02/2021 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Winter Survey 1 | 15/07/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Winter Survey 2 | 12/08/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Winter Survey 3 | 18/08/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Spring Survey 1 | 22/10/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Spring Survey 2 | 10/11/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Summer Survey 1 | 10/12/2020 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Koala |
| Impact Site 5 (east) | Year 6 Summer Survey 3 | 25/02/2021 | 500 | Koala |
| Impact Site 6 (west) | Year 6 Winter Survey 1 | 15/07/2020 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Winter Survey 2 | 13/08/2020 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Yellow-bellied Glider |

| Site | Survey | Date | Transect Length (m) | Call Playback Species |
|----------------------|------------------------|------------|---------------------|---------------------------------|
| Impact Site 6 (west) | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Spring Survey 2 | 10/11/2020 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Summer Survey 1 | 10/12/2020 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Yellow-bellied Glider |
| Impact Site 6 (west) | Year 6 Summer Survey 3 | 8/02/2021 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Winter Survey 1 | 12/08/2020 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Winter Survey 2 | 18/08/2020 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Winter Survey 3 | 20/08/2020 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Spring Survey 1 | 13/10/2020 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Spring Survey 2 | 10/11/2020 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Summer Survey 2 | 4/02/2021 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Yellow-bellied Glider |
| Control site 1 | Year 6 Summer Survey 1 | 14/01/2021 | 500 | Yellow-bellied Glider |
| Control site 2 | Year 6 Winter Survey 1 | 12/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Winter Survey 2 | 18/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Spring Survey 1 | 23/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Spring Survey 2 | 9/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Summer Survey 1 | 20/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Summer Survey 2 | 4/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Control site 2 | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Control site 3 | Year 6 Winter Survey 1 | 9/08/2020 | 500 | Koala |
| Control site 3 | Year 6 Winter Survey 2 | 13/08/2020 | 500 | Koala |
| Control site 3 | Year 6 Winter Survey 3 | 18/08/2020 | 500 | Koala |
| Control site 3 | Year 6 Spring Survey 1 | 13/10/2020 | 500 | Koala |
| Control site 3 | Year 6 Spring Survey 2 | 9/11/2020 | 500 | Koala |
| Control site 3 | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Koala |
| Control site 3 | Year 6 Summer Survey 1 | 14/01/2021 | 500 | Koala |
| Control site 3 | Year 6 Summer Survey 2 | 4/02/2021 | 500 | Koala |
| Control site 3 | Year 6 Summer Survey 3 | 8/02/2021 | 500 | Koala |
| Control site 4 | Year 3 Winter Survey 1 | 14/07/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Winter Survey 2 | 13/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Spring Survey 2 | 23/10/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Winter Survey 3 | 12/11/2020 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Summer Survey 1 | 12/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Koala and Yellow-bellied Glider |
| Control site 4 | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Koala and Yellow-bellied Glider |
| Control site 5 | Year 6 Winter Survey 1 | 14/07/2020 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Winter Survey 2 | 13/08/2020 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Spring Survey 1 | 15/10/2020 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Spring Survey 2 | 23/10/2020 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Spring Survey 3 | 12/11/2020 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Summer Survey 1 | 12/01/2021 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Summer Survey 2 | 20/01/2021 | 500 | Yellow-bellied Glider |
| Control site 5 | Year 6 Summer Survey 3 | 11/02/2021 | 500 | Yellow-bellied Glider |
| Control site 6 | Year 6 Winter Survey 1 | 15/07/2020 | 500 | Koala |



| <i>Site</i> | <i>Survey</i> | <i>Date</i> | <i>Transect Length (m)</i> | <i>Call Playback Species</i> |
|----------------|------------------------|-------------|----------------------------|------------------------------|
| Control site 6 | Year 6 Winter Survey 2 | 20/08/2020 | 500 | Koala |
| Control site 6 | Year 6 Winter Survey 3 | 25/08/2020 | 500 | Koala |
| Control site 6 | Year 6 Spring Survey 1 | 22/10/2020 | 500 | Koala |
| Control site 6 | Year 6 Spring Survey 2 | 10/11/2020 | 500 | Koala |
| Control site 6 | Year 6 Spring Survey 3 | 19/11/2020 | 500 | Koala |
| Control site 6 | Year 6 Summer Survey 1 | 14/01/2021 | 500 | Koala |
| Control site 6 | Year 6 Summer Survey 2 | 8/02/2021 | 500 | Koala |
| Control site 6 | Year 6 Summer Survey 3 | 22/02/2021 | 500 | Koala |

Table A3 Weather Conditions During Nocturnal Surveys During Year 6 Post Construction Monitoring

| <i>Date</i> | <i>Survey Type</i> | <i>Temperature</i> | <i>Wind</i> | <i>Cloud Cover</i> | <i>Moon Phase</i> | <i>Humidity</i> | <i>Evidence of Rain within 24hrs</i> | <i>Evidence of Rain within 48hrs</i> | <i>Rainfall (mm)*</i> | <i>Comments</i> | <i>Flowering Resources Observed</i> |
|-------------|--|--------------------|----------------------------|--------------------|-------------------|-----------------|--------------------------------------|--------------------------------------|--------------------------------|--|--|
| 14/07/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | Light (leaves moving) | 0-25 % | No moon | Low | No | No | 0.6mm in 24hrs, 0.6mm in 48hrs | Last quarter moon phase. Variable wind from light to moderate. | Low and uncommon Forest Red Gum Low and uncommon Narrow-Leaved Red Gum |
| 15/07/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | Light (leaves moving) | 0-25 % | No moon | Low | No | No | 0mm in 24hrs, 0.6mm in 48hrs | Occasional moderate wind gusts. | Low Forest Red Gum Low and uncommon Narrow-Leaved Red Gum Low Broad-leaved Paperbark Low <i>Angophora woodsiana</i> |
| 9/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | Moderate (branches moving) | 0-25 % | No moon | Moderate | No | Yes | 0.2mm in 24hrs, 0.2mm in 48hrs | - | - |
| 12/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | Light (leaves moving) | 0-25 % | No moon | Moderate | No | No | 0 | - | Low <i>Angophora woodsiana</i> |
| 13/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | No wind | 0-25 % | No moon | Moderate | No | No | 0.2mm in 24hrs, 0.2mm in 48hrs | - | Low <i>Angophora woodsiana</i> Low Narrow-Leaved Red Gum Low Tindal's Stringybark |
| 18/08/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | Light (leaves moving) | 26-50 % | No moon | Moderate | No | No | 0mm in 24hrs, 0mm in 48hrs | - | - |
| 20/08/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | Light (leaves moving) | 0-25 % | No moon | Low | No | No | 0 | Occasional moderate wind gusts. | Low Forest Red Gum Low Turpentine |
| 25/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | No wind | 0-25 % | 26-50 % | Low | No | No | 2.4mm in 24hrs, 2.4mm in 48hrs | Late shower/ storm passed between 9:00 and 9.30pm. | - |
| 13/10/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | No wind | 0-25 % | No moon | Moderate | No | No | 0 | Last quarter moon phase, late rise. | Medium Melaleuca sieberi Low Tindal's Stringybark |
| 15/10/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | No wind | 0-25 % | 0-25 % | Moderate | No | No | 0 | - | Low Turpentine |
| 22/10/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 26-50 % | High | No | No | 0 | - | - |
| 23/10/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 26-50 % | 26-50 % | High | No | No | 0.4mm in 24hrs, 0.4mm in 48hrs | - | Medium Turpentine Medium Tindal's Stringybark |
| 9/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 0-25 % | Moderate | No | No | 0.8mm in 24hrs, 0.8mm in 48hrs | - | - |
| 10/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 0-25 % | 0-25 % | Moderate | No | No | 0mm in 24hrs, 0.8mm in 48hrs | - | Low Northern Grey Ironbark |
| 11/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 0-25 % | Moderate | No | No | 0 | - | - |



| Date | Survey Type | Temperature | Wind | Cloud Cover | Moon Phase | Humidity | Evidence of Rain within 24hrs | Evidence of Rain within 48hrs | Rainfall (mm)* | Comments | Flowering Resources Observed |
|------------|--|-----------------|-----------------------|-------------|------------|----------|-------------------------------|-------------------------------|------------------------------------|---|---|
| | playback) | | | | | | | | | | |
| 12/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 0-25 % | Moderate | No | No | 0 | - | Low Northern Grey Ironbark Low Tindal's Stringybark |
| 19/11/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | No wind | 0-25 % | 0-25 % | Moderate | No | No | 0 | - | - |
| 10/12/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 0-25 % | Moderate | No | No | 3.2mm in 24hrs, 3.2mm in 48hrs | - | High <i>Angophora woodsiana</i> |
| 14/12/2020 | Threatened Frogs - Year 6 Summer Survey 1 | Mild (15-20°C) | No wind | 76-100 % | No moon | High | Yes | Yes | 118.6mm in 24hrs, 160.4mm in 48hrs | Rain during survey. | - |
| 15/12/2020 | Threatened Frogs - Year 6 Summer Survey 2 | Warm (>20-28°C) | No wind | 0-25 % | No moon | High | Yes | Yes | 17.4mm in 24hrs, 136mm in 48hrs | - | - |
| 7/01/2021 | Threatened Frogs - Year 6 Summer Survey 3 | Warm (>20-28°C) | No wind | 76-100 % | No moon | High | Yes | Yes | 18.8mm in 24hrs, 51.4mm in 48hrs | - | - |
| 12/01/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 0-25 % | No moon | Low | Yes | Yes | 0 | - | High <i>Angophora woodsiana</i> |
| 14/01/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 0-25 % | No moon | Moderate | No | No | 0 | - | Medium <i>Angophora woodsiana</i> Low Pink Bloodwood |
| 20/01/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 76-100 % | 26-50 % | High | Yes | Yes | 3.2mm in 24hrs, 7mm in 48hrs | Light showers during survey. | Medium Pink Bloodwood Low Narrow-Leaved Red Gum |
| 4/02/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 0-25 % | No moon | High | No | Yes | 0 | - | Low Broad-leaved Paperbark Medium Pink Bloodwood |
| 8/02/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 26-50 % | No moon | High | Yes | Yes | 1.4mm in 24hrs, 1.4mm in 48hrs | Light showers during survey. | Light Broad-leaved Paperbark Medium Pink Bloodwood |
| 11/02/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 26-50 % | No moon | Moderate | Yes | Yes | 0mm in 24hrs, 6mm in 48hrs | - | Medium Broad-leaved Paperbark Medium Pink Bloodwood |
| 18/02/2021 | Threatened Frogs - Year 6 Summer Survey 4 | Warm (>20-28°C) | No wind | 76-100 % | 0-25 % | High | Yes | Yes | 11.4mm in 24hrs, 59.6mm in 48hrs | - | - |
| 22/02/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 0-25 % | 51-75 % | High | Yes | Yes | 0mm in 24hrs, 3mm in 48hrs | Not able to survey in optimal moon phase due to prolonged wet weather when the moon phase was suitable. | High Pink Bloodwood |
| 25/02/2021 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 26-50 % | 51-75 % | High | Yes | Yes | 0mm in 24hrs, 3mm in 48hrs | Bright moon phase not avoidable due to rain. | High Pink Bloodwood |
| 14/07/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | Light (leaves moving) | 0-25 % | No moon | Low | No | No | 0.6mm in 24hrs, 0.6mm in 48hrs | Last quarter moon phase. Variable wind from light to moderate. | Low and uncommon Forest Red Gum Low and uncommon |

| Date | Survey Type | Temperature | Wind | Cloud Cover | Moon Phase | Humidity | Evidence of Rain within 24hrs | Evidence of Rain within 48hrs | Rainfall (mm)* | Comments | Flowering Resources Observed |
|------------|--|-----------------|----------------------------|-------------|------------|----------|-------------------------------|-------------------------------|--------------------------------|--|--|
| | | | | | | | | | | | Narrow-Leaved Red Gum |
| 15/07/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | Light (leaves moving) | 0-25 % | No moon | Low | No | No | 0mm in 24hrs, 0.6mm in 48hrs | Occasional moderate wind gusts. | Low Forest Red Gum Low and uncommon Narrow-Leaved Red Gum Low Broad-leaved Paperbark Low <i>Angophora woodsiana</i> |
| 9/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | Moderate (branches moving) | 0-25 % | No moon | Moderate | No | Yes | 0.2mm in 24hrs, 0.2mm in 48hrs | - | - |
| 12/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | Light (leaves moving) | 0-25 % | No moon | Moderate | No | No | 0 | - | Low <i>Angophora woodsiana</i> |
| 13/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | No wind | 0-25 % | No moon | Moderate | No | No | 0.2mm in 24hrs, 0.2mm in 48hrs | - | Low <i>Angophora woodsiana</i> Low Narrow-Leaved Red Gum Low Tindal's Stringybark |
| 18/08/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | Light (leaves moving) | 26-50 % | No moon | Moderate | No | No | 0mm in 24hrs, 0mm in 48hrs | - | - |
| 20/08/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | Light (leaves moving) | 0-25 % | No moon | Low | No | No | 0 | Occasional moderate wind gusts. | Low Forest Red Gum Low Turpentine |
| 25/08/2020 | Threatened mammals (spotlighting/ call playback) | Cool (10-15°C) | No wind | 0-25 % | 26-50 % | Low | No | No | 2.4mm in 24hrs, 2.4mm in 48hrs | Late shower/ storm passed between 9:00 and 9.30pm. | - |
| 13/10/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | No wind | 0-25 % | No moon | Moderate | No | No | 0 | Last quarter moon phase, late rise. | Medium Melaleuca sieberi Low Tindal's Stringybark |
| 15/10/2020 | Threatened mammals (spotlighting/ call playback) | Mild (15-20°C) | No wind | 0-25 % | 0-25 % | Moderate | No | No | 0 | - | Low Turpentine |
| 22/10/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 26-50 % | High | No | No | 0 | - | - |
| 23/10/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 26-50 % | 26-50 % | High | No | No | 0.4mm in 24hrs, 0.4mm in 48hrs | - | Medium Turpentine Medium Tindal's Stringybark |
| 9/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 0-25 % | Moderate | No | No | 0.8mm in 24hrs, 0.8mm in 48hrs | - | - |
| 10/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | No wind | 0-25 % | 0-25 % | Moderate | No | No | 0mm in 24hrs, 0.8mm in 48hrs | - | Low Northern Grey Ironbark |
| 11/11/2020 | Threatened mammals (spotlighting/ call playback) | Warm (>20-28°C) | Light (leaves moving) | 0-25 % | 0-25 % | Moderate | No | No | 0 | - | - |

*Rainfall data is from the Woolgoolga to Ballina Pacific Highway Upgrade Darky's Road weather station. Rainfall is recorded at 9am for the listed dates.



Appendix B

Nest Box Monitoring Locations and Results

Table B1 Year 6 Post Construction Nest Box Monitoring Installation Data and Results

| Site | Nest Box No. | Date Installed | Easting | Northing | Nest Box Height (m) | Tree Species | DBH (cm) | Nest Box Orientation | Tree Height (m) | Year 6 Winter Monitoring | | Year 6 Spring Monitoring | | Year 6 Summer Monitoring | |
|------------------------|--------------|----------------|---------|----------|---------------------|------------------------|----------|----------------------|-----------------|--------------------------|--|--------------------------|---|--------------------------|--|
| | | | | | | | | | | Date | Results | Date | Results | Date | Results |
| Impact Site 2 (west) | 1 | 26/07/2017 | 521701 | 6762394 | 9 | Small-fruited Grey Gum | 40 | SW | 26 | 22/07/2020 | Nil spp. Nil evidence of use. | 20/10/2020 | Nil spp. Nil evidence of use. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (west) | 2 | 26/07/2017 | 521638 | 6762383 | 9 | Red Mahogany | 35 | SW | 25 | 22/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. Ants. |
| Impact Site 2 (west) | 3 | 26/07/2017 | 521584 | 6762311 | 8 | Bloodwood | 35 | E | 24 | 22/07/2020 | Nil spp. Nil evidence of use. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (west) | 4 | 26/07/2017 | 521525 | 6762282 | 12 | Spotted Gum | 40 | SW | 26 | 22/07/2020 | Nil spp. Leaf nesting material. | 20/10/2020 | Nil spp. Leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. Ants. |
| Impact Site 2 (west) | 5* | 26/07/2017 | 521488 | 6762244 | 14 | Grey Ironbark | 50 | SW | 31 | - | - | - | - | - | - |
| Impact Site 2 (west) | 6 | 26/07/2017 | 521456 | 6762166 | 12 | Spotted Gum | 45 | SW | 33 | 22/07/2020 | Nil spp. Old leaf nesting material. Ants. | 20/10/2020 | Nil spp. Old leaf nesting material. Ants. | 29/01/2021 | Nil spp. Old leaf nesting material. Ants nest. |
| Impact Site 2 (median) | 1* | 26/07/2017 | 521825 | 6762370 | 10 | Red Mahogany | 50 | S | 27 | - | - | - | - | - | - |
| Impact Site 2 (median) | 2 | 26/07/2017 | 521772 | 6762341 | 13 | Red Mahogany | 60 | E | 27 | 22/07/2020 | Nil spp. Old leaf nesting material. | 22/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (median) | 3 | 26/07/2017 | 521757 | 6762307 | 7 | Swamp Box | 50 | SW | 24 | 22/07/2020 | Nil spp. Old leaf nesting material. | 22/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (median) | 4 | 26/07/2017 | 521709 | 6762282 | 10 | Grey Ironbark | 40 | S | 28 | 22/07/2020 | 1 x female, 1 x male Squirrel Glider. | 22/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (median) | 5 | 26/07/2017 | 521665 | 6762261 | 11 | Swamp Box | 50 | SE | 28 | 22/07/2020 | Nil spp. Nil evidence of use. | 22/10/2020 | Nil spp. Nil evidence of use. Ants | 1/02/2021 | Nil spp. Nil evidence of use. |
| Impact Site 2 (median) | 6 | 26/07/2017 | 521632 | 6762191 | 8 | Spotted Gum | 40 | SE | 28 | 22/07/2020 | Nil spp. Leaf nesting material. | 22/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (east) | 1 | 27/07/2017 | 521894 | 6762345 | 12 | Red Mahogany | 50 | S | 25 | 22/07/2020 | Nil spp. Leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (east) | 2 | 27/07/2017 | 521806 | 6762234 | 11 | Spotted Gum | 40 | SW | 27 | 22/07/2020 | Nil spp. Ants. | 20/10/2020 | Nil spp. Ants. | 29/01/2021 | Nil spp. Ants. |
| Impact Site 2 (east) | 3 | 27/07/2017 | 521768 | 6762166 | 8 | Red Mahogany | 30 | SE | 22 | 22/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Very old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (east) | 4 | 27/07/2017 | 521720 | 6762116 | 11 | Spotted Gum | 40 | SW | 29 | 22/07/2020 | Nil spp. Fresh leaf nesting material. | 20/10/2020 | Nil spp. Fresh leaf nesting material. | 29/01/2021 | 1 x adult Squirrel Glider. Sex undetermined. Dispersed when establishing line. |
| Impact Site 2 (east) | 5 | 27/07/2017 | 521687 | 6762085 | 15 | Stringy Bark | 40 | SW | 29 | 22/07/2020 | Frog (<i>Litoria</i> sp. dispersed). Old leaf nesting material. | 20/10/2020 | Nil spp. Very old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 2 (east) | 6 | 27/07/2017 | 521644 | 6762026 | 10 | Spotted Gum | 30 | S | 25 | 22/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 3 (west) | 1* | 11/08/2017 | 522612 | 6763123 | 10 | Red Mahogany | 45 | S | 20 | - | - | - | - | - | - |
| Impact Site 3 (west) | 2* | 11/08/2017 | 522634 | 6763156 | 12 | White Mahogany | 65 | S | 25 | - | - | - | - | - | - |
| Impact Site 3 (west) | 3 | 11/08/2017 | 522645 | 6763207 | 8 | Spotted Gum | 40 | S | 25 | 23/07/2020 | Nil spp. Old leaf nesting material. | 22/10/2020 | 1 x glider. Species not confirmed, dispersed during setup. Old leaf nesting material. | 1/02/2021 | 2 x Squirrel Gliders: 1 male, 1 unknown sex. |
| Impact Site 3 (west) | 4* | 11/08/2017 | 522695 | 6763226 | 12 | Stringy Bark | 40 | S | 20 | - | - | - | - | - | - |
| Impact Site 3 (west) | 5 | 11/08/2017 | 522716 | 6763250 | 12 | Swamp Box | 55 | S | 25 | 23/07/2020 | Nil spp. Nil evidence of use. | 22/10/2020 | Nil spp. Nil evidence of use. | 1/02/2021 | Nil spp. Nil evidence of use. |
| Impact Site 3 (east) | 1 | 27/07/2017 | 522834 | 6763203 | 9 | Red Mahogany | 40 | SE | 26 | 23/07/2020 | Nil spp. Fresh leaf nesting material. | 20/10/2020 | Nil spp. Fresh leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 3 (east) | 2 | 27/07/2017 | 522779 | 6763146 | 10 | Blackbutt | 30 | S | 28 | 23/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 3 (east) | 3 | 27/07/2017 | 523467 | 6764328 | 11 | Red Mahogany | 30 | SW | 25 | 22/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. Termites on outside and within box. |
| Impact Site 3 (east) | 3 | 27/07/2017 | 522745 | 6763100 | 11 | Spotted Gum | 40 | S | 27 | 23/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 3 (east) | 4 | 27/07/2017 | 522717 | 6763062 | 9 | Red Mahogany | 30 | E | 24 | 23/07/2020 | Nil spp. Fresh leaf nesting material. Droppings on lid. | 20/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Fresh leaf nesting material. |
| Impact Site 3 (east) | 5 | 27/07/2017 | 522655 | 6762996 | 12 | Spotted Gum | 40 | SW | 26 | 23/07/2020 | Nil spp. Fresh leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. Gecko (likely Robust Velvet Gecko | 1/02/2021 | 1 x female Squirrel Glider adult. |

| Site | Nest Box No. | Date Installed | Easting | Northing | Nest Box Height (m) | Tree Species | DBH (cm) | Nest Box Orientation | Tree Height (m) | Year 6 Winter Monitoring | | Year 6 Spring Monitoring | | Year 6 Summer Monitoring | |
|------------------------|--------------|----------------|---------|----------|---------------------|----------------|----------|----------------------|-----------------|--------------------------|--|--------------------------|---|--------------------------|--|
| | | | | | | | | | | Date | Results | Date | Results | Date | Results |
| | | | | | | | | | | | | | <i>Oedura robusta</i> . | | |
| Impact Site 4 (west) | 1* | 11/08/2017 | 523320 | 6764536 | 8 | Stringy Bark | 45 | S | 25 | - | - | - | - | - | - |
| Impact Site 4 (west) | 2* | 11/08/2017 | 523302 | 6764501 | 8 | Stringy Bark | 55 | S | 30 | - | - | - | - | - | - |
| Impact Site 4 (west) | 3* | 11/08/2017 | 523284 | 6764450 | 10 | Stringy Bark | 50 | S | 30 | - | - | - | - | - | - |
| Impact Site 4 (west) | 4* | 11/08/2017 | 523270 | 6764391 | 15 | Bloodwood | 35 | S | 30 | - | - | - | - | - | - |
| Impact Site 4 (west) | 5* | 11/08/2017 | 523246 | 6764347 | 8 | Blackbutt | 120 | S | 35 | - | - | - | - | - | - |
| Impact Site 4 (west) | 6* | 11/08/2017 | 523216 | 6764293 | 10 | Blackbutt | 65 | E | 30 | - | - | - | - | - | - |
| Impact Site 4 (median) | 1^ | 11/08/2017 | 523391 | 6764279 | 8 | Bloodwood | 80 | S | 25 | 23/07/2020 | Nil spp. Nil evidence of use. | - | - | - | - |
| Impact Site 4 (median) | 2* | 11/08/2017 | 523385 | 6764336 | 8 | Smudgy Apple | 40 | S | 25 | - | - | - | - | - | - |
| Impact Site 4 (median) | 3* | 11/08/2017 | 523405 | 6764386 | 10 | Smudgy Apple | 60 | S | 25 | - | - | - | - | - | - |
| Impact Site 4 (median) | 4* | 11/08/2017 | 523442 | 6764445 | 10 | Smudgy Apple | 55 | S | 30 | - | - | - | - | - | - |
| Impact Site 4 (median) | 5* | 11/08/2017 | 523468 | 6764494 | 12 | Smudgy Apple | 50 | S | 25 | - | - | - | - | - | - |
| Impact Site 4 (east) | 1* | 27/07/2017 | 523513 | 6764408 | 8 | Red Mahogany | 40 | S | 25 | - | - | - | - | - | - |
| Impact Site 4 (east) | 2* | 27/07/2017 | 523486 | 6764362 | 9 | Bloodwood | 45 | SW | 26 | - | - | - | - | - | - |
| Impact Site 4 (east) | 4 | 27/07/2017 | 523438 | 6764249 | 8 | Bloodwood | 65 | SE | 25 | 22/07/2020 | Nil spp. Nil evidence of use. | 20/10/2020 | Nil spp. Nil evidence of use. | 29/01/2021 | Nil spp. Ants. Nil evidence of use. |
| Impact Site 4 (east) | 5 | 27/07/2017 | 523408 | 6764202 | 8 | Smudgy Apple | 40 | S | 25 | 22/07/2020 | Nil spp. Leaf nesting material and scent. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 4 (east) | 6* | 27/07/2017 | 523553 | 6764450 | 8 | Red Mahogany | 45 | E | 24 | - | - | - | - | - | - |
| Impact Site 6 (west) | 1 | 26/07/2017 | 524788 | 6767065 | 10 | Scribbly Gum | 50 | S | 20 | 23/07/2020 | Nil spp. Fresh leaf nesting material. | 22/10/2020 | Nil spp. Fresh leaf nesting material. Ants nest. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 6 (west) | 2 | 26/07/2017 | 524782 | 6767007 | 12 | Stringy Bark | 35 | S | 25 | 23/07/2020 | Nil spp. Leaf nesting material. | 22/10/2020 | Nil spp. Fresh leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Impact Site 6 (west) | 3 | 26/07/2017 | 524710 | 6766877 | 15 | Blackbutt | 40 | SE | 30 | 23/07/2020 | 1 x glider dispersed when establishing rope and glided to hollow-bearing stag close by. Either Sugar Glider or Squirrel Glider. | 22/10/2020 | 1 x Squirrel Glider female (dispersed when setting line) one dependant juvenile in box. | 1/02/2021 | 2 x gliders, including 1 adult female. Female dispersed during climb. Species not confirmed. |
| Impact Site 6 (west) | 4 | 26/07/2017 | 524678 | 6766843 | 12 | Bloodwood | 40 | S | 20 | 23/07/2020 | Nil spp. Fresh leaf nesting material. | 22/10/2020 | Nil spp. Fresh leaf nesting material. | 1/02/2021 | Nil spp. Fresh leaf nesting material. |
| Impact Site 6 (west) | 5* | 26/07/2017 | 524657 | 6766761 | 8 | Stringy Bark | 40 | S | 27 | - | - | - | - | - | - |
| Control site 1 | 1 | 27/07/2017 | 522303 | 6762009 | 11 | Spotted Gum | 45 | E | 30 | 22/07/2020 | Nil spp. Old leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Leaf nesting material. |
| Control site 1 | 2 | 27/07/2017 | 522354 | 6762008 | 9 | Spotted Gum | 30 | S | 27 | 22/07/2020 | Nil spp. Leaf nesting material | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Control site 1 | 3 | 27/07/2017 | 522423 | 6762010 | 8 | Red Mahogany | 45 | E | 27 | 22/07/2020 | Nil spp. Leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. Odour. |
| Control site 1 | 4 | 27/07/2017 | 522517 | 6761981 | 8 | White Mahogany | 45 | SW | 24 | 22/07/2020 | Nil spp. Nil evidence of use. | 20/10/2020 | Nil spp. Nil evidence of use. | 29/01/2021 | Nil spp. Ants. |
| Control site 1 | 5 | 27/07/2017 | 522568 | 6761980 | 14 | Grey Ironbark | 45 | S | 30 | 22/07/2020 | Nil spp. Leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. Termites. |
| Control site 2 | 1 | 11/08/2017 | 523210 | 6762772 | 10 | Bloodwood | 40 | S | 20 | 23/07/2020 | Unidentified glider dispersed from nest box and glided to stag with hollows. Suspected Squirrel due to bush tail. Fresh leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Control site 2 | 2 | 11/08/2017 | 523251 | 6762765 | 12 | Scribbly Gum | 45 | S | 25 | 23/07/2020 | Nil spp. Fresh leaf nesting material. | 20/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Control site 2 | 3* | 11/08/2017 | 523305 | 6762777 | 15 | Blackbutt | 60 | SE | 30 | - | - | - | - | - | - |
| Control site | 4 | 11/08/2017 | 523340 | 6762777 | 10 | Bloodwood | 50 | S | 25 | 23/07/2020 | Nil spp. Nil evidence of use. Box slightly fire | 20/10/2020 | Nil spp. Nil evidence of use. | 1/02/2021 | Nil spp. Old leaf nesting |

| Site | Nest Box No. | Date Installed | Easting | Northing | Nest Box Height (m) | Tree Species | DBH (cm) | Nest Box Orientation | Tree Height (m) | Year 6 Winter Monitoring | | Year 6 Spring Monitoring | | Year 6 Summer Monitoring | |
|----------------|--------------|----------------|---------|----------|---------------------|------------------------|----------|----------------------|-----------------|--------------------------|---|--------------------------|---|--------------------------|---|
| | | | | | | | | | | Date | Results | Date | Results | Date | Results |
| 2 | | | | | | | | | | | damaged. | | | | material. |
| Control site 2 | 5 | 11/08/2017 | 523405 | 6762789 | 8 | Turpentine | 45 | S | 25 | 23/07/2020 | Nil spp. Nil evidence of use. | 20/10/2020 | Nil spp. Old leaf nesting material. | 1/02/2021 | Nil spp. Old leaf nesting material. |
| Control site 4 | 1 | 26/07/2017 | 521084 | 6763138 | 8 | Spotted Gum | 40 | S | 28 | 22/07/2020 | Nil spp. Old leaf nesting material. | 22/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Control site 4 | 2 | 26/07/2017 | 521093 | 6763099 | 9 | Spotted Gum | 45 | SE | 28 | 22/07/2020 | 2 x Squirrel Gliders. Dispersed when establishing line. | 22/10/2020 | 3 x Squirrel Gliders in nesting material. One dispersed when installing string. At least two remained in the box. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Control site 4 | 3 | 26/07/2017 | 521134 | 6763032 | 10 | Small-fruited Grey Gum | 45 | E | 27 | 22/07/2020 | Nil spp. Fresh leaf nesting material. | 22/10/2020 | Nil spp. Fresh leaf nesting material and musty smell indicative of recent usage. | 22/10/2020 | Nil spp. Old leaf nesting nesting material. |
| Control site 4 | 4 | 26/07/2017 | 521155 | 6762979 | 12 | Grey Ironbark | 40 | S | 30 | 22/07/2020 | Nil spp. Fresh leaf nesting material. | 22/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Control site 4 | 5 | 26/07/2017 | 521195 | 6762945 | 12 | Grey Ironbark | 30 | SE | 20 | 22/07/2020 | 2 x Squirrel Gliders. Dispersed when arborist began climbing. | 22/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Control site 5 | 1 | 26/07/2017 | 521045 | 6763490 | 12 | Grey Ironbark | 75 | S | 32 | 22/07/2020 | Nil spp. Ants. | 22/10/2020 | Nil spp. Ants. | 29/01/2021 | Nil spp. Ants. |
| Control site 5 | 2* | 26/07/2017 | 521026 | 6763553 | 15 | Blackbutt | 55 | SW | 32 | - | - | - | - | - | - |
| Control site 5 | 3 | 26/07/2017 | 521030 | 6763633 | 9 | Bloodwood | 55 | SW | 28 | 22/07/2020 | 1 x Lace Monitor | 22/07/2020 | Nil spp. Leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. Remnant of bees nest. |
| Control site 5 | 4 | 26/07/2017 | 521016 | 6763719 | 9 | Swamp Box | 45 | S | 23 | 22/07/2020 | Nil spp. Old leaf nesting material. | 22/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Old leaf nesting material. |
| Control site 5 | 5 | 26/07/2017 | 521012 | 6763758 | 7 | Narrow-leaved Red Gum | 40 | E | 24 | 22/07/2020 | 1 x Lace Monitor | 22/10/2020 | Nil spp. Old leaf nesting material. | 29/01/2021 | Nil spp. Fresh leaf nesting material. |

* Nest box was not monitored during Year 6 because it was burnt in the 2019 bushfire

^ Not monitored after Year 6 Winter due to the removal of access track.



Appendix C

Fauna Underpass Monitoring Results

Table C1

Summary of Fauna Underpass Monitoring Results During the Year 6 Reporting Period

| | C3 | | | C6 | | | C6 Pipes | | | C7 | | | C8 | | | C9 | | | C10 | | | NBT3 | | | SBT3 | | | NBT2 | | | SBT2 | | | Total | | | |
|----------------------------|----|-----|-----|-----|-----|-----|----------|-----|-----|-----|-----|-----|-----|-----|-----|----|-----|-----|-----|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|------|-----|-----|-------|------|-----|---|
| | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | NR | RCC | UCC | | | | |
| Antechinus sp. | 4 | | | 4 | 1 | 1 | | | | 1 | | | 1 | | | | | | 1 | | | 3 | | | 2 | 1 | 1 | | | | | | | 12 | 2 | 2 | |
| Bandicoot sp. | | | | | | | | | | | | | 1 | | | | | | 1 | | | 3 | | | 16 | 15 | 15 | | | | | | | 21 | 15 | 15 | |
| Black Rat | 7 | | | 157 | 133 | 89 | 3 | 2 | 1 | 57 | 50 | 49 | 37 | 32 | 30 | 1 | 1 | 1 | 6 | 6 | 6 | 13 | 3 | 3 | 53 | 25 | 15 | 8 | 1 | 1 | 10 | 4 | 4 | 352 | 257 | 199 | |
| Bush Rat | | | | | | | | | | | | | | | | | | | 1 | | | 4 | | | 1 | | | 3 | 1 | 1 | | | | 9 | 1 | 1 | |
| Cane Toad | | | | 9 | 1 | 1 | 8 | | | 1 | | | 4 | | | | | | 4 | 1 | 1 | 6 | | | 1 | | | 2 | | | 3 | | | 38 | 2 | 2 | |
| Cat | 5 | | | 10 | 8 | 5 | 2 | | | | 18 | 14 | 12 | 18 | 15 | 10 | | | 7 | 2 | 2 | | | | | | | 1 | 1 | 1 | | | | 61 | 40 | 30 | |
| Common Brushtail Possum | | | | | | | | | | 2 | 2 | 2 | | | | 1 | | | | | | | | | | | | | | | | | | | 3 | 2 | 2 |
| Eastern Blue-tongue Lizard | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 | 1 | 1 | | | | | | | | | 2 | 1 | 1 |
| Eastern Grey Kangaroo | 1 | | | | | | | | | | | | | | | 2 | 2 | 1 | | | | 57 | 51 | 49 | 84 | 77 | 77 | 18 | 16 | 16 | 5 | 5 | 5 | 167 | 151 | 148 | |
| Eastern Water Dragon | 6 | | | 79 | 45 | 24 | 1 | | | 15 | 9 | 5 | 44 | 21 | 14 | 4 | 1 | 1 | 9 | 6 | 3 | 12 | 7 | 7 | 31 | 9 | 8 | 6 | 4 | 3 | 50 | 21 | 17 | 257 | 123 | 82 | |
| Eastern Water Skink | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 14 | | | 15 | | | |
| European Fox | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | 2 | 1 | | | 3 | 2 | 2 | |
| European Hare | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | 3 | 2 | 2 | |
| Green Tree Frog | | | | | | | | | | | | | 1 | | | | | | | | | 2 | | | 2 | | | | | | | | 3 | 1 | 1 | | |
| Green Tree Snake | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | 1 | | | |
| House Mouse | | | | 10 | 4 | 2 | | | | | | | | | | | | | 9 | | | | | | 16 | 3 | 2 | 2 | | | 4 | | | 41 | 7 | 4 | |
| Lace Monitor | 2 | | | 4 | 3 | 3 | 12 | 8 | 4 | 75 | 71 | 59 | 55 | 43 | 34 | 12 | 11 | 8 | 15 | 9 | 7 | 4 | 4 | 4 | 7 | 6 | 6 | 8 | 8 | 8 | 7 | 7 | 6 | 201 | 170 | 139 | |
| Land Mullet | | | | | | | | | | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | 2 | |
| Longnosed Bandicoot | | | | 2 | 2 | 2 | | | | 2 | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | 4 | 4 | 4 | |
| Macropod sp. | 1 | | | | | | 2 | | | 8 | 5 | 3 | 1 | 1 | 1 | 7 | 6 | 5 | | | | 12 | 9 | 8 | 27 | 27 | 27 | | | | 1 | | | 59 | 48 | 44 | |
| Northern Brown Bandicoot | | | | | | | | | | | | | | | | | | | | | | 4 | 3 | 3 | 13 | 12 | 12 | 2 | | | | | | 19 | 15 | 15 | |
| Red-bellied Black Snake | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 2 | | | |
| Red-necked Wallaby | | | | | | | | | 1 | | | | | | | 2 | | | 4 | | | 34 | 31 | 27 | 48 | 46 | 43 | 4 | 4 | 3 | 3 | 3 | 3 | 96 | 84 | 76 | |
| Ringtail Possum | | | | | | | | | | | | | | | | | | 1 | 1 | 1 | | | | | | | | | | | | | | 1 | 1 | 1 | |
| Rodent | 1 | | | 23 | 10 | 4 | 8 | | | 15 | 8 | 5 | 17 | 4 | 3 | 3 | 1 | 1 | 3 | | | 22 | | | 29 | 6 | 5 | 12 | 3 | 2 | 14 | 1 | 1 | 147 | 33 | 21 | |
| Shortbeaked Echidna | 2 | | | | | | | | | 5 | 5 | 5 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | 8 | 6 | 6 | |
| Skink sp. | | | | | | | 1 | | | | | | 1 | | | | | | 2 | | | | | | 1 | | | 4 | 1 | 1 | 9 | 1 | 1 | 18 | 2 | 2 | |
| Striped Marsh Frog | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | | | 1 | | | |
| Sun Skink | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | 2 | | | 2 | | | 5 | | | |
| Swamp Wallaby | 1 | | | | | | | | | 61 | 40 | 21 | 3 | 3 | 3 | 18 | 13 | 12 | 3 | 2 | 1 | 44 | 40 | 38 | 88 | 79 | 75 | 10 | 10 | 10 | 29 | 29 | 29 | 257 | 216 | 189 | |
| Water Rat | | | | | | | | | | 1 | 1 | 1 | | | | 4 | 1 | 1 | | | | 1 | | | | | | 1 | | | | | | 7 | 2 | 2 | |
| Grand Total | 30 | 0 | 0 | 298 | 207 | 131 | 37 | 10 | 5 | 265 | 209 | 166 | 183 | 120 | 96 | 54 | 36 | 30 | 58 | 27 | 21 | 228 | 148 | 139 | 421 | 307 | 287 | 89 | 52 | 49 | 157 | 73 | 68 | 1820 | 1189 | 992 | |

NR = No. of records

RCC = No. of complete crossings

UCC = No. of unique complete crossings

NBT2 = Northbound bridge over Tabbimoble Floodway No.2

NBT3 = Northbound bridge over Tabbimoble Floodway No.3

SBT2 = Southbound bridge over Tabbimoble Floodway No.2

SBT3 = Southbound bridge over Tabbimoble Floodway No.3

Table C2 Underpass Scat/ Track Search Results for Year 6 Post Construction Monitoring

| Date | Site | Season | Survey Number | Species | Identification Confidence | Recording Type | Direction of Movement | Complete Crossing | Comments |
|-----------|------|--------|---------------|--|---------------------------|----------------|-------------------------|-------------------|---|
| 3/8/2020 | NBT2 | Winter | 1 | Rattus sp. | Probable | Scats | - | - | - |
| 3/8/2020 | NBT2 | Winter | 1 | Ringtail Possum (Pseudocheirus peregrinus) | Probable | Scats | - | - | - |
| 3/8/2020 | NBT3 | Winter | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west and west-east | Yes | - |
| 3/8/2020 | NBT3 | Winter | 1 | Elapid sp. | Definite | Carcass | - | - | - |
| 3/8/2020 | NBT3 | Winter | 1 | Southern Myotis (Myotis macropus) | Definite | Present | - | - | Individual roosting in scupper. |
| 3/8/2020 | SBT2 | Winter | 1 | Ringtail Possum (Pseudocheirus peregrinus) | Probable | Scats | - | - | - |
| 3/8/2020 | SBT2 | Winter | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 3/8/2020 | SBT2 | Winter | 1 | Antechinus sp. | Probable | Scats | - | - | - |
| 3/8/2020 | SBT2 | Winter | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 3/8/2020 | SBT2 | Winter | 1 | European Fox (Vulpes vulpes) | Probable | Scats | - | - | - |
| 3/8/2020 | SBT3 | Winter | 1 | Macropod sp. | Probable | Scats | - | - | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 3/8/2020 | C3 | Winter | 1 | Rattus sp. | Probable | Tracks | Non-directional | No | Habitation activity. |
| 3/8/2020 | C3 | Winter | 1 | Approx. 1800 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Large guano deposits. |
| 3/8/2020 | C6 | Winter | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 3/8/2020 | C6 | Winter | 1 | 5 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins in fauna underpass and lift hole in the culverts to the south. Minor guano deposits. |
| 3/8/2020 | C6 | Winter | 1 | Cat (Felis catus) | Definite | Tracks | Non-directional | No | - |
| 3/8/2020 | C7 | Winter | 1 | Water Rat (Hydromys chrysogaster) | Probable | Scats | - | - | - |
| 3/8/2020 | C7 | Winter | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west | Yes | - |
| 3/8/2020 | C7 | Winter | 1 | Cat (Felis catus) | Probable | Tracks | East-west | Yes | - |
| 3/8/2020 | C7 | Winter | 1 | 7 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Minor guano deposits. |
| 3/8/2020 | C7 | Winter | 1 | 2 Eastern Crevice Skink (Egernia mcphreei) | Definite | Present | - | - | Sheltering in cell join. |
| 3/8/2020 | C7 | Winter | 1 | Lace Monitor (Varanus varius) | Possible | Tracks | Incomplete | No | - |
| 3/8/2020 | C8 | Winter | 1 | Approx. 350 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Moderate guano deposits. |
| 3/8/2020 | C9 | Winter | 1 | 9 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Guano deposits. |
| 3/8/2020 | C9 | Winter | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west and west-east | Yes | - |
| 3/8/2020 | C10 | Winter | 1 | Green Tree Frog (Litoria caerulea) | Definite | Present | - | - | Sheltering in cell join. |
| 3/8/2020 | C10 | Winter | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 3/8/2020 | C10 | Winter | 1 | Approx. 1000 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Large guano deposits. |
| 27/8/2020 | NBT2 | Winter | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 27/8/2020 | NBT2 | Winter | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 27/8/2020 | NBT3 | Winter | 2 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west and west-east | Yes | - |
| 27/8/2020 | NBT3 | Winter | 2 | Macropod sp. | Probable | Scats | - | - | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 27/8/2020 | NBT3 | Winter | 2 | Eastern Grey Kangaroo (Macropus giganteus) | Probable | Tracks | East-west | Yes | - |
| 27/8/2020 | NBT3 | Winter | 2 | 1 Eastern Bent-winged Bat (Miniopterus orianae oceanensis) | Definite | Present | - | - | Roosting in scupper. |
| 27/8/2020 | SBT2 | Winter | 2 | Ringtail Possum (Pseudocheirus peregrinus) | Probable | Scats | - | - | - |
| 27/8/2020 | SBT2 | Winter | 2 | Green Tree Frog (Litoria caerulea) | Probable | Scats | - | - | - |
| 27/8/2020 | SBT2 | Winter | 2 | Antechinus sp. | Definite | Scats | - | - | - |
| 27/8/2020 | SBT2 | Winter | 2 | Water Rat (Hydromys chrysogaster) | Definite | Scats | - | - | - |
| 27/8/2020 | SBT2 | Winter | 2 | Macropod sp. | Probable | Scats | - | - | - |
| 27/8/2020 | SBT2 | Winter | 2 | Water Dragon (Intellagama lesueurii) | Definite | Present | - | - | - |
| 27/8/2020 | SBT3 | Winter | 2 | Macropod sp. | Probable | Scats | - | - | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 27/8/2020 | SBT3 | Winter | 2 | Rattus sp. | Probable | Scats | - | - | - |
| 27/8/2020 | SBT3 | Winter | 2 | Sun Skink (Lampropholis delicata) | Definite | Present | - | - | - |
| 27/8/2020 | SBT3 | Winter | 2 | Macropod sp. | Probable | Tracks | East-west | Probable | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 27/8/2020 | C3 | Winter | 2 | Rattus sp. | Probable | Scats | - | - | - |
| 27/8/2020 | C3 | Winter | 2 | Approx. 1650 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Large guano deposits. |
| 27/8/2020 | C3 | Winter | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 27/8/2020 | C6 | Winter | 2 | 2 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins in fauna underpass and lift hole in the culverts to the south. Minor guano deposits. |
| 27/8/2020 | C6 | Winter | 2 | Cat (Felis catus) | Definite | Tracks | Non-directional | No | - |

| Date | Site | Season | Survey Number | Species | Identification Confidence | Recording Type | Direction of Movement | Complete Crossing | Comments |
|------------|------|--------|---------------|---|---------------------------|------------------|-------------------------|-------------------|--|
| 27/8/2020 | C6 | Winter | 2 | Cane Toads (Rhinella marina) | Definite | Present | - | - | In pooled water within culvert. |
| 27/8/2020 | C7 | Winter | 2 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west | Yes | - |
| 27/8/2020 | C7 | Winter | 2 | Cat (Felis catus) | Probable | Tracks | East-west | Yes | - |
| 27/8/2020 | C7 | Winter | 2 | 5 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Guano present. |
| 27/8/2020 | C7 | Winter | 2 | Cat (Felis catus) | Possible | Tracks | East-west | Unknown | - |
| 27/8/2020 | C8 | Winter | 2 | Approx. 220 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Moderate guano deposits. |
| 27/8/2020 | C9 | Winter | 2 | 10 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Guano present. |
| 27/8/2020 | C9 | Winter | 2 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west and west-east | Yes | - |
| 27/8/2020 | C9 | Winter | 2 | 1 Eastern Bent-winged Bat (Miniopterus orianae oceanensis) | Definite | Present | - | - | Roosting in culvert cell joins. Guano present. |
| 27/8/2020 | C9 | Winter | 2 | Antechinus sp. | Possible | Scats | - | - | - |
| 27/8/2020 | C10 | Winter | 2 | Water Rat (Hydromys chrysogaster) | Probable | Scats | - | - | - |
| 27/8/2020 | C10 | Winter | 2 | Approx. 750 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Large guano deposits. |
| 27/8/2020 | C10 | Winter | 2 | Green Tree Frog (Litoria caerulea) | Definite | Present | - | - | Sheltering in cell join. |
| 18/9/2020 | NBT2 | Spring | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 18/9/2020 | NBT2 | Spring | 1 | Water Dragon (Intellagama lesueurii) | Definite | Scats | - | - | - |
| 18/9/2020 | NBT3 | Spring | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | East-west and west-east | Yes | - |
| 18/9/2020 | NBT3 | Spring | 1 | Eastern Grey Kangaroo (Macropus giganteus) | Probable | Tracks | East-west | Yes | - |
| 18/9/2020 | NBT3 | Spring | 1 | Macropod sp. | Probable | Scats | - | - | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 18/9/2020 | NBT3 | Spring | 1 | Rattus sp. | Definite | Scats and tracks | - | - | - |
| 18/9/2020 | NBT3 | Spring | 1 | Striped Marsh Frog (Limnodynastes peronii) | Definite | Present | - | - | - |
| 18/9/2020 | NBT3 | Spring | 1 | Martin's Bar-sided Skink (Eulamprus martini) | Definite | Present | - | - | - |
| 18/9/2020 | SBT2 | Spring | 1 | Antechinus sp. | Probable | Scats | - | - | - |
| 18/9/2020 | SBT2 | Spring | 1 | Rattus sp. | Probable | Scats | - | - | - |
| 18/9/2020 | SBT2 | Spring | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 18/9/2020 | SBT3 | Spring | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 18/9/2020 | SBT3 | Spring | 1 | Sun Skink (Lampropholis delicata) | Definite | Present | - | - | - |
| 18/9/2020 | SBT3 | Spring | 1 | Macropod sp. | Probable | Tracks | East-west | Likely | - |
| 18/9/2020 | C3 | Spring | 1 | Approx. 55 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Large guano deposits. |
| 18/9/2020 | C3 | Spring | 1 | Rattus sp. | Probable | Tracks | Non-directional | - | Habitation activity. |
| 18/9/2020 | C3 | Spring | 1 | Cane Toads (Rhinella marina) | Definite | Present | - | - | Sheltering in cell near pooled water. |
| 18/9/2020 | C6 | Spring | 1 | Rattus sp. | Definite | Scats | - | - | Underpass cleaned as part of construction works. |
| 18/9/2020 | C7 | Spring | 1 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west | Yes | - |
| 18/9/2020 | C7 | Spring | 1 | Cat (Felis catus) | Probable | Tracks | East-west | Yes | - |
| 18/9/2020 | C7 | Spring | 1 | Lace Monitor (Varanus varius) | Possible | Tracks | Incomplete | - | - |
| 18/9/2020 | C8 | Spring | 1 | Water Dragon (Intellagama lesueurii) | Definite | Present | - | - | - |
| 18/9/2020 | C9 | Spring | 1 | 3 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Guano present. |
| 18/9/2020 | C9 | Spring | 1 | Antechinus sp. | Probable | Scats | - | - | - |
| 18/9/2020 | C9 | Spring | 1 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west and west-east | Yes | - |
| 18/9/2020 | C10 | Spring | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Scats | - | - | In culvert |
| 18/9/2020 | C10 | Spring | 1 | Short-beaked Echidna (Tachyglossus aculeatus) | Probable | Tracks | East-west | Yes | - |
| 18/9/2020 | C10 | Spring | 1 | Approx. 50 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell joins. Guano present. |
| 18/9/2020 | C10 | Spring | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 18/9/2020 | C10 | Spring | 1 | Rattus sp. | Probable | Scats | - | - | - |
| 12/11/2020 | NBT2 | Spring | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 12/11/2020 | NBT2 | Spring | 2 | Amphibian | Possible | Scats | - | - | - |
| 12/11/2020 | NBT2 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Possible | Scats | - | - | - |
| 12/11/2020 | NBT2 | Spring | 2 | Ringtail Possum (Pseudocheirus peregrinus) | Possible | Scats | - | - | - |
| 12/11/2020 | NBT3 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west | Yes | - |
| 12/11/2020 | NBT3 | Spring | 2 | Macropod sp. | Probable | Scats | - | - | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 12/11/2020 | SBT2 | Spring | 2 | Antechinus sp. | Probable | Scats | - | - | - |
| 12/11/2020 | SBT2 | Spring | 2 | Rattus sp. | Probable | Scats | - | - | - |
| 12/11/2020 | SBT2 | Spring | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |

| Date | Site | Season | Survey Number | Species | Identification Confidence | Recording Type | Direction of Movement | Complete Crossing | Comments |
|------------|------|--------|---------------|--|---------------------------|----------------------------|-------------------------|-------------------|--|
| 12/11/2020 | SBT2 | Spring | 2 | Egernia sp. | Definite | Present | - | - | - |
| 12/11/2020 | SBT2 | Spring | 2 | Amphibian | Possible | Scats | - | - | - |
| 12/11/2020 | SBT3 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Definite | Scats | - | - | - |
| 12/11/2020 | SBT3 | Spring | 2 | Sun Skink (Lampropholis delicata) | Definite | Present | - | - | - |
| 26/11/2020 | C3 | Spring | 2 | Two dead Little Bent-winged Bats (Miniopterus australis) | Definite | Present; guano | - | - | - |
| 26/11/2020 | C3 | Spring | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 26/11/2020 | C3 | Spring | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 26/11/2020 | C3 | Spring | 2 | Common Brushtail Possum (Trichosurus vulpecula) | Possible | Scats | - | - | - |
| 26/11/2020 | C3 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Scats and tracks | Non-directional | No | Eastern side of culvert |
| 3/8/2020 | C6 | Spring | 2 | Rattus sp. | Probable | Scats | - | - | - |
| 3/8/2020 | C6 | Spring | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 3/8/2020 | C6 | Spring | 2 | Cane Toad (Rhinella marina) | Definite | Present | - | - | Within and around pooled water |
| 3/8/2020 | C6 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Possible | Scats | - | - | Pipe culverts to the south. |
| 26/11/2020 | C7 | Spring | 2 | Rattus sp. | Probable | Scats | - | - | - |
| 26/11/2020 | C7 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west | Yes | - |
| 26/11/2020 | C8 | Spring | 2 | Rattus sp. | Probable | Scats | - | - | - |
| 26/11/2020 | C8 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | West-east | Yes | - |
| 26/11/2020 | C8 | Spring | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 26/11/2020 | C9 | Spring | 2 | Water Dragon (Intellagama lesueurii) | Definite | Present at entrance; scats | - | - | - |
| 26/11/2020 | C9 | Spring | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 26/11/2020 | C9 | Spring | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Scats and tracks | West-east | Yes | - |
| 26/11/2020 | C10 | Spring | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 26/11/2020 | C10 | Spring | 2 | Common Brushtail Possum (Trichosurus vulpecula) | Probable | Scats | - | - | - |
| 20/1/2021 | NBT2 | Summer | 1 | Amphibian | Probable | Scats | - | - | - |
| 20/1/2021 | NBT2 | Summer | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 20/1/2021 | NBT2 | Summer | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Tracks | Non-directional | No | - |
| 15/2/2021 | NBT3 | Summer | 1 | Swamp Wallaby (Wallabia bicolor) | Definite | Scats and tracks | East-west and west-east | Yes | - |
| 15/2/2021 | NBT3 | Summer | 1 | Eastern Grey Kangaroo (Macropus giganteus) | Probable | Tracks | East-west and west-east | Yes | - |
| 15/2/2021 | NBT3 | Summer | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 15/2/2021 | NBT3 | Summer | 1 | Amphibian | Probable | Scats | - | - | - |
| 15/2/2021 | NBT3 | Summer | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | NBT3 | Summer | 1 | Martin's Bar-sided Skink (Eulamprus martini) | Definite | Present | - | - | - |
| 20/1/2021 | SBT2 | Summer | 1 | Antechinus sp. | Probable | Scats | - | - | - |
| 20/1/2021 | SBT2 | Summer | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 20/1/2021 | SBT2 | Summer | 1 | Egernia sp. | Probable | Present | - | - | Not able to be captured to confirm identification |
| 20/1/2021 | SBT2 | Summer | 1 | Amphibian | Probable | Scats | - | - | - |
| 20/1/2021 | SBT2 | Summer | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | SBT3 | Summer | 1 | Cane Toad (Rhinella marina) | Definite | Present | - | - | - |
| 15/2/2021 | SBT3 | Summer | 1 | Swamp Wallaby (Wallabia bicolor) | Probable | Scats and Tracks | East-west and west-east | Yes | - |
| 15/2/2021 | SBT3 | Summer | 1 | Macropod sp. | Probable | Scats | - | - | Likely Eastern Grey Kangaroo or Red-necked Wallaby |
| 15/2/2021 | SBT3 | Summer | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | SBT3 | Summer | 1 | Rattus sp. | Definite | Scats | - | - | - |
| 20/1/2021 | C3 | Summer | 1 | Rattus sp. | Definite | Scats and tracks | Non-directional | Unknown | Habitation activity. |
| 20/1/2021 | C3 | Summer | 1 | Lace Monitor (Varanus varius) | Probable | Tracks | East-west | Unknown | - |
| 20/1/2021 | C3 | Summer | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 20/1/2021 | C3 | Summer | 1 | Water Rat (Hydromys chrysogaster) | Probable | Scats | - | - | - |
| 20/1/2021 | C3 | Summer | 1 | 1 Little Bent-winged Bats (Miniopterus australis) | Definite | Present | - | - | Roosting in culvert cell join. Guano present. |
| 20/1/2021 | C6 | Summer | 1 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 20/1/2021 | C6 | Summer | 1 | Amphibian | Probable | Scats | - | - | - |
| 20/1/2021 | C6 | Summer | 1 | Rattus sp. | Definite | Tracks | East-west and west-east | Yes | Pipe culvert to south |
| 20/1/2021 | C6 | Summer | 1 | Lace Monitor (Varanus varius) | Probable | Tracks | Incomplete | Unknown | Pipe culvert to south |
| 20/1/2021 | C6 | Summer | 1 | Cane Toad (Rhinella marina) | Definite | Present | - | - | Pipe culvert to south |

| Date | Site | Season | Survey Number | Species | Identification Confidence | Recording Type | Direction of Movement | Complete Crossing | Comments |
|-----------|------|--------|---------------|--|---------------------------|------------------|------------------------------------|-------------------|---|
| 20/1/2021 | C7 | Summer | 1 | Amphibian | Probable | Scats | - | - | - |
| 20/1/2021 | C7 | Summer | 1 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west and west-east | Yes | - |
| 20/1/2021 | C7 | Summer | 1 | Cat (Felis catus) | Probable | Tracks | N/A | No | At western end of culvert |
| 20/1/2021 | C7 | Summer | 1 | Lace Monitor (Varanus varius) | Probable | Tracks | West-east | Yes | - |
| 20/1/2021 | C8 | Summer | 1 | Amphibian | Probable | Scats | - | - | - |
| 20/1/2021 | C8 | Summer | 1 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | N/A | No | At western end of culvert |
| 20/1/2021 | C8 | Summer | 1 | Lace Monitor (Varanus varius) | Probable | Tracks | Incomplete | Unknown | - |
| 20/1/2021 | C9 | Summer | 1 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west and west-east | Yes | - |
| 20/1/2021 | C10 | Summer | 1 | Water Rat (Hydromys chrysogaster) | Probable | Tracks | Non-directional | No | Habitation activity. |
| 20/1/2021 | C10 | Summer | 1 | Cane Toads (Rhinella marina) | Definite | Present | - | - | 100's of toadlets and one adult in culvert. |
| 15/2/2021 | NBT2 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | NBT2 | Summer | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 20/1/2021 | NBT3 | Summer | 2 | Amphibian | Probable | Scats | - | - | - |
| 20/1/2021 | NBT3 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 20/1/2021 | NBT3 | Summer | 2 | Ringtail Possum (Pseudocheirus peregrinus) | Possible | Scats | - | - | - |
| 15/2/2021 | SBT2 | Summer | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 15/2/2021 | SBT2 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 20/1/2021 | SBT3 | Summer | 2 | Cane Toad (Rhinella marina) | Definite | Present | - | - | - |
| 20/1/2021 | SBT3 | Summer | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Scats and tracks | Non-directional | Unknown | - |
| 20/1/2021 | SBT3 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | C3 | Summer | 2 | Rattus sp. | Definite | Scats and tracks | Non-directional | Unknown | Habitation activity. |
| 15/2/2021 | C3 | Summer | 2 | Lace Monitor (Varanus varius) | Probable | Tracks | East-west | Yes | - |
| 15/2/2021 | C3 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | C3 | Summer | 2 | Water Rat (Hydromys chrysogaster) | Probable | Scats | - | - | - |
| 15/2/2021 | C3 | Summer | 2 | Amphibian | Probable | Scats | - | - | - |
| 15/2/2021 | C3 | Summer | 2 | Cane Toad (Rhinella marina) | Definite | Carcass | - | - | - |
| 15/2/2021 | C6 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | C6 | Summer | 2 | Amphibian | Probable | Scats | - | - | - |
| 15/2/2021 | C6 | Summer | 2 | Rattus sp. | Definite | Tracks | East-west and west-east | Yes | Pipe culvert to south |
| 15/2/2021 | C6 | Summer | 2 | Lace Monitor (Varanus varius) | Probable | Tracks | Incomplete | Unknown | Pipe culvert to south |
| 15/2/2021 | C6 | Summer | 2 | Cane Toad (Rhinella marina) | Definite | Carcass | - | - | Pipe culvert to south |
| 15/2/2021 | C7 | Summer | 2 | Amphibian | Probable | Scats | - | - | - |
| 15/2/2021 | C7 | Summer | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west and west-east | Yes | - |
| 15/2/2021 | C7 | Summer | 2 | Possum | Possible | Scats | - | - | - |
| 15/2/2021 | C8 | Summer | 2 | Amphibian | Probable | Scats | - | - | - |
| 15/2/2021 | C8 | Summer | 2 | Swamp Wallaby (Wallabia bicolor) | Probable | Tracks | East-west | Yes | - |
| 15/2/2021 | C8 | Summer | 2 | Cat (Felis catus) | Probable | Tracks | N/A | No | At western end of culvert |
| 15/2/2021 | C8 | Summer | 2 | Lace Monitor (Varanus varius) | Probable | Tracks | East-west and west-east | Yes | - |
| 15/2/2021 | C8 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 15/2/2021 | C8 | Summer | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 15/2/2021 | C9 | Summer | 2 | Lace Monitor (Varanus varius) | Possible | Scats and tracks | West-east | Yes | - |
| 15/2/2021 | C9 | Summer | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 15/2/2021 | C9 | Summer | 2 | Water Dragon (Intellagama lesueurii) | Probable | Scats | - | - | - |
| 20/1/2021 | C10 | Summer | 2 | Possum | Possible | Scats | - | - | - |
| 20/1/2021 | C10 | Summer | 2 | Lace Monitor (Varanus varius) | Probable | Tracks | Unclear (could be both directions) | Yes | - |
| 20/1/2021 | C10 | Summer | 2 | Rattus sp. | Definite | Scats | - | - | - |
| 20/1/2021 | C10 | Summer | 2 | Cane Toads (Rhinella marina) | Definite | Present | - | - | 100's of toadlets and four adults in culvert. |
| 4/12/2020 | C6 | Summer | Opportunistic | Cane Toads (Rhinella marina) | Definite | Present | - | - | Within and around pooled water |
| 4/12/2020 | C6 | Summer | Opportunistic | Water Dragon (Intellagama lesueurii) | Definite | Present | West-east | Yes | - |



Appendix D

Restoration of Vegetation Connectivity Corridor Results

Table D1 Vegetation Quadrat Results for Year 3 Autumn, Year 4 Spring and Year 6 Spring Post Construction Monitoring

| TREES (T1) > 3m | | | Q1 | | | Q2 | | | Q3 | | | Q4 | | | Q5 | | | Q6 | | | Q7 | | | Q8 | | |
|---|------------------------|--------------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|
| Scientific name | Common name | Native/ Weed | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp |
| <i>Acacia concurrens</i> | Currahkah | Native | | | | | | | 3 | 2 | | | | | | | | | | | 1 | 1 | | | 1 | |
| <i>Allocasuarina littoralis</i> | Black Sheoak | Native | | | | 1 | 1 | | 1 | 1 | | 1 | 1 | | | | | | 1 | | 1 | 1 | | | | |
| <i>Banksia ericifolia subsp. ericifolia</i> | Heath-leaved Banksia | Native | | | | | | | | | | | | | | | | | | | | 1 | | | | |
| <i>Callistemon salignus</i> | Willow Bottlebrush | Native | | | | | | | | | | | | | | | | 1 | 1 | | | 1 | | | | |
| <i>Eucalyptus tereticornis</i> | Forest Red Gum | Native | 1 | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 2 | 1 | | | |
| <i>Lophostemon suaveolens</i> | Swamp Box | Native | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 5 | 2 | 2 | 4 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| <i>Melaleuca quinquenervia</i> | Broad-leaved Paperbark | Native | 5 | 5 | 6 | 3 | 3 | 3 | 1 | 1 | | 2 | 1 | 2 | | | | 2 | 2 | 1 | | | | 2 | 2 | 1 |
| <i>Melaleuca sieberi</i> | Sieber's Paperbark | Native | 1 | | | | | | | | | | | 1 | | | | | | | 1 | 1 | | | | |
| Number of native species | | | 4 | 2 | 2 | 4 | 4 | 3 | 5 | 5 | 2 | 4 | 4 | 4 | 2 | 2 | 2 | 4 | 5 | 3 | 5 | 7 | 2 | 2 | 3 | 2 |
| Number of exotic species | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Height (m) | | | 6 | 6 | 7 | 5 | 5 | 8 | 6 | 6 | 10 | 6 | 6 | 8 | 5 | 5 | 7 | 6 | 6 | 8 | 6 | 6 | 7 | 6 | 6 | 8 |
| Cover of native species* | | | 5 | 6 | 6 | 3 | 3 | 3 | 4 | 4 | 5 | 3 | 3 | 4 | 2 | 2 | 2 | 4 | 4 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| Cover of exotic species* | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Cover score

| Class | Percentage Cover |
|-------|------------------|
| 1 | <5% sparse |
| 2 | <5% common |
| 3 | 5-25% |
| 4 | 26-50% |
| 5 | 51-75% |
| 6 | 76-100% |

Table D1 Vegetation Quadrat Results for Year 3 Autumn, Year 4 Spring and Year 6 Spring Post Construction Monitoring

| SHRUBS (T2) < 3m | | | Q1 | | | Q2 | | | Q3 | | | Q4 | | | Q5 | | | Q6 | | | Q7 | | | Q8 | | |
|---|--------------------------|--------------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|
| Scientific name | Common name | Native/ Weed | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp |
| <i>Acacia concurrens</i> | Curracabah | Native | | | | | 1 | 1 | 3 | 2 | 2 | | | | | | | 1 | 1 | | 1 | 1 | 1 | | | 2 |
| <i>Acacia melanoxylon</i> | Blackwood | Native | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | |
| <i>Allocasuarina littoralis</i> | Black Sheoak | Native | 1 | | | 1 | 1 | | 1 | 1 | | 1 | 1 | | | | | 1 | 1 | | | | | | | |
| <i>Amyema congener</i> | Mistletoe | Native | | 1 | | | | | | | | | | | | | | | | | | | | 1 | 1 | |
| <i>Baccharis halimifolia</i> * | Groundsel Bush | Weed | 1 | | | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | | | | | | | | | | 1 | 1 | |
| <i>Banksia ericifolia</i> subsp. <i>ericifolia</i> | Heath-leaved Banksia | Native | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 1 | 1 | | | | | | | |
| <i>Banksia oblongifolia</i> | Swamp Banksia | Native | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | | 1 | 1 | | | | |
| <i>Callistemon pachyphyllus</i> | Wallum Bottlebrush | Native | | | | 1 | 1 | | 1 | 1 | | 1 | | | | | | 1 | 1 | | 1 | 1 | | | | |
| <i>Callistemon salignus</i> | Willow Bottlebrush | Native | | | | | | | | | | | | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | | | |
| <i>Cinnamomum camphora</i> * | Camphor Laurel | Weed | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| <i>Eucalyptus tereticornis</i> | Forest Red Gum | Native | | | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | | |
| <i>Glochidion ferdinandi</i> var. <i>ferdinandi</i> | Cheese Tree | Native | | | | | | | 1 | | | | | | | | | | | | | | | | | |
| <i>Leptospermum brachyandrum</i> | Teatree | Native | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | |
| <i>Lophostemon suaveolens</i> | Swamp Box | Native | 1 | 1 | 1 | 1 | 2 | 2 | 3 | 4 | 4 | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| <i>Melaleuca linariifolia</i> | Flax-leaved Paperbark | Native | | | | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | |
| <i>Melaleuca nodosa</i> | Prickly-leaved Paperbark | Native | 1 | 1 | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | | | 2 | 2 | 1 | | | |
| <i>Melaleuca quinquenervia</i> | Broad-leaved Paperbark | Native | 2 | 2 | | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | | 1 |
| <i>Melaleuca sieberi</i> | Sieber's Paperbark | Native | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | 1 | 1 | 1 | | | |
| <i>Melaleuca thymifolia</i> | Thyme Honey-myrtle | Native | | | 2 | | | | | | | | | | | | | | | | | | | | | |
| Number of native species | | | 7 | 7 | 5 | 10 | 11 | 7 | 11 | 11 | 7 | 9 | 8 | 4 | 5 | 5 | 4 | 11 | 10 | 4 | 10 | 10 | 6 | 4 | 3 | 3 |
| Number of exotic species | | | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| Height (m) | | | 2 | 2 | 1 | 3 | 3 | 2 | 4 | 4 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Cover of native species* | | | 3 | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 |
| Cover of exotic species* | | | 1 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |

*Cover score

| Class | Percentage Cover |
|-------|------------------|
| 1 | <5% sparse |
| 2 | <5% common |
| 3 | 5-25% |
| 4 | 26-50% |
| 5 | 51-75% |
| 6 | 76-100% |

| GROUNDCOVERS (G) | | | Q1 | | | Q2 | | | Q3 | | | Q4 | | | Q5 | | | Q6 | | | Q7 | | | Q8 | | |
|---|---------------------|--------------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|--------|---------|---------|
| Scientific name | Common name | Native/ Weed | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp | Yr 3 A | Yr 4 Sp | Yr 6 Sp |
| <i>Ageratina adenophora</i> * | Crofton Weed | Weed | 1 | 1 | | | | | | | | 2 | 1 | | | | | 1 | 1 | | | | | 1 | 1 | |
| <i>Ageratum houstonianum</i> * | Blue Billygoat Weed | Weed | 1 | 1 | 2 | 1 | 1 | 1 | | | | | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | 1 | | | 1 | 1 |
| <i>Alternanthera denticulata</i> | Lesser Joyweed | Native | | | 2 | | | | | 1 | | | | | | | | | | | | | | | | |
| <i>Alternanthera sp.</i> | Joyweed | ? | | 1 | | | 1 | | | | | | | | | | | | | | | | | | | |
| <i>Ambrosia artemisiifolia</i> * | Annual Ragweed | Weed | | | | | | | | | | | | | 1 | 1 | | | 1 | | | | | | | |
| <i>Andropogon virginicus</i> * | Whiskey Grass | Weed | 1 | | 3 | | | | | | | | | | | | | | | | | | | | | |
| <i>Aster subulatus</i> * | Wild Aster | Weed | | | 1 | | 1 | 1 | 1 | 1 | | 1 | 1 | | | | | 1 | | 1 | | | | | 1 | 1 |
| <i>Axonopus fissifolius</i> * | Carpet Grass | Weed | 1 | | | | | | 1 | | | 1 | | | | 1 | | | | 1 | | 2 | | | 2 | |
| <i>Bidens pilosa</i> * | Cobbler's Pegs | Weed | | | | | | 1 | | | | | | | | | | 1 | 1 | | | | | | 1 | |
| <i>Capillipedium spicigerum</i> | Scented-top Grass | Native | 2 | | | 2 | | | 2 | | | 2 | | | | | | | | 1 | | | | | | |
| <i>Carex gaudichaudiana</i> | | Native | | | | | | | | | 1 | | | | | | | | | | | | | | | |
| <i>Cenchrus clandestinus</i> * | Kikuyu | Weed | 3 | 3 | 1 | 2 | 2 | 2 | 1 | 2 | | 1 | 3 | | | | | | | 2 | 3 | | | 2 | 3 | 1 |
| <i>Centella asiatica</i> | Pennywort | Native | | 2 | 3 | 1 | 2 | 2 | | | 2 | 1 | 2 | 1 | | 1 | | | 1 | | 2 | 2 | | 2 | 2 | 2 |
| <i>Cheilanthes sieberi subsp. sieberi</i> | Mulga Fern | Native | | | | 1 | | | | | | | | | | | | | | | | | | | | |
| <i>Chorizandra cymbaria</i> | Bristle-sedge | Native | | 1 | 3 | | | 1 | | | | | | | | | | | | | | | | | | |
| <i>Conyza bonariensis</i> * | Fleabane | Weed | | | | | 1 | 1 | | | 1 | | | | | | | | | | | | | | 1 | |
| <i>Crassocephalum crepidioides</i> * | Thickhead | Weed | | | | 1 | | 1 | | | | 1 | | | | | | | | 1 | | | | | 1 | 1 |
| <i>Crotalaria lanceolata</i> * | Rattlepod | Weed | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| <i>Cuphea carthagenensis</i> * | Cuphea | Weed | 1 | 2 | 2 | | | | | | | | | 1 | | | | | | | | | | | | |
| <i>Cynodon dactylon</i> | Common Couch | Native | | | | | | 1 | | | | 1 | 1 | | | | 2 | | 1 | 2 | 2 | 3 | 2 | | 2 | |
| <i>Cyperus polystachyos</i> | Bunchy Sedge | Native | 1 | | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | | 1 | | | | 1 | | 1 | 1 | | | 2 | | |
| <i>Cyperus sesquiflorus</i> * | Globe Sedge | Weed | | | | | | 1 | | | 2 | | | | | | | | 1 | | | | | | | 1 |
| <i>Dianella caerulea</i> | Blue Flax lily | Native | | 1 | 1 | | 1 | 1 | | 1 | 1 | | | | | | | | | | | 1 | | | | |
| <i>Dichondra repens</i> | Kidney Weed | Native | | | | 1 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | | | | 1 | 1 | 1 | 2 | | | 2 | | | 1 |
| <i>Digitaria sanguinalis</i> * | Summer Grass | Weed | | | | | | | | | | 1 | | | 5 | | | | | | | | | | | |
| <i>Eclipta platyglossa</i> | Eclipta | Native | | | | | | 1 | | | 1 | | | | | | | 1 | | 1 | | | | | | |
| <i>Eleocharis philippinensis</i> | | Native | 1 | | | | | | | | | | | | | | | | | | | | | | | |

Table D2 Photo Point Results for Year 6 Spring Monitoring



Q1



Q2



Q3



Q4



Q5



Q6



Q7



Q8



Appendix E

Roadkill Monitoring Results

Table E1 Roadkill Monitoring Survey Dates and Results for Year 6 Post Construction Monitoring

| Season | Date | Survey No. | Species | Lane | Fauna Fencing Present | Comment | Approx. Age of Carcass | Easting | Northing |
|--------|------------|---------------|--------------------------|----------------------|-----------------------|--|------------------------|---------|----------|
| Winter | 9/07/2020 | Opportunistic | Dove | Northbound | Yes | - | 1 day | 524002 | 6765346 |
| Winter | 10/07/2020 | 1 | Northern Brown Bandicoot | Southbound | Yes | - | < 1 week | 524144 | 6765552 |
| Winter | 15/07/2020 | 2 | - | - | - | Nil roadkill detected | - | | |
| Winter | 12/08/2020 | 3 | Unidentifiable Bird | Southbound | Yes | - | 1 week | 524319 | 6765870 |
| Winter | 20/08/2020 | 4 | Unidentifiable Bird | Northbound | Yes | - | < 1 week | 521090 | 6761313 |
| Winter | 26/08/2020 | Opportunistic | Greater Glider | Northbound | Yes | In winter 2020, only one lane per lane was open | 2 days | 522022 | 6762587 |
| Spring | 18/09/2020 | 1 | Short-beaked Echidna | Northbound | Yes | Fencing on western side but not at median | 1 day | 523183 | 6764024 |
| Spring | 2/10/2020 | 2 | Lace Monitor | Northbound | Yes | Fencing not likely to be a barrier to Lace Monitor | 1 week | 523564 | 6764788 |
| Spring | 8/10/2020 | 3 | - | - | - | Nil roadkill detected | - | | |
| Spring | 22/10/2020 | 4 | - | - | - | Nil roadkill detected | - | | |
| Spring | 12/11/2020 | Opportunistic | Little Red Flying-fox | Bundjalung Rest Area | No | - | 1 day | 522508 | 6763137 |
| Summer | 1/12/2020 | 1 | Koala | Northbound | Yes | - | 1 week | 522129 | 6762673 |
| Summer | 1/12/2020 | 1 | Little Red Flying-fox | Northbound | Yes | At Bundjalung Rest Area exit | 3 days | 522287 | 6762792 |
| Summer | 1/12/2020 | 1 | Red-necked Wallaby | Bundjalung Rest Area | No | - | 1 week | 522625 | 6763490 |
| Summer | 1/12/2020 | 1 | Unidentifiable Bird | Southbound | Yes | - | 1 week | 524019 | 6765336 |
| Summer | 1/12/2020 | 1 | Unidentifiable Bird | Southbound | Yes | Medium sized bird | < 1 week | 521266 | 6761610 |
| Summer | 20/01/2021 | 2 | Cane Toad | Northbound | Yes | - | < 1 week | 521305 | 6761822 |
| Summer | 20/01/2021 | 2 | Kookaburra | Southbound | Yes | - | 1-2 weeks | 524133 | 6765524 |
| Summer | 20/01/2021 | 2 | Little Red Flying-fox | Northbound | Yes | - | 1-2 weeks | 521171 | 6761449 |
| Summer | 20/01/2021 | 2 | Unidentifiable Bird | Southbound | Yes | - | 1 day | 523049 | 6763651 |
| Summer | 20/01/2021 | 2 | Cane Toad | Northbound | Yes | - | 1 week | 521686 | 6762321 |
| Summer | 4/02/2021 | 3 | Magpie | Southbound | Yes | - | 1 week | 523002 | 6763561 |
| Summer | 15/02/2021 | 4 | Carpet Python | Southbound | Yes | - | 1 week | 522885 | 6763363 |
| Summer | 15/02/2021 | 4 | Cane Toad | Northbound | Yes | - | < 1 week | 521681 | 6762172 |
| Summer | 15/02/2021 | 4 | Crow | Northbound | Yes | - | 2 days | 524176 | 6765668 |
| Summer | 15/02/2021 | 4 | Carpet Python | Northbound | Yes | - | < 1 week | 522530 | 6763000 |



Appendix F

Rufous Bettong/ Brush-tailed Phascogale Camera Trap Results

Table F1

Year 3 Rufous Bettong and Brush-tailed Phascogale Camera Trap Results - Number of Traps that Recorded Each Species at Each Site per Season

| | Impact Site 1 (west) | | | Impact Site 1 (east) | | | Impact Site 2 (west) | | | Impact Site 2 (east) | | | Impact Site 3 (west) | | | Impact Site 3 (east) | | | Impact Site 4 (west) | | | Impact Site 4 (east) | | | Impact Site 5 (west) | | | Impact Site 5 (east) | | | Control Site 1 | | | Control Site 2 | | | Control Site 3 | | | Control Site 4 | | | Control Site 5 | | | Total No. of Sites/Species | | | |
|--------------------------|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------------|----|----|----------------|----|----|----------------|----|----|----------------|----|----|----------------|----|----|----------------|---------|-------|----------------------------|----|----|---|
| | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | Impact | Control | Total | | | | |
| Antechinus sp. | 2 | | 3 | 1 | 1 | 1 | 3 | 1 | 2 | 5 | | | 3 | 2 | 1 | 3 | 2 | | 3 | 2 | 1 | 1 | | | 4 | 2 | 2 | 2 | 1 | 1 | 2 | | | 2 | | | 1 | | 2 | | | | 10 | 4 | 14 | | | | |
| Bandicoot | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | 1 | | | | | | 2 | 1 | 3 | | | | |
| Black Rat | 1 | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | 1 | 4 | | | |
| Brown Antechinus | | | 1 | | | | | | | | | | | | | | | | 1 | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | 4 | 0 | 4 | | | |
| Brush-tailed Phascogale | 1 | | 1 | | 2 | | 2 | 3 | | | | | | | 3 | | | | | | | | | | 5 | | 1 | 2 | | | | | | | 2 | | 1 | 1 | 3 | | | | 6 | 2 | 8 | | | | |
| Bush Rat | 4 | 4 | 4 | 4 | 4 | 6 | 3 | 4 | 2 | 5 | 6 | 1 | 4 | 5 | | 5 | 4 | 1 | | 1 | 2 | 3 | 2 | 1 | 4 | 6 | 6 | 5 | | 6 | 5 | 3 | 4 | 2 | 1 | 4 | 1 | 1 | 5 | 4 | 3 | 6 | 6 | 1 | 10 | 5 | 15 | | |
| Common Brushtail Possum | 3 | 1 | 2 | 3 | 5 | 2 | 3 | 5 | 3 | | | 1 | 2 | | | | | | 5 | 4 | 2 | | | | 1 | | | | 1 | 1 | | | | 1 | | | 2 | 1 | 1 | | 1 | | | 7 | 4 | 11 | | | |
| Common Ringtail Possum | 1 | | | | | | | | | | | 1 | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | 3 | 0 | 3 | | |
| Dingo / Wild Dog | | | | 1 | 1 | 2 | 1 | | | | | | 1 | | 1 | | | 1 | | | 1 | 1 | | | | | | | | | | | | | 1 | | 1 | | | | | | | 6 | 3 | 9 | | | |
| Eastern Grey Kangaroo | 1 | 1 | | | 1 | 2 | | | | | | | 1 | | | | | | 2 | | 1 | | 1 | 1 | | 2 | 3 | 1 | 2 | 2 | 1 | | | | 2 | | 1 | | | 1 | | | 6 | 4 | 10 | | | | |
| Fawn-footed Melomys | | | | | | 2 | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 2 | 4 | | | |
| Feral Cat | | | | | | | | | | | | | | | | | | | 1 | | | | | | 2 | | | | | | | | | | | | | | | | | | | 2 | 0 | 2 | | | |
| Feral Cat or Dog | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 0 | 1 | | |
| House Mouse | 1 | | 1 | | | | 1 | | 1 | 2 | | 2 | | | | | | | | | | | | | | 2 | | 2 | | | | | | | | | | | | | | | | | 5 | 0 | 5 | | |
| Koala | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 2 | 3 | | |
| Long-nosed Bandicoot | 4 | 1 | 5 | 3 | 4 | 3 | | 1 | 4 | 4 | 1 | 1 | 1 | | 2 | 4 | 1 | | 1 | 2 | 1 | 3 | 2 | 1 | 5 | 4 | 1 | 4 | | 5 | 2 | 1 | 2 | | 2 | 1 | 2 | | 4 | 1 | 5 | 6 | | | 10 | 5 | 15 | | |
| Long-nosed Potoroo | | | | | | | | | | | | | | | | | | | 4 | 5 | 3 | 2 | 1 | | | | | | 1 | | 2 | | | | | | | | | | | | | | 2 | 3 | 5 | | |
| Macropod sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | 1 | 1 | |
| Native Mouse | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 0 | 2 | | |
| Northern Brown Bandicoot | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 3 | 1 | 6 | 4 | 1 | 4 | 3 | 1 | 3 | 3 | 3 | 4 | 2 | 3 | 1 | 1 | 5 | 3 | | 1 | 2 | 1 | 3 | 5 | 1 | 2 | 3 | 2 | 2 | | | 2 | 1 | 10 | 5 | 15 | | | |
| Red-necked Pademelon | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 5 | 3 | | | 1 | 2 | | 1 | | 1 | | | | 3 | 2 | | 4 | 2 | 1 | 1 | 4 | 5 |
| Red-necked Wallaby | | | 1 | 1 | | | 1 | | | | | | | | | 1 | | | | | | | | 1 | | 1 | 3 | | | 2 | | | | | | | | | | | 1 | 1 | 1 | 7 | 3 | 10 | | | |
| Rodent | 1 | | | 1 | | | 1 | | 2 | | | | | | | | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | 6 | 0 | 6 | | |
| Short-beaked Echidna | 1 | | | | 1 | | 3 | 3 | 5 | 3 | 1 | | 1 | | 2 | 2 | 2 | 1 | 3 | | 1 | 1 | | 1 | | 3 | 1 | 1 | | 3 | | 2 | | 1 | 2 | 1 | 4 | | | 1 | 2 | 1 | 10 | 5 | 15 | | | | |
| Short-eared Possum | | | 3 | 1 | 1 | 2 | | | | | 1 | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 5 | 2 | 7 | | |
| Swamp Rat | | | | | | | | | | | | 1 | 1 | | | | | | | | | | 2 | | | | | | | | | | | | | | | | | | | | | | 2 | 1 | 3 | | |
| Swamp Wallaby | 4 | 4 | 1 | 5 | 6 | 5 | 4 | 4 | 4 | 4 | 4 | 1 | 2 | 3 | 1 | 2 | 4 | 1 | 3 | 4 | 3 | 4 | 3 | 2 | | 5 | 3 | 1 | 1 | | 3 | 4 | 2 | 3 | 4 | 4 | 5 | 3 | | 2 | 2 | | 4 | 3 | | 10 | 5 | 15 | |
| Wild Dog | | | | | | | | | | | | | | | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 0 | 1 | | |
| Yellow-footed Antechinus | 1 | 4 | 1 | 1 | 5 | 3 | | | | 2 | 6 | | 5 | 1 | | 5 | 1 | 1 | | 1 | 3 | 5 | | 1 | | 5 | 1 | 3 | 2 | | 5 | 4 | | 4 | 4 | 1 | 3 | 5 | 2 | 1 | 1 | | 3 | 1 | | 9 | 5 | 14 | |
| No. Species/Site | 14 | 7 | 12 | 12 | 12 | 10 | 10 | 9 | 9 | 10 | 7 | 6 | 11 | 10 | 7 | 9 | 9 | 6 | 9 | 11 | 10 | 10 | 9 | 7 | 11 | 12 | 8 | 12 | 10 | 5 | 9 | 11 | 7 | 9 | 5 | 9 | 8 | 8 | 4 | 13 | 10 | 8 | 10 | 12 | 7 | | | | |
| W = Winter | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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W = Winter

Sp = Spring

Su = Summer

Table F1

Year 4 Rufous Bettong and Brush-tailed Phascogale Camera Trap Results - Number of Traps that Recorded Each Species at Each Site per Season

| | Impact Site 1 (wes) | | | Impact Site 1 (east) | | | Impact Site 2 (west) | | | Impact Site 2 (east) | | | Impact Site 3 (west) | | | Impact Site 3 (east) | | | Impact Site 4 (west) | | | Impact Site 4 (east) | | | Impact Site 5 (wes) | | | Impact Site 5 (east) | | | Control Site 1 | | | Control Site 2 | | | Control Site 3 | | | Control Site 4 | | | Control Site 5 | | | Total No. of Sites/Species | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | W | Sp | Su | Impact | Control | Total | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Antechinus sp. | | 3 | | | 3 | 4 | | 1 | | 2 | | 5 | | 1 | | 2 | | 1 | | 2 | | 1 | | 4 | | 4 | | 3 | | 6 | | 4 | | 2 | | 1 | | 2 | | 1 | | 1 | | 4 | | 5 | | 2 | | 4 | | 2 | | 1 | | | 3 | | 3 | | 5 | | 3 | | 4 | | 10 | | 5 | | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bandicoot sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 4 | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Black Rat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 4 | | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brown Hare | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brush-tailed Phascogale | | 2 | | | 2 | 2 | | 1 | | 1 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 5 | | 2 | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bush Rat | | 6 | | | 6 | 6 | | 4 | | 4 | | 6 | | 4 | | 5 | | 4 | | 5 | | 6 | | 3 | | 5 | | 6 | | 4 | | 5 | | 1 | | 2 | | 3 | | 3 | | 2 | | 4 | | 5 | | 1 | | 2 | | 5 | | 1 | | 5 | | 4 | | | 4 | | | 2 | | 1 | | | 3 | | 6 | | 6 | | 6 | | 10 | | 5 | | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Common Brushtail Possum | | 3 | | | 3 | 4 | | 2 | | 1 | | 6 | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6 | | 3 | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Common Dunnart | | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 0 | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Common Ringtail Possum | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 1 | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dingo / Wild Dog / Cat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 3 | | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dusky Antechinus | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 0 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Eastern Grey Kangaroo | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7 | | 2 | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Fawn-footed Melomys | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 2 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Feathertail Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 0 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Feral Cat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2 | | 1 | | 3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| House Mouse | | 1 | | | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 6 | | 2 | | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Koala | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 1 | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Long-nosed Bandicoot | | 6 | | | 4 | 4 | | 2 | | 2 | | 1 | | 2 | | 5 | | 2 | | 1 | | 3 | | | 3 | | 4 | | 2 | | 4 | | 3 | | 2 | | 1 | | 3 | | 1 | | 1 | | | | | | | | | | | | | 10 | | 5 | | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Long-nosed Potoroo | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 3 | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Macropod sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7 | | 2 | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Northern Brown Bandicoot | | 3 | | | 4 | 5 | | 4 | | 2 | | 6 | | 4 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10 | | 5 | | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Petaurus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 0 | | 1 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Possible Native Mouse | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 1 | | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Red-necked Pademelon | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 4 | | 8 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Red-necked Wallaby | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 2 | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rodent sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 7 | | 4 | | 11 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Short-beaked Echidna | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 10 | | 5 | | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Short-eared Brushtail Possum | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | 5 | | 1 | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Squirrel Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 0 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Swamp Rat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | | 1 | | 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Swamp Wallaby | | 5 | | | 4 | 2 | | 3 | | 4 | | 4 | | 4 | | 2 | | 3 | | 1 | | 4 | | 3 | | 3 | | 4 | | 4 | | 6 | | 3 | | 5 | | 4 | | 3 | | | | | | | | | | | | | | | | 10 | | 5 | | 15 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Rat | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | 0 | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Yellow-footed Antechinus | | 5 | | | 1 | 1 | | 3 | | 3 | | 1 | | 4 | | 5 | | 4 | | 1 | | 5 | | 2 | | 2 | | 1 | | 4 | | 3 | | 3 | | 3 | | 3 | | 1 | | | | | | | | | | | | | | | | 9 | | 5 | | 14 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| No. Species/Site | | 12 | | 13 | | 10 | | 14 | | 15 | | 10 | | 11 | | 13 | | 12 | | 8 | | 12 | | 8 | | 13 | | 10 | | 10 | | 10 | | 9 | | 10 | | 13 | | 11 | | 8 | | 13 | | 9 | | 10 | | 7 | | 9 | | 12 | | 11 | | 13 | | 16 | | 10 | | 12 | | 8 | | 7 | | 12 | | 7 | | 12 | | 10 | | 9 | | 9 | | 13 | | 9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mean | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

W = Winter
 Sp = Spring
 Su = Summer

Year 6 Rufous Bettong and Brush-tailed Phascogale Camera Trap Results - Number of Traps that Recorded Each Species at Each Site per Season

W = Winter
Sp = Spring
Su = Summer



Appendix G

Spotlighting and Call Playback Results

Table G1

Spotlighting and Call Playback Results for Year 6 Post Construction Monitoring - Impact Sites

| | Impact Site 1 (west) | | | | Impact Site 1 (east) | | | | Impact Site 2 (west) | | | | Impact Site 2 (median) | | | | Impact Site 2 (east) | | | | Impact Site 3 (west) | | | | Impact Site 3 (east) | | | | Impact Site 4 (median) | | | | Impact Site 4 (east) | | | | Impact Site 5 (west) | | | | Impact Site 5 (east) | | | | Impact Site 6 (west) | | | |
|------------------------------|-------------------------|----------|----------|----------|-------------------------|----------|----------|----------|-------------------------|----------|----------|-----------|---------------------------|----------|----------|----------|-------------------------|----------|----------|----------|-------------------------|----------|----------|----------|-------------------------|----------|----------|----------|---------------------------|----------|----------|----------|-------------------------|----------|----------|-----------|-------------------------|----------|----------|----------|-------------------------|----------|----------|----------|-------------------------|----------|----------|----------|
| Species | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T |
| Bandicoot sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Brush-tail Possum | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Feathertail Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Greater Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Long-nosed Bandicoot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Macropod sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Masked Owl | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Northern Bandicoot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Powerful Owl | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Red-necked Wallaby | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Short-eared Brushtail Possum | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Squirrel Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sugar Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Yellow-bellied Glider | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Petaurus sp. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grand Total | 1 | 0 | 2 | 3 | 2 | 1 | 1 | 4 | 2 | 7 | 4 | 13 | 1 | 1 | 3 | 5 | 2 | 3 | 1 | 6 | 0 | 1 | 4 | 5 | 2 | 1 | 0 | 3 | 1 | 1 | 6 | 8 | 2 | 6 | 3 | 11 | 0 | 4 | 0 | 4 | 1 | 2 | 1 | 4 | 1 | 1 | 0 | 2 |
| No. Species/ Site | 1 | 0 | 2 | 2 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 4 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 4 | 0 | 1 | 4 | 5 | 2 | 1 | 0 | 3 | 1 | 1 | 4 | 5 | 1 | 4 | 2 | 4 | 0 | 2 | 0 | 2 | 1 | 2 | 1 | 4 | 1 | 1 | 0 | 2 |

W = Winter

Sp = Spring

Su = Summer

T = Total

Table G1

Spotlighting and Call Playback Results for Year 6 Post Construction Monitoring - Control Sites and Combined Impact and Control Sites Total

| | Control site 1 | | | | Control site 2 | | | | Control site 3 | | | | Control site 4 | | | | Control site 5 | | | | Control site 6 | | | | Grand Total | No. of Sites/ Species |
|------------------------------|----------------|----------|----------|----------|----------------|----------|----------|----------|----------------|----------|----------|----------|----------------|----------|----------|-----------|----------------|----------|----------|----------|----------------|----------|----------|----------|-------------|--------------------------|
| Species | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | W | Sp | Su | T | | |
| Bandicoot sp. | 1 | | | 1 | 1 | | | 1 | | | | | | | | | | | | | | | | | 4 | 4 |
| Brush-tail Possum | | 1 | | 1 | | | | | | 1 | | 1 | | 1 | | 1 | | | | | | | 1 | 1 | 8 | 7 |
| Feathertail Glider | | | | | | | 1 | 1 | | | | | | | | | | | | | | | | | 5 | 5 |
| Greater Glider | | | | | 1 | | | 1 | | | | | | | 2 | 2 | | | | | | | | | 20 | 7 |
| Long-nosed Bandicoot | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| Macropod sp. | | | | | | | | | | | | | | | | | | | | | | | | | 2 | 1 |
| Masked Owl | | | | | | 1 | | 1 | | 1 | | 1 | | | | | | | | | | | | | 3 | 3 |
| Northern Bandicoot | | | | | | 1 | | 1 | | | | | | | | | | | | | | | | | 1 | 1 |
| Powerful Owl | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| Red-necked Wallaby | | | | | | | | | | | | | | | | | | | | | | | | | 3 | 1 |
| Short-eared Brushtail Possum | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 |
| Squirrel Glider | | | | | | | 1 | 1 | | 1 | | 1 | 1 | | 1 | | | | | | | | | | 17 | 11 |
| Sugar Glider | | | | | | 2 | | 2 | | | | | | | | | | 2 | | 2 | | | 1 | 1 | 16 | 10 |
| Yellow-bellied Glider | | | 1 | 1 | 1 | | | 1 | | | | | 2 | 3 | | 5 | 1 | | 1 | | | | | | 14 | 7 |
| Petaurus sp. | | | | | | | | | | | | | 1 | | 1 | | | | | | | | 1 | 1 | 3 | 3 |
| Grand Total | 1 | 1 | 1 | 3 | 3 | 4 | 2 | 9 | 0 | 3 | 0 | 3 | 3 | 5 | 2 | 10 | 1 | 2 | 0 | 3 | 0 | 0 | 3 | 3 | 99 | |
| No. Species/ Site | 1 | 1 | 1 | 3 | 3 | 3 | 2 | 8 | 0 | 3 | 0 | 3 | 2 | 3 | 1 | 5 | 1 | 1 | 0 | 2 | 0 | 0 | 3 | 3 | | |
| Mean | | | | | | | | | | | | | | | | | | | | | | | | | 6.6 | 4.2 |
| SD | | | | | | | | | | | | | | | | | | | | | | | | | 6.70 | 3.47 |

W = Winter
 Sp = Spring
 Su = Summer
 T = Total

Table G2 Spotlighting and Call Playback Results

| Site | Date | Season | No. Animals | Sex | Age Class | No. of Dependant young | Species | Behaviour | Comments | Easting | Northing |
|------------------------|------------|--------|-------------|---------|-----------|------------------------|------------------------------|--|--|---------|----------|
| Impact Site 1 (west) | 20/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Calling independent of call playback | No visual | 521219 | 6761812 |
| Impact Site 1 (west) | 12/01/2021 | Summer | 1 | Unknown | Unknown | 0 | Squirrel Glider | Very fast, in lower canopy on branch of Forest Red Gum | - | 521192 | 6761665 |
| Impact Site 1 (west) | 20/01/2021 | Summer | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | At least one calling independent of call playback | 50m to west, no visual | 521155 | 6761762 |
| Impact Site 1 (east) | 14/07/2020 | Winter | 1 | Unknown | Unknown | 0 | Squirrel Glider | In canopy of Pink Bloodwood | Probable ID. Partial visual | 520990 | 6761092 |
| Impact Site 1 (east) | 20/08/2020 | Winter | 1 | Unknown | Adult | 0 | Squirrel Glider | Perched on Small-Fruited Grey Gum limb | Probable ID. | 520947 | 6761015 |
| Impact Site 1 (east) | 15/10/2020 | Spring | 1 | Unknown | Adult | 0 | Short-eared Brushtail Possum | In canopy of Forest Red Gum | - | 521052 | 6761309 |
| Impact Site 1 (east) | 11/02/2021 | Summer | 1 | Unknown | Adult | 0 | Squirrel Glider | In fork of Forest Red Gum | Probable ID. Partial visual | 521044 | 6761296 |
| Impact Site 2 (west) | 14/07/2020 | Winter | 1 | Unknown | Adult | 0 | Greater Glider | Perched in top of Small-Fruited Grey Gum | - | 521647 | 6762370 |
| Impact Site 2 (west) | 12/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Squirrel Glider | Calling, glided from Small-Fruited Grey Gum to west | - | 521354 | 6761989 |
| Impact Site 2 (west) | 15/10/2020 | Spring | 1 | Unknown | Adult | 0 | Greater Glider | In canopy of Spotted Gum | - | 521326 | 6761938 |
| Impact Site 2 (west) | 15/10/2020 | Spring | 1 | Unknown | Adult | 0 | Greater Glider | Perched in top of canopy of Northern Grey Ironbark | - | 521614 | 6762337 |
| Impact Site 2 (west) | 15/10/2020 | Spring | 1 | Unknown | Unknown | 0 | Greater Glider | In canopy of Spotted Gum | - | 521687 | 6762402 |
| Impact Site 2 (west) | 23/10/2020 | Spring | 1 | Unknown | Adult | 0 | Greater Glider | Top of canopy of Small-Fruited Grey Gum | - | 521625 | 6762354 |
| Impact Site 2 (west) | 19/11/2020 | Spring | 1 | Unknown | Adult | 0 | Brushtail Possum | Resting in canopy of large Forest Red Gum | Probable ID. High up and obscured by foliage | 521422 | 6762117 |
| Impact Site 2 (west) | 19/11/2020 | Spring | 1 | Unknown | Adult | 0 | Greater Glider | Resting in canopy of Spotted Gum | - | 521668 | 6762381 |
| Impact Site 2 (west) | 19/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Sugar Glider | Resting high in canopy of Spotted Gum | Probable ID, based on thin tail and profile | 521668 | 6762400 |
| Impact Site 2 (west) | 12/01/2021 | Summer | 1 | Unknown | Unknown | 0 | Sugar Glider | Sat still for several minutes, on limb of Forest Red Gum with many hollows | - | 521474 | 6762208 |
| Impact Site 2 (west) | 12/01/2021 | Summer | 1 | Unknown | Unknown | 0 | Brushtail Possum | Sat still for long time. | Very high in canopy | 521457 | 6762140 |
| Impact Site 2 (west) | 20/01/2021 | Summer | 1 | Unknown | Adult | 0 | Greater Glider | Perched high in canopy in foliage | - | 521516 | 6762181 |
| Impact Site 2 (west) | 20/01/2021 | Summer | 1 | Unknown | Adult | 0 | Greater Glider | Perched up in tree limbs | - | 521582 | 6762332 |
| Impact Site 2 (median) | 20/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Squirrel Glider | On Blackbutt trunk. Still on detection | - | 521817 | 6762415 |
| Impact Site 2 (median) | 13/10/2020 | Spring | 1 | Female | Adult | 0 | Squirrel Glider | Moving through Acacia sp. understorey | - | 521322 | 6761777 |
| Impact Site 2 (median) | 12/01/2021 | Summer | 1 | Unknown | Adult | 0 | Feathertail Glider | Moving through canopy | - | 521806 | 6762333 |
| Impact Site 2 (median) | 4/02/2021 | Summer | 1 | Male | Subadult | 0 | Sugar Glider | Foraging for invertebrates on stingybark | - | 521637 | 6762163 |
| Impact Site 2 (median) | 11/02/2021 | Summer | 1 | Unknown | Adult | 0 | Sugar Glider | Perched in fork, high in canary of Small-Fruited Grey Gum | - | 521534 | 6762059 |
| Impact Site 2 (east) | 18/08/2020 | Winter | 1 | Unknown | Adult | 0 | Squirrel Glider | Foraging on honeydew on trunk of Spotted Gum | - | 521553 | 6761946 |
| Impact Site 2 (east) | 20/08/2020 | Winter | 1 | Unknown | Adult | 0 | Powerful Owl | Roosting in Spotted Gum | Spotlight result. No call | 521701 | 6761993 |
| Impact Site 2 (east) | 13/10/2020 | Spring | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Calling in response to call-playback | No visual | 521717 | 6762139 |
| Impact Site 2 (east) | 23/10/2020 | Spring | 1 | Unknown | Adult | 0 | Yellow-bellied Glider | Calling in response to call-playback | - | 521634 | 6762049 |
| Impact Site 2 (east) | 12/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Bandicoot sp. | Calling | - | 521740 | 6762057 |
| Impact Site 2 (east) | 4/02/2021 | Summer | 1 | Unknown | Adult | 0 | Yellow-bellied Glider | Calling in response to call-playback | - | 521635 | 6761943 |
| Impact Site 3 (west) | 9/11/2020 | Spring | 1 | Male | Adult | 0 | Yellow-bellied Glider | Calling in response to call-playback | Heard twice far in the distance to the east | 523038 | 6764006 |
| Impact Site 3 (west) | 4/02/2021 | Summer | 1 | Unknown | Adult | 0 | Long-nosed Bandicoot | Foraging | - | 522789 | 6763795 |
| Impact Site 3 (west) | 4/02/2021 | Summer | 1 | Unknown | Adult | 0 | Sugar Glider | Foraging | - | 522762 | 6763774 |
| Impact Site 3 (west) | 11/02/2021 | Summer | 1 | Unknown | Adult | 0 | Greater Glider | Perched in branch high in Blackbutt. | - | 522861 | 6763873 |
| Impact Site 3 (west) | 22/02/2021 | Summer | 1 | Unknown | Adult | 0 | Squirrel Glider | Foraging in flowering Pink Bloodwood | Probable ID | 522823 | 6763824 |
| Impact Site 3 (east) | 12/08/2020 | Winter | 1 | Unknown | Adult | 0 | Squirrel Glider | Foraging | - | 522719 | 6763040 |
| Impact Site 3 (east) | 18/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Petaurus sp. | Gliding, observed mid air | Sugar or Squirrel Glider, partial visual | 522947 | 6763367 |
| Impact Site 3 (east) | 12/11/2020 | Spring | 1 | Unknown | Adult | 0 | Masked Owl | Calling, first distant then close. One call from near rope bridge | Not observed | 522762 | 6763137 |
| Impact Site 4 (median) | 13/08/2020 | Winter | 1 | Unknown | Adult | 0 | Squirrel Glider | Perched in top of Spotted Gum | - | 521621 | 6762206 |
| Impact Site 4 (median) | 12/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Bandicoot sp. | Fled in long grass | - | 523746 | 6764883 |
| Impact Site 4 (median) | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Feathertail Glider | Gliding and landing on flowering <i>Angophora woodsiana</i> | - | 523488 | 6764603 |
| Impact Site 4 (median) | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Sugar Glider | Moving along trunk of flowering Pink Bloodwood | - | 523570 | 6764588 |
| Impact Site 4 (median) | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Sugar Glider | Foraging in <i>Angophora woodsiana</i> | - | 523439 | 6764376 |
| Impact Site 4 (median) | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Squirrel Glider | Grooming in Blackbutt | - | 523492 | 6764449 |
| Impact Site 4 (median) | 4/02/2021 | Summer | 1 | Unknown | Adult | 0 | Brushtail Possum | Foraging in top canopy of Blackbutt | - | 523721 | 6764872 |
| Impact Site 4 (median) | 8/02/2021 | Summer | 1 | Unknown | Adult | 0 | Squirrel Glider | Climbing down trunk of Small-Fruited Grey Gum. | - | 523547 | 6764584 |
| Impact Site 4 (east) | 9/08/2020 | Winter | 1 | Unknown | Adult | 0 | Greater Glider | Perched in horizontal branch of Tindal's Stringybark | - | 523925 | 6764358 |

| | | | | | | | | | | | |
|----------------------|------------|--------|---|---------|----------|---|-----------------------|--|---|--------|---------|
| Impact Site 4 (east) | 18/08/2020 | Winter | 1 | Unknown | Adult | 0 | Greater Glider | Climbed up tree, remained in fork. | - | 523926 | 6764284 |
| Impact Site 4 (east) | 13/10/2020 | Spring | 1 | Unknown | Adult | 0 | Squirrel Glider | Perched in canopy of Tindal's Stringybark | - | 523984 | 6764292 |
| Impact Site 4 (east) | 9/11/2020 | Spring | 1 | Unknown | Adult | 0 | Sugar Glider | Climbing and foraging. | - | 524042 | 6764325 |
| Impact Site 4 (east) | 9/11/2020 | Spring | 2 | Unknown | Unknown | 0 | Macropod sp. | Disturbed, fled into bush | - | 524027 | 6764258 |
| Impact Site 4 (east) | 9/11/2020 | Spring | 1 | Unknown | Adult | 0 | Greater Glider | Perched in large Blackbutt | - | 523735 | 6764290 |
| Impact Site 4 (east) | 12/11/2020 | Spring | 1 | Unknown | Adult | 0 | Greater Glider | Perched on limb of large tree. | - | 523856 | 6764358 |
| Impact Site 4 (east) | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Sugar Glider | Perched high in canopy. | Probable ID | 524007 | 6764325 |
| Impact Site 4 (east) | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Greater Glider | Perched in canopy of <i>Angophora woodsiana</i> | - | 523585 | 6764347 |
| Impact Site 4 (east) | 4/02/2021 | Summer | 1 | Unknown | Adult | 0 | Greater Glider | Perched in top branches of White Mahogany | - | 523917 | 6764327 |
| Impact Site 5 (west) | 19/11/2020 | Spring | 1 | Unknown | Adult | 0 | Sugar Glider | Foraging in canopy | Probable ID | 524017 | 6766196 |
| Impact Site 5 (west) | 19/11/2020 | Spring | 3 | Male | Adult | 0 | Red-necked Wallaby | Two males fighting, one additional wallaby | - | 524363 | 6766174 |
| Impact Site 5 (east) | 18/08/2020 | Winter | 1 | Unknown | Adult | 0 | Sugar Glider | Foraging along limbs of Corymbia sp. | - | 524830 | 6766251 |
| Impact Site 5 (east) | 22/10/2020 | Spring | 1 | Unknown | Adult | 0 | Brushtail Possum | Perched in tree branch | - | 524713 | 6766279 |
| Impact Site 5 (east) | 10/11/2020 | Spring | 1 | Unknown | Subadult | 0 | Greater Glider | Perched mid-canopy in Swamp Box | - | 524819 | 6766163 |
| Impact Site 5 (east) | 20/01/2021 | Summer | 1 | Unknown | Unknown | 0 | Feathertail Glider | Gliding between trees | - | 524683 | 6766275 |
| Impact Site 6 (west) | 15/07/2020 | Winter | 1 | Unknown | Adult | 0 | Greater Glider | Perched mid-canopy in BlackButt | - | 524557 | 6766628 |
| Impact Site 6 (west) | 19/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Feathertail Glider | Glided away when disturbed | - | 524480 | 6766419 |
| Control site 1 | 12/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Bandicoot sp. | Calling | No visual | 522493 | 6761994 |
| Control site 1 | 13/10/2020 | Spring | 1 | Unknown | Adult | 0 | Brushtail Possum | In branch of Spotted Gum | - | 522612 | 6762007 |
| Control site 1 | 14/01/2021 | Summer | 1 | Unknown | Adult | 0 | Yellow-bellied Glider | Calling independent of call playback | - | 522439 | 6762095 |
| Control site 2 | 12/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Call heard in response to call playback | Call 100m north of transect | 523640 | 6762904 |
| Control site 2 | 12/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Bandicoot sp. | Calling | - | 523774 | 6762894 |
| Control site 2 | 18/08/2020 | Winter | 1 | Unknown | Adult | 0 | Greater Glider | Perched in Blackbutt | - | 523237 | 6762765 |
| Control site 2 | 23/10/2020 | Spring | 1 | Unknown | Unknown | 0 | Sugar Glider | Calling | Not observed | 523651 | 6762777 |
| Control site 2 | 9/11/2020 | Spring | 1 | Unknown | Adult | 0 | Sugar Glider | Self-grooming in fork of tree | - | 523812 | 6762894 |
| Control site 2 | 9/11/2020 | Spring | 1 | Unknown | Adult | 0 | Masked Owl | Calling twice, briefly and relatively quietly | Probable ID | 523501 | 6762851 |
| Control site 2 | 12/11/2020 | Spring | 1 | Unknown | Subadult | 0 | Northern Bandicoot | Running across track | - | 523325 | 6762788 |
| Control site 2 | 20/01/2021 | Summer | 1 | Unknown | Unknown | 0 | Feathertail Glider | Foraging in flowering Pink Bloodwood | - | 523199 | 6762769 |
| Control site 2 | 4/02/2021 | Summer | 1 | Unknown | Subadult | 0 | Squirrel Glider | Feeding | - | 523294 | 6762813 |
| Control site 3 | 13/10/2020 | Spring | 1 | Unknown | Unknown | 0 | Squirrel Glider | Foraging near flowering Melaleuca sieberi | Probable ID, glimpse of bushy tail, brief eye shine. Obscured by epicormic growth. Partial visual | 524321 | 6764071 |
| Control site 3 | 9/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Brushtail Possum | Calling | Possible ID, calling to NE. No visual | 524620 | 6764040 |
| Control site 3 | 9/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Masked Owl | Calling | Possible ID, calling to south | 524169 | 6764121 |
| Control site 4 | 14/07/2020 | Winter | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Calling | - | 521067 | 6763344 |
| Control site 4 | 13/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Squirrel Glider | In canopy of Spotted Gum | Possible ID, not clearly observed | 521098 | 6763111 |
| Control site 4 | 13/08/2020 | Winter | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Calling independent of call playback | - | 520964 | 6763124 |
| Control site 4 | 15/10/2020 | Spring | 1 | Male | Unknown | 0 | Yellow-bellied Glider | Calling | - | 521086 | 6763087 |
| Control site 4 | 23/10/2020 | Spring | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Calling | - | 521084 | 6763121 |
| Control site 4 | 12/11/2020 | Spring | 1 | Unknown | Adult | 0 | Yellow-bellied Glider | Calling | - | 521070 | 6763158 |
| Control site 4 | 12/11/2020 | Spring | 1 | Female | Adult | 1 | Brushtail Possum | Perched in tree | - | 521325 | 6762789 |
| Control site 4 | 12/11/2020 | Spring | 1 | Unknown | Adult | 0 | Petaurus sp. | entered hollow | Sugar or Squirrel Glider, entered hollow before ID | 521315 | 6762799 |
| Control site 4 | 12/01/2021 | Summer | 2 | Unknown | Unknown | 0 | Greater Glider | Roosting in Northern Grey Ironbark | Possible female with near mature subadult | 521326 | 6762765 |
| Control site 5 | 14/07/2020 | Winter | 1 | Unknown | Unknown | 0 | Yellow-bellied Glider | Calling | - | 521054 | 6763368 |
| Control site 5 | 23/10/2020 | Spring | 1 | Unknown | Unknown | 0 | Sugar Glider | Still in upper branches | Probable ID, partly obscured by branches | 521027 | 6763612 |
| Control site 5 | 12/11/2020 | Spring | 1 | Unknown | Unknown | 0 | Sugar Glider | In burnt stag, calling twice during spotlighting | - | 521006 | 6763716 |
| Control site 6 | 8/02/2021 | Summer | 1 | Unknown | Unknown | 0 | Sugar Glider | Calling | Calling from south, no visual | 522282 | 6764783 |
| Control site 6 | 22/02/2021 | Summer | 1 | Unknown | Unknown | 0 | Petaurus sp. | Foraging on blossom in Pink Bloodwood | Sugar or Squirrel Glider, partial visual | 521928 | 6764884 |
| Control site 6 | 22/02/2021 | Summer | 1 | Unknown | Adult | 0 | Brushtail Possum | Perched in <i>Angophora woodsiana</i> | - | 522192 | 6764819 |



Appendix H

Threatened Frog Survey Results

Table H1 **Threatened Frog Survey Results**

| Site | Survey | Green-thighed Frog Survey Results | | | | | | | | | | Other species (present = 1) | | | | | | | | | | | | | | | | | | | | |
|----------------------------|---|-----------------------------------|-----------------------|------|-----------|---|--------------------------------------|------------------------|------------------------------|-------------------------|-----------------------------|--------------------------------|--------------------------------|------------------------------|-----------------------------------|------------------------------------|-------------------------|------------------------|------------------------|-----------------------|---------------------------|----------------------------|-----------------------|-----------------------|------------------------------|------------------------------|------------------------|------------------------|--|-----------------------------------|------------------------------------|--------------------|
| | | No. of Green-thighed Frog | No. of Wallum Froglet | Sex | Age Class | Behaviour | Recording Type | <i>Adelotus brevis</i> | <i>Crinia parvisignifera</i> | <i>Crinia signifera</i> | <i>Lechriodus fletcheri</i> | <i>Limnodynastes dumerilii</i> | <i>Limnodynastes dumerilii</i> | <i>Limnodynastes peronii</i> | <i>Limnodynastes tasmaniensis</i> | <i>Limnodynastes terraereginae</i> | <i>Litoria caerulea</i> | <i>Litoria chloris</i> | <i>Litoria dentata</i> | <i>Litoria fallax</i> | <i>Litoria gracilenta</i> | <i>Litoria latopalmata</i> | <i>Litoria nasuta</i> | <i>Litoria tyleri</i> | <i>Mixophyes fasciolatus</i> | <i>Pseudophryne coriacea</i> | <i>Rhinella marina</i> | <i>Uporoleia fusca</i> | Total no. of species at each site per survey event | Total no. of species per site | Easting | Northing |
| Impact Site 2 (west) | Year 6 Summer Survey 1 | 5 | - | Male | Unknown | - | - | - | - | - | - | - | - | - | - | 1 | 1 | 1 | - | 1 | - | - | - | - | - | - | - | - | 5 | - | 2 frogs: 521520 3 frogs: 521588 | 6762250 6762336 |
| Impact Site 2 (west) | Year 6 Summer Survey 2 | 1 | - | Male | Unknown | Immediate response to call-playback | Call identification | - | - | - | - | - | 1 | - | - | 1 | 1 | - | - | 1 | - | - | - | - | - | - | 1 | - | 6 | - | 521605 | 6762348 |
| Impact Site 2 (west) | Year 6 Summer Survey 3 | 6 | - | Male | Adult | Calling | Call identification and spotlighting | - | - | 1 | - | - | 1 | 1 | - | 1 | - | 1 | - | 1 | - | - | 1 | - | - | - | 1 | - | 9 | - | 521586 | 6762345 |
| Impact Site 2 (west) | Year 6 Summer Survey 4 | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | - | 9 | - | 521522 | 6762312 |
| Impact Site 2 (west) Total | | 12 | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | - | 1 | - | - | 13 | - | - |
| Impact Site 2 (east) | Year 6 Summer Survey 1 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | - | - | - | - | 1 | - | - | - | - | - | 5 | - | 521836 | 6762280 | |
| Impact Site 2 (east) | Year 6 Summer Survey 2 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | 1 | - | 1 | - | - | - | - | 4 | - | 521835 | 6762313 | |
| Impact Site 2 (east) | Year 6 Summer Survey 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | - | - | 1 | - | 1 | - | 1 | 1 | 1 | - | 1 | - | 7 | - | 521875 | 6762293 | |
| Impact Site 2 (east) | Year 6 Summer Survey 4 | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | - | - | - | 1 | - | - | - | 1 | 1 | 1 | 1 | 6 | - | 521889 | 6762329 | |
| Impact Site 2 (east) Total | | - | - | - | - | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | 1 | - | 1 | - | 1 | 1 | 1 | - | 1 | 1 | - | 10 | - | - | |
| Impact Site 3 (west) | Year 6 Summer Survey 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | - | 1 | - | 1 | - | 1 | - | - | - | - | - | 4 | - | 522727 | 6763583 | |
| Impact Site 3 (west) | Year 6 Summer Survey 2 | 1 | - | Male | Adult | Calling | Call identification | - | - | - | - | - | 1 | - | 1 | 1 | - | 1 | - | 1 | - | 1 | - | - | - | 1 | 1 | 9 | - | 522845 | 6763633 | |
| Impact Site 3 (west) | Year 6 Summer Survey 3 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | - | - | - | 1 | - | 1 | - | 1 | - | - | - | - | 5 | - | 522757 | 6763545 | |
| Impact Site 3 (west) | Year 6 Summer Survey 4 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | - | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 | - | 522745 | 6763566 | |
| Impact Site 3 (west) Total | | 1 | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | 1 | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 15 | - | - | |
| Impact Site 3 (east) | Year 6 Summer Survey 1 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | 1 | 1 | - | - | 1 | - | 1 | - | 1 | - | - | - | - | 8 | - | 523134 | 6763621 | |
| Impact Site 3 (east) | Year 6 Summer Survey 2 | - | - | - | - | - | - | - | - | 1 | - | - | - | 1 | 1 | - | - | 1 | - | 1 | - | 1 | - | - | 1 | - | - | 7 | - | 523095 | 6763579 | |
| Impact Site 3 (east) | Year 6 Summer Survey 3 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | - | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | - | 8 | - | 523221 | 6763644 | |
| Impact Site 3 (east) | Year 6 Summer Survey 4 | - | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 | 9 | - | 523179 | 6763640 | |
| Impact Site 3 (east) Total | | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | 1 | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 | 1 | 1 | - | - | 11 | - | - | |
| Impact Site 5 (west) | Year 6 Summer Survey 1 | 8 | - | Male | Adult | Calling | Call identification and spotlighting | - | 1 | - | - | - | 1 | - | - | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | - | 1 | 1 | 9 | - | 6 frogs: 524250 2 frogs: 524248 | 6766165 6766156 |
| Impact Site 5 (west) | Year 6 Summer Survey 2 | 6 | - | Male | Adult | Calling from pond edge | Call identification and spotlighting | - | 1 | - | - | - | 1 | - | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 13 | - | 5 frogs: 524242 1 frog: 524241 | 6766169 6766158 | |
| Impact Site 5 (west) | Year 6 Summer Survey 3 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | 1 | 1 | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | - | - | 1 | 11 | - | 524292 | 6766134 |
| Impact Site 5 (west) | Year 6 Summer Survey 4 | 2 | - | Male | Adult | Calling without call-playback stimulus | Call identification | - | 1 | 1 | - | - | 1 | - | - | - | - | 1 | 1 | 1 | - | - | - | - | 1 | 1 | - | 9 | - | 524245 | 6766159 | |
| Impact Site 5 (west) Total | | 16 | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 15 | - | - | |
| Impact Site 5 (east) | Year 6 Summer Survey 1 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | 1 | 1 | 1 | - | 1 | - | 1 | - | - | - | - | - | 9 | - | 524493 | 6766087 | |
| Impact Site 5 (east) | Year 6 Summer Survey 2 | - | - | - | - | - | - | - | 1 | - | 1 | - | 1 | - | - | 1 | - | 1 | 1 | 1 | - | 1 | - | - | - | - | - | 10 | - | 524490 | 6766083 | |
| Impact Site 5 (east) | Year 6 Summer Survey 3 | - | 5 | - | - | Calling | Call identification | - | 1 | 1 | - | - | 1 | - | - | 1 | - | 1 | 1 | - | 1 | - | 1 | - | - | 1 | - | 10 | - | 524515 | 6766066 | |
| Impact Site 5 (east) | Year 6 Summer Survey 4 | - | 10 | Male | Adult | - | - | - | 1 | 1 | - | - | 1 | - | - | - | 1 | 1 | - | 1 | 1 | - | 1 | - | - | 1 | - | 9 | - | 524506 | 6766061 | |
| Impact Site 5 (east) Total | | - | 15 | - | - | - | - | - | 1 | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 | 1 | 1 | - | 1 | - | - | 1 | - | - | - | 14 | - | - | |
| Control site 3 | Year 6 Summer Survey 1 | - | - | - | - | - | - | - | 1 | 1 | - | - | - | - | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | 9 | - | 524414 | 6764028 | |
| Control site 3 | Year 6 Summer Survey 2 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | 1 | - | 10 | - | 524310 | 6764068 | |
| Control site 3 | Year 6 Summer Survey 3 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | 1 | - | 1 | - | 1 | - | 1 | - | - | 1 | - | 1 | 9 | - | 524618 | 6763985 | |
| Control site 3 | Year 6 Summer Survey 4 | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | - | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 | 1 | 1 | 10 | - | 524465 | 6764035 | |
| Control site 3 Total | | - | - | - | - | - | - | - | 1 | 1 | - | - | 1 | - | 1 | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 | - | 1 | 1 | - | 12 | - | - | |
| Control site 4 | Year 6 Summer Survey 1 | 3 | - | Male | Adult | Calling | Call identification | - | - | - | - | - | 1 | 1 | - | - | 1 | 1 | - | 1 | - | 1 | 1 | - | 1 | - | 1 | 10 | - | 521236 | 6762930 | |
| Control site 4 | Year 6 Summer Survey 2 | 2 | - | Male | Adult | Calling | Call identification | - | - | - | - | 1 | - | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | - | 1 | - | 1 | - | 12 | - | 521240 | 6762922 | |
| Control site 4 | Year 6 Summer Survey 3 | - | - | - | - | - | - | - | - | - | - | - | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | 1 | 1 | - | 9 | - | 521235 | 6762901 | | |
| Control site 4 | Year 6 Summer Survey 4 | - | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | - | 1 | - | 1 | - | 1 | - | 1 | 1 | - | 1 | - | 9 | - | 521217 | 6762869 | | |
| Control site 4 Total | | 5 | - | - | - | - | - | - | - | 1 | - | 1 | 1 | 1 | - | 1 | 1 | 1 | - | 1 | - | 1 | 1 | 1 | 1 | - | - | - | 14 | - | - | |
| Control site 5 | Summer Survey 1 | 10 | - | Male | Adult | Calling | - | - | - | 1 | - | - | - | - | 1 | - | - | 1 | - | 1 | - | 1 | - | - | - | 1 | - | 6 | - | 521014 | 6763633 | |
| Control site 5 | Summer Survey 2 | 6 | - | Male | Adult | Calling | - | - | - | - | 1 | - | 1 | - | - | 1 | 1 | - | 1 | - | 1 | 1 | - | - | 1 | 1 | 1 | 10 | - | 521038 | 6763513 | |
| Control site 5 | Summer Survey 3 | 3 | - | Male | Adult | Calling from pond edge | Call identification | - | - | - | 1 | - | 1 | - | - | 1 | - | - | 1 | - | 1 | 1 | 1 | - | 1 | - | 9 | - | 1 frog: 521047 2 frogs: 521016 | 6763498 6763686 | | |
| Control site 5 | Summer Survey 4 | 3 | - | Male | Adult | Calling | Call identification | 1 | - | - | - | - | 1 | 1 | 1 | - | 1 | - | 1 | 1 | - | 1 | 1 | - | 1 | - | 12 | - | 521031 | 6763504 | | |
| Control site 5 Total | | 22 | - | - | - | - | - | - | 1 | - | - | 1 | 1 | 1 | 1 | - | 1 | 1 | - | 1 | 1 | 1 | - | 1 | 1 | - | - | 16 | - | - | | |
| | Total no. of individuals | 56 | 15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | |
| | Mean no. of individuals at each site per survey event | 1.6 | 0.4 | - | - | Total no. of sites species was recorded | 2 | 5 | 7 | 1 | 3 | 1 | 9 | 3 | 4 | 9 | 5 | 8 | 3 | 9 | 3 | 9 | 9 | 5 | 5 | 9 | 5 | - | 13.3 | Mean no. of species per site | - | |
| | SD | 2.66 | 1.84 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 8.6 | 2.00 | SD | - | | |

Squirrel Glider Radio Tracking for Post Construction Ecological Monitoring Devils Pulpit Pacific Highway Upgrade



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|-------------------|---------------------------|---------------------------|-------------------------|
| 2885-1041 | First issue | 25/11/2020 | David Andrighetto |
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Table of Contents

| | | |
|-----------|-------------------------------------|-----------|
| 1. | Introduction | 1 |
| 1.1 | Background | 1 |
| 1.1.1 | Introduction | 1 |
| 1.1.2 | Vegetated Medians | 4 |
| 2. | Methodology | 9 |
| 2.1 | Radio Tracking | 9 |
| 2.1.1 | Initial Squirrel Glider Capture | 9 |
| 2.1.2 | Radio Tracking | 12 |
| 2.1.3 | Squirrel Glider Retrieval | 13 |
| 2.1.4 | Timing | 13 |
| 2.1.5 | Weather Condition | 14 |
| 3. | Results | 15 |
| 3.1 | Results | 15 |
| 3.1.1 | Location and Road Crossing Results | 15 |
| 3.1.2 | Den Trees Usage | 17 |
| 3.1.3 | Home Range Results | 22 |
| 3.2 | Glider Performance | 22 |
| 3.3 | Moon Influence | 24 |
| 4. | Discussion | 29 |
| 4.1 | Road Crossings at Vegetated Medians | 29 |
| 4.2 | Frequency of Road Crossing | 30 |
| 4.3 | Home Range and Denning | 30 |
| 4.4 | Nest Box Usage | 31 |
| 4.5 | Moon Influence | 31 |
| 5. | Recommendations | 32 |
| 5.1 | Recommendations | 32 |

Illustrations

| | | |
|------------------|--|----|
| Illustration 1.1 | Site Locality | 3 |
| Illustration 1.2 | Vegetated Medians | 8 |
| Illustration 3.1 | Radio Tracking Results | 19 |
| Illustration 3.2 | Glider F7 Crossing Sequence At Impact Site 2 | 21 |
| Illustration 3.3 | Home Range Analysis | 25 |
| Illustration 3.4 | Tree Locations for Glide Performance Calculation and Home Range Analysis Results | 27 |



Tables

| | | |
|------------------|--|-----------|
| <u>Table 1.1</u> | <u>EMP Vegetated Median Monitoring Objectives – Hyder 2011</u> | <u>2</u> |
| <u>Table 1.2</u> | <u>Vegetated Median Description</u> | <u>6</u> |
| <u>Table 1.3</u> | <u>Potential Glide Tree Data: Impact Site 2 (northbound lane) and Impact Site 4 (both lanes) (Source: GeoLINK 2019b)</u> | <u>7</u> |
| <u>Table 1.4</u> | <u>Impact Site 2 Southbound Lane Potential Glide Tree Data (GeoLINK 2012a)</u> | <u>7</u> |
| <u>Table 2.1</u> | <u>Summary of Survey Effort</u> | <u>9</u> |
| <u>Table 2.2</u> | <u>Inspected Nest Boxes</u> | <u>10</u> |
| <u>Table 2.3</u> | <u>Attribute Data of Collared Squirrel Gliders</u> | <u>11</u> |
| <u>Table 3.1</u> | <u>Radio Tracking Results Overview</u> | <u>15</u> |
| <u>Table 3.2</u> | <u>Summary of Glider Locations Relative To Highway</u> | <u>16</u> |
| <u>Table 3.3</u> | <u>Number, Location and Direction of Highway Lane Crossings</u> | <u>16</u> |
| <u>Table 3.4</u> | <u>Number of Days/Nights and Frequency (%) Gliders were Recorded in Habitat Relative to Highway</u> | <u>17</u> |
| <u>Table 3.5</u> | <u>Diurnal Squirrel Glider Diurnal Den Tree Usage</u> | <u>18</u> |
| <u>Table 3.6</u> | <u>Home Range Analysis</u> | <u>22</u> |
| <u>Table 3.7</u> | <u>Summary of Tree Height, Highway Gap and Minimum Glide Performance Calculations for Northbound Lane Crossing at Recorded Home Ranges</u> | <u>23</u> |
| <u>Table 3.8</u> | <u>Numbers of Active and Denning Glider Nocturnal Fixes and Moon Illumination (the table gives both observed and expected (in brackets) numbers)</u> | <u>24</u> |

Plates

| | | |
|------------------|---|-----------|
| <u>Plate 2.1</u> | <u>Female Squirrel Glider (F6) with radio collar fitted</u> | <u>11</u> |
|------------------|---|-----------|

Appendices

Appendix A Weather Conditions and Moon Phase

Appendix B Den Tree Attribute Data

Appendix C Glider Performance Calculations



Executive Summary

Squirrel Glider (*Petaurus norfolcensis*) radio tracking was undertaken at the two vegetated medians at the Devils Pulpit Pacific Highway Upgrade site as part of the post construction monitoring phase of the *Devils Pulpit Upgrade Ecological Monitoring Program* (EMP). The objective of the radio tracking was to determine if Squirrel Gliders are crossing the highway at the vegetated medians.

Nest box inspection and Elliott B trapping was undertaken to capture gliders. Five Squirrel Gliders were collared and radio tracked during July and August 2019. Four of the five gliders crossed the Pacific Highway northbound lane, moving between the vegetation within and west of the medians. A total of 48 crossings were recorded. Crossings were made at both medians by both male and female gliders. No glider movements between the medians and habitat east of the highway across the southbound lane were recorded.

Fifteen den trees were used by the Squirrel Gliders during the radio tracking averaging four den trees per glider (SD: 2.5). One male glider used a den tree in the northern median on most (70 per cent) days, although was mainly active in habitat west of the highway at night. No gliders denned in the nest boxes after the initial capture.

Home range sizes varied from 2.54 to 20.49 ha based on the MPC analysis and 2.52 and 14.09 ha based on the Kernel 95 analysis. The home range of four of the gliders included the respective median and habitat to the west of the highway. Only one glider included a median as part of its core home range.

Review of tree height data and glide performance calculations found that required glide performances to cross the northbound lane within recorded home ranges were within the average glide performance standard deviation range recorded by previous studies.

A chi square test of glider activity results and moon illumination found that gliders were:

- More active during no or low moon illumination periods
- Nocturnal denning more when night conditions were bright, corresponding with periods when the moon was present during the first quarter - full - last quarter half of the moon phase.

The radio tracking results demonstrate that both male and female Squirrel Gliders were able to cross the northbound lane of the Pacific Highway at both medians at the Devils Pulpit site under no night traffic conditions. No crossings of the southbound lane were recorded, therefore the maintenance of Squirrel Glider movement across this newly constructed carriageway has not been demonstrated.

The results do not rule out the potential for traffic related behavioural barriers at the site. Previous studies and the results from other Devils Pulpit post construction monitoring activities however suggests that traffic may not be a factor impacting glider movement across the highway at the site.

Overall, based on the clearing widths at the time of the radio tracking and records of gliders crossing high traffic volume roads; it is expected that Squirrel Gliders could cross both the northbound and southbound lanes of the Pacific Highway at the vegetated medians when both lanes are open to traffic. Several recommendations are provided for Transport for NSW consideration.



1. Introduction

1.1 Background

1.1.1 Introduction

The Devils Pulpit Pacific Highway upgrade (the project) comprises a 7.3 kilometre section of the Pacific Highway at Devils Pulpit, between Grafton and Ballina on the NSW north coast (refer to **Illustration 1.1**). The project involved widening the Pacific Highway from a single two-way carriageway to a four-lane dual carriageway and was completed in March 2014.

The *Devils Pulpit Upgrade Ecological Monitoring Program* (EMP - Hyder 2012) was prepared to address the ecological monitoring consent conditions for the project. The broad objective of the EMP is to monitor the effectiveness of the mitigation measures identified in the Biodiversity Offset Strategy for threatened species directly impacted by the project. GeoLINK is engaged by Transport for NSW (formerly Roads and Maritime Services) to implement the post construction terrestrial species monitoring component of the EMP. Year 3 and 4 post construction monitoring have been completed to date (GeoLINK 2018; 2019a), with the Year 6 post construction monitoring scheduled to finish in early 2021.

Section 7 Monitoring Crossing Structures of the EMP includes monitoring of the vegetated medians. An overview of this 'mitigation measure' and corresponding monitoring objectives as outlined in the EMP are provided in **Table 1.1**. The program includes a range of fauna monitoring techniques including hair tube, spotlighting and nest box monitoring methods, as well as provisional Squirrel Glider (*Petaurus norfolcensis*) radio tracking.

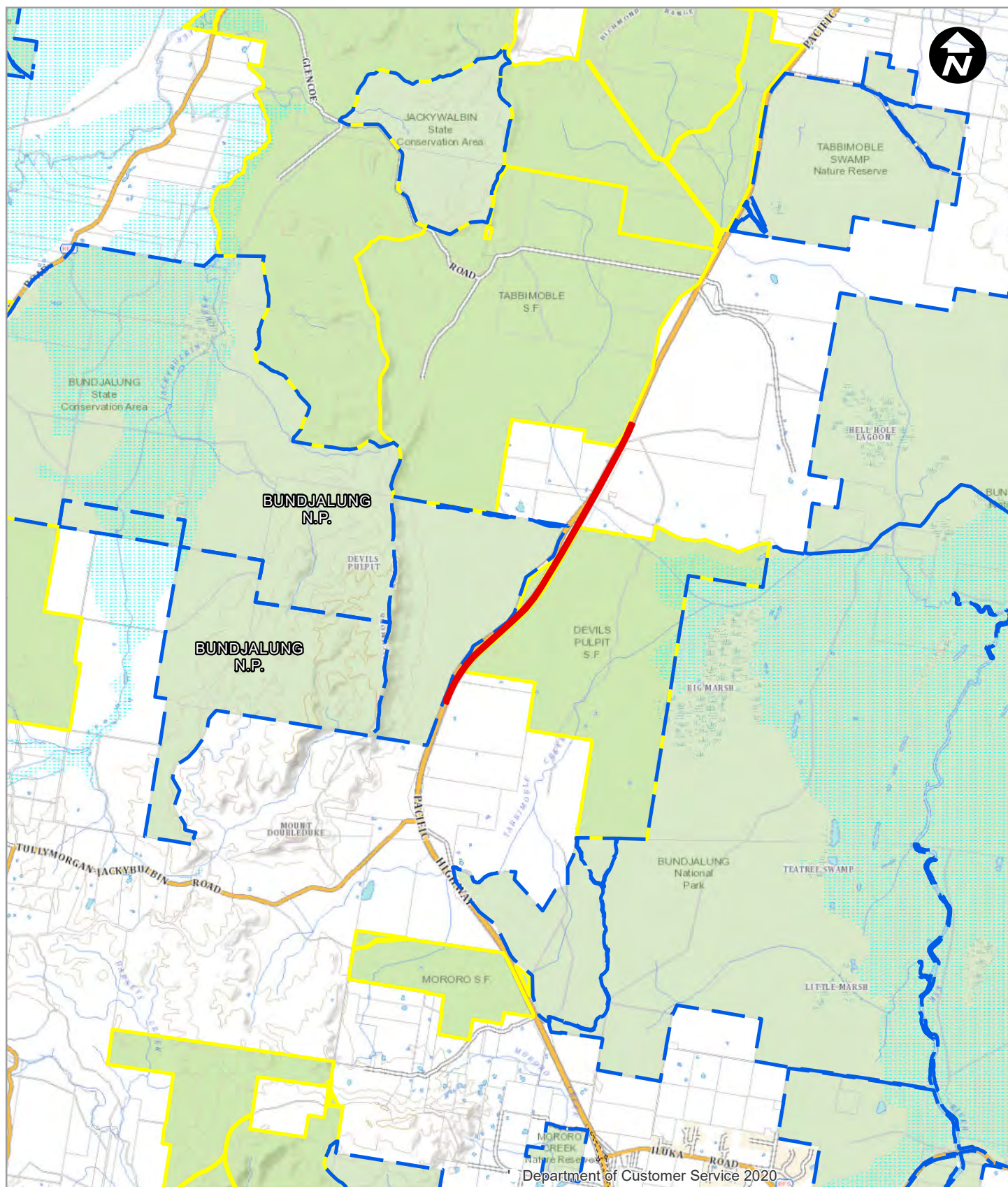
The provisional radio tracking was triggered during the Year 3 post construction monitoring by the detection of Squirrel Gliders in both vegetated medians associated with the project (GeoLINK 2018). The specific radio tracking requirements of the EMP state:

'Radio-tracking. *Captured gliders will be weighed, sexed and assigned to age classes based on tooth condition, ventral fur colour and breeding status and fitted with a radio transmitter. A telemetry receiver will be used to located these gliders and will be radio tracked at least one night a week for the following 4 weeks. Individual will aim to be located between 2 and 4 times a night and at least once each day. Once located, a GPS recording will be made, the tree/shrub it is located in and behaviour will be recorded. Tagged individuals will be trapped and transmitters removed at the end of the monitoring period.'*

This report documents the results of the Squirrel Glider radio tracking undertaken for the project. The specific objective of the radio tracking is to determine if Squirrel Gliders are crossing the highway at the vegetated medians. The results will be incorporated into the final (Year 6) post construction monitoring report to determine the overall monitoring findings against the EMP performance measures.

Table 1.1 EMP Vegetated Median Monitoring Objectives – Hyder 2011

| Mitigation Measure | Objective | Target Species | Features Being Monitoring |
|---------------------------|---|--|---|
| Vegetated medians | <ul style="list-style-type: none"> ■ Maintain fauna movements and habitat connectivity for arboreal mammals. ■ Reduce gap crossing distance for gliding mammals. ■ Reduce road kill. | <ul style="list-style-type: none"> ■ Greater Glider ■ Sugar Glider ■ Squirrel Glider ■ Yellow-bellied Glider | <ul style="list-style-type: none"> ■ Two vegetated medians at chainage 66.300- 67.800 and 69.300- 70.700. ■ Gliders will be able to use vegetated median to move between Devils Pulpit State Forest and Bundjalung National Park due to short glide distances. ■ Supports Dry Sclerophyll Forest and Floodplain Forest vegetation communities. |



LEGEND

- The project
- National park reserve
- State forest

GDA 1994 MGA Zone 56

0 2 Km

Site Locality - Illustration 1.1



1.1.2 Vegetated Medians

The project encompasses two vegetated medians that are monitored as part of the EMP. Locations of the medians are shown in **Illustration 1.2**. A description of each median is provided in **Table 1.2**. As detailed in GeoLINK (2018), the southern median corresponds with monitoring Impact Site 2, while the northern median corresponds with monitoring Impact Site 4. The northbound lane at both medians comprises the original two lane highway alignment which has now been upgraded. The southbound lane was cleared and constructed during the project.


Tree height data of potential glide trees on both sides of the northbound and southbound lanes at the subject medians has been collected as part of previous glider crossing assessments (GeoLINK 2019b; 2012a) and are included in **Table 1.2** and **Table 1.3**. This data is relevant to conditions at the time of the radio tracking, prior to post fire hazardous tree removal in December 2019 and additional clearing and tree removal associated with the Woolgoolga to Ballina Pacific Highway upgrade (W2B) in early 2020. The information in **Table 1.3** was obtained as part of the *W2B Devils Pulpit Widened Median Glider Crossing Ability Assessment* (GeoLINK 2019b) and provides recent tree height and glide distance data at:

- Impact Site 2 (median): the entire northbound lane.
- Impact Site 4 (median):
 - The entire northbound lane
 - The southbound lane between chainage 69,770 and 70,970 only. The clearing width from Devils Pulpit construction elsewhere along the southbound lane was approximately 50 m or greater.

During data collection, the northbound lane at each median was divided into 100 m chainage zones. A minimum of one potential glide/launch tree was identified for each chainage zone. At the southbound lane between chainage 69,770 and 70,970 (corresponding with W2B chainages 108800 and 109000), all potential glide/launch trees were identified. Potential glide/launch trees were characterised as trees >20 cm diameter at breast height (DBH) opposite a potential landing tree on the other side of the respective lane (DBH >20 cm), where the distance to a potential landing tree was ≤50 m. Attribute data for each potential glide/launch tree was recorded and included survey location, species, DBH, tree height, ground height at base of tree, road height at base of tree and distance to closest landing tree.

The southbound lane at Impact Site 2 (median) was not included as part of the GeoLINK (2019b) assessment as impacts from W2B clearing in this area were minimal. Tree height and clearing width data was previously obtained as part of the *Devils Pulpit Pacific Highway Class A Upgrade – Rope Bridge Assessments for Target Glider Species at the Northern and Southern Vegetated Medians/ Glider Crossings* (GeoLINK 2012a) for 100 m chainage zones. Average recorded tree height, distance of trees to the clearing edge and clearing width data from this assessment is provided in **Table 1.4**. During data collection, tree height and the distance of trees to the clearing edge was recorded via field survey, while clearing width data was recorded by GIS analysis.

It should be noted that regrowth acacia trees up to 12.5 m tall and 0.1 m DBH are common within the previously cleared Devils Pulpit clearing limits along the southbound lane. The narrow DBH causes this vegetation not to satisfy the criteria of launch or landing trees in the GeoLINK (2019b) assessment. Glider use of the acacia regrowth reduces the required glide distance, however gliders using this vegetation to cross the highway may be vulnerable to vehicle strike.



Note: Unanticipated post fire hazardous tree clearing in December 2019 and additional clearing as part of the W2B project along the northbound lane in early 2020 impacted potential glider launch/landing trees at both medians. Therefore the conditions monitored as part of the radio tracking are different to current site conditions.

At the time of the radio tracking, the northbound lane at both medians was closed to traffic, and subject to construction works (drainage, pavement, minor realignment and fencing) during daylight hours. Northbound traffic was diverted to the southbound lane which supported two lanes with two-way traffic. The batch plant and construction access gate at Impact Site 4 (median) was operational as part of W2B construction. The distance between vegetation on opposite sides of the highway in areas within a vegetated median at Devils Pulpit ranged between approximately 55 m and 90 m.

Table 1.2 Vegetated Median Description

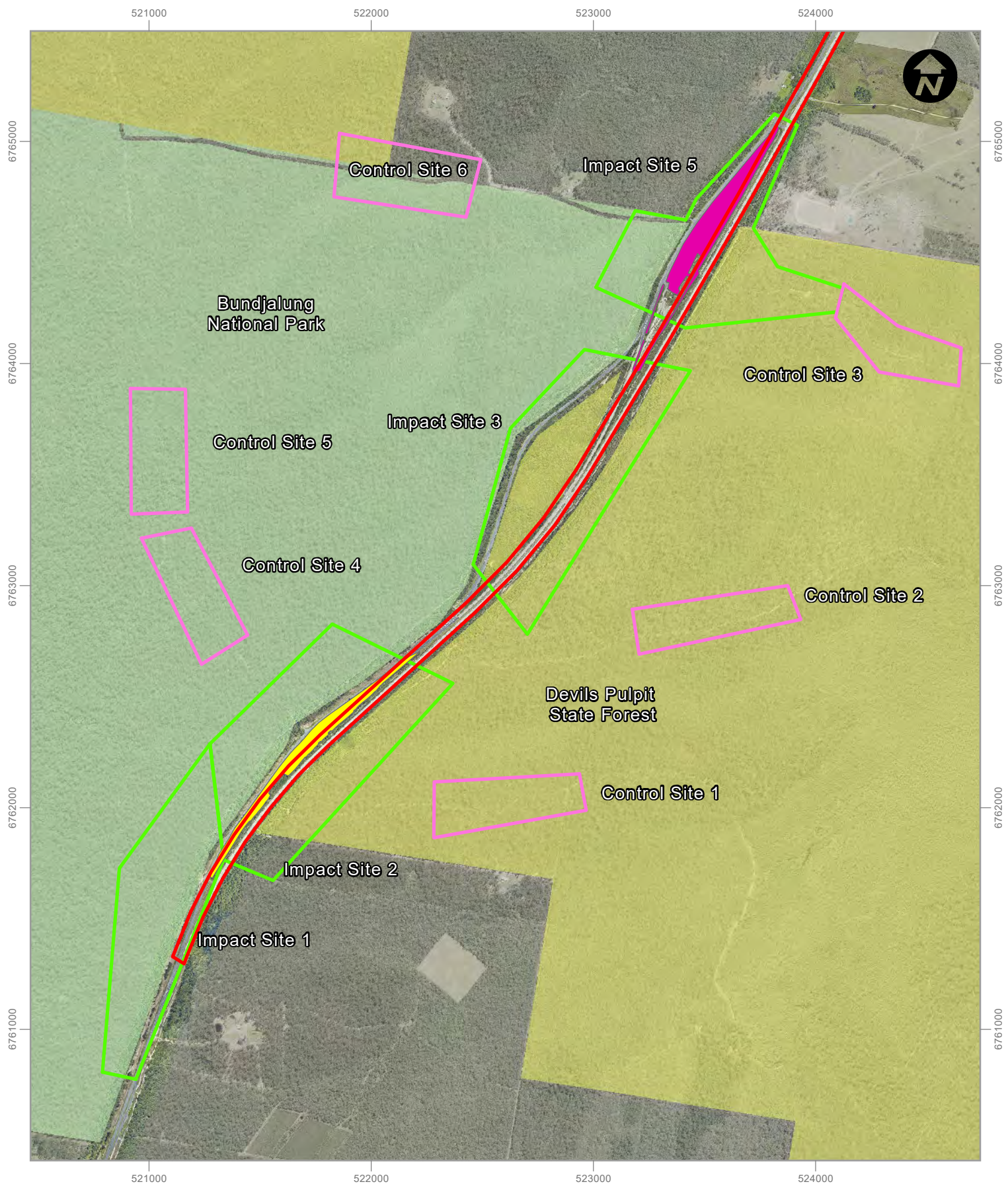
| Site | Chainage | Length (km) | Width (m) | Area of Vegetation (ha) | Vegetation Form and Class (Hyder 2011) | Comment |
|------------------------|-----------------|--------------------|------------------|--------------------------------|--|--|
| Impact Site 2 (median) | 66.300-67.800 | 1.4 | 15-65 | 5.58 | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> - Spotted Gum Dry Sclerophyll Forest - Blackbutt Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> - Forest Red Gum Floodplain Forest. | Southern median. |
| Impact Site 4 (median) | 69.300-70.700 | 1.3 | 15-115 | 7.80 | <ul style="list-style-type: none"> ■ Dry Open Sclerophyll Forest (shrubby sub formation): <ul style="list-style-type: none"> - Blackbutt Dry Sclerophyll Forest. - Scribbly Gum Dry Sclerophyll Forest. ■ Grassy Woodlands: <ul style="list-style-type: none"> - Eastern Red Gum Floodplain Forest. | Northern median. Encompasses ancillary facility site used during Devils Pulpit and W2B construction. |

Table 1.3 Potential Glide Tree Data: Impact Site 2 (northbound lane) and Impact Site 4 (both lanes) (Source: GeoLINK 2019b)

| Site | Average Tree Height (m) | | | Average Distance to Landing Tree (m) | |
|--|--------------------------------|--------------------|--------------------|---|--------------------|
| | No. Trees Assessed | West | East | West | East |
| Impact Site 2 (median) – Northbound Lane | West: 11 East: 11 | 32.3 (SD: 4.46) | 32.3 (SD: 4.41) | 43.1 (SD: 4.88) | 43.4 (SD: 4.94) |
| Impact Site 4 (median) – Northbound Lane | West: 12 East: 12 | 24.7 (SD: 5.25) | 25.1 (SD: 4.95) | 37.1 (SD: 3.41) | 37.2 (SD: 3.43) |
| Impact Site 4 (median) – Southbound Lane Chainage 108800 to 109000 | West: 12 East: 12 | 23.4 (SD: 4.24) | 22.8 (SD: 3.20) | 42 (SD: 6.56) | 45.6 (SD: 5.75) |

Table 1.4 Impact Site 2 Southbound Lane Potential Glide Tree Data (GeoLINK 2012a)

| Location | No. Trees Assessed | Average Largest Tree Height (m) | Average Distance of Trees to Clearing Edge | Average Clearing Width |
|-----------------|---------------------------|--|---|-------------------------------|
| East | 9 | 26.7 (SD: 2.40) | 3.6 (SD: 2.53) | 40.3 (SD: 4.37) |
| West | 9 | 30.6 (SD: 3.00) | 4.5 (SD: 3.07) | 40.3 (SD: 4.37) |



GDA 1994 MGA Zone 56

LEGEND

- | | | |
|--|---|---|
| Devil's Pulpit concept clearing limit | Impact Site 4 (median) | State forest |
| Control site | Impact Site 2 (median) | National park reserve |
| Impact site | | |

0 450 Metres

Vegetated Medians - Illustration 1.2

2. Methodology

2.1 Radio Tracking

Radio tracking was undertaken in winter 2019 and comprised three distinct components:

- Initial Squirrel Glider capture and collaring via nest box inspection and Elliott B trapping.
- Radio tracking.
- Squirrel Glider recapture (Elliott B trapping), assessment and collar removal.

The specific methodology for each component is detailed below. A summary of survey dates and effort is provided in **Table 2.1**.

Table 2.1 Summary of Survey Effort

| <i>Survey Component</i> | <i>Location</i> | <i>Commencement Date</i> | <i>Completion Date</i> | <i>Total Survey Effort</i> |
|--|------------------------------------|--------------------------|------------------------|---|
| Initial Squirrel Glider Capture | | | | |
| Nest box inspection | Impact Site 2 (east, median, west) | 3/07/2019 | 3/07/2019 | 18 nest boxes inspected |
| | Impact Site 4 (east, median, west) | 2/07/2019 | 3/07/2019 | 17 nest boxes inspected (8 nest boxes inspected twice) |
| Elliott B trapping | Impact Site 2 (east, median, west) | 8/07/2019 | 11/07/2019 | 10 arboreal Elliott B traps set for 3 nights: 30 trap nights |
| | Impact Site 4 (east, median, west) | 8/07/2019 | 11/07/2019 | 10 arboreal Elliott B traps set for 3 nights: 30 trap nights |
| Radio Tracking | | | | |
| Radio tracking | Impact Site 2 and Impact Site 4 | 2/07/2019 | 27/08/2019 | Diurnal den fixes: 89 Nocturnal fixes: 287 Total days that fixes were collected: 28 |
| Squirrel Glider Recapture | | | | |
| Elliott B Trapping | Impact Site 2 and Impact Site 4 | 5/08/2019 | 28/08/2019 | 10-40 arboreal Elliott B (varying configurations): 417 trap nights |

2.1.1 Initial Squirrel Glider Capture

Initial Squirrel Glider capture was under using nest box inspection and Elliott B trapping. The 35 Squirrel Glider nest boxes (Hollow Log Home – rear entry timber design) associated with Impact Site 2 and Impact Site 4 were inspected by a tree climber under ecologist direction. The entrance to the nest boxes were blocked prior to opening and inspecting the boxes. **Table 2.2** details the nest box configuration at the relevant sites. Further details on the nest box locations and installation dates are provided in GeoLINK (2018).

Ten Squirrel Gliders were recorded during the nest box inspection (four from Impact Site 2 and six from Impact Site 4). Two adult males and two adult females were fitted with 5.9 g brass loop single stage radio collars (Sirtrack model V1C 116B, Havelock North, New Zealand). The collared gliders were captured from:

- Impact Site 2 (west): One male (referred to as M9) and one female (referred to as F7) captured from the same nest box (Impact Site 2 West Nest Box 6).
- Impact Site 4 (west): One male (referred to as M5) and one female (referred to as F6) captured from the same nest box (Impact Site 4 West Nest Box 5).

The other six gliders were not collared, as five gliders dispersed when establishing climbing ropes during nest box inspection and the other captured glider was a sub-adult and not suitable for collaring. Eight nest boxes from which gliders had escaped or had fresh nesting material (indicated by bright green leaves) were accessed a second time the day after the first inspection but no gliders were present.

Supplementary arboreal Elliott B trapping was undertaken in an attempt to capture and collar more gliders. Specifically, 20 Elliott B traps were set on platforms three metres above the ground along two transects with ten traps each at Impact Site 2 (east) and Impact Site 4 (east). The transects ran parallel to the highway, with the traps set approximately 30-60 m from the road edge and 40-50 m apart. Traps were baited with a rolled oats, peanut butter, honey and apple mix. Trap trees were sprayed with a honey, vanilla essence and water solution as an attractant. The traps were set for three nights (60 trap nights in total) and checked each morning. An additional adult female Squirrel Glider (referred to as F4) was captured and collared from Impact Site 4 (east).

In total five adult Squirrel Gliders were collared. Attribute data of the collared gliders is provided in **Table 2.3**. A photograph of a Squirrel Glider with a fitted radio collar is provided in **Plate 2.1**.

Table 2.2 Inspected Nest Boxes

| Site | No. of Nest Boxes |
|----------------------------|--------------------------|
| Impact Site 2 (east) | 6 |
| Impact Site 2 (median) | 6 |
| Impact Site 2 (west) | 6 |
| Total Impact Site 2 | 18 |
| Impact Site 4 (east) | 6 |
| Impact Site 4 (median) | 5 |
| Impact Site 4 (west) | 6 |
| Total Impact Site 4 | 17 |
| Total (all sites) | 35 |

Table 2.3 Attribute Data of Collared Squirrel Gliders

| Ref. No. | Sex | Age | Weight (g) | Ventral Fur Colour | Breeding Status | Capture Site | Date Collared |
|-----------------|------------|----------------|-------------------|---------------------------|---|----------------------|----------------------|
| F4 | Female | 2-3 years | 170 | Cream | Previously breed. No dependant young present. | Impact Site 4 (east) | 9/07/2019 |
| M5 | Male | Adult >3 years | 231 | Yellow | Adult over >3 years | Impact Site 4 (west) | 2/07/2019 |
| F6 | Female | >2 years | 170 | Cream | Previously breed. No dependant young present. | Impact Site 4 (west) | 2/07/2019 |
| F7 | Female | 1-2 years | 200 | Cream | Previously breed. No dependant young present. | Impact Site 2 (west) | 3/07/2019 |
| M9 | Male | >2 years | 195 | Yellow | Adult | Impact Site 2 (west) | 3/07/2019 |



Plate 2.1 Female Squirrel Glider (F6) with radio collar fitted



2.1.2 Radio Tracking

2.1.2.1 Radio tracking Protocols

Previous experience with radio tracking Squirrel Gliders had shown that they or their group members chewed off whip (flexible external antennae) antennas, preventing the signal from being transmitted (D. Sharpe personal observations). As GPS collars require a whip antenna, it was not possible to use this approach due to the risk of damage and non-acquisition of data. Therefore, tuned loop single stage VHF transmitters were used. The receiver comprised a yagi three-element directional antennae and Sirtrack Ultra 148-156MHz radio receiver.

Radio tracking was conducted over a five-week period commencing in early July 2019. Radio tracking was conducted on foot four to five times per week during the core study period with additional radio tracking undertaken one to two times per week over the four week glider recapture period. A diurnal den fix was obtained each day. Nightly radio tracking procedures began at dusk after den watches or transmitter signal had shown that gliders were active, terminating between 8:30 pm and 1:00 am (typically 10:30 pm). Generally, three to six location fixes were obtained for each individual per 24 hours. The order of glider tracking was changed each night to avoid systematic bias. The minimum time period between location fixes of each glider was 30 minutes to ensure independence of location fixes (see Sharpe and Goldingay 2007 and Goldingay et al. 2010). On occasions, a shorter period between location fixes was recorded when gliders were actively moving in proximity to the highway edge to capture potential road crossings. Location fixes with less than 30 minutes separation were not used in the home range analysis.

The tree each glider occupied was identified by visually sighting the individual or by circling the tree with the receiver on to pin point the location of the individual. Location data were captured using the ESRI Collector app. This allowed the current location to be viewed on an aerial image. A data entry form captured the location and date and time of each fix. The form also allowed the glider to be individually identified and their behaviour documented if they were visually located and active (e.g. gliding, climbing, nectar feeding). The species, height, DBH and presence and/or number of flowers of each occupied tree was also recorded. Additional comments could also be entered if required (e.g. another glider present). As locations accumulated, Collector enabled real-time viewing of each individual's movement area. Collector operated as a stand-alone application while in the field. Data was synchronised back to the server at the completion of each night's radio tracking. This provided back-up for data and allowed multiple personnel to interact with the database.

2.1.2.1 Glider Movement Analysis

Location data from radio tracking, nest box capture and Elliott B trapping was used to identify potential glider movements across the highway or into the median. ESRI ArcGIS and Microsoft Excel were used during the analysis.



2.1.2.2 Home Range Analysis

Location data from radio tracking, nest box capture and Elliott B trapping were analysed using the Minimum Convex Polygon (MCP) and Fixed Kernel (FK) home range estimators. The FK is generally regarded as the most robust estimator (Worton 1989; Seaman and Powell 1996), while the MCP has been widely used over a long period of time (Mohr 1947), enabling comparisons to other studies. For the MCP, only the 100 per cent home range boundary was estimated. The FK enables various activity contours to be estimated. The 95 per cent boundary is typically used to estimate the home range boundary, while the 50 per cent contour defines the home range core (area of concentrated activity) (e.g. Sharpe and Goldingay 2007).

2.1.2.3 Moon Influence Analysis

To determine whether the moon phase was influencing nocturnal glider behaviour (i.e. whether gliders were active or denning), an analysis with the nocturnal radio tracking results was undertaken using moon rise and set times, and percent illumination information obtained from timeanddate.com for Lismore NSW. Nocturnal fixes were categorised into 'active' or 'denning' based on each individual gliders activity at the time of each fix. Moon illumination (i.e. the percentage of visible moon illuminated) at the time of each fix was identified and defined based on two categories: ≤50 per cent and 51-100 per cent. Moon illumination was nominated as ≤50 per cent where radio tracking fix times were one hour after moonrise and one hour before moon set, or where no moon was present. Location fixes of less than 30 minutes were not used. Nocturnal den fixes from 30 July 2020 were also not included unless that individual had previously been observed as active that night due to a hailstorm that occurred shortly before dusk. A chi square test was performed using the number of active (location fixes) and non-active (nocturnal den fixes) to test for associations between glider activity and the moon illumination categories.

2.1.3 Squirrel Glider Retrieval

Retrieval of collared gliders was undertaken using Elliott B trapping. Nest box inspection was not undertaken as no gliders returned to the nest boxes to den during the entire two month radio tracking and glider retrieval period (this is discussed further in **Sections 3 and 4**). Between 20 and 40 Elliott B traps were used and set on grids located within the core of identified home ranges, adjacent to occupied den trees, or within key observed foraging areas. The trap configuration changed progressively as gliders were captured. Traps were set three metres above the ground and baited as per the initial capture trapping (refer to **Section 2.1.1**). Four hundred and seventeen Elliott B trap nights were undertaken to recapture the five collared gliders.

2.1.4 Timing

The EMP schedules radio tracking in spring/summer of post construction Year 4. The timing was rescheduled to winter of post construction Year 5 for the following reasons:

- Avoid conflicts with W2B clearing and provide a post clearing adjustment period for gliders whose home range were impacted by the W2B main line clearing; and
- Target the period when the highest Squirrel Glider nest box occupation rates had been recorded (i.e. winter 2019a) to maximise animal capture.

This was endorsed by RMS and NSW Environmental Protection Agency (EPA – Peter Higgs – Senior Threatened Species Officer; email correspondence dated 20 December 2018).



2.1.5 Weather Condition

Weather conditions and moon phase during the radio tracking are provided in **Appendix A**. Weather conditions were mostly dry, though moderate rainfall events occurred in early July and early August. The Yamba Pilot Station (located approximately 20 km south-east of the site) recorded a combined mean high temperature of 21.5°C and a mean low of 11.1°C for July and August 2019. Below average rainfall had been recorded during the nine months preceding the radio tracking. July 2019 also received below average rainfall and August rainfall was slightly above average (BoM 2019). Two full moons occurred during the radio tracking period, creating bright nocturnal conditions over the corresponding week.

3. Results

3.1 Results

3.1.1 Location and Road Crossing Results

The results of the radio tracking are provided in **Table 3.1**, **Table 3.2**, **Table 3.3** and **Table 3.4**. All recorded glider locations are displayed in **Illustration 3.1**.

Three hundred and seventy-six location fixes were recorded during the radio tracking, including 89 diurnal (mean 17.8 per glider) and 287 nocturnal fixes (mean 57.4 per glider). Glider F6 died 13 days after being collared due to predation (suspected forest owl foraging), therefore limited data was collected for this animal.

Table 3.1 Radio Tracking Results Overview

| <i>Glider</i> | <i>Sex</i> | <i>Site</i> | <i>Diurnal Den Fixes</i> | <i>Nocturnal Den</i> | <i>Nocturnal Active</i> | <i>Nocturnal Total</i> | <i>Total Fixes</i> | <i>Fixes used in HR Analysis</i> | <i>Additional Locations Points*</i> |
|---------------|------------|---------------|--------------------------|----------------------|-------------------------|------------------------|--------------------|----------------------------------|-------------------------------------|
| F4 | F | Impact Site 4 | 18 | 19 | 40 | 59 | 77 | 69 | 2 |
| M5 | M | Impact Site 4 | 23 | 20 | 48 | 68 | 91 | 77 | 2 |
| F6 | F | Impact Site 4 | 8 | 0 | 20 | 20 | 28 | 27 | 2 |
| F7 | F | Impact Site 2 | 21 | 18 | 55 | 73 | 94 | 72 | 2 |
| M9 | M | Impact Site 2 | 20 | 14 | 52 | 66 | 86 | 70 | 2 |
| TOTAL | - | - | 90 | 71 | 215 | 286 | 376 | 315 | 10 |

** includes capture and recapture locations (nest box or Elliott B trapping), including recorded mortality location for F6*

Four of the five gliders (M5, F6, F7 and M9) were recorded west of the highway and within the median at the respective site (refer to **Table 3.2**). F4 was only recorded east of the highway. No gliders were recorded on both sides of the highway. M5 was the only glider recorded denning within a median.

Table 3.2 Summary of Glider Locations Relative To Highway

| Squirrel Glider | Diurnal Den Fix and Capture* | | | | Nocturnal Fix | | | | |
|-----------------|------------------------------|--------|------|-------|---------------|--------|------|-------|-------|
| | East | Median | West | Total | East | Median | West | West^ | Total |
| F4 | 20 | 0 | 0 | 20 | 59 | 0 | 0 | 0 | 59 |
| M5 | 0 | 17 | 8 | 25 | 0 | 25 | 43 | 0 | 68 |
| F6 | 0 | 0 | 10 | 10 | 0 | 1 | 15 | 4 | 20 |
| F7 | 0 | 0 | 23 | 23 | 0 | 13 | 60 | 0 | 73 |
| M9 | 0 | 0 | 22 | 22 | 0 | 3 | 63 | 0 | 66 |
| Total | 20 | 17 | 63 | 100 | 59 | 43 | 181 | 4 | 286 |

* includes capture and recapture locations (nest box or Elliott B trapping), including recorded mortality location for F6.

^ site is west of the current Pacific Highway alignment and east of old Pacific Highway/Bundjalung rest area. An approximate 20 m wide road crossing is required to access this site.

Four of the five gliders crossed the Pacific Highway northbound lane, with 48 crossing recorded in total (24 in each direction – refer to **Table 3.3**). Crossings were made at both medians by both male and female gliders. M5 crossed the northbound lane the most (28 occasions), which was associated with denning within the median at Impact Site 4 and foraging predominantly to the west of the highway (refer to **Table 3.4**). F6 crossed the old Pacific Highway at the Bundjalung rest area on eight occasions requiring a horizontal glide distance of approximately 20 m; however this was not captured as a highway lane crossing. No road crossings were recorded for F4. No southbound lane crossings (i.e. movements between the medians and habitat east of the highway) were recorded.

Table 3.3 Number, Location and Direction of Highway Lane Crossings

| Squirrel Glider | Site | Northbound Lane | | Southbound Lane | | Total |
|-----------------|---------------|-----------------|------|-----------------|------|-------|
| | | West | East | West | East | |
| F4 | Impact Site 4 | 0 | 0 | 0 | 0 | 0 |
| M5 | Impact Site 4 | 14 | 14 | 0 | 0 | 28 |
| F6 | Impact Site 4 | 1 | 1 | 0 | 0 | 2 |
| F7 | Impact Site 2 | 6 | 6 | 0 | 0 | 12 |
| M9 | Impact Site 2 | 3 | 3 | 0 | 0 | 6 |
| Mean | - | 4.8 | 4.8 | 0 | 0 | 9.6 |
| SD | - | 5.63 | 5.63 | 0.00 | 0.00 | 11.26 |

Table 3.4 shows the number and frequency of days and nights (when active) that gliders were recorded relative to the highway (west, median, east). Three gliders (F6, F7 and M9) were recorded denning only in habitat west of the highway and visited the median on between 11 to 33 per cent of nights when the gliders were active. One glider (M5) mostly denned within the median at Impact Site 4 (70 per cent of days den fixes were recorded), however was only recorded active within the median on a small number of nights (18 per cent) relative to the number of active nights west of the highway (88 per cent).

Table 3.4 Number of Days/Nights and Frequency (%) Gliders were Recorded in Habitat Relative to Highway

| <i>Squirrel Glider</i> | <i>Site</i> | <i>No. of Days Diurnal Denning was Recorded* (%)</i> | | | | <i>No. of Nights Active Nocturnal Fixes were Recorded (%)^</i> | | | |
|------------------------|---------------|--|-------------|---------------|-------------|--|-------------|---------------|-------------|
| | | <i>Total</i> | <i>West</i> | <i>Median</i> | <i>East</i> | <i>Total</i> | <i>West</i> | <i>Median</i> | <i>East</i> |
| F4 | Impact Site 4 | 18 | 0 (0%) | 0 (0%) | 18 (100%) | 18 | 0 (0%) | 0 (0%) | 18 (100%) |
| M5 | Impact Site 4 | 23 | 7 (30%) | 16 (70%) | 0 (0%) | 17 | 15 (88%) | 3 (18%) | 0 (0%) |
| F6 | Impact Site 4 | 9 | 8 (100%) | 0 (0%) | 0 (0%) | 9 | 9 (100%) | 1 (11%) | 0 (0%) |
| F7 | Impact Site 2 | 22 | 22 (100%) | 0 (0%) | 0 (0%) | 18 | 17 (94%) | 6 (33%) | 0 (0%) |
| M9 | Impact Site 2 | 21 | 21 (100%) | 0 (0%) | 0 (0%) | 19 | 18 (95%) | 3 (16%) | 0 (0%) |
| Mean | - | 18.6 | 11.6 | 3.2 | 3.6 | 16.2 | 11.8 | 3.3 | 0.0 |
| SD | - | 2.27 | 3.82 | 2.86 | 3.22 | 1.63 | 2.99 | 0.80 | 0.00 |

* Includes nest box denning where relevant and tree denning.

^ Excludes nights when only nocturnal denning was recorded.

Illustration 3.2 shows two tracked northbound lane crossing sequences of glider F7 at Impact Site 2. The sequences comprise:

- 8/07/2019: Sequence of six nocturnal fix locations obtained over a one hour and 45 minute period between 19:26 and 21:11.
- 6/08/2019: Sequence of eight nocturnal fix points obtained over a one hour and 49 minute period between 18:40 and 20:29. The sequence starts with the glider leaving a den tree (D04).

In both sequences F7 starts west of the highway, moves into the median then returns to the western side of the highway.

3.1.2 Den Trees Usage

Fifteen den trees were used during the radio tracking (refer to **Table 3.5** and **Illustration 3.1**), averaging 4.0 den trees per glider (SD: 2.5). Attribute data of each tree is provided in **Appendix C**. A higher number of den trees were used by the gliders at Impact Site 2 (F7 and M9) compared to the gliders at Impact Site 4 (F4, M5 and F7). Fourteen of the den trees were located on land east or west of the highway. One den tree (D13) was located within the median (Impact Site 4). Daytime den usage per tree varied between one and 17 (average 5.8). At Impact Site 2 (west) it was not possible to determine which den tree was being utilised by F7 and M9 on one occasion each. No nest box denning was recorded after the initial glider capture. Nocturnal inspection of nest boxes was observed on two occasions by M5.



Two social groups were identified based on shared den tree occupation and overlapping home ranges (e.g. Sharpe and Goldingay 2007). M5 and F6 shared a den at Impact Site 4 on four days, all within the same den tree (D15). This comprised 50 per cent of the den fixes for F6 prior to the recorded mortality. M5 stopped denning in den tree D15 after F6 died. F7 and M9 shared a den on nine (47 per cent) of the 19 days that den fixes were collected for both gliders at Impact Site 2. Four den trees were shared by F7 and M9 (D5, D6, D8 and D9).

Table 3.5 Diurnal Squirrel Glider Diurnal Den Tree Usage




| <i>Tree Location</i> | <i>Impact Site 2 West</i> | | | | | | | | | | <i>Impact Site 4 East</i> | | | | <i>Impact Site 4 Median</i> | <i>Impact Site 4 West</i> | <i>Total Den Fixes</i> | <i>No. of Den Trees Used</i> | <i>No. Occasions Denning with Another Collared Glider</i> |
|------------------------|---------------------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|---------------------------|------------|------------|------------|-----------------------------|---------------------------|------------------------|------------------------------|---|
| <i>Squirrel Glider</i> | <i>D01</i> | <i>D02</i> | <i>D03</i> | <i>D04</i> | <i>D05</i> | <i>D06</i> | <i>D07</i> | <i>D08</i> | <i>D09</i> | <i>N/A*</i> | <i>D10</i> | <i>D11</i> | <i>D12</i> | <i>D14</i> | <i>D13</i> | <i>D15</i> | | | |
| F4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 7 | 4 | 0 | 0 | 18 | 4 | 0 |
| M5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 16 | 6 | 22 | 2 | 4 (F6) |
| F6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 8 | 1 | 4 (M5) |
| F7 | 0 | 0 | 2 | 1 | 2 | 1 | 11 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 7 | 9 (M9) |
| M9 | 8 | 1 | 0 | 0 | 1 | 0 | 6 | 2 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 6 | 9 (F7) |
| Total | 8 | 1 | 2 | 1 | 3 | 1 | 17 | 4 | 2 | 2 | 6 | 1 | 7 | 4 | 16 | 14 | 89 | - | - |

** On these occasions the den tree was unable to be confirmed due to adverse conditions or variability in signal direction.*




LEGEND

-  Impact Site 2 (median)
 Den tree

F7 fix

-  Capture (nest box)
 Diurnal den fix
 Nocturnal fix

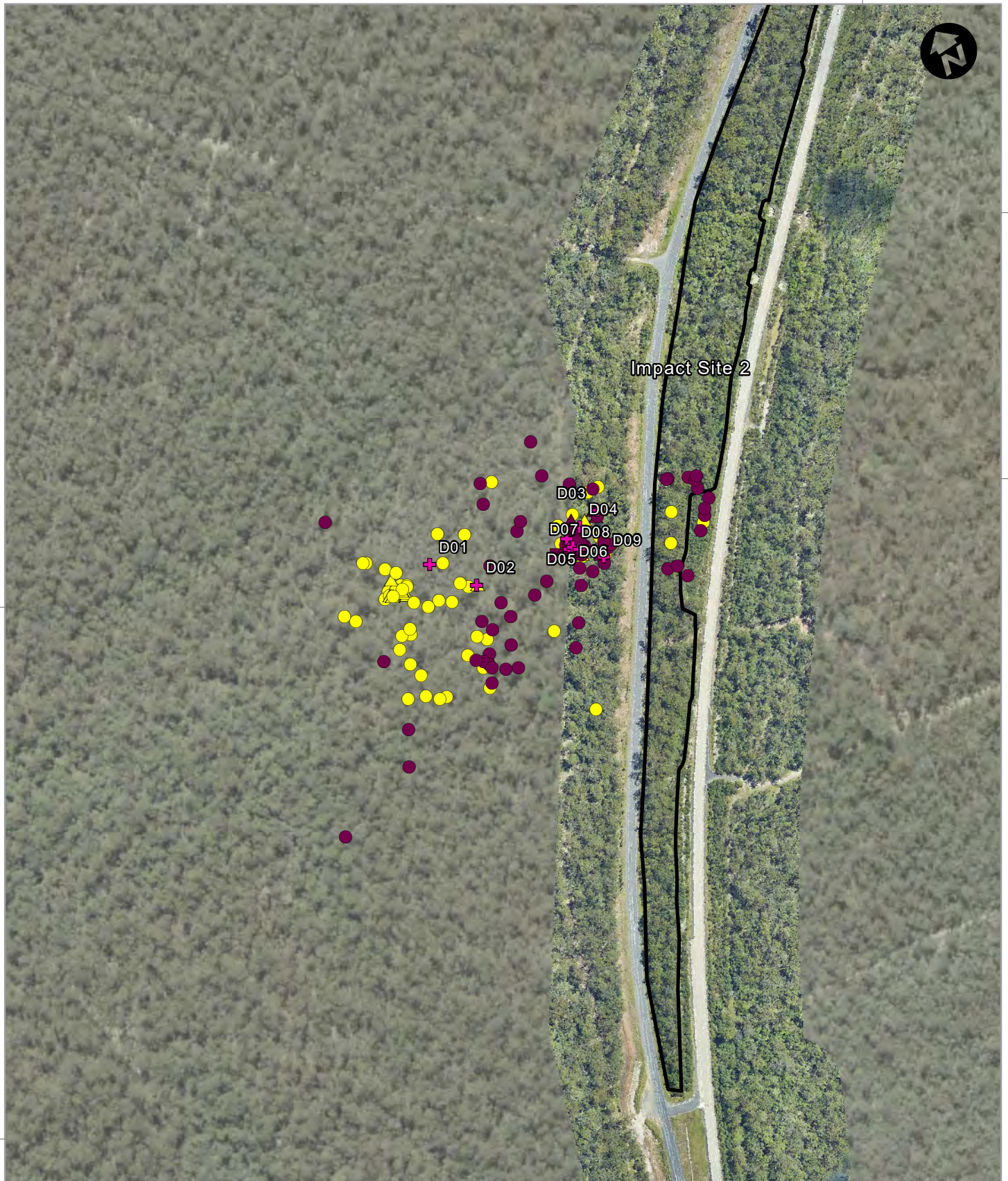
M9 fix

-  Capture (nest box)
 Diurnal den fix
 Nocturnal fix

0 100 Metres



Radio Tracking Results Illustration 3.1 - Sheet 1 of 2



6765000

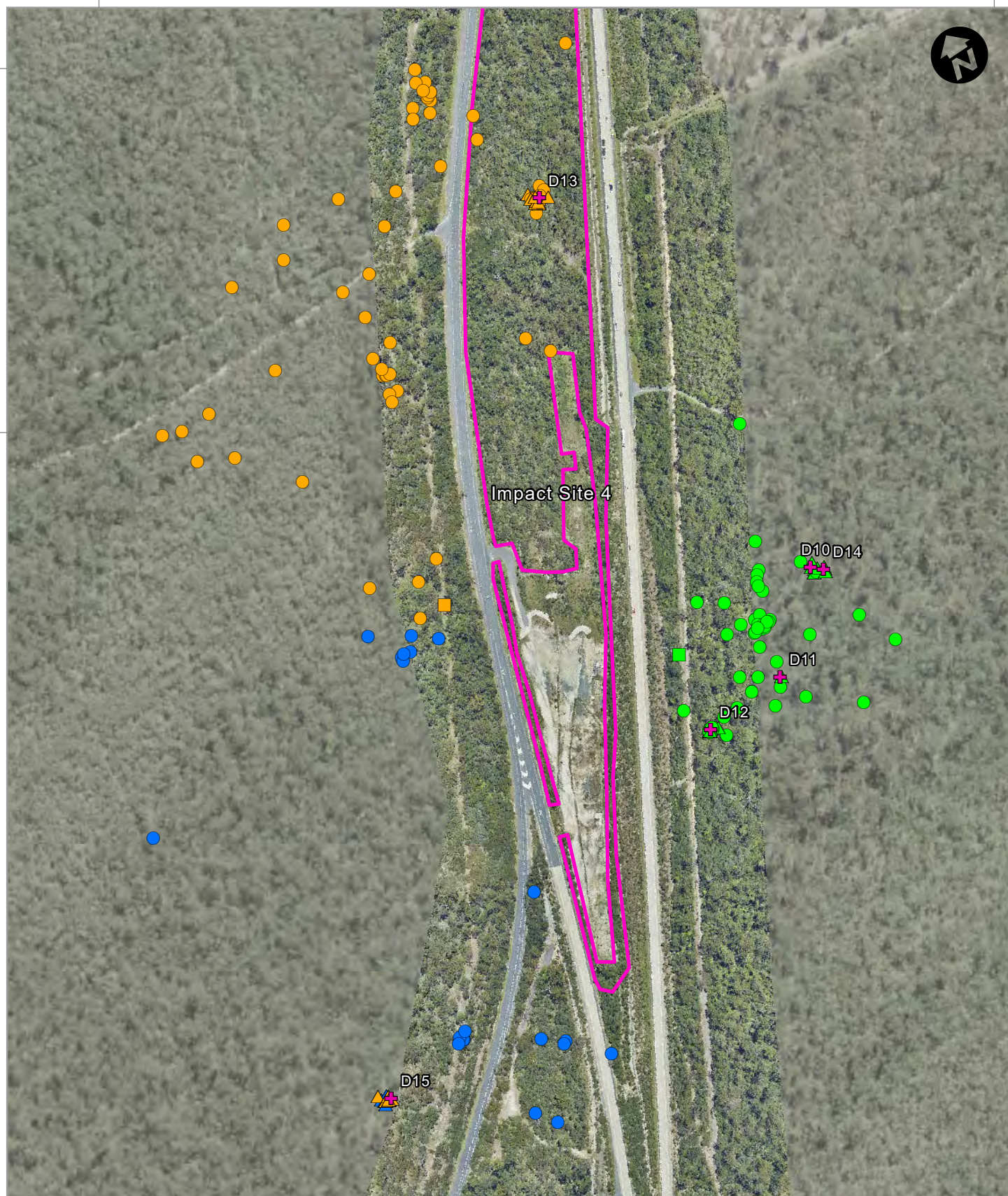
524000

6765000

524000

523000

6764000



6764000

523000

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LEGEND

Impact Site 4 (median)

+ Den tree

F4 fix

■ Capture (Elliott B)

▲ Diurnal den fix

● Nocturnal fix

M5 fix

■ Capture (nest box)

▲ Diurnal den fix

● Nocturnal fix

F6 fix

■ Capture (nest box)

▲ Diurnal den fix

● Nocturnal fix

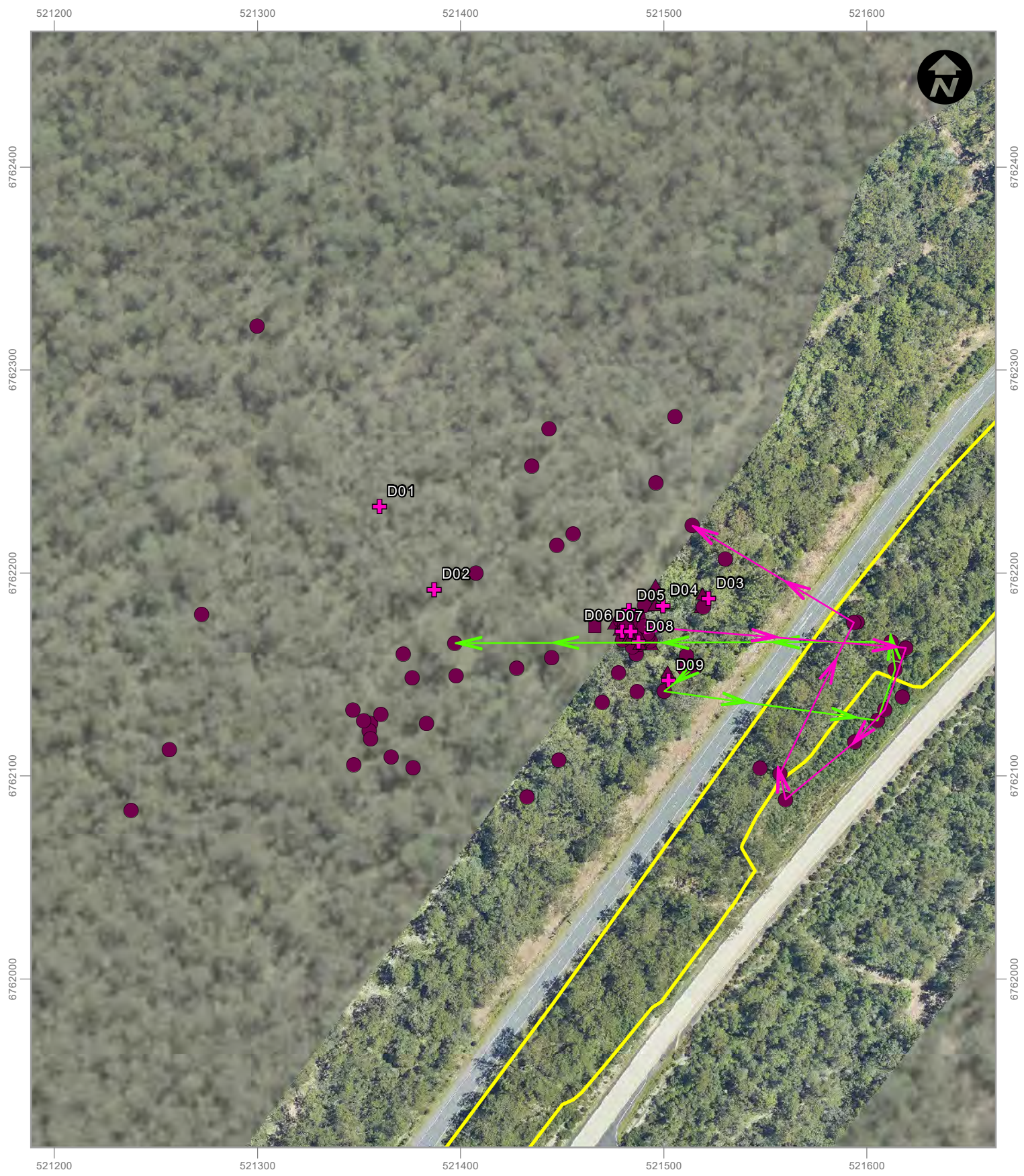
0 100 Metres

GeoLINK
environmental management and design

Squirrel Glider Radio Tracking for Post Construction Ecological Monitoring
2885-1044

Radio Tracking Results Illustration 3.1 - Sheet 2 of 2

Information shown is for illustrative purposes only
Drawn by: AB Checked by: RE Reviewed by: DSA
Source of base data: DFSI
Date: 12/08/2020



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LEGEND

- | | |
|---|--------------------|
| Impact Site 2 (median) | Den tree |
| F7 Crossing 8/07/2019 between 19:26 and 21:11 | Capture (nest box) |
| F7 Crossing 6/08/2019 between 18:40 and 20:29 | Diurnal den fix |
| | Nocturnal fix |

0 50 Metres

Glider F7 Crossing Sequence At Impact Site 2 - Illustration 3.2

3.1.3 Home Range Results

Home range analysis results are provided in **Table 3.6** and displayed in **Illustration 3.3**. Home range sizes varied from 2.54 to 20.49 ha based on the MPC analysis and 2.52 and 14.09 ha based on the Kernel 95 analysis. F4 had the smallest home range which was located exclusively on the eastern side of the highway at Impact Site 4.

M5 and F6 had overlapping home ranges, although the Kernel analysis shows that large portions of their ranges were not overlapping. The mortality of F6 is likely to have influenced this outcome. The home range of both animals included habitat to the west of the highway as well as the median at Impact Site 4. The Kernel 50 home range analysis showed that M5's core home range included the median in the vicinity of den tree D13.

F7 and M9 had overlapping home ranges encompassing land to the west of the highway and the median at Impact Site 2. The Kernel 50 home range analysis results for both animals did not encompass the median.

Table 3.6 Home Range Analysis

| Glider | Days | Fixes | | | | MCP (ha) | Kernel (ha) | | | |
|--------|------|-------|-----------|---------|-------|----------|-------------|-------|----|-----------|
| | | Den* | Nocturnal | Capture | Total | | 50 | 95 | h | grid size |
| F4 | 21 | 18 | 49 | 2 | 69 | 2.54 | 0.46 | 2.52 | 20 | 15 |
| M5 | 26 | 18 | 58 | 1 | 77 | 20.49 | 1.51 | 14.09 | 50 | 15 |
| F6 | 11 | 6 | 20 | 1 | 27 | 13.72 | 1.25 | 11.75 | 55 | 15 |
| F7 | 22 | 12 | 59 | 1 | 72 | 7.51 | 0.52 | 4.76 | 35 | 15 |
| M9 | 22 | 11 | 58 | 1 | 70 | 5.23 | 0.57 | 6.64 | 35 | 15 |
| Mean | 20.4 | 17.4 | 48.4 | 1.2 | 67.0 | 9.90 | 0.86 | 7.95 | 39 | 15 |
| S.E. | 2.24 | 1.49 | 5.33 | 0.18 | 4.64 | 2.89 | 0.19 | 1.93 | 6 | 0 |

Includes only independent fix locations used in home range analysis.

3.2 Glider Performance

Tree height and glide performance calculations from GeoLINK (2019b) were overlaid with home range analysis results to provide an indication of minimum highway crossing glide performance (refer to **Appendix C** and **Illustration 3.4**). Horizontal glide distance ranged between 34 m and 50 m (average 40 m). Tree height of potential launch trees ranged between 14 m and 40 m (average 26 m). The findings for each individual glider are summarised in **Table 3.7** and show:

- Numerous potential launch trees occurred within the home ranges of F7 and M9 on both sides of the northbound lane at Impact Site 2. Minimum required glide performance ratio (vertical drop: horizontal plane) was 1:1.5 for west-east glider movement and 1:1.29 for east-west glider movement.
- Several potential launch trees occurred within the home range of F6 on both sides of the northbound lane at Impact Site 4. Minimum required glide performance ratio was 1:2.17 for west-east glider movement and 1:2.47 for east-west glider movement.
- Numerous potential launch trees occurred within the home range of M5 on both sides of the northbound lane at Impact Site 4. Minimum required glide performance ratio (vertical drop: horizontal plane) was 1:1.27 for west-east glider movement and 1:1.30 for east-west glider movement across the northbound lane.

Table 3.7 Summary of Tree Height, Highway Gap and Minimum Glide Performance Calculations for Northbound Lane Crossing at Recorded Home Ranges

| <i>Glider Home Range</i> | <i>Potential Glide Tree Ref.</i> | <i>Location Relative to Northbound Lane</i> | <i>Tree Height (m)</i> | <i>Distance to Closest Landing Tree (m)</i> | <i>Minimum Required Glide Ratio (vertical drop: horizontal plane)*</i> | <i>Minimum Required Glide Angle*</i> | <i>Frequency of Potential Launch Trees</i> |
|--------------------------|----------------------------------|---|------------------------|---|--|--------------------------------------|--|
| F7 and M9 | SNW06 | West | 40.0 | 50.0 | 1:1.51 | 30.2 | Numerous launch trees in zone |
| F7 and M9 | SNE06 | East (median) | 34.0 | 43.0 | 1:1.29 | 37.7 | Numerous launch trees in zone |
| F7 and M9 | SNW07 | West | 31.0 | 43.0 | 1:1.66 | 31.1 | Numerous launch trees in zone |
| F7 and M9 | SNE07 | East (median) | 29.0 | 43.0 | 1:1.97 | 26.9 | Numerous launch trees in zone |
| F6 | NNW01 | West | 20.0 | 38.5 | 1:2.17 | 24.7 | Several nearby launch trees |
| F6 | NNE01 | East (median) | 23.0 | 42.0 | 1:2.47 | 22 | Several launch trees present |
| M5 | NNW02 | West | 25.0 | 42.0 | 1:2.08 | 25.6 | Several launching trees available in zone |
| M5 | NNE02 | East (median) | 14.0 | 43.0 | 1:4.14 | 13.6 | Several launching trees available in zone |
| M5 | NNW03 | West | 31.0 | 34.0 | 1:1.27 | 38.2 | Numerous launch tree options available |
| M5 | NNE03 | East (median) | 21.0 | 34.0 | 1:1.91 | 27.6 | Numerous launch tree options available |
| M5 | NNW04 | West | 25.0 | 37.0 | 1:1.70 | 30.5 | Numerous launch options available |
| M5 | NNE04 | East (median) | 23.0 | 37.0 | 1:2.02 | 26.3 | Numerous launch options |
| M5 | NNW05 | West | 28.0 | 39.0 | 1:1.80 | 29 | Various launch options |
| M5 | NNE05 | East (median) | 20.0 | 39.0 | 1:2.22 | 24.3 | Minimal tall launch tree options |
| M5 | NNW06 | West | 26.0 | 34.0 | 1:1.56 | 32.6 | Numerous launch trees available |
| M5 | NNE06 | East (median) | 20.0 | 34.0 | 1:2.13 | 25.1 | Numerous launch trees available |
| M5 | NNW07 | West | 31.0 | 39.0 | 1:1.42 | 35.1 | Several launch options in zone |
| M5 | NNE07 | East (median) | 33.0 | 39.0 | 1:1.30 | 37.5 | Several launch options in zone |
| Mean | - | - | 26.3 | 39.5 | 1:1.923 | 28.78 | - |
| SD | - | - | 6.4 | 4.3 | 0.657 | 6.22 | - |

* Calculations are based on Goldingay and Taylor (2009) where Potential Glide Distance = $1.84 \times (\text{tree height} - 2 \text{ m} - 3 \text{ m} + \text{elevation difference}) + 2 \text{ m}$. This allows for gliding 2 m below the tree top; 2 m out from the trunk; and landing 3 m above ground.

3.3 Moon Influence

Table 3.8 shows the numbers of active and denning nocturnal glider fixes at ≤50 per cent and 51-100 per cent moon illumination. A chi square test showed that there were significant differences in glider activity in the two moon illumination categories ($\chi^2 = 92$, $< P 0.001$). Gliders were often denning during the night when the moon illumination was between 51-100 per cent. In contrast, gliders were more active at night when the moon was absent or illumination was ≤50 per cent.

Table 3.8 Numbers of Active and Denning Glider Nocturnal Fixes and Moon Illumination (the table gives both observed and expected (in brackets) numbers)

| <i>Moon Illumination</i> | <i>Active Nocturnal Fix</i> | <i>Denning Nocturnal Fix</i> | <i>Total</i> |
|---------------------------------|------------------------------------|-------------------------------------|---------------------|
| 0-50% | 173 (141) | 16 (48) | 189 |
| 51-100% | 31 (63) | 53 (21) | 84 |
| Total | 204 | 69 | 273 |



LEGEND

Impact Site 2 (median)
 Den tree

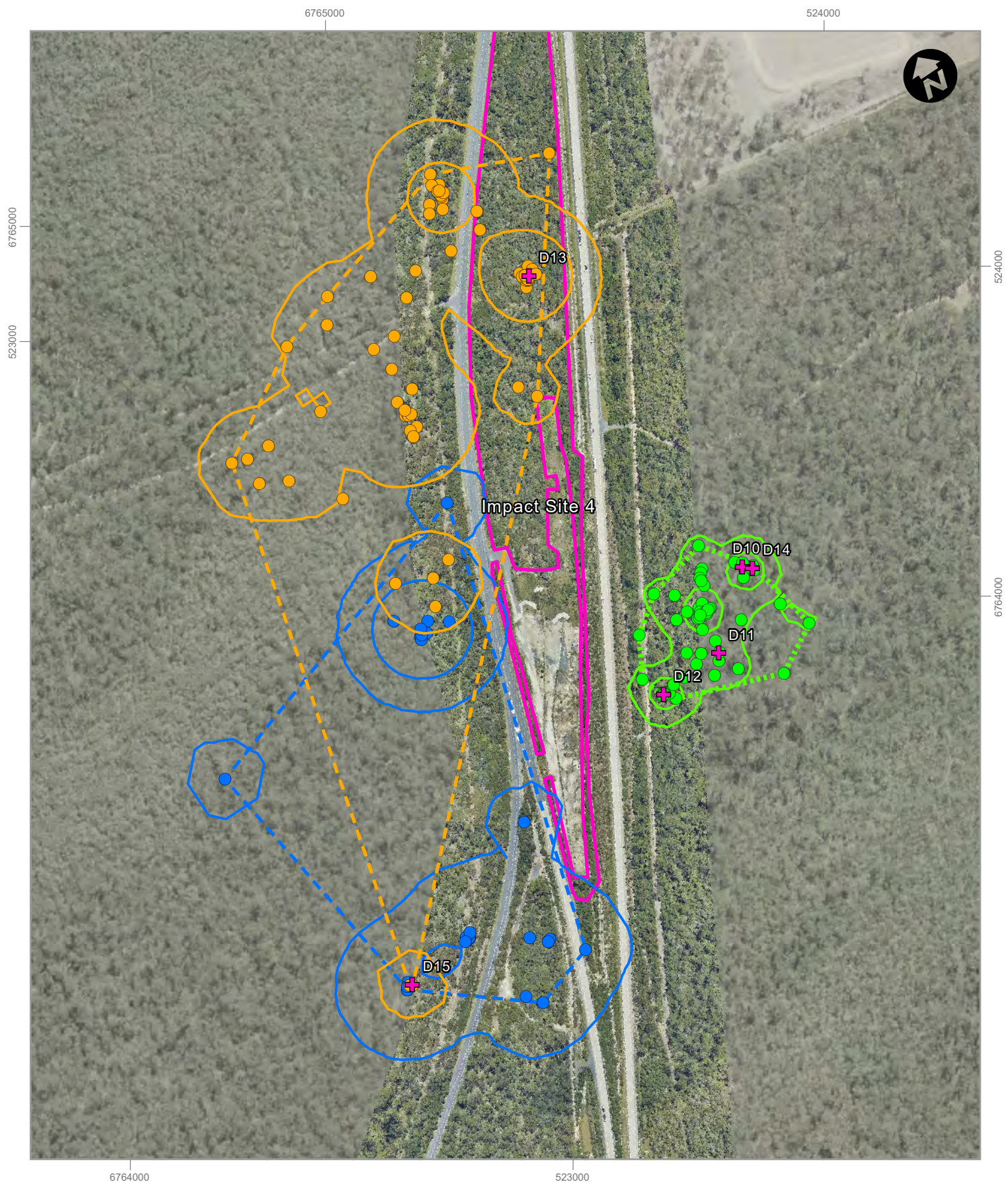
F7 fix
 F7 FK home range estimate

M9 fix
 M9 FK home range estimate
 M9 MCP home range estimate

GDA 1994 MGA Zone 56

0 120 Metres

Home Range Analysis Illustration 3.3 - Sheet 1 of 2



GDA 1994 MGA Zone 56

LEGEND

- | | | | |
|---|--|---|---|
| Impact Site 4 (median) | ● F4 fix | ● M5 fix | ● F6 fix |
| + Den tree | F4 FK home range estimate | M5 FK home range estimate | F6 FK home range estimate |
| | F4 MCP home range estimate | M5 MCP home range estimate | F6 MCP home range estimate |

0 120 Metres



LEGEND

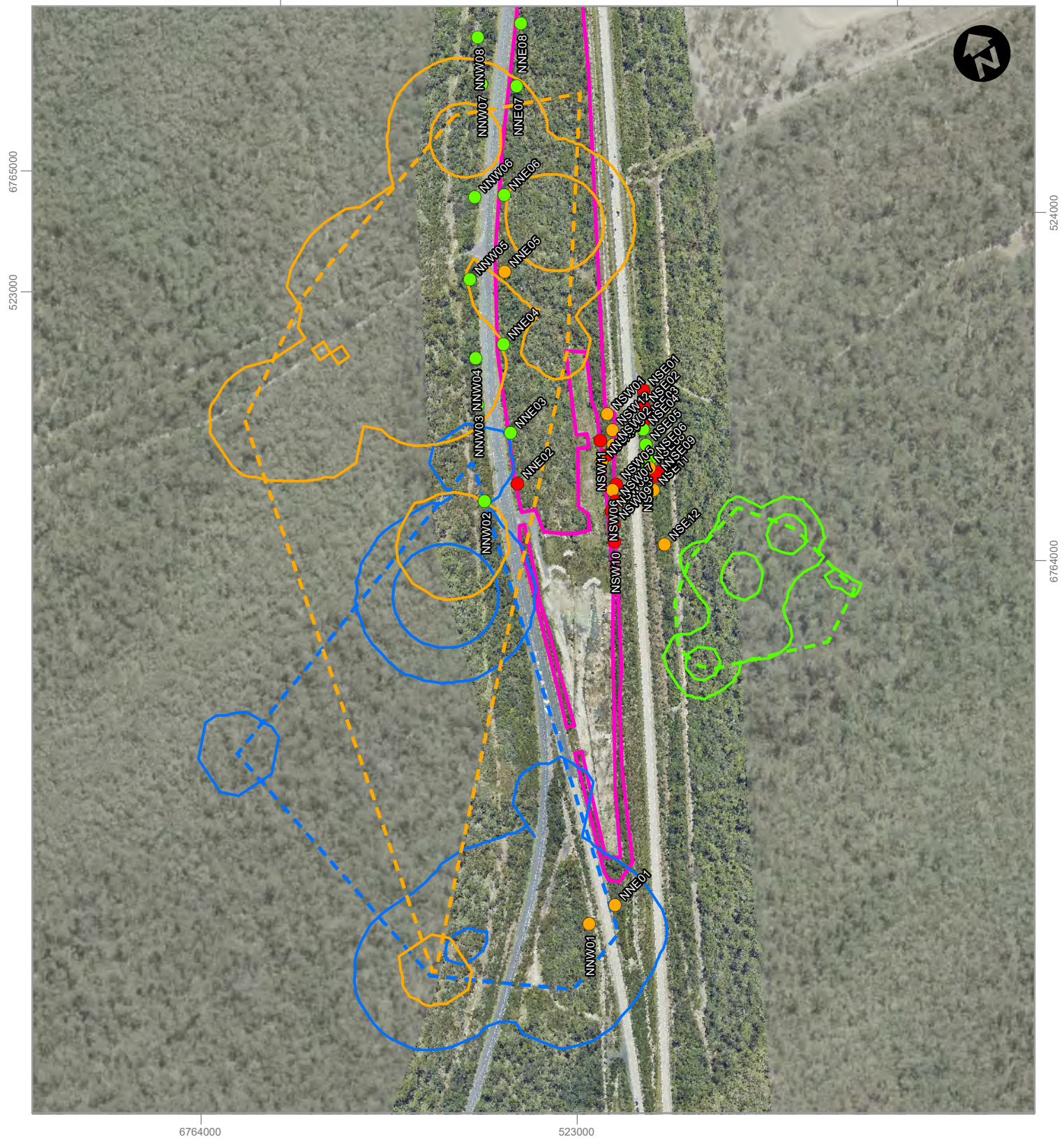
- Impact Site 2 (median)
- F7 FK home range estimate
- F7 MCP home range estimate
- M9 FK home range estimate
- M9 MCP home range estimate

Potential glide tree based on 1:1.84 glide ratio (GeoLINK 2019b)

- Yes
- No however within glide angle standard deviation range
- No

Tree Locations for Glide Performance Calculation and Home Range Analysis Results Illustration 3.4 - Sheet 1 of 2

0 120 Metres



6764000

523000

GDA 1994 MGA Zone 56

LEGEND

Impact Site 4 (median)

- F4 FK home range estimate
- F4 MCP home range estimate
- M5 FK home range estimate
- M5 MCP home range estimate
- F6 FK home range estimate
- F6 MCP home range estimate

Potential glide tree based on 1:1.84 glide ratio (GeoLINK 2019b)

- Yes
- No however within glide angle standard deviation range
- No

0 120 Metres

Tree Locations for Glide Performance Calculation and Home Range Analysis Results Illustration 3.4 - Sheet 2 of 2

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Source of base data:

Date:

Revision:



4. Discussion

4.1 Road Crossings at Vegetated Medians

The radio tracking results demonstrate that both male and female Squirrel Gliders were able to cross the northbound lane of the Pacific Highway at both medians at the Devils Pulpit site under no night traffic conditions. All four gliders that crossed the northbound lane used the medians as part of their home ranges that extend into habitat to the west. The distance between trees on opposite sides of the northbound lane at recorded home ranges was typically <50 m and required a glide performance similar or less than the average Squirrel Glider glide performance recorded by Goldingay and Taylor (2009; i.e. 28.5° ($SD7.4^\circ$)) to cross the lane.


One female glider (F6) crossed the northbound lane in a location requiring an above average glide performance at the southern end of the median at Impact Site 4. A 24.7° glide angle for west-east movement and 22° glide angle for east-west movement was required. This is within the average glide performance standard deviation range recorded in Goldingay and Taylor (2009).

The radio tracking results are consistent with previous studies that have recorded Squirrel Gliders using vegetated medians (van der Ree, et al. 2010) or constructed glider poles (Taylor and Goldingay 2013; Soanes et al. 2013; Goldingay et al. 2018) to cross roads where glide distances are achievable.

No crossings of the southbound lane were recorded, therefore the maintenance of Squirrel Glider movement across this newly constructed carriageway has not been demonstrated. It is unclear if this was due to:

- The radio tracked gliders home range did not encompass habitat on the eastern side of the southbound lane. The vegetation edge along the southbound lane may be used to define the eastern home range extent of radio tracked gliders.
- The small sample of gliders able to be captured and radio tracked as part of this study.
- The southbound lane creating a barrier to glider movement. Clearing width, tree height and glider performance calculations based on conditions at the time of the radio tracking however indicate that Squirrel Gliders could physically cross the southbound lane at both medians. The required glide performance was within the average glide performance standard deviation range recorded in Goldingay and Taylor (2009).

The radio tracking results do not rule out the potential for traffic related behavioural barriers at the site. The northbound lane was closed to traffic and subject to only daytime construction works during the radio tracking. Both lanes of traffic were however open during Years 3 and 4 post construction monitoring spotlighting and nest box monitoring at Devils Pulpit between winter 2017 and summer 2019. Varying occurrences of Squirrel Gliders in the medians were recorded during this period (GeoLINK 2019a, 2018). This suggests that the gliders were crossing with live traffic. These results and records of Squirrel Gliders crossing roads of varying width and traffic volumes within the glide capability (van der Ree 2006; Melton 2007; Goldingay et al. 2018; personal observations); suggests that traffic may not be a factor impacting glider movement across the highway at the site. Further monitoring would be required to determine potential traffic impacts on glider movement.



Overall, based on the clearing widths at the time of the radio tracking it is expected that Squirrel Gliders could cross both the northbound and southbound lanes of the Pacific Highway at the vegetated medians when both lanes are open to traffic. Known habitat occurs on both sides of the highway and the vegetated medians provide crossing opportunities for both resident and dispersing gliders.

4.2 Frequency of Road Crossing

The recorded frequency of glider movement across the northbound lane into the median was greater than Squirrel Glider visits to the Devils Pulpit rope bridge poles during the post construction monitoring undertaken to date (GeoLINK 2019a, 2018). This suggests that the vegetated medians at the Devils Pulpit site provide greater opportunities for Squirrel Glider movement across the highway. Part of the reason for this could be that there are many more crossing opportunities when numerous potential launch trees are available compared to a singular location when artificial crossing structures are used. However, given accumulating evidence of the use of arboreal crossing structures by the Squirrel Glider and other gliding species (e.g. Ball and Goldingay 2008; Soanes et al. 2015, 2018; Goldingay et al. 2018), the use of rope bridges and gliding poles is warranted where clearing gaps exceed gliding ability.

Numerous studies have looked at Squirrel Glider use of vegetated medians, rope bridges and poles to cross roads (e.g. Soanes et al. 2014; Soanes et al. 2013; Taylor 2010). The frequency of use of these crossing structures varies depending on specific site conditions and glider home range configurations. The objective of any glider crossing structure and target frequency of fauna movement should be considered when determining the appropriate glider connectivity structure for a particular site. Site topography, maintenance requirements and clearing impacts should also be considered.

4.3 Home Range and Denning

Recorded home range sizes and den tree numbers were comparable to those recorded in similar Squirrel Glider studies that reported mean kernel estimates of 4.3 - 14.8 ha (Sharpe and Goldingay 2007; Goldingay et al. 2010; Brearley et al. 2011). Two gliders from Impact Site 4 (northern median; one male and one female) and two gliders from the Impact Site 2 (southern median; one male and one female) were from the same family group. They supported overlapping home ranges and were recorded den sharing on multiple occasions. Limited overlap between the two gliders from the northern median (M5 and F6) however suggested the potential polygynous social arrangement.

Polygyny is thought to develop where there are sufficient food resources to enable males to defend the home range of more than one female (Lee and Cockburn 1985). For example, Goldingay (1990) attributed the occurrence of polygyny in the Yellow-bellied Glider (*Petaurus australis*) to the availability of nectar in a coastal forest in southern NSW relative to a nearby hinterland forest where nectar was not important and groups were monogamous (Goldingay and Kavanagh 1990). While members of polygynous groups typically den together, there are unknown reasons for them to den apart in some locations. This situation was observed in the Squirrel Glider at a site on the lower NSW north coast (Dr David Sharpe unpublished data).



4.4 Nest Box Usage

The Squirrel Gliders showed a negative response to nest box inspection and collaring, indicated by:

- None of the radio tracked Squirrel Gliders returning to the nest boxes to den during the radio tracking
- Observations of gliders vacating nest boxes during the day prior to any interaction with the respective nest box during initial nest box inspections (e.g. during establishment of string lines and climbing ropes).

The latter shows a negative response to the nest box inspection, not just from the stress from the handling and collaring process. The observation has implications for other nest box monitoring projects, including:

- Nest box design and inspection ability
- Monitoring methodology and frequency
- Results interpretation.

The availability of tree hollow den sites within the local landscape may also influence post disturbance nest box usage. At the Devils Pulpit site for example, hollow-bearing trees were relatively common and provided alternative denning opportunities not associated with direct human interaction.

4.5 Moon Influence

The behaviour of Squirrel Gliders at the site was observed to be influenced by the moon's illumination. While Squirrel Gliders are known to return to den between feeding bouts (Sharpe and Goldingay 2018), this study found that Squirrel Gliders were:

- More active during no or low moon illumination periods
- Nocturnal denning more when night conditions were bright, corresponding with periods when the moon was present during the first quarter - full - last quarter half of the moon phase.

Linley et. al., (2020) found that moon phase affects the nocturnal activity of mammal species and that, for prey species, there might be trade-offs between predation risk and foraging.

Sharpe and Goldingay (2018) in contrast did not observed any moon phase variation in the percentage of time used for feeding by the Squirrel Glider in Brisbane, however a complex interaction between season, moon phase or sex was observed. The consistent anthropogenic lighting (light pollution) in Brisbane may have influenced this outcome, resulting in the gliders being less influenced by variation in moon illumination. Light pollution is low at the Devils Pulpit site, with anthropogenic lighting being relatively localised to highway and associated with vehicle lights and a rest area.

These findings have implications for:

- Squirrel Glider survey design and results interpretation
- Understanding behaviour in natural and modified (artificial lighting) environments.



5. Recommendations

5.1 Recommendations


The following recommendations are provided for Transport for NSW consideration:

- Ecological monitoring programs developed for future projects should be designed and timed to enable before and after impact trends to be clearly observed. A greater understanding of Squirrel Glider activity and home ranges at the site before impact would have enabled greater interpretation of post construction monitoring results and the overall effectiveness of connectivity measures.
- While the completed radio tracking has satisfied EMP requirements, repeating the Squirrel Glider radio tracking under operational conditions (post Woolgoolga to Ballina construction influences; with two lanes of open traffic and 'normal' traffic volumes) would help determine whether traffic is affecting glider movement across the highway. This is not a requirement of the EMP, however could be encouraged in collaboration with research institutions (e.g. as part of post graduate studies).
- Nest box monitoring programs should consider potential disturbance influences when developing programs and interpreting results.
- Squirrel glider surveys and monitoring programs should be designed with consideration to potential moon phase/illumination influences. Nocturnal surveys targeting active Squirrel Gliders in environments with no or low levels of light pollution should avoid periods of bright moon illumination.



References

- Ball, T.M. and Goldingay, R.L. (2008) Can wooden poles be used to connect habitat for a gliding mammal? *Landscape and Urban Planning* **87**: 140-46.
- BoM (2019). *Climate Data Online*, for the Yamba Pilot Station (site number: 058012). Australian Government Bureau of Meteorology (BoM) website: www.bom.gov.au/climate/data/, accessed 24/12/2019.
- Brearley, G., McAlpine, C., Bell, S. and Bradley, A. (2011) Squirrel glider home ranges near urban edges in eastern Australia. *Journal of Zoology* **285**: 256-65.
- GeoLINK (2019a). *Second Annual Report for Post Construction Year 3, 4 and 6 Ecological Monitoring Devils Pulpit Pacific Highway Upgrade*. Unpublished report prepared for NSW Roads and Maritime Services. GeoLINK Consulting, Lennox Head.
- GeoLINK (2019b). *W2B Devils Pulpit Widened Median Glider Crossing Ability Assessment*. Unpublished report prepared for BMD Construction. GeoLINK Consulting, Lennox Head.
- GeoLINK (2018). *First Annual Report for Post Construction Year 3, 4 and 6 Ecological Monitoring Devils Pulpit Pacific Highway Upgrade*. Unpublished report prepared for NSW Roads and Maritime Services. GeoLINK Consulting, Lennox Head.
- GeoLINK (2012a). *Devils Pulpit Highway Class A Upgrade – Rope Bridge Assessment for Target Glider Species at the Northern and Southern Vegetated Medians/Glider Crossings*. Unpublished report prepared for John Holland Group. GeoLINK Consulting, Lennox Head.
- GeoLINK (2012b). *Devils Pulpit Pacific Highway Class A Upgrade – Rope Bridge Assessments for Target Glider Species at the Northern and Southern Vegetated Medians/Glider Crossings*. Unpublished report prepared for John Holland Group. GeoLINK Consulting, Lennox Head.
- Goldingay, R.L. (1992) Socioecology of the yellow-bellied glider (*Petaurus australis*) in a coastal forest. *Australian Journal of Zoology* **40**: 267-78.
- Goldingay, R.L. and Kavanagh, R.P. (1990) Socioecology of the yellow-bellied glider, *Petaurus australis*, at Waratah-Creek, N.S.W. *Australian Journal of Zoology* **38**: 327-41.
- Goldingay, R. L. and Taylor, B.D. (2009). Gliding performance and its relevance to gap crossings by the squirrel glider (*Petaurus norfolcensis*)., *Australian Journal of Zoology*, **57**, 99-104.
- Goldingay, R.L., Sharpe, D.J. and Dobson, M.D.J. (2010) Variation in the home-range size of the squirrel glider (*Petaurus norfolcensis*). *Australian Mammalogy* **32**, 183-88.
- Goldingay, R. L., Taylor, B. D., Parkyn, J. L. (2018). Use of tall wooden poles by four species of gliding mammal provides further proof of concept for habitat restoration, in *Australian Mammalogy* <https://doi.org/10.1071/AM18008>.
- Hyder (2012). *Devils Pulpit Upgrade – Ecological Monitoring Program*. Unpublished report prepared for NSW Roads and Maritime Services. Hyder Consulting Pty, Ltd, North Sydney.
- Hyder (2011). *Pacific Highway Upgrade – Devils Pulpit Project – Appendix D. Technical Working Paper – Ecology*. Unpublished report prepared for NSW Roads and Traffic Authority. Hyder Consulting Pty, Ltd, North Sydney.



Lee, A.K. and Cockburn, A. (1985) Evolutionary Ecology of Marsupials. Cambridge University Press, Cambridge.

Linley G. D., Pauligk Y., Marneweck C., and Ritchie E. G. (2020). Moon phase and nocturnal activity of native Australian mammals, in *Australian Mammalogy* - <https://doi.org/10.1071/AM19070>

Sharpe, D.J. and Goldingay, R.L. (2007) Home range of the Australian squirrel glider *Petaurus norfolcensis* (Diprotodontia). *Journal of Mammalogy* **88**, 1515-22.

Soanes K., Carmody Lobo M., Vesk P. A., McCarthy M. A., Moore J. L. and van der Ree R. (2013). Movement re-established but not restored: inferring the effectiveness of road-crossing mitigation for a gliding mammal by monitoring use, in *Biological Conservation* **159**, 434–441

Soanes K., Vesk P. A. and van der Ree R. (2015). Monitoring the use of road-crossing structures by arboreal marsupials: insights gained from motion-triggered cameras and passive integrated transponder (PIT) tags, in *Wildlife Research* **42**, 241-256

Soanes, K., Taylor, A. C., Sunnucks, P., Vesk, P. A., Cesarini, S., and van der Ree, R. (2018). Evaluating the success of wildlife crossing structures using genetic approaches and an experimental design: lessons from a gliding mammal, in *Journal of Applied Ecology* **55**, 129–138.

Soanes, K., Taylor, A.C., Sunnucks, P., Vesk, P.A., Cesarini, S., van der Ree, R. and Wiersma, Y. (2018) Evaluating the success of wildlife crossing structures using genetic approaches and an experimental design: Lessons from a gliding mammal. *Journal of Applied Ecology* **55**: 129-38. Taylor, B. D. (2010). *Use and effectiveness of engineered road crossing-structures for wildlife in eastern Australia*. Thesis, Griffith School of Environment Science, Environment, Engineering and Technology, Griffith University.

Taylor, B. D. and Goldingay, R. L. (2013). Squirrel glider use of roadside glide poles to cross a road gap, in *Australian Mammalogy* **35**;119.

van der Ree, R. (2006). Road upgrade in Victoria a filter to the movement of the endangered squirrel glider (*Petaurus norfolcensis*): results of a pilot study, in *Ecological Management and Restoration* **7**, 226-228.

van der Ree R., Cesarini S., Sunnucks P., Moore J. L., and Taylor A. (2010). Large gaps in canopy reduce road crossing by a gliding mammal, in *Ecology and Society* **15**, 35.



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Appendix A

Weather Conditions and Moon Phase

Table A1 Weather Conditions and Moon Phase During July and August 2019

| Date | Temperature | | Rainfall (mm)* | Moon Phase^ | Moon Rising Time^ | Moon Set Time^ | Illumination (%)^ |
|----------------|-----------------|-------------------|------------------|---------------|-------------------|----------------|-------------------|
| | High* | Low* | | | | | |
| 1/07/2019 | 19.7 | 13.7 | 0.2 | | 4:42 am | 3:33 pm | 4.3 |
| 2/07/2019 | 21.8 | 12.5 | 0 | | 5:45 am | 4:27 pm | 0.8 |
| 3/07/2019 | 20.8 | 11.9 | 0.2 | New moon | 6:47 am | 5:27 pm | 0.1 |
| 4/07/2019 | 21.5 | 13.5 | 4.4 | | 7:46 am | 6:32 pm | 2.5 |
| 5/07/2019 | 20.7 | 15.9 | 25.8 | | 8:41 am | 7:40 pm | 7.8 |
| 6/07/2019 | 20.5 | 16.2 | 6.4 | | 9:30 am | 8:47 pm | 15.7 |
| 7/07/2019 | 19.5 | 12.7 | 4 | | 10:13 am | 9:53 pm | 25.7 |
| 8/07/2019 | 18.1 | 14.1 | 10.4 | | 10:54 am | 10:57 pm | 36.9 |
| 9/07/2019 | 20.5 | 11.2 | 1.2 | First quarter | 11:31 am | - | 48.6 |
| 10/07/2019 | 21.6 | 10.2 | 0.2 | | 12:08 pm | 12:00 am | 60.2 |
| 11/07/2019 | 23.4 | 11.2 | 0 | | 12:46 pm | 1:01 am | 70.9 |
| 12/07/2019 | 24.8 | 11.2 | 0 | | 1:25 pm | 2:01 am | 80.4 |
| 13/07/2019 | 23.1 | 13.1 | 0 | | 2:06 pm | 3:01 am | 88.3 |
| 14/07/2019 | 17.9 | 8 | 0 | | 2:51 pm | 4:00 am | 94.3 |
| 15/07/2019 | 19.4 | 8.2 | 0 | | 3:39 pm | 4:58 am | 98.2 |
| 16/07/2019 | 22 | 7.3 | 0 | | 4:30 pm | 5:52 am | 99.9 |
| 17/07/2019 | 19.8 | 7.7 | 0 | | 5:23 pm | 6:42 am | - |
| 18/07/2019 | 19.2 | 9.8 | 0 | Full moon | 6:18pm | 7:27 am | 99.5 |
| 19/07/2019 | 21.9 | 7.4 | 0 | | 7:11 pm | 8:08 am | 97.2 |
| 20/07/2019 | 21 | 8.1 | 0 | | 8:05 pm | 8:46 am | 93.0 |
| 21/07/2019 | 23.3 | 9.4 | 0 | | 8:57 pm | 9:20 am | 87.2 |
| 22/07/2019 | 23.2 | 9.6 | 0 | | 9:49 pm | 9:52 am | 80.0 |
| 23/07/2019 | 23.3 | 11.2 | 0 | | 10:41 pm | 10:23 am | 71.6 |
| 24/07/2019 | 25 | 9.3 | 0 | | 11:34 pm | 10:54 am | 62.4 |
| 25/07/2019 | 17.6 | 10.5 | 0 | Third quarter | - | 11:26 am | 52.5 |
| 26/07/2019 | 22.6 | 11.8 | 2.4 | | 12:28 am | 12:00 pm | 42.2 |
| 27/07/2019 | 20.9 | 13.4 | 0 | | 1:25 am | 12:38 pm | 32.0 |
| 28/07/2019 | 20.6 | 10.8 | 0 | | 2:24 am | 1:22 pm | 22.2 |
| 29/07/2019 | 21.6 | 10.5 | 0 | | 3:26 am | 2:11 pm | 13.5 |
| 30/07/2019 | 21.6 | 11.4 | 0 | | 4:28 am | 3:08 pm | 6.4 |
| 31/07/2019 | 14.6 | 11.1 | 5.8 | | 5:29 am | 4:12 pm | 1.8 |
| Monthly | Mean: 21 | Mean: 11.1 | Total: 61 | - | - | - | - |



| Date | Temperature | | Rainfall (mm)* | Moon Phase^ | Moon Rising Time^ | Moon Set Time^ | Illumination (%)^ |
|------------|-------------|------------|----------------|---------------|-------------------|----------------|-------------------|
| | High* | Low* | | | | | |
| 1/08/2019 | 19.1 | 11.1 | 43.2 | New moon | 4:42 am | 3:33 pm | 4.3 |
| 2/08/2019 | 19.2 | 10.7 | 21 | | 5:45 am | 4:27 pm | 0.8 |
| 3/08/2019 | 20.1 | 10.1 | 12 | | 6:47 am | 5:27 pm | 0.1 |
| 4/08/2019 | 20.4 | 10.1 | 0.6 | | 7:46 am | 6:32 pm | 2.5 |
| 5/08/2019 | 23.2 | 10.8 | 0.2 | | 8:41 am | 7:40 pm | 7.8 |
| 6/08/2019 | 22 | 11.1 | 0 | | 9:30 am | 8:47 pm | 15.7 |
| 7/08/2019 | 20.2 | 12.3 | 0 | | 10:13 am | 9:53 pm | 25.7 |
| 8/08/2019 | 26.8 | 13 | 0 | First quarter | 10:54 am | 10:57 pm | 36.9 |
| 9/08/2019 | 23.6 | 11.8 | 0 | | 11:31 am | - | 48.6 |
| 10/08/2019 | 21.2 | 12.3 | 0 | | 12:08 pm | 12:00 am | 60.2 |
| 11/08/2019 | 19.1 | 10.1 | 0 | | 12:46 pm | 1:01 am | 70.9 |
| 12/08/2019 | 18.8 | 7.4 | 0 | | 1:25 pm | 2:01 am | 80.4 |
| 13/08/2019 | 20.2 | 8.8 | 0 | | 2:06 pm | 3:01 am | 88.3 |
| 14/08/2019 | 20.5 | 11.3 | 0.2 | | 2:51 pm | 4:00 am | 94.3 |
| 15/08/2019 | 22.7 | 10.2 | 0 | Full moon | 3:39 pm | 4:58 am | 98.2 |
| 16/08/2019 | 25.3 | 11.4 | 0 | | 4:30 pm | 5:52 am | 99.8 |
| 17/08/2019 | 26 | 10.3 | 0 | | 5:23 pm | 6:42 am | - |
| 18/08/2019 | 21.8 | 11.4 | 0 | | 6:18 pm | 7:27 am | 99.5 |
| 19/08/2019 | 26.7 | 14.1 | 0 | | 7:11 pm | 8:08 am | 97.2 |
| 20/08/2019 | 19.1 | 7.7 | 0 | | 8:05 pm | 8:46 am | 93.0 |
| 21/08/2019 | 25.9 | 8.9 | 0 | | 8:57 pm | 9:20 am | 87.2 |
| 22/08/2019 | 26.5 | 11.9 | 0 | | 9:49 pm | 9:52 am | 80.0 |
| 23/08/2019 | 20 | 12.1 | 0 | | 10:41 pm | 10:23 am | 71.6 |
| 24/08/2019 | 22.8 | 9.1 | 0 | Third quarter | 11:34 pm | 10:54 am | 62.4 |
| 25/08/2019 | 23.7 | 10.9 | 0 | | - | 11:26 am | 52.5 |
| 26/08/2019 | 22.1 | 13 | 0 | | 12:28 am | 12:00 pm | 42.2 |
| 27/08/2019 | 23.5 | 14.9 | 0 | | 1:25 am | 12:38 pm | 32.0 |
| 28/08/2019 | 19.8 | 15.9 | 0 | | 2:24 am | 1:22 pm | 22.2 |
| 29/08/2019 | 21 | 12.6 | 0 | | 3:26 am | 2:11 pm | 13.5 |
| 30/08/2019 | 19.3 | 10.9 | 0.6 | New moon | 4:28 am | 3:08 pm | 6.4 |
| 31/08/2019 | 19.2 | 10.7 | 1.2 | | 5:29 am | 4:12 pm | 1.8 |
| Monthly | Mean: 26.8 | Mean: 11.2 | Total: 79 | - | - | - | - |

* Weather data is from Australian Government Bureau of Meteorology (BoM), Climate Data Online website: www.bom.gov.au/climate/data/, for the Yamba Pilot Station (site number: 058012). Accessed 24/12/2019.

^ Moon phase data is from timeanddate.com for Lismore, NSW. Accessed 24/12/2019.




Appendix B

Den Tree Attribute Data

Table B1 Den Tree Attribute Data

| HBT No. | Site | Common Name | Scientific Name | Comment | Tree Height (m) | DBH (cm) | Easting | Northing | Total Hollows | Small Limb Hollow (<5cm) | Medium Limb Hollow (5-15cm) | Large Limb Hollow (>15cm) | Small Trunk Hollow (<5cm) | Medium Trunk Hollow (5-15cm) | Large Trunk Hollow (>15cm) |
|---------|---------------|------------------------|--------------------------------|--|-----------------|----------|---------|----------|---------------|--------------------------|-----------------------------|---------------------------|---------------------------|------------------------------|----------------------------|
| D01 | Impact 2 west | Stag | - | Hollow not visible from the ground. | 20 | 35 | 521360 | 6762233 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| D02 | Impact 2 west | Stag | - | Dead Swamp Box (<i>L. suaveolens</i>) | 22 | 95 | 521387 | 6762192 | - | - | - | - | - | - | - |
| D03 | Impact 2 west | Forest Red Gum | <i>Eucalyptus tereticornis</i> | Possible den tree only. Hollows not visible on the ground and signal was variable. | 39 | 120 | 521522 | 6762188 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| D04 | Impact 2 west | Northern Grey Ironbark | <i>Eucalyptus siderophloia</i> | Trunk hollow has vertical opening | 26 | 45 | 521499 | 6762184 | 2 | 0 | 1 | 0 | 0 | 1 | 0 |
| D05 | Impact 2 west | Northern Grey Ironbark | <i>Eucalyptus siderophloia</i> | Possible den tree only. No visible hollows. Possible cavity in folk. | 30 | 85 | 521483 | 6762181 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D06 | Impact 2 west | Forest Red Gum | <i>Eucalyptus tereticornis</i> | Medium limb hollow is in a termitaria. | 20 | 40 | 521479 | 6762171 | 4 | 1 | 2 | 0 | 0 | 1 | 0 |
| D07 | Impact 2 west | Broad-leaved Paperbark | <i>Melaleuca quinquenervia</i> | Vertical pipe. | 15 | 60 | 521484 | 6762171 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| D08 | Impact 2 west | Northern Grey Ironbark | <i>Eucalyptus siderophloia</i> | Possible den tree only. Not used often and variable signal. | 32 | 90 | 521487 | 6762166 | 2 | 1 | 1 | 0 | 0 | 0 | 0 |
| D09 | Impact 2 west | Stag | - | Vertical hollow opening | 18 | 110 | 521502 | 6762147 | 2 | 0 | 0 | 0 | 0 | 0 | 2 |
| D10 | Impact 4 east | Scribbly Gum | <i>Eucalyptus signata</i> | - | 24 | 120 | 523563 | 6764187 | 3 | 1 | 2 | 0 | 0 | 0 | 0 |



| HBT No. | Site | Common Name | Scientific Name | Comment | Tree Height (m) | DBH (cm) | Easting | Northing | Total Hollows | Small Limb Hollow (<5cm) | Medium Limb Hollow (5-15cm) | Large Limb Hollow (>15cm) | Small Trunk Hollow (<5cm) | Medium Trunk Hollow (5-15cm) | Large Trunk Hollow (>15cm) |
|----------------|-----------------|--------------------|------------------------------|----------------|------------------------|-----------------|----------------|-----------------|----------------------|------------------------------------|------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|
| D11 | Impact 4 east | Smudgy Apple | <i>Angophora woodsiana</i> | - | 24 | 65 | 523481 | 6764117 | 2 | 1 | 0 | 0 | 0 | 1 | 0 |
| D12 | Impact 4 east | Stag | - | - | 20 | 60 | 523399 | 6764112 | 3 | 0 | 2 | 0 | 0 | 1 | 0 |
| D13 | Impact 4 median | Tallowwood | <i>Eucalyptus microcorys</i> | - | 26 | 120 | 523542 | 6764620 | 10 | 6 | 4 | 0 | 0 | 0 | 0 |
| D14 | Impact 4 west | Smudgy Apple | <i>Angophora woodsiana</i> | - | 20 | 60 | 523572 | 6764179 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| D15 | Impact 4 west | Smudgy Apple | <i>Angophora woodsiana</i> | - | 24 | 60 | 522955 | 6763988 | 4 | 1 | 3 | 0 | 0 | 0 | 0 |



Appendix C

Glider Performance Calculations

Tree height data from GeoLINK (2019)b

| Median | W2B Chaiage Zone | Lane | Potential Glide Tree Ref. No. | Location | Ground Elevation at Tree Base (m) | Tree Height (m) | Distance to Closest Landing Tree (m) | Species | DBH (mm) | Road Elevation (m) | Tree Base Elevation to Road Elevation Difference (m) | Ground Elevation at Landing Tree (m) | Elevation Difference Between Launch and Landing Tree Bases (m) | Field Survey Date | Frequency of Potential Launch Trees | Frequency of Potential Landing Trees | Potential Glide Distance (m) | Potential Glide Distance minus Distance to Launch Tree | Potential for Successful Glide? | Distance for Glide Angle Calculation | Height for Glide Angle Calculation | Required Glide Ratio | Required Glide Angle | Greater Than Lower Standard Deviation (>21.1) | Glider Home Range |
|-----------------|------------------|------------|-------------------------------|----------|-----------------------------------|-----------------|--------------------------------------|----------------|----------|--------------------|--|--------------------------------------|--|-------------------|---|--|------------------------------|--|--|--------------------------------------|------------------------------------|----------------------|----------------------|---|-------------------|
| Southern Median | 105900-106000 | Northbound | SNW06 | West | 31.7 | 40.0 | 50.0 | Grey Gum | 1200 | 37.8 | -6.1 | 35 | -3.3 | 12/03/2019 | Numerous other closer launch tree of slightly shorter in height | Less than five potential landing trees | 60.33 | 10.3 | Yes | 48 | 31.70 | 1.51 | 30.2 | Yes | F7 and M9 |
| Southern Median | 105900-106000 | Northbound | SNE06 | East | 34.7 | 34.0 | 43.0 | Spotted Gum | 700 | 37.8 | -3.1 | 32 | 2.7 | 12/03/2019 | Numerous launch trees in zone | Landing trees mostly obscured by regrowth; approximately 5 available | 60.33 | 17.3 | Yes | 41 | 31.70 | 1.29 | 37.7 | Yes | F7 and M9 |
| Southern Median | 106000-106100 | Northbound | SNW07 | West | 27.7 | 31.0 | 43.0 | Red Gum | 650 | 28.8 | -1.1 | 29 | -1.3 | 12/03/2019 | Numerous launch trees in zone | Numerous landing trees | 47.45 | 4.4 | Yes | 41 | 24.70 | 1.66 | 31.1 | Yes | F7 and M9 |
| Southern Median | 106000-106100 | Northbound | SNE07 | East | 27.8 | 29.0 | 43.0 | Red Gum | 800 | 28.8 | -1.0 | 31 | -3.2 | 12/03/2019 | Numerous launch trees in zone | Numerous landing trees | 40.27 | -2.7 | No however within glide angle standard deviation range | 41 | 20.80 | 1.97 | 26.9 | Yes | F7 and M9 |
| Northern Median | 108400-108500 | Northbound | NNW01 | West | 26.8 | 20.0 | 38.5 | Bloodwood | 450 | 25.6 | 1.2 | 25 | 1.8 | 12/03/2019 | Several nearby launch trees | Only one suitable landing trees on the eastern side | 32.91 | -5.6 | No however within glide angle standard deviation range | 36.5 | 16.80 | 2.17 | 24.7 | Yes | F6 |
| Northern Median | 108400-108500 | Northbound | NNE01 | East | 25.2 | 23.0 | 42.0 | Bloodwood | 750 | 25.6 | -0.4 | 27 | -1.8 | 12/03/2019 | Several launch trees present | Regrowth on western side will eventually obscure landing trees | 39.17 | -2.8 | No however within glide angle standard deviation range | 40 | 16.20 | 2.47 | 22 | Yes | F6 |
| Northern Median | 108800-108900 | Northbound | NNW02 | West | 17.2 | 25.0 | 42.0 | Red Mahogany | 750 | 17.290001 | -0.1 | 18 | -0.8 | 12/03/2019 | Several launching trees available in zone | Several landing trees available in zone | 44.69 | 2.7 | Yes | 40 | 19.20 | 2.08 | 25.6 | Yes | M5 |
| Northern Median | 108800-108900 | Northbound | NNE02 | East | 17.9 | 14.0 | 43.0 | White Mahogany | 400 | 18.578 | -0.7 | 17 | 0.9 | 12/03/2019 | Several launching trees available in zone | Several landing trees available in zone | 20.22 | -22.8 | No | 41 | 9.90 | 4.14 | 13.6 | No | M5 |
| Northern Median | 108900-109000 | Northbound | NNW03 | West | 16.2 | 31.0 | 34.0 | Blackbutt | 1200 | 15.773001 | 0.4 | 17 | -0.8 | 12/03/2019 | Numerous launch tree options available | Numerous landing tree options available | 55.73 | 21.7 | Yes | 32 | 25.20 | 1.27 | 38.2 | Yes | M5 |
| Northern Median | 108900-109000 | Northbound | NNE03 | East | 16.8 | 21.0 | 34.0 | White mahogany | 210 | 16.053 | 0.7 | 16 | 0.8 | 12/03/2019 | Numerous launch tree options available | Numerous landing tree options available | 40.20 | 6.2 | Yes | 32 | 16.76 | 1.91 | 27.6 | Yes | M5 |
| Northern Median | 109000-109100 | Northbound | NNW04 | West | 15.6 | 25.0 | 37.0 | Blackbutt | 700 | 15.65 | 0.0 | 15 | 0.6 | 12/03/2019 | Numerous launch options available | Numerous landing options available | 47.32 | 10.3 | Yes | 35 | 20.63 | 1.70 | 30.5 | Yes | M5 |
| Northern Median | 109000-109100 | Northbound | NNE04 | East | 15.3 | 23.0 | 37.0 | White Mahogany | 300 | 15.65 | -0.3 | 16 | -0.7 | 12/03/2019 | Numerous launch options | Only one or two landing options due to scrubby regrowth | 41.25 | 4.2 | Yes | 35 | 17.33 | 2.02 | 26.3 | Yes | M5 |
| Northern Median | 109100-109200 | Northbound | NNW05 | West | 14.6 | 28.0 | 39.0 | Red Mahogany | 1000 | 14.74 | -0.2 | 17 | -2.5 | 12/03/2019 | Various launch options | Few landing options due to dense regrowth on east side | 47.17 | 8.2 | Yes | 37 | 20.55 | 1.80 | 29 | Yes | M5 |
| Northern Median | 109100-109200 | Northbound | NNE05 | East | 16.7 | 20.0 | 39.0 | Blackbutt | 210 | 14.74 | 2.0 | 15 | 1.7 | 12/03/2019 | Minimal tall launch options | Several landing options on west side. | 32.71 | -6.3 | No however within glide angle standard deviation range | 37 | 16.69 | 2.22 | 24.3 | Yes | M5 |
| Northern Median | 109200-109300 | Northbound | NNW06 | West | 13.5 | 26.0 | 34.0 | Ironbark | 700 | 13.87 | -0.4 | 14 | -0.5 | 12/03/2019 | Numerous launch trees available | Numerous landing trees available | 47.08 | 13.1 | Yes | 32 | 20.50 | 1.56 | 32.6 | Yes | M5 |
| Northern Median | 109200-109300 | Northbound | NNE06 | East | 14.0 | 20.0 | 34.0 | Bloodwood | 700 | 13.87 | 0.1 | 14 | 0.0 | 12/03/2019 | Numerous launch trees available | Numerous landing trees available | 36.96 | 3.0 | Yes | 32 | 15.00 | 2.13 | 25.1 | Yes | M5 |
| Northern Median | 109300-109400 | Northbound | NNW07 | West | 13.0 | 31.0 | 39.0 | Blackbutt | 1000 | 13.22 | -0.2 | 13 | 0.0 | 12/03/2019 | Several launch options in zone | Several landing options in zone | 57.20 | 18.2 | Yes | 37 | 26.00 | 1.42 | 35.1 | Yes | M5 |
| Northern Median | 109300-109400 | Northbound | NNE07 | East | 13.4 | 33.0 | 39.0 | Blackbutt | 1000 | 13.22 | 0.2 | 13 | 0.4 | 12/03/2019 | Several launch options in zone | Several landing options in zone | 61.62 | 22.6 | Yes | 37 | 28.40 | 1.30 | 37.5 | Yes | M5 |