To: Greg Manning, Assistant Secretary
From: s. 47F(1) , Director, Post Approvals Section

s. 47F(1) 24 August 2018

Western Sydney Airport – Biodiversity Offset Delivery Plan

Timing: 24 August 2018

Recommendations:

That you:

1. Approve the Western Sydney Airport Biodiversity Offset Delivery Plan at **Attachment A**, as meeting the requirements of Condition 30 of the Western Sydney Airport Plan.

Approved / Please discuss

2. Subject to your approval, sign the letter to the Department of Infrastructure, Regional Development and Cities at **Attachment B**, notifying them of your decision.

Signed / Not signed

s. 47F(1)

Greg Manning, Assistant Secretary,
Assessments (WA, SA, NT) & Post Approvals Branch

Date: 24 August 2018

Comments:

Background

1. On 31 July 2018, the Department of Infrastructure, Regional Development and Cities (DIRDC) submitted the Western Sydney Airport Biodiversity Offset Delivery Plan (BODP) (**Attachment A**) in accordance with condition 30(1) of the Airport Plan (**Attachment C**). Approval of the BODP is being sought by 24 August 2018, to enable to commencement of Main Construction Works in accordance with condition 30(3) of the Airport Plan.
2. Condition 30 of the Airport Plan requires the DIRDC to prepare and submit to an Approver for approval a BODP in relation to carrying out of the developments described in Part 3 of the Airport Plan.
3. Further context for the Airport Plan is provided at **Attachment D**.
4. Section 3.10.1 of the Airport Plan defines the Approver for the BODP and any matter relating to this plan as the Environment Minister or an SES employee in the Environment Department. For the purpose of the BODP you have been identified as the Approver.

Development of the BODP

5. Following determination of the Airport Plan, the Department liaised extensively with DIRDC. The Department also reviewed and provided comment on an updated Biodiversity Assessment Report (BAR) (**Attachment E**) and draft chapters of the BODP, which were submitted in tranches in early 2018.
6. Condition 30(2) of the Airport Plan sets out the criteria for approval of the BODP as being that an Approver is satisfied that the BODP: (a) takes into account (i) sections 28.5.3.3 to 28.5.3.5 in Chapter 28 of the EIS (**Attachment F**), (ii) the Biodiversity Offset Package in Volume 4 of the EIS (**Attachment G**), and (iii) the EPBC Act Offsets Policy, and (b) is otherwise appropriate.

- Section 28.5.3.3 notes the requirement for offsets to be calculated with reference to the EPBC Act Offsets Policy, and with reference to the NSW Framework for Biodiversity Assessment (FBA) methodology for NSW listed species.
- Section 28.5.3.4 identifies the NSW Biobanking Scheme as the primary mechanism to deliver the required biodiversity offsets, but notes that a variety of other mechanisms will also be considered.
- Section 28.5.3.5 sets out the expected content of the BODP and states that the BODP submitted to the Department will identify and secure biodiversity offsets, where possible, prior to substantial impacts occurring.
- The Biodiversity Offset Package provides preliminary offset calculations and identifies several potential Biobank sites as well as outlining what the BODP is expected to deliver, including: additional information to support offset calculations, specific information on offset sites including management, risk of development and security, and identification of additional sites.

7. Table 1 of the BODP sets out how condition 30(2) and the other components of this condition are addressed in the plan.

Impacts to protected matters

8. The BAR in the final EIS identified that the developments described in Part 3 of the Airport Plan will have likely significant impacts on Cumberland Plains Woodland ecological community and foraging habitat for the Grey-headed flying-fox.
9. The updated BAR also includes impacts to habitat for the Swift Parrot as required by condition 30, and the Spiked Rice-flower, which has been discovered at the airport site since finalisation of the EIS. The quantum of impact to protected matters determined in the updated BAR is summarised below.

Protected matter	**impact**
Cumberland Plains Woodland	141 ha*
Grey-headed Flying-fox foraging habitat	187.8 ha
Swift Parrot foraging habitat	187.8 ha
Spiked Rice-flower	4118 stems

*** Revised from 145.8 ha in the updated BAR (dated August 2018) based on a recent ecological survey.**

Consideration of the BODP against condition 30

10. Chapters 2 and 3 of the BODP are based on and informed by the updated BAR. The Department is satisfied that condition 30(4) of the Airport Plan has been adequately addressed because the BAR has been independently verified following consultation with the NSW Office of Environment and Heritage (see section 8 of the BAR and signed letter from the independent verifier), and because chapters 2 and 3 summarise and are consistent with the BAR in terms of:
    - Habitat quality descriptions based on updated field surveys conducted in accordance with the FBA and with regard to the key diagnostic characteristics and condition thresholds specified in the Cumberland Plains Woodland (CPW) listing advice (Section 2.2.1 of the BODP).
    - The quantum of impact to protected matters as noted in the table above.
11. The BODP was prepared by a Suitably Qualified Expert with tertiary qualification and experience exceeding the requirements set out on the Airport Plan definitions. This addresses condition 30(5) of the Airport Plan.
12. Based on the above and the following sections, the Department also considers that the BODP is consistent with the EPBC Act Offsets Policy and addresses the other requirements under condition 30(6) and the proposed direct offsets are expected to provide improved

3 connectivity and strategic value in accordance with condition 30(7) of the Airport Plan. Other compensatory measures are also expected to provide seed stock that will be used to rehabilitate CPW in strategic locations.

13. Condition 31 of the Airport Plan requires that preparation of the BODP is informed by the Biodiversity Expert Group (BEG), and in particular, their advice must be sought on whether and how conservation outcomes improve or maintain the viability of the biodiversity values to be offset. This advice must be included in the BODP.
14. Chapters 4 and 5 provide summaries of the advice of the BEG members. This advice is general rather than advice relating to any specific parcels of land (excluding Orchard Hills) or research project. The BODP is consistent with advice provided by the BEG.
15. The advice also includes evidence of consultation with Local Aboriginal land Councils and Aboriginal Groups in Western Sydney and Chapter 7 proposes longer term other compensatory measures with consideration of Aboriginal land management. This addresses the condition 30(8) of the Airport Plan.
16. Conditions 30(9) to 30(15) are more administrative in nature although these are addressed in Table 1.1 of the BODP.
17. With consideration of the BODP against the requirements of condition 30 of the Airport plan, the Department is of the view that the BODP meets the criteria its approval as set out in condition 30(2) of the Airport Plan, in that it has taken into account the relevant sections of the EIS and the EPBC Act Offsets Policy, and is otherwise appropriate.

Direct Offsets

18. Chapter 6 of the BODP describes the direct offset mechanisms proposed to offset the impacts of the airport.

Orchard Hills site

19. The BODP includes a proposal to conserve Department of Defence land at Orchard Hills (Orchard Hills site). This site is an ammunition depot and much of it covered by a Commonwealth heritage listing which includes natural heritage values, including CPW.
20. It is proposed that no less than 900 ha of the Orchard Hills site will be secured and managed to deliver habitat for Commonwealth and State offset requirements. The Orchard Hills site's contribution to meeting the airports offset requirements has been calculated using the EPBC Act offset calculator (see Tables 6.2 to 6.5 of the BODP). The calculations determined that the site will deliver:
    - at least 90 percent of offset requirements for CPW by improving existing CPW (389.1 ha) that meets the EPBC condition thresholds and by securing poorer quality CPW (398.1 ha) that will be rehabilitated to threshold condition.
    - 47 percent of the offset requirements for Swift Parrot habitat (471.1 ha)
    - 71 percent of the offset requirements for Grey-headed Flying-fox habitat (471.1 ha), as well as habitat for state protected maters.
21. The site provides no offsets for the Spiked Rice-flower, which will be offset through other mechanisms.
22. The Department reviewed earlier offset calculations and requested clarification and justification for the input parameter values (habitat quality and risk of loss) used in the calculator (**Attachment H**). DIRDC has addressed these comments in the BODP by:
    - Providing habitat quality scoring tables that provide a clear link between qualitative habitat descriptions and the site quality scores used in the calculator (at both the impact and offset site).
    - Highlighting the significant development pressures on native vegetation (including CPW) in Western Sydney, justifying the proposed averted risk of loss of 7 percent (respectively 8 percent and 15 percent risk without and with offset).

23. Condition 30(6)(e) of the Airport Plan requires that the BODP provides evidence that the arrangements for managing the direct offsets will be provided through mechanisms that are enduring, enforceable and auditable.

24. Options to legally secure the Orchard Hills site were discussed between the Department, DIRDC and the Department of Defence. The outcome of these discussions is that a Commonwealth conservation agreement would not meaningfully add to securing the offsets due to existing protections and that it is Commonwealth land. There are also legal constraints limiting the use of State-based mechanisms on land owned by the Department of Defence.

25. Furthermore, the Orchard Hills site, being Commonwealth land, has existing enduring protection through provisions of Part 3 (the requirement for environmental approvals), Part 13 (Species and Communities) and Part 15 (Protected Areas) of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Enforceability and auditability are discussed in the following points.

26. The site is also subject to a Memorandum of Understanding (MoU) between the Department of Defence and the DIRDC (**Attachment I**) to 'conserve and manage a biodiversity offset area at Defence establishment Orchard Hills'. The MoU is an important and appropriate mechanism complementing the enduring protection under the EPBC Act in the circumstance where other more commonly used state-based arrangements are unavailable. Key features of the MoU are:

    - Significant funding will be provided to the Department of Defence to improve the management, specifically to support the biodiversity offset outcomes, of the Orchard Hills offset area;
    - Conservation of not less than 900 ha of the Orchard Hills site in perpetuity (Clause F(a)), with the Department of Defence retaining ownership for defence purposes (Clause B).
    - The provision of measurable ecological improvements to the site consistent with the EPBC Offsets Policy through the development, funding and implementation of an Offset Plan (Clause F(b)).
    - The development and implementation of the Offset Plan, to be approved by DIRDC in consultation with the Department (Clause 7.2), in accordance with Clause 7.2.
    - A commitment that DIRDC and the Department of Defence will work together to agree on reinstatement works in the event of damage or destruction to the Orchard Hills offset site (with advice from an independent expert if required) or consider alterative arrangements such as offsetting in other areas at Orchard Hills. This is discussed further in point 28.

27. Following advice from the Department that commitments set out only in the MoU would not be enforceable, the final BODP references the MoU and specifically commits to preparing and implementing the Offset Plan through specified management actions and ongoing monitoring and reporting (section 6.1.4). The BODP is enforceable under conditions of the Airport Plan and therefore its offset commitments are also enforceable and auditable as required under condition 30(6)(e) of the Airport Plan.

28. Clause 20 of the MoU includes commitments in the event of damage or destruction of the Orchard Hills offset site. The commitments under this clause include:

    - Defence and DIRDC (the parties) considering and assessing the impact to the Orchard Hills offset site and the nature of any reinstatement work.
    - The parties jointly engaging an independent expert to assess the biodiversity impacts on the Orchard Hills offset site and determine the reinstatement work. This would occur in the event that the parties are unable to agree or there is insufficient information to proceed with reinstatement works.
    - If the parties agree that reinstatement work should proceed, Defence will carry out the reinstatement work.

- If the parties determine that reinstatement work is not practical or appropriate, they will work together to consider alternative arrangements, such as access to other areas at Orchard Hills.

29. The Department considers that this clause provides an appropriate contingency in such an event. While this clause is not explicitly referenced in the BODP, the combined monitoring and reporting requirements of the MOU and BODP provide adequate controls to deal with damage or destruction of the Orchard Hills offset site.

30. The Orchard Hills site has enduring protection through provisions of the EPBC Act and the MoU between the Department of Defence and DIRDC. The MoU's commitments to permanently conserve the Orchard Hills offset site and manage, monitor and report through the Offset Plan are reflected in the BODP. Based on the existing protections and commitments to improve the condition of the offset site in addition to the protection of the site, the Department is satisfied that the BODP is enduring, enforceable and auditable.

Other direct offset mechanisms

31. Noting that the Orchard Hills site is not expected to meet all of the DIRDC's offset obligations, additional direct offsets for CPW, habitats for the Grey-headed Flying-fox and Swift Parrot, and the Spiked Rice-flower will be delivered through:

    - The purchase of credits through the NSW Biodiversity Offsets Scheme (Section 6.2.1 and Table 8.1).
    - Acquisition of land to improve connectivity within the Cumberland Plain Corridor (Section 6.2.2 and Table 8.1).
    - Restoration and rewilding programs to improve the extent, connectivity and condition of native vegetation and habitat in the Cumberland Plain (Section 6.2.3 and Table 8.1).

30. The relative contribution of the various direct offset mechanism to meeting the DIRDC's offset obligations for each of the four protected matters is provided in the table below. While there is certainty around the minimum percent contribution for the Orchard Hills site (which may vary slightly based on a more detailed ecological survey to inform implementation of the Offset Plan), the percent contributions for the other mechanisms are dependent on finding suitable sites.

31. Section 6.2 of the BODP outlines DIRDC's approach to identifying, securing Biobank sites and land for acquisition and restoration and rewilding. While this is more general than what the EIS (section 28.5.3.5 and the Offset Package) indicated would be in the plan, the intent of the BODP is consistent with the EIS and the Department is satisfied that the direct offset proposals have taken the relevant sections of the EIS into account.

32. Furthermore, Table 8.1 provides timeframes for securing the other direct offsets and the DIRDC has considered a number of sites that could be secured through the other direct offset mechanisms (see section 8.2.3), some of which have been discussed at the BEG meetings.

Offset mechanism	CPW	Grey-headed Flying-fox	Swift Parrot	Spiked Rice-flower
Percent contribution to meeting offset obligations				
Orchard Hills	>90	71	47	0
Biodiversity credits	5 to 10	25 to 35	< 35	100
Land aquisition	< 5	< 5	< 5	<15
Restoration and rewilding	5 to 10	5 to 15	< 15	< 15
Total	< 115 to 125	< 106 to 126	< 102	< 130

Summary of direct offsets

33. DIRDC's offset calculations are based on securing at least 900 ha of the Orchard Hills site as a direct offset. Approximately 1370 ha of the site is heritage listed and presents an opportunity to source additional offsets, if required.

34. DIRDC continue to investigate the best way to secure the balance of their direct offset requirements through purchasing credits under the NSW Biodiversity Offsets Scheme, the acquisition of strategic parcels of land to be managed in perpetuity by a third party and restoration and rewilding programs in the Cumberland Plain.

35. The BODP presents some level of residual risk of the offset outcomes not being achieved as specific parcels of land have not been identified in relation to any of the other direct offset mechanisms mentioned in point 32 above. This risk applies to the balance of offset requirements after Orchard Hills is accounted for (from 100% for the Spiked Rice-flower to <10 percent for CPW). However, there is a commitment in Table 8 of the BODP to secure the balance of direct offsets in accordance with the following timeframes:

    a. Purchase of credits in tranches from 2018/19 with the required credits being purchased and secured within 3 years of approval of the BODP.

    b. Strategic parcels of land to be identified and secured within 3 years of establishment of an advisory group in 2018/19.

    c. Restoration and rewilding programs will be scoped and identified from 2018/19 and delivered for up to 10 years.

36. The Department considers that the residual risk is mitigated through:

    a. The airport being a staged project and the acquisition and securing of offsets is likely to broadly align with stages of construction.

    b. Demonstration of adequate land to meet all offset requirements through DIRDC's register of potential Biobanking sites (to secure biodiversity credits) presented during with meetings with the Department and at the BEG meetings.

    c. The likelihood of being able to engage with land acquisition and restoration and rewilding opportunities, as these were presented by members (and proponents of specific projects) at BEG meetings.

    d. the availability of additional land at the Orchard Hills site if needed (subject to agreement by the Department of Defence).

Other compensatory measures LEX-21979

37. Chapter 7 of the BODP provides an overview of the Greening Australia seed collection and production program and the Threatened flora propagation program that are respectively required by conditions 32 and 33 of the Airport Plan. These are presented as other compensatory measures and are expected to provide seeds and cuttings of Spiked Rice-flower based on genetic sampling across the airport site population as well as native seeds based on a range of species associated with CPW.

Recommendation

38. Based on the Department's assessment, it is recommended that you:

- Approve to the Western Sydney Airport Biodiversity Offset Delivery Plan at **Attachment A**.

Contact Officer

s. 47F(1)

ATTACHMENTS

A: Final Biodiversity Offset Delivery Plan (**For Approval**)

B: Letter to the Department of Infrastructure, Regional Development and Cities (**For Signing**)

C: Western Sydney Airport Plan (**For information**)

D: History and context for the Airport Plan (**For information**)

E: Updated Biodiversity Assessment Report (**For information**)

F: Sections 28.5.3.3 to 28.5.3.5 in Chapter 28 of the EIS (**For information**)

G: Biodiversity Offset Package in Volume 4 of the EIS (**For information**)

H: DoEE comments on the BODP (**For information)**

I: Memorandum of Understanding between the Departments of Infrastructure and Defence in relation to the Orchard Hills offset site (**For information)**

Australian Government
Department of the Environment and Energy

Mr Garth Taylor
General Manager Communications, Environment Legal
Western Sydney Unit
Department of Infrastructure, Regional Development and Cities
GPO Box 594
CANBERRA ACT 2601

Dear Mr Taylor

Western Sydney Airport – Biodiversity Offset Delivery Plan

Thank you for your letter dated 15 August 2018 to the Department, seeking approval of the Western Sydney Airport Biodiversity Offset Delivery Plan, in accordance with Condition 30 of the Western Sydney Airport - Airport Plan under the *Airports Act 1996* (Airports Act). I note that for the purposes of this plan I have been identified as the Approver in accordance with the Airport Plan.

Officers of this Department have considered the Biodiversity Offset Delivery Plan as provided on 31 July 2018 and are satisfied it meets the requirements of Condition 30 of the Airport Plan. On this basis, and as a delegate identified in accordance with the Airport Plan, I have decided to approve the Biodiversity Offset Delivery Plan.

The Department looks forward to being consulted on the development of the Offset Plan for Orchard Hills. I also note that the Department will receive regular reports during implementation of the Biodiversity Offset Delivery Plan.

Should you require any further information please contact s. 47F(1) on (02) s. 47F(1) or post.approvals@environment.gov.au.

Yours sincerely

s. 47F(1)

Greg Manning, Assistant Secretary
Assessments (WA, SA, NT) & Post Approvals Branch

24 August 2018

History and context for the Airport Plan

- On 23 December 2014, a delegate of the Minister for the Environment determined that construction for the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999*.
- On 15 September 2016, the final Environmental Impact Statement (EIS) was provided to the Environment Minister.
- Approval for construction and operation of the airport is controlled by the Airports Act 1996, which provides for the preparation of an Airport Plan, which serves as the authorisation for the development of the airport.
- On 11 November 2016, Minister Frydenberg sent a notice in accordance with section 96(B)(3) of the Airports Act containing specified conditions to be included in the Airport Plan for the protection of the environment. The conditions drafted by the Department were done in consideration of the draft Airport Plan and the final Environment Impact Statement (EIS) for the proposal.
- On 12 December 2016, the Prime Minister, the Hon Malcolm Turnbull MP, and the Minister for Urban Infrastructure, the Hon Paul Fletcher MP, announced the determination of the finalised Airport Plan for the Western Sydney Airport.
- This determination provides the authorisation for the construction and operation of Stage 1 of the Western Sydney Airport (a single runway facility expected to be operational in the mid-2020s).

Department of Infrastructure and Regional Development

Western Sydney Airport

Stage 1 Development Biodiversity Assessment Report

September 2017

Limitations

GHD has prepared this report pursuant to the conditions in the Department of Infrastructure and Regional Development Deed of Standing Quotation (SON2030181), the Commonwealth RFQTS Number DEHP-ID-242, the subsequent response accepted and referenced in the relevant Official Order (collectively the "Contract"): In particular, this report has been prepared by GHD for the Commonwealth and may only be used and relied on by the Commonwealth and the party or parties identified in the Contract (Other Parties) in accordance with the Contract for the purpose agreed between GHD and the Commonwealth as set out in the Contract and further Section 1.4 of this report. Other than as stated in the Contract, GHD disclaims responsibility to any person other than the Commonwealth (or the Other Parties) arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the Contract and are subject to the scope limitations set out in the Contract and this report.

GHD otherwise disclaims responsibility to any person other than Department of Infrastructure and Regional Development and the Other Parties arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Infrastructure and Regional Development and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and field surveys undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific survey locations. Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report. Site conditions (including the presence or abundance of threatened biota) may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

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Appendices

Appendix A – Framework for Biodiversity Assessment data

Appendix B – Field survey results

Appendix C – Western Sydney Airport BioBanking Assessment Review (WSP 2017)

Glossary of terms

Term	Definition
Affected threatened biota	Threatened species or communities listed under the EPBC Act, which are likely to suffer a significant impact as a result of a proposal and which require biodiversity offsets having regard to the EPBC Act Offset Policy.
Airport site	The site for Sydney West Airport as defined in the Airports Act.
BBAM	The NSW *BioBanking Assessment Methodology* (OEH, 2014).
Biobank site	Land that is designated by a biobanking agreement to be a biobank site.
Biobanking agreement	An agreement entered into between the landowner and the NSW Environment Minister under Part 7A of the TSC Act for establishing a biobank site.
BioBanking Trust Fund	The Trust Fund established under Part 7A of the TSC Act to hold funds from the sale of credits.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the FBA or the BBAM. Includes ecosystem credits or species credits.
Biodiversity credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biobanking statement; or required to offset the impacts of a Major Project in accordance with the FBA; or that would be generated through conservation and management of a biobank site under a BioBanking agreement (means the report set out in Appendix B).
Biodiversity offset delivery plan	The biodiversity offset delivery plan, which will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan. Its development will be guided by the framework established in the biodiversity offset package.
Biodiversity offset package	Appendix K2 to the EIS, which outlines the approach to the delivery of biodiversity offsets for the airport, including an estimate of the quantum of offsets required, options to deliver these offsets, an estimate of the costs involved and the additional steps required to finalise their delivery.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including native species, populations and ecological communities, and their habitats.
CEEC	Critically endangered ecological community.
Construction Impact Zone (CIZ)	The area that would be directly impacted by construction of the Stage 1 development as indicatively shown in the Airport Plan. A full description is provided in Chapter 6 of the EIS.
Department of Infrastructure and Regional Development	The Australian Government Department responsible for proposing Stage 1 of the Western Sydney Airport.
DoE	Australian Government Department of the Environment (now Department of the Environment and Energy).
DoEE	Department of the Environment and Energy.
DPI	The NSW Department of Primary Industries.
DSEWPaC	The former Department of Sustainability, Environment, Water, Populations and Communities, now the Commonwealth Department of the Environment and Energy.

Term	Definition
Ecosystem credit	The class of biodiversity credits created or required for the impact on EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur within a vegetation type according to the BBAM.
EEC	Endangered ecological community
Environmental Conservation Zone	The area at the airport site that would be provided as an environmental conservation zone, as outlined in the Land Use Plan in the Airport Plan (see the Airport Plan).
EPBC Act	The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPBC Act-listed biota	Threatened species and communities and migratory species listed under the EPBC Act.
FBA	The Framework for Biodiversity Assessment (OEH, 2014a). The methodology to assess impacts on biodiversity that is used to assess all biodiversity values on the development site for a Major Project under the NSW *Environmental Planning and Assessment Act 1979* (EPA Act) and in accordance with The NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014a).
FM Act	The NSW *Fisheries Management Act 1994*
Food tree	A tree species that is recognised as being of value as a foraging resource for a given fauna species.
Habitat tree	A tree that is recognised as being of value as a shelter, roosting and/or nesting resource for fauna species. Includes hollow-bearing trees, stags (standing dead trees) and trees with nests or other signs of fauna occupancy.
HIAL	High Intensity Approach Lighting
Long term development	The longer term stage in the development of the airport, including parallel runways and facilities for up to 82 million passengers annually (nominally occurring in 2063).
Main Construction Works	Substantial physical works on a particular part of the Airport Site (including large scale vegetation clearance, bulk earthworks and the carrying out of other physical works, and the erection of buildings and structures) described in Part 3 of the Airport Plan, other than TransGrid Relocation Works or Preparatory Activities.
Migratory species	Species that are listed as migratory under the EPBC Act.
MNES	'Matters of national environmental significance' listed under the EPBC Act, including threatened biota, migratory species, World Heritage/National Heritage sites and Ramsar wetland sites.
NPW Act	The NSW *National Parks and Wildlife Act 1974*
NPWS	The NSW National Parks and Wildlife Service
NSW-listed biota	Threatened species, populations and communities listed under the NSW TSC Act or FM Act.
NW Act	The NSW *Noxious Weeds Act 1993*
OEH	The NSW Office of Environment and Heritage
PMST	Protected Matters Search Tool. A database administered by the Department of the Environment that contains known and predicted records of matters of national environmental significance listed under the EPBC Act.
Potential offset areas	The areas within the potential offset sites that have been identified in the offset package (Appendix K2 of volume 4 the EIS) that would be suitable to offset impacts on affected threatened biota listed under the EPBC Act. Only includes vegetation and habitat which is appropriate to offset impacts on the

Term	Definition
	affected threatened biota having regard to the EPBC Act Offset Policy and which are linked to biodiversity credits which are available for sale.
Potential offset sites	The potential offset sites that have been identified in the offset package (Appendix K2 of volume 4 the EIS) in order to offset biodiversity impacts.
Preparatory Activities	Preparatory Activities mean the following: (a) day-to-day site and property management activities; (b) site investigations, surveys (including dilapidation surveys), monitoring, and related works (e.g. geotechnical or other investigative drilling, excavation, or salvage); (c) establishing construction work sites, site offices, plant and equipment, and related site mobilisation activities (including access points, access tracks and other minor access works, and safety and security measures such as fencing, but excluding bulk earthworks); and (d) enabling preparatory activities such as: i. demolition or relocation of existing structures (including buildings, services, utilities and roads); ii. the disinterment of human remains located in grave sites identified in the European and other heritage technical report in volume 4 of the EIS; and iii. application of some environmental impact mitigation measures;and (e) any other activities which an Approver determines are Preparatory Activities for this definition
Species credit	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Species credit-type threatened species	Threatened species that are linked to species credits according to the BBAM (rather than ecosystem credits) because they cannot be reliably predicted to use an area of land based on habitat surrogates according to the BBAM.
Stage 1 Construction Impact Zone	The disturbance footprint for construction of the Stage 1 development, including the anticipated extent of vegetation clearing and grubbing, earthworks, drainage works and the permanent infrastructure that would be constructed for Stage 1 of the airport.
Stage 1 development	The initial stage in the development of the airport, including a single runway and facilities for 10 million annual passengers (the EIS assumes the airport could be operating at this level approximately 5 years after operations commence which for assessment purposes has been assumed to be 2030).
TAP	Threat Abatement Plan
TEC	Threatened ecological community listed under the EPBC Act and/or the TSC Act.
The EPBC Act Offsets Policy	The *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012* (DSEWPaC, 2012)
The locality	Land within a 10 km radius of the airport site.
The offsets assessment guide	The spreadsheet offset calculator that accompanies the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012).
The region	A bioregion defined in a national system of bio-regionalisation. For this study this is the Sydney Basin Bioregion as defined in the Interim Biogeographic Regionalisation for Australia (Thackway and Cresswell, 1995).
Threatened biota	Threatened species, populations or communities listed under the EPBC Act, TSC Act or FM Act.

Term	Definition
TSC Act	The NSW *Threatened Species Conservation Act 1995*
Western Sydney Airport (or 'the airport')	The airport. The airport is referred to as Sydney West Airport under the Airports Act.
WSP	WSP is a company that provides engineering, design and environmental services.

1. Introduction

1.1 Background

Badgerys Creek was announced by the Australian Government in 2014 as the site of a new airport for Western Sydney. Western Sydney Airport (WSA) is to be developed on approximately 1,780 hectares of land acquired by the Commonwealth in the 1980s and 1990s. Construction is expected to start in the second half of 2018 and airport operations are expected to commence in 2026.

On 23 December 2014, the Australian Government Minister for the Environment determined that the construction and operation of the airport would require assessment in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Guidelines for the content of an environmental impact statement (EIS) were issued in January 2015. The Western Sydney Airport Environmental Impact Statement (EIS) was finalised on 15 September 2016. Stage 1 of Western Sydney Airport would be constructed and operated in accordance with the Airport Plan which authorised the Stage 1 development in accordance with the *Airports Act 1996* (Cth) (the Airports Act). The Airport Plan was determined by the Minister for Urban Infrastructure on 5 December 2016 and includes conditions notified by the Minister for the Environment and Energy.

The airport would provide both domestic and international services, with development staged in response to demand. The initial development of the airport (referred to as the Stage 1 development) would include a single, 3,700 metre runway coupled with landside and airside facilities for the safe and efficient movement of approximately 10 million passengers per year as well as freight operations.

As demand increases, additional aviation infrastructure and aviation support precincts are expected to be developed until the first runway reaches capacity at around 37 million passenger movements. At this time, expected to be around 2050, a second parallel runway is expected to be required. In the longer term, approximately 40 years after operations commence, the airport development is expected to fully occupy the airport site, with additional passenger and transport facilities for around 82 million passenger movements per year.

The Airport Plan authorises the Stage 1 development and sets out the long term vision of the airport's development over a number of stages. This enables preliminary consideration of the implications of longer term airport operations. Any airport development beyond Stage 1, including the construction of additional terminal areas or supporting infrastructure to expand the capacity of the airport using the first runway or construction of a second runway, would be managed in accordance with the existing process in the Airports Act. This includes a requirement that, for major airport developments (defined in the Airports Act), a major development plan be approved by the Australian Government Minister for Infrastructure and Regional Development following a referral under the EPBC Act.

The Airport Plan contains a number of biodiversity conditions which require mitigation and management measures to be implemented to reduce the potential impacts on biodiversity values. The Airport Plan biodiversity conditions largely reflect the Environmental Management Framework contained within Chapter 28 of the EIS for WSA. The biodiversity conditions are detailed in section 1.2 and require the preparation of this Biodiversity Assessment Report (BAR) for the Stage 1 development in order to quantify offsets for the project (hereafter referred to as the 'Stage 1 BAR').

1.2 Biodiversity conditions

Section 3.10 of the Airport Plan sets out the conditions to be complied with in relation to the Stage 1 Development, including the conditions specified in the notice given by the Environment Minister in response to the revised draft Airport Plan. These conditions include the preparation of a Biodiversity Offset Delivery Plan (BODP), which must be informed by a Stage 1 BAR in order to assess biodiversity impacts within the Construction Impact Zone and quantify the offset requirements for the project. Conditions that relate to the requirement for the Stage 1 BAR and its content are detailed in Table 1 along with reference to where each condition is addressed in this report.

Table 1 Airport Plan conditions related to the Stage 1 BAR

No.	Environmental Condition	Where addressed in this report
30 (4)	The Biodiversity Offset Delivery Plan must be based on and informed by a Biodiversity Assessment Report that:	
	(a) includes the results of an updated ecological survey that has applied the field survey methodology of the FBA for areas within the Construction Impact Zone;	Section 4 Section 5 Section 6
	(b) has had regard to the key diagnostic characteristics and condition thresholds specified in the Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (Threatened Species Scientific Committee, 2008), particularly regarding patch size and contiguous native vegetation; and	Section 3.3.2 Section 4.5.1
	(c) has been independently verified by a person accredited in accordance with section 142B(1)(c) of the Threatened Species Conservation Act 1995 (NSW), appointed following consultation with OEH.	Section 8

22

LEX-21079

MULGOA CREEK
THE NORTHERN ROAD
LUDDENHAM ROAD
OAKY CREEK
BADGERYS CREEK
ELIZABETH DRIVE
PARK ROAD
COSGROVES CREEK
ADAMS ROAD
LUDDENHAM
JERRYS CREEK
BADGERYS CREEK ROAD
BADGERYS CREEK
SOUTH CREEK
DEVONSHIRE ROAD
THE NORTHERN ROAD
FIFTEENTH AVENUE
GREENDALE ROAD
DUNCANS CREEK
DWYER ROAD
GREENDALE
MOORE GULLY
THOMPSONS CREEK
KING STREET
KEMPS CREEK

Paper Size A3

0 250 500 1,000

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Watercourses
- Roads

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	07 Jul 2017

Site location

Figure 1

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z002_Dev_Site_Location.mxd

Data source: Topographic Features and Inset data - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013. Created by:jrprice

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1.3 The proposal

1.3.1 Stage 1

Stage 1 of the airport would include a 3,700 metre runway on an approximate north-east/south-west orientation. The Stage 1 development would also include a single full length parallel taxiway and a range of aviation support facilities such as passenger terminals, cargo and maintenance areas, car parks and navigational instrumentation capable of facilitating the safe and efficient movement of approximately 10 million domestic and international passengers per year which is consistent with approximately 63,000 air traffic movements per year. The airport is proposed to operate on a 24-hour, curfew free basis.

The existing terrain at the airport site is undulating and substantial earthworks are required to create a level surface to allow construction of the runway, taxiways and support services. The Stage 1 Construction Impact Zone is predominantly located within the northern portion of the site following the alignment of the runway. There will also be limited earthworks in the southern portion of the site during Stage 1 for the establishment of drainage swales and detention ponds as part of the water management system developed for the airport site.

The Airport Plan authorises the development of critical infrastructure within the Stage 1 Construction Impact Zone. The long term development of the airport would be subject to further environmental assessment and approval processes under the Airports Act.

1.3.2 Long term development

The airport would be progressively developed as demand increases beyond 10 million annual passengers. Additional aviation infrastructure and support services such as taxiways, aprons, terminals and support facilities would be required to service the growing demand.

Areas that may be subject to further development in the future that are outside the Stage 1 Construction Impact Zone are the subject of a separate biodiversity assessment.

1.3.3 Environmental Conservation Zone

Portions of the airport site would remain undeveloped in the longer term to conserve riparian corridors and other features of higher environmental value. These areas have been included in the Environmental Conservation Zone (EC1) in the Airport Plan and would be managed for biodiversity conservation. The Environmental Conservation Zone (EC1) on the airport site will be protected through the Land Use Plan outlined in the Airport Plan and reproduced in Chapter 4 of the EIS, the construction environmental management plans (Section 28.5 of Chapter 28 of the EIS), the operational environmental management plans (Section 28.6 of Chapter 28 of the EIS) and general obligations in the *Airports (Environment Protection) Regulations (AEPR) 1997.* The Land Use Plan limits the types of activities that can take place within the EC1 zone. The Land Use Plan, as part of the Airport Plan, must be complied with in accordance with the *Airports Act 1996*.

Condition 7 and Condition 23 of the Airport Plan require the Biodiversity CEMP and the Biodiversity, Land and Safety OEMP to contain measures to protect and manage the areas in the EC1 Zone, including guiding vegetation rehabilitation and management activities.

1.4 Purpose of this report

This Stage 1 BAR has been prepared in accordance with Condition 30(4) of the Airport Plan to achieve independent verification by a person accredited under the TSC Act.

The purpose of this report is to:

- describe the background to the assessment, including relationship with other reports and consideration of the Airport Plan conditions related to the content and purpose of the Stage 1 BAR.
- describe the biodiversity values of the Stage 1 Construction Impact Zone, incorporating the results of an updated field survey completed in accordance with:
  - the field survey requirements of the FBA.
  - the key diagnostic characteristics and condition thresholds specified in the *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (Threatened Species Scientific Committee (TSSC) 2008).
- calculate the offsets required for impacts on plants, animals and their habitats affected by the Stage 1 development with reference to the FBA and associated credit calculator.
- confirm that the Stage 1 BAR has been independently verified by an accredited assessor appointed following consultation with the NSW Office of Environment and Heritage (OEH).
- demonstrate compliance with the Airport Plan biodiversity Condition 30(4).

Any changes to the Construction Impact Zone through the development and approval of a Construction Plan will be incorporated into this report at a later date if required.

The Stage 1 BAR has been submitted for review and verification by the independent verifier.

2. Legislative context

2.1 Airports Act

Major airport developments at existing federally leased airports require approvals under the *Airports Act 1996* (Airports Act), through the approval of major development plans submitted by an Airport Lesee Company. As this process did not appropriately cater for development of an airport at a new site, the Airports Act was amended in 2015 to provide for a single and transparent mechanism for the authorisation of development of the airport. The amended Airports Act requires the preparation of an 'Airport Plan' to guide the development of the airport. The Airport Plan may be determined by the Infrastructure Minister following receipt of a notice from the Environment Minister in accordance with the Airports Act.

2.2 EPBC Act

The EIS was prepared and finalised under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The then Department of the Environment, now called the Department of the Environment and Energy, issued guidelines for the content of an EIS to be prepared for the airport in January 2015.

A draft EIS was prepared to address the requirements of the EPBC Act and the EIS guidelines and released for public exhibition. The EIS was finalised to take into account submissions received during the public exhibition period and provide additional information relevant to the Environment Minister's consideration of the environmental impacts of the proposal.

The finalisation of this EIS was a pre-condition to the determination of the Airport Plan under the Airports Act. The final EIS sits alongside the Airport Plan as a companion document. The Airport Plan specifies how Stage 1 of the airport is to be developed on the airport site, while the EIS assessed the environmental, social and economic impacts associated with the Stage 1 development, including impacts on biodiversity values. This Stage 1 BAR presents an updated assessment of impacts on biodiversity values, including further consideration of the objects of the EPBC Act and associated policy and guidelines.

The objects of the EPBC Act include to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance (MNES) and to promote the conservation of biodiversity. Under the EPBC Act, an action includes a proposal, undertaking or activity.

The EPBC Act identifies MNES as:

- world heritage properties;
- national heritage places;
- wetlands of international importance (Ramsar wetlands);
- threatened species and ecological communities;
- migratory species;
- Commonwealth marine areas;
- Great Barrier Reef Marine Park;
- nuclear actions (including uranium mining); and
- a water resource, in relation to coal seam gas development and large coal mining development.

The EPBC Act also is concerned with actions that affect, or are taken on, Commonwealth land, or are carried out by a Commonwealth agency.

The EPBC Act was addressed in the EIS and has been subject to an updated assessment in this Stage 1 BAR through:

- desktop review to determine the threatened or migratory species or threatened ecological communities that have been previously recorded within the locality and hence could occur in the Stage 1 Construction Impact Zone, subject to the habitats present;
- desktop assessment and field surveys to describe the environment of the Stage 1 Construction Impact Zone, including biodiversity values and threatened biota listed under the EPBC Act or under NSW legislation (see below);
- targeted field surveys for threatened ecological communities and threatened and migratory species; and
- assessment of potential impacts on the environment and on specific MNES that could arise from the construction and operation of the airport and measures to avoid or mitigate potential impacts (GHD, 2016a).

2.3 New South Wales legislation and policy

The airport site is located on Commonwealth owned land. Consequently, the airport proposal does not require environmental assessment or approvals under various NSW environmental planning and assessment legislation. However, the EPBC Act requires protection of the environment, and it is therefore appropriate to consider threatened biota that are listed under NSW legislation and other aspects of the airport site's biodiversity as part of this assessment. Condition 30 of the Airport Plan requires the preparation of a Biodiversity Assessment Report for the Construction Impact Zone which applies the *Framework for Biodiversity Assessment – NSW Biodiversity Offsets Policy for Major Projects* (the FBA) (OEH 2014a), and as such, the FBA has been used to describe and assess impacts on these biodiversity values.

2.3.1 Framework for Biodiversity Assessment

The FBA underpins the policy, and contains the assessment methodology that is required to quantify the potential impacts on biodiversity and to determine the required offsets for a major project.

This Stage 1 BAR was prepared with reference to the FBA and the *Credit Calculator for Major Projects and BioBanking Operational Manual* (OEH 2016a) as required by Condition 30(4) of the Airport Plan. Field surveys were conducted in accordance with the FBA, including description and sampling of plant community types in accordance with the methodology (see Section 3.2.2). The FBA credit calculator was used to assess the biodiversity values at the Stage 1 Construction Impact Zone and to determine offset requirements for impacts on plants, animals and their habitat on Commonwealth land (see Section 6).

Where a proponent seeks to establish an offset for a major project, the BioBanking Assessment Methodology (BBAM) must be used to assess the biodiversity values of the offset site and to identify the number and type of biodiversity credits that may be created on the offset site.

2.3.2 Threatened Species Conservation Act 1995

As at the date the Airport Plan was determined, the TSC Act was the applicable legal framework in NSW and the Airport Plan requires that this Stage 1 BAR be prepared by reference to TSC Act requirements set out in the FBA. The TSC Act has since been replaced by new legislation which is described further below. This section describes the legislation as it stood at the time the Airport Plan was determined.

The TSC Act provides legal status for biota of conservation significance in NSW. The TSC Act aims to, inter alia, 'conserve biological diversity and promote ecologically sustainable development'. The TSC Act contains schedules that list endangered, critically endangered and vulnerable species, populations, ecological communities, and key threatening processes in NSW.

Threatened biota listed under the TSC Act has been considered in this assessment through:

- desktop assessment and field survey to identify threatened biota that may be present at the airport site or affected by the airport; and
- consideration of impacts on threatened biota and measures to avoid or mitigate potential impacts.

Section 142B(1)(c) of the TSC Act provides for the accreditation of suitably qualified and experienced persons to undertake and prepare biodiversity surveys and assessments (accredited assessors). For the purposes of preparing a BAR or a Biodiversity Offset Strategy, the application of the FBA to determine the number of biodiversity credits required at a development site must be made by an accredited assessor. This Stage 1 BAR and associated FBA calculations have been completed by s. 47F(1) (accredited assessor number 0073). This Stage 1 BAR has been independently verified by s. 47F(1) (accredited assessor number 0058).

Part 7A of the TSC Act establishes the NSW Biodiversity Banking and Offsets Scheme (BioBanking), which was enabled by the *Threatened Species Conservation Amendment (Biodiversity Banking) Act 2006*. BioBanking includes a methodology for assessing biodiversity values at offset sites and provides a framework for managing biodiversity offset sites. The BODP will identify biodiversity credits (along with other measures as appropriate) generated at offset sites that have been assessed and conserved within the framework of BioBanking.

The NSW Government has been developing a reform package for biodiversity conservation and land management, including reforms to the regulation of: native plants and animals, and private land conservation. The legislative reforms (including the repeal of the existing legislation) were passed by the NSW Parliament on 17 November 2016 and were contained in:

- the *Biodiversity Conservation Act 2016*, and
- the *Local Land Services Amendment Act 2016*.

The new legislation took effect on 25 August 2017. As this report was prepared prior to this date, it is based on the framework for the listing of threatened species and private land conservation contained in the TSC Act, which is consistent with the requirements of the Airport Plan.

3. Methodology

3.1 Literature and desktop assessment

A desktop assessment was undertaken to identify MNES listed under the EPBC Act and threatened flora and fauna species, populations and ecological communities (biota) listed under the TSC Act and FM Act that have previously been identified at the airport site or are likely to occur. Desktop assessment is also a formal requirement of section 6.4 of the FBA 'Assessing species that cannot be predicted by habitat surrogates (species credits)'.

3.1.1 Literature review

A literature review was undertaken as part of the EIS and was updated in this Stage 1 BAR. The literature review assisted with identifying gaps in field surveys conducted previously, and with focusing field survey techniques and effort.

Biodiversity resources pertaining to the airport site and locality (i.e. within a 10 kilometres radius of the airport site) that were reviewed included:

- the previous EIS and specialist reports prepared for an airport at Badgerys Creek between 1996 and 1999;
- the *Environmental field survey of Commonwealth land at Badgerys Creek Report* (SMEC 2014) and associated specialist reports;
- *Western Sydney Airport referral of proposal action* (DIRD 2014)*;*
- *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer et al 2010);
- *Native Vegetation of the Cumberland Plain, Western Sydney* (NPWS 2006);
- aerial photographs and satellite imagery of the study area; and
- management plans, ecological assessments and research papers relating to the biodiversity values at the airport site and especially the threatened biota that is known or likely to occur in the locality.

The results of previous biodiversity assessments conducted at the airport site have been reviewed, compared against current site conditions and incorporated in this report where appropriate.

3.1.2 Database review

A database review was undertaken as part of the EIS to identify threatened species and ecological communities listed under the EPBC Act that may be affected by the airport, as well as threatened species, populations and communities listed under the TSC Act and FM Act. Database records pertaining to the airport site and locality since 1980 were reviewed prior to field investigations and included:

- the Commonwealth Department of Environment and Energy Protected Matters Search Tool (PMST) for all MNES that are known or are predicted to occur within a 10 kilometre radius of the airport site (DoE 2015a) (database queried on 2 February 2015);
- DoE online species profiles and threats database (DoE 2015b);

- Office of Environment and Heritage (OEH) Wildlife Atlas database (licensed) for records of threatened species, populations and endangered ecological communities listed under the TSC Act that have been recorded within the locality (OEH 2015a), data supplied by OEH on 2 February 2015;
- OEH threatened biota profiles for descriptions of the distribution, habitat requirements and flowering season (where relevant) of threatened biota (OEH 2015b). This resource was used to identify the suite of threatened biota that could potentially be affected by the airport and to inform habitat assessments;
- the NSW VIS Classification 2.1- Community Identification (OEH 2015c) and NSW vegetation types database (OEH 2014b) to identify matching plant community types (PCTs) at the airport site;
- mapping and descriptions of the NSW Mitchell landscapes (DECC 2008a, 2008b);
- Birdlife Australia Atlas Data for records of birds observed within a 3 kilometre radius of the airport site (Birdlife Australia 2015), data supplied by Birdlife Australia on 8 May 2015;
- Birdline NSW (2015). Birdline NSW is a site for the reporting of rare or unusual birds outside their normal range, unusually high or low numbers, early or late arrivals or departures for migrant species and interesting behaviour or unusual habitat usage. This resource was checked to determine the arrival date and movements of Swift Parrots in NSW; and
- the DPI online protected species viewer for records of threatened aquatic species listed under the EPBC and FM Act that have been recorded within the locality (DPI 2015a) (database queried on 2 February 2015).

Following collation of database records and species and community profiles, a threatened biota 'likelihood of occurrence' assessment was prepared with reference to the broad habitats at the airport site. This was further refined following field surveys and assessment of habitat present at the airport site for the EIS (See Section 4 and Appendix A of GHD 2016a).

The likelihood of occurrence assessment for the EIS was updated and refined to help inform field survey effort for this Stage 1 BAR and the calculation of species credits.

3.1.3 Identification of candidate species credit species

Threatened species that cannot reliably be predicted to occur at a development site based on vegetation type, distribution and habitat criteria are identified by the Threatened Species Profile Database (TSPD) as 'species credit species'. The particular habitat components of some ecosystem credit species, such as breeding habitat for a cave roosting bat, are also assessed for species credits (OEH 2014a).

An assessor must identify candidate species credit species for a development in accordance with Section 6.5.1.2 of the FBA. Candidate species credit species have been identified in this Stage 1 BAR based on:

- the threatened species listed in the likelihood of occurrence assessment in the EIS (Appendix A of GHD 2016a), filtered to include only species credit species listed in the TSPD (accessed via BioNet, OEH 2017);
- updated Wildlife Atlas database records of threatened species and populations in the locality (OEH 2017), data supplied by OEH on 20 February 2017;
- the list of species credit species predicted to occur at the site generated by the FBA credit calculator based on geographic, vegetation and habitat data.

The candidate species credit species list for the project area is included in Appendix A along with a 'survey time matrix' stating when targeted surveys for each species may be conducted according to the FBA, and the outcome of targeted surveys and habitat assessments.

3.2 EIS field surveys

3.2.1 Overview

Staged surveys of the airport site were conducted between February and June 2015 for the draft EIS. Supplementary surveys were conducted between July and December 2015 and in April 2016 to support geotechnical and European cultural heritage investigations at the airport site and to help address limitations of the initial survey and finalise the EIS. Surveys were conducted by a team of suitably qualified ecologists and built on previous surveys carried out by SMEC (2014) and those undertaken by Biosis Research (1999) for the previous EIS.

Vegetation survey and assessment for both EPBC Act and TSC Act protected matters was carried out with reference to the FBA (OEH 2014a, 2016) in order to assess vegetation type and condition and to help calculate the quantum of offsets required for the Stage 1 Construction Impact Zone.

Survey methods and effort were also designed with reference to various threatened species survey guidelines. These included the Commonwealth survey guidelines for nationally threatened frogs (DEWHA 2010a) and birds (DEWHA 2010b), the survey guidelines for threatened species listed under the TSC Act (DEC 2004a), species-specific survey methods detailed by the NSW National Parks and Wildlife Service (NPWS 2000, 2002, 2003), survey methods detailed in recovery plans (e.g. for the Grey-headed Flying-fox - DECCW 2009) and referral guidelines (e.g. for the Koala - DoE 2014).

Survey methodology is discussed in Section 3.2.2 and 3.2.3, and survey effort, site stratification and timing is discussed in Section 3.4. Limitations of surveys are discussed in Section 3.4.3.

3.2.2 Flora survey

Flora surveys included vegetation mapping and targeted threatened flora searches. Vegetation within the Stage 1 Construction Impact Zone was surveyed with reference to the FBA (OEH 2014a, 2016) and appropriate threatened species survey guidelines (DEC 2004a). The flora survey effort described below is for the Stage 1 Construction Impact Zone only.

The flora survey involved the following techniques:

- vegetation surveys and mapping;
- plot-transect surveys;
- wetland surveys; and
- targeted threatened flora surveys.

Survey sites were selected using air photo interpretation and field habitat assessment. The locations of plot-transect surveys completed during the flora survey are displayed in Figure 3. A summary of survey effort is provided in Table 4 (Section 3.4.1) and the breakdown of survey effort between mapped vegetation zones in the Stage 1 Construction Impact Zone is provided in Table 15 (Section 4.2.2). A detailed description of the methodology is provided below.

Vegetation surveys and mapping

Vegetation types were classified according to vegetation structure, species composition, soil type and landscape position. Plot/transect data was compared with Tozer et al (2010) diagnostic species lists for equivalent vegetation map units to help confirm the identity of matching

vegetation types (OEH 2014b). This approach is endorsed by the NSW OEH for confirming the identity of floristically similar vegetation types and is particularly relevant for identifying vegetation that may comprise a particular threatened ecological community (TEC) (Steenbeeke, G, OEH, pers. comm.).

Wetlands were mapped as a native vegetation zone if they featured greater than 10 per cent cover of native plant species and/or habitat features such as standing dead trees, shallow marginal water or mudflats. Waterbodies that were free of native plants or habitat features such as steep sided clay lined dams, concrete lined dams or flooded quarry pits were included in the mapped area of 'Cleared land and cropland'. Some smaller wetlands were also included in the mapped area of woodland, forest or grassland vegetation zones if they could not be accurately separated and defined on an aerial photo.

Plot/transect surveys

Plot/transect surveys were conducted in the Stage 1 Construction Impact Zone in accordance with the FBA to confirm vegetation types and assess site condition. The site value was determined by assessing ten biometric habitat attributes against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement. Cover abundance data was collected for each flora species within the 20 metre x 20 metre portion of each plot/transect.

Plots were used to sample potential vegetation zones (i.e. vegetation types and broad condition classes) based on the initial site stratification. A total of 28 plot/transects were sampled within the Stage 1 Construction Impact Zone as shown on Figure 3.

Species richness and biometric plot/transect data was recorded on pro forma data sheets along with a description of the landscape position, soil type, geology and disturbance history for each vegetation zone.

Wetland surveys

Wetlands were not sampled using plot/transects because of the inherent safety risk. Wetland vegetation was sampled by walking the margins of waterbodies and noting dominant plant species and percentage cover in each vegetation strata present (i.e. trees, shrubs, emergent, aquatic and fringing plants). Wetlands were defined based on observed vegetation structure, species composition and whether they were natural or artificial as inferred from geomorphic positon and presence of features such as dam walls. No natural freshwater wetlands were observed in the Stage 1 Construction Impact Zone. Artificial wetlands were matched to the closest equivalent native vegetation type.

This data was recorded on pro forma data sheets along with a description of the landscape position, soil type, geology, habitat resources present and disturbance history for each wetland sampled.

Targeted threatened flora surveys

Threatened plant surveys were conducted throughout all accessible portions of the Stage 1 Construction Impact Zone The suite of threatened plants potentially present was identified based on the desktop assessment results. Habitat for these species was identified based on OEH threatened species profiles and the experience and judgement of GHD ecologists. Much of the Stage 1 Construction Impact Zone contains highly modified landforms that are dominated by exotic species. These areas feature very little native plant cover, do not contain natural soil profiles or soil seed banks and could be readily discounted as containing any threatened plant

species. Areas of potential threatened plant habitat (i.e. near-intact native vegetation and areas with natural topsoil) were systematically traversed on foot and inspected for threatened plants.

A supplementary threatened plant survey was conducted over one day in April 2016 targeting the general location of an unregistered *Marsdenia virdiflora* subsp. *viridflora* population (i.e. not included in the NSW Wildlife Atlas) that was mentioned in some submissions on the Draft EIS.

3.2.3 Fauna survey

The targeted fauna survey effort described below was conducted across the entire airport site, noting that fauna are mobile and often transitory in their use of habitat resources. Survey locations are shown on Figure 3b to 3e.

Surveys conducted across the airport site for the EIS included:

- four days and four nights of targeted frog surveys in March 2015;
- eleven days and six nights of targeted fauna surveys (diurnal and nocturnal) in March-May 2015; and
- two days of targeted winter bird surveys in May-June 2015.

Fauna surveys mainly focussed on detecting threatened and migratory fauna species likely to be impacted by the airport, and providing a quantitative assessment of habitat features that would be removed. Surveys were designed with reference to various survey guidelines (see Section 3.2.1). Targeted surveys included diurnal bird surveys, searches for the Cumberland Plain Land Snail (*Meridolum corneovirens*), spotlighting, call playback, infra-red camera surveys and Anabat surveys. Opportunistic observations were also recorded throughout the surveys.

Diurnal Bird surveys

Diurnal bird surveys comprised the following methods:

- Area Searches
  - Area searches targeting all bird species were performed in the early morning within the airport site on ten mornings in March and April 2015. Surveys were conducted in two locations by either one or two ecologists each morning. A total of 13 sites were surveyed in early morning surveys. Most sites were visited once only, however a number of sites were surveyed on two occasions. Surveys comprised area searches of at least one hour duration targeting larger woodland patches and wetland areas. Grassland areas were also surveyed while moving between woodland patches or dams. Species were identified by sight and call. Incidental observations of all birds were also recorded throughout the day during general surveys.
  - Area searches targeting the Swift Parrot (*Lathamus discolor*) and Gang-gang Cockatoo (*Callocephalon fimbriatum*) but also noting other species encountered, were carried out in many woodland patches in the mornings and afternoons of 21 May and 9 June 2015. The Swift Parrot occurs in western Sydney in winter months, foraging on winter-flowing eucalypts and lerps. Surveys were conducted with regard to the survey guidelines for the Swift Parrot included in DEWHA (2010b) and the bird survey guidelines contained in DEC (2004a). In addition, opportunistic surveys were carried out from 5 to 8 May 2015 for these species. Information on timing of the arrival of Swift Parrots in NSW was gained from Birdline NSW (2015). The first record of the species in NSW via this resource was on 28 April 2015 near Corowa. Sightings of the species in western Sydney were reported on various occasions from 14 May 2015 (Birdline NSW 2015).

- Wetland bird surveys
  - Dams were targeted during early morning bird surveys as well as general fauna surveys throughout the day. Surveys included scanning the water body, muddy edges and emergent vegetation with binoculars.
- Driven transects
  - Slow driven transects were conducted on 21 May and 9 June 2015 to target Swift Parrots and Gang-gang Cockatoos, with other birds also noted. This method combined with targeted area searches ensured as much of the airport site was covered as possible over these dates when these species were likely to be in the locality.

Microchiropteran bat surveys

Microbat ultrasonic echolocation call recordings (Anabat surveys) were undertaken using two Anabat units over ten nights and one unit on one additional night (totalling 21 Anabat unit nights). Of these, seven nights (14 Anabat unit nights) were in March (within the preferred survey season for Anabat surveys) and the remainder were in April and May. Anabats were placed at a total of 12 locations in the airport site. In most locations, Anabat units were left for two nights. In some instances, access or timing constraints meant that Anabat units were left at a location for only one night. Fixed recordings were undertaken from dusk until the following morning. Locations of survey sites are provided on Figure 3. A total of 206.5 hours from 21 nights of recording (all sites combined) was completed.

Calls were identified using zero-crossing analysis and AnalookW software (version 4.1t, Chris Corben 2015) by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from published guidelines. *The Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for possible species (Pennay et al 2011; Churchill 2008; van Dyck and Strahan 2008) and records from the Atlas of NSW Wildlife (OEH 2015a). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of four or more consecutive pulses of similar frequency. Calls with less than four defined pulses were excluded from the analysis. Due to variability in the quality of calls and the difficulty in distinguishing some species, the identification of each call was assigned a confidence rating (see Mills et al 1996 and Duffy et al 2000) as summarised in Table 2. Due to the absence of reference calls from the airport site, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Table 2 Confidence ratings applied to bat call analysis

Species Identification	Description
D - Definite	Species identification not in doubt.
P - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
Po – Possible (Species Group)	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species e.g. *Chalinolobus gouldii / Mormopterus* spp. *Nyctophilus* spp. The calls of *Nyctophilus geoffroyi* and *N. gouldi* cannot be distinguished during the analysis process and are therefore lumped together. *Scotorepens orion/Scoteanax rueppellii/Falsistrellus tasmaniensis.*

Targeted frog surveys

Targeted surveys for the Green and Golden Bell Frog (*Litoria aurea)* were conducted over four nights in March. Surveys were carried out with regard to the significant impact guidelines for this species (DEWHA 2009a) and the Commonwealth survey guidelines for threatened frogs (DEWHA 2010a). The referral guidelines recommend an initial habitat assessment followed by at least four nights of surveys between September and March, during warm and windless weather conditions following rainfall. Surveys of about an hour are recommended for wetlands up to 50 metres in width. Where possible, surveys should include use of a nearby reference site (DEWHA 2009a). The survey guidelines for threatened frogs further recommend surveys be undertaken within one week of heavy rainfall (i.e. greater than 50 mm in seven days) between October and February.

The Green and Golden Bell Frog population at Homebush was used as a reference population for the survey. This site was visited once each week prior to and during the survey at the airport site to determine the level of frog activity and confirm that conditions were likely to be suitable for the detection of the targeted species if present. Surveys at the airport site were conducted in early March 2015, in warm and windless conditions. Surveys were not possible in February 2015 (when there were many days of heavy rain) due to property access constraints. Heavy rain fell on the afternoon of survey night 2, and for some survey dates, rainfall of about 28 mm was recorded over the previous week (see Table 3). Other frog species were calling and were active during surveys at the airport site, suggesting that if Green and Golden Bell Frogs were present, they would also be active. Green and Golden Bell Frogs were active (but not calling) at the reference site at these times.

A summary of weather conditions and observed frog activity during surveys is provided in Table 3.

Table 3 Weather conditions during targeted frog surveys

Survey	Date	Temperature		Rainfall in preceding 24 hours (mm)	Rainfall in preceding 7 days (mm)	Conditions during survey	Frog activity during survey
		(min.)	(max.)				
Reference site night 1	6/3/15	13.4	30.7	0.0	20.4	Warm and windless	Frogs calling and active
Airport site survey night 1	11/3/15	17.8	30.6	0.0	0.0	Warm and windless	Frogs calling and active
Reference site night 2	*11/3/15*	*20.1*	*30.1*	*0.0*	*0.0*	*Warm and windless*	*Green and Golden Bell Frogs active.*
Airport site survey night 2	12/3/15	17.4	28.4	28.6	28.6	Warm and windless	Frogs calling and active
Airport site survey night 3	18/3/15	15.2	30.3	0.0	28.6	Warm and windless	Frogs calling and active
Reference site night 3	*18/3/15*	*17.3*	*30.3*	*0.0*	*14.6*	*Warm and windless*	*Green and Golden Bell Frogs active.*
Airport site survey night 4	19/3/15	15.0	32.0	0.0	0.0	Warm and windless	Frogs calling and active

Note: Airport site weather data from Badgerys Creek weather station (067108) and reference site weather data from the Sydney Olympic Park weather station (66212) (BOM 2015a).

Frog surveys targeted farm dams, creeks and other water bodies, which were identified during the initial one-day site inspection, by aerial photograph inspection, desktop review and during field surveys. Given the size of the airport site, targeted surveys of one hour were carried out at sites with better quality habitat, while rapid surveys were conducted at others. These are described further below. Targeted surveys were carried out each night at four of the sites, while other sites were visited once only during surveys to enable a greater coverage of the airport site.

Frog surveys were undertaken with reference to DECC (2008d) hygiene protocols. Measures adopted comprised sterilising boots between survey sites to prevent transfer or introduction of chytrid fungus, and avoiding the use of suncream and insect repellent on hands.

Frog surveys included the following methods:

- Targeted surveys
  - Diurnal inspections of selected dams were conducted in the afternoons prior to nocturnal surveys on the four nights. Searches for basking frogs and call playback were undertaken at these dams. Scans for basking frogs were also conducted at dams during general fauna surveys in late March and early April. Notes at each water body were taken, and included size, geomorphology, presence of habitat features and structure, type and species composition of wetland and aquatic vegetation.
  - Active nocturnal searches for frogs were performed for a minimum of one hour at each survey site focussing on areas of suitable habitat. Creek banks and dam edges were systematically searched and aquatic vegetation was visually scanned using spotlights. Call playback and vocalisations imitating the call of the Green and Golden Bell Frog were broadcast at each targeted survey site, comprising a minimum of five minutes calling followed by a ten minute listening period. For larger dams, calls were broadcast at a number of locations around the dam edges. Frogs were identified by sight and call.
- Rapid surveys
  - Call playback and vocalisations imitating the call of the Green and Golden Bell Frog were broadcast at each rapid survey site, comprising a minimum of five minutes calling followed by a ten minute listening period. All frogs heard calling were recorded. Some rapid surveys were able to be completed in properties that are mapped as ‘access not obtained’ on Figure 3a because wetland habitat could be seen and frogs could be heard calling from adjoining land in the survey area.

Nocturnal bird and mammal surveys

Nocturnal bird and mammal surveys comprised the following:

- Call playback

Call playback was undertaken on a total of nine nights at the airport site. Calls of the Barking Owl (*Ninox connivens*), Powerful Owl (*Ninox strenua*), and Masked Owl (*Tyto novaehollandiae*) were broadcast in woodland areas. Calls were broadcast through a 15 watt megaphone for a minute each with gaps of about a minute between the call of each species. Calls were then repeated. A quiet listening period of ten minutes was held prior to and following call playback. Potential roost sites were scanned with a spotlight.

- Spotlighting

Spotlighting targeting nocturnal birds and mammals was conducted over nine nights at the airport site. Spotlighting was undertaken by three ecologists using 210 lumens P14 Led Lenser torches. Each survey lasted between 1-2 hours. Surveys were carried out along road reserves

and in larger woodland patches. Spotlighting for frogs was conducted separately as part of the targeted frog surveys described above, although any frogs heard or observed during other spotlighting surveys were recorded. Similarly, any nocturnal mammals and birds heard or observed during the targeted frog surveys were recorded.

Infra-red camera surveys

Two infra-red cameras were placed at four separate locations in woodland or near dams in the airport site to target cryptic species. Cameras were baited with a mixture of chicken wings and tinned sardines. Cameras were left set for a minimum of three weeks. Cameras were set to take three pictures over one minute when triggered by movement, with at least five minutes between each set of photographs.

Cumberland Plain Land Snail searches

Targeted searches for Cumberland Plain Land Snails were carried out in larger patches of vegetation (where possible with regard to access constraints) and along road reserves in the airport site. Active searches were conducted in leaf litter at the base of trees and under rubbish and logs. Searches were conducted for between half an hour to an hour in woodland patches, depending on the size of the patch. Live snails were photographed, and empty shells were collected and sent to the Australian Museum for identification and confirmation. GPS waypoints were collected for search areas, and for any snails recorded.

Koala scat searches

Targeted Koala scat searches were conducted in conjunction with the searches for the Cumberland Plain Land Snail, as both scats and snails occur in leaf litter at the base of trees. Scat searches focussed on Forest Red Gum (*Eucalyptus tereticornis*), a primary food tree in the Sydney area (DECC 2008c), and Grey Box (*Eucalyptus moluccana*), a secondary food tree in the Sydney area (DECC 2008c). Searches were conducted for between half an hour to an hour in woodland patches, depending on the size of the patch.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during the field survey. Scats, burrows and diggings were noted and mature trees (ie trees between 20 to 80 per cent of their life expectancy, rather than saplings) were scanned for roosting birds.

Fauna habitat assessment

Habitat assessments were conducted to help describe the suite of native fauna likely to occur in the Stage 1 Construction Impact Zone. Particular attention was paid to habitat features and resources considered important for threatened species.

Habitat assessments included identification and assessment of:

- vegetation patch size, connectivity, age, disturbance and floristic and structural diversity (important for determining habitat suitability for many threatened birds and mammals);
- quality of substrate to provide foraging habitat and shelter for Cumberland Plain Land Snails, frogs, reptiles and ground-foraging birds, including rocks, logs, peeling bark, leaf litter and native grassland;
- presence of winter-flowering eucalypts (important for the Swift Parrot (*Lathamus discolor*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) and food trees of the Koala (*Phascolarctos cinereus*) and Glossy Black-cockatoo (*Calyptorhynchus lathami*);
- hollow-bearing trees and logs which provide refuge, nest and den sites for a range of threatened fauna species;

- stags and other roost sites for raptors and owls;
- artificial roost habitats including bridges and culverts for birds and microbats; and
- wetlands, water courses and moist grassland and other foraging or breeding habitat for waterbirds (including migratory birds), frogs, reptiles and mammals.

Evidence of animal presence was noted during the time spent on site, including specific searches for:

- mammal scats at the base of trees or along tracks and runways;
- tracks in soft substrate;
- nest/den sites within logs, tree bases or tree trunks;
- guano or moth remains at the base of hollow-bearing trees (diagnostic of the presence of tree-roosting bats);
- scratches on tree trunks (potential evidence of Koalas, gliders or goannas) and worn bark around tree hollows (diagnostic of active use of hollows); and
- owl pellets, whitewash or animal remains beneath trees (diagnostic of owl or raptor roosts).

Locations of important habitat features were captured with a handheld global positioning system (GPS) unit or a tablet.

Mapping of hollow-bearing trees was undertaken to provide an indication of the distribution and number of hollow-bearing trees as well as sizes of hollows that would be removed for the airport. Given the large area of the airport site and access constraints at the time of surveys, detailed mapping was not undertaken throughout the entire site. Data collected included tree species, height, diameter at breast height, and number, size and location of hollows.

3.2.4 Rapid assessments

Supplementary ‘rapid assessments’ were conducted between March and December 2015 and in April 2016. The purpose of these supplementary surveys was to help avoid or mitigate impacts on biodiversity values arising from geotechnical or European cultural heritage investigations at the airport site, to assess impacts of proposed infrastructure on land adjoining the airport site and to help address limitations of the initial survey.

Rapid assessments comprised a combination of the following survey techniques as relevant to the site features at each location:

- visual inspection of the investigation area and assessment of vegetation type and condition patch size, connectivity, age, disturbance and floristic and structural diversity;
- assessment of the conservation significance of vegetation with reference to the identification and condition criteria for listed TECs;
- assessment of the presence and quality of fauna habitat resources such as shelter substrate for Cumberland Plain Land Snails, hollow-bearing trees and logs, stags and roost sites, wetlands and water courses;
- active searches for resident fauna in areas of suitable habitat including checking of shelter substrate for Cumberland Plain Land Snails; and
- targeted searches for threatened plants.

The investigation areas for rapid assessments are indicated on Figure 3a and comprised:

- the area potentially subject to impacts from geotechnical investigations at test pit or bore hole locations each around 200m^2, one ripping trial location around two hectares in area and associated access tracks;
- the area for European cultural heritage investigations comprising three grave cut locations each around one to two hectares in area and associated temporary access tracks; and
- the location for High Intensity Approach Lighting (HIAL) on land adjoining the airport site.

The results of the rapid assessments were used to refine and update the biodiversity assessment in the final EIS, particularly in portions of the survey area that could not be accessed during the initial targeted survey period. This process included fine scale adjustments to the vegetation zone and TEC mapping.

3.3 Updated field surveys

3.3.1 Overview

Updated surveys within the Stage 1 Construction Impact Zone were conducted in February to August 2017. The purpose of the updated surveys was to:

- survey portions of the site that could not be accessed due to landowner restrictions through 2015;
- refine the mapping of vegetation, especially the extent of derived native grasslands;
- collect additional plot/transect data and other data as required to apply the field survey methodology of the FBA for areas within the Construction Impact Zone, in accordance with Condition 30(4)(a) of the Airport Plan (noting the field survey effort for the EIS was stratified across the entire airport site and that additional effort was required to adequately sample the Construction Impact Zone in isolation);
- help determine the offset requirements for the loss of foraging habitat for the Swift Parrot (*Lathamus discolor*) as required by Condition 30(4)(b) of the Airport Plan;
- refine the mapping of EPBC Act Cumberland Plain Woodland CEEC based on the key diagnostic characteristics and condition thresholds specified in the listing advice for the community (TSSC 2008).

Survey methodology is discussed in Section 3.3.2 and 0, and survey effort, site stratification and timing is discussed in Section 3.4.1. Survey locations are shown on Figure 2. Limitations of surveys are discussed in Section 3.4.3.

3.3.2 Flora survey

An updated vegetation survey was conducted within the Stage 1 Construction Impact Zone to ensure that the total survey effort met the requirements of the FBA and the Airport Plan conditions.

The flora survey involved the following techniques:

- updated vegetation surveys and mapping;
- additional plot-transect surveys;
- additional targeted threatened flora surveys.

Survey sites were selected using air photo interpretation and field habitat assessment. The locations of plot-transect surveys completed during the flora survey are displayed in Figure 3. A summary of updated survey effort is provided in Table 4 (Section 3.4.1) and the breakdown of

survey effort between mapped vegetation zones is provided in Table 15 (Section 4.2.2). A detailed description of the methodology is provided below.

Vegetation surveys and mapping

Vegetation mapping prepared for the final EIS Biodiversity Assessment (GHD 2016) was ground-truthed in the field via driven and walked transects. Particular attention was given to areas of the site where access was not available due to landowner restrictions in 2015-16 and to mapping the extent of derived native grasslands and EPBC Act Cumberland Plain Woodland CEEC. Necessary adjustments were made with reference to a GPS tablet in the field.

Vegetation types were classified according to vegetation structure, species composition, soil type and landscape position. Plot/transect data were compared with Tozer et al (2010) diagnostic species lists for equivalent vegetation map units to help confirm the identity of matching vegetation types (OEH 2014b). In some cases, comparison with Tozer et al (2010) diagnostic species lists did not provide a clear 'signal' for a single vegetation type, notably with regards to plot/transects with HN528 ('Shale Plains Woodland') and HN529 ('Shale Hills Woodland'). In these cases further consideration was given to landscape position, topography and continuity with other defined patches of a given vegetation type.

Native vegetation types were further split into broad condition classes with reference to the FBA to yield vegetation zones as follows:

- 'Moderate/good – high' condition vegetation which featured over storey, mid storey and groundcover vegetation at benchmark levels for the equivalent vegetation type (i.e. woodland or forest structure and predominately native groundcover vegetation);
- 'Moderate/good – medium' condition vegetation which featured over storey and mid storey vegetation at or close to benchmark levels for the equivalent vegetation type (i.e. woodland or forest structure) but less than 50 per cent of the groundcover present was native species;
- 'Moderate/good – poor condition' vegetation which featured over storey and mid storey vegetation cover substantially below benchmark levels for the equivalent vegetation type but greater than 50 per cent of the groundcover present was native species (i.e. derived native grassland, shrubland or scrub structure);
- 'Low' condition vegetation which was dominated by perennial plant species and featured over storey and mid storey vegetation cover substantially below benchmark levels for the expected native vegetation type and less than 50 per cent of the groundcover present was native species (i.e. exotic grassland, shrubland or scrub structure).

'Cleared land and cropland' was mapped separately and excluded from native vegetation zones. These areas comprised vegetation dominated by exotic annual plant species, bare earth or infrastructure. Native over storey and mid storey plants were only present as isolated individuals. Less than 50 per cent of the groundcover present was native species or greater than 90 per cent of the ground surface was bare earth or infrastructure.

EPBC Act Cumberland Plain Woodland CEEC was identified and mapped according to the criteria in the listing advice for the community (TSSC 2008), specifically areas of woodland or forest on shale-influenced soils that:

- contain characteristic native species with a minimum projective foliage cover of >10 per cent;
- are part of a patch >0.5 hectares in size;
- >50 per cent of the perennial understorey vegetation cover present is native; or

- are part of a patch of native vegetation 5 ha in size, or a patch that contains at least one tree that is large (>80cm diameter at breast height) or hollow-bearing; and
- >30 per cent of the perennial understorey vegetation cover present is native.

Data collected in the plot/transect and rapid assessment surveys described below were used to assess each candidate patch of Cumberland Plain Woodland at the airport site against these criteria.

Plot/transect surveys

Plot/transect surveys were conducted in the Stage 1 Construction Impact Zone in accordance with the FBA to confirm vegetation types and assess site condition. Supplementary plot/transect surveys were conducted to meet the field survey requirements of the FBA with sampling bias towards areas that could not be accessed in 2015, potential derived native grassland, freshwater wetlands and potential EPBC Act Cumberland Plain Woodland CEEC.

Plot/transects were used to sample vegetation zones (i.e. vegetation types and broad condition classes) based on the updated vegetation mapping. A total of 60 plots were sampled within the Stage 1 Construction Impact Zone as shown on Figure 3, with 32 of these plots sampled during the updated surveys conducted in 2017.

Rapid plot/transects

Rapid plot/transects were conducted in areas of moderate condition Cumberland Plain Woodland to help confirm whether this vegetation met the required criteria to comprise EPBC Act Cumberland Plain Woodland. This technique was developed to help deliver a fine scale 'patch by patch' assessment of the key diagnostic characteristics and condition thresholds for EPBC Act Cumberland Plain Woodland across the survey area.

Rapid plot/transects comprised a simplified form of the FBA plot/transect methodology. Native vegetation cover and exotic plant cover were collected along a 50 m transect and habitat resources were measured in a 50 m x 20 m plot as per the methodology. However only the most abundant plant species were recorded in the 20 m x 20 m plot in order to save time and increase survey coverage. These data were not entered in the FBA credit calculator except in the case of vegetation zone 13 because this zone was created as a result of independent verifier review after the updated field surveys had been completed. This meant that there was not the opportunity to purposefully stratify survey effort across this vegetation zone and ensure that the required number of plot/transects was sampled during the survey period. To avoid potential underestimation of the site value score in these areas benchmark plant species richness data were entered in the credit calculator for rapid plot/transects 2 and 3.

A total of five rapid assessment plots were sampled within the Stage 1 Construction Impact Zone as shown on Figure 3.

Rapid assessments

Updated 'rapid assessments' were conducted across the Stage 1 Construction Impact Zone to help assess the extent and quality of habitat resources, derived native grasslands and EPBC Act Cumberland Plain Woodland.

Rapid assessments comprised a combination of the survey techniques described above in Section 3.2.4, including visual assessment of vegetation type and condition with reference to the identification criteria for listed TECs. A representative photo and brief field notes were captured with a handheld GPS at each rapid assessment area.

Targeted threatened flora surveys

Supplementary threatened plant surveys were conducted throughout accessible portions of the Stage 1 Construction Impact Zone with reference to the *NSW Guide to Surveying Threatened Plants* (OEH 2016b). The suite of threatened plants potentially present was identified based on the desktop assessment results. Areas of potential threatened plant habitat (i.e. near-intact native vegetation and areas with natural topsoil) were systematically traversed on foot and inspected for threatened plants. Parallel field traverses through areas of known or likely threatened plant habitat were conducted using the techniques and minimum spacing specified in the guide (OEH 2016b).

A population of the threatened plant Spiked Rice-flower (*Pimelea spicata*) was detected at the airport site during the supplementary surveys in March 2017. A further four days of intensive targeted surveys were conducted by two ecologists to confirm the extent of this population and to count and map individual plants. The supplementary surveys included parallel field traverses through areas of known or likely habitat with a minimum spacing of five metres as specified in the guide (OEH 2016b).

A population of the threatened plant *Dillwynia tenuifolia* was detected at the airport site during a site inspection in June 2017. A further 1.5 days of intensive targeted surveys were conducted by two ecologists to confirm the extent of this population and to count and map individual plants. The supplementary surveys included parallel field traverses through areas of known or likely habitat with a minimum spacing of five metres as specified in the guide (OEH 2016b).

3.3.3 Fauna survey

Updated fauna surveys conducted in the Stage 1 Construction Impact Zone for this biodiversity assessment included detailed habitat assessments and targeted fauna searches. Survey locations are shown on Figure 3b to 3e.

A total of five days of additional diurnal fauna surveys were conducted at the Stage 1 Construction Impact Zone in February and March 2017, including:

- habitat assessments
- diurnal bird surveys;
- active searches for the Cumberland Plain Land Snail; and
- opportunistic observations.

The methodology for these techniques is as described for the EIS surveys in Section 3.2.3 above.

Additional targeted habitat assessments were conducted to quantitatively assess the extent and quality of habitat resources for the Swift Parrot as an input to the BODP.

3.4 Survey effort, timing, limitations and staff

3.4.1 Survey stratification, effort and timing

Field survey methods and effort were designed with reference to the Commonwealth survey guidelines for threatened species listed under the EPBC Act (DEWHA 2010a, b, c, d), the NSW draft Threatened Species Survey Guidelines (DEC 2004a), and any relevant survey and habitat information in recovery plans and environmental impacts assessment guidelines for relevant threatened species (see Section 3.2.1 and the references provided in Section 10). A summary of survey effort is provided in Table 4.

Table 4 Survey effort and timing

Survey focus	Survey method	EIS Survey Effort	EIS Survey Dates	Updated Survey Effort	Updated Survey Dates
Initial survey	Site familiarisation	1 day	13/02/2015		
Targeted frog surveys	Diurnal inspections of dams for basking frogs	4 afternoons	11-12/03/2015 18-19/03/2015		
	Targeted surveys of dams for frogs, call playback	4 nights	11-12/03/2015 18-19/03/2015		
	Rapid aural surveys, call playback	4 nights	11-12/03/2015 18-19/03/2015		
Vegetation mapping and threatened flora surveys	BioBanking plot/transect surveys	28 plot/transects	Feb-May 2015, April 2016	32 plot/transects	Feb-March 2017
	Targeted threatened flora searches	20 days (including around 76 dedicated person hours, comprising a team of two spending at least 2 hours per day on site)	Feb-May 2015	11.5 days (including around 114 dedicated person hours comprising a team of two spending at least 1 hour per day on each of 5 days on site; 4 full days of dedicated *Pimelea spicata* surveys; and 1.5 days of dedicated *Dillwynia tenuifolia* surveys; and 2 days of dedicated *Marsdenia*	April 2016 Feb-April 2017 June 2017 August 2017

Survey focus	Survey method	EIS Survey Effort	EIS Survey Dates	Updated Survey Effort	Updated Survey Dates
				viridiflora subsp. *viridiflora* surveys).	
	Wetland assessments	7 sites	Feb-April 2015		
Fauna surveys	Habitat assessment	18 days	Feb-May 2015	5 days	Feb-April 2017
	Diurnal bird surveys	16 days	Feb-May 2015	5 days	Feb-April 2017
	Early morning bird surveys	10 mornings (2-3 people for 1-2 hours on each morning) – 13 sites visited at least once	Feb-May 2015		
	Microchiropteran bat surveys (Anabat)	21 Anabat unit nights over 12 locations	Feb-April 2015		
	Targeted frog surveys	2 people for 4 afternoons and nights (80 person hours)	February 2015		
	Spotlighting (birds and mammals)	3 people on 5 nights (30 person hours) and a further 2 people on 4 nights (16 person hours)	Feb-April 2015		
	Call playback (owls)	9 nights (0.25 hour per night, followed by spotlighting survey of 1 hour)	Feb-April 2015		

Survey focus	Survey method	EIS Survey Effort	EIS Survey Dates	Updated Survey Effort	Updated Survey Dates
	Infra-red cameras	2 cameras, each at two locations for 4 weeks each	Feb-April 2015		
	Active searches for the Cumberland Plain Land Snail, other ground fauna and scats	11 days (35 sites, about 25 person hours)	Feb-May 2015	5 days (about 10 dedicated person hours)	Feb-March 2017
	Koala scat searches	11 days (35 sites, about 25 person hours)	Feb-May 2015		
	Opportunistic observations	18 days	Feb-May 2015	8 days	Feb-March 2017
	Winter bird surveys	2 people for 2 days	May and June, 2015		
Aquatic surveys	Aquatic habitat assessment Macroinvertebrate sampling Fish surveys Water quality sampling	2 people for 5 days (sampling at 12 sites, of which 6 were in the airport site)	March and May, 2015		
Stage 1 geotechnical investigation locations	Rapid assessment	47 sites over 4 days	April and May 2015		
European cultural heritage investigation locations	Rapid assessment	4 sites over one day	November 2015		
Stage 2 geotechnical investigation locations	Rapid assessment	56 sites over 6 days	October and November 2015		
High Intensity	Rapid assessment	½ day	April 2016		

Survey focus	Survey method	EIS Survey Effort	EIS Survey Dates	Updated Survey Effort	Updated Survey Dates
Approach Lighting (HIAL) sites					
Downstream surveys	Downstream rapid assessments	1 day	April 2016		

Targeted surveys at the airport site for the EIS were stratified between vegetation and habitat types as required by the NSW draft Threatened Species Survey Guidelines (DEC 2004a). Stratification is necessary to ensure that the full range of potential habitats and vegetation types are systematically sampled. The survey area should be initially stratified on biophysical attributes (e.g. landform, geology, elevation, slope, soil type, aspect), followed by vegetation structure (e.g. forest, woodland, shrubland), and then floristics (e.g. species) (DEC 2004a).

The airport site has relatively uniform biophysical attributes, comprising either rolling low hills on shale substrate or riparian corridors on alluvium. These units were further split based on vegetation structure to yield four broad habitat types which comprised the stratification units for the field survey as follows:

- woodland, comprising grassy eucalypt woodlands on rolling hills and flats on shale or shale-gravel substrate;
- riparian forest, comprising grassy eucalypt forest or closed woodlands on flats on alluvial substrate;
- grassland, comprising native and exotic grassland in a variety of geomorphic positions; and
- wetland, comprising freshwater wetlands and farm dams in a variety of geomorphic positions.

Survey stratification units are mapped on Figure 2. Cleared land and cropland is also shown, which comprises extensively modified land with minimal native vegetation cover or habitat resources. Cleared land and cropland was not sampled with targeted survey techniques but was sampled by broad survey techniques such as vegetation mapping and habitat assessments as well as opportunistic fauna observations.

Targeted fauna survey techniques were purposefully split between these stratification units based on the total area of each habitat type at the airport site and the likelihood of the targeted species occurring in each habitat type. The survey effort that was conducted in each stratification unit is summarised in Table 5.

Vegetation plot/transects were stratified between individual vegetation zones based on floristics and condition. The EIS surveys were stratified across the airport site. The updated surveys conducted for this Stage 1 BAR were stratified across the Stage 1 Construction Impact Zone only and included the minimum number of plot/transects in each vegetation zone specified by the FBA. The split of plot/transects between vegetation zones in the Stage 1 Construction Impact Zone is summarised in Table 9.

Table 5 Fauna survey site stratification according to habitat type

	Woodland	Riparian forest	Grassland	Wetland
Total Area of habitat type within the airport site (hectares)	**216.2**	**90.1**	**1037.5**	**39.0**
Survey technique Number of survey sites	*Number of survey sites*			
Active searches	28	7		
Anabat recording (sites)	4	2	1	5
Call playback	6	3		
Camera trap	3	1		
Diurnal bird surveys (sites)	8	4		4
Rapid frog survey		1		15
Targeted frog surveys				11
Spotlighting	4	5		
Wetland assessments				7
Winter bird surveys	16	7		

The site stratification and survey effort should be considered along with the following considerations and qualifications:

- the point location for targeted fauna surveys shown on Figure 2 indicates the starting point for a survey that sampled a broader area, including:
  - active searches within the entire patch of treed vegetation surrounding the point over at least one hour;
  - diurnal bird surveys and winter bird surveys over around one hectare of treed vegetation, one kilometre of edge habitat or an entire wetland over at least one hour; and
  - targeted frog surveys around the margins of an entire wetland for at least one hour.
- call playback events were stratified between woodland and riparian forest in order to increase the variety of locations and habitat features sampled. However, the airport site was considered a single 'site' for the purposes of calculating the total number of nights of survey effort. This is based on the fact that calls broadcast with a 100W megaphone may be heard at least a kilometre away (DEC 2004a) and that the home ranges of threatened forest owls typically range from 500 to over 1000 hectares (DEC 2006a). The nine nights of call playback performed at the airport site is sufficient to achieve a 90 per cent chance of detection of each of the forest owl species that were targeted (DEC 2004a);
- anabat recording, bird surveys and spotlighting events that were mainly focussed on woodland or riparian forest also sampled adjoining areas of grassland and nearby dams. Similarly, sampling focussed on dams also sampled adjacent woodland and grassland areas;
- early morning bird surveys were conducted at the same location on different days on some occasions, thus the survey effort identified on Figure 2 and in Table 5 is an underestimate of the total number of times the different stratification units were visited;

- diurnal bird surveys and active searches for the Cumberland Plain Land Snail during the 2017 supplementary surveys were conducted in conjunction with plot/transect surveys and were not purposefully stratified between fauna habitat types; and
- habitat assessments, targeted searches for threatened plants and opportunistic fauna observations were performed in all native vegetation at the airport site during all time spent on site.

3.4.2 Weather conditions during the EIS surveys

Weather conditions during the EIS surveys were generally conducive for field surveys and the detection of fauna and flora. Frog survey conditions have been discussed in Section 3.2.3. Weather was generally sunny and mild to warm during the biodiversity surveys. Rain fell on seven days during the biodiversity surveys, but most days were dry. Rainfall was well above average across the Sydney region during summer and autumn 2015. Badgerys Creek had a new rainfall record of 83.6 millimetres in one day in late April. Minimum temperatures were above average across the city during summer and autumn and nights were particularly warm in early May (BOM 2015b). These conditions were generally suitable for the detection of the species likely to occur at the airport site. Plants were generally healthy and not dormant and most species had above ground vegetation, flowers and/or fruit that permitted positive identification to the species level. Fauna species were active and calling.

Weather details for the Badgerys Creek weather station (BOM 2015a) during the survey period are summarised in Table 6.

Table 6 Weather conditions during EIS surveys

Survey	Date	Temperature (°C)		Rainfall (millimetres)
		(min.)	(max.)	
Initial survey	13/02/2015	18.9	26.7	7.6
Frog surveys	11/03/15	17.8	30.6	0
Frog surveys	12/03/15	17.4	28.4	28.6
Frog surveys	18/03/15	15.2	30.3	0
Frog surveys	19/03/15	15.0	32.0	0
Terrestrial biodiversity surveys	24/03/15	17.1	24.7	0
Terrestrial biodiversity surveys	25/03/15	11.8	24.4	10.8
Terrestrial biodiversity surveys	26/03/15	13.4	28.1	0
Terrestrial biodiversity surveys	27/03/15	8.2	26.7	0
Terrestrial biodiversity surveys	31/03/15	15.8	22.9	4.2
Terrestrial biodiversity surveys	1/04/15	15.5	26.1	3.6
Terrestrial biodiversity surveys	2/04/15	14.7	28.9	0
Terrestrial biodiversity surveys	5/05/2015	12.9	25.8	0.2
Terrestrial biodiversity surveys	6/05/2015	10.4	19.3	0
Terrestrial biodiversity surveys	7/05/2015	4.7	18.5	0
Terrestrial biodiversity surveys	8/05/2015	6.6	20.4	0
Winter bird surveys	20/05/2015	10.3	23.7	3.8
Winter bird surveys	10/06/2015	6.3	14.9	0

3.4.3 Weather conditions during the updated surveys

Weather conditions during the updated surveys were generally conducive for field surveys and the detection of fauna and flora. Weather was generally mild to warm during the biodiversity surveys, with high humidity and some rainfall. Rain fell on three days during the biodiversity surveys (BOM 2017).

Weather conditions were generally suitable for the detection of the species likely to occur at the airport site. Plants were generally healthy and not dormant and most species had above ground vegetation, flowers and/or fruit that permitted positive identification to the species level. Notably a local population of the threatened plant *Pimelea spicata* featured actively growing above ground tissue, including flowers. Conditions were suitable for detecting *P. spicata* and other plant species that are known to grow or flower in response to rainfall. Fauna species were active and calling.

Weather details for the Badgerys Creek weather station (BOM 2017) during the survey period are summarised in Table 7.

Table 7 Weather conditions during updated surveys

Survey	Date	Temperature (°C)		Rainfall (millimetres)
		(min.)	(max.)	
Terrestrial biodiversity surveys	22/02/2017	14.7	32.2	0
Terrestrial biodiversity surveys	23/02/2017	15.8	35.8	0
Terrestrial biodiversity surveys	21/03/2017	22.3	27.2	0
Terrestrial biodiversity surveys	22/03/2017	20.7	31.6	16.2
Terrestrial biodiversity surveys	23/03/2017	19.6	22.7	8.8
Targeted *Pimelea spicata* surveys	24/03/2017	17.5	24.7	7.4
Targeted *Pimelea spicata* surveys	27/03/2017	16.7	29.1	0
Targeted *Pimelea spicata* surveys	28/03/2017	18.7	24.4	0

Note: Airport site weather data from Badgerys Creek weather station (067108)

3.4.4 Survey limitations

Flora and fauna field surveys conducted on the airport site would not be expected to detect all of the species present, however given the many days and various seasons over which surveys have been conducted, these would have recorded a large proportion of species that would occur. Flora and fauna surveys were conducted by GHD at the airport site between February and June 2015 for the EIS. Supplementary surveys were conducted between July and December 2015 and in April 2016 to support geotechnical and European cultural heritage investigations at the airport site and to help address limitations of the initial survey. Additional surveys were conducted in March and April 2017 to update the biodiversity assessment for the Stage 1 Construction Impact Zone, including the opportunity to survey properties where access has not been possible in the 2015 and 2016 surveys.

Previously, surveys were conducted by SMEC at the airport site in September 2014 and these built upon surveys conducted for the previous EIS (Biosis 1999).

The current field surveys were appropriately stratified to sample representative habitats on sites and conducted in accordance with survey effort and seasonal requirements of relevant survey guidelines (DEC 2004a; DEWHA 2010a, b, c, d; OEH 2014a). The majority of the terrestrial survey effort was conducted in March, during the nominated survey period for most fauna groups (DEC 2004a; DEWHA 2010a, b) and in April when conditions were still warm and fauna were still active.

Some species that may occur in the locality or region on a seasonal basis, use habitats periodically (as part of a wider home range) or become active at different times of the year may not have been recorded. These species may include flora species that are difficult or impossible to locate or identify at certain times of year due to a lack of reproductive material and/or their seasonal nature (in particular, native orchids and forbs). Field surveys aimed to identify areas of

suitable habitat for cryptic species and where necessary to assess the likelihood of occurrence at the airport site.

The targeted Green and Golden Bell Frog surveys were conducted towards the end of the nominated September-March survey period because of property access restrictions. On no occasion did a total of greater than 50 mm of rain fall in the week prior to a given survey as is specified in the EPBC Act significant impact guidelines for the species (DEWHA 2009a). However conditions were warm, humid and still and other frog species were calling and were active and easily detected during surveys at the airport site. Green and Golden Bell Frogs were active (but not calling) at the reference site and were readily observed. Given these considerations, it is likely that the targeted Green and Golden Bell Frog surveys would have detected the species if a population was present at the airport site.

The airport site was occupied by multiple landowners and featured a variety of land uses at the time of the field surveys. Access was not able to be obtained to the entire airport site. Figure 2a shows the 'survey area' at the airport site that was the subject of targeted biodiversity surveys and direct observations. Properties that are mapped as 'access not obtained' were not accessed on foot because of access restrictions or because they contained land uses such as mines or intensive agriculture and could be reliability discounted as containing biodiversity values based on a desktop assessment. These properties were assessed based on a combination of air photo assessment, direct observations from adjoining properties or public land and extrapolation of results from the survey area.

For the above reasons, the impact assessment and conclusions of this report draw upon information obtained from a variety of sources in addition to the field survey data. Where it is considered that the likelihood of observing a particular threatened species was diminished due to the extent of survey effort or seasonal or climatic factors, then this has been indicated. An assessment of the likelihood of occurrence of threatened species has been provided, on the basis of known distributional ranges, previous records in the locality, and habitat and resource availability at the airport site. The assessment of impacts includes those threatened species recorded at the airport site during the field surveys as well as those species not detected but considered likely to occur or to be impacted by the airport.

3.4.5 Staff qualifications

Qualifications of staff that undertook recent field surveys and prepared this report and/or the EIS are provided in Table 14. Flora and fauna surveys were conducted under a Section 132C scientific licence (SL100146) issued under the NSW *National Parks and Wildlife Act 1974* and complied with GHD's animal ethics permit requirements. All aquatic sampling was carried out with current scientific research permits under Section 37 of the FM Act (permit number P01/0081(C)) and complied with GHD's ethics permit requirements.

Table 8 Qualifications of staff

Name	Position/Role	Qualifications	Years' Experience
s. 47F(1)	Senior Ecologist / desktop assessment, site surveys, credit calculations and reporting	BSc, MSc (Physical Geography) NSW BioBanking Assessor Accreditation (number 0073)	13+ years
s. 47F(1)	Senior Ecologist / desktop assessment, site surveys, reporting	BSc, PhD (Zoology) NSW BioBanking Assessor Accreditation (number 160)	13+ years
s. 47F(1)	Graduate Ecologist / desktop assessment, data processing.	BSc, MPhil. (Zoology)	3+ years
s. 47F(1)	Principal Ecologist/direction and technical review	BSc (Ecology), MEnvLaw	23+ years
s. 47F(1)	Senior Aquatic Ecologist / reporting, analysis, impacts assessment	BSc, MSc (Ecology and Evolution)	10+ years
s. 47F(1)	Aquatic ecologist/ field surveys, macrophyte identifications	BA (Geographic Sciences), BSc (Ecology)	5 years
s. 47F(1)	Aquatic Ecologist/ field surveys, reporting	BSc (hons.)	5 years
s. 47F(1)	Senior Aquatic Taxonomist / macroinvertebrate and fish identifications	Advanced Diploma Aquatic Resource Management	10+ years
s. 47F(1)	Principal Aquatic Ecologist / direction and technical review	Ph.D (Coastal management)	15 years
s. 47F(1)	Senior Ecologist / site surveys	BEnvSc (Hons) Bush Regeneration Cert 2 NSW BioBanking Assessor Accreditation (number 0134)	9+ years

ELIZABETH DRIVE
LUDDENHAM ROAD
PARK ROAD
ADAMS ROAD
BADGERYS CREEK ROAD
GREENDALE ROAD
DWYER ROAD
THE NORTHERN ROAD

Note: systematic traverses, vegetation mapping,
habitat assessment and targeted threatened plant searches conducted across the entire survey area.

Legend

- Stage one construction impact zone
- Airport site
- Environmental conservation
- Roads
- Watercourses
- Access not obtained
- Survey area (2015-16 EIS and other investigations)
- Supplementary survey area (2017)

Paper Size A3
0 250 500 1,000
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number 21-26204
Revision A
Date 29 Aug 2017

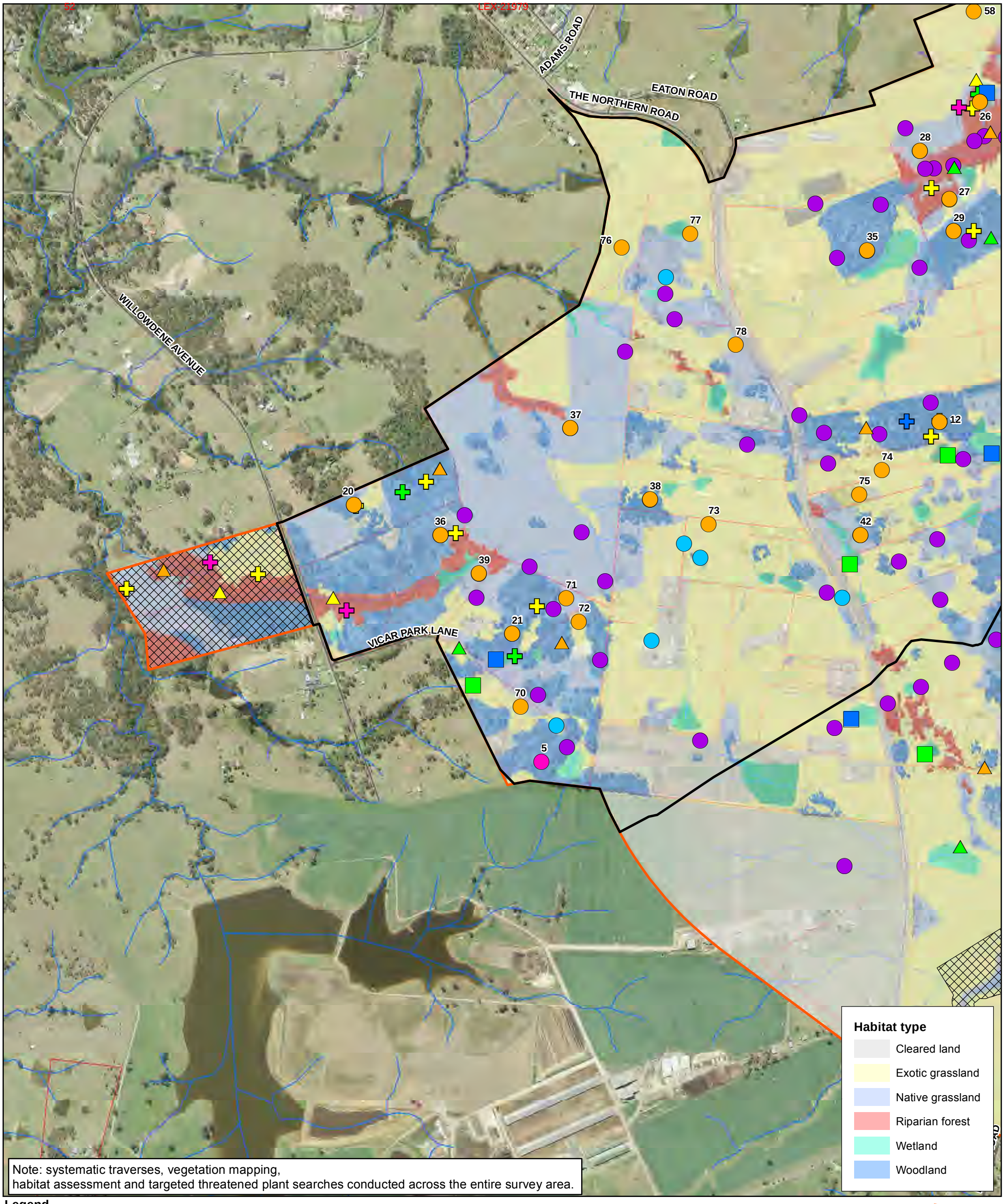
Survey locations

Figure 2A

\\ghdnet\ghd\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z008_Survey_Effort_V2.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Ecological survey data - GHD 2017. Created by:Mweerakoon



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
- Call playback for owls
- Diurnal bird survey
- Winter bird survey
- Rapid frog survey
- Targeted frog survey
- Photo point
- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	11 Jul 2017

Survey locations

Figure 2B

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z003_Survey_Effort.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice

LUDDENHAM ROAD
ELIZABETH DRIVE
ADAMS ROAD
ANTON ROAD
JACKSON ROAD
FERNDALE ROAD
LONGLEYS ROAD
TAYLORS ROAD
THE NORTHERN ROA

Note: systematic traverses, vegetation mapping,
habitat assessment and targeted threatened plant searches conducted across the entire survey area.

Habitat type
- Cleared land
- Exotic grassland
- Native grassland
- Riparian forest
- Wetland
- Woodland

Legend
- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
- Call playback for owls
- Diurnal bird survey
- Winter bird survey
- Rapid frog survey
- Targeted frog survey
- Photo point
- Plot/transect
- Rapid plot/transect

Paper Size A3
0 100 200 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	11 Jul 2017

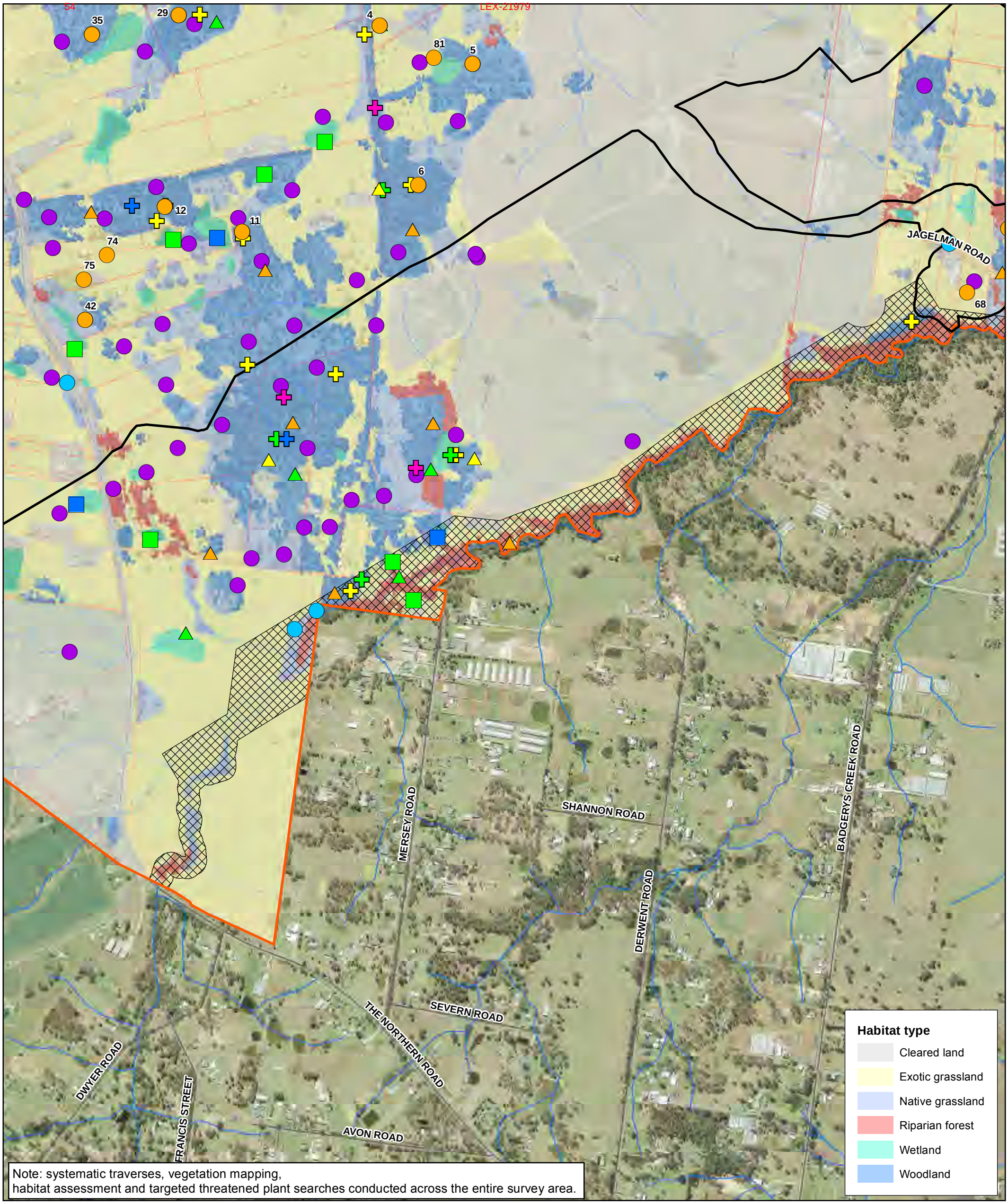
Survey locations

Figure 2C

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z003_Survey_Effort.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
- Call playback for owls
- Diurnal bird survey
- Winter bird survey
- Rapid frog survey
- Targeted frog survey
- Photo point
- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	11 Jul 2017

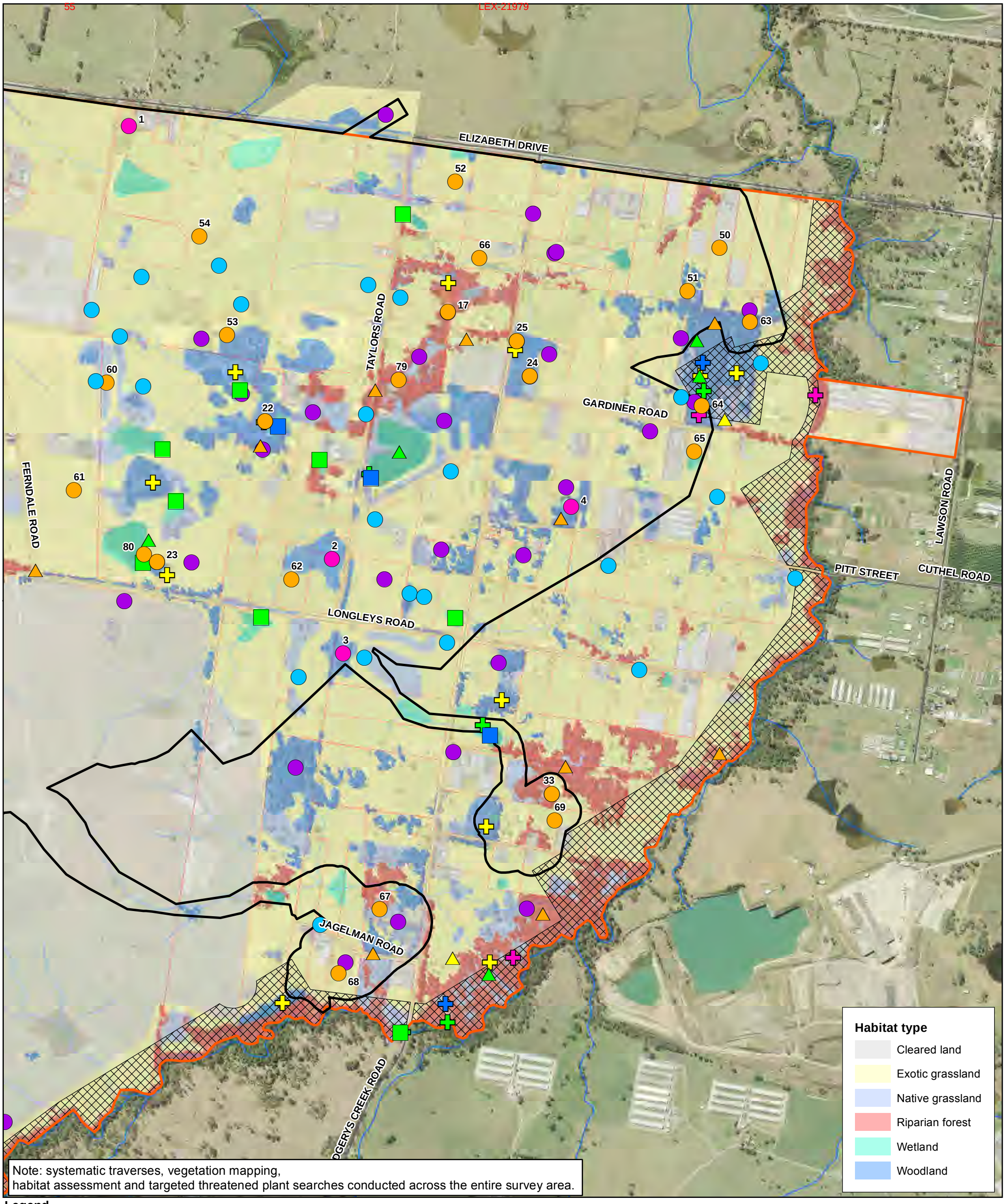
Survey locations

Figure 2D

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z003_Survey_Effort.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Watercourses
- Rapid assessment
- Active searches for snails, ground fauna and scats
- Anabat recording
- Spotlighting
- Camera trap
- Call playback for owls
- Diurnal bird survey
- Winter bird survey
- Rapid frog survey
- Targeted frog survey
- Photo point
- Plot/transect
- Rapid plot/transect

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	11 Jul 2017

Survey locations

Figure 2E

N:\AU\Sydney\Projects\21\26204\GIS\Maps\Deliverables\21_26204_Z003_Survey_Effort.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:jrprice

4. Existing environment

4.1 Physical environment

4.1.1 Topography and landscape

The Stage 1 Construction Impact Zone is part of an elevated ridge system dividing the Nepean River and South Creek catchments on the Cumberland Plain. The site is characterised by rolling landscapes typical of the Bringelly Shale (see Section 4.1.2) with a prominent ridge in the west of the site, reaching an elevation of about 120 metres AHD, and smaller ridgelines in the vicinity with elevations of about 100 metres AHD. The topography of the Stage 1 Construction Impact Zone generally slopes away from the ridges in the west, with elevations between 40 metres and 90 metres AHD.

The Stage 1 Construction Impact Zone features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses prior to the EIS were agriculture and low density rural residential development.

The Stage 1 Construction Impact Zone is contained within the 'Cumberland Plain' Mitchell Landscape (DECC, 2008a). This landscape comprises low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast, with vegetation characterised by grassy woodlands and open forest dominated by Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*) and poorly drained valley floors with forests of Cabbage Gum (*E. amplifolia)* and Swamp Oak (*Casuarina glauca*) (DECC 2008b).

4.1.2 Geology and soils

The dominant geological formations beneath the Stage 1 Construction Impact Zone are Bringelly Shale, the Luddenham Dyke and Alluvium (Bannerman & Hazelton 1990). Bringelly Shale is a Triassic age geological unit mainly comprising claystone and siltstone and some areas of sandstone underlying parts of the Stage 1 Construction Impact Zone. The dyke outcrops toward the peak of the ridge in the west of the Stage 1 Construction Impact Zone. Alluvium at the Stage 1 Construction Impact Zone comprises Quaternary age sedimentary deposits along Cosgrove Creek and Badgerys Creek (refer to Chapter 17 of the EIS).

Geotechnical investigations at the Stage 1 Construction Impact Zone generally indicated surficial silt and/or clay topsoils overlying firm residual clays from the weathering of Bringelly Shale, with areas of alluvial gravels, sands, silts and clays associated with Badgerys Creek. The Stage 1 Construction Impact Zone contains the Blacktown, Luddenham and South Creek soil landscapes. Kurosols (soils with strong texture contrast between the topsoil horizon and strongly acid subsoils horizon) occur over the majority of the airport site. Hydrosols (soils that are saturated for prolonged periods) occur in the vicinity of Badgerys Creek.

4.1.3 Hydrology

Within the broader catchment, the Stage 1 Construction Impact Zone lies in the Badgerys Creek, Cosgroves Creek and Duncans Creek sub-catchments. Badgerys Creek and Cosgroves Creek are tributaries of South Creek.

Badgerys Creek starts about two kilometres south-west of the airport site and flows north-easterly along its southern boundary before joining South Creek about four kilometres downstream. South Creek ultimately drains to the Hawkesbury River. Between the airport site

and the confluence, the creek traverses agricultural land and passes the Elizabeth Drive landfill site.

The headwaters of Oaky Creek are located in the Stage 1 Construction Impact Zone and it flows north to Cosgroves Creek, before its confluence with South Creek about seven kilometres downstream. Cosgroves Creek starts about one kilometre north of the airport site and flows north-easterly before joining South Creek about six kilometres north-west. In the reach between Oaky Creek and South Creek, Cosgroves Creek passes through rural lots, the Twin Creeks Golf and Country Club and beneath an above-ground Sydney Water Corporation water pipeline. The creek catchments are largely rural and without residential development downstream of the site, with the exception of the Twin Creeks Golf and Country Club residential estate downstream of the site towards Cosgroves Creek's confluence with South Creek.

Duncans Creek starts about three kilometres south-west of the airport site and flows north-westerly before joining the Nepean River about nine kilometres downstream from the airport site. This creek is located just outside the airport site at the western end. Duncans Creek receives flows from a number of unnamed tributaries in the Stage 1 Construction Impact Zone. The Duncans Creek catchment downstream of the Stage 1 Construction Impact Zone is rural and zoned for primary production (plant or animal cultivation).

Drainage lines in the Stage 1 Construction Impact Zone and airport site are shown on Figure 1.

The majority of watercourses at the airport site are first and second order, accounting for approximately 70 per cent of the total length of the mapped watercourses on the airport site. Badgerys Creek attains the highest stream order on the site, being fourth order for most of its length along the eastern boundary of the airport site. The Stage 1 Construction Impact Zone includes only first and second order drainage lines and excludes the riparian corridors of Oaky Creek and Badgerys Creek.

Downstream of the airport site, Badgerys and Cosgrove Creeks are 4th order watercourses, Oaky Creek is a 3rd order watercourse and Duncans Creek is a 5th order watercourse.

The reaches of Badgerys, Oaky, Cosgroves and Duncans Creeks and their tributaries that flow through and downstream of the Stage 1 Construction Impact Zone are highly modified and in poor condition as a result of historical and current land use and disturbance. Despite having a generally well-vegetated riparian zone in some areas, these watercourses are considered to be in moderate geomorphic condition due to past clearing, the construction of online dams and ongoing agricultural activities (GHD 2016b).

All of the affected reaches on the airport site are small and ephemeral and largely intermittent. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats.

The riparian and aquatic habitat values of creek lines in the Stage 1 Construction Impact Zone and up and downstream of the Stage 1 Construction Impact Zone are discussed in more detail in Section 4.4 of Appendix K1 of the EIS (GHD 2016a). The potential impacts of alterations in hydrology and water quality (as a result of construction and operation of the airport) on receiving watercourses downstream of the airport site are discussed further in Sections 5 and 5.3.

All native vegetation types at the airport are likely to be groundwater dependent to some degree (BOM 2015c). The creek lines in the Stage 1 Construction Impact Zone and in the immediate vicinity are not likely to be groundwater dependent (GHD 2016a).

There are no wetlands of significance in the Stage 1 Construction Impact Zone or immediately downstream.

4.1.4 Climate

The airport site is located in Western Sydney, which has a humid subtropical climate, and is generally a few degrees warmer than the Sydney central business district, although nights are cooler. The mean maximum temperature occurs in January, and is about 30 degrees Celsius on average. July is the coolest month, with the mean maximum being about 17 degrees Celsius. Rainfall occurs throughout the year, with summer being the wettest season. Annual rainfall is about 700 millimetres on average.

4.1.5 Land uses

The local Badgerys Creek environment has remained largely unchanged since the late 1990s with land use characterised by large and small rural holdings and residential allotments (SMEC 2014). Existing activities in the Stage 1 Construction Impact Zone include residential, agriculture, light commercial and demolition works. Associated disturbance at the site includes use of pesticides and fertilisers, chemical storage tanks and drums, rubbish dumping, stockpiled demolition waste, and stockpiled fill material of unknown origin.

The Stage 1 Construction Impact Zone is surrounded by low-density rural residential, light industrial and mixed agricultural land uses. The Western Sydney Priority Growth Area plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands (DoP 2016).

4.2 Plant species and vegetation zones

4.2.1 Plant species

A total of 272 species from 75 families were recorded at the Stage 1 Construction Impact Zone, comprising 182 native species and 90 exotic species. The Poaceae (grasses, 52 species, including 18 exotics), Asteraceae (30 species, including 13 native species), Fabaceae (20 species, including 17 native species) and Cyperaceae (16 species, of which only two was exotic) were the most diverse families recorded. The list of plant species recorded at the airport site is provided in Appendix B. A breakdown of plant species along with their cover and abundances in individual plot/transects has been provided separately to the independent verifier in electronic table form.

A total of 60 plot/transects was sampled across the Stage 1 Construction Impact Zone along with additional wetland assessments and opportunistic observations of native plant species. This survey is likely to have revealed the majority of the native plant species present at the site. There is a chance that some cryptic and/or seasonally flowering species were not detected, potentially including threatened species as discussed in Section 4.5.2. The airport site contains a considerable greater diversity of exotic plant species than are listed in Appendix B, mainly associated with residential gardens or cropland. These areas were not a focus of this biodiversity assessment, beyond visual inspection to confirm that they did not contain native vegetation communities. No formal sampling of the plant species present in these areas was undertaken.

Based on the results of the field surveys, the airport site contains only moderate native plant species richness. Biometric plot/transect data revealed that 46 out of the 60 plots sampled in native vegetation featured native plant species richness that was below benchmark values for an undisturbed example of the equivalent plant community type. The majority of the native vegetation at the airport site has been previously cleared, grazed or otherwise modified and is in moderate or poor condition.

The suite of plant species at the airport site is representative of shale-derived soils, transitional shale-gravel soils, alluvial soils and wetlands. The airport site does not contain any sandstone

outcrops or sandstone-derived soils, shale-sandstone transition soils, or deep Tertiary alluvial deposits and does not contain any plant species that have habitat requirements specific to these soil types. Many of the threatened plant species known or predicted to occur in the locality have these specific habitat requirements and would not occur at the airport site (see Appendix A).

4.2.2 Vegetation zones

Field surveys confirmed the presence and distribution of five NSW plant community types at the airport site. Stands of these plant community types include near-intact vegetation in 'moderate/good – high' condition, partially cleared or regrowth vegetation in 'moderate/good – poor' condition and extensively modified areas in 'low' condition (according to the FBA OEH 2014a). Accordingly, 12 vegetation zones (plant community types and broad condition classes) were identified and mapped at the airport site, as shown on Figure 3. Attributes of these vegetation zones are summarised in Table 9 and described in Table 11 to Table 21 below.

The most extensive vegetation zones at the airport site are various types of exotic grassland. These vegetation zones contain no native over storey or mid storey and less than 50 per cent of the ground cover vegetation is native. Grassland areas contain occasional isolated paddock trees that are remnants of adjoining native woodland and forest. Exotic grassland areas have been mapped and described as low condition forms of the plant community type that is most likely to have occurred previously in Table 19,

Table 20 and Table 21 below. There are also extensive areas of buildings, hard stand, bare earth, crop land and waterbodies that feature minimal vegetation cover that have been collectively mapped as 'cleared land and cropland'. Cleared land and cropland areas are described in

Table 22 below.

Grey Box - Forest Red Gum grassy woodland on flats is associated with mid and lower slopes, on shale derived soils across the airport site and is the most extensive native plant community type. It comprises an open forest or woodland of Forest Red Gum (*Eucalyptus tereticornis*) and Grey Box (*Eucalyptus moluccana*) with a grassy understorey and occasional dense patches of the shrub species Native Blackthorn (*Bursaria spinosa spinosa*).

There are small areas of tertiary gravel influenced soils in the east of the airport site that support Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest with a canopy of Forest Red Gum and Grey Box along with Broad-leaved Ironbark (*Eucalyptus fibrosa*), a characteristic mid storey of Honey Myrtle (*Melaleuca decora*) and a shrub and grass understorey. Vegetation zone 8, 'Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest', comprises a derived scrub or shrubland form of this plant community type. Vegetation zone 8 does not occur in the Stage 1 Construction Impact Zone and so was not sampled directly as part of this Stage 1 BAR and is not described in detail below.

There is a volcanic intrusion in the central western portion of the site which is associated with steeper terrain, rock fragments in soil profiles and some rock outcropping. In other parts of the Cumberland Plain, this geology is often associated with Moist Shale Woodland and Western Sydney Dry Rainforest (NPWS 2002a; Tozer et al 2010). However, at the airport site it contains Grey Box - Forest Red Gum grassy woodland on hills with relatively few species representative of these other communities. Plot/transect data was compared with Tozer et al (2010) diagnostic species lists to confirm the identity of this vegetation type. The observed vegetation may be because of frequent and/or recent fire and other disturbance at the airport site, which has prevented a succession towards rainforest species.

The above vegetation types grade into Forest Red Gum - Rough-barked Apple grassy woodland along the riparian corridors of Badgerys Creek and other drainage lines through the airport site. This community is a closed woodland or forest of Forest Red Gum, Grey Box and Cabbage Gum (E*ucalyptus amplifolia)* along with Swamp Oak (*Casuarina glauca*), Broad-leaved Apple (*Angophora subvelutina)* and paperbarks (*Melaleuca* spp.). Understorey vegetation is similar to Shale Plains Woodland along with additional moisture loving species such as rushes and sedges.

The condition of these plant community types varies across the airport site as a result of previous land uses and grazing intensity. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. There is moderate to severe weed infestation throughout, with linear remnants along roads and isolated patches in agricultural land the most severely affected. Notwithstanding the generally moderate to poor condition of vegetation at the airport site, it has high conservation significance as a result of the presence of threatened biota and the generally limited extent and quality of similar vegetation in the Western Sydney region.

There are patches of derived native grassland at the airport site that comprise poor condition forms of the native vegetation communities described above. These areas contain at least 50 per cent native groundcover, mainly comprising native grasses such as Kangaroo Grass (*Themeda australis*). There is a moderate species richness, but relative low cover and abundance of understorey herbs associated with the woodlands and forests described above. Exotic grasses and herbs are present throughout.

There are a large number of dams and flooded depressions throughout the airport site formed by the construction of barriers across small drainage lines. These water bodies contain a moderate diversity and abundance of native wetland plants.

There are local occurrences of one threatened ecological community (TEC) listed under the EPBC Act and three TECs listed under the TSC Act at the airport site as described in Section 4.5.1. The distribution of plant community types at the airport site is closely tied to soil type, underlying geology and drainage, all of which are correlated with geomorphic position.

Table 9 Vegetation zones at the airport site and the Stage 1 Construction Impact Zone

Zone ID	Vegetation Zone	Condition	EPBC Act Status	TSC Act Status	Area at the airport site (hectares)	Area in Stage 1 Construction Impact Zone (hectares)	Survey effort in Stage 1 Construction Impact Zone
1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good –high	Some patches comprise Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)[1]	Cumberland Plain Woodland (CEEC)	154.1	105.8	Plot/transects 2, 5, 6, 11, 12, 22, 23, 25, 31, 35 Rapid plot/transect 4
2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor		Cumberland Plain Woodland (CEEC)	127.4	110.5	Plot/transects 3, 24, 28, 30, 37, 42, 57, 59, 60, 78
3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good – medium or high	Some patches comprise Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)[1`]	Cumberland Plain Woodland (CEEC)	46.0	38.7	Plot/transects 20, 21, 36, 38 Rapid plot/transect 5
4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor		Cumberland Plain Woodland (CEEC)	18.3	15.3	Plot/transects 39, 41, 71, 75
5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good – medium or high		River-flat Eucalypt Forest (EEC)	90.1	35.0	Plot/transects 17, 26, 29, 33
6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor		River-flat Eucalypt Forest (EEC)	24.8	10.9	Plot/transects 27, 67, 79
7	Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/good – medium or high	Some patches comprise Cumberland Plain Woodland and Shale-gravel Transition Forest (CEEC)[1]	Shale-Gravel Transition Forest (EEC)	9.8	5.2	Plot/transects 51, 63, 64
8	Poor condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/good - poor		Shale-Gravel Transition Forest (EEC)	1.8	0.0	n/a
9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			39.0	32.1	Plot/transects 65, 77, 80, 81 Wetland assessment at targeted frog survey sites 2, 4, 5, 8, 9, 10, 11

Zone ID	Vegetation Zone	Condition	EPBC Act Status	TSC Act Status	Area at the airport site (hectares)	Area in Stage 1 Construction Impact Zone (hectares)	Survey effort in Stage 1 Construction Impact Zone
13	Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - medium		Cumberland Plain Woodland (CEEC)	6.3	6.1	Plot/transect 53 Rapid plot/transects 2, 3
	Total native vegetation				**517.5**	**359.6**	
10	Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Low			652.5	530.7	Plot/transects 4, 50, 52, 54, 56, 58, 61, 62, 76 Rapid plot/transect 1
11	Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Low			42.3	42.3	Plot/transects 70, 72, 73, 74
12	Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Low			170.4	43.9	Plot/transects 55, 66, 68, 69
x	Cleared land or cropland	Cleared			389.1	177.1	General observations
	Total				1771.9	**1153.6**	

Notes:

EEC – endangered ecological community. CEEC – critically endangered ecological community.

1 Subject to patch size and condition according to the criteria in the listing advice for the community (TSSC 2008) (see Section 4.5.1)

ADAMS ROAD
EATON ROAD
THE NORTHERN ROAD
WILLOWDENE AVENUE
VICAR PARK LANE

20 26 28 27 29 35 77 76 78 37 12 74 75 38 73 42 36 39 71 72 21 70 5

Legend

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
- 2 - Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
- 3 - Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - high)
- 4 - Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529,Moderate/good - poor)
- 5 - Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)
- 6 - Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
- 7 - Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - high)
- 8 - Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - poor)
- 9 - Good condition artificial freshwater wetland on floodplain (HN630, Moderate/good)
- 10 - Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)
- 11 - Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Low)
- 12 - Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Low)
- 13 - Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- x - Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Vegetation zones

Figure 3A

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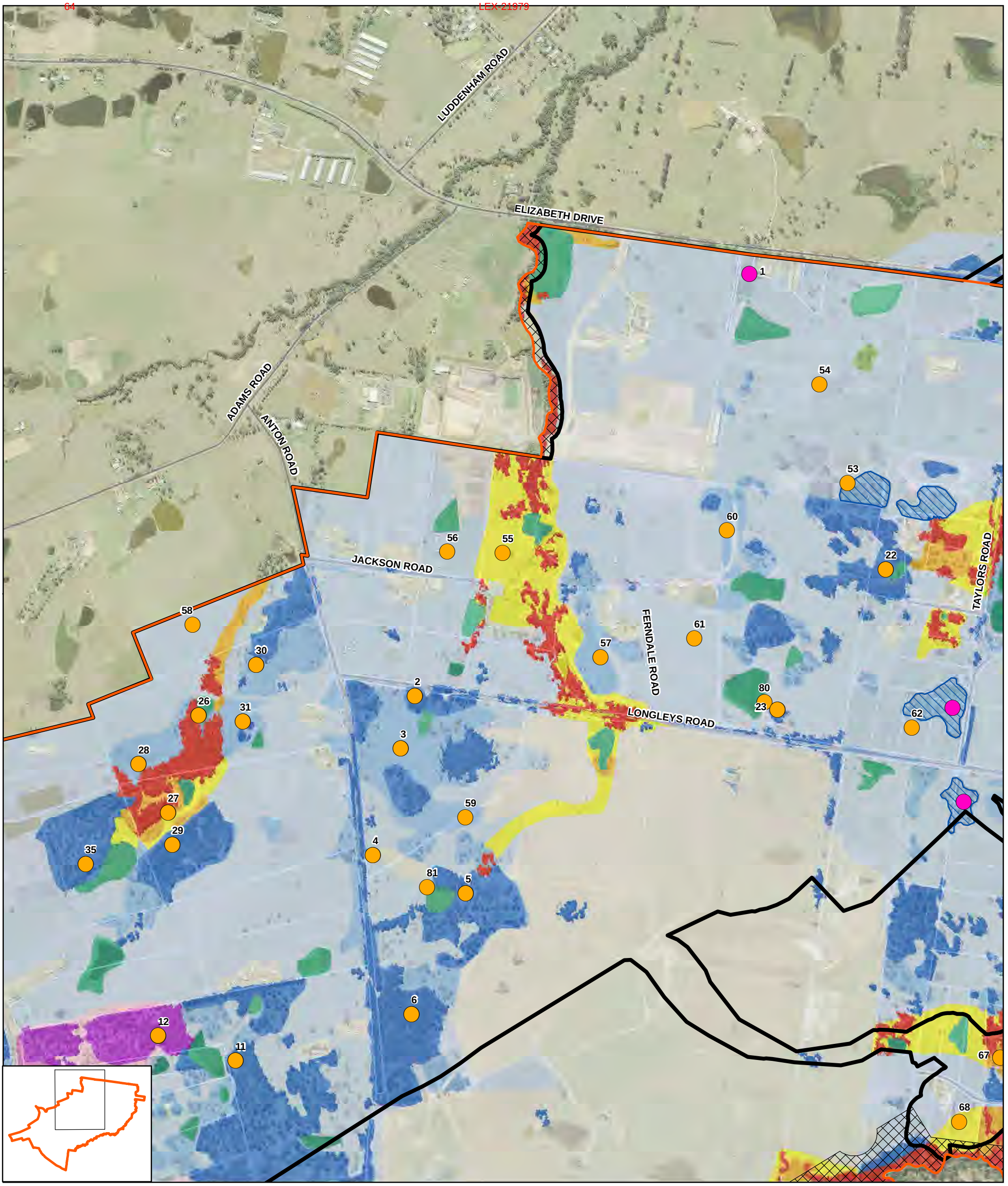
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Please refer to 'Digital Data Sources' on the second page of the EISData source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017. Created by:afoddy



Legend

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
- 2 - Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
- 3 - Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - high)
- 4 - Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529,Moderate/good - poor)
- 5 - Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)
- 6 - Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
- 7 - Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - high)
- 8 - Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - poor)
- 9 - Good condition artificial freshwater wetland on floodplain (HN630, Moderate/good)
- 10 - Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)
- 11 - Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Low)
- 12 - Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Low)
- 13 - Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- x - Cleared land or cropland

Paper Size A3

0 100 200 400

Metres

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Vegetation zones

Figure 3B

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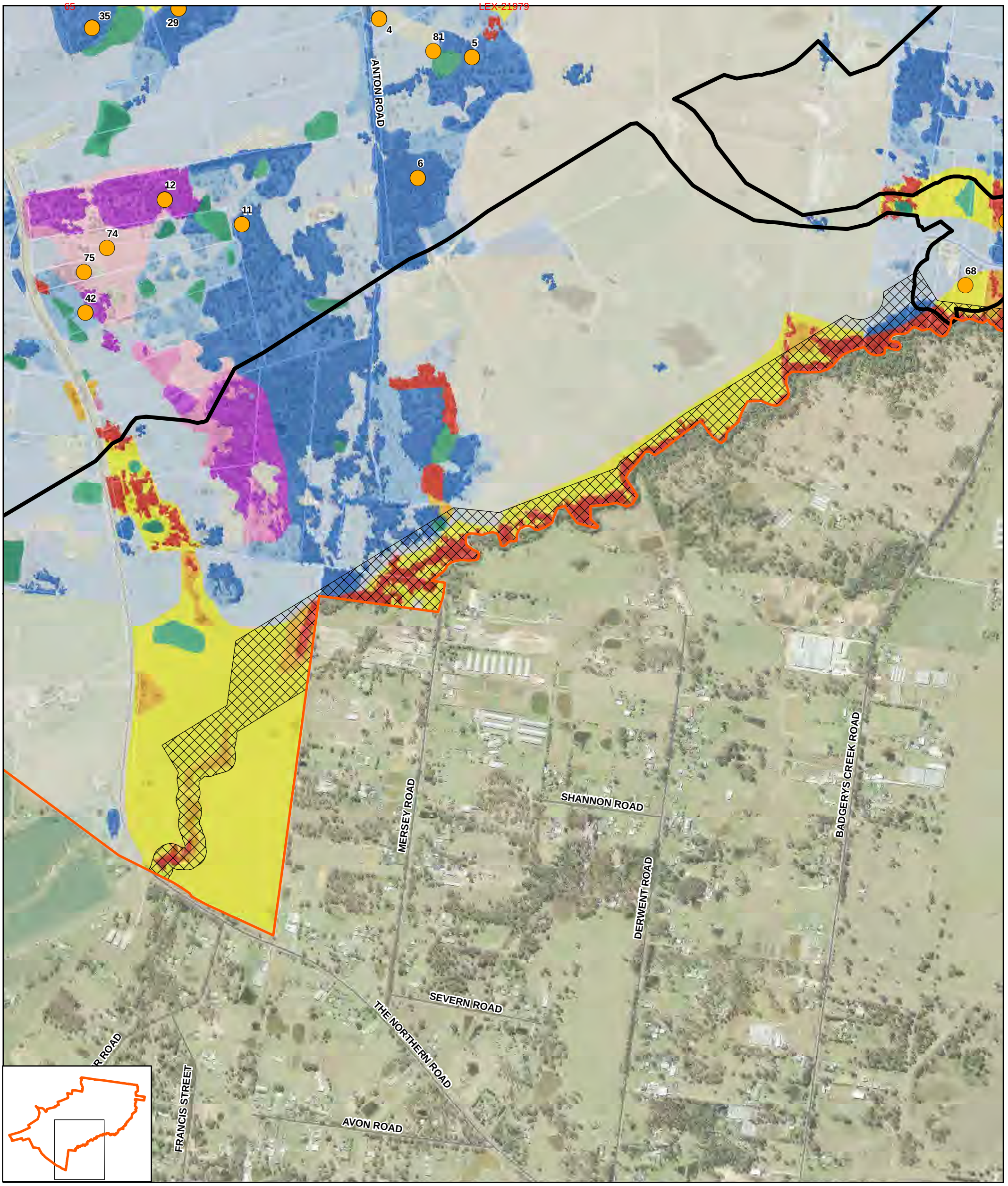
Data source: Please refer to 'Digital Data Sources' on the second page of the EISData source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017. Created by:afoddy



Legend

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
- 2 - Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
- 3 - Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - high)
- 4 - Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529,Moderate/good - poor)
- 5 - Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)
- 6 - Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
- 7 - Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - high)
- 8 - Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - poor)
- 9 - Good condition artificial freshwater wetland on floodplain (HN630, Moderate/good)
- 10 - Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)
- 11 - Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Low)
- 12 - Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Low)
- 13 - Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- x - Cleared land or cropland

Paper Size A3

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Metres

Map Projection: Transverse Mercator
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Vegetation zones

Figure 3C

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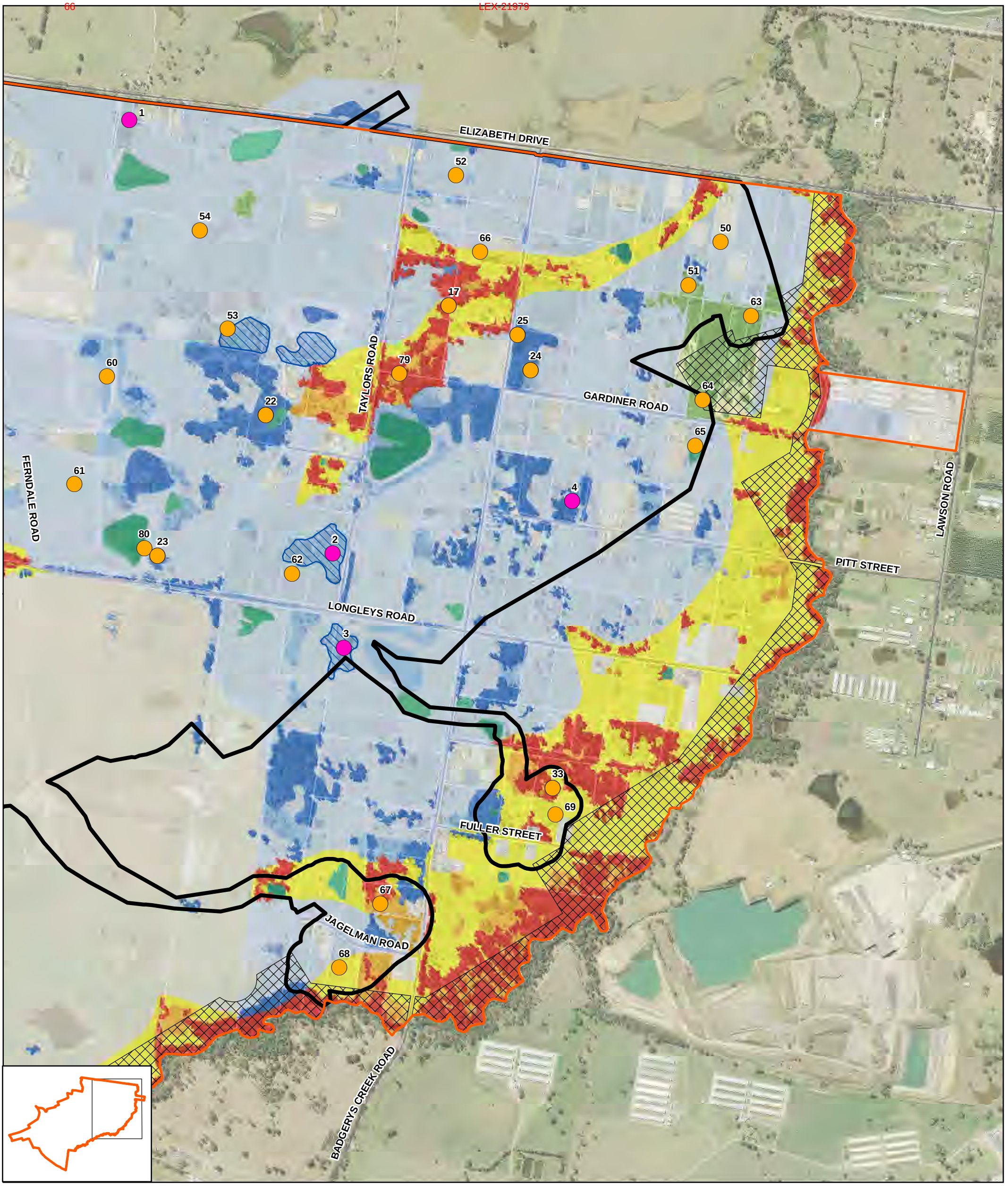

Legend

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- Plot/transect
- Rapid plot/transect

- 1 - Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - high)
- 2 - Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
- 3 - Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - high)
- 4 - Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529,Moderate/good - poor)
- 5 - Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - high)
- 6 - Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
- 7 - Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - high)
- 8 - Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - poor)
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Vegetation zones

Figure 3D

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

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Table 10 Good condition Grey Box - Forest Red Gum grassy woodland on flats

1- Good condition Grey Box - Forest Red Gum grassy woodland on flats	
Plant community type (OEH, 2015c)	HN528- Grey Box - Forest Red Gum grassy woodland on flats, Sydney
Equivalent Map Units	Cumberland Shale Plains Woodland (GW p29) (Tozer et al 2010); Shale Plains Woodland (NPWS 2002).
Area	105.8 hectares
Survey effort	Plot/transects 2, 5, 6, 11, 12, 22, 23, 25, 31, 35. Rapid plot/transect 4
Condition (DECC, 2008)	Moderate/good –high. Remnant or regrowth native vegetation with near-intact over storey. Species richness was above benchmark in seven of the 10 plots while midstorey cover was low for this plant community type in the majority of plot/transects sampled. Native groundcover (other) and grass cover was high in this vegetation type with six and eight plot/transects sampled respectively above benchmark values. All canopy species were observed regenerating. No hollow-bearing trees were recorded within plot/transects sampled. There were generally low quantities of fallen woody debris, including none in three of the 10 plot/transects sampled. There is frequently high exotic plant cover (10-84 per cent in plot/transects sampled) mainly consisting of grasses and herbs in the under storey.
Conservation significance	Comprises a local occurrence of 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest' (Cumberland Plain Woodland) which is listed as a CEEC under the EPBC Act. Also comprises a local occurrence of 'Cumberland Plain Woodland' which is listed as a CEEC under the TSC Act.
Landscape position	On shale derived soils on mid and lower slopes and flats in gently undulating terrain across the airport site.
Structure	Woodland or open forest with a sparse mid storey and a generally sparse shrub/grass understorey. Some patches have a very dense mid storey of Native Blackthorn (*Bursaria spinosa spinosa*).
Over storey	Continuous, around 15-25 metres tall and around 20 per cent cover. Features a mixed canopy of Grey Box (*Eucalyptus moluccana*) and Forest Red Gum (*E. tereticornis*) with occasional Thin-leaved Stringybark (*E. eugenioides*).
Mid storey	Patchy and variable (<1 per cent to 26.5 per cent cover). Generally sparse cover of tall shrubs such as *Dillwynia sieberi* or Gorse Bitter-pea (*Daviesia ulicifolia*) but with occasional very dense patches of Native Blackthorn, Black Wattle *(Acacia decurrens)* or Parramatta Wattle *(Acacia parramattensis)* to five metres tall and 50-80 per cent cover.
Groundcover	Dense and dominated by grasses and grass like plants such as Kangaroo Grass (*Themeda australis*), Weeping Grass (*Microlaena stipoides* var. *stipoides*), Threeawn Speargrass (*Aristida vagans*), Paddock Love Grass (*Eragrostis leptostachya*) and *Lomandra filiformis* subsp. *filiformis*. Other understorey species include: occasional shrubs such as Peach Heath (*Lissanthe strigosa*); moderate cover and species richness of herbs such as *Caesia parviflora* var. *vittata*, Kidney Weed (*Dichondra repens*), Native Wandering Jew (*Commelina cyanea*) and Blue Trumpet (*Brunoniella australis*); locally high cover of chenopods such as Climbing Saltbush (*Einadia nutans* subsp. *nutans*) and Berry Saltbush (*Einadia hastata*); and moderate cover and species richness of scramblers such as Amulla (*Eremophila debilis*) and *Glycine* species. There are occasional patches of leaf litter and bare earth.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants present include small trees and tall shrubs such as African Boxthorn (*Lycium ferocissimum*) and African Olive (*Olea europaea* subsp. *cuspidata*); pasture grasses such as *Setaria parviflora,* Kikuyu (*Pennisetum clandestinum*) and Paspalum (*Paspalum dilatatum*); weedy grasses such as African Lovegrass (*Eragrostis curvula*) and Panic Veldtgrass (*Ehrharta erecta*); widespread wind borne herbs such as Fireweed (*Senecio madagascariensis*)

1- Good condition Grey Box - Forest Red Gum grassy woodland on flats	
	and Dandelion (*Taraxacum officinale*); opportunistic herbs of disturbed areas such as Greater Beggar's Ticks (*Bidens subalternans*), Black-berry Nightshade (*Solanum nigrum*) and *Solanum sisymbriifolium*; and climbers such as Moth Vine (*Araujia sericifera*) and Bridal Creeper (*Asparagus asparagoides*).
Good condition woodland with a grassy understorey.	
Good condition woodland with a shrub/grass understorey and dense patches of Native Blackthorn.	

Table 11 Poor condition Grey Box - Forest Red Gum grassy woodland on flats

2- Poor condition Grey Box - Forest Red Gum grassy woodland on flats	
Plant community type (OEH, 2015c	HN528- Grey Box - Forest Red Gum grassy woodland on flats.
Equivalent Map Units	Closest equivalents are Cumberland Shale Plains Woodland (GW p29) (Tozer et al 2010) and Shale Plains Woodland (NPWS 2002A) though poor condition patches are generally not mapped.
Area	110.5 hectares
Survey effort	Plot/transects 3, 24, 28, 30, 37, 42, 57, 59, 60, 78.
Condition (DECC, 2008)	Moderate/good – poor, incorporating some areas of 'Low' that feature less than 50 per cent native groundcover. Highly modified remnant or regrowth native vegetation with minimal over storey cover (0 per cent in nine of the 11 plot/transects sampled). Species richness, mid storey and native ground forb cover attributes were below benchmark values for this plant community type in the majority of plot/transects sampled. Native grass cover was consistently well above benchmark values. The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived native Blackthorn shrub land or sub-mature over storey regeneration over exotic groundcover. All canopy species were observed regenerating somewhere within the full extent of this vegetation zone across the airport site but many patches did not feature any regeneration. There were no hollow-bearing trees and very little fallen woody debris (woody debris recorded within two of the 11 plot/transects sampled only). There is frequently high exotic plant cover (6-82 per cent in plot/transects sampled) mainly consisting of exotic grasses.
Conservation significance	Does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines (DEWHA 2010d). Comprises a local occurrence of 'Cumberland Plain Woodland' listed as a CEEC under the TSC Act and defined in relevant guidelines.
Landscape position	On shale derived soils on mid and lower slopes and flats in gently undulating terrain across the airport site.
Structure	Mainly a derived grassland with a sparse mid storey and very occasional, isolated trees. Some patches of derived shrubland or scrub with a very dense mid storey.
Over storey	Absent other than occasional isolated Grey Box or Forest Red Gum.
Mid storey	Patchy and variable. Generally sparse cover of tall shrubs such as *Dillwynia sieberi* but with occasional very dense patches of Native Blackthorn, Hickory wattle (*Acacia implexa),* Black Wattle or Parramatta Wattle to five metres tall and 23 per cent cover.
Groundcover	Dense and dominated by grasses and grass like plants especially Kangaroo Grass, along with Bladey Grass (*Imperata cylindrica*), Common Couch (*Cynodon dactylon)* Weeping Grass, Speargrasses (*Aristida* sp.) and *Lomandra filiformis* subsp. *filiformis*. Other understorey species include occasional shrubs such as Peach Heath; low cover and moderate species richness of herbs such as Kidney Weed, Native Wandering Jew and Blue Trumpet; and scramblers such as *Glycine* species. There are occasional patches of bare earth.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants present include shrubs and woody vines such as African Boxthorn and Blackberry (*Rubus fruticosus* species aggregate); pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as African Lovegrass and Panic Veldtgrass; widespread wind borne herbs such as Fireweed and Dandelion; and opportunistic herbs of disturbed areas such as Cobbler's Pegs (*Bidens pilosa*), Spear Thistle (*Cirsium vulgare)* and *Solanum sisymbriifolium*.

2- Poor condition Grey Box - Forest Red Gum grassy woodland on flats	
Derived native grassland with occasional shrubs and regenerating eucalypts.	
Kangaroo Grass dominated derived native grassland at Plot/transect 57.	

Table 12 Good condition Grey Box - Forest Red Gum grassy woodland on hills

3- Good condition Grey Box - Forest Red Gum grassy woodland on hills	
Plant community type (OEH, 2015c	HN529- Grey Box - Forest Red Gum grassy woodland on shale, Sydney Basin (Grey Box - Forest Red Gum grassy woodland on hills).
Equivalent Map Units	Cumberland Shale Hills Woodland (GW p28) (Tozer et al 2010); Shale Hills Woodland (NPWS 2002).
Area	38.7 hectares
Survey effort	Plot/transects 20, 21, 36, 38. Rapid plot/transect 5
Condition (DECC, 2008)	Moderate/good – medium or high. Remnant or regrowth native vegetation with near-intact over storey and native species richness that was below benchmark values in all but one of the plot/transects sampled. Native mid storey cover was well below benchmark values in all plot/transects sampled. Native grass and groundcover was high for all plot/transects, while native shrub cover was within benchmark values. All canopy species were observed regenerating. There are few hollow-bearing trees, including only one in the four plot/transects sampled. There is frequently high exotic plant cover (24-44 per cent in plot/transects sampled) mainly consisting of woody weeds in the mid storey.
Conservation significance	Comprises a local occurrence of 'Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest' (Cumberland Plain Woodland) which is listed as a CEEC under the EPBC Act. Also comprises a local occurrence of 'Cumberland Plain Woodland', which is listed as a CEEC under the TSC Act.
Landscape position	On shale derived soils on mid and upper slopes and ridges in undulating terrain, mainly in the west and south west of the airport site.
Structure	Woodland or open forest with a sparse mid storey and a generally sparse shrub/grass understorey. Some patches have a very dense mid storey of Native Blackthorn.
Over storey	Continuous, around 15-25 metres tall and around 17 per cent cover. Features a mixed canopy of Grey Box and Forest Red Gum with occasional Thin-leaved Stringybark.
Mid storey	Patchy and variable. Generally sparse but with occasional very dense patches of Native Blackthorn or Hickory Wattle (*Acacia implexa)* to five metres tall and up to 10 per cent cover.
Groundcover	Moderately dense, species rich and structurally variable. Groundcover species include: moderate cover of grasses and grass like plants such as, Weeping Grass, Two-colour Panic (*Panicum simile*), Red Grass (*Bothriochloa macra*), Threeawn Speargrass, Many-flowered Mat-rush (*Lomandra multiflora* subsp. *multiflora*) and *Lomandra filiformis* subsp. *filiformis*; occasional shrubs such as Wedge Guinea Flower (*Hibbertia diffusa*); moderate to high cover and species richness of herbs such as Indian Weed *(Sigesbeckia orientalis subsp. orientalis), Plectranthus parviflorus*, Native Wandering Jew, Forest Nightshade (*Solanum prinophyllum*) and Blue Trumpet; locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp*. trigonos*; and moderate cover and species richness of scramblers such as Amulla (*Eremophila debilis*) and *Glycine* species. There are occasional patches of leaf litter and bare earth.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants include localised very dense stands of small trees and tall shrubs such as African Boxthorn, Lantana (*Lantana camara)* and especially African Olive; pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as African Lovegrass and Panic Veldtgrass; widespread wind borne herbs such as Fireweed and Dandelion; opportunistic herbs of disturbed areas such as Greater Beggar's Ticks, *Solanum sisymbriifolium* and Paddy's Lucerne *(Sida rhombifolia),* including localised severe infestations; and climbers such as Moth Vine.

3- Good condition Grey Box - Forest Red Gum grassy woodland on hills	
Medium condition woodland with a grassy understorey and moderate weed infestation.	
Good condition woodland with a shrub/grass understorey and dense patches of Native Blackthorn.	

Table 13 Poor condition Grey Box - Forest Red Gum grassy woodland on hills

4- Poor condition Grey Box - Forest Red Gum grassy woodland on hills	
Plant community type (OEH, 2015c	HN529- Grey Box - Forest Red Gum grassy woodland on hills.
Equivalent Map Units	Closest equivalent is Cumberland Shale Hills Woodland (GW p28) (Tozer et al 2010) and Shale Hills Woodland (NPWS 2002a) though poor condition patches are generally not mapped.
Area	15.3 hectares
Survey effort	Plot/transects 39, 41, 71, 75.
Condition (DECC, 2008)	Moderate/good – poor, incorporating some areas of 'Low' that feature less than 50 per cent native groundcover. Highly modified remnant or regrowth native vegetation with sparse over storey cover (zero per cent in three of the four plot/transects sampled). Species richness was below benchmark values, with very low native midstorey cover in all plot/transects sampled. Native grass cover was consistently well above benchmark values in three of the four plots sampled in this vegetation type. Forb cover was variable but at benchmark values in ungrazed paddocks or near refuges such as rock outcrops. The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived native Blackthorn shrub land or sub-mature over storey regeneration over exotic groundcover. All canopy species were observed regenerating somewhere within the full extent of this vegetation zone across the airport site but many patches did not feature any regeneration. There were no hollow-bearing trees and sparse fallen woody debris. There is moderate exotic plant cover (34-49 per cent in plot/transects sampled) consisting of either exotic grasses and herbs in the groundcover or dense woody weeds in the mid storey.
Conservation significance	Does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines (DEWHA 2010d). Comprises a local occurrence of 'Cumberland Plain Woodland' listed as a CEEC under the TSC Act and defined in relevant guidelines.
Landscape position	On shale derived soils on mid and upper slopes and ridges in undulating terrain, mainly in the west and south west of the airport site.
Structure	Mainly a derived grassland with a sparse mid storey and very occasional, isolated trees. Some patches of derived shrubland or scrub with a very dense mid storey.
Over storey	Absent other than occasional isolated Grey Box or Forest Red Gum.
Mid storey	Patchy. Very low cover of tall shrubs such as Native Blackthorn but with occasional patches of Native Blackthorn or Hickory wattle to five metres tall and one per cent cover.
Groundcover	Dense and dominated by grasses and sedges especially Kangaroo Grass, along with Weeping Grass, Two-colour Panic, Red Grass, Paddock Love Grass and Common Fringe-sedge (*Fimbristylis dichotoma*). Other understorey species include: very occasional shrubs such as Peach Heath; moderate cover of Rock Fern (*Cheilanthes sieberi* subsp. *sieberi*); moderate cover and species richness of herbs such as Kidney Weed, Common Woodruff (*Asperula conferta*), and Blue Trumpet; and scramblers such as *Glycine* species. There are occasional patches of bare earth and rock outcropping.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants present include; dense patches of African Olive; shrubs and woody vines such as African Boxthorn and Blackberry (*Rubus fruticosus* species aggregate); pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as Rhodes Grass (*Chloris gayana*) and African Lovegrass; widespread wind borne herbs such as Fireweed and Dandelion; and opportunistic herbs of disturbed areas such as Cobbler's Pegs, Purpletop (*Verbena bonariensis*), Spear Thistle and *Solanum sisymbriifolium*.

4- Poor condition Grey Box - Forest Red Gum grassy woodland on hills	
Derived native grassland with no mid storey	
Derived native grassland with occasional patches of Native Blackthorn.	

Table 14 Good condition Forest Red Gum - Rough-barked Apple grassy woodland

5- Good condition Forest Red Gum - Rough-barked Apple grassy woodland	
Plant community type (OEH, 2015c	HN526- Forest Red Gum - Rough-barked Apple grassy woodland on floodplains, Sydney Basin (Forest Red Gum - Rough-barked Apple grassy woodland).
Equivalent Map Units	Cumberland River-flat Forest (FoW p33) (Tozer et al 2010); Alluvial Woodland and Riparian forest (NPWS 2002a).
Area	35 hectares
Survey effort	Plot/transects 17, 26, 29, 33.
Condition (DECC, 2008)	Moderate/good – medium or high. Remnant or regrowth native vegetation with near-intact over storey that was below benchmark values in all four plot/transects sampled. Native mid storey cover was variable and within benchmark values for one plot/transect only. Species richness, native grass cover and shrub cover was generally above benchmark values for this plant community type in the majority of plot/transects sampled. Forb cover was sparse and well below benchmark values in three of the four plot/transects sampled. All canopy species were observed regenerating. Hollow-bearing trees are present, including four in the four plot/transects sampled. There is moderate exotic plant cover (16-30 per cent in plot/transects sampled) consisting of woody weeds in the mid storey, herbs in the groundcover and dense vine thickets.
Conservation significance	Comprises a local occurrence of 'River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions' (River-flat eucalypt forest) which is listed as an EEC under the TSC Act.
Landscape position	On alluvial soils on banks and terraces of drainage lines throughout the site, including Badgerys Creek, Oaky Creek and their tributaries.
Structure	Closed woodland or forest with a variable, locally dense mid storey and a patchy shrub/grass understorey. Some patches have a very dense mid storey of Native Blackthorn, Paperbarks (*Melaleuca* species), Swamp Oak (*Casuarina glauca)* or Acacia species.
Over storey	Continuous, around 15-25 metres tall and around 14 per cent cover. Features a mixed canopy of Forest Red Gum, Cabbage Gum (*Eucalyptus amplifolia* subsp. *amplifolia)* and Grey Box with occasional Thin-leaved Stringybark.
Mid storey	Patchy and variable (<1 per cent to 50 per cent cover in plot/transects sampled). Moderate in most areas but with occasional very dense patches of Native Blackthorn, Prickly-leaved Tea Tree (*Melaleuca styphelioides*), Flax-leaved Paperbark (*Melaleuca linariifolia*), Swamp Oak (*Casuarina glauca)* or Acacia species to ten metres tall and up to 49 per cent cover.
Groundcover	Moderately dense, species rich and structurally variable. Groundcover species include: moderate cover of grasses especially Weeping Grass along with Threeawn Speargrass, Early Spring Grass (*Eriochloa pseudoacrotricha*), *Oplismenus aemulus;* and Slender Rat's Tail Grass (*Sporobolus creber*); locally dense patches of sedges such as Slender Flat-sedge (*Cyperus gracilis*), *Cyperus polystachyos and* occasional very dense patches of Native Blackthorn shrubs; moderate to high cover and species richness of herbs such as Indian Weed*, Plectranthus parviflorus*, Native Wandering Jew, Forest Nightshade, Indian Pennywort (*Centella asiatica*) and Blue Trumpet; locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp*. trigonos*; and moderate cover and species richness of scramblers such as Amulla, Slender Tick-trefoil (*Desmodium varians*) and *Glycine* species. Native vines such as Headache Vine (*Clematis glycinoides*) are locally abundant. There are occasional patches of leaf litter and bare earth. Drainage lines through this vegetation zone feature high species richness and cover/abundance of native aquatic herbs and ferns such as *Marsilea mutica, Alternanthera denticulate, Eleocharis cylindrostachys, Triglochin microtuberosa* and *Myriophyllum variifolium*.

5- Good condition Forest Red Gum - Rough-barked Apple grassy woodland	
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including frequent severe infestations. Exotic plants present include localised very dense stands of small trees and tall shrubs such as African Boxthorn, Lantana, Green Cestrum (*Cestrum parqui*), Blackberry and especially African Olive; pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum; weedy grasses such as Panic Veldtgrass; widespread wind or bird spread herbs such as Fireweed, Madeira Winter Cherry (*Solanum pseudocapsicum*) and Dandelion; opportunistic herbs of disturbed areas such as Greater Beggar's Ticks, *Solanum sisymbriifolium* and Paddy's Lucerne; and localised very severe 'vine thickets' of scramblers such as Wandering Jew (*Tradescantia fluminensis*) and climbers such as Moth Vine, Madeira Vine (*Anredera cordifolia*) and Bridal Creeper *(Asparagus asparagoides)*.
Medium condition forest with intact mid and over storey but severe infestation with exotic vines and scramblers.	
Good condition forest with characteristic mid storey of *Melaleuca* species and Swamp Oak.	

Table 15 Poor condition Forest Red Gum - Rough-barked Apple grassy woodland

6- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland	
Plant community type (OEH, 2015c	HN526- Forest Red Gum - Rough-barked Apple grassy woodland on floodplains, Sydney Basin (Forest Red Gum - Rough-barked Apple grassy woodland).
Equivalent Map Units	Closest match is Cumberland River-flat Forest (FoW p33) (Tozer et al 2010) and Alluvial Woodland and Riparian forest (NPWS 2002a) though poor condition patches are generally not mapped.
Area	10.9 hectares
Survey effort	Plot/transects 27, 67, 79.
Condition (DECC, 2008)	Moderate/good – poor, incorporating some areas of 'Low' that feature less than 50 per cent native groundcover. Highly modified remnant or regrowth native vegetation with over storey cover below benchmark values in two of three plots sampled. Mid storey and native ground forb and shrub cover attributes were at or below benchmark values for this plant community type in the majority of plot/transects sampled. Species richness and native grass cover was consistently well above benchmark values for most plot/transects. The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived Swamp Oak or Paperbark low closed woodland or native Blackthorn shrub land. All canopy species were observed regenerating somewhere within the full extent of this vegetation zone across the airport site but many patches did not feature any regeneration. There were no hollow-bearing trees and little fallen woody debris (below benchmark in all plot/transects sampled). There is frequently high exotic plant cover (6-38 per cent in plot/transects sampled) mainly consisting of grasses and herbs.
Conservation significance	Comprises a local occurrence of River-flat Eucalypt Forest, which is listed as an EEC under the TSC Act.
Landscape position	On alluvial soils on banks and terraces of drainage lines throughout the site, including Badgerys Creek, Oaky Creek and their tributaries.
Structure	The majority of the mapped area of this vegetation zone is a derived grassland. There are some patches of derived Swamp Oak or Paperbark low closed woodland or native Blackthorn shrub land.
Over storey	Generally absent. Occasional isolated Forest Red Gum, Cabbage Gum or Grey Box.
Mid storey	Patchy and variable. Low cover overall but with occasional very dense patches of Native Blackthorn, Prickly-leaved Tea Tree, Flax-leaved Paperbark and especially Swamp Oak to ten metres tall and up to 21 per cent cover.
Groundcover	Moderately dense, species rich and structurally variable. Groundcover species include: moderate cover of grasses especially Weeping Grass along with Threeawn Speargrass, *Oplismenus aemulus* and Slender Rat's Tail Grass; locally dense patches of sedges such as Slender Flat-sedge and *Cyperus polystachyos*; occasional very dense patches of Native Blackthorn shrubs; low to moderate cover and moderate species richness of herbs such as Kidney Weed, Native Wandering Jew, Indian Pennywort and Lesser Joyweed (*Alternanthera denticulata*); locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp. *trigonos*; and moderate cover and species richness of scramblers such as Amulla, Slender Tick-trefoil (*Desmodium varians*) and *Glycine* species. There are frequent patches of bare earth associated with livestock. Drainage lines and flooded depressions through this vegetation zone feature moderate species richness and cover/abundance of native aquatic herbs and ferns such as *Marsilea mutica, Alternanthera denticulate, Eleocharis cylindrostachys, Triglochin microtuberosa* and *Myriophyllum variifolium*.
Exotic species	A variety of exotic plants are present throughout this vegetation zone, including localised very dense infestations. Exotic plants include localised very dense stands of small trees and tall shrubs such as African Boxthorn, Lantana, Green Cestrum and Blackberry; localised dense patches of the exotic sedge Sharp Rush (*Juncus acutus* subsp. *acutus*); pasture grasses such as *Setaria parviflora,* Kikuyu and Paspalum;

6- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland	
	weedy grasses such as Panic Veldtgrass; widespread wind or bird spread herbs such as Common Sowthistle (*Sonchus oleraceus*), Fireweed, Madeira Winter Cherry and Dandelion; and opportunistic herbs of disturbed areas such as Greater Beggar's Ticks, *Solanum sisymbriifolium* and Paddy's Lucerne.
Poor condition forest with a regrowth acacia midstorey at plot/transect 79	
Poor condition forest with a mixed understorey of native and exotic species and native midstorey at plot/transect 67.	

Table 16 Good condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest

7- Good condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest	
Plant community type (OEH, 2015c	HN512 - Broad-leaved Ironbark – Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin (Broad-leaved Ironbark - *Melaleuca decora* grassy open forest).
Equivalent map units	Castlereagh Shale-Gravel Transition Forest (DSF p502) (Tozer et al 2010); Shale Gravel Transition Forest (NPWS 2002a).
Area	5.2 hectares
Survey effort	Plot/transect 51, 63 ,64.
Condition (DECC, 2008)	Moderate/good – high. Near-intact, remnant or regrowth native vegetation with an overstorey and midstorey cover within benchmark values for two of the three plot/transects sampled. Native ground cover was typically above benchmark values while shrub cover was well within benchmark for this plant community type. Species richness was below benchmark in all plot/transects sampled. Two of four canopy species were observed regenerating. There were no hollow-bearing trees and there was small quantities of fallen woody debris. This vegetation zone contains moderate exotic plant cover including 16-78 per cent along the plot/transects sampled.
Conservation significance	Comprises a local occurrence of Cumberland Plain Woodland which is listed as a CEEC under the EPBC Act. Also comprises a local occurrence of the related community Shale-Gravel Transition Forest, which is listed as a separate EEC under the TSC Act.
Landscape position	Occurs on free draining, gravelly clay or sandy clay soils derived from alluvium on mid and upper slopes in the north east of the airport site.
Structure	Open forest with a variable, moderate to dense, structurally complex mid storey and a sparse shrub/grass understorey.
Over storey	Continuous, around 15-25 metres tall and around 16 per cent cover. Features a mixed canopy of Broad-leaved Ironbark (*Eucalyptus fibrosa*) and Forest Red Gum with occasional Thin-leaved Stringybark.
Mid storey	Variable and structurally complex, including mature *Melaleuca decora* to 10 metres tall and up to 40 per cent cover throughout; occasional very dense patches of Native Blackthorn, Black Wattle or Parramatta Wattle to five metres tall and 50 per cent cover and a range of other small trees such as Dwarf Cherry (*Exocarpos strictus*) and Wedge-leaf Hop-bush (*Dodonaea viscosa* subsp. *cuneata*).
Groundcover	Dense and dominated by grasses and grass like plants such as Threeawn Speargrass, Purple Wiregrass (*Aristida ramosa*), Wiry Panic (*Entolasia stricta*), Kangaroo Grass, Wallaby Grass (*Austrodanthonia racemosa*), Slender Chloris (*Chloris divaricata* var. *divaricata*), *Lomandra filiformis* subsp. *filiformis* and Many-flowered Mat-rush. Other understorey species include occasional: localised dense patches of *Melaleuca nodosa* and occasional other shrubs such as shrubs such as Rough Guinea Flower (*Hibbertia aspera*), Prickly Currant Bush (*Coprosma quadrifida*) and Sticky Cassinia (*Cassinia uncata*); herbs such as Pomax (*Pomax umbellata*), Variable Stinkweed (*Opercularia varia*), Slender Wire Lily (*Laxmannia gracilis*) and *Caesia parviflora* var. *vittata*; and scramblers such as *Glycine* species. There are occasional patches of leaf litter, gravel and bare earth.
Exotic species	There was no exotic species recorded along the transect sampled. This plant community type has generally very low exotic plant cover. Exotic plant species recorded include African Love Grass and wind-borne environmental weeds such as Dandelion and Fleabane.

7- Good condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest	
A patch of this vegetation zone in the northeast of the airport site, showing the characteristic dense mid storey of *Melaleuca decora* and gravelly soil.	

Table 17 Poor condition Broad-leaved Ironbark – *Melaleuca decora* grassy open forest

8 - Poor condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest on clay/gravel	
Plant community type (OEH, 2015c	HN512 - Broad-leaved Ironbark – Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin (Good condition Broad-leaved Ironbark - *Melaleuca decora* grassy open forest on clay/gravel).
Equivalent map units	Castlereagh Shale-Gravel Transition Forest (DSF p502) (Tozer et al 2010) and Shale Gravel Transition Forest (NPWS 2002a) though poor condition patches are generally not mapped.
Area	Not present in the Stage 1 construction impact zone. Present in the environmental conservation zone and a potential receptor for indirect impacts outside the Stage 1 construction impact zone.
Survey effort	Not directly sampled for this Stage 1 BAR. The description below is from survey data collected across the broader airport site.
Condition (DECC, 2008)	Moderate/good –poor. Sub-mature regrowth native vegetation. No overstorey other than isolated trees. Species richness and most other native vegetation cover attributes were close to benchmark values for this plant community type. All canopy species were observed regenerating. There were no hollow-bearing trees and very little fallen woody debris.
Conservation significance	Does not meet the condition criteria for a local occurrence of the CEEC Cumberland Plain Woodland as defined under the EPBC Act and associated guidelines (DEWHA, 2010d). Comprises a local occurrence of the related community Shale-Gravel Transition Forest, which is listed as an EEC under the TSC Act.
Landscape position	Occurs on free draining, gravelly clay or sandy clay soils derived from alluvium on mid and upper slopes in the north east of the airport site.
Structure	Derived scrub, shrubland or grassland.
Over storey	Generally absent. Occasional isolated Broad-leaved Ironbark or Grey Box.
Mid storey	Patchy and variable. Moderate cover overall but with occasional very dense patches of *Melaleuca nodosa, Melaleuca decora* or Native Blackthorn to five metres tall.
Groundcover	Areas of derived grassland feature a dense cover of grasses and grass like plants such as Threeawn Speargrass, Wiry Panic, Kangaroo Grass, Weeping Grass, Two-colour Panic and *Lomandra filiformis* subsp. *filiformis*. Areas of derived scrub or shrubland feature a diverse patchy mix of sub mature mid storey species such as Wedge-leaf Hop-bush and *Melaleuca nodosa,* shrubs such as Rough Guinea Flower and Peach Heath, herbs such as Pomax and Hairy Stinkweed; and scramblers such as *Glycine* species. There are occasional substantial patches of leaf litter, gravel and bare earth.

8 - Poor condition Broad-leaved Ironbark –*Melaleuca decora* grassy open forest on clay/gravel	
Exotic species	There is moderate to high exotic plant cover throughout, including African Love Grass, Fleabane, Paddys Lucerne, Kikuyu and a diverse mix of assorted garden escapees.
A patch of derived *Melaleuca* scrub.	

Table 18 Good condition artificial freshwater wetland on floodplain

9- Good condition artificial freshwater wetland on floodplain (HN630)	
Plant community type (OEH, 2015c	HN630 - *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin (Freshwater wetland).
Equivalent map unit	Closest match is Coastal Freshwater lagoon (FrW p313) though both natural and artificial examples have not been mapped because patches are too small to model (Tozer et al 2010). NPWS (2002) does not map or describe freshwater wetlands.
Area	32.1 hectares
Survey effort	Plot/transect 65, 77, 80, 81. Wetland assessment at targeted frog survey sites 2, 4, 5, 8, 9, 10, 11.
Condition (DECC, 2008)	Moderate/good. Near-intact, remnant native vegetation where this plant community type occurs throughout the majority of the airport site. Structure and species composition has probably been affected by changes to the drainage of the airport site, including creation of near-permanently inundated sedgelands upstream of culverts. These changes fall within the natural range of variation of the community.
Conservation significance	Not listed under the EPBC Act. Does not comprise an occurrence of the TEC 'Freshwater wetlands on coastal floodplains' listed under the TSC Act because artificial wetlands created on previously dry land are not regarded as part of this community (DECC, 2008).
Landscape position	Occurs on near-permanently inundated soils derived from alluvium on lower flats, depressions and drainage lines throughout the airport site. Vegetation structure appears to vary with inundation frequency and depth and proximity to native woodland or forest.
Structure	Sedgeland or wet herbfield with a variable, moderate to dense understorey of shrubs, grasses, sedges, rushes and herbs. Artificial water bodies without native wetland vegetation have not been included in this vegetation zone. Large water bodies have been identified and included in 'Cleared land and cropland'. A number of smaller water bodies also fall within the mapped area of 'Exotic grassland'.
Over storey	Generally absent. Occasional isolated Cabbage Gum, *Melaleuca decora,* Flax-leaved Paperbark or Swamp Oak.
Mid storey	Generally absent. Occasional patches of *Melaleuca* species or Tantoon (*Leptospermum polygalifolium*) to two metres tall and up to one per cent cover.
Groundcover	Dense, structurally complex and variable. The most widespread form is a rushland, of species such as Common Reed (*Phragmites australis*), Cumbungi (*Typha orientalis*), Spike Rush and *Schoenoplectus validus*. Other wetland species include: moisture loving grasses such as Water Couch (*Zoysia macrantha* and Cooch; floating aquatic ferns such as Nardoo (*Marsilea mutica)* and *Azolla* species; emergent aquatic herbs such as Wooly Frogmouth (*Phylidrum lanuginosum), Persicaria* species and *Ludwigia peploides* subs. *montevidensis*; submerged aquatic herbs such as *Triglochin microtuberosum* and *Myriophyllum* species; and moisture loving herbs of wetland margins such as *Centella asiatica* and Swamp Goodenia (*Goodenia paniculata*).
Exotic species	There is generally low to moderate exotic plant cover. There is low to moderate cover of exotic moisture loving herbs such as *Ludwigia peruviana* throughout and occasional localised dense patches of the exotic sedge Sharp Rush. They are frequently fringed by African Love Grass or pasture grasses because the majority of these freshwater wetlands are surrounded by exotic grassland in cleared agricultural land. There is a localised severe infestation of Alligator Weed (*Alternanthera philoxeroides*) in the north western portion of the airport site associated with a dammed section of Oaky Creek.

9- Good condition artificial freshwater wetland on floodplain (HN630)	
An artificial freshwater wetland with native emergent rushes, fringing sedges and floating aquatic ferns surrounded by derived native grassland and exotic pasture grasses.	
An artificial freshwater wetland with native emergent rushes and sedges, water-loving grasses and herbs and floating aquatic ferns surrounded by native riparian forest.	

Table 19 Low condition Grey Box - Forest Red Gum grassy woodland on flats

10- **Low condition Grey Box – Forest Red Gum grassy woodland on flats**	
Plant community type (OEH, 2015c	HN528- Grey Box - Forest Red Gum grassy woodland on flats, Sydney
Area	530.7 hectares
Survey effort	Plot/transects 4, 50, 52, 54, 56, 58, 61, 62, 76. Rapid plot/transect 1
Condition (DECC, 2008)	Low. Very low native over storey and no mid storey cover. Less than 50 per cent of the ground cover present is native and native cover is frequently less than 10 per cent.
Conservation significance	Exotic vegetation.
Landscape position	Occurs on shale, alluvium and shale-gravel transition derived soils in a variety of topographic positions across the airport site. The most extensive areas are associated with lower slopes and alluvial flats adjoining Badgerys Creek in the east of the airport site and gently undulating terrain through the central portion of the airport site.
Structure	Closed tussock grassland or closed stoloniferous (i.e. running along the ground) grassland. Some areas of exotic garden vegetation, artificial water bodies, gravel tracks, houses and farm infrastructure have been included in the mapped extent of this vegetation zone.
Over storey	Absent apart from isolated paddock trees, which are frequently senescent (i.e. dead or dying).
Mid storey	Absent apart from occasional isolated Native Blackthorn, Swamp Oak, acacias or *Dilwinia sieberi.*
Groundcover	Dominated by exotic grasses as described below. A patchy and variable cover of native species is occasionally present, including shrubs such as Peach Heath, grasses such as Kangaroo Grass, Speargrass (*Aristida* species) and Common Couch, sedges such as Common Fringe-sedge; and scramblers such as *Glycine* species. There are occasional extensive areas of bare earth associated with grazing, top soil removal or dumped fill.
Exotic species	Moderate to very high exotic plant cover dominated by pasture grasses such as Kikuyu, *Setaria parviflora* and Carpet Grass (*Axonopus fissifolius).* There are also extensive areas dominated by noxious or environmental weeds such as African Love Grass, Khaki Weed (*Alternanthera pungens*), Blackberry (*Rubus fruticosus* species aggregate) or Noogoora Burr (*Xanthium occidentale)* and infestations of environmental weeds such as Dandelion, Rhodes Grass (*Chloris gayana*), *Solanum sysimbrifolium*, Stinkgrass (*Eragrostis cilianensis*) and Lamb's Tongues (*Plantago lanceolata*) throughout.
Heavily grazed exotic grassland.	

10- **Low condition Grey Box – Forest Red Gum grassy woodland on flats**	
Ungrazed exotic grassland.	

Table 20 Low condition Grey Box - Forest Red Gum grassy woodland on hills

11- **Low condition Grey Box – Forest Red Gum grassy woodland on hills**	
Plant community type (OEH, 2015c	HN529- Grey Box - Forest Red Gum grassy woodland on shale, Sydney Basin (Grey Box - Forest Red Gum grassy woodland on hills).
Area	42.3 hectares
Survey effort	Plot/transects 70, 72, 73, 74.
Condition (DECC, 2008)	Low. No native over storey and no mid storey cover. Less than 50 per cent of the ground cover present is native and native cover is frequently less than 10 per cent.
Conservation significance	Exotic vegetation.
Landscape position	Occurs on shale, alluvium and shale-gravel transition derived soils in a variety of topographic positions across the airport site. The most extensive areas are associated with lower slopes and alluvial flats adjoining Badgerys Creek in the east of the airport site and gently undulating terrain through the central portion of the airport site.
Structure	Closed tussock grassland or closed stoloniferous (i.e. running along the ground) grassland. Some areas of exotic garden vegetation, artificial water bodies, gravel tracks, houses and farm infrastructure have been included in the mapped extent of this vegetation zone.
Over storey	Absent apart from isolated paddock trees, which are frequently senescent (i.e. dead or dying).
Mid storey	Absent apart from occasional isolated Native Blackthorn, Swamp Oak, acacias or *Dilwinia sieberi.*
Groundcover	Dominated by exotic grasses as described below. A patchy and variable cover of native species is occasionally present, including shrubs such as Peach Heath, grasses such as Kangaroo Grass, Speargrass (*Aristida* species) and Common Couch, sedges such as Common Fringe-sedge; and scramblers such as *Glycine* species. There are occasional extensive areas of bare earth associated with grazing, top soil removal or dumped fill.
Exotic species	Moderate to very high exotic plant cover dominated by pasture grasses such as Kikuyu, *Setaria parviflora* and Carpet Grass (*Axonopus fissifolius).* There are also extensive areas dominated by noxious or environmental weeds such as African Love Grass, Khaki Weed (*Alternanthera pungens*), Blackberry (*Rubus fruticosus* species aggregate) or Noogoora Burr (*Xanthium occidentale)* and infestations of environmental weeds such as Dandelion, Rhodes Grass (*Chloris gayana*), *Solanum sysimbrifolium*, Stinkgrass (*Eragrostis cilianensis*) and Lamb's Tongues (*Plantago lanceolata*) throughout.

11- **Low condition Grey Box – Forest Red Gum grassy woodland on hills**	
Heavily grazed exotic grassland at plot/transect 70.	
Ungrazed exotic grassland at plot/transect 74.	

Table 21 Low condition Forest Red Gum - Rough-barked Apple grassy woodland

12- **Low condition Forest Red Gum – Rough-barked Apple grassy woodland**	
Plant community type (OEH, 2015c	HN526- Forest Red Gum - Rough-barked Apple grassy woodland on floodplains, Sydney Basin (Forest Red Gum - Rough-barked Apple grassy woodland).
Area	43.9 hectares
Survey effort	Plot/transect 55, 66, 68, 69.
Condition (DECC, 2008)	Low. Very low native over storey mid storey cover. Less than 50 per cent of the ground cover present is native and native cover is frequently less than 10 per cent.
Conservation significance	Exotic vegetation.
Landscape position	Occurs on shale, alluvium and shale-gravel transition derived soils in a variety of topographic positions across the airport site. The most extensive areas are associated with lower slopes and alluvial flats adjoining Badgerys Creek in the east of the airport site and gently undulating terrain through the central portion of the airport site.
Structure	Closed tussock grassland or closed stoloniferous (i.e. running along the ground) grassland.
Over storey	Absent apart from isolated paddock trees, which are frequently senescent (i.e. dead or dying).
Mid storey	Absent apart from occasional isolated Native Blackthorn, Swamp Oak, acacias or *Dilwinia sieberi.*
Groundcover	Dominated by exotic grasses as described below. A patchy and variable cover of native species is occasionally present, including shrubs such as Peach Heath, grasses such as Kangaroo Grass, Speargrass (*Aristida* species) and Common Couch, sedges such as Common Fringe-sedge; and scramblers such as *Glycine* species. There are occasional extensive areas of bare earth associated with grazing, top soil removal or dumped fill.
Exotic species	Moderate to very high exotic plant cover dominated by pasture grasses such as Kikuyu, *Setaria parviflora* and Carpet Grass (*Axonopus fissifolius).* There are also extensive areas dominated by noxious or environmental weeds such as African Love Grass, Khaki Weed (*Alternanthera pungens*), Blackberry (*Rubus fruticosus* species aggregate) or Noogoora Burr (*Xanthium occidentale)* and infestations of environmental weeds such as Dandelion, Rhodes Grass (*Chloris gayana*), *Solanum sysimbrifolium*, Stinkgrass (*Eragrostis cilianensis*) and Lamb's Tongues (*Plantago lanceolata*) throughout.
Exotic understorey and sparse midstorey cover at plot/transect 55.	

12- **Low condition Forest Red Gum – Rough-barked Apple grassy woodland**	
Ungrazed exotic grassland at plot/transect 68.	

Table 22 Cleared land and cropland

x- Cleared land and cropland	
Plant community type (OEH, 2015c	No equivalent plant community type.
Area	177.1 hectares
Survey effort	General observations.
Condition (DECC, 2008)	Cleared. No native over storey or mid storey. Less than 50 per cent of the ground cover present is native and/or >90 per cent of the ground cover is bare earth or hardstand.
Conservation significance	Cleared land or exotic vegetation.
Landscape position	Occurs on shale, alluvium and shale-gravel transition derived soils in a variety of topographic positions across the airport site. The most extensively cleared areas are associated with small rural residential lots in the suburb of Badgerys Creek in the east of the airport site, a quarry in the central north of the site and cropland on gently undulating terrain through the central portion of the airport site.
Structure	No natural structural equivalent. This vegetation zone includes planted or fallow cropland, exotic garden vegetation, artificial water bodies, bitumen roads and tracks, a quarry, houses and farm infrastructure.
Over storey	Absent apart from isolated paddock trees, which are frequently senescent (i.e. dead or dying).
Mid storey	Absent apart from occasional isolated Native Blackthorn, Swamp Oak, acacias or *Dilwinia sieberi.*
Groundcover	Dominated by exotic crops or weeds as described below. Patchy and variable cover of opportunistic native species is occasionally present, including shrubs such as Peach Heath, grasses such as Kangaroo Grass, Speargrass (*Aristida* species) and Common Couch, sedges such as *Juncus usitasis* and scramblers such as *Glycine* species. There are extensive areas of infrastructure or bare earth associated with quarrying, race tracks, fallow cropland, top soil removal or dumped fill.
Exotic species	There is patchy and variable exotic plant cover dominated by flower, grain or vegetable crops. There are also extensive areas dominated by noxious or environmental weeds such as African Olive, Blackberry or Inkweed (*Phytolacca octandra)* and minor infestations of environmental weeds such as African Love Grass, *Bidens* species, Rhodes Grass, *Solanum sysimbrifolium* and Lamb's Tongues throughout.

x- Cleared land and cropland	
Extensive green houses comprising cleared land, distinct from the surrounding exotic grassland.	
Ploughed cropland at the location of previous records of *Pultenaea parviflora* (Biosis 1999; SMEC 2014) (see Section 4.5.2). Part of an extensive commercial farm in the centre of the site.	

Table 23 Medium condition Grey Box - Forest Red Gum grassy woodland on flats

13- Medium condition Grey Box - Forest Red Gum grassy woodland on flats	
Plant community type (OEH, 2015c)	HN528- Grey Box - Forest Red Gum grassy woodland on flats, Sydney
Equivalent Map Units	Cumberland Shale Plains Woodland (GW p29) (Tozer et al 2010); Shale Plains Woodland (NPWS 2002).
Area	6.1 hectares
Survey effort	Plot/transect 53 Rapid plot/transects 2, 3
Condition (DECC, 2008)	Moderate/good – medium. Remnant or regrowth native vegetation with canopy present but over-storey cover below benchmark values. In many areas, there was evidence of dieback, including patches of dead trees. Species richness was below benchmark in plot 53 and was probably below benchmark in rapid plots 2 and 3, however because the rapid plot/transect methodology did not include a comprehensive count of species richness these data were entered at benchmark values ensuring a conservative approach to offset calculations. Midstorey cover was very low for this plant community type in all of the plot/transects sampled. Native groundcover (other) and grass cover was high in this vegetation type with six and eight plot/transects sampled respectively above benchmark values. All canopy species were observed regenerating. No hollow-bearing trees were recorded within plot/transects sampled. There were generally low quantities of fallen woody debris, including none in two of the three plot/transects sampled. There is frequently high exotic plant cover (82-98 per cent in plot/transects sampled) mainly consisting of grasses and herbs in the under storey.
Conservation significance	Comprises a local occurrence of 'Cumberland Plain Woodland' which is listed as a CEEC under the TSC Act. Does not comprise an occurrence of EPBC Act Cumberland Plain Woodland because less than 30 per cent of the perennial groundcover present is composed of native plant species.
Landscape position	On shale derived soils on mid and lower slopes and flats in gently undulating terrain across the airport site.
Structure	Woodland or open forest with a sparse mid storey and a generally sparse shrub/grass understorey.
Over storey	Patchy, around 15-25 metres tall and around 5-15 per cent cover. Features a mixed canopy of Grey Box and Forest Red Gum with occasional Red Ironbark and Thin-leaved Stringybark.
Mid storey	Patchy and sparse (0 to <5 per cent cover). Occasional tall shrubs such as *Dillwynia sieberi* or patches of Native Blackthorn, Black Wattle or Parramatta.
Groundcover	Sparse and patchy. Where present, dominated by grasses and grass like plants such as Weeping Grass, Threeawn Speargrass and *Lomandra filiformis* subsp. *filiformis*. Other understorey species include: occasional herbs such as Kidney Weed, Native Wandering Jew and Blue Trumpet; locally high cover of chenopods such as Climbing Saltbush and *Einadia trigonos* subsp*. trigonos*; and occasional scramblers such as *Glycine* species. There are occasional patches of leaf litter and bare earth.
Exotic species	A variety of exotic plants is present throughout this vegetation zone, including localised very dense infestations. Greater than 50 per cent of the perennial groundcover vegetation present is exotic plants throughout the entire vegetation zone, including 82-98 per cent cover in the plot/transects sampled. Exotic plants include localised very dense infestations of small trees such as African Boxthorn and African Olive; very high, dense cover of pasture grasses such as Prairie Grass (*Bromus catharticus*), *Briza subaristata*, Kikuyu, Rhodes Grass (*Chloris gayana)* and Paspalum; widespread wind borne herbs such as Fireweed; and

13- Medium condition Grey Box - Forest Red Gum grassy woodland on flats	
	opportunistic herbs of disturbed areas such as Purpletop (*Verbena bonariensis)* and *Solanum sisymbriifolium*; and climbers such as Moth Vine.
Medium condition woodland with predominantly exotic understorey.	
Medium condition woodland with predominantly exotic understorey.	

4.2.3 Noxious and environmental weeds

The Australian Weeds Strategy (AWS) provides a framework to establish consistent guidelines for all parties, identifying priorities for weed management across the nation with the aim of minimising the impact of weeds on Australia's environmental, economic and social assets (AWS 2015). The AWS includes the identification of 'weeds of national significance' (WoNS) which are recognised as Australia's worst invasive plants. These weeds cause negative impacts to many of Australia's natural and productive landscapes. Nine WoNs were observed at the airport site (Table 24).

Eight of the WoNS recorded at the airport site are also listed as noxious weeds under the *Noxious Weeds Act 1993* (NW Act) in the Liverpool Local Government Area control area surrounding the airport site. A further seven listed noxious weed species were recorded at the airport site (DPI 2015b). The Noxious Weeds Act Control Category and control requirements for these species are included in Table 24. Noxious weeds are placed into one of five categories, with control requirements of Class 1 weeds the most onerous (is total eradication) and no control requirements for Class 5 weeds, although Class 5 weeds are notifiable and have restrictions on their sale and movement. These control requirements are not a legal requirement on Commonwealth land, however have been included as a guide to the comparative seriousness of each weed species.

As stated in Section 4.2.1, the airport site is likely to contain additional exotic plant species to those revealed by the field surveys because survey effort was not focussed on domestic gardens and other areas that were dominated by exotic plants. The airport site may therefore contain additional WoNS and noxious weeds. Those species identified in Table 24 should be considered a guide to the most serious and widespread of the weeds at the airport site.

Table 24 Noxious weeds and WoNS recorded at the airport site

Scientific Name	Common Name	WoNS (AWS 2015)	NW Act Control Category (DPI 2015b)	Control Requirements (DPI 2015b)
Alternanthera philoxeroides	Alligator Weed	Yes	3	The plant must be fully and continuously suppressed and destroyed.
Anredeira cordifolia	Madeira Vine	Yes		
Asparagus asparagoides	Bridal Creeper	Yes	4	The plant must not be sold, propagated or knowingly distributed.
Bryophyllum species	Mother of Millions	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
Cestrum parqui	Green Cestrum	No	3	The plant must be fully and continuously suppressed and destroyed.

Scientific Name	Common Name	WoNS (AWS 2015)	NW Act Control Category (DPI 2015b)	Control Requirements (DPI 2015b)
Cortaderia selloana	Pampas Grass	No	3	The plant must be fully and continuously suppressed and destroyed and the plant must not be sold, propagated or knowingly distributed.
Lantana camara	Lantana	Yes	4	The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold, propagated or knowingly distributed.
Ligustrum lucidum	Small-leaved Privet-	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Ligustrum sinense	Broad-leaved Privet	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Lycium ferocissimum	African Boxthorn	Yes	4	The plant must not be sold, propagated or knowingly distributed.
Olea europa subsp. *cuspidata*	African Olive	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
Opuntia stricta	Common Prickly Pear	Yes	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed.
Ricinus communis	Castor Oil Plant	No	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread.
Rubus fruticosus species aggregate	Blackberry	Yes	4	The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread and the plant must not be sold, propagated or knowingly distributed. This is an All of NSW declaration.
Salvinia molesta	Salvinia	Yes	2	Regionally Prohibited Weed. The plant must be eradicated from the land and that land must be kept free of the plant.
Senecio madagascariensis	Fireweed	Yes	4	The plant must not be sold, propagated or knowingly distributed.

The distribution and abundance of WoNS and noxious weeds are linked to disturbance. Particularly severe or extensive infestations include:

- Madeira Vine, Bridal Creeper, Lantana, privet species and African Olive in the riparian corridor of Badgerys Creek;
- African Olive and privet species in the riparian corridors of small drainage lines in the west of the airport site;
- Alligator Weed in dammed sections of Oaky Creek and the adjoining floodplain in the north of the airport site; and
- African Boxthorn, African Olive, Common Prickly Pear and Blackberry on the margins of commercial farms in the centre of the airport site and on rural residential lots in the suburb of Badgerys Creek.

There are patchy, generally minor infestations of wind and vehicle-spread environmental weeds throughout the airport site. These widespread weeds include African Love Grass and herbs such as Dandelion, Fleabane, Cobblers Pegs and the WoNs Fireweed.

4.3 Terrestrial fauna species and habitats

4.3.1 Fauna species

A high diversity of fauna species was recorded at the airport site during the recent surveys and the surveys by Biosis Research (1997) and SMEC (2014). A total of 192 fauna species were recorded during the recent survey, including 137 bird species, 14 bat species, 12 terrestrial or arboreal mammal species, 11 frog species, 12 reptile species, four snail species, and two fish species. As many as 10 other microchiropteran bat species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification. A further 17 fauna species, including seven bird species, seven mammal species, two reptile species and one frog species were recorded by Biosis Research (1997) and/or SMEC (2014). The full list of fauna species recorded is presented in Appendix B.

One threatened fauna species listed under the EPBC Act was recorded at the airport site. The Grey-headed Flying-fox (*Pteropus poliocephalus*) was recorded during the EIS surveys and the surveys for the 1999 EIS (PPK 1999). A further 12 threatened fauna species listed under the TSC Act (but not under the EPBC Act) have been recorded at the airport site during current and previous surveys. These are discussed in more detail in Section 4.5.3. Locations of threatened fauna recorded at the airport site are shown on Figure 5.

A number of introduced fauna species were recorded. These included seven bird species, six mammal species (including the Red Fox (*Vulpes vulpes*), Goat (*Capra hircus*) and Rabbit (*Oryctolagus cuniculus*)), one fish species (Mosquitofish (*Gambusia holbrooki*)), and two snail species (Garden Snail (*Cantareus aspera*) and Asian Trampsnail (*Bradybaena similaris*)).

4.3.2 Fauna habitats

Five broad fauna habitat types were recorded within the Stage 1 Construction Impact Zone:

- grassland and cropped areas;
- native woodland;
- riparian forest;
- dams; and
- buildings and other structures.

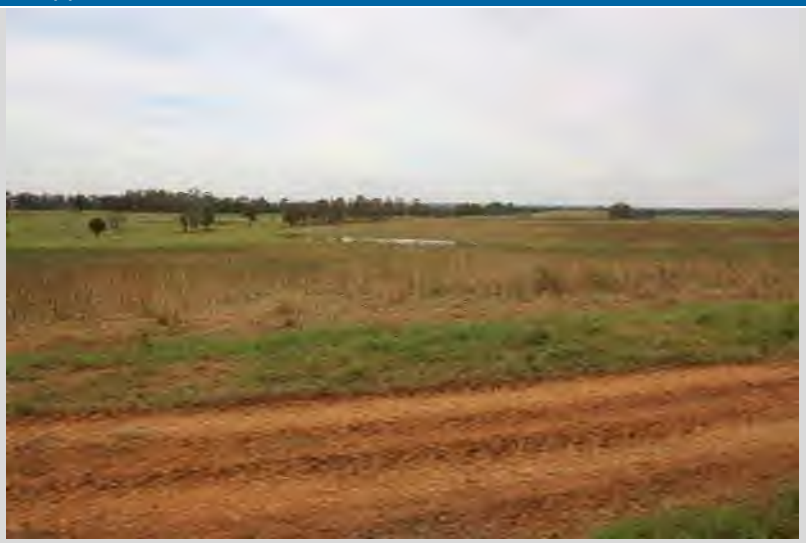
These habitat types are described in

Table 25 to Table 29 below.

Table 25 Fauna habitats of grassland and cropped areas

Grassland and cropped areas		
Description	The majority of the Stage 1 Construction Impact Zone contains grassland within fenced grazing land. These areas would have historically supported native woodland vegetation but have been extensively modified by previous clearing and agriculture. Exotic grassland and cleared land contain few habitat resources of relevance to most native species due to low structural and floristic diversity. Exotic grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna species. Occasional paddock trees and shrubs (e.g Native Blackthorn or African Olive) also occur in these areas. Regrowth trees and shrubs would provide some foraging resources for native woodland birds. Most of the species recorded in grassland areas would use these areas as an adjunct to the higher quality, more extensive areas of suitable habitat at and adjoining the Stage 1 Construction Impact Zone. Some small fauna species such as lizards may rely on grassland habitat for their survival.	
Typical fauna species recorded	Bird species commonly recorded in this habitat type include the Magpie-lark (*Grallina cyanoleuca*), Australian Magpie (*Cracticus tibicen*), Australian Raven (*Corvus coronoides*), White-winged Chough (*Corcorax melanorhamphos*), Australian Pipit (*Anthus novaeseelandiae*) and Welcome Swallow (*Hirundo neoxema*). Use of fertiliser in some paddocks led to large number of birds such as the Straw-necked Ibis (*Threskiornis spinicollis*) foraging in fields. Where grass was long, cryptic species such as the Brown Quail (*Coturnix ypsilophora*) were sometimes observed. A range of raptors were recorded hunting over the grassland areas. These included the Black-shouldered Kite (*Elanus axillaris*), Brown Falcon (*Falco berigora*), Wedge-tailed Eagle (*Aquila audax*) and the Little Eagle (*Hieraaetus morphnoides*). Double-barred Finches (*Taeniopygia bichenovii*), Yellow-rumped Thornbills (*Acanthiza chrysorrhoa*) and Superb Fairy-wrens (*Malurus superbus*) were observed where shrubs and paddock trees were present. Grassland and cropped areas provide foraging habitat for larger herbivorous species, including the Eastern Grey Kangaroo (*Macropus giganteus*) and Swamp Wallaby (*Wallabia bicolor*). These mammals were recorded only in small numbers. Bats typical of open agricultural land such as the White-striped Freetail Bat (*Tadarida australis*) and Gould's Wattled Bat (*Chalinolobus gouldii*) were recorded. Grassland areas also provide habitat for a range of reptile species, including snakes and small lizards. Small grass skinks (*Lampropholis* spp.) were observed, as was a Red-bellied Black-snake (*Pseudechis porphyriacus*). Spotted Grass Frogs (*Limnodynastes tasmaniensis*) were heard calling from small soaks in grassland areas and an Eastern Dwarf Tree Frog (*Litoria fallax*) was recorded in thick grass.	
Threatened fauna species recorded	Little Eagle (*Hieraaetus morphnoides*) (TSC Act)	Forages for rabbits and other mammals in grassland.
	White-throated Needletail (*Hirundapus caudacutus*)	Foraging for insects above grassland areas.
Introduced species recorded	European Rabbit (*Oryctolagus cuniculus*) Brown Hare (*Lepus europaeus*) Red Fox (*Vulpes vulpes*) House Mouse (*Mus musculus*)	

Grassland and cropped areas



Cropped land.

Exotic grassland.

Table 26 Fauna habitats of native woodland

Native Woodland	
Description	Native woodland in the Stage 1 Construction Impact Zone provides moderate quality fauna habitats. Habitat resources include: mature canopy trees (i.e. trees between 20 to 80 per cent of their life expectancy) and associated nectar, fruits and leaves as well as foraging substrate; a range of fruiting and flowering small trees and shrubs; and connectivity with wetland and aquatic habitat. Woodland and forest in the Stage 1 Construction Impact Zone forms some more extensive patches particularly where it is connected by riparian corridors (see Figure 3) however the majority is fragmented and subject to edge effects. There are roads, residences, agriculture and industry throughout the Stage 1 Construction Impact Zone and associated noise and light disturbance and barriers to fauna movement. Grazing and the presence of exotic pest fauna would further reduce the value of habitats. The Stage 1 Construction Impact Zone and broader airport site contain only moderate quantities of pre-European occupation age trees and associated habitat resources such as tree hollows and stags. These trees include hollows with a range of sizes, orientations and landscape positions and both living and dead trees. *Eucalyptus* species provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and Native Blackthorn would help provide year-round foraging resources for a range of native birds, bats and mammals. Much of the shrub and ground layer vegetation and habitat features of the woodland and forest in the Stage 1 Construction Impact Zone have been removed and 'cleaned up' for grazing. Woodland in the Stage 1 Construction Impact Zone generally contains low quantities of woody debris and leaf litter, although some patches have higher quantities of these resources. Fallen timber and leaf litter provides shelter habitat for small reptiles, snakes and small mammals. A number of termite mounds were observed within the Stage 1 Construction Impact Zone.
Typical fauna species recorded	Nectarivorous species, including the Eastern Spinebill (*Acanthorhynchus tenuirostris*) and White-plumed Honeyeater (*Lichenostomus penicillatus*) were recorded foraging in woodland areas. Insectivorous species recorded included the Rufous Whistler (*Pachycephala rufiventris*), Golden Whistler (*Pachycephala pectoralis*), Black-faced Cuckoo-shrike (*Coracina novaehollandiae*), Eastern Yellow Robin (*Eopsaltria australis*) and Grey Shrike-thrush (*Colluricincla harmonica*). In some woodland patches Bell Miners (*Manorina melanophrys*) were dominant. Small and gregarious flocking bird species such as Silvereye (*Zosterops lateralis*), Red-browed Finches (*Neochmia temporalis*), Double-barred Finches (*Taeniopygia bichenovii*), White-browed Scrubwrens (*Sericornis frontalis*) and Grey Fantail (*Rhipidura albiscapa*) were recorded foraging in the shrubby midstorey where this was present. Hollow-bearing trees provide nesting habitat for species such as the Galah (*Eolophus roseicapilla*), Eastern Rosella (*Platycercus eximius*) and Common Brush-tailed Possum (*Trichosurus vulpecula*). Microbat species recorded included species typical of open woodland and/or agricultural areas, and some species that require large tracts of continuous vegetation. The East Coast Freetail Bat (*Mormopterus (Micronomus) norfolkensis*) was the most common microchiropteran bat species recorded in the Stage 1 Construction Impact Zone. Other species included the Chocolate Wattled Bat (*Chalinolobus morio*) and Eastern Freetail Bat (*Mormopterus ridei*). The Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), which does require larger tracts, was possibly recorded during recent surveys and recorded previously by Biosis Research (1999). This species may use the Badgerys Creek corridor and large adjacent woodland patches for foraging and breeding. Elegant Snake-eyed Skinks (*Cryptobepharus pulcher*) were regularly observed basking on logs and timber, and Dark-flecked Garden Sunskinks (*Lampropholis delicata*) were regularly observed in the leaf litter. The Cumberland Plain Land Snail (*Meridolum corneovirens*) and Common Southern Carnivorous Snail (*Austrorhytida capillacea*) were recorded where deep litter occurred at the base of trees. Termite mounds showed some evidence of disturbance, most likely from Short-beaked Echidnas (*Tachyglossus aculeatus*).

Native Woodland		
Threatened fauna species recorded	Grey-headed Flying-fox (*Pteropus poliocephalus*) EPBC Act/TSC Act	Would forage throughout woodland patches. No breeding habitat present.
	East Coast Freetail Bat (*Mormopterus norfolkensis*) - TSC Act	Would forage throughout woodland patches. May breed in hollow-bearing trees.
	Little Lorikeet (*Glossopsitta pusilla*) - TSC Act	Would forage throughout woodland patches. Unlikely to breed in the area.
	Scarlet Robin (*Petroica boodang*) - TSC Act	Would forage throughout woodland patches. Unlikely to breed in the area.
	Varied Sittella (*Daphoenositta chrysoptera*) - TSC Act	Would forage throughout woodland patches. May breed in the area.
	Cumberland Plain Land Snail (*Meridolum corneovirens*) - TSC Act	Occurs in leaf litter in woodland patches.
Migratory fauna species recorded	Rufous Fantail (*Rhipidura rufifrons*)	Would forage throughout woodland patches. Unlikely to breed in the area.
Introduced species recorded	Garden Snail (*Cantareus aspersa*) Asian Tramp Snail (*Bradybaena similaris*)	

Shale-Gravel Transition Forest.

Cumberland Plain Woodland.

Table 27 Fauna habitats of riparian forest

Riparian forest		
Description	There is a relatively extensive network of drainage lines and waterbodies across the Stage 1 Construction Impact Zone. Most drainage lines feature moderate geomorphorphic condition, generally contain good instream and riparian vegetation but moderate to severe weed infestation and some evidence of degradation by cattle such as grazing, bank erosion, increased turbidity and probably also nutrient enrichment from waste. Badgerys Creek, which runs from the south-west along the southern and eastern boundaries of the airport site, is located outside the Stage 1 Construction Impact Zone, however is located immediately adjacent to one of the large basins. Riparian forest is a closed woodland or forest of eucalypts with Swamp Oak (*Casuarina glauca*) present along the margins of the creeks. This species also occurs on the associated flats. A range of paperbarks (*Melaleuca* spp.) are also present. Understorey vegetation is similar to the adjacent native woodland along with additional moisture loving species such rushes and sedges. Large, hollow-bearing trees tend to occur in higher densities along the riparian corridor than in other woodland patches. *Eucalyptus* and other species provide foraging and shelter resources for a range of birds and mammals. Foraging resources include seasonal nectar resources, seeds and insects. Winter-flowering acacias and paperbarks would help provide year-round foraging resources for a range of native birds, bats and mammals. Much of the shrub and ground layer vegetation and habitat features of the riparian areas in the Stage 1 Construction Impact Zone have been removed and 'cleaned up' for grazing. Low quantities of woody debris and leaf litter are present, although some patches have higher quantities of these resources. Fallen timber and leaf litter provides shelter habitat for small reptiles, snakes and small mammals. Dense weed infestations are present along the creek banks which may also reduce habitat quality for some species. Drainage lines provide habitat for native fish and aquatic invertebrates and breeding habitat for a number of stream breeding frogs. These drainage lines are not suitable habitat for any of the threatened frogs with the potential to occur in the locality, which are generally associated with clear, rocky streams located on sandstone substrates higher in the catchment.	
Typical fauna species recorded	A higher diversity of bird species tended to occur along the Badgerys Creek riparian corridor compared to woodland patches. Species recorded included the Scarlet Robin (*Petroica boodang*), Varied Sittella (*Daphoenositta chrysoptera*), and Black Bittern (*Ixobrychus flavicollis*), listed as vulnerable species under the TSC Act. The migratory Rufous Whistler (*Rhipidura rufifrons*) was observed at a number of locations, including along Badgerys Creek. Other species included the Scarlet Honeyeater (*Myzomela sanguinolenta*), Weebill (*Smicrornis brevirostris*), Olive-backed Oriole (*Oriolus sagittatus*), Fan-tailed Cuckoo (*Cacomantis flabelliformis*), Eastern Shrike-tit (*Falcunculus frontatus*), Azure Kingfisher (*Ceyx azureus*) and Buff-rumped Thornbill (*Acanthiza reguloides*). Some of these species also occurred in woodland patches away from riparian corridors. The Swamp Wallaby (*Wallabia bicolor*) was recorded along the riparian corridor. A small colony of microbats was observed under the bridge over Badgerys Creek on Badgerys Creek Road. Microbats recorded included the East Coast Freetail Bat (*Mormopterus norfolkensis*) and the Southern Myotis (*Myotis macropus*) (probable record). This latter species would forage along the creek and nearby dams. Eastern Snake-necked Turtles (*Chelodina longicolllis*) were observed on occasion in the creeks. Also recorded were Eastern Water Skinks (*Egernia quoyii*) and Australian Water Dragons (*Intellagama lesueurii*). The Striped Marsh Frog (*Limnodynastes peroni*) was the most common frog heard calling along the creeks. Native fish such as gudgeons were observed, as well as introduced species such as the Mosquitofish (*Gambusia holbrooki*).	
Threatened fauna species recorded	Grey-headed Flying-fox (*Pteropus poliocephalus*) EPBC Act/TSC Act	Would forage throughout riparian forest. No breeding habitat present.
	East Coast Freetail Bat (*Mormopterus norfolkensis*) - TSC Act	Would forage throughout riparian forest. May breed in hollow-bearing trees.

Riparian forest		
	Southern Myotis (*Myotis macropus*) – TSC Act	Would forage along creeklines. May roost in hollow-bearing trees.
	Little Lorikeet (*Glossopsitta pusilla*) - TSC Act	Would forage throughout riparian forest. Unlikely to breed in the area.
	Scarlet Robin (*Petroica boodang*) - TSC Act	Would forage throughout riparian forest. Unlikely to breed in the area.
	Varied Sittella (*Daphoenositta chrysoptera*) - TSC Act	Would forage throughout riparian forest. May breed in the area.
	Black Bittern (*Ixobrychus flavicollis*) – TSC Act	Would forage and may breed within the riparian forest.
	Cumberland Plain Land Snail (*Meridolum corneovirens*) - TSC Act	Occurs in leaf litter along the outer margins of the riparian forest, where it intergrades with Cumberland Plain Woodland.
Migratory fauna species recorded	Rufous Fantail (*Rhipidura rufifrons*)	Would forage throughout riparian forest. Unlikely to breed in the area.
Introduced species recorded	Garden Snail (*Cantareus aspersa*) Asian Tramp Snail (*Bradybaena similaris*)	

Riparian forest in poorer condition along Badgerys Creek.

Riparian forest in good condition adjacent to Badgerys Creek.

Table 28 Fauna habitats of dams

Dams		
Description	There are a number of dams and flooded depressions in the Stage 1 Construction Impact Zone with varying growth of native wetland and aquatic plants, including some water bodies with extensive reed beds. These range in habitat value for native fauna depending on their size, presence of emergent or aquatic vegetation, and level of use by cattle and associated disturbance. Many dams contained a variety of aquatic vegetation, including *Typha orientalis*, *Eleocharis cylindrostachys*, and *Eleocharis sphacelata* and have been mapped as a native freshwater wetland vegetation zone (see Table 17).	
Typical fauna species recorded	A moderate diversity and abundance of native waterfowl, waders and other wetland birds were observed in these water bodies. One migratory waterbird, the Lathams Snipe (*Gallinago hardwickii*) was recorded. The White-bellied Sea-eagle (*Haliaeetus leucogaster*) was observed on a number of occasions roosting near or flying over a number of dams. A range of ducks and grebes was observed, including various common species and three threatened Blue-billed Ducks (*Oxyura australis*). Large flocks of ibis (*Threskiornis* spp.), herons (*Ardea* spp. and *Egretta* spp.), and cormorants (*Phalacrocorax* spp.) were observed. Coots, moorhens and swamphens were common. Occasional Black-winged Stilts (*Himantopus himantopus*), spoonbills (*Platalea* spp.) and Black-fronted Dotterels (*Elseyornis melanops*) were observed. Australian Reed Warblers (*Acrocephalus australis*) and Golden-headed Cisticolas (*Cisticola exilis*) were recorded at dams with dense stands of reeds. A range of frog species was recorded during targeted nocturnal surveys. These included Peron's Tree Frog (*Litoria peronii*), Verreaux's Tree Frog (*Litoria verreauxii*), Eastern Dwarf Tree Frog (*Litoria fallax*), Broad-palmed Frog (*Litoria latopalmata*), Striped Marsh Frog (*Lymnodynastes peronii*), Spotted Grass Frog (*Limnodynastes tasmaniensis*), and Common Eastern Froglet (*Crinia signifera*). Also heard calling nearby in damp grassy areas were the Smooth Toadlet (*Uperoleia laevigata*), Wrinkled Toadlet (*Uperoleia rugosa*) and Bibron's Toadlet (*Pseudophryne bibroni*). Potential habitat for the Green and Golden Bell Frog (*Litoria aurea*) is present at many dams however none were recorded during targeted surveys. Eastern Snake-necked Turtles (*Chelodinia longicolllis*) were observed in a number of dams and moving between dams. Red-bellied Black-Snakes (*Pseudechis porphyriacus*) were observed near dams and this species is likely to hunt for frogs in these areas. Long-finned Eels (*Anguilla rhinehardtii*) and Mosquitofish (*Gambusia holbrooki*) were also observed in a number of dams.	
Threatened fauna species recorded	Blue-billed Duck (*Oxyura australis*) – TSC Act	Would forage in dams on occasion when birds are present in the locality. Highly unlikely to breed in the area.
Migratory fauna species recorded	Latham's Snipe (*Gallinago hardwickii*)	Would forage and may breed around margins of dams.
Introduced species recorded	Red Fox (*Vulpes vulpes*) Mosquitofish (*Gambusia holbrooki*)	

Dams

Typical farm dam in open paddock.

Larger farm dam adjacent to riparian forest.

Table 29 Fauna habitats of buildings and other structures

Buildings and other structures		
Description	A small number of sheds and buildings are present in the Stage 1 Construction Impact Zone. These provide roosting habitat for birds and microbats. Sheds and buildings are also likely to provide shelter for rodents and snakes. Roosting microbats were observed under the bridge over Badgerys Creek on Badgerys Creek Road.	
Typical fauna species recorded	Birds observed roosting in buildings and under bridges included Welcome Swallows (*Hirundo neoxena*) and Fairy Martins (*Petrochelidon ariel*). A Barn Owl (*Tyto javanica*) was heard one night, and may also roost in old buildings and sheds in the Stage 1 Construction Impact Zone. A number of bat species, small mammals and snakes may also utilise old buildings at the site.	
Threatened fauna species recorded	Southern Myotis (*Myotis macropus*) – TSC Act	Possible colony recorded under a bridge over Badgerys Creek. Likely to forage over open water and may also roost in tree hollows.
Introduced species recorded	House Mouse (*Mus musculus*)	

Roosting bats and swallow nests under Badgerys Creek Road bridge.

4.3.3 Connectivity

Wildlife corridors are vital for the maintenance of ecological processes, including the movement of animals and the continuation of viable populations. Corridors can consist of a sequence of stepping stones across the landscape (discontinuous areas of habitat such as paddock trees, wetlands and roadside vegetation), continuous lineal strips of vegetation and habitat (such as riparian strips, ridge lines etc.), or they may be parts of an extensive patch of vegetation (DEC 2004b).

Connectivity of vegetation in the Stage 1 Construction Impact Zone with vegetation outside the Stage 1 Construction Impact Zone is limited (see Figure 6). As is the case within the site, most vegetation in the locality occurs as small patches, with long linear patches of vegetation tending to occur along creek lines. The Badgerys Creek corridor is the main wildlife corridor in the area.

Most patches of native vegetation in the Stage 1 Construction Impact Zone were mapped by Ecological Australia (2012), who mapped riparian corridors and core stands of vegetation, as being linked, and thus having a patch size of greater than 100 hectares. There is only limited connectivity however with other patches of vegetation outside the Stage 1 Construction Impact Zone. Large expanses of cleared land occur along the northern edge of Elizabeth Drive and

Adam's Road. Small patches of vegetation to the south and west provide 'stepping stones' to other patches of vegetation outside the Stage 1 Construction Impact Zone.

Connectivity for fauna species is thus mainly between closely linked patches within the Stage 1 Construction Impact Zone, and along the Badgerys Creek Corridor outside the Stage 1 Construction Impact Zone. Species with only limited mobility, such as the Cumberland Plain Land Snail, have minimal opportunities for dispersal. The Cumberland Plain Land Snail would generally be restricted to isolated patches of vegetation in which the local population occurs, with no opportunity for movement between patches that are separated by grassland or cleared land. Small woodland birds would tend to move along the riparian corridors or along roadside vegetation to access other areas of habitat. More mobile fauna, such as Grey-headed Flying-foxes and larger birds would move easily between patches of vegetation in the Stage 1 Construction Impact Zone and other areas of habitat in the locality.

Habitat connectivity through and outside the Stage 1 Construction Impact Zone would be further reduced by development in coming years, including future airport development outside the Stage 1 Construction Impact Zone. The Western Sydney Priority Growth Area plan shows that the area to the east and south east of the Stage 1 Construction Impact Zone will be set aside for industrial / employment lands (DoP 2010). The Northern Road upgrade and realignment would comprise a barrier to fauna movement along the western boundary of the Stage 1 Construction Impact Zone. Likely future road and rail links to the airport would further fragment and isolate habitat. The Badgerys Creek riparian corridor is likely to continue to function as an important fauna movement corridor.

4.4 On site and downstream aquatic environments

The Stage 1 Construction Impact Zone is located in the upper reaches of the catchments of Badgerys, South and Oaky/Cosgrove Creeks, which flow northward from the site and drain to the Hawkesbury River, and Duncans Creek which flows westward and drains into the Nepean River. Badgerys and South Creeks converge approximately 4 kilometres downstream of the Stage 1 Construction Impact Zone, at the edge of the Twin Creeks Golf and Country Club. Cosgroves Creek subsequently converges with South Creek north of the Country Club.

Approximately 70 per cent of the total length of the mapped watercourses on the airport site are first and second order watercourses (GHD 2016b). Badgerys Creek (which is located outside the Stage 1 Construction Impact Zone) is fourth order for most of its length along the eastern boundary of the airport site. Downstream of the airport site, Badgerys and Cosgrove Creeks are 4th order watercourses, Oaky Creek is a 3rd order watercourse and Duncans Creek is a 5th order watercourse. The Strahler stream order of mapped watercourses on the airport site and downstream are displayed in Figure 4-12 of the *Western Sydney Airport Environmental Impact Statement; Surface Water Quality Assessment* (GHD 2016c). There are also numerous farm dams constructed along watercourses, accounting for around 16 per cent of the mapped watercourse length in the Stage 1 Construction Impact Zone.

The creeklines and tributaries in the Stage 1 Construction Impact Zone traverse partially cleared agricultural land. Riparian vegetation varies with the degree of previous clearing from near-intact Eucalypt forest (see vegetation description in Table 12 above), to derived *Melaleuca* or *Casuarina* scrub (see Table 13 above), to exotic grassland (see Table 21). The creek channels support occasional patches of native macrophytes along with noxious and environmental weeds.

Downstream of the Stage 1 Construction Impact Zone, Badgerys, Oakey, Cosgroves and Duncans Creeks also pass through predominantly cleared agricultural land. Remnant native vegetation within the downstream riparian corridors where present is composed of medium-poor to low condition River-flat Eucalypt Forest which extends up to ~20m from creek banks. As in

the Stage 1 Construction Impact Zone, the vegetation has been heavily modified following many decades of agricultural activity and development. Dense patches of native and exotic aquatic vegetation are present throughout the creek channels.

Both through and downstream of the Stage 1 Construction Impact Zone, Badgerys, Cosgroves and Duncans Creeks display evidence of past and ongoing bed degradation. This is evidenced through the presence of active headcuts and over-steepened eroding banks. As a result, despite often having a generally well-vegetated riparian zone, these watercourses are considered to be in moderate geomorphic condition (GHD 2016b). Tributaries of Badgerys and Cosgroves Creeks across the airport site are also considered to be in largely moderate geomorphic condition as a result of past clearing, the construction of online dams and ongoing agricultural activities (GHD 2016b).

Badgerys, Oaky, Cosgroves and Duncans Creeks are highly modified and in poor condition as a result of historical and current land use and disturbance. All of the affected reaches are small and ephemeral and largely intermittent. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats. Fish habitat is minimal at most sites and the habitats present are not suitable for threatened fish or invertebrate species (dragonflies) known or predicted to occur in the wider locality.

4.5 Conservation significance

4.5.1 Threatened ecological communities

Larger and better condition patches of Grey Box - Forest Red Gum grassy woodland on flats, Grey Box - Forest Red Gum grassy woodland on hills and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest in the Stage 1 Construction Impact Zone comprise occurrences of ‘Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest’ (Cumberland Plain Woodland). Cumberland Plain Woodland is listed as a critically endangered ecological community (CEEC) under the EPBC Act. EPBC Act Cumberland Plain Woodland was identified according to the criteria in the listing advice for the community (TSSC 2008) as a particular focus of the EIS and updated surveys as described in Section 3.3.2.

Patches of woodland in the Stage 1 Construction Impact Zone that comprise an occurrence of EPBC Act Cumberland Plain Woodland are shown on Figure 4. A patch is defined as a discrete and continuous area that comprises the ecological community. A patch may include small-scale disturbances such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community – for instance the easy movement of wildlife or dispersal of plant spores and seeds’ (DEWHA, 2010).

There are 145.2 hectares of EPBC Act Cumberland Plain Woodland in the Stage 1 Construction Impact Zone. The area of EPBC Act Cumberland Plain Woodland has increased from the 104.9 hectares that was mapped in the EIS (GHD 2016a) based on the results of the updated field survey and assessment completed in 2017. This change in area is mainly because some smaller patches of woodland with high canopy foliage cover that were mapped in a matrix of derived native grassland or scrub with minimal canopy foliage cover were mapped together as a single patch. The resultant larger patches of woodland have lower canopy foliage cover when averaged across the patch as a whole but still exceed 10 per cent cover and meet the standard of EPBC Act Cumberland Plain Woodland.

Patches of EPBC Act Cumberland Plain Woodland in the Stage 1 Construction Impact Zone include many ‘larger patches (>5 ha) which are inherently valuable due to their rarity’ as defined in the listing advice for the community (TSSC 2008) (see Figure 5). There are only very occasional ‘patches that have large mature trees (ie trees between 20 to 80 per cent of their life

expectancy) or trees with hollows (habitat) that are very scarce on the Cumberland Plain' (TSSC 2008).

Some patches of better condition woodland have native tree cover greater than 10 per cent but do not qualify as EPBC Act Cumberland Plain Woodland because they are less than 0.5 hectares in area and are isolated from other native vegetation (DEWHA 2010d). The area of these smaller patches was confirmed with GIS.

Derived native grassland and other moderate/good – poor condition vegetation in the Stage 1 Construction Impact Zone does not meet the condition criteria for a local occurrence of EPBC Act Cumberland Plain Woodland as defined in the listing advice for the community (TSSC 2008) and associated guidelines (DEWHA 2010d). This vegetation does not qualify because native tree species are not present with a minimum projected foliage cover of greater than 10 per cent (DEWHA 2010d). The low project foliage cover in these areas was confirmed through a combination of air photo interpretation, walked traverses and by directly sampling cover in a representative number of plot/transects and rapid plot/transects spread across the mapped extent of the associated vegetation zones (see Figure 4 and Appendix A).

Patches of moderate/good – medium condition woodland do not meet the condition criteria for EPBC Act Cumberland Plain Woodland because less than 50 per cent of the perennial understorey vegetation is composed of native plant species and/or because it is part of a patch that is less than five hecatres in area and less than 30 per cent of the perennial understorey vegetation is composed of native plant species (DEWHA 2010d). The low native ground cover in these areas was confirmed through a combination of walked traverses and direct sampling of cover in a representative number of plot/transects and rapid plot/transects spread across the mapped extent of the associated vegetation zones (see Figure 4 and Appendix A).

All of the native vegetation in the Stage 1 Construction Impact Zone, including derived native grasslands, comprise local occurrences of TECs listed under the TSC Act (see Figure 4) as follows:

- Both good and poor condition patches of Grey Box - Forest Red Gum grassy woodland on flats and Grey Box - Forest Red Gum grassy woodland on hills comprise the CEEC 'Cumberland Plain Woodland in the Sydney Basin Bioregion'.
- Both good and poor condition patches of Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest comprise the EEC 'Shale-Gravel Transition Forest in the Sydney Basin Bioregion'.
- Both good and poor condition patches of Forest Red Gum - Rough-barked Apple grassy woodland comprise the EEC 'River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions'.

Patches of good condition artificial freshwater wetlands on floodplains in the Stage 1 Construction Impact Zone feature predominantly native plant species but are associated with dams and flooded depressions that have been formed by the construction of barriers across small drainage lines. They are clearly not natural geomorphic features. They do not comprise a local occurrence of the TEC 'Freshwater wetlands on coastal floodplains' because artificial wetlands created on previously dry land for purposes such as sewerage treatment, stormwater management and farm production are not regarded as part of this community (DECC 2008e).

Exotic grassland, cropland and cleared land in the Stage 1 Construction Impact Zone occupy former habitat for the TECs described above but are dominated by exotic plants or bare earth. They could not regenerate into functional ecological communities, even with assisted natural regeneration and do not comprise part of the occurrences of these TECs.

No threatened ecological communities listed under the FM Act occur in the Stage 1 Construction Impact Zone or in adjoining or downstream areas.

4.5.2 Threatened flora species and populations

Threatened species recorded or likely to occur

A population of Spiked Rice Flower (*Pimelea spicata*) was recorded in March 2017 at five properties in the north-western portion of the Stage 1 Construction Impact Zone (see Figure 4). A total of 4,118 clumps of *Pimelea spicata* were recorded, including many flowering plants. *Pimelea spicata* is listed as an endangered species under the TSC and EPBC Acts. *Pimelea spicata* is a cryptic species that is very hard to detect when not flowering. A population at a site may consist only of underground tubers and the soil seed bank during droughts or because of excessive grazing or weed infestation. The species is known to grow rapidly and flower in response to fire and/or favourable rainfall. The recent heavy summer and autumn rainfall combined with the exclusion of grazing and slashing since the properties were vacated in 2015-2016 is likely to have contributed to the current abundance of the species. The observed clumps of *Pimelea spicata* are located within an area of 2.94 hectares of occupied habitat. The extent of occupied habitat was mapped using GIS as a 20 metre wide buffer around recorded clumps of *Pimelea spicata* where the buffer area contained areas of suitable grassland or grassy woodland habitat. The buffer area was modified to exclude clearly unsuitable habitat such as gravel tracks, water, fill or rubbish.

Four individuals of *Pultenaea parviflora* were recorded on the southern side of Longleys Road between Ferndale and Taylors Road by SMEC (2014) and these records were verified by GHD during the current field surveys (Figure 4B). *Pultenaea parviflora* is listed as a vulnerable species under the EPBC Act and an endangered species under the TSC Act. This is a significant reduction from the 68 individuals previously recorded along both sides of Longleys Road in this location in 1999 (Biosis 1999; SMEC 2014). The former locations of the 64 specimens currently contain cleared, ploughed cropland or severely weed infested road edges. Past management actions by previous tenants, which appear to have resulted in a decline of the former population, include clearing of native vegetation, ploughing, planting with exotic crops, harvesting of exotic crops, grading of Longleys Road, construction of road batters and table drains and slashing of the road corridor. This past management has resulted in transformation of the former area of occupied habitat for *P. parviflora* into bare earth and exotic grassland. These areas do not comprise occupied or potential habitat for this species (see photo in

Table 22).

Seed and cutting collections were made from this *Pultenaea parviflora* population by the Royal Botanic Gardens Trust on a number of occasions in 1990 and 1991, with the aim of testing propagation methods for the species and also ultimately replanting the species at the airport as part of landscaping works (RBGS 1992).

A population of *Dillwynia tenuifolia* was recorded in June 2017 at a property off Gardiner Road in the north-eastern portion of the airport site, within the Stage 1 Construction Impact Zone (see Figure 4D). *Dillwynia tenuifolia* is listed as a vulnerable species under the NSW TSC Act. It is not listed as a threatened species under the EPBC Act. One and a half days of dedicated, targeted survey effort for *Dillwynia tenuifolia* was conducted to define the extent of the population.

There are 294 individual *Dillwynia tenuifolia* at the airport site, including 11 individuals in the Stage 1 Construction Impact Zone. 283 individuals are located outside of the Stage 1 Construction Impact Zone, and of these 275 are located in the Environmental Conservation

Zone and eight individuals are located in the potential disturbance area for longer term development (i.e. land that is not in the Stage 1 Construction Impact Zone or the Environmental Conservation Zone).

Endangered populations recorded

A total of 145 stems of *Marsdenia viridiflora* subsp. *viridiflora* have been recorded in the Stage 1 Construction Impact Zone, with the majority recorded in Grey Box - Forest Red Gum grassy woodland on flats adjacent to Longleys Road and Anton Lane in the centre of the airport site (see Figure 4). These comprise part of the endangered *Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas listed under the TSC Act.

Dillwynia tenuifolia is listed at Kemps Creek as an endangered population. The Kemps Creek endangered population is located around three kilometres to the east of the Stage 1 Construction Impact Zone in an area bound by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek. *Dillwynia tenuifolia* individuals or habitat in the Stage 1 Construction Impact Zone are not part of this endangered population.

No other threatened flora species or populations listed under the TSC Act have been recorded in the Stage 1 Construction Impact Zone.

Threatened species or populations with a moderate likelihood of occurrence

No other threatened flora species listed under the EPBC Act have been recorded in the Stage 1 Construction Impact Zone. There is potential habitat for up to four threatened flora species listed under the EPBC Act: Downy Wattle (*Acacia pubescens*); White-flowered Wax Plant (*Cynanchum elegans*); Small-flowered Grevillea (*Grevillea parviflora* subsp. *parviflora*) and Austral Toadflax (*Thesium australe)*.

There is potential habitat in the Stage 1 Construction Impact Zone for at least one additional threatened plant species listed under the TSC Act: *Grevillea juniperina* subsp*. juniperina*.

Threatened species not likely to occur

The remainder of the threatened flora species previously recorded or predicted to occur in the locality would not occur because the Stage 1 Construction Impact Zone is outside of their known distribution and/or does not contain suitable habitat (Appendix A). The Stage 1 Construction Impact Zone does not contain any sandstone outcrops or sandstone-derived soils, shale-sandstone transition soils, or deep Tertiary alluvial deposits and does not contain any threatened plant species that have habitat requirements specific to these soil types. These threatened flora species would not occur in the Stage 1 Construction Impact Zone and would not be impacted by the airport.

A summary of flora species recorded or with at least a moderate likelihood of occurrence in the Stage 1 Construction Impact Zone is provided in Table 30.

Table 30 Threatened flora recorded or that may occur in the Stage 1 Construction Impact Zone

Species	Common Name	EPBC Act Status	TSC Act Status	Likelihood of occurrence
Pultenaea parviflora		V	E	Present
Marsdenia viridiflora subsp. *viridiflora*			EP	Present
Cynanchum elegans	White-flowered Wax Plant	E	E	Possible
Pimelea spicata	Spiked Rice-flower	E	E	Present
Acacia pubescens	Downy Wattle	E	V	Possible
Grevillea parviflora subsp. *parviflora*	Small-flower Grevillea	V	V	Possible
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea		V	Possible
Thesium australe	Austral Toadflax	V	V	Possible
Dillwynia tenuifolia			V	Present

Key: E – endangered species; EP – endangered population; V – vulnerable species

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LEX-21979

ADAMS ROAD

THE NORTHERN ROAD

DWYER ROAD

Note: point labels indicate number of threatened plants at the point location

LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)
- *Dillwynia tenuifolia* (vulnerable species under the TSC Act)
- *Pimelea spicata*) (endangered species under the TSC Act and EPBC Act)

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)
- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)

- Plot/transect
- Rapid plot/transect

Note: point labels indicate plot ID

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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GHD

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Revision	A
Date	28 Aug 2017

Threatened flora and ecological communities

Figure 4A

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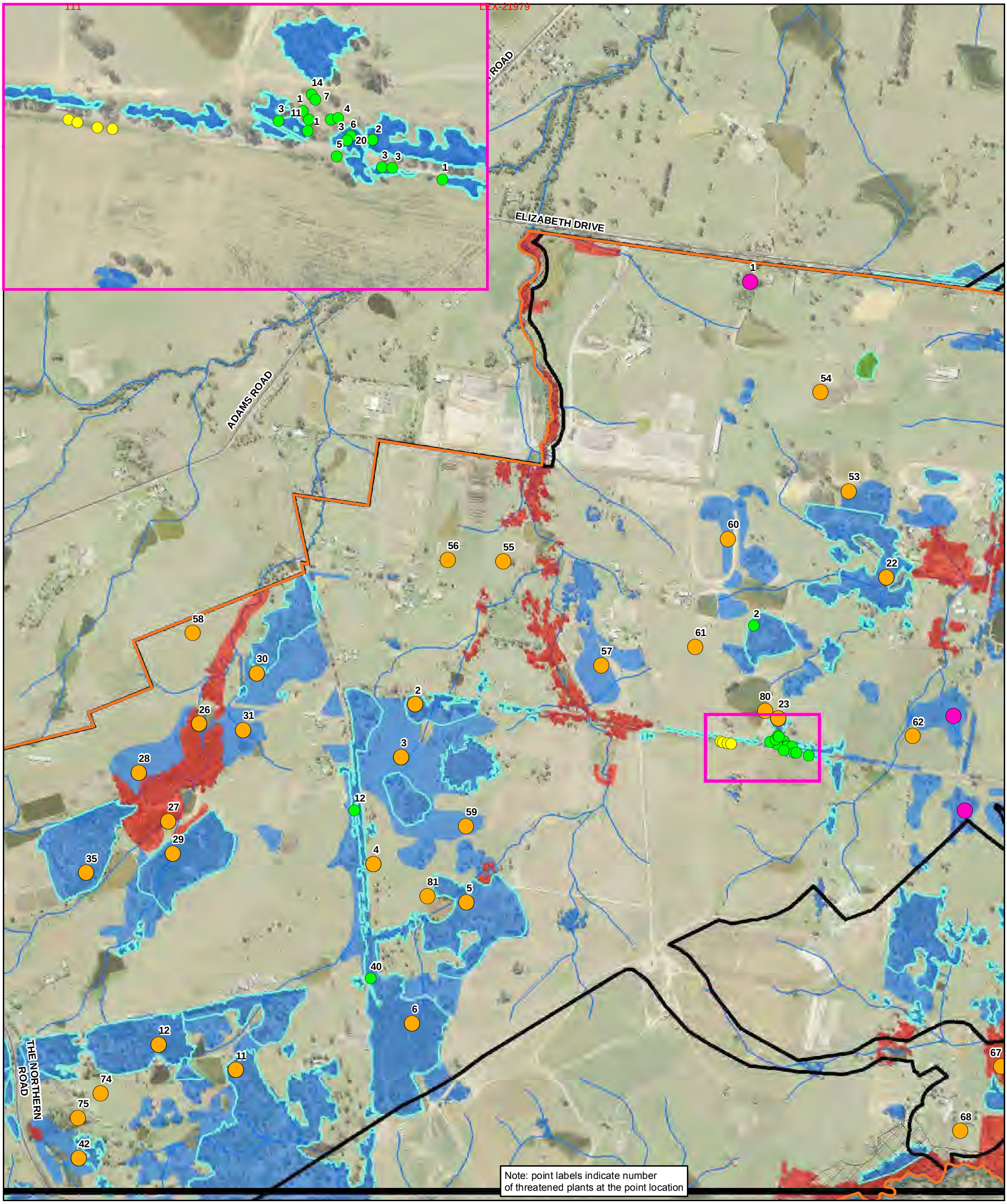
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller



LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)
- *Dillwynia tenuifolia* (vulnerable species under the TSC Act)
- *Pimelea spicata*) (endangered species under the TSC Act and EPBC Act)

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)
- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)

- Plot/transect
- Rapid plot/transect

Note: point labels indicate plot ID

Paper Size A3
0 100 200 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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Threatened flora and ecological communities

Figure 4B

G:\21\26204\GIS\Maps\Deliverables\21_26204_Z004_Threatened_Flora_SMA.mxd (SMA record: 2)
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

112
35
29
4
LEX-21979
81
5
40
6
12
11
74
75
42
68
THE NORTHERN ROAD
BADGERYS CREEK ROAD
DWYER ROAD
Note: point labels indicate number of threatened plants at the point location

LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)
- *Dillwynia tenuifolia* (vulnerable species under the TSC Act)
- *Pimelea spicata*) (endangered species under the TSC Act and EPBC Act)

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)
- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)

- Plot/transect
- Rapid plot/transect

Note: point labels indicate plot ID

Paper Size A3
0 100 200 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

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Revision	A
Date	28 Aug 2017

Threatened flora and ecological communities

Figure 4C

G:\21\26204\GIS\Maps\Deliverables\21_26204_Z004_Threatened_Flora_SMA.mxd (SMA record: 3)
Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

113

LEX-21979

ELIZABETH DRIVE

BADGERYS CREEK ROAD

Note: point labels indicate number of threatened plants at the point location

LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses

- *Pultenaea parviflora* (endangered species under the EPBC Act and TSC Act)
- *Marsdenia viridiflora* subsp. *viridiflora* (endangered population under the TSC Act)
- *Dillwynia tenuifolia* (vulnerable species under the TSC Act)
- *Pimelea spicata*) (endangered species under the TSC Act and EPBC Act)

- Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CEEC under EPBC Act and TSC Act)
- Cumberland Plain Woodland (CEEC under the TSC Act)
- River Flat Eucalypt Forest (EEC under the TSC Act)
- Shale/gravel Transition Forest (EEC under the TSC Act)

- Plot/transect
- Rapid plot/transect

Note: point labels indicate plot ID

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	28 Aug 2017

Threatened flora and ecological communities

Figure 4D

G:\21\26204\GIS\Maps\Deliverables\21_26204_Z004_Threatened_Flora_SMA.mxd (SMA record: 4)

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

LEGEND

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Roads
- Watercourses
- *Pimelea spicata* (endangered species under the TSC Act and EPBC Act)
- Occupied *Pimelea spicata* habitat

Paper Size A3

0 20 40 80 Meters

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number	21-26204
Revision	A
Date	28 Aug 2017

Threatened flora and ecological communities

Figure 4E

G:\21\26204\GIS\Maps\Working\21_26204_Pimelea_Spicata_population.mxd

Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

4.5.3 Threatened fauna species

Threatened species recorded or likely to occur

One threatened fauna species listed under the EPBC Act was recorded at the airport site during the recent surveys: the Grey-headed Flying-fox (*Pteropus poliocephalus*). This species is listed as a vulnerable species under the EPBC Act and under the TSC Act. The Grey-headed Flying-fox was also recorded at the airport site during previous surveys for the 1999 EIS (PPK 1999). There are no Grey-headed Flying-fox camps located at the airport site, although there are at least seven known camps within 20 kilometres.

All native woodland and forest in the Stage 1 Construction Impact Zone provides foraging habitat for the Grey-headed Flying-fox. Dominant canopy species include Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus mollucana*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*). Forest Red Gum and Grey Box are recognised as 'significant species' in the blossom diet of the Grey-headed Flying-fox (Eby and Law 2008) however none of these species are highly productive flowering species. Forest Red Gum scores in the upper quartile of all diet plants for the region for productivity and reliability of flowering (0.67, where a score of 1 is highly productive and highly reliable). This species flowers in late winter and spring, partly during the 'food bottleneck'. Grey Box has low productivity and reliability (0.35). It flowers in late summer and early autumn. Broad-leaved Ironbark has high productivity bu t is an unreliable flowerer (0.54) (Eby and Law 2008). This species flowers in summer and early autumn, providing forage habitat during the Grey-headed Flying-fox breeding period. Habitat at the airport site is thus somewhat productive during food bottlenecks, and may be habitat critical to the survival of the Grey-headed Flying-fox, as defined in the draft recovery plan (DECCW 2009).

The Swift Parrot (*Lathamus discolor*) may occur in the Stage 1 Construction Impact Zone on occasion during its winter migration, but was not detected during targeted surveys. This species is listed as a critically endangered species under the EPBC Act and an endangered species under the TSC Act.

There are eight local records of the Swift Parrot. There are scattered records of this species across the Cumberland Plain, but limited evidence of any concentration of records at any locations (OEH 2015a). In addition, there are very few records of the species in south-western Sydney. There are no previous records (last 30 years) from within the airport site or immediate surrounds. GHD obtained atlas records from both OEH and BirdLife Australia. A broad-scale habitat map prepared for the Greater Southern Sydney Region (DECC 2007) identifies the largest area of habitat for the Swift Parrot within the Burragorang Valley (approximately 30 kilometres to the southwest of the Stage 1 Construction Impact Zone), with smaller patches around Glenmore, west of Liverpool, and around Wedderburn.

Targeted surveys were conducted in the Stage 1 Construction Impact Zone for this species following confirmation of its arrival in Western Sydney in May 2015. Eucalypts had started to flower prior to a second survey in June 2015. Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Grey Box and Red Bloodwood (*Corymbia gummifera*) are important nectar sources in coastal parts of the non-breeding range. Commonly used lerp infested trees include Inland Grey Box (*Eucalyptus microcarpa)*, Grey Box (*Eucalyptus moluccana)* and Blackbutt (*Eucalyptus pilularis)*. Forest Red Gum is a food tree in coastal areas, including the Sydney Metro and Hawkesbury-Nepean areas (Saunders and Tzaros 2011). The occurrence of Swift Parrots at foraging sites has been linked with the abundance of lerp, nectar and non-aggressive competitors (Swift Parrot Recovery Team 2001). Swift Parrots have been found to preferentially forage in large, mature trees that provide more reliable foraging resources than younger trees (Saunders and Tzaros 2011).

Dominant canopy species in the airport site include Grey Box and Forest Red Gum which would provide nectar and lerp resources. Much of the Stage 1 Construction Impact Zone is vegetated with relatively young regrowth which reduces habitat quality, although patches containing large, old-growth trees are also present. A range of aggressive competitors such as the Noisy Miner (*Manorina melanocephala*) and the Bell Miner (*Manorina melanophrys*) are common in the Stage 1 Construction Impact Zone, potentially further reducing habitat suitability for the Swift Parrot.

The Stage 1 Construction Impact Zone would not provide core winter foraging resources for the Swift Parrot given the presence of mostly young regrowth and aggressive competitors, and the lack of evidence of any records at or near the site for the last 30 years. The Stage 1 Construction Impact Zone may provide shelter or supplementary foraging resources for migrating individuals.

Twelve threatened fauna species listed under the TSC Act were positively recorded during recent and previous surveys:

- Cumberland Plain Land Snail (*Meridolum corneovirens*), listed as an endangered species.
  - Habitat for the Cumberland Plain Land Snail occurs in larger patches with remnant trees. Live snails and shells of this species were recorded at a variety of locations (see Figure 5) where moist, deep leaf litter was present. In general, this species was recorded at locations where it had previously been recorded for the 1999 EIS, as well as some additional locations. In some locations, including some where the species had previously been recorded, appropriate potential habitat with good leaf litter was present but no individuals were found. Locations that were searched but where no individuals were recorded are also mapped on Figure 5. Lack of evidence of the species at these locations may have been as a result of individuals burrowing deep into the soil and not being found, or previous local extinction of a population. This species was not detected where leaf litter was shallow, woodland patches were small and remnant trees were absent. It is likely that in isolated patches of regrowth woodland, the species has not been able to recolonise due to distance between patches and inhospitable habitat (ie cleared land). The native Common Southern Carnivorous Snail (*Austrorhytida capillacea*) was also found in woodland patches in deep leaf litter. The introduced Garden Snail (*Cantareus aspersa*) was recorded at a number of locations, generally in the open, or in grassy areas, and the Asian Tramp Snail (*Bradybaena similaris*) was recorded in a weedy area near Elizabeth Drive.
- Little Eagle (*Hieraaetus morphnoides*), listed as a vulnerable species.
  - Little Eagles were observed on a number of occasions soaring above open grassland in the Stage 1 Construction Impact Zone. The Little Eagle would prey upon small to medium sized mammals such as rodents and rabbits that occur at the site. It is likely that the Stage 1 Construction Impact Zone forms part of the home range of a number of breeding pairs. The species may use tall trees to nest in, although no raptor nests were observed during surveys.
- White-bellied Sea-eagle (*Haliaeetus leucogaster*), listed as a vulnerable species (listed on the TSC Act in December 2016).
  - White-bellied Sea-eagles were observed at a number of locations in the Stage 1 Construction Impact Zone soaring above grasslands or large water bodies. An individual was observed roosting in a stag adjacent to a large dam near Longleys Road, however no nests were observed.
- Little Lorikeet (*Glossopsitta pusilla*), listed as a vulnerable species.

  - A pair of Little Lorikeets was observed flying over the western portion of the airport site. Individuals within a regional population of this nomadic species are likely to forage in the Stage 1 Construction Impact Zone when eucalypts are in flower. While hollow-bearing trees are present in some locations, the species is unlikely to breed in the Stage 1 Construction Impact Zone given the level of fragmentation.
- Dusky Woodswallow (*Artamus cyanopterus*), listed as a vulnerable species (listed on the TSC Act in August 2016).
  - Groups of Dusky Woodswallows were observed at a number of locations across the Stage 1 Construction Impact Zone foraging above open woodland and grassland.
- Scarlet Robin (*Petroica boodang*), listed as a vulnerable species.
  - One Scarlet Robin was recorded foraging with a mixed bird species group in River-flat Eucalypt Forest near Badgerys Creek and may also occur in larger patches of Cumberland Plain Woodland in the Stage 1 Construction Impact Zone. The Scarlet Robin may breed and forage in larger woodland patches in the Stage 1 Construction Impact Zone, although it tends to breed in woodland on foothills and ridges, moving to lower more open habitats in winter (OEH 2015b).
- Varied Sittella (*Daphoenositta chrysoptera*), listed as a vulnerable species.
  - About three or so individuals were recorded foraging with a mixed bird species group in River-flat Eucalypt Forest near Badgerys Creek and this species may also occur in larger patches of Cumberland Plain Woodland in the Stage 1 Construction Impact Zone. It is likely to breed and forage in larger woodland patches at the airport site.
- Black Bittern (*Ixobrychus flavicollis*), listed as a vulnerable species.
  - A Black Bittern was observed in the northern section of Badgerys Creek. This species may breed and forage in the riparian corridor and at dams in the Stage 1 Construction Impact Zone where there is good cover of aquatic plants.
- Blue-billed Duck (*Oxyura australis*), listed as a vulnerable species.
  - Three individuals were observed on the large, deep constructed dam on Taylors Road. This species is unlikely to rely on habitats present in the Stage 1 Construction Impact Zone. It only rarely occurs in coastal areas as a vagrant generally during times of drought and breeding occurs in swamps in inland NSW.
- East Coast Freetail Bat (*Mormopterus norfolkensis*), listed as a vulnerable species.
  - The East Coast Freetail Bat was recorded at many locations in the Stage 1 Construction Impact Zone, and was often the most common bat species recorded. It may roost and breed in hollow-bearing trees in the Stage 1 Construction Impact Zone. It would forage in woodland and open areas in the Stage 1 Construction Impact Zone.
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), listed as a vulnerable species.
  - The Eastern False Pipistrelle was recorded during the surveys for the 1999 EIS. Possible calls of the species were recorded during recent surveys. The Eastern False Pipistrelle prefers large tracts of vegetation, and would mainly occur along the Badgerys Creek riparian corridor and nearby large patches of vegetation.
- Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*), listed as a vulnerable species.
  - This species was recorded during the surveys for the 1999 EIS. Possible calls of the species were recorded during recent surveys. No breeding habitat for this species is present in the Stage 1 Construction Impact Zone, although it may roost in buildings in

the Stage 1 Construction Impact Zone. This species forages in cleared and wooded areas, and could therefore forage throughout the Stage 1 Construction Impact Zone.

One additional microchiropteran bat species was probably recorded in the Stage 1 Construction Impact Zone during the surveys above based on echolocation call analysis:

- Southern Myotis (*Myotis macropus*), listed as a vulnerable species.
  - Probable calls of the Southern Myotis were recorded at a number of locations in the Stage 1 Construction Impact Zone. Calls were considered to be most likely the Southern Myotis given habitat preferences and local records. However due to the lack of local reference calls and known overlap with *Nyctophilus* species, a definitive identification from analysis of echolocation call recordings could not be made. A small colony of bats was recorded roosting under the bridge over Badgerys Creek (outside the Stage 1 Construction Impact Zone). A large number of calls probably attributable to the Southern Myotis were also recorded at this location and so for the purposes of this assessment it is assumed that this was a roosting colony of the species. Farm dams and creeks would provide foraging habitat for this species. It may roost in tree hollows and in old buildings in the Stage 1 Construction Impact Zone.

Two additional threatened bat species were possibly recorded in the Stage 1 Construction Impact Zone during the recent surveys based on echolocation call analysis. Poor data quality and/or interspecific call similarities precluded definitive identification of these species:

- Greater Broad-nosed Bat (*Scoteanax rueppellii*), listed as a vulnerable species; and
- Eastern Cave Bat (*Vespadelus troughtoni*), listed as a vulnerable species. The calls of three different Vespadelus species are very similar, and could not be distinguished to confirm the presence of this species. The Stage 1 Construction Impact Zone is near the limit of this species' distribution. It is known to occur in the Blue Mountains area.

A number of other threatened fauna species listed under the TSC Act are likely to occur in the Stage 1 Construction Impact Zone, based on a combination of recent records in the locality and the presence of potential habitat. The Stage 1 Construction Impact Zone contains areas of habitat in moderate to good condition for each of these species and is likely to support viable local populations or would provide foraging habitat for transient species. Species likely to occur include:

- Small woodland birds: Potential foraging and breeding habitat for a range of woodland birds previously recorded in the locality is present in the Stage 1 Construction Impact Zone. These include the Flame Robin (*Petroica phoenicea*) and Diamond Firetail (*Stagonopleura guttata*).
- Hollow-dependent birds: Potential foraging and breeding habitat for a range of woodland birds previously recorded in the locality is present in the Stage 1 Construction Impact Zone. These include the Gang-gang Cockatoo (*Callocephalon fimbriatum*), Powerful Owl (*Ninox strenua*) and Masked Owl (*Tyto novaehollandiae*).

Notwithstanding the generally moderate condition of fauna habitat in the Stage 1 Construction Impact Zone, it has high conservation significance as a result of the presence of threatened species described above and the generally limited extent and quality of similar habitat in the Western Sydney region.

No threatened aquatic fauna species listed under the EPBC Act or the FM Act were recorded in the Stage 1 Construction Impact Zone or in upstream or downstream habitats and none are likely to occur given known distributions and the absence of suitable habitat (see below).

A summary of threatened fauna species recorded or that may occur in the Stage 1 Construction Impact Zone is provided in Table 31.

Table 31 Threatened fauna recorded or that may occur in the Stage 1 Construction Impact Zone

Species	Scientific name	EPBC Act Status	TSC Act Status	Likelihood of occurrence	Credit type[1]
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Recorded outside the Stage 1 Construction Impact Zone	Ecosystem[2]
Cumberland Plain Land Snail	Meridolum corneovirens		E	Present	Species
Little Eagle	*Hieraaetus morphnoides*		V	Present	Ecosystem
Little Lorikeet	*Glossopsitta pusilla*		V	Present	Ecosystem
Scarlet Robin	*Petroica boodang*		V	Present	Ecosystem
Varied Sittella	*Daphoenositta chrysoptera*		V	Present	Ecosystem
Black Bittern	*Ixobrychus flavicollis*		V	Recorded outside the Stage 1 Construction Impact Zone	Species
Blue-billed Duck	*Oxyura australis*		V	Present	Ecosystem
East Coast Freetail Bat	Mormopterus norfolkensis		V	Present	Ecosystem
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*		V	Present	Ecosystem
Eastern Bentwing Bat	*Miniopterus schreibersii oceanensis*		V	Present	Ecosystem[2]
Dusky Woodswallow	*Artamus cyanopterus*		V	Present	Ecosystem
White-bellied Sea-eagle	*Haliaeetus leucogaster*		V	Present	Ecosystem[2]
Southern Myotis	*Myotis macropus*		V	Probably recorded (anabat)	Species[3] (roosting habitat)
Greater Broad-nosed Bat	*Scoteanax rueppellii*		V	Possibly recorded (anabat)	Ecosystem[2]
Eastern Cave Bat	*Vespadelus troughtoni*		V	Possibly recorded (anabat)	Ecosystem[2]
Yellow-bellied Sheath-tail Bat	*Saccolaimus flaviventris*		V	Possible	Ecosystem
Swift Parrot	*Lathamus discolor*	CE	E	Likely	Ecosystem
Powerful Owl	*Ninox strenua*		V	Likely	Ecosystem
Masked Owl	*Tyto novaehollandiae*		V	Likely	Ecosystem
Flame Robin	*Petroica phoenicea*		V	Likely	Ecosystem
Hooded Robin	*Melanodryas cucullata*		V	Possible	Ecosystem
Diamond Firetail	*Stagonopleura guttata*		V	Likely	Ecosystem
Speckled Warbler	*Pyrrholaemus sagittatus*		V	Possible	Ecosystem
Black-chinned Honeyeater	*Melithreptus gularis*		V	Possible	Ecosystem

Species	Scientific name	EPBC Act Status	TSC Act Status	Likelihood of occurrence	Credit type[1]
Gang-gang Cockatoo	*Callocephalon fimbriatum*		V	Possible	Ecosystem
Glossy Black-cockatoo	*Calyptorhynchus lathami*		V	Possible	Ecosystem
Barking Owl	*Ninox connivens*		V	Possible	Ecosystem
Square-tailed Kite	*Lophoictinia isura*		V	Possible	Ecosystem
Australian Painted Snipe	*Rostratula australis*	E	E	Possible	Ecosystem
Australasian Bittern	*Botaurus poiciloptilus*	E	E	Possible	Ecosystem
Freckled Duck	*Stictonetta naevosa*		V	Possible	Ecosystem

Notes: CE – critically endangered; E – endangered species; V – vulnerable species; 1) Ecosystem or species credit type species as defined by the TSPD (OEH, 2017); 2) The particular habitat component linked to species credits is not present at the Stage 1 Construction Impact Zone and so it is assessed as an ecosystem credit type species; 3) The particular habitat component linked to species credits is present at the Stage 1 Construction Impact Zone.

Threatened species with a low likelihood of occurrence

A number of species listed under the EPBC Act identified through the desktop review have a low likelihood of occurrence in the Stage 1 Construction Impact Zone based on low habitat suitability, lack of nearby records or lack of previous records (see Appendix A). In particular, two species identified in the *Guidelines for the Content of a Draft Environmental Impact Statement – Western Sydney Airport* (DoE 2015f) as potentially being significantly impacted by the airport (the Large-eared Pied Bat and Green and Golden Bell Frog) have a low likelihood of occurrence in the Stage 1 Construction Impact Zone and are therefore unlikely to be significantly impacted by the airport. In addition, the Australian Painted Snipe, Australasian Bittern and the Koala were assessed as having a low likelihood of occurrence given the habitats present and lack of records or low numbers of records in the locality (see Appendix A). These species are discussed below.

In NSW, the Large-eared Pied Bat (*Chalinolobus dwyeri*) is widely distributed, but uncommon, in the sandstone areas of the Sydney Basin. Most records in the Sydney Basin occur in the Greater Blue Mountains area, including in the Blue Mountains and Wollemi National Parks (DECC 2007).

Habitat critical to the survival of the Large-eared Pied Bat noted in the Recovery Plan (DERM 2011) includes sandstone cliffs for roosting and proximate fertile wooded valley habitat for foraging (DECC 2007). This species is dependent on roosts, including sandstone caves and overhangs, used for diurnal and nocturnal shelter (when not feeding) and for rearing young (DERM 2011). It appears to forage in nearby fertile valleys and plains and along watercourses rather than sandstone landscapes and nearly all records are within several kilometres of cliff lines or rocky terrain (DERM 2011).

Large expanses of suitable habitat for this species are present in the Blue Mountains National Park to the west of the Stage 1 Construction Impact Zone and at Bents Basin State Conservation Area to the south-west. No breeding colonies are known from these areas. The closest record of a lactating female and/or indication of a maternity roost for the species has been recorded near Ulan in NSW a few hundred kilometres to the north of the Stage 1 Construction Impact Zone (Fly By Night 2005).

Predictive habitat modelling in the Greater Southern Sydney region highlighted vegetation remnants on the Cumberland Plain, including in the vicinity of the Stage 1 Construction Impact

Zone, as moderate quality foraging habitat for the Large-eared Pied Bat (DECC 2007). However, it is noted that many remnants may not be used if the distance from suitable roosting habitat is too far, or if remnants have become too isolated as a result of clearing (DECC 2007), which is likely to be the case in the Stage 1 Construction Impact Zone. The Large-eared Pied Bat has been recorded in transitional forests at a few locations on the edge of the Cumberland Plain, including near Oakdale, Douglas Park and Bargo (DECC 2007). These records are near extensive tracts of vegetation in reserves and/or along larger watercourses and are over 30 kilometres from the Stage 1 Construction Impact Zone. More local records include at Bents Basin State Conservation Area to the south-west of the airport site where the Nepean River flows through extensively vegetated sandstone gorge country.

The Large-eared Pied Bat has not been recorded in the Stage 1 Construction Impact Zone during either the recent or previous surveys but could conceivably occur on occasion. The Stage 1 Construction Impact Zone is not considered to comprise habitat critical for the survival of the Large-eared Pied Bat given it does not contain sandstone cliffs required for roosting and is not located in close proximity to sandstone escarpment country. The small, scattered patches of remnant vegetation in the Stage 1 Construction Impact Zone and the extensive areas of cleared agricultural land and urban development between areas of known sandstone habitat, including Bents Basin State Conservation Area and the Blue Mountains National Park and the Stage 1 Construction Impact Zone, make it unlikely that a local population of this species would occur or be dependent on the site.

No Green and Golden Bell Frogs (*Litoria aurea*) were recorded during the targeted surveys carried out in March 2015, despite the presence of suitable habitat in the Stage 1 Construction Impact Zone. Similarly, none were recorded during the surveys conducted for the EIS in October 1998 (Lemckert 1999) and there are no other previous records of this species in the Stage 1 Construction Impact Zone (OEH 2015a). Numerous farm dams are present and many of these appear to provide good quality potential habitat, with a range of emergent flora species, including *Typha orientalis*, *Eleocharis cylindrostachys*, and *Eleocharis sphacelata*. Surrounding grassland would provide basking sites for frogs if present. Mosquitofish (*Gambusia holbrooki*) were observed at many of the dams, potentially reducing habitat quality for this species.

Targeted surveys for the Green and Golden Bell Frog were conducted at a reference site at Homebush Bay in unison with the surveys in the Stage 1 Construction Impact Zone. Targeted surveys had been conducted at the Homebush Bay reference site earlier in 2015 but concluded at the end of February. Green and Golden Bell Frogs had not been heard calling at Homebush Bay through March 2015 after a surge in activity with the stormy weather of January/February 2015. Through March there were a large number of juvenile Green and Golden Bell Frogs dispersing from a breeding event in early summer and tadpoles from a late January breeding event (O'Meara, J. Sydney Olympic Park Authority, pers. comm.). Several juvenile Green and Golden Bell Frogs and a mature adult were observed on two out of three nights that surveys were conducted at the reference site (Harrington, J. Sydney Olympic Park Authority, pers. comm.).

Large numbers of nine other species of frogs were recorded during the most recent surveys in the Stage 1 Construction Impact Zone, showing that frogs in general were active at this time and suggesting that if Green and Golden Bell Frogs were present, they would have been recorded. As described above and in Section 3.4.3, targeted surveys were conducted late in the 2014-15 breeding season and no frogs were calling at the reference site which may have reduced the chances of detecting the species. However given the observed Green and Golden Bell Frog activity at the reference site and the number of individuals of other frog species recorded in the Stage 1 Construction Impact Zone, it is likely that this relatively conspicuous species would have been detected if present. It is likely that the Green and Golden Bell Frog does not occur in the Stage 1 Construction Impact Zone. According to Lemckert (1999) this is a

typical situation for this species, as it appears to have become extinct through most of its range, despite the presence of apparently excellent habitat. Many populations in western Sydney have become extinct over recent decades. According to White and Pyke (2008), formerly known populations at Liverpool, Merrylands, Milperra, and Mount Druitt, also in western Sydney, are extinct or probably extinct.

The Australian Painted Snipe (*Rostratula australis*) may occur on rare occasions at wetlands and nearby flooded grassland in the Stage 1 Construction Impact Zone. This species is most common in eastern Australia, although most records in NSW are from the Murray-Darling Basin (DoE 2015b). The Australian Painted Snipe inhabits many different types of shallow, brackish or freshwater terrestrial wetlands, especially temporary ones which have muddy margins and small, low-lying islands (Birdlife Australia 2015). There are no local records of this species, and none were recorded during surveys, however the species is cryptic and could potentially occur but not be detected.

The Australasian Bittern (*Botaurus poiciloptilus*) may also occur on rare occasions at wetlands in the Stage 1 Construction Impact Zone. The species' preferred habitat comprises wetlands with tall dense vegetation, particularly those dominated by sedges, rushes and reeds (DoE 2011). There are no local records of this species, and none were recorded during surveys, however the species is cryptic and could potentially occur but not be detected.

The Koala was also identified as having a low likelihood of occurrence in the Stage 1 Construction Impact Zone despite the presence of primary food tree species (DECC 2008c) (see Appendix A). There are few records of the Koala in the locality. It has been recorded to the west in the Blue Mountains National Park, and to the east in the Western Sydney Parklands area, however there is minimal connectivity between these areas and the Stage 1 Construction Impact Zone. No Koalas have been observed in the Stage 1 Construction Impact Zone, and no scats were recorded during targeted searches.

The vegetation in the Stage 1 Construction Impact Zone has been assessed to determine if it comprises 'habitat critical to the survival of the Koala' as defined in the referral guidelines for the species (DoE 2014). In accordance with the guidelines, an attribute score of five or over indicates habitat critical to the survival of the Koala. The assessment of Koala habitat in the Stage 1 Construction Impact Zone is summarised in Table 32. The outcome of this assessment (a total attribute score of 2) is that potential Koala habitat in the Stage 1 Construction Impact Zone is not habitat critical to the survival of the species.

Table 32 Assessment of Koala habitat in the Stage 1 Construction Impact Zone

Attribute	Score	Habitat appraisal	
Koala occurrence	+0	Desktop	EPBC PMST report identified the koala as 'known to occur' in the locality. There are no records of Koalas within 2 km of the Stage 1 Construction Impact Zone from the last 5 years (OEH 2015b). No evidence of the species was noted during previous surveys (Biosis 1999).
		On-ground	No Koala scats or Koalas were recorded during diurnal habitat searches or nocturnal spotlighting surveys.
Vegetation structure and composition	+2	Native vegetation in the Stage 1 Construction Impact Zone contains *Eucalyptus tereticornis* (a primary feed tree) and *Eucalyptus moluccana* (a secondary feed tree).	
Habitat connectivity	0	Native woodland in the Stage 1 Construction Impact Zone is patchy with minimal connectivity both in the Stage 1 Construction Impact Zone and the surrounding locality.	
Key existing threats	0	Three 80 km/hr roads are located in the Stage 1 Construction Impact Zone. Many domestic dogs were observed in the Stage 1 Construction Impact Zone and feral dogs are also likely to occur.	
Recovery value	0	Vegetation in the Stage 1 Construction Impact Zone is unlikely to be important for achieving recovery objectives given the lack of connectivity and presence of existing threats.	
Total	2	Decision: The total habitat score in the Stage 1 Construction Impact Zone is 2 and therefore the habitat present does constitute habitat critical to the survival of the Koala.	

Threatened species not likely to occur

The remainder of the terrestrial threatened fauna species previously recorded or predicted to occur in the locality would not occur due to a lack of suitable habitat, and/or a lack of local records (see Appendix A). These species would not occur in the Stage 1 Construction Impact Zone and would not be impacted by the airport.

The Giant Burrowing Frog (*Heleioporus australiacus*) was identified in the assessment process notice following determination of the airport as a controlled action, as potentially being significantly impacted by the airport (DoE 2015c). This species has a strong habitat association with sandstone geology, especially the Hawkesbury Sandstone plateaux surrounding Sydney, where it occurs on sandy soils supporting heath, woodland or open forest (Stauber 2006). It does not occur on the Shale and alluvium substrates of the Cumberland Plain and would not occur in the Stage 1 Construction Impact Zone. The conservation advice for the Giant Burrowing Frog does not include Cumberland Plain Woodland as a vegetation type in which the species occurs (DoE 2014d).

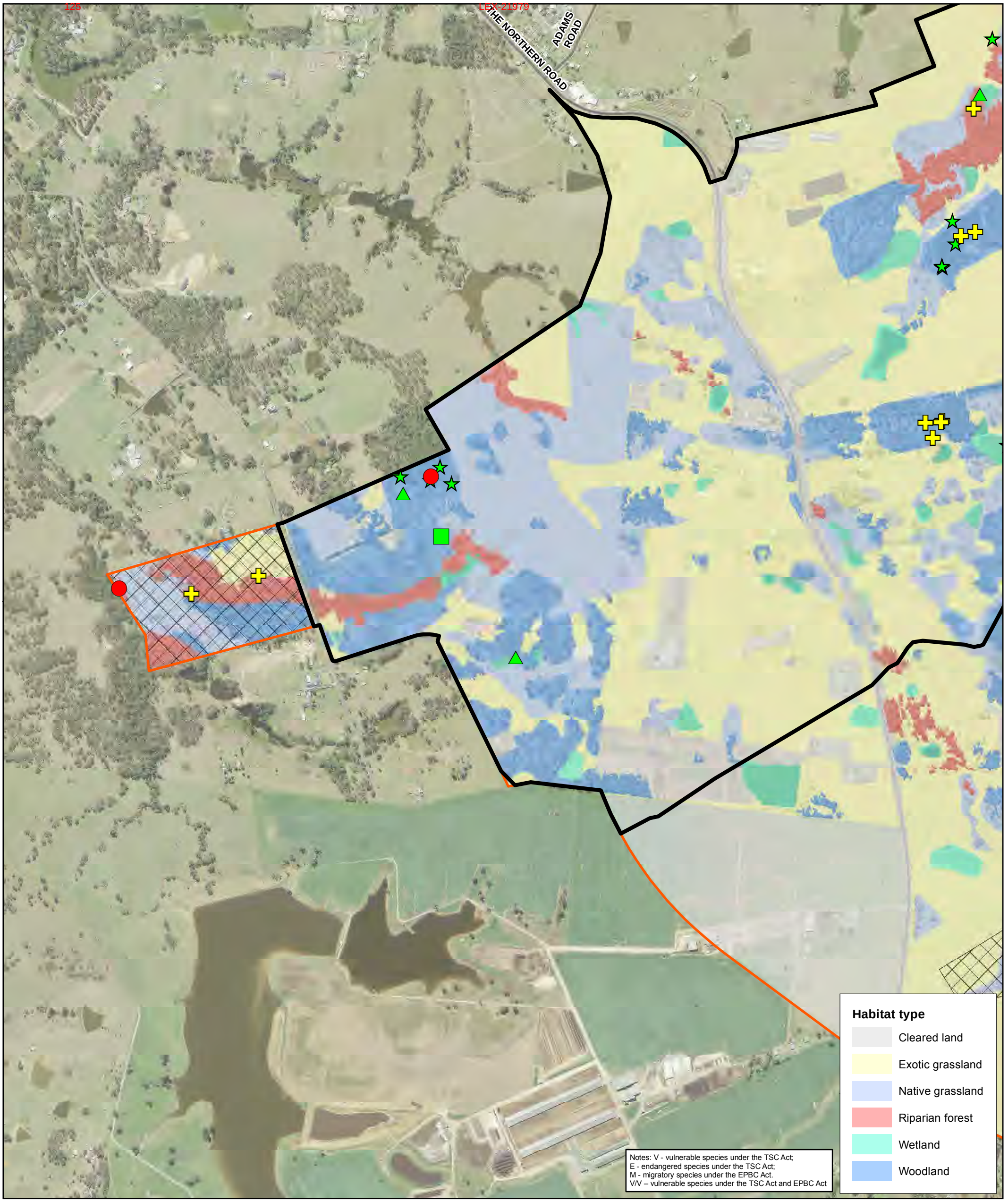
The Spotted-tailed Quoll (*Dasyurus maculatus*) is unlikely to occur at the airport site. There are no local records of this species and very few records on the Cumberland Plain. Most records of the species in the region are from the Blue Mountains National Park, Ku-ring-gai Chase National Park, Holsworthy army base and vegetated land near Oakdale which is connected to Nattai State Recreation Area and the Warragamba Special Area (OEH 2015a). The Spotted-tailed Quoll has a preference for mature wet forest habitats and requires large areas of relatively intact vegetation through which to forage. Females occupy home ranges of up to 650 hectares and males up to 2,560 hectares (DoE 2015b). No extensive areas of mature wet forest are present near the Stage 1 Construction Impact Zone. There is limited connectivity between the Stage 1 Construction Impact Zone and any large patches of vegetation.

Surveys for the Spotted-tailed Quoll included searches for habitat resources, scats and latrines over 18 days of surveys, spotlighting on nine nights and remote cameras at four locations for four weeks each. Given the few records for this species on the Cumberland Plain, the lack of

large expanses of native vegetation in the local area connected to the Stage 1 Construction Impact Zone, the lack of suitable habitat in the Stage 1 Construction Impact Zone, and lack of evidence of the species during surveys, this species is unlikely to occur in the Stage 1 Construction Impact Zone.

There is no suitable aquatic habitat for EPBC Act-listed threatened fish predicted to occur in the broader catchment, such as the Macquarie Perch (*Macquaria australasica*) or the Australian Grayling (*Prototroctes maraena*), in the Stage 1 Construction Impact Zone or in habitats sampled downstream. Potential indirect impacts of the project on downstream water quality and flows would not be of a magnitude or extent to impact habitat for such species that may occur within the broader catchment at considerable distance downstream of the site.

Similarly, it is unlikely that the Stage 1 Construction Impact Zone or areas immediately downstream support habitat for threatened dragonflies listed under the FM Act that are known from the greater Sydney region and that have been predicted to occur in the broader catchment. Larvae of the Sydney Hawk Dragonfly (*Austrocorrdulia leonardii*) are found in small creeks with gravel or sandy bottoms, in narrow shaded riffle zones with moss and rich riparian vegetation. Riffle zone habitat is very limited in the Stage 1 Construction Impact Zone and in downstream areas and where present, does not occur with other required habitat features. Similarly, there is no suitable habitat for the Adams Emerald Dragonfly (*Archaeophya adamsi*) which is generally found in steams and small rivers amongst rocks and litter and in riffle areas. No larval specimens belonging to the families from which these species belong were recorded during the macroinvertebrate surveys at the site or in downstream or upstream habitats and given the absence of suitable habitat and lack of local records neither is considered likely to occur or be impacted by the project.



Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species

- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species

- Latham's Snipe
- Rufous Fantail
- White-throated Needletail

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number 21-26204
Revision A
Date 29 Aug 2017

Threatened fauna and habitat features

Figure 5A

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice

LUDDENHAM ROAD

ELIZABETH DRIVE

ADAMS ROAD

THE NORTHERN ROAD

Habitat type
- Cleared land
- Exotic grassland
- Native grassland
- Riparian forest
- Wetland
- Woodland

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act

Legend
- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species
- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
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- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species
- Latham's Snipe
- Rufous Fantail
- White-throated Needletail

Paper Size A3
0 100 200 400
Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Date 29 Aug 2017

Threatened fauna and habitat features

Figure 5B

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice

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LEX-21979

BADGERYS CREEK ROAD

THE NORTHERN ROAD

DWYER ROAD

Habitat type

- Cleared land
- Exotic grassland
- Native grassland
- Riparian forest
- Wetland
- Woodland

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act

Legend

- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species

- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species

- Latham's Snipe
- Rufous Fantail
- White-throated Needletail

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Threatened fauna and habitat features

Figure 5C

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice

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LEX-21979

ELIZABETH DRIVE

BADGERYS CREEK ROAD

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;
M - migratory species under the EPBC Act.
V/V – vulnerable species under the TSC Act and EPBC Act

Habitat type
- Cleared land
- Exotic grassland
- Native grassland
- Riparian forest
- Wetland
- Woodland

Legend
- Airport site
- Stage one construction impact zone
- Environmental conservation
- Roads
- Habitat tree

Threatened species
- Blue-billed Duck (V)
- Black Bittern (V)
- Cumberland Plain Land Snail (E) (present)
- East Coast Freetail Bat (V)
- Grey-headed Flying-fox (V/V)
- Large-footed Myotis (V)
- Little Eagle (V)
- Scarlet Robin (V)
- Varied Sittella (V)
- Little Lorikeet (V)
- Dusky Woodswallow (V)

Migratory species
- Latham's Snipe
- Rufous Fantail
- White-throated Needletail

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Infrastructure and Regional Development
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Revision A
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Threatened fauna and habitat features

Figure 5D

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened & migratory species mapping - GHD 2017. Created by:jrprice

4.5.4 Migratory species

Overview

Three migratory bird species listed under the EPBC Act have been positively recorded at the airport site.

Two migratory wetland species was recorded in the Stage 1 Construction Impact Zone. One Latham's Snipe (*Gallinago hardwickii*) was disturbed from exotic grassland adjacent to a dam. In addition, a flock of about 40 shorebirds was disturbed one night during frog surveys. These were not able to be identified, however are likely to be a type of sandpiper, based on the body shape in flight and the calls. Potential species include the Marsh Sandpiper (*Tringa stagnatilis*) and the Sharp-tailed Sandpiper (*Calidris acuminata*), which are known to occur on farm dams or the Common Greenshank (*Tringa nebularia*) previously recorded in the locality.

A flock of White-throated Needletails (*Hirundapus caudacutus*) was also recorded foraging high above the aiport site. The Rufous Fantail (*Rhipidura rufifrons*) was observed in a number of woodland patches the Stage 1 Construction Impact Zone.

The EPBC Act lists migratory species that are listed under international agreements, as well as families of birds (such as ducks, waders, eagles and hawks) that are also known to be migratory but are not listed under international agreements. A range of waterfowl and waders have been recorded in the Stage 1 Construction Impact Zone. Other seasonally migratory or nomadic species would also be likely to utilise habitats in the Stage 1 Construction Impact Zone on occasion.

An assessment of the importance of habitat in the Stage 1 Construction Impact Zone for these migratory birds has been prepared with reference to the *Draft significant impact guidelines* (DEWHA 2009b) and is provided below.

Migratory wetland species

Two migratory shorebird species were recorded in the Stage 1 Construction Impact Zone: one Latham's Snipe (*Gallinago hardwickii*) and a flock of an unidentified sandpiper species (see Section 4.3.2). Potential species include the Marsh Sandpiper (*Tringa stagnatilis*) and the Sharp-tailed Sandpiper (*Calidris acuminata*).

A critical consideration in assessing the significance of potential impacts on listed migratory shorebird species is whether or not a proposed action is likely to affect 'important habitat' (DEWHA 2009b). Important habitat is defined separately for 35 of the listed migratory shorebird species and Latham's Snipe (*Gallinago hardwickii*).

Important habitat for Latham's Snipe occurs at sites that have previously been identified as internationally important for the species, or sites that:

- support at least 18 individuals of the species; and
- are naturally occurring open freshwater wetlands with vegetation cover nearby (for example, tussock grasslands, sedges, lignum or reeds within 100 m of the wetland) (DEWHA 2009).

The Stage 1 Construction Impact Zone has not been previously identified as an internationally important site for Latham's Snipe. This species has been recorded five times previously in the locality. Only one Latham's Snipe was recorded in the Stage 1 Construction Impact Zone, but given the size of the Stage 1 area and other local records, it is possible that the area could support 18 or more individuals of the species. Wetlands in the Stage 1 Construction Impact Zone are artificial farm dams rather than naturally occurring freshwater wetlands and the Stage 1 Construction Impact Zone therefore does not meet the criteria for important habitat.

An area of 'important habitat' for the 35 migratory shorebird species identified in DEWHA (2009b) is defined as either:

- a site that is identified as internationally important; or
- a site that supports either:
    a) at least 0.1 per cent of the flyway population of a single species; or
    b) at least 2000 migratory shorebirds; or
    c) at least 15 shorebird species (DEWHA 2009b).

One unidentified migratory shorebird species was recorded at a farm dam in the Stage 1 Construction Impact Zone. The flock of about 40 individuals is highly unlikely to make up 0.1 per cent of the species' population. For example, the Australian population of the Common Greenshank (*Tringa nebularia*) is estimated to be about 60,000 (DoE 2015b). No other shorebird species were recorded in the Stage 1 Construction Impact Zone and there are no previous records of migratory wader species in the Stage 1 Construction Impact Zone. Given the low number of birds recorded and the low species diversity present, the Stage 1 Construction Impact Zone is unlikely to comprise important habitat for migratory shorebird species.

Other migratory species

Other migratory species recorded in the Stage 1 Construction Impact Zone include the Rufous Fantail (*Rhipidura rufifrons*). Important habitat for these migratory birds is defined in the significance criteria for listed migratory species (DoE 2013) as follows:

- habitat utilised by a migratory species occasionally or periodically within the region that supports an ecologically significant proportion of the population of the species;
- habitat that is of critical importance to the species at particular life-cycle stages;
- habitat utilised by a migratory species which is at the limit of the species range; and
- habitat within an area where the species is declining.

The small migratory birds could forage and breed in the Stage 1 Construction Impact Zone. Other areas of potential habitat are present in the locality. The Stage 1 Construction Impact Zone is not considered important habitat for this species, according to the significant impact criteria for migratory species (DEWHA 2009) because:

- The habitat for migratory species in the Stage 1 Construction Impact Zone is equivalent to similar habitats present throughout the locality and region. There are many thousands of hectares of such habitat in the region, including extensive areas in National Parks. The Stage 1 Construction Impact Zone would only ever support a small number of individuals of any migratory species and never an ecologically significant proportion of the population of any species.
- The Stage 1 Construction Impact Zone does not contain any specific habitat resources that would be of critical importance to any migratory species at particular life-cycle stages. Shelter, foraging and breeding habitat within the Stage 1 Construction Impact Zone is also available in many thousands of hectares of similar vegetation in the region.
- The habitat for migratory species in the Stage 1 Construction Impact Zone is surrounded in all directions by equivalent habitat and is not the terminal patch of habitat near the limit of any species' range.

4.5.5 Other MNES

No other MNES of relevance to this report occur in the Stage 1 Construction Impact Zone.

5. Impact assessment

5.1 Overview

Impacts on EPBC Act-listed threatened biota are described in Section 5.6. Impacts on other plants, animals and their habitats, including TSC Act-listed biota are described in the FBA calculations included in Section 6.

5.2 Construction impacts

5.2.1 Construction framework

Construction activities for the Stage 1 development are anticipated to occur in four major phases as follows:

- site preparation activities which includes securing the Construction Impact Zone, establishment of site services and construction facilities; and,
- enabling works such as the removal or relocation of existing utility infrastructure, such as the TransGrid assets, and the disinterment of human remains on the airport site;
- Main Construction Works, such as the clearing of vegetation and earthworks programme, the construction of the runway, taxiways, apron areas, internal road network, the terminal complex, air traffic control tower, freight, cargo and maintenance facilities and a fuel farm; and
- site commissioning activities at the completion of the aviation infrastructure activities, such as testing and commissioning of all facilities in readiness for the operation of the airport.

For the purposes of this assessment, it is assumed that the Main Construction Works would largely proceed from the north-east to the south-west of the airport site to allow for the early relocation of existing infrastructure such as The Northern Road and the TransGrid 330 kilovolt (kV) transmission line (section 5.5). The relocation of existing utilities infrastructure (other than the TransGrid transmission line) would be subject to separate approval processes, but will likely be required to occur concurrently with other site preparation activities.

The Stage 1 Construction Impact Zone would include the area of bulk earthworks in the northern half of the airport site, which would facilitate the development of the runway, terminal and aviation support facilities, as well as areas of disturbance outside the bulk earthworks boundary that would be used for ancillary infrastructure such as drainage controls, detention ponds, perimeter roads, security fencing and site services. No significant construction would occur outside the Stage 1 Construction Impact Zone.

Clearance of vegetation would be restricted to the Construction Impact Zone for the Stage 1 development, and remnant vegetation in the southern portion of the site would remain largely intact.

For the purposes of the EIS modelling, site preparatory activities were indicatively scheduled from late-2016. Enabling prepatory activities are scheduled from late-2017. Sectors of the site would be subject to progressive transition to the aviation infrastructure activities which would be completed over approximately five years to the mid-2020s. The hours of construction would generally be between 6.00 am and 6.00 pm, Monday to Saturday. However, some works are likely to occur outside these work hours.

The construction framework for the airport has been developed, based on contemporary construction methodologies for similar scale projects, to provide a reasonable indication of the likely construction activities and the potential sequencing, methodology and equipment that may be used in the development of the airport site. The final construction methodology and timing would be subject to refinement during detailed design. Further detail regarding the construction framework is provided in Chapter 6 of the EIS (GHD 2015b).

5.2.2 Removal of vegetation

All vegetation and habitat resources would be removed within the Stage 1 Construction Impact Zone shown on Figure 3. The boundary of this area depicts the extent of vegetation clearing and grubbing, earthworks, permanent detention basins and the permanent infrastructure that would be constructed for Stage 1 of the airport. Construction of the Stage 1 development would result in direct impacts within a 1153.6 hectare disturbance footprint, including 359.6 hectares of native vegetation as shown on Figure 3. This updated area has increased from the impact area presented in the EIS, mainly because of the reclassification of certain areas of exotic grassland as derived native grassland. The extent of clearing of vegetation and habitats within the Stage 1 Construction Impact Zone is summarised in Table 33 below.

As part of the indicative site layout for the Stage 1 airport, included within the Airport Plan, around 2.1 hectares for preparatory works for surface water management features, such as detention ponds, fall within the Environmental Conservation Zone at the airport site. The final layout of surface water management features will be confirmed during the detailed design process and the finalisation of the airport site layout, however, the intent is to not encroach on the conservation zone wherever possible. Pending the finalisation of the airport design, and in accordance with the indicative site layout, these impacts have been assessed and will be offset accordingly to compensate for any vegetation removal that may be required. If this area is required to support surface water management, following detention pond construction, it would be allowed to regenerate and support native vegetation as well as provide fauna habitat resources in the longer term and, as such, it has also been included in the total conservation area.

There may be minor additional earthworks or other disturbance associated with works such as drainage swales up and downstream of the proposed sediment basins. These features would be defined at the detailed design stage. Based on a general assessment of their likely size and location they would affect a small area (typically around 25 metres in cross section including construction access) and would coincide with existing drainage lines located in exotic grassland and cropland. Constructing these features would have a minor effect on the overall extent of vegetation removal.

No full or partial vegetation removal outside of the Stage 1 Construction Impact Zone for matters such as Asset Protection Zones (APZs) is anticipated or has been assessed in this BAR. In accordance with the Airport Plan and the EIS, the design, construction and operation of the airport is required to implement appropriate bushfire management mitigation measures. This will include but is not limited to fuel reduction activities that are sensitive to biodiversity values, and the provision of appropriate setbacks and Asset Protection Zones in consideration of the biophysical environment. The perimeter of the Stage 1 Construction Impact Zone will include fuel-reduced surfaces such as hardstand, mown grass or access tracks that would provide a sufficient buffer between infrastructure and retained vegetation in the Environmental Conservation Zone or land adjoining the airport site.

Land clearance is listed as a Key Threatening Process (KTP) under the EPBC Act. The removal of 359.6 hectares of native vegetation in the Stage 1 Construction Impact Zone would comprise land clearance as defined under the EPBC Act and would constitute a notable increase in the operation of this KTP in the locality. The effect of the airport on the operation of KTPs is

assessed further in Section 5.4. Other than small areas of understorey vegetation in drainage swales and basins, removal of native vegetation for construction of Stage 1 would be permanent and irreversible.

The net impact of the extent of vegetation removal for construction of Stage 1 development is mitigated by the generally poor quality of the disturbance area. Around 222.9 hectares of the 1153.6 hectare impact zone contains better condition native vegetation (including freshwater wetlands) with an intact natural structure. This vegetation frequently comprises small, fragmented patches with moderate weed infestation. There is a further 136.7 hectares of poor condition vegetation that comprises derived native grassland or scrub with moderate to severe weed infestation and 616.9 hectares of low condition vegetation that comprises exotic grassland or scrub. The remaining 177.1 hectares of the Stage 1 Construction Impact Zone contains crop land, infrastructure or cleared land (see Figure 3).

Impacts would be further mitigated by the retention of around 117.1 hectares of land in the Environmental Conservation Zone, including around 47.6 hectares of better condition native vegetation and representative areas of most of the vegetation types at the airport site (see Figure 3). All or part of the 69.5 hectares of derived native grassland, exotic grassland, cleared land and cropland within the conservation zone could be revegetated.

Table 33 Estimated area of vegetation removal in the Stage 1 Construction Impact Zone

Vegetation Zone	TSC Act Status	EPBC Act Status	Area in Stage 1 Construction Impact Zone (hectares)	Area in Environmental Conservation Zone (hectares)
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC	CEEC	105.8	6.9
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC		110.5	4.3
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	CEEC	CEEC	38.7	
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	CEEC		15.3	
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	EEC		35.0	36.2
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	EEC		10.9	7.6
Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	EEC	CEEC	5.2	4.1
Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512)	EEC		0.0	1.4
Good condition artificial freshwater wetland on floodplain (HN630)			32.1	0.5
Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	CEEC		6.1	
Total native vegetation			**359.6**	**60.9**
Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)			530.7	9.5
Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)			42.3	
Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)			43.9	44.7
Cleared land or cropland			177.1	2.1
Total			**1153.6**	**117.1**

The Stage 1 development would include impacts on a local occurrence of Cumberland Plain Woodland, patches of which are commensurate with the EPBC Act-listed form of this TEC. There would also be impacts on a number of TECs listed under the TSC Act and on populations of threatened plants listed under the EPBC Act and/or TSC Act as shown on Figure 4. Impacts on EPBC Act-listed threatened biota are described in Section 5.6. Impacts on other plants, animals and their habitats including TSC Act-listed biota are described in the FBA calculations included in Section 6.

The majority of the earthworks footprint is disturbed, cleared land containing exotic pasture species or environmental weeds. These areas contain little native vegetation cover and have limited habitat value for native plants. Any vegetation clearing required in these areas would remove a small number of individuals of non-threatened native plants and noxious and environmental weeds.

The clearing of around 359.6 hectares of native vegetation would involve the removal of a large number of individuals and a moderately diverse range of non-threatened native plants. The Stage 1 earthworks footprint includes around 190.8 hectares of native woodland and forest vegetation in medium or high condition that contains an over storey of mature trees. Mature trees have particular value within plant populations because they take longer to replace and are sources of pollen and seed.

Under the Land Use Plan in the Airport Plan, around 60.9 hectares of native vegetation, including 46.9 hectares of better condition vegetation with a forest or woodland structure, would be retained in the Environmental Conservation Zone at the airport site. This zone contains representative areas of the majority of the vegetation types at the airport site and would support many of the plant species that occur in the impact area. The Environmental Conservation Zone is placed along the south-eastern perimeter of the airport site to help maintain vegetation connectivity and to allow pollination, seed fall and other ecological processes that are necessary to maintain plant populations. Flora populations are also likely to persist within adjoining areas of alternative habitat beyond the airport site.

Plant species with a limited distribution in the locality would be most affected by vegetation clearing for the airport. Notably the population of *Pimelea spicata* and the endangered population of *Marsdenia viridiflora* subsp. *viridiflora* at the airport site would be completely removed, which would comprise a significant impact at the local scale.

This reduction in the extent of native vegetation is less significant at the regional scale and is unlikely to threaten the persistence of any populations of native plants and vegetation communities. It is unlikely that an ecologically significant proportion of any regional plant populations would be located entirely within the airport site. At the regional scale flora populations would persist in habitat that is conserved in Kemps Creek Nature Reserve, Mulgoa Nature Reserve, existing and proposed biobank sites at Mulgoa and in the Ropes and South Creek riparian corridors, the Western Sydney Regional Park and other offset sites linked to the North and South West Growth Centres. Notably there is a parcel of land with shale/gravel transition habitat located at Kemps Creek around three kilometres to the east of the site that is to be set aside as an offset for the South West Growth Centres. This site contains local populations of *Pultenaea parviflora* and other threatened plant species that may be affected by Main Construction Works of the airport (OEH 2015a).

5.2.3 Removal of terrestrial and wetland fauna habitat

Construction of the Stage 1 development would result in the removal of fauna habitat and associated resources within a maximum disturbance footprint of around 1153.6 hectares as shown on Figure 5A to D. The extent of fauna habitat removal and associated features and resources within the Stage 1 Construction Impact Zone is summarised in Table 34 below.

Table 34 Estimated area of fauna habitat in the Stage 1 Construction Impact Zone, Environmental Conservation Zone and locality

Habitat type	Area in Stage 1 Construction Impact Zone (hectares)	Estimated extent in the locality (hectares)[1]	Percentage of the estimated extent in the locality)	Area in Environmental Conservation Zone (hectares)[3]
Woodland	155.8	10,014	1.56%	10.7
Riparian forest	35.0	2555	1.37%	36.2
Sandstone woodland, forest and scrub		4825	0%	
Total woodland and forest	**190.8**	**17,393**	**1.10%**	**46.9**
Wetlands[2]	32.1			0.5
Native grassland[2]	136.7			13.5
Exotic grassland[2]	616.9			54.1
Cleared land and cropland	177.1			2.1

Notes: 1) Based on GHD mapping within the airport site and on a composite of Tozer et al (2010) and NPWS (2002) mapping in the locality. 2) Grassland and wetland vegetation has not been mapped by Tozer et al (2010) or NPWS (2002). 3) Includes around 2.1 hectares for preparatory works for surface water management features (such as detention ponds) that fall within the Environmental Conservation Zone. This area would require initial vegetation removal and earthworks and so has been included in the impact calculations. If required to support surface water management, the disturbed area would be allowed to regenerate and will support native vegetation and provide fauna habitat resources in the longer term and so has also been included in the total area of the Environmental Conservation Zone.

The airport site provides habitat for a range of fauna groups typical of the Cumberland Plain (see Section 4.3). Native fauna present include species of macropods, flying-foxes and bats, a wide variety of birds, reptiles including goannas, snakes and lizards, frogs and small fish. A discussion of specific impacts of habitat loss on threatened biota and migratory species is provided in Section 8. Fauna that would be most affected include those that occur in grassland areas, artificial wetlands and dams and those that can use fragmented patches of woodland vegetation, as the site does not provide habitat for species that need extensive patches of vegetation. Key habitats that would be lost include those associated with grassland areas, farm dams, riparian habitat and woodland stands.

The Stage 1 development would result in the disturbance of exotic grassland or cropland and derived native grassland, which provides only limited habitat values for fauna in isolation, but is valuable as it is part of the mosaic of habitat over a large area. The loss of these areas would remove foraging, breeding and shelter habitat for small grassland animals such as skinks, and would result in the loss of entire populations of these species. The loss of this habitat would remove foraging habitat for a wide range of species, including macropods, open-country microchiropteran bats, and bird species such as the Australian Magpie, Australian Raven, Magpie-lark, Straw-necked Ibis and Cattle Egret in particular.

A large number of artificial wetlands (farm dams), minor drainage lines and associated damp soaks would be removed. In total, 32.1 hectares of wetland habitat and 35.0 hectares of riparian habitat would be lost. This would result in the loss of local populations of frog species. Large areas of habitat for waterbirds, including migratory species, would be destroyed. Foraging habitat for a range of microchiropteran bat species, including in particular the Southern Myotis, would be removed.

Construction of Stage 1 would have permanent and irreversible impacts on fauna habitats present at the airport site. Construction would require the permanent removal of a maximum area of 190.8 hectares of woodland and forest habitat, consisting of vegetation, including young regrowth and more mature trees (ie trees between 20 to 80 per cent of their life expectancy).

This area comprises all native vegetation not including derived grassland. Clearing of this vegetation would permanently remove foraging and breeding resources for native fauna, particularly in forest and woodland habitats, which comprise a canopy of eucalypt trees of varying age classes. Eucalyptus and other native canopy species provide nectar resources as well as foraging substrate for a diverse range of arboreal species, such as birds and arboreal mammals, as well as bats.

Construction of the Stage 1 development would result in the loss of at least 50 hollow-bearing trees, which occur as scattered trees across the airport site. Note that this is an underestimate of the total numbers present, as not all patches of vegetation were able be visited, and some smaller or less obvious hollows may have been missed in stands that were surveyed. Hollow-bearing trees occur at low densities across the airport site due to the previous clearing of vegetation. Much of the woodland present is young regrowth, and often no hollow-bearing trees are present in woodland patches. Hollow-bearing trees are critical habitat components for many tree-dwelling fauna species at the airport site, including arboreal mammals, microchiropteran bats and woodland birds that rely on hollows for shelter and breeding habitat. Due to the long timeframe it takes for hollows to form in eucalypts (usually greater than 150 years) (Gibbons et al 2000), the loss of these hollows represents a long-term reduction in habitat resources for fauna.

Shrub layers and leaf litter would also be removed as a result of construction. This would result in the loss of habitat for small woodland birds that rely on these resources for foraging and breeding. In addition, loss of leaf litter would remove habitat for small reptiles and gastropods that rely on this feature for shelter, breeding and foraging.

5.2.4 Removal of aquatic fauna habitat

The Stage 1 construction would involve the infilling of stream reaches, including the upper reaches of Oaky Creek and smaller drainage lines that feed into Badgerys, Cosgroves and Duncans Creeks within the Construction Impact Zone. Infilling would result in the permanent loss of riparian and aquatic habitats associated with these features. All of the affected reaches are small and largely intermittent. The net impact of the removal of these stream reaches is mitigated in part by their degraded nature. All are highly modified and in poor condition as a result of historical and current land use and disturbance. Water quality is poor and the macroinvertebrate and fish communities are dominated by species indicative of disturbed habitats. Fish habitat is moderate or minimal at most sites and the habitats present are not suitable for threatened fish or invertebrate species (dragonflies) known or predicted to occur in the wider locality.

Badgerys Creek, which comprises the largest watercourse at the airport site, would be retained within a conservation area.

A large number of artificial wetlands (farm dams) would be removed. In total, 32.1 hectares of wetland habitat would be removed. These provide only limited habitat for native fish species, with most dams dominated by the exotic Eastern Gambusia. Farm dams are not key fish habitat and do not provide habitat for threatened species listed under the FM Act.

5.2.5 Habitat fragmentation

Habitat fragmentation can result in reduced dispersal and reproductive success of biota within the fragment, a decline in populations resulting from increased predation by introduced species or native species that do not normally occur in the community, and an increased probability that stochastic events (e.g. fire) may reduce population numbers below critical levels required for their survival (Andrews 1990). In general, larger fragments are less susceptible to adverse impacts than are smaller fragments.

Construction of the Stage 1 development would contribute to fragmentation at a local and regional scale by removing patches of habitat, severing vegetated corridors and by creating an extensive, permanent footprint that would comprise a significant barrier to movement of many species. These include in particular those that rely on connectivity of woodland patches to move through the landscape, such as small woodland birds and certain microchiropteran bats.

The airport would be located in a highly fragmented, rural landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for some fauna species, particularly those that are limited by dispersal abilities and habitat preferences. More mobile species such as birds and bats can readily traverse this landscape. The suite of fauna species recorded in field surveys is dominated by generalist species of open country, reflecting the fragmented nature of vegetation at the airport site (see Section 4.3.1).

Few woodland patches that would be impacted by the airport development extend across the boundary of the airport site. Much of the Badgerys Creek corridor would be retained, minimising fragmentation impacts along the southern boundary of the airport site. The project would result in the further fragmentation of a number of stands of woodland at the western boundary of the Stage 1 development. As these stands of vegetation are currently located adjacent to mostly cleared agricultural land, these have already been subject to historical fragmentation. The fragmentation of these patches would impact resident fauna, and in particular less mobile species such as the Cumberland Plain Land Snail (if present at these locations). Patches of vegetation to the west of Willowdene Avenue would be conserved and managed as part of the conservation land for the airport, and revegetation works would be carried out which would improve and expand these patches.

The geographic distribution of native vegetation on the Cumberland Plain has undergone a very large reduction since European settlement (NSW Scientific Committee 2009). The remaining area of the Cumberland Plain Woodland ecological community is severely fragmented, with more than half of the remaining tree cover mapped by Tozer et al (2010) occurring in patches of less than 80 hectares and half of all mapped patches being smaller than 3 hectares (NSW Scientific Committee 2009). Any patches of the community that are greater than five hectares in area are considered inherently valuable due to their rarity (DoE 2015b). Construction within the Stage 1 airport earthworks footprint would contribute to fragmentation at a regional scale by removing patches of woodland, including a total of about 145.2 hectares of Cumberland Plain Woodland in mostly regenerating patches (Figure 4). Some patches are at least five hectares in area and include large, mature and hollow-bearing trees and as such meet the criteria for the most valuable remnant patches of this community (DoE, 2015c).

Overall, despite the current patchy and fragmented distribution of vegetation at the airport site and in the locality, construction of Stage 1 would comprise a significant increase in the degree of habitat fragmentation in the locality. Construction of Stage 1 would create a gap in habitat that is around 1153.6 hectares in area and about 1.5 kilometres wide from north to south and almost 7 kilometres long from east to west. This area would be mostly inhospitable to fauna given the presence of cleared areas, fences, infrastructure and lights and, ultimately, large and noisy machinery. The gap would create a barrier to ecological processes such as dispersal, pollination and seed fall. Mobile, aerial species such as larger birds, flying foxes and microbats of open country (i.e. those that do not need connected woodland patches to traverse the landscape) would be able to traverse the site. Birds typical of open areas such as ibises and magpies or small grassland reptiles may continue to occur in areas of open space at the airport site and move through it, however there would be specific management measures incorporated into the design of the airport to make the site unattractive to birds to deter them from using the site, as they can pose a risk of aircraft strike (see Section 5.3.1). The proposed runway,

terminals, carpark and other built features would comprise a significant barrier to the majority of fauna species particularly in combination with security fences. Light, noise, aircraft and vehicle movement may further deter fauna species from crossing these gaps in habitat. Many generalist species of open country that currently occur at the airport site would not be able to move over or through the airport.

Long term development at the airport site, including construction of a second runway and associated infrastructure, would increase the total area up to around 1770 hectares and further increase habitat fragmentation in the locality and region. The realignment of The Northern Road, potential future orbital road links, realigned transmission lines and future rail links to the airport would further fragment habitat in the area. The Western Sydney Priority Growth Area structure plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands. The Badgerys Creek riparian corridor is identified as flood prone land and non-certified land and would be conserved under the strategic assessment (DoP 2010).

These impacts on habitat connectivity would be partially mitigated by the retention of habitat in the Environmental Conservation Zone. The conservation zone comprises around 117.1 hectares of land, including 46.9 hectares of woodland and forest and 69.5 hectares that could be revegetated. It is located around the perimeter of the airport site, encompassing the riparian corridors of Badgerys Creek and Duncans Creek and some moderate sized patches of Cumberland Plain Woodland east and west of the airport site. The Environmental Conservation Zone would help to maintain vegetated fauna movement corridors around the airport site, and would provide habitat stepping-stones to assist movement.

5.2.6 Fauna injury, mortality or displacement

Clearing of native vegetation and removal of grassland and wetland habitat would result in fauna injury, mortality and displacement of individuals. The airport would cause displacement or mortality of less mobile fauna that are within the area to be cleared for the airport at the time of construction activities. The magnitude of likely impacts would vary between types of fauna, depending on their size and ecology. Some fauna may be able to seek refuge and persist in alternative habitat outside the airport site; however given the size of the airport site, entire local populations of some small animals (e.g. skinks, snails) could be destroyed.

Birds are relatively mobile and so most individuals would be able to avoid vegetation clearing (which is minimal) or construction operations. Most individuals that would be directly affected by construction of the airport would be displaced initially rather than killed. Continued survival of displaced fauna would depend on the carrying capacities of neighbouring remnants and the existing fauna present and their territories. Many of the small patches in nearby areas are likely to be at carrying capacity already. Given the large area of fauna habitats that would be removed and fauna that would be displaced, it is likely that many displaced individuals would not be able to compete for resources with existing resident fauna. Mortality of less mobile individuals, such as nestlings, old or sick birds would also occur. Birds that currently breed at or in the vicinity of the airport site, which are likely to include common and widespread species such as Noisy Miners and Australian Magpies, may have breeding success disrupted for one or more seasons.

Macropods and other large terrestrial mammals are likely to readily avoid vegetation clearing or construction operations and so individuals directly affected by the airport would be displaced rather than killed. Staged vegetation clearing would provide some opportunity for fauna to move to other adjacent areas, including conservation areas and areas of the site outside of the Stage 1 Construction Impact Zone.

There would be mortality of terrestrial animals less able to avoid the disturbance. There would also be mortality of individuals sheltering in leaf litter, woody debris, tree hollows, crevices or

under bark. These would include the Cumberland Plain Land Snail, smaller terrestrial mammals, nocturnal species and especially arboreal mammals and microbats which may be sheltering in felled trees. Displaced individuals would be vulnerable to predation since they would be disturbed in daylight hours and would experience energy costs, increased risk of predation and increased competition for resources (especially for alternative hollows). This may result in impacts beyond the disturbance area by favouring aggressive or generalist species, such as the Brush-tailed Possum, over less aggressive species such as the Sugar Glider.

There will be mortality of aquatic fauna, including fish, eels, turtles and frogs, associated with the infilling of steams and draining of artificial wetlands within the Stage 1 area. The magnitude of impacts on aquatic fauna is limited to some extent by the highly modified nature of much of the aquatic habitat present and the predominance of common and widespread species that are typical of similar habitats on surrounding lands.

Mitigation measures including pre-clearing surveys, fauna rescue and relocation protocols, and draining of dams will be outlined in a Biodiversity Construction Environmental Management Plan (CEMP), required under the Airport Plan, to minimise the risk of mortality of fauna as a result of clearing (Section 7.2). The southern perimeter fence would not be installed until clearing is completed to allow fauna to escape to adjacent areas.

5.2.7 Weed invasion and other edge effects

'Edge effects' refers to factors, including increased noise and light, weed invasion, tree failure or erosion and sedimentation, at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to plant community type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the airport site.

Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. A comparison of edge effects in a variety of different habitat types estimated that on average edge effects generally occur up to 50 metres away from the disturbed edge (Bali 2005).

Vegetation in the airport site and adjacent areas mainly occurs as small, isolated patches already subject to edge effects. Construction of the airport may result in some novel edge effects where vegetation to be retained is located immediately adjacent to the Stage 1 Construction Impact Zone. Novel edges would be created along the western and north-western boundaries of the airport site and sections of the riparian corridors of Badgerys Creek and Duncans Creek that currently adjoin intact native vegetation within the airport site. The Environmental Conservation Zone would provide a buffer between the airport site and adjoining areas of native vegetation along its eastern, southern and western boundaries, including the majority of the vegetation within and adjoining the riparian corridors of Badgerys Creek and Duncans Creek. The northern and south-western boundaries of the Stage 1 Construction Impact Zone adjoin extensively cleared agricultural land. No new edges would be created.

The extent or severity of weed infestations may increase along the novel edges created by the airport. Construction activities may further increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles.

There is also the potential for the proliferation of noxious terrestrial and aquatic weeds in reaches downstream through discharge of water from the Stage 1 area containing weed propagules. This may result in the invasion of pools and establishment in stream channels during dry conditions, resulting in deterioration of water quality, loss of native species,

restrictions in flow and pool connectivity and degradation of riparian vegetation and aquatic habitats.

Edge effects can increase the incidence of aggressive bird species such as the Noisy Miner, which can in turn reduce the habitat value for smaller, less aggressive woodland birds. In particular, this may reduce habitat quality for threatened bird species such as the Varied Sittella, recorded along the Badgerys Creek riparian corridor.

Measures to minimise the spread of weeds will be documented in a Biodiversity CEMP (Section 7.2).

Overall given the fragmented nature of habitat in the locality and the extent of exotic plant cover, the airport would have a minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations.

5.2.8 Altered hydrology and downstream impacts

Construction of the Stage 1 development involves substantial alteration of the existing landform and hydrology within the Construction Impact Zone and has the potential to alter the hydrological regime downstream of the airport site through:

- removal of watercourses within the Construction Impact Zone and alteration of the catchments of Badgerys Creek, Cosgroves Creek and Duncans Creek. The total length of watercourses that would be removed is 36.5 kilometres. The majority of these watercourses are minor drainage lines and less defined channels;
- the replacement of a large tract of land with impervious surfaces, particularly in terms of the runway area, roads and other paved surfaces. This will increase surface runoff and potentially result in a minor decrease in groundwater recharge to the downstream reaches; and
- the capture and treatment of surface water to control the volume and quality of stormwater discharges from the site.

The airport site would include substantial and large-scale earthworks which would modify drainage direction and overland flow paths, changing the nature of flooding on site. As construction progresses and the area of impervious area increases, runoff from the airport site would increase due to a reduction in ground surface infiltration. Without mitigation this would result in increased flows from the site and the potential for associated flooding, geomorphological and ecological impacts downstream (GHD 2016b).

There is a potential for a minor reduction in groundwater recharge associated with the increase in paved surfaces with the establishment of the Stage 1 development. Overall, minimal change to local groundwater recharge would be expected as the existing shale derived clay soils have low permeability and the majority of rainfall is therefore released as stormwater runoff rather than infiltrating to groundwater. It is not expected that a reduction in recharge would affect any sensitive ecological receptors or beneficial uses of the groundwater system.

Groundwater drawdown is also expected during Main Construction Works as a result of the reprofiling of the airport site and deeper excavations for the establishment of basements in the terminal complex. Due to low inherent hydraulic conductivities of the geology in these areas, it can be expected that seepage volumes would be relatively small. Groundwater seepage into excavations for building basements would need to be managed by pumping to stormwater management facilities or other suitable treatment systems.

A water management system has been incorporated into the Airport Plan to mitigate the increase in runoff and reduce offsite impacts of surface water flows and discharges from the

site. The water management system would be established at the start of the Main Construction Works (GHD 2016b) for management of stormwater discharges during both the construction and operation of the Stage 1 development. The water management system includes a series of grassed swales to convey runoff from the developed areas within the airport site, and a series of bio-retention and flood detention basins to manage flow quality and quantity prior to discharge to the receiving waters.

There is potential for impacts on downstream flows and aquatic ecology if the volume of discharge from detention basins on the site disrupts the existing flow regime downstream of the point of discharge. Depending on the nature of surface runoff water treatment, releases downstream could be more or less persistent or intermittent based on the time it takes to treat water to a sufficient level prior to release. A persistent release strategy would represent the greatest departure from current conditions given that the streams in the project area are small and ephemeral in nature. However, it would result in aeration of the waterway and the creation or enhancement of downstream riffle habitat, which would provide a beneficial outcome. An intermittent release strategy would have the opposite effect, though it may be in keeping with the existing hydrological modification associated with the presence of numerous farm dams on streams within this system. If baseflows were to be lowered, habitat deterioration in reaches downstream could occur. Results of the current study show that many of the sites downstream had low dissolved oxygen concentrations, which is probably one of the factors that contributed to the poor status of the aquatic health in those reaches. Few native species were recorded in creeks assessed in field surveys. No habitat for threatened species listed under the FM Act is present in the creeks.

The flood detention basins provide controlled release to the receiving waters in a way that mimics the natural flows as closely as possible over a range of storm durations and magnitudes. The airport site comprises approximately 4 per cent of the total catchment area for South Creek and any minor alteration to the hydrological regime is anticipated to have negligible influence on downstream flows in the catchment.

Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands is listed as a Key Threatening Process (KTP) under the TSC Act and the FM Act. Given the above considerations, the airport would have minimal influence on this KTP in particular on the airport site (see Section 5.4).

As noted above, the airport design and Land Use Plan includes measures purposefully designed to avoid further substantial alteration of hydrological regimes downstream of the airport site. A detailed Surface Water Management Plan would be developed and will consider potential adverse impacts on downstream environments throughout the course of the construction period. Mitigation measures to address impacts of changed hydrology on aquatic and riparian communities downstream of the site are required by the Airport Plan conditions and summarised in Section 9.

5.2.9 Impacts on groundwater dependent ecosystems

As noted in Section 4.1.3, all native vegetation types at the airport are considered to be groundwater dependent ecosystems. Construction of the Stage 1 development would result in direct impacts on 222.9 hectares of good condition native vegetation with an intact natural structure considered to be groundwater dependent ecosystems. There are unlikely to be impacts on the 136.7 hectares of derived native grassland given the depth to groundwater is at least 2.4m for the majority of the airport site.

Few woodland patches that would be impacted by the airport development extend across the boundary of the airport site. Much of the Badgerys Creek corridor would be retained, minimising fragmentation impacts along the southern boundary of the airport site. There would be further

fragmentation of a number of stands of woodland at the western boundary of the Stage 1 development, which would mean that some groundwater dependent ecosystems located outside the project boundary would be impacted by fragmentation. As these are currently located adjacent to mostly cleared agricultural land, these have already been subject to historical fragmentation. Patches of vegetation to the west of Willowdene Avenue would be conserved and managed as part of the conservation land for the airport, and revegetation works would be carried out which would improve and expand these patches.

Sensitive vegetation would remain along the riparian corridors of Duncans, Oaky and Badgerys Creeks. This vegetation is expected to intersect alluvial deposits which historical data suggest has limited hydraulic connection to the shale aquifers potentially impacted by the establishment of the airport. While there may be minor changes to groundwater flow within the shale aquifers, the overall groundwater fluctuation would be small and any drawdown impacts in areas of sensitive vegetation are expected to be minor (GHD 2016e).

Further, in riparian areas near to discharge points it can be expected that, while discharge rates would change, overall groundwater fluctuations would be small. Consequently, groundwater drawdown impacts in areas of sensitive vegetation are expected to be minor. There may be enhanced drawdown in localised areas where cuttings or building basements are present. Due to the hydraulic characteristics of the intersected geology, this impact is expected to be very localised (GHD 2016e).

It is expected that construction of the airport would result in a minor reduction in rainfall recharge and hence reduce groundwater discharge to surrounding creek systems. Historical water quality data and the existing hydrogeological conditions suggest that groundwater discharge forms a very low component of creek flow. This implies that the overall reliance on groundwater discharge is low and that groundwater discharge changes would have minor impacts (GHD 2016e).

During no-flow periods stagnant pool levels may be linked to surrounding groundwater elevations. While the construction of the airport may reduce overall groundwater discharge rates, it is not expected that groundwater elevations would change significantly at discharge points, such that stagnant pools will drain. Because of this, it is expected that impacts would be negligible (GHD 2016e).

Mitigation and monitoring measures were recommended in the EIS to address the identified issues and potential emergent issues that might arise during the construction and development stages of the airport and are detailed in the Groundwater Report (GHD 2016e). In line with these measures and the conditions contained in the Airport Plan, the Department commenced groundwater monitoring adjacent to woodland areas outside of the Construction Impact Zone in December 2016.

5.2.10 Erosion, sedimentation and contamination

The locality features existing hydrological modification as a result of numerous dams on the main stem channels of local waterways. These affect flow conditions and are often a source of nutrient rich, low oxygen water due to their accumulation of organic material and the long residence times for nutrients entering them. Sampling (as outlined in the EIS) and previous studies (as outlined in SMEC 2014) has shown that the water quality of the project area is poor with high levels of nutrients and suspended solids and elevated electrical conductivity levels due to salinity issues. The combination of elevated nutrients and low flows also probably contributed to the low dissolved oxygen levels observed in this study and the generally poor aquatic health on site and in downstream reaches.

There is the potential for indirect impacts on aquatic habitats adjoining and downstream of the airport site as a result of erosion and sediment mobilisation and accidental spills or release of contaminants.

Potential sources within the airport site would include:

- runoff from areas stripped of vegetation;
- runoff from soil stockpiles;
- runoff from hardstand areas, including temporary roads, processing areas and site facilities;
- leakage or spillage of hydrocarbon products from vehicles, wash down areas and workshops;
- refuelling bays and fuel, oil and grease storages; and
- release of contaminants contained in soil disturbed during earthworks.

There is a considerable risk of biodiversity impacts arising from these factors because of the scale of the Construction Impact Zone and especially the volume of earthworks. Clearing and bulk earthworks would increase the surface area and in some instances the slope of exposed soil surfaces at the airport site. These conditions would present a risk of erosion and associated surface water quality impacts (GHD 2016b).

There are sensitive environmental receptors adjacent to the Stage 1 Construction Impact Zone, including the Badgerys Creek riparian corridor and associated native vegetation. The downstream riparian corridors of Cosgrove Creek, Badgerys Creek and Duncans Creek would be particularly susceptible to impacts, although these reaches already exhibit poor aquatic health. The Airport Plan includes conditions that require monitoring within and downstream of the site and implementation of measures to maintain water quality. The Department commenced surface water quality monitoring in accordance with the conditions in November 2015.

There is a risk of sediment mobilisation and transportation to downstream environments given the extent and magnitude of clearing and earthworks for the airport. Increased sediment mobilisation could result in short term elevations in turbidity, but in worse cases, could result in the short to medium term infilling of pool habitat and smothering of riffle habitat downstream. This would markedly reduce the habitat quality for aquatic fauna. Elevated turbidity can have both direct and indirect effects on aquatic flora and fauna. Suspended sediment particles, if in high enough concentrations, can clog the gills of macroinvertebrates, abrade and damage the gills of fish and clog the filter feeding apparatus of some macroinvertebrate species. Prolonged periods of elevated turbidity can lead to reduced growth of periphyton and submerged aquatic macrophytes, which are a food and habitat source for resident aquatic fauna. Unless there is catastrophic uncontrolled sediment runoff, it is likely that elevated turbidity will be short lived. Local aquatic flora and fauna are likely to be adapted to experiencing short pulses of elevated turbidity during rainfall events. Given these considerations and the mitigation measures that would be implemented in accordance with the Airport Plan, potential impacts are likely to be both short term and limited.

Contamination of downstream waterways as a result of fuel, oil or chemical spills may occur during construction. If not properly contained, these could potentially result in reduced habitat quality and potentially the direct mortality of aquatic fauna and flora. In general, most fuel and oil spills will be small in size, such that their potential impacts will be highly localised. Fuel also volatilises such that small spills are likely to result in short-lived impacts to aquatic flora and fauna. There is always the potential for larger spills to occur, which could lead to more extensive

and medium term impacts in reaches downstream. Surfactants used to clean up large fuel and oil spills can also be toxic to aquatic flora and fauna.

The airport site has historically comprised a variety of land uses, including rural residential, agricultural, poultry farming and light commercial activities. High risk areas for potential contamination typically comprised sites of demolished buildings, significant disturbance of earth (indicating filling with material of unknown origin), the dumping and/or stockpiling of waste material that may contain asbestos and current or historic fuel storage areas (refer to chapter 14 of the EIS). Given the historic landuse at the airport site, it is possible that soil excavation could result in contaminants being unearthed. If not properly identified and contained/removed, those chemicals could be mobilised to local waterways as part of surface water runoff. It is possible that these chemicals may result in acute toxicity effects to local aquatic fauna, though it is likely that their influence would be temporary, small in extent and somewhat nullified by dilution during runoff events.

The design capacity and placement of the water management system would ensure that all drainage water from disturbed areas would typically be captured prior to discharge. The drainage system would include the main detention basins (see Figure 1–1) supplemented by a series of interim sediment basins and control measures within the immediate work area. The drainage system would have the effect of improving the quality of the surface water prior to release by allowing sediment to settle within the basins. The drainage system, in combination with other standard construction erosion control measures, would readily mitigate the potential impacts of sedimentation (GHD 2016b).

Soil protection measures and techniques for the management of chemicals and spills will be documented in CEMPs as required by the Airport Plan conditions (see Section 7.2). Any localised increases in erosion hazard or sources of other contaminants as a result of construction would be limited to the immediate earthworks footprint and there would be appropriate control devices and buffers between the earthworks footprint and sensitive receptors, staged clearing and rapid stabilisation of soil surfaces.

With the sediment basins and other mitigation measures in place, construction is not expected to have any significant impact on existing water quality concentrations in the receiving waters downstream of the site. Any exceedances would likely be localised and short term (GHD 2016c). As such, the Stage 1 development is not likely to affect water quality of downstream aquatic habitats.

The water management system includes a series of grassed swales to convey runoff from the developed areas within the airport site, and a series of bio-retention and flood detention basins to manage flow quality and quantity prior to discharge to the receiving waters. Low flows are diverted to the bio-retention system for water quality treatment, while the higher flows are designed to bypass the system and discharge directly into the flood detention basins. The flood detention basins provide controlled release to the receiving waters in a way that mimics the natural flows as closely as possible over a range of storm durations and magnitudes.

5.2.11 Dust generation

Construction of the Stage 1 development would result in dust emissions generated during both the bulk earthworks and the aviation infrastructure activities. High dust levels could reduce habitat quality for flora and fauna species by reducing plant and animal health in adjacent areas of vegetation. Dust may affect photosynthesis, respiration and transpiration in plants and allow the penetration of gaseous pollutants. This then leads to decreased productivity, and in the long-term can alter community structure (Farmer 1993). Dust would also impact health of fauna, such as through respiratory disease, and the reduction in health of animals would be exacerbated by changes to plant health and community structure. Mitigation measures to

minimise impacts of dust will be documented in a soil and water management CEMP (see Section 7.2).

5.2.12 Generation of light, noise and vibration

There would be noise impacts during construction as a result of vegetation clearing, the movement of vehicles and operation of plant. Much of the airport site currently experiences ongoing noise from vehicles travelling along roads, from agricultural activities and from light aircraft operating from existing aerodromes. Given the existing noise levels in the vicinity of the airport, clearing and construction noise is not likely to be a novel impact for most fauna species. Background noise levels associated with clearing and construction would increase, and would persist for many years. This would impact fauna both within the site and in adjacent areas. There is the potential for individuals that nest or den in trees that are close to the airport edge abandoning their nests and dens as a result of noise during construction. Noise may also affect general fauna activity in these areas. Many fauna individuals are, however, likely to become habituated to the increased noise levels in the long-term.

Light spill from construction areas may occur at night. Parts of the airport site are already subject to light from streetlights, residences and other buildings. Construction would change the location of lighting, introducing light to areas previously not subjected to artificial light, and increasing light levels in areas already subject to existing light. This may disturb fauna in adjacent vegetation, changing their behaviour patterns. Fauna are likely to become habituated to light in the long-term.

Vibration impacts may result from works associated with the airport, such as heavy vehicle movement and construction activities. Vibration may deter native fauna from using the area surrounding the source of vibration. This may potentially interrupt dispersal within the locality if an individual is unwilling to travel through an area where vibration is detectable, or may cause some species to abandon an area in search of areas where vibration is not detectable. Within the airport site, some level of vibration is already present as a result of vehicles travelling along roads in the area. Vibration throughout the airport site and adjacent areas during construction would increase.

5.2.13 Spread of pests and pathogens

Construction activities within the airport site have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can cause 100 per cent mortality in some populations once introduced into an area. Mitigation measures to prevent the introduction or spread of disease that could potentially impact threatened biota in adjacent areas will be documented in a CEMP in accordance with the Airport Plan conditions (see Section 7.2).

5.2.14 Fire

Construction of the airport has a risk of fire, for example from storage of combustible fuels or ignition from works areas. The risk of fires spreading to adjacent areas would be expected to be minimal given the fire hazard management plan and other measures to contain and control the outbreak of fire.

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5.3 Operation impacts

5.3.1 Bird and bat strike

The presence of the airport would create a risk of mortality for birds and bats at or near the airport. Birds are often attracted to airports because of grass, lights, water, feeding trees, or roosts, while flying-foxes tend to come in contact with aircraft while transiting between roosting sites and foraging areas (Parsons et al 2009).

Most bird strikes occur at take-off or landing and within 5 kilometres of aerodromes, regardless of the type of aerodrome (ATSB 2009). Species involved in bird strikes are generally typical of the habitats that occur in close proximity to the site of the airport, rather than migratory species moving at higher altitude across the landscape. Ninety-three per cent of bird strikes occur below 3500 ft.

Analysis of strike data from 2002-2009 found that in general lapwings and plovers were the most common species to be involved in aircraft strike in Australia (597 incidences), followed by flying-foxes (542 incidences) and Galahs (532 incidences). In NSW, this order is reversed, with Galahs being the most common species struck by aircraft, followed by flying-foxes then lapwings and plovers (ATSB 2009). Galahs are the species for which strikes of more than one bird (i.e. a flock) are most likely to occur, according to data collected between 2004 and 2014 (ATSB 2014). Combining raptor groups, kites, hawks and eagles were struck 769 times over the period in Australia, and 98 times in NSW (ATSB 2009). Large water birds, such as ibis and herons, were struck 170 times between 2002 and 2009 (ATSB 2009) and waders such as curlews and sandpipers (i.e. migratory waders), were hit 187 times in this period, the majority (180) being from Queensland and the Northern Territory (ATSB 2009). The highest rate of bird strike was found to occur at Darwin and Cairns, likely due to the higher bird populations present in tropical areas (ATSB 2009).

A high diversity of bird species was recorded at the airport site, including many species that occur in large flocks, or would fly at heights where aircraft strike is a risk. A small number of large raptors were observed in the airport site, including Wedge-tailed Eagles, White-bellied Sea-eagles, Little Eagles, Black Kites and Whistling Kites. It is most likely that one or two pairs of each species occur in or near the airport site. Large flocks of ibis and herons occur in and around the airport site, due to the large number of farm dams as well as fertilised crop fields, as do a wide variety of ducks and other water birds. Few migratory wader species are likely to occur in and around the airport site, although at least two species were recorded. A wide range of other bird species is also likely to be at risk of aircraft strike, including magpies, swallows, ducks and ravens.

The bird and bat strike risk assessment prepared for the airport (Avisure 2015) found that these species would be likely to remain in the area and present at least a moderate strike risk during operation of the airport. Farm dams are common in the surrounding area and present the greatest bird hazard for the airport. Nearby landfills, such as Spring Farm Landfill, also support high numbers of large birds, which may result in birds transiting operational airspace (Avisure 2015). Although potentially moderate and high risk species were recorded in surveys by both Avisure and GHD, their numbers were not unusually large and there were limited transits through the air (Avisure 2015). While birds are likely to be struck on occasion, management measures would minimise the risk of this occurring, and as such the viability of populations in the local area are not likely to be threatened.

As noted above, flying-foxes are one of the more common species hit by aircraft in Australia and NSW. Flying-foxes can be resident at a camp, may migrate locally between nearby camps, or may move nomadically long distances (Eby 1996). Camp populations do not function as a unit. Individuals or small groups move independently of other flying-foxes (Eby 1991), and may

therefore move between camps at different times. A radio-tracking study of Grey-headed Flying-foxes in Sydney found that individuals or small groups were frequently found to roost at various sites throughout metropolitan Sydney, and interchange between the Cabramatta and Gordon colony sites was observed. Gordon colony bats were also recorded at various camps on the NSW north and south coasts (Augee and Ford 1999). A previous radio-tracking study had also found considerable interchange between bats in adjacent colonies (Spencer et al 1991). Based on bat strike data collected at Australian airports between 1996 and 2006, most bat strikes occurred around sunset, and about three quarters of recorded bat strikes occurred during landing of aircraft. Grey-headed Flying-foxes typically leave their day roost within 30 minutes after sunset. Bat strike rates differed in airports depending on location, with the five highest rates of bat-strike occurring in tropical regions (Parsons et al 2009).

Given these results, movement of flying-foxes can occur between the camps present near the airport at any time. There are at least seven camps located within 20 kilometres of the airport (Avisure 2015), and the locations of these may result in individual bats flying across the airport and approaches and being at risk of mortality from aircraft strike. In addition, bats travelling from local camps to foraging areas may also fly across the airport and approaches and be at risk of mortality from aircraft strike. While occasional bats may be killed by aircraft strike, this is not likely to substantially change the population numbers in nearby camps.

Despite the risk of bird and bat strike due to species presence and abundance, habitat availability on and around the site, and projected aircraft movements, the location of the airport would reduce the overall risk relative to other possible locations. For example, the airport site is not located in a tropical area, is not near an estuary, is not within a major bird migratory route, and does not have flying-fox camps in close proximity. As such the overall abundance of birds and bats would be lower than if these were the case. Habitats currently on the airport site that are attractive to birds, including in particular farm dams and wetlands, will be removed during construction of the Stage 1 development. In addition, the available habitat in the locality would reduce over time as areas around the airport urbanise (Avisure 2015). Furthermore, each potential contributor to bird and bat strike risk at the airport can be managed to an acceptable risk level so the overall bird and bat strike risk for the airport is low (Avisure 2015).

Given the presence of proximate suitable habitat and the movements of birds and bats through the local landscape, there is a potential for birds to be struck on occasion. As outlined in the EIS and the conditions in the Airport Plan, additional surveys (including those conducted for this BAR) will be conducted to inform the detailed design and mitigation measures to reduce the risks of bird strikes and associated impacts on biodiversity. Based on existing data for airports throughout Australia and the findings of the bird and bat strike assessment (Avisure 2015), the numbers of birds and bats likely to be involved in air strikes over time is unlikely to be of a magnitude that would adversely affect the viability of populations of native fauna in the local area.

5.3.2 Terrestrial fauna strike

Movement of aircraft and support vehicles on the tarmac has the potential to result in mortality or injury of fauna that reside or forage in cleared areas alongside the tarmac. These fauna species may attempt to cross the tarmac and thus be struck by aircraft and support vehicles. Fencing of the airport is likely to prevent large mammalian fauna such as kangaroos and wallabies occurring within the airport site, thus minimising the potential for impact. The airport would be designed to be unattractive to wildlife and would be managed to deter occurrence. Measures to minimise the risk of terrestrial fauna strike will be documented in a Biodiversity CEMP and traffic and access management CEMP (see Section 7.2).

Operation of the airport would increase general traffic in the area surrounding the airport, and could result in increased risk of fauna mortality on surrounding roads. Vehicle strike on surrounding roads is already likely to be high, given the presence of vegetated and agricultural areas. As further development occurs as a result of the airport and more areas of agricultural and forested land are removed, fauna mortality from vehicle strike would reduce.

5.3.3 Noise and vibration

Increased noise and vibration would occur in adjacent vegetated areas from the operation of the airport, via both aircraft and vehicle movements. Fauna most at risk would be those residing in close proximity to the airport. Most fauna species are likely to become accustomed to the noise and vibration, as many species that occur in the surrounding area are already accustomed to noise from roads and agricultural areas. The increased noise and vibration may result in the displacement of less tolerant species.

Noise would extend into surrounding areas as a result of landing and take-off of aircraft. Indicative flight paths for the Stage 1 operation of a single runway are included in the conceptual airspace design. Final flight paths for the airport will be developed through the formal airspace design process which is outlined under Condition 16 of the Airport Plan. Based on the 05/23 runway orientation for Stage 1, there are two main operating modes that will occur, depending on the prevailing meteorological conditions (section 2.1.5.2 of the Airport Plan). Aircraft may approach the airport from the south-west and take off to the north-east or approach the airport from the north-east and take off to the south-west. The indicative flight paths presented in Chapter 7 of the EIS show two major departure tracks in each direction, which each branch off to other flight paths at distances that are relatively far from the airport. For departures to the south-west there is a third flight path passing roughly over the township of Warragamba that then extends in a north-west direction. This flight path was designed for use by non-jet aircraft only, which would limit predicted noise exposure in areas beneath this route. Total numbers of aircraft movements per day are predicted to be about 198 in 2030, increasing to over 1000 in 2063. The majority of aircraft movements are likely to be by large aircraft, such as the Airbus A320 (refer to Chapter 7 of the EIS).

An overall sound power level (noise level at source) of 151 dBA has been assumed for take-off of aircraft based on previous measurements of a number of aircraft types. Reverse thrust during landing would result in an overall sound power level (noise level at source) of 154 dBA. Taxiing aircraft may produce a sound power level (noise level at source) of 138 dBA. Noise levels above 65 dBA are expected to extend up to about four kilometres outside the northern boundary of the airport (Wilkinson Murray 2015a).

Given the removal of vegetation during construction, there would be minimal impact of noise on fauna within the airport itself, as most fauna would no longer occur within the airport site. Aircraft operations to the north-east of the airport will occur over areas where there is minimal native vegetation. Aircraft noise would impact fauna that occur along riparian corridors such as South

Creek, and at farm dams in the area. Aircraft operations to the south-west of the airport would occur over relatively small patches of vegetation in close proximity to the airport.

Noise has been shown to have a variety of impacts on fauna, including changing foraging behaviour, impacting breeding success and changing species occurrences (Barber et al 2009). A number of studies have investigated the effect of aircraft noise on fauna. Peregrine Falcons (*Falco peregrinus*) have been shown to be tolerant of aircraft noise in the range 80-87 dBA, but low level aircraft flights have resulted in flight response, nest abandonment or reproductive failure (Ellis, Ellis, & Mindell, 1991). Anderson et al (1996) found that Red-tailed Hawks (*Buteo jamaicensis*) show strong avoidance behaviour as a result of novel impacts from low-level helicopter flights, but do habituate to the noise over time. Ducks have been shown to react to low-flying aircraft, but the energetic costs to each species were deemed low because disruptions represented a low percentage of their time-activity budgets, only a small proportion of birds reacted to disturbance, and the likelihood of resuming the activity disrupted by an aircraft disturbance event was high (Conomy et al 1998). Some animals have been shown to change their distributions in response to anthropogenic noise. The response of Sonoran Pronghorn (*Antilocapra americana sonoriensis*) to military jets (avoiding high areas) could exacerbate habitat fragmentation and connectivity (Landon et al 2003).

A number of studies have investigated impacts of road traffic noise on fauna. Studies on bats have found that some species avoid foraging in noisy areas such as near highways (noise levels between 68-80 dBA) as the noise may interfere with listening for prey (Schaub et al 2008). Similarly, highways have also been shown to have an impact on woodland birds, resulting in lower incidence of bird occurrence near noise (Reijnen et al 1995). Traffic noise has also been shown to interfere with frogs, resulting in decreases in calling activity, and preventing females from easily locating the source of male calls, both of which could reduce reproductive success (Bee and Swanson 2007, Lengagne 2008).

Most impacts on fauna are likely to occur near the airport, where aircraft are low and noise levels are highest. Many species would have already relocated given the removal of vegetation associated with construction of the airport. Given the patchy nature of surrounding vegetation, this may increase competition for resources in other areas of native vegetation. Species less tolerant to disturbance may be displaced as a result of the airport. Constant noise from aircraft and other vehicles would make the surrounding area less suitable for species that are less tolerant of disturbance. Species that remain in the area may be affected by aircraft and other noise at the airport. Some birds are known to abandon their nests in response to noise. This would be of particular concern for the White-bellied Sea-eagle and Little Eagle as these large raptors are likely to use permanent nest sites near the airport. These species may have the initial breeding season disrupted when the operation of the airport commences, but are likely to relocate and breed elsewhere. Other more resilient fauna species are likely to become accustomed to the noise, and this increased or novel impact is unlikely to result in a decrease in population numbers or diversity of these species.

5.3.4 Light

Increased light would result from the operation of the airport, via landing lights, tarmac lighting, terminal lighting and aircraft and vehicles. Impacts would be greatest in areas immediately adjoining the airport. Some fauna species are likely to become accustomed to the light, including species such as possums and the Tawny Frogmouth which are common and widespread in areas with street lights across suburban Sydney. Many fauna individuals and species that are currently resident at the airport site would already be accustomed to existing residential and road lighting. The increased light may result in the displacement of less-tolerant species, but could also attract some birds and bats that forage on insects attracted to light.

These species may then be susceptible to aircraft strike in the absence of mitigation (see Section 5.3.1).

5.3.5 Fire

Operation of the airport will create a risk of fire, for example from storage of combustible fuels, and ignition from works areas. The risk of fires spreading to adjacent areas would be expected to be minimal given the fire hazard management plan and other measures to contain and control the outbreak of fire.

5.3.6 Contamination

Operation of the airport could result in spills of aviation fuel, vehicle fuel and other chemicals. Management of the airport is also likely to require the use of pesticides and/or herbicides in mown areas near the tarmac and along roadsides. These chemicals could potentially enter local waterways and impact aquatic and riparian habitat downstream of the airport. Appropriate mitigation measures would be incorporated into the management of the airport and other infrastructure to minimise the risk of impact of chemical spills.

5.3.7 Water quality

The change in land use from a largely rural-residential area to an airport facility will have long-term effects on water quality in downstream reaches close to the airport site. Existing water quality at the airport site is poor, with high levels of nutrients and suspended solids and elevated electrical conductivity levels. Nutrient loads in the existing waterways are generally high and do not achieve ANZECC water quality objectives for total phosphorus and total nitrogen. However, total suspended solids loads are generally low and below ANZECC Guideline levels (GHD 2016c).

Nine bio-retention basins would be located along the perimeter of the airport site. Basins 1, 2, 3, 4, and 5 would be located along the southern boundary to provide water quality treatment of the stormwater flows prior to discharge to Badgerys Creek. Basins 6 and 7 would be situated along the northern boundary to manage the flows discharging into Oaky Creek and Cosgroves Creek. Basins 8 and 9 would be positioned to manage flows discharging into Duncans Creek. All the basins are proposed for construction during Stage 1 of the project, except for basins 4 and 5, which would be constructed during the long term development phase (GHD 2016c).

Modelling the impact of surface water runoff pollutants on the receiving water environment has been undertaken for suspended solids, nutrients (phosphorous and nitrogen) and gross pollutants. The modelling has considered the effectiveness of the proposed water management system to meet the objectives for the receiving waters in accordance with:

- existing or pre-development pollutant loads for consideration of a neutral or beneficial effect (NORBE);
- the Western Sydney Urban Design (WSUD) Guidelines; and
- the ANZECC Guidelines / Airports (Environment Protection) Regulations 1997.

The NORBE approach to water quality management requires that post development pollutant loads discharging from a site are managed such that the water quality is equal to or better than the pre-development or existing loads. The approach is typically extremely difficult to achieve when modifying land use from a rural to an urbanised or developed catchment.

The Stage 1 development would result in increased loads of phosphorous and nitrogen, largely as a function of the increase in runoff volumes associated with the modified catchment areas and changes to land use. Relative increases in phosphorous and nitrogen loads attributed to the airport would be most pronounced at the airport site and would progressively decrease

downstream of the airport site as receiving waterways receive flows from the wider catchment. The proposed drainage system would be effective at reducing loads of suspended solids in surface water in comparison to existing conditions.

The WSUD Guidelines specify pollutant reduction targets as a practical way of treating urban stormwater quality, with targets of 80 per cent of suspended solids, 45 per cent of total phosphorus, and 45 per cent of total nitrogen should be retained on the airport site. The proposed water management system has been designed to achieve the WSUD Guidelines and the civil design has allowed for flexibility to increase the level of treatment in the future. The nine basin outlets effectively represent the locations where the pollutant loads generated from the airport would discharge into the downstream environment. The results show that, in terms of suspended solids, total phosphorus and total nitrogen Basins 1, 3, 6, 7 and 8 satisfy the reduction target. Basins 2 and 9 do not completely satisfy the retention target and increasing the treatment area is recommended during the detailed design of these basins.

The ANZECC Guidelines take into account the relative health and assimilative capacity of the receiving waterways and aim to keep the pollutant concentrations exported from a site to levels that the receiving waterways can sustain. While the Stage 1 development will generally result in improvements in pollutant concentrations locally and regionally, the improvements would not be sufficient to meet the default ANZECC guideline objectives due to the degraded nature of the existing catchment. Nevertheless, it is noted that the airport does not preclude the opportunity to make further improvements in downstream water quality in South Creek in the future, to work towards satisfying the NSW Water Quality Objectives.

Additional design measures would need to be assessed and included for implementation during the detailed design phase. These would include the provision of enhanced bioretention systems and the provision of diversion drains to convey flows from residual sub-catchment areas to the proposed bio-retention basins. Additional mitigation and management measures, including water quality monitoring, should also be implemented during the construction and operational phases of the project (GHD 2016c).

An estimated 2.5 ML of domestic wastewater per day would be generated during operation of the Stage 1 development (GHD 2016c). The wastewater would be reticulated, treated and recycled (as grey water) or irrigated on site. Treatment and irrigation methods would be determined in detailed design, but it is expected that wastewater would be treated to a high quality with membrane biological reactor technology to produce high quality reclaimed water suitable for beneficial reuse or irrigation.

The key risks to surface water and groundwater associated with the irrigation of reclaimed water are runoff to surface water or infiltration to groundwater. These risks would be limited as reclaimed water would be relatively high quality and appropriate management practices such as balancing storages and proper irrigation scheduling to avoid excessive irrigation are proposed.

Given the existing poor water quality downstream of the site and with the implementation of the above mitigation measures, it is expected that the airport would have no adverse impact on downstream water quality and aquatic health (GHD 2016c). As such, the airport is unlikely to have an adverse impact on downstream key fish habitat and other aquatic or riparian habitat, or on threatened species that may occur downstream of the airport site.

5.3.8 Hydrology and downstream impacts

The alterations to the topography and permeability of the airport site made during the Main Construction Works would persist through operation of the Stage 1 development. Flows in receiving watercourses upstream and downstream of the airport site would be affected, relative to existing conditions. The Stage 1 development would result in a portion of the airport site currently draining towards the catchments of Oaky and Cosgroves Creeks to the north being diverted south towards Badgerys Creek whilst a portion of the airport site draining to Badgerys Creek would be diverted to Duncans and Oaky Creeks.

Changes to flooding have the potential to affect the physical condition of watercourses. Hydrologic and hydraulic modelling indicates that duration, volume and velocity of surface water flows in watercourses would be generally similar or reduced when compared to existing flow conditions (GHD 2016b).

Minor impacts on aquatic habitat downstream of the site may occur as a result of altered hydrology. These impacts are likely to be generally restricted to reaches close to the airport site. Further downstream, inflow from other creeks will dissipate these changes. Given the existing generally poor quality of aquatic habitats at the airport site and downstream of the airport site, the airport is unlikely to have a substantial impact on fish habitat in downstream areas. No threatened species listed under the FM Act are likely to occur immediately downstream of the airport site. The airport is unlikely to have an impact on the habitat of terrestrial threatened species that may occur downstream of the airport site.

The surface water management systems at the airport site will be designed to avoid substantial alteration to surface water drainage patterns and the volume of downstream flow. This will minimise the potential for adverse impacts to the downstream environment (GHD 2016b). Detention basins are the primary design control measure proposed to mitigate increases in peak flow and changes to the timing of flows as well as manage discharge velocities.

An estimated 2.5 ML of domestic wastewater per day would be generated during operation of the Stage 1 development (GHD 2016c). The wastewater will be reticulated, treated and recycled (as grey water), or potentially used for irrigation on site. Irrigation water has the potential to affect the quantity of flow into receiving waterways depending on the means of application and irrigation technology. The irrigation area would be designed and operated in accordance with the risk framework and management principles contained in the *National Guidelines on Water Recycling (Environment Protection and Heritage Council 2006)* and the Environmental guidelines: *Use of effluent by irrigation* (NSW DEC 2004). It is considered that this approach would minimise potential impacts to the patterns of flow in the downstream environment.

Treatment and irrigation methods would be determined in detailed design but is expected that wastewater would be treated with Membrane Biological Reactor technology. This technology produces high quality reclaimed water suitable for beneficial reuse or irrigation (refer to GHD 2016b).

Any groundwater seepage into cuts and subsurface basement areas would be treated and discharged back to the environment and/or removed offsite to a treatment facility. Groundwater seepage is not considered likely in significant volumes and discharge of high volumes into the surface water system would not be required (GHD 2016b).

Mitigation measures to address operational impacts of changed hydrology on aquatic and riparian communities downstream of the site will be implemented in accordance with the Airport Plan conditions and the Surface Water Hydrology and Geomorphology report (GHD 2016b). The Department has commenced water monitoring at the airport site in accordance with the Airport Plan conditions.

5.3.9 Impacts on groundwater dependent ecosystems

While the sources of groundwater quality impacts during airport operation would be slightly different to those present during construction (refer to Section 5.2.9), the overall migration pathways and risk to sensitive receptors would be similar. As noted for construction, there will always be an inherent risk (albeit very low) to water quality at surrounding surface water features and sensitive groundwater reliant vegetation (GHD 2016e). Mitigation and monitoring of groundwater is being implemented by the Department to address the identified issues and potential emergent issues that might arise during the operational stages of the airport and to allow remedial action to be taken where required.

5.3.10 Fuel jettisoning

Emergency fuel jettisoning (commonly referred to as fuel dumping) could result in impacts on biodiversity values by introducing harmful contaminants into sensitive environments. The region surrounding the airport includes sensitive receptors, including native terrestrial vegetation and freshwater, estuarine and marine environments. However, given the rarity of fuel jettisoning globally, the low known occurrence in Australian airspace, and the high evaporation rates known to occur at high altitude, it is unlikely that fuel jettisoning from aircraft using the airport would have any impact on biodiversity values.

Fuel jettisoning is extremely rare and usually related to emergencies for civilian aircraft where aircraft need to make an unscheduled landing. Aircraft do not jettison fuel as a standard procedure when landing. Many of the commonly used aircraft that perform the majority of domestic flights in Australia (e.g. the Boeing 737 and the Airbus 320) do not have fuel jettisoning capability as they do not need to reduce their weight in order to make an emergency landing. All international long haul aircraft, and some medium-to-long haul aircraft are able to jettison fuel (refer to Chapter 7 of the EIS).

Instances of fuel jettisoning are extremely rare worldwide. In Australian airspace, there were 10 reported instances of civilian aircraft dumping fuel in 2014 from 698,856 domestic air traffic movements and 31,345 international movements (approximately 0.001 per cent of all movements). There are no recorded cases in Australia of fuel from civil aircraft reaching the ground.

The procedure for fuel jettisoning is specified in the En Route supplement of the Aeronautical Information Package published by Airservices Australia as outlined in Chapter 7 of the EIS. When fuel jettisoning is required, the pilot in command requests authority from air traffic control before commencing the operation and must:

- take reasonable precautions to ensure the safety of persons or property in the air and on the ground;
- where possible, conduct a controlled jettison in clear air at an altitude above 6,000 feet (approximately 1.8 kilometres) and in an area nominated by air traffic control; and
- notify air traffic control immediately after an emergency jettison.

The unauthorised jettisoning of fuel in flight is an offence. The Air Navigation (Fuel Spillage) Regulations 1999 prescribe penalties for the unauthorised release of fuel from an aircraft other than in an emergency. The effects of fuel jettisoning on local air quality would be limited due to the inability of many aircraft to jettison fuel, the rapid vaporisation and dispersion of jettisoned fuel and the strict regulations on altitudes and locations for fuel jettisoning. For these reasons, fuel jettisoning is not considered likely to have any immediate or future impact on local air quality or biodiversity values.

5.3.11 Introduction of novel species

As with any international airport or seaport, operation of the airport poses a biosecurity risk. There is the potential for the introduction of exotic species as a result of the transport of goods on aircraft. For example, the one record of Yellow Crazy Ants (*Anololepis gracilipes*) from New Zealand is likely to have been a transit passenger (on taro in air baggage) (Biosecurity New Zealand, undated). Invasion of Yellow Crazy Ants is listed as a key threatening process under the TSC Act (see Section 5.4). Any escaped novel species could potentially establish in nearby vegetated areas, or be transported to other areas of native vegetation with cargo, and impact the local native flora and fauna.

All aircraft arriving in Australia from overseas are subject to Australian biosecurity requirements administered by the Department of Agriculture and Water Resources. Further, the airport and airlines using the airport would be expected to comply with all Australian laws relating to biosecurity, similar to existing airports already in operation.

5.4 Key threatening processes and threat abatement plans

A threatening process is defined as a key threatening process (KTP) if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community (DoE 2015d). A process can be listed as a KTP if it could:

- cause a native species or ecological community to become eligible for inclusion in a threatened list (other than the conservation dependent category); or
- cause an already listed threatened species or threatened ecological community to become more endangered; or
- adversely affect two or more listed threatened species or threatened ecological communities.

KTPs are listed under the EPBC Act, TSC Act and FM Act. Some KTPs are listed under more than one Act.

Threat abatement plans (TAPs) establish a national framework to guide and coordinate Australia's response to key threatening processes registered under the EPBC Act. TAPs have also been listed under the TSC Act. The plans identify research, management and other actions needed to ensure the long-term survival of native species and ecological communities affected by KTPs.

KTPs of relevance to the airport are discussed in Table 35. Where TAPs have been published for the KTPs, these are also noted.

Mitigation measures will be documented in a Biodiversity CEMP and implemented in accordance with the Airport Plan conditions where relevant for KTPs detailed in Table 35 (see Section 7.2). Mitigation measures have been developed with reference to the information provided in the KTP listing and the relevant TAPs. The construction and operation of the airport would not result in any actions that would contravene any relevant TAPs.

Table 35 Key Threatening Processes and Threat Abatement Plans of relevance to the airport

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Comment
EPBC Act key threatening processes			
Clearing of native vegetation	EPBC Act, TSC Act		It is expected that approximately 359.6 hectares of native vegetation would be cleared in the Stage 1 Construction Impact Zone. This includes around 190.8 hectares of better condition vegetation with a forest or woodland structure and 136.7 hectares of derived native grassland or scrub, as well as 32.1 hectares of wetlands. Given the extent of vegetation removal and habitat fragmentation on the Cumberland Plain this would comprise a substantial contribution to the operation of this KTP. Mitigation measures will be documented in a Biodiversity CEMP (see Section 7.2) to minimise the impact of the airport on native vegetation as far as possible.
Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	EPBC Act, TSC Act		Garden plants are present at the airport site, particularly in proximity to existing or recently demolished residences. Garden plants were also observed in native vegetation that had regrown where a nursery used to be located. Clearing of vegetation for the airport is not likely to further increase the spread of these garden plants. Alligator Weed was recorded at a large dam at the western end of Elizabeth Drive and Salvinia and Water Hyacinth were recorded in the broader study area. Construction of the airport could result in the spread of these aquatic Weeds of National Significance to downstream areas outside the airport. Mitigation measures will be documented in a Biodiversity CEMP (see Section 7.2) to minimise the spread of weeds.
Novel biota and their impact on biodiversity	EPBC Act		Airports create a biosecurity risk by providing a means for novel biota to enter an area. Management of biosecurity at airports is carried out by the Australian Quarantine Inspection Service (AQIS). Mitigation measures will be documented in a Biodiversity CEMP (see Section 7.2) to minimise the the risk of impact during operation of novel biota in the area.
Infection of native plants by *Phytophthora cinnamomi*	EPBC Act, TSC Act	Disease in natural ecosystems caused by *Phytophthora cinnamomi*	Cumberland Plain Woodland is identified in the *Phytophthora cinnamomi* TAP (DoE 2014b) as a TEC that may be impacted by disease. Construction activities have the potential to introduce Phytophthora into the airport site, through the transport and movement of plant, machinery and vehicles, as well as through any landscaping works following construction. The Biodiversity CEMP and related plans required by the Airport Plan conditions will include environmental management measures to reduce potential impacts on soil, water and native vegetation (see Section 7.2).

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Comment
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	EPBC Act, TSC Act	Infection of amphibians with chytrid fungus resulting in chytridiomycosis	Chytrid fungus is a water borne pathogen and could be spread through water or mud on vehicles, machinery, footwear and other equipment. Chytrid invades the skin of frogs causing skin legions, which can kill them or make them susceptible to other threats (e.g. predators, climate change). This highly virulent fungal pathogen of amphibians is capable at a minimum of causing sporadic deaths in some populations, and 100 per cent mortality in other populations. It is unknown if the disease occurs at the airport site. Construction activities have the potential to introduce or spread chytrid fungus in adjacent areas. Mitigation measures will be documented in a Biodiversity CEMP (see Section 7.2) to minimise the risk of introduction or spread of chytrid fungus at the airport site, in line with recommendations in the TAP (DEH 2006).
Aggressive exclusion of birds from potential woodland and forest habitat by over-abundant noisy miners (*Manorina melanocephala*)	EPBC Act, TSC Act		Noisy Miners are a dominant species at the airport site. Clearing of vegetation for the airport may increase the incidence of this species in adjacent woodland and forest habitat, either through displacement of individuals or an increase in patchiness, which may encourage their presence, further exacerbating this KTP.
Predation by the European red fox	EPBC Act, TSC Act	Predation by the red fox (*Vulpes vulpes*)	The European Red Fox was recorded at the airport site during field surveys. Predation by the Red Fox has the potential to affect the Grey-headed Flying-fox and migratory species (mainly wetland birds) assessed in this report. Clearing of vegetation would remove habitat for this species at the airport site, but may result in displacement of individuals into adjacent areas, increasing the risk of predation by the species in the short term. The operation of the airport is not likely to exacerbate the operation of this KTP as the site would be fenced.
Predation by feral cats	EPBC Act, TSC Act	Predation by feral cats	The Feral Cat (*Felis catus)* was not recorded at the airport site during field surveys but it is likely that feral cats occur at the airport site and prey on individuals of relevant threatened fauna. Clearing of vegetation would remove habitat for this species at the airport site, but may result in displacement of individuals into adjacent areas, increasing the risk of predation by the species in the short term. The operation of the airport is not likely to exacerbate the operation of this KTP as the site would be fenced.
Competition and land degradation by rabbits	EPBC Act, TSC Act	Competition and land degradation by rabbits	The Rabbit was recorded at the airport site. The airport is unlikely to lead to an increase in the abundance or distribution of rabbits within the airport site, but may displace individuals to adjacent areas in the short term. The operation of the airport is not likely to exacerbate the operation of this KTP as the site would be fenced and feral animal control would be carried out.

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Comment
Human-caused climate change	EPBC Act, TSC Act		Deforestation associated with construction of the airport and combustion of fuels associated with construction and operation will contribute to anthropogenic emissions of greenhouse gases. The Stage 1 development would remove about 359.6 hectares of native vegetation. Construction and operation of the airport would lead to considerable fuel combustion. Hence, the airport would exacerbate this KTP. The airport is located in Western Sydney, a region undergoing substantial urban development. All development in the region would contribute to the increase in greenhouse gas emissions, further increasing the risks associated with climate change. The contribution of the Stage 1 developoment to global greenhouse gas emissions would not be significant: The airport would contribute less than 0.09 per cent of NSW's total anthropogenic emissions for 2011-2012, and would account for approximately 0.11 per cent of the total forecast 'Transport' greenhouse gas emissions for Australia in 2029-2030 (GHD 2016d). The EIS identifies a number of mitigation measures to minimise the proposed airport's greenhouse gas emissions including measures to minimise the clearing of vegetation where possible, which will be documented in a Biodiversity CEMP (see Section 7.2).
TSC Act and FM Act key threatening processes			
Clearing of hollow-bearing trees	TSC Act		Hollows are not abundant at the airport site given the young age of much of the regenerating woodland. Some large hollow-bearing trees are present along riparian corridors and in larger patches of woodland that contain remnant vegetation. Given the area of vegetation to be cleared, a large number of hollows would be lost, reducing breeding habitat for species such as possums, bats and parrots. Few large hollows suitable for forest owls and large cockatoos are present. Habitat management will be documented in a Biodiversity CEMP (see Section 7.2), including the use of nest boxes in the conservation areas to limit impacts on fauna and their habitats (see Section 7.2).
Removal of dead wood and dead trees	TSC Act		The airport site contains areas with fallen timber. The airport will result in the removal of this timber during construction of the airport. Mitigation measures will be documented in a Biodiversity CEMP (see Section 7.2) including habitat management procedures such as the use of nest boxes in the conservation areas.
Introduction and establishment of Exotic Rust Fungi of the order	TSC Act		Construction activities have the potential to introduce Myrtle Rust to the airport site. The construction program would include environmental

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Comment
Pucciniales pathogenic on plants of the family Myrtaceae			management measures, including specific consideration of measures to reduce potential impacts on soil, water and native vegetation (see Section 7.2).
Invasion of plant communities by perennial exotic grasses	TSC Act		The airport site features large areas of exotic grassland. There is the potential for perennial exotic grasses to invade adjacent native vegetation through disturbance during construction of the airport. The Biodiversity CEMP would include weed management measures and specific consideration of potential impacts on soil, water and native vegetation (see Section 7.2).
Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	TSC Act		Bell Miners were recorded at the airport site. Clearing of vegetation for the airport and associated displacement of birds may increase the incidence of this species in adjacent woodland and forest habitat, further exacerbating this KTP.
Invasion of native plant communities by African Olive *Olea europaea* subsp. *cuspidata* (Wall. ex G. Don) Cif.	TSC Act		The airport site contains areas already infested with African Olive. There is the potential for this species to invade adjacent native vegetation through disturbance during construction of the airport. The Biodiversity CEMP will include environmental management measures, including weed management and specific consideration of potential impacts on soil, water and native vegetation (see Section 7.2).
Invasion of the Yellow Crazy Ant *Anoplolepis gracilipes* (Fr. Smith) into NSW	TSC Act		Crazy ants have been intercepted in Australian ports at least 161 times since 1988 (OEH 2014). Crazy ants have the potential to displace native fauna and to kill invertebrates, reptiles, hatchling birds and small mammals. The operation of the airport has the potential to be a means by which this species enters the Western Sydney area and other areas of NSW and Australia. Management of biosecurity at airports is carried out by the Australian Quarantine Inspection Service (AQIS) and any risks are managed through the biosecurity regulatory framework.
Predation by the Plague Minnow (*Gambusia holbrooki*)	TSC Act	Predation *by Gambusia holbrooki* (plague minnow)	Eastern Gambusia are the most abundant fish species at the airport site. Dewatering of farm dams during construction has the potential to increase the incidence of this species in local waterways. Implementation of a protocol for the management of removal of dams will be documented in a Biodiversity CEMP in order to minimise human dispersal of the species, in line with the TAP (NPWS 2003).

Key Threatening Process (KTP)	Act	Threat Abatement Plan (TAP)	Comment
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	TSC Act; FM Act		Construction of the airport would remove sections of creeks, including the upper reaches of Oaky Creek. The airport would alter the natural landform through placement of fill, increasing the proportion of hardstand surfaces in the airport site and modifying surface water flows. The airport has been designed to mitigate impacts on aquatic habitats downstream of the site. Monitoring of surface water quality has commenced at the airport site.
The degradation of native riparian vegetation along NSW water courses	FM Act		The riparian corridor along Badgerys Creek would be protected. Other riparian vegetation within the airport site would be removed. There is the potential for downstream impacts on riparian vegetation resulting from the removal of vegetation upstream. Mitigation measures will be documented in a Biodiversity CEMP to limit the potential for adverse impacts on riparian vegetation during construction (see Section 7.2). The airport design and Land Use Plan includes measures to manage surface water that have been purposefully designed to capture water on site and to avoid substantial alteration of surface water drainage patterns outside of the airport site.
The removal of large woody debris from NSW rivers and streams	FM Act		Construction of the airport would remove sections of creeks, including the upper reaches of Oaky Creek, and would remove large woody debris from these creeks. The removal of creeks and large woody debris would reduce breeding habitat for fish in the locality. There would be no disturbance of large woody debris in Badgerys Creek.

5.5 Cumulative impacts

The potential for cumulative impacts due to the Stage 1 development and the long term development at the airport site has been considered.

Other planned and potential infrastructure developments in the locality include the realignment of The Northern Road around the airport site, implementation of the Western Sydney Infrastructure Plan which includes the M12 motorway and The Northern Road upgrades, potential future orbital road links, realignment of transmission lines and potential extension of the South West Rail Link, including a potential rail connection to the airport. The Western Sydney Priority Growth Area structure plan shows that the area to the east and south east of the airport site will be set aside for industrial / employment lands (DoP 2010).

The airport is likely to result in facilitated impacts on biodiversity values (i.e. impacts that are more likely to occur because the airport has been developed). Construction of the airport is likely to accelerate economic activity in the locality, commercial developments in the surrounding Broader Western Sydney Employment Area and housing development in the South West Growth Centre. These developments and activities would result in cumulative and facilitated impacts connected to Stage 1 of the airport, including:

- additional removal of native vegetation and habitat resources;
- additional injury, displacement or mortality of individuals within local flora and fauna populations;
- increased fragmentation of habitat and creation of novel edge effects in remnant native vegetation;
- increased generation of noise and light and increased risk of plane strike associated with a second runway at the airport site and vehicle collisions associated with other transport infrastructure;
- increased risk of the spread of weeds, pathogens or pest fauna and/or increased negative impacts arising from these factors;
- increased risk of toxicity or degradation of habitat due to the generation of contaminants; and
- further alterations to the hydrology of catchments (noting that the airport would be designed to avoid adverse changes to hydrology and may result in an overall improvement in water quality).

Many of these cumulative impacts would exacerbate the effect of already significant impacts of Stage 1, such as the reduction in extent of Cumberland Plain Woodland, removal of Grey-headed Flying-fox habitat and removal of small terrestrial fauna populations at the airport site (see Section 5). Impacts of construction of the long term development would be significant in their own right. Other infrastructure proposals and larger-scale commercial developments in the locality would also likely result in a significant impact on Cumberland Plain Woodland and habitats for certain threatened fauna species.

The biodiversity values that are likely to be affected have relatively low ecosystem resilience because of the existing cumulative impacts of development in Western Sydney. At least 90 per cent of the estimated pre-European extent of each of the native vegetation types at the airport site have been removed (OEH 2015c). Remnant vegetation is also severely fragmented at a regional scale, with more than half of the remaining tree cover mapped by Tozer et al (2010) occurring in patches of less than 80 hectares and half of all mapped patches of Cumberland Plain Woodland being smaller than three hectares (NSW Scientific Committee 2009). Future biodiversity assessments and development approvals will need to carefully consider the

avoidance, mitigation and offsetting of impacts in order to ensure that cumulative impacts do not result in unacceptable impacts such as the local or regional extinction of any biota.

Cumulative impacts connected to the airport would occur in the context of human induced climate change, which is recognised as a serious threat to biodiversity values. Climate change threatens biodiversity values directly, by affecting ecosystem processes and habitats, and indirectly, by compounding the impacts of existing and ongoing pressures on biodiversity values (Steffen et. al 2009; DoE 2015e). Stage 1 of the airport, long term development at the airport site and related development in the locality would contribute to the impacts of climate change through removal of vegetation and production of greenhouse gases.

'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a key threatening process (KTP) under the EPBC act and consists of reductions in the bioclimatic range within which a given species or ecological community exists due to emissions induced by human production of greenhouse gases (DoE 2015d). Ecosystems in which the KTP occurs include: alpine habitats; coral reefs; wetlands and coastal ecosystems; polar communities; tropical forests; temperate forests; and arid and semi-arid environments (DoE 2015d). Although temperate forests such as the ecosystems at the airport site are included in this list, they would not be particularly susceptible to the impacts of climate change. The species ecosystems which are most at risk are those which function within a limited range of climatic parameters such as tropical coral reefs or alpine environments (Steffen et. al 2009). The temperate woodlands and forests at the airport site are associated with a comparatively broad and mild set of climatic conditions. The climate of Western Sydney includes pronounced seasonal and multi-annual variability in temperature and especially rainfall. It is widely accepted that the ecological communities associated with *Eucalyptus* woodlands of south eastern Australia are tolerant of this variability. This is apparent in the presence of adaptive characteristics or life history strategies that provide resilience to drought or wildfire.

The biodiversity values of sclerophyllous vegetation in south-eastern Australia may be at risk of negative impacts as a result of increased wild fire frequency or intensity due to climate change, with pockets of fire-sensitive vegetation that occur in flammable matrices most at risk (Steffen et. al 2009). Pockets of Western Sydney Dry Rainforests and Moist Shale Woodland in the locality would be susceptible to these impacts (TSSC 2013) however the majority of the region features grassy woodland or forest vegetation that is tolerant of fire (DEC 2005; NPWS 2006; Tozer 2010). The recommended fire regimes for grassy woodland or forest vegetation types on the Cumberland Plain is no more frequently than every five to seven years but no less frequently than every 35 years (DECCW 2010).

Climate change is not recognised as a specific threat in the conservation advice for Cumberland Plain Woodland (Threatened Species Scientific Committee 2008), *Pultenaea parviflora* or other threatened biota known or likely to occur at the airport site (DoE 2015b). Climate change is recognised as a threat, priority unknown, in the recovery plan for the Grey-headed Flying-fox due to the potential for changes in the distribution or reproduction of some *Eucalyptus* food tree species or the increased occurrence of extremely high temperatures (DECCW 2009). Overall climate change is likely to have a relatively minor effect on ecosystem resilience and potential cumulative impacts on biodiversity values at the airport site when compared to more immediate threats such as removal of vegetation and habitat.

The biodiversity offsets will be sought through the BODP, which is based on this Stage 1 BAR, and will set out the specific actions to be taken to meet the offset conditions for the airport as set out in the Airport Plan.

The BODP will be submitted and require approval from the Environment Minister or an SES Officer in DoEE prior to the commencement of Main Construction Works for the Stage 1

development of the airport, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

Long term development at the airport site would require separate calculation of any additional biodiversity offsets with reference to the prevailing airport master plan(s) and the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy October 2012* (EPBC Act Offsets Policy). Other major developments in the locality would need to deliver biodiversity offsets in accordance with the NSW biodiversity assessment and offsetting policy and/or the EPBC Act Offsets Policy. The cumulative benefits of biodiversity offsets should help to compensate for the cumulative impacts of the various developments.

The Growth Centres strategic assessment has considered development impacts and biodiversity offsets at the regional scale and has provided for the conservation of the Western Sydney Parklands and other substantial conservation areas (DoP 2010). Through the strategic assessment the NSW Government has committed to delivering conservation outcomes for a range of matters of national environmental significance including:

- a minimum of 998 ha of Cumberland Plain Woodland that will be retained and protected within the Growth Centres, including a minimum of 363 ha of high management viability examples of these communities.
- at least 2,400 ha of either Cumberland Plain Woodland or other grassy woodland communities which are similar to Cumberland Plain Woodland in floristic structure will be protected outside of the Growth Centres (DoP 2010).

Conservation of Cumberland Plain Woodland and other biodiversity values as part of the Growth Centres Strategic Assessment would help to conserve local and regional populations of these biota in conjunction with the offset package for the airport.

The Cumberland Plain Recovery Plan identified priority conservation lands that are intended to maintain the biodiversity values of the Cumberland Plain (DECCW 2010). Many of these priority conservation lands have been securely titled for conservation under BioBanking agreements, through the South West Growth Centres Strategic Assessment or other mechanisms. These conservation areas are located in the same region as the airport site and include Cumberland Plain Woodland, Grey-headed Flying-fox habitat and other biodiversity values that would be affected by the airport. Future development in the region should be linked to the conservation of additional areas through the provision of biodiversity offsets. This approach should help to maintain biodiversity values at the local and regional scale despite potentially serious cumulative and/or facilitated impacts connected to the airport.

5.6 Impacts on EPBC Act-listed threatened biota

5.6.1 Threatened ecological communities

Identification of affected threatened ecological communities

A total of 145.2 hectares native vegetation in the Stage 1 Construction Impact Zone is EPBC Act Cumberland Plain Woodland (see Section 4.5.1).

A patch of Moist Shale Woodland considered to comprise a local occurrence of the TEC 'Western Sydney Dry Rainforest and Moist Woodland on Shale' was identified by SMEC (2014) at the airport site. Additional assessment of this area conducted as part of the current surveys concluded that it contained Cumberland Plain Woodland (i.e. the vegetation types Grey Box - Forest Red Gum grassy woodland on hills and Grey Box - Forest Red Gum grassy woodland on flats) with relatively few species representative of Moist Shale Woodland. These vegetation types collectively comprise an occurrence of Cumberland Plain Woodland. 20 m x 20 m

vegetation plot data was compared with Tozer (2010) diagnostic species lists to confirm the identity of these vegetation types.

The absence of characteristic mesic trees, shrubs, climbers and ferns and a generally grassy rather than shrubby understorey (TSSC 2013) further support the classification as Cumberland Plain Woodland (noting that the only widespread shrub species present is Native Blackthorn which is a diagnostic species in all three vegetation types (Tozer 2010) and is widely recognised as indicating a response to fire regime or other disturbance within Cumberland Plain Woodland rather than any environmental factor characteristic of another ecological community (NSW Scientific Committee 1997; DECCW 2010; TSSC 2008).

Western Sydney Dry Rainforest and Moist Woodland is not present at the airport site and as such the construction and operation of the airport would not have an impact on an occurrence of this TEC. Impacts on this TEC are not considered further in this assessment.

No other TECs listed under the EPBC act are known or likely to be affected by construction or operation of the airport.

Table 36 Threatened ecological communities listed under the EPBC Act within the Stage 1 Construction Impact Zone

Ecological Community	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
Cumberland Plain Woodland	CEEC	Present.	Certain. Direct impacts within a local occurrence of the community.	Direct removal of up to 145.2 hectares of vegetation in a local occurrence of the community	Likely.

CEEC – critically endangered ecological community

Significance of Impacts on Cumberland Plain Woodland

An assessment of significance was prepared in accordance with the '*Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999'* (DoE 2013a) for impacts on Cumberland Plain Woodland (GHD 2016a, Appendix D). The Stage 1 development would include the permanent removal of 145.2 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the form of the community listed under the EPBC Act as shown on Figure 4. A permanent reduction in extent of this magnitude would threaten the viability and persistence of Cumberland Plain Woodland within the locality.

The outcome of the assessment of significance was that Stage 1 of the airport is likely to have a significant impact on the local and regional occurrence of Cumberland Plain Woodland. A significant impact would occur through a substantial reduction in the extent of the community and increase in the degree of fragmentation, which would in turn result in a substantial negative effect on the potential for recovery of the community (GHD 2016a, Appendix D).

A biodiversity offset delivery plan (BODP) will be prepared for the airport to compensate for these significant impacts (see Section 7.3). The offsets secured through the BODP will assist in the recovery of the community through the protection and management of Cumberland Plain Woodland at offset sites in perpetuity.

5.6.2 Threatened flora species

Identification of affected flora species

The desktop assessment, field surveys and habitat assessments described in this report have been used to identify the threatened plants that may be affected by the airport, through either direct or indirect impacts. The outcome of these assessments is summarised in Appendix A.

The Stage 1 Construction Impact Zone includes the entire population of at least 4,118 *Pimelea spicata* at the airport site and at least four individual *Pultenaea parviflora.* There is potential habitat for an additional four threatened flora species in the Stage 1 Construction Impact Zone. They are at a moderate risk of impact as a result of the airport (see Table 37) based on an assessment of the numbers of local records and presence and quality of potential habitat.

The remainder of the threatened flora species previously recorded or predicted to occur in the locality would not occur because the airport site is outside of their known distribution and/or does not contain suitable habitat (Appendix A). The airport site does not contain any sandstone outcrops or sandstone-derived soils, shale-sandstone transition soils, or deep Tertiary alluvial deposits and does not contain any threatened plant species that have habitat requirements specific to these soil types. Construction and operation of the airport would not have an impact on these threatened species or their habitat.

Table 37 Threatened species listed under the EPBC Act with a moderate to high risk of impact within the Stage 1 Construction Impact Zone

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
Spiked Rice-flower	Endangered	Present. 4,118 clumps were recorded at the airport site.	Certain. The recorded individuals and a large area of potential shale woodland habitat would be removed.	4,118 clumps and 2.94 hectares of occupied habitat within up to 155.8 hectares of better quality potential habitat. Removal of a further 157.9 hectares of poor quality potential habitat.[1]	Likely.
Pultenaea parviflora	Vulnerable	Present. Four individuals were recorded at the airport site.	Certain. The recorded individuals and a large area of potential shale woodland habitat would be removed.	Four individuals and up to 155.8 hectares of better quality potential habitat and a further 157.9 hectares of poor quality potential habitat.[1]	Unlikely.
White-flowered Wax Plant	Endangered	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in	Possible. A large area of potential habitat in woodland and forest would be removed.	Up to 190.8 hectares of better quality potential habitat and a further 136.7 hectares of	Unlikely.

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impact
		the locality and there is potential habitat at the airport site.		poor quality potential habitat.[2]	
Downy Wattle	Vulnerable	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in the locality and there is potential habitat at the airport site.	Possible. A small area of potential habitat in Shale-Gravel Transition Forest would be removed.	Up to 5.2 hectares of potential habitat.[3]	Unlikely.
Small-flower Grevillea	Vulnerable	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. The species has been recorded in the locality and there is potential habitat at the airport site.	Possible. A small area of potential habitat in Shale-Gravel Transition Forest would be removed.	Up to 5.2 hectares of potential habitat.[3]	Unlikely.
Austral Toadflax	Vulnerable	Possible. Not recorded at the airport site despite multiple rounds of targeted surveys. There is potential habitat at the airport site.	Possible. A large area of potential habitat in grassy woodland or grassland would be removed.	Up to 190.8 hectares of better quality potential habitat and a further 136.7 hectares of poor quality potential habitat.[2]	Unlikely.

Notes: 1) Comprising the areas of Good and poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528), Grey Box - Forest Red Gum grassy woodland on hills (HN529) and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 33.

2) Comprising the areas of Good and poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528), Grey Box - Forest Red Gum grassy woodland on hills (HN529), Forest Red Gum - Rough-barked Apple grassy woodland (HN526) and Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 33.

3) Comprising the area of Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512) as shown in Table 33.

Significance of impacts on threatened plants

Assessments of significance have been prepared with reference to the Significant impact guidelines 1.1 (DoE 2013a) for threatened plant species that are known or likely to be impacted by the airport (GHD 2016a, Appendix D).

The original assessment of significance for *Pimelea spicata* concluded that the airport would not be likely to result in a significant impact on the species because there was no evidence that a population would be directly affected or that the potential habitat at the airport site was of particular importance (GHD 2016a, Appendix D). A population of *Pimelea spicata* was recorded during the updated surveys conducted for this Stage 1 BAR. The assessment of significance has been revised based on consideration of impacts to this known population of at least 4,118 clumps of *Pimelea spicata* and at least 2.94 hectares of occupied habitat. At a local level the construction of the airport may interfere substantially with the recovery of *Pimelea spicata* and is likely to have a significant impact on the species .

A significant impact would occur through:

- removal of at least 4,118 *Pimelea spicata* clumps within 2.94 hectares of occupied habitat comprising the entire population at the airport site and probably comprising a significant proportion of the population within the locality;
- removal of up to 155.8 hectares of better quality potential habitat and a further 157.9 hectares of poor quality potential habitat;
- further fragmentation of habitat within an already highly fragmented landscape; and
- possible further clearing of habitat for the species as a result of cumulative and facilitated development in the locality following construction of the airport.

This reduction in the extent of native vegetation is less significant at the regional scale and is unlikely to threaten the persistence of any populations of native plants and vegetation communities. It is unlikely that an ecologically significant proportion of any regional plant populations would be located entirely within the airport site.

The BODP for the airport would include the protection and management of known and potential *Pimelea spicata* habitat at offset sites in perpetuity to compensate for these significant impacts and assist in the recovery of the species (see Section 7.3). Further, *Pimelea spicata* will be included in the threatened flora propagation plan implemented in accordance with the Airport Plan conditions (see Section 7.2).

Construction of Stage 1 of the airport would remove four individual *Pultenaea parviflora* which would remove the known local population at the airport site. The quantum of impacts on potential *Pultenaea parviflora* habitat has changed slightly based on the updated surveys and assessments included in this Stage 1 BAR, however the conclusion of the assessment of significance included in the EIS is supported by these updated results.

The airport would also require the removal of 155.8 hectares of better quality potential habitat for Stage 1 and up to 45.3 hectares of better quality potential habitat for the long term development at the airport site. The EPBC Act assessment of significance guidelines 1.1 includes specific criteria for assessing impacts on a vulnerable species, which primarily relate to impacts on an important population (DoE 2013a).

The population of *Pultenaea parviflora* at the airport site is not an important population because:

- it is not identified in a recovery plan;
- it would not be important for breeding or dispersal because it includes only four plants and it is in a comparatively isolated and poor quality patch of habitat that is surrounded by extensive areas of cleared cropland or grazing country;

- it is not important for maintaining genetic diversity because it comprises only four plants that are in close proximity and as such would be unlikely to contain much genetic diversity. Further, this genetic material has already been retained via the Royal Botanic Gardens Trust sampling and propagation programme (RBGS 1992); and
- this population is near the limit of the species range as it is at the western extent of recognised outlier populations near Kemps Creek (OEH 2015b). The majority of the known population at Kemps Creek is associated with a parcel of land within tertiary gravel and shale/gravel transition habitat located around three kilometres to the east of the site (OEH 2015a). This land parcel is to be set aside as an offset for the South West Growth Centres. The population at the airport site would probably make a very minor contribution to the viability of this population.

Therefore the airport would not result in any direct impacts on an important population of the species and would not substantially interfere with the recovery of *Pultenaea parviflora.* The airport would not result in a significant impact on *Pultenaea parviflora*. As discussed in Section 4.5.2, collection and propagation of this population has previously been carried out, with plants located at the Australian Botanic Garden, Mount Annan. Further propagation will be carried out as part of the implementation of a threatened flora propagation plan in accordance with the Airport Plan conditions (see Section 7.2).

Construction and operation of the airport would not affect any known populations of the White-flowered Wax Plant and Downy Wattle and the vulnerable species Small-flower Grevillea and Austral Toadflax. Despite targeted surveys there is no evidence that the airport site or any adjoining areas of vegetation contain populations of these threatened plants (Biosis 1999; SMEC 2014; OEH 2015a). There is a moderate risk of impacts on a local population of these threatened plants through the removal, modification or fragmentation of potential habitat at the airport site. Any populations of these threatened plant species at the airport site are likely to have relatively low viability since they are not abundant or extensive enough to have been detected by surveys, the airport site is extensively degraded and modified and there is limited potential for either recruitment or population expansion given the extent of habitat fragmentation. Any local populations of these species, if present, would probably make a minor contribution to the maintenance or recovery of these species. Given these considerations, the airport is unlikely to interfere with the recovery of any of these threatened plant species. The airport would not result in a significant impact on these threatened plant species.

Changes to water quality or hydrology are unlikely to impact threatened flora habitat that occurs downstream of the airport site. Implementation of additional measures are proposed so that the airport would have no adverse impact on downstream water quality (GHD 2016c).

Since the airport is not likely to result in a significant impact on *Pultenaea parviflora*, White-flowered Wax Plant, Downy Wattle, Small-flower Grevillea and Austral Toadflax there is no requirement to calculate or to deliver direct biodiversity offsets for these species in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012). However, any potential impacts on these threatened plant species and populations would be substantially offset through the conservation and management of Cumberland Plain Woodland and other native vegetation in the locality and region as part of the BODP for the project (see Section 7.3).

5.6.3 Threatened fauna species

Identification of affected fauna species

The desktop assessment, field surveys and habitat assessments described in this report have been used to identify the threatened fauna species that may be affected by the airport, through

either direct or indirect impacts. The outcome of these assessments is summarised in Appendix A.

The Grey-headed Flying-fox (*Pteropus poliocephalus*), was recorded foraging at the site or flying over the site during the current surveys, as well as in previous surveys (Biosis Research 1999). No other threatened fauna species listed under the EPBC Act have been recorded at the airport site. The Swift Parrot is likely to forage at the airport site on occasion during its winter migration to the mainland. Construction of the airport would remove potential habitat for this species. The Swift Parrot has been identified in the Airport Plan conditions as a species that requires biodiversity offsets under the EPBC Act offset policy (DSEWPaC 2012). The risk of impact and quantum of impact on these threatened fauna species is summarised in Table 38.

Table 38 Threatened fauna species listed under the EPBC Act with a moderate to high risk of impact within the Stage 1 Construction Impact Zone

Species	EPBC Act Status	Likelihood of occurrence	Risk of impact	Quantum of impact	Significance of impacts
Grey-headed Flying-fox	V	Present. Would forage in woodland stands at the airport site. No roost camps present at the airport site.	Certain. Large area of potential foraging habitat would be removed. Moderate risk of aircraft strike during operation.	190.8 hectares of foraging habitat [1] Low numbers of bats likely to be subject to aircraft strike.	Likely
Swift Parrot	CE	Likely. May forage on occasion in the airport site during winter when trees are flowering. 8 records within the locality (OEH 2015a).	Moderate. Large area of potential foraging habitat would be removed. Low risk of aircraft strike during operation.	Up to 190.8 hectares of potential foraging habitat.[1] Very low numbers of birds likely to be subject to aircraft strike.	Unlikely

V = vulnerable species; CE = critically endangered species

Notes: 1) Comprising the area of woodland and forest habitat at the airport site as shown in Table 34.

As described in Section 4.5.3, no habitat for the Giant Burrowing Frog is present at the airport site. The airport would not affect a population of this species. Potential indirect impacts on the Blue Mountains World Heritage Area would be highly unlikely to affect a population of this species. The airport would not have a significant impact on this species as there is no potential habitat for the species at the airport site.

The Large-eared Pied Bat has not been recorded at the airport site during either the recent or previous surveys. The airport site does not contain habitat critical for the survival of the Large-eared Pied Bat as defined in the Recovery Plan (DERM 2011) and as described in Section 4.5.3. The airport will not destroy or interfere with maternity or other roost sites or remove foraging habitat proximate to such habitat features. It is likely that the airport site is too distant from sandstone escarpment areas and contains remnant vegetation that is too fragmented and isolated to comprise important habitat for this species (see Section 4.5.3). Whilst it is conceivable that this species could occur at the site on occasion, it is unlikely that a local population would be dependent on the site for its persistence and the airport is therefore unlikely to have a significant impact on the Large-eared Pied Bat.

As described in Section 4.5.3, no Green and Golden Bell Frogs were recorded during the current targeted surveys at the airport site, or during previous targeted surveys carried out at the

airport site (Lemckert 1999). There are no previous records of the species at the airport site (OEH 2015a). This species is likely to have become extinct in the area many years ago, if it was present at all (Lemckert 1999). Based on this evidence, the airport is highly unlikely to have a significant impact on this species.

Low quality potential habitat is present in the airport site for a number of other threatened fauna species listed under the EPBC Act as described in Appendix A. These species may occur on a transient or opportunistic basis only. The airport is highly unlikely to have a significant impact on these species. These species are not considered further in this report.

No threatened aquatic fauna species listed under the EPBC Act were recorded or are likely to occur at the airport site or in upstream or downstream habitats.

Significance of impacts on threatened fauna

Assessments of significance have been prepared in accordance with the Significant impact guidelines 1.1 (DoE 2013a) for threatened fauna species that may occur at the airport site or be affected by the Stage 1 development (GHD 2016a, Appendix D). The quantum of impacts on threatened fauna has changed slightly based on the updated surveys and assessments included in this Stage 1 BAR. Nevertheless, the conclusions of the assessment of significance included in the EIS are supported by the updated results.

The construction of the airport may interfere substantially with the recovery of the Grey-headed Flying-fox and is likely to have a significant impact on the species.

A significant impact would occur through:

- construction of the airport, which would remove 190.8 hectares of potential habitat for Stage 1 which represents 0.70 per cent of the potential foraging habitat for the Grey-headed Flying-fox within the locality;
- reducing areas of habitat that contribute to the availability of foraging resources for local camps when resources are scarce and at critical lifecycle stages;
- further fragmentation of foraging habitat within an already highly fragmented landscape; and
- possible further clearing of foraging habitat for the species as a result of cumulative and facilitated development in the locality following construction of the airport.

The offsets secured through the BODP for the airport will compensate for these significant impacts and will assist in the recovery of the species through the protection and management of Grey-headed Flying-fox habitat at offset sites in perpetuity (see Section 7.3).

The Swift Parrot may occur at the airport site on occasion outside the breeding season when the eucalypts are in flower. The airport site is unlikely to represent core winter foraging resources for the Swift Parrot due to the lack of evidence of the species in the airport site and immediate surrounds (both during recent surveys and from historical records), and the presence of mainly young regrowth and aggressive competitors such as the Noisy Minor. The airport site may provide shelter or supplementary foraging resources for migrating individuals.

Construction of Stage 1 of the airport would remove 190.8 hectares of highly fragmented, relatively low quality potential foraging habitat. 46.8 hectares of potential habitat would be retained within the Environmental Conservation Zone along Badgerys Creek and in the western portion of the airport site. A total of about 17,393 hectares of potential foraging habitat (woody native vegetation) is mapped in the locality, although not all of this vegetation is likely to be suitable for the species. There is a low risk of aircraft strike for this species given the low numbers that may forage in the area, and lack of good quality foraging habitat in surrounding areas. Operation of the airport would increase general traffic in the area surrounding the airport,

and could result in increased risk of fauna mortality on surrounding roads. This is unlikely to substantially impact the Swift Parrot, given its low incidence in the area.

The assessment of significance for this species conducted for the EIS concluded that the airport would not be likely to result in a significant impact on the Swift Parrot (GHD 2016a, Appendix D) and the results of the updated surveys and assessment support this conclusion. However, Condition 30(4)(b) of the Airport Plan states that the BODP for the airport must include the protection and management of Swift Parrot foraging habitat at offset sites (see Section 7.3).

6. Framework for biodiversity assessment calculations

6.1 Landscape features

The FBA requires the assessment of landscape features to help describe the biodiversity values of the study area and assess the impacts of the project. The airport is a site-based development (rather than linear infrastructure) and so the landscape value has been assessed according to the methodology for site-based major projects (OEH 2014b). Landscape features relevant to the credit calculations are shown on and are summarised in Table 39.

Table 39 Summary of landscape features

Landscape feature	Stage 1 Construction Impact Zone
Major Catchment	The Stage 1 Construction Impact Zone is located entirely within the Hawkesbury/Nepean major catchment.
Interim Biogeographic regionalisation of Australia (IBRA) bioregion and IBRA subregions	The Stage 1 Construction Impact Zone is located entirely within the 'Sydney Basin' IBRA bioregion and Cumberland – Hawkesbury/Nepean IBRA subregion (DSEWPaC 2011).
Mitchell landscape	The Stage 1 Construction Impact Zone contains the Cumberland Plain Mitchell landscape (DECC 2008).
% Native vegetation cover	The outer assessment circle is 4000 hectares in area and the inner assessment circle is 400 hectares.
	The current native vegetation cover in the outer assessment circle is 16-20 per cent (around 800 hectares out of the 4000 hectare circle).
	The future native vegetation cover in the outer assessment circle is 11-15 per cent (around 480 hectares out of the 4000 hectare circle, given the removal of around 318.4 hectares of native vegetation for the airport).
	The current native vegetation cover in the inner assessment circle is 31-35 per cent (around 122 hectares out of the 400 hectare circle).
	The future native vegetation cover in the inner assessment circle is <5 per cent (around 12 hectares out of the 400 hectare circle, given the removal of 110 hectares of native vegetation for the airport).
Connectivity value - class	The Stage 1 development would affect the 20 metre wide riparian corridor of a 4th order stream where the stage one Construction Impact Zone intersects the riparian corridor of Badgerys Creek.
	A patch size polygon of around 670 hectares is shown on Figure 6 however, the actual patch of connected native vegetation continues outside this area in the riparian corridors of Badgerys Creek to the north and Duncans Creek to the west. This is well above the patch size required to achieve the maximum patch size score for the assessment (OEH, 2014b) (>100 ha, as the airport site is in the Cumberland Mitchell landscape, which is 89 per cent cleared (OEH 2015d).

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LEX-21979

THE NORTHERN ROAD

LUDDENHAM ROAD

MULGOA CREEK

PARK ROAD

COSGROVES CREEK

OAKY CREEK

ELIZABETH DRIVE

ADAMS ROAD

LUDDENHAM

KEMPS CREEK

JERRYS CREEK

GREENDALE ROAD

DUNCANS CREEK

SOUTH CREEK

BADGERYS CREEK

BADGERYS CREEK ROAD

FIFTEENTH AVENUE

DEVONSHIRE ROAD

NEPEAN RIVER

GREENDALE ROAD

DWYER ROAD

THE NORTHERN ROAD

THOMPSONS CREEK

Paper Size A3

0 270 540 1,080

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

LEGEND

- Airport site
- Stage 1 construction impact zone
- Environmental conservation
- Inner assessment circle (400 hectares)
- Outer assessment circle (4000 hectares)
- Patch size (>100ha)
- Native vegetation
- Watercourses
- Roads

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Landscape assessment

Figure 6

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Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017. Created by:jrprice

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6.2 Native vegetation

One vegetation zone was created for each NSW vegetation type and broad condition state in the Stage 1 Construction Impact Zone. The area of each zone was calculated using GIS. Vegetation zones within the Stage 1 construction area are summarised in Table 33.

Development impacts are expected to be restricted to the Stage 1 Construction Impact Zone. Given the mitigation measures specified in the Biodiversity Assessment (GHD 2016a) and EIS (GHD 2016b), adjoining land uses, and the extent of existing weed infestation and disturbance in the study area, the development would not result in any tangible secondary impacts. Therefore, no additional, secondary impacts have been included in the credit calculations.

Table 40 Vegetation zones

Veg Zone ID	Vegetation Zone	Condition	TSC Act Status[1]	EPBC Act Status[1]	Area	Plot/transects required	Plot/transects completed
1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - high	CEEC	CEEC	105.8	5	10 (Plot/transects 2, 5, 6, 11, 12, 22, 23, 25, 31, 35)
2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor	CEEC		110.5	6	10 (Plot/transects 3, 24, 28, 30, 37, 42, 57, 59, 60, 78)
3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	CEEC	CEEC	38.7	4	4 (Plot/transects 20, 21, 36, 38)
4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor	CEEC		15.3	4	4 (Plot/transects 39, 41, 71, 75)
5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good	EEC		35.0	4	4 (Plot/transects 17, 26, 29, 33)
6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor	EEC		10.9	3	3 (Plot/transects 27, 67, 79)
7	Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/good	EEC	CEEC	5.2	3	3 (Plot/transects 51, 63, 64)
9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good			32.1	4	4 (Plot/transects 65, 77, 80 ,81)

Veg Zone ID	Vegetation Zone	Condition	TSC Act Status[1]	EPBC Act Status[1]	Area	Plot/transects required	Plot/transects completed
10	Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Low			530.7	5	9 (Plot/transects 4, 50, 52, 54, 56, 58, 61 ,62, 76)
11	Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Low			42.3	3	4 (Plot/transects 70, 72, 73, 74)
12	Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Low			43.9	3	4 (Plot/transects 55, 66, 68, 69)
13	Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - medium	CEEC		6.1	3	3 (Plot/transect 53, rapid plot/transects 2 and 3)[3]
	Total				**1153.6**		**60 plot/transects, 2 rapid plot/transects**

Notes: 1) CEEC – critically endangered ecological community; EEC – endangered ecological community.

2) Vegetation zone area (ha) / number of plot/transects that must be sampled according to the FBA: 0-4 ha / 1 per 2 ha or 1 if low; >4-20 ha / 3 plots or 2 if low; >20-50 ha/ 4 plots or 3 if low; >50-100 ha / 5 plots or 3 if low; >100 - 250 ha / 6 plots or 4 if low; >250-1000 ha / 7 plots or 5 if low (OEH 2014a).

3) Benchmark plant species richness data was entered for rapid plot/transects.

Site value data was collected using the BioBanking plot/transect methodology and was entered for each plot/transect field in each vegetation zone. Vegetation zone 13 was created as a result of independent verifier review after the updated field surveys had been completed and so there was not the opportunity to purposefully stratify survey effort across this vegetation zone and ensure that the required number of plot/transects was sampled. As a result, two of the three vegetation survey points in this new vegetation zone were only rapid plot/transects and only the dominant plant species were recorded. To avoid potential underestimation of the site value score in these areas, benchmark plant species richness data was entered for rapid plot/transects 2 and 3.

6.3 Threatened species

6.3.1 Predicted threatened species

The credit calculator reports the suite of threatened fauna species that are predicted to be associated with ecosystem credits generated for the development. That is, the threatened fauna species that are predicted to use habitat within the vegetation types at the airport site. Each of these species has a ‘threatened species multiplier’ that feeds into the ecosystem credit calculations. The species with the highest threatened species multiplier drives the credit calculations. If that fauna species or specific habitat resources for that species are not present at the airport site, then the threatened species multiplier score may be adjusted.

The suite of threatened species associated with ecosystem credits for the development is shown in Table 41. There is known or potential habitat for each of these threatened species in

the Stage 1 Construction Impact Zone and so the threatened species multipliers have not been adjusted.

Table 41 Predicted threatened species (ecosystem credit species)

Common name	Scientific name	Threatened species multiplier	On site [1]
Australian Painted Snipe	*Rostratula australis*	1.3	Yes
Barking Owl	*Ninox connivens*	3.0	Yes
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*	1.3	Yes
Black-tailed Godwit	*Limosa limosa*	2.6	Yes
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*	2.0	Yes
Bush Stone-curlew	*Burhinus grallarius*	2.6	Yes
Diamond Firetail	*Stagonopleura guttata*	1.3	Yes
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	2.2	Yes
Eastern Freetail-bat	*Mormopterus norfolkensis*	2.2	Yes
Flame Robin	*Petroica phoenicea*	1.3	Yes
Freckled Duck	*Stictonetta naevosa*	1.3	Yes
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2.0	Yes
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	1.8	Yes
Greater Broad-nosed Bat	*Scoteanax rueppellii*	2.2	Yes
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7	Yes
Little Eagle	*Hieraaetus morphnoides*	1.4	Yes
Little Lorikeet	*Glossopsitta pusilla*	1.8	Yes
Masked Owl	*Tyto novaehollandiae*	3.0	Yes
Painted Honeyeater	*Grantiella picta*	1.3	Yes
Powerful Owl	*Ninox strenua*	3.0	Yes
Scarlet Robin	*Petroica boodang*	1.3	Yes
Speckled Warbler	*Chthonicola sagittata*	2.6	Yes
Spotted Harrier	*Circus assimilis*	1.4	Yes
Spotted-tailed Quoll	*Dasyurus maculatus*	2.6	No
Square-tailed Kite	*Lophoictinia isura*	1.4	Yes
Swift Parrot	*Lathamus discolor*	1.3	Yes
Turquoise Parrot	*Neophema pulchella*	1.8	Yes
Varied Sittella	*Daphoenositta chrysoptera*	1.3	Yes
White-fronted Chat	*Epthianura albifrons*	0.8	Yes
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	2.2	Yes

Note: 1) habitat resources for the species are present at the site and it is likely to occur on site at least from time to time.

6.3.2 Species credits

Species credit species cannot be reliably predicted to use an area of land based on habitat surrogates according to the FBA. These species require targeted survey, with the impacts and offset requirements expressed in terms of individual species credits rather than being linked to ecosystem credits.

Section 6 of the FBA outlines the process for assessing species credit species. An assessor must identify a threatened species as a candidate species for the development site if:

- the geographic distribution of the species is known or predicted to include the IBRA subregion in which the development site is located; and
- the development site contains habitat features or components associated with the species, as identified in the Threatened Species Profile Database;
- or past surveys undertaken at the development site indicate that the species is present.

The credit calculator references geographic, vegetation and habitat data for the project site to generate a list of the species credit-type threatened species predicted to occur. This list has been expanded and modified to include threatened species previously recorded in the locality based on BioNet data (OEH 2017).

A table of potential candidate threatened species prepared in accordance with the FBA is included in Appendix A. This table includes the 'Threatened species survey / time matrix and survey effort' table generated by the FBA credit calculator along with a summary of BioNet records of each species and the survey effort completed. Appendix A also includes a summary of the specific techniques and timing of survey effort employed for each species.

The majority of the species credit-type species predicted to occur have been reliably excluded from occurring at the airport site or being affected by the airport based on field survey effort undertaken in accordance with the survey time matrix (see Section 4.5 and Appendix A).

Four species were not targeted by surveys at appropriate times of year according to the survey / time matrix. These species do not comprise candidate species credit species as defined in Section 6.1.5.2 of the FBA because the development site does not contain habitat features or components associated with the species. Further, the airport site is outside the known or likely distribution of these species. Each of these species can be reliably excluded from occurring at the airport site or being affected by the airport based on the desktop assessment and on-site habitat assessments undertaken as follows:

- *Hibbertia* sp. Bankstown – only known from a single extant population at Bankstown airport where it occurs in a modified landscape on Tertiary alluvium that is likely to have formerly supported Castlereagh Scribbly Gum woodland. Only very marginal habitat is present in the shale landcsapes at the airport site. This species has not previously been recorded in the locality and has only been identified as a potential candidate species based on its regional distribution. When considered at a fine scale, the Stage 1 Construction Impact Zone does not contain habitat features or components associated with the species.
- *Hypsela sessiliflora* – the airport site is outside of the species' known, limited distribution at a single location less than 10 m x 15 m on the Cumberland Plain in Western Sydney. Further, this species is considered extinct under the EPBC Act and may not be a valid taxon (Leonard, G. pers. comm.).
- Sydney Plains Greenhood (*Pterostylis saxicola*) – only marginal habitat is present in the shale landcsapes at the airport site. This species grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils. This species has not previously been recorded in the locality and has only been identified as a potential candidate species based on its regional distribution. When considered at a fine scale, the Stage 1 Construction Impact Zone does not contain habitat features or components associated with the species.
- Matted Bush-pea (*Pultenaea pedunculata*) – only known from three disjunct populations on the Cumberland Plain in Sydney at Villawood and Prestons, and north-west of Appin. There is broadly suitable habitat present in the shale and shale-gravel transition

landscapes at the airport site, however this species has not previously been recorded in the locality and has only been identified as a potential candidate species based on its regional distribution. When considered at a fine scale, the Stage 1 Construction Impact Zone does not contain habitat features or components associated with the species.

The species credit-type threatened species that are present at the airport site are summarised in Table 42 along with the extent of impacts. For plants, impacts were calculated based on the number of individuals in the Stage 1 Construction Impact Zone. For animals, impacts were calculated based on the extent of habitat for the species in the Stage 1 Construction Impact Zone as described below.

Table 42 Impacts on species credit-type threatened species

Common name	Scientific name	TSC Act Status	Likelihood of occurrence	Quantum of impact
Dillwynia tenuifolia	*Dillwynia tenuifolia*	Vulnerable	Present. 11 individuals were recorded in the Stage 1 Construction Impact Zone.	11 individuals
Pultenaea parviflora	*Pultenaea parviflora*	Endangered	Present. Four individuals were recorded in the Stage 1 Construction Impact Zone.	4 individuals
Pimelea spicata	Spiked Rice-flower	Endangered	Present. 4118 clumps were recorded in the Stage 1 Construction Impact Zone.	4118 clumps
Marsdenia viridiflora subsp. *viridiflora*	*Marsdenia viridiflora* subsp. *viridiflora*	Endangered population	Present. 145 stems were recorded in the Stage 1 Construction Impact Zone.	145 stems
Cumberland Plain Land Snail	*Meriodolum corneovirens*	Endangered	Present in the Stage 1 Construction Impact Zone. Generally occurs in larger remnant patches of Cumberland Plain Woodland with deep leaf litter.	190.8 hectares
Large-footed Myotis roosting habitat	*Myotis macropus* roosting habitat	Vulnerable	Probably recorded (based on echo-location call analysis). Likely to forage along creeks and above dams. May roost under bridges and in tree-hollows at the airport site. Habitat present in the Stage 1 Construction Impact Zone.	74.5 hectares
Black Bittern	*Ixobrychus flavicollis*	Vulnerable	Present. Recorded in riparian vegetation along Badgerys Creek. Habitat present in the Stage 1 Construction Impact Zone.	17.2 hectares

Cumberland Plain Land Snail

The Cumberland Plain Land Snail was recorded at multiple locations across the Stage 1 Construction Impact Zone and airport site. Species credits were calculated for the species, by preparing a Cumberland Plain Land Snail species polygon consistent with Section 6.5.1 of the FBA (OEH 2014a). The area of known and potential habitat for the Cumberland Plain Land Snail was mapped based on the location of the individuals found within the Stage 1 Construction Impact Zone and areas of suitable habitat identified during the GHD field surveys (see Figure 5). The species polygon is more extensive than the area of known habitat confirmed by field surveys because the Cumberland Plain Land Snail may burrow during hot, dry weather and not be detected. Habitat was defined based on the presence of native over storey and predominantly native ground cover species, dense moist leaf litter, friable topsoil, woody debris or other shelter substrate and known vegetation associations as described in the threatened species profile for the species (OEH 2017c).

Based on the approach described above, a 190.8 hectare Cumberland Plain Land Snail species polygon was mapped at the airport site as shown on Figure 7.

Southern Myotis roosting habitat

Probable calls of the Southern Myotis were recorded at a number of locations in the Stage 1 Construction Impact Zone. A small colony of bats were recorded roosting under the bridge over Badgerys Creek and large number of calls probably attributable to the Southern Myotis were also recorded at this location. Farm dams and creeks would provide foraging habitat for this species. It may roost in tree hollows, culverts and old buildings in the Stage 1 Construction Impact Zone where they are located close to suitable foraging habitat.

Species credits were calculated for the species, by preparing a Southern Myotis roosting habitat species polygon consistent with the FBA. The area of roosting habitat for the species was mapped based on the presence of woodland or forest with hollow-bearing trees or other roost sites within the vicinity of third and fourth order drainage lines or freshwater wetlands. This was achieved with GIS by buffering water bodies by 100 metres and then clipping out areas that did not contain suitable roost sites such as tree hollows. The draft species polygons were checked against habitat assessments completed during field surveys and at selected locations ground-truthed during the updated 2017 field surveys.

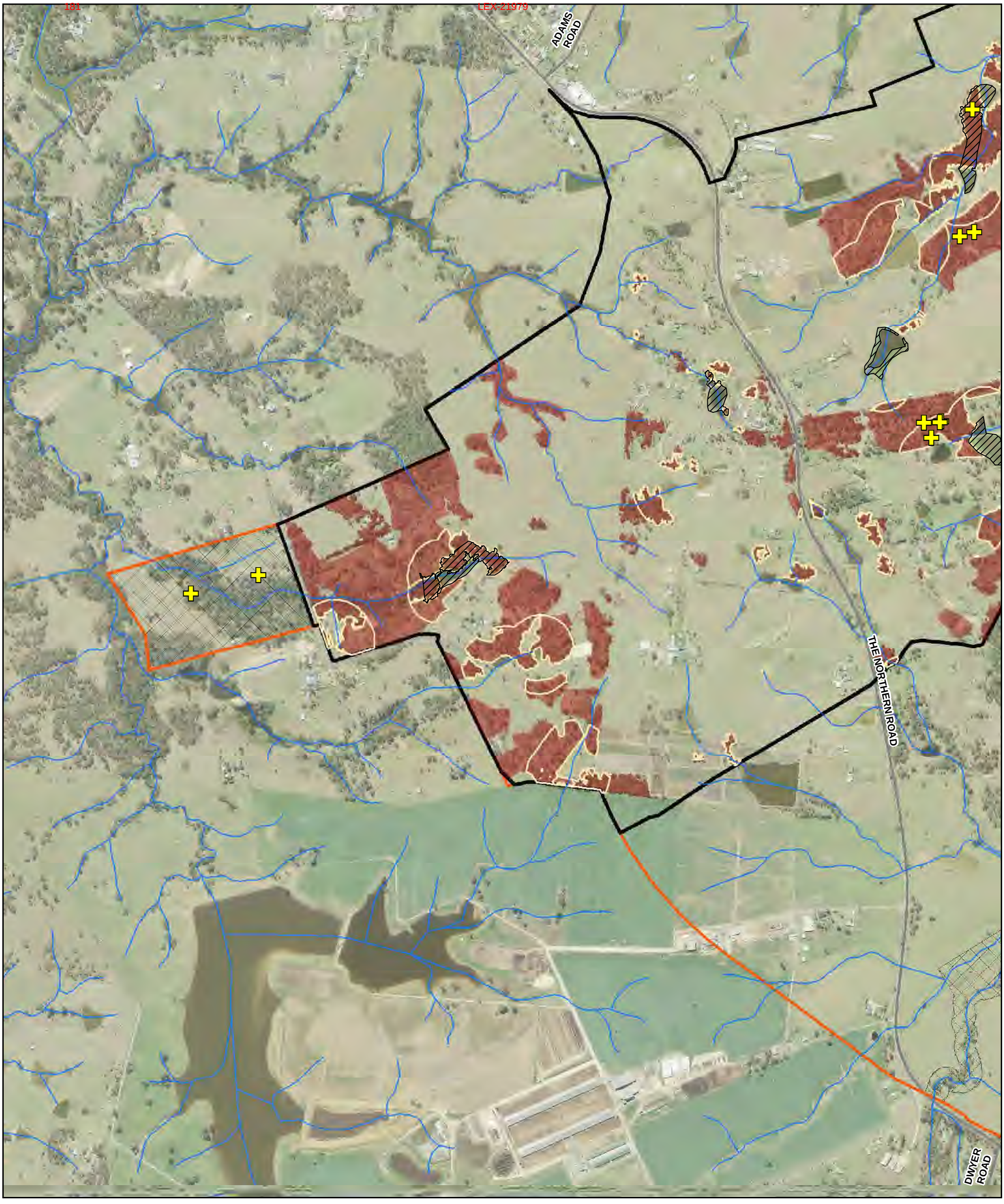
Based on the approach described above, a 74.5 hectare Southern Myotis species polygon was mapped at the airport site as shown on Figure 7.

Black Bittern

A Black Bittern was recorded roosting in dense riparian vegetation in the Badgerys Creek riparian corridor outside of the Stage 1 Construction Impact Zone. Larger, more densely vegetated dams and permanent creeks in the Stage 1 Construction Impact Zone would provide foraging habitat for this species. It may roost and potentially nest in reed beds and riparian forest in the Stage 1 Construction Impact Zone where they are located close to suitable foraging habitat.

Species credits were calculated for the species, by preparing a Black Bittern species polygon consistent with the FBA. The area of Black Bittern habitat was mapped based on the presence of riparian forest or reed beds within the vicinity of permanent drainage lines or freshwater wetlands. Freshwater wetlands with minimal fringing or emergent vegetation were excluded from the species polygon. The draft species polygons were checked against habitat assessments completed during field surveys and ground-truthed at selected locations during the updated 2017 field surveys.

Based on the approach described above, a 17.2 hectare Black Bittern species polygon was mapped at the airport site as shown on Figure 7.



Legend

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Watercourses
- Roads

Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Black Bittern species polygon
- Southern Myotis species polygon
- Cumberland Plain Land Snail species polygon

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Species polygons

Figure 7A

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

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LEX-21979

LUDDENHAM ROAD

ELIZABETH DRIVE

ADAMS ROAD

THE NORTHERN ROAD

Legend

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Watercourses
- Roads

Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Black Bittern species polygon
- Southern Myotis species polygon
- Cumberland Plain Land Snail species polygon

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Species polygons

Figure 7B

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

THE NORTHERN ROAD

BADGERYS CREEK ROAD

DWYER ROAD

Legend

- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Watercourses
- Roads

Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Black Bittern species polygon
- Southern Myotis species polygon
- Cumberland Plain Land Snail species polygon

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;

Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

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Job Number	21-26204
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Date	07 Jul 2017

Species polygons

Figure 7C

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

184

LEX-21979

ELIZABETH DRIVE

BADGERYS CREEK ROAD

Legend

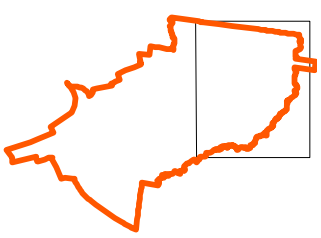
- The airport site
- Stage 1 construction impact zone
- Environmental conservation
- Watercourses
- Roads

Threatened species

- Black Bittern (V)
- Cumberland Plain Land Snail (E)
- Southern Myotis (V)

- Black Bittern species polygon
- Southern Myotis species polygon
- Cumberland Plain Land Snail species polygon

Notes: V - vulnerable species under the TSC Act;
E - endangered species under the TSC Act;



Paper Size A3

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

Department of Infrastructure and Regional Development
Stage 1 Biodiversity Assessment Report

Job Number 21-26204
Revision A
Date 07 Jul 2017

Species polygons

Figure 7D

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Topographic Features - NSW LPI DTDB 2015, Airport layout data - WSU 2016, Aerial imagery - NSW LPI 2013, Vegetation mapping - OEH & GHD 2017, Ecological survey data - GHD 2017, Threatened species mapping - GHD 2017. Created by:apmiller

6.4 Avoid and minimise impacts

6.4.1 Impact mitigation

The airport site was selected based on criteria such as site topography, surrounding topography, proximity to infrastructure, and the need to minimise potential environmental and social impacts. Given this range of selection criteria, the size of site required and the constraints associated with the safe operation of an airport it would not have been possible to completely avoid impacts on biodiversity values. The airport site that has been selected is rural and residential land that has been extensively modified by clearing for agriculture, dwellings and industry. Impacts on native flora and fauna, while significant, are substantially less than would be associated with an undisturbed 'green field' site. Construction of the Stage 1 development would result in direct impacts within a 1153.6 hectare disturbance footprint of which 359.6 hectares is native vegetation.

The opportunity to further modify the extent or layout of the airport is limited by constraints such as the length and position of the runway, size of terminal and parking required, access, security and the obstacle limitation surface that is required to ensure safe operation of the airport. As such, there is little opportunity to further avoid impacts on biodiversity values in the Stage 1 Construction Impact Zone.

6.4.2 Final project area

The final project area comprises the Stage 1 Construction Impact Zone as shown on Figure 1. The final project area is shown with:

- vegetation on Figure 3;
- threatened flora and ecological communities on Figure 4;
- threatened fauna and habitat resources on Figure 5; and
- species polygons (i.e. the extent of habitat for species credit type species) on Figure 7.

6.4.3 Direct impacts

Construction in the Stage 1 Construction Impact Zone would result in direct impacts comprising:

- disturbance of an overall construction footprint of 1153.6 hectares, including 359.6 hectares of native vegetation;
- creation of a gap in habitat that is around 1150 hectares in area and about 2 kilometres wide from north to south and almost 4 kilometres long from east to west;
- permanent removal of 145.2 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the EPBC Act form of the critically endangered ecological community (CEEC);
- removal of local populations of the threatened plants *Pimelea spicata*, *Marsdenia viridiflora* subsp. *viridiflora* and *Pultenaea parviflora*; and
- removal of occupied or potential habitat for threatened fauna, including the species credit species Cumberland Plain Land Snail, Southern Myotis roosting habitat and Black Bittern.

No full or partial vegetation removal outside of the Stage 1 Construction Impact Zone for matters such as Asset Protection Zones is anticipated or has been assessed in this BAR. In accordance with the Airport Plan and the EIS, the design, construction and operation of the airport is required to implement appropriate bushfire management mitigation measures. This will include but is not limited to fuel reduction activities that are sensitive to biodiversity values, and the

provision of appropriate setbacks and Asset Protection Zones in consideration of the biophysical environment.

A more detailed description of direct impacts and the likely effect on the biodiversity values of the Stage 1 Construction Impact Zone is provided in Section 5.

The impact mitigation and environmental management measures specified in Chapter 28 of the EIS (GHD 2015b) will be implemented in accordance with the Airport Plan and are likely to ensure that construction impacts are restricted to the Stage 1 Construction Impact Zone. There are unlikely to be any indirect impacts associated with construction activities that would result in the loss or substantial degradation of threatened species habitat. As described in Section 5.3 the project would not result in any substantial operational impacts on biodiversity values. Given the mitigation measures that would be implemented at the airport site, adjoining land uses, previous activities at the airport site and the extent of existing development, weed infestation and disturbance in the locality, the project would not result in any tangible indirect impacts.

Therefore, no additional indirect impacts have been included in the credit calculations.

6.5 Impact summary

6.5.1 Impacts on biodiversity that require further consideration

Certain impacts on biodiversity values of a major project require further consideration by the consent or approval authority. These are impacts that are particularly complicated or severe. A decision will be made by the consent or approval authority on whether it is appropriate for these impacts to occur or whether modifications to the major project are required to avoid or minimise the impact.

The airport is not the subject of a consent or approval application under NSW legislation and therefore this section of the FBA does not apply and is not discussed further in this Stage 1 BAR.

6.5.2 Impacts requiring biodiversity offsets

Vegetation zones 1 to 9 and also 13 in Table 40 are native vegetation and threatened species habitat and each have a current site value score of greater than 17. Therefore, impacts on these vegetation zones require the calculation of biodiversity offsets. There is a total of 359.6 hectares of native vegetation and threatened species habitat requiring biodiversity offsets in the Stage 1 Construction Impact Zone.

Changes in site biodiversity values through the development of a site is the basis for calculation of biodiversity credits required to offset impacts. Complete clearing of vegetation for a development reduces the site values to zero. There are certain circumstances where portions of a development are managed such that some site value is retained. These circumstances include Asset Protection Zones where only partial vegetation removal may be required. In such cases, vegetation zones should be split into separate management zones to allow separate calculation of impacts of full vegetation removal versus partial vegetation removal. All native vegetation and habitat within the Stage 1 Construction Impact Zone would be removed. The default decrease in site value was entered in the credit calculator for all management zones (i.e. the site values for all vegetation and habitat attributes were reduced to zero). Management zones in the Stage 1 Construction Impact Zone are summarised in Table 43.

The results of the biodiversity offset calculations are presented in Section 6.6.

Table 43 Management zones

Management Zone	Veg Zone ID	Vegetation Zone	Condition	Area (ha)	Management / Site Attribute Scores
MZ1	1	Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good	105.8	Full removal / Default decrease in site value.
MZ2	2	Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - poor	110.5	Full removal / Default decrease in site value.
MZ3	3	Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good	38.7	Full removal / Default decrease in site value.
MZ4	4	Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/good - poor	15.3	Full removal / Default decrease in site value.
MZ5	5	Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good	35.0	Full removal / Default decrease in site value.
MZ6	6	Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/good - poor	10.9	Full removal / Default decrease in site value.
MZ7	7	Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/good	5.2	Full removal / Default decrease in site value.
MZ9	9	Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/good	32.1	Full removal / Default decrease in site value.
MZ10	10	Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN528)	Low	530.7	Full removal / Default decrease in site value.
MZ11	11	Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Low	42.3	Full removal / Default decrease in site value.
MZ12	12	Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Low	43.9	Full removal / Default decrease in site value.
MZ13	13	Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/good - medium	6.1	Full removal / Default decrease in site value

6.5.3 Areas not requiring offset determination

Vegetation zones 10 to 12 in Table 40 are predominantly exotic vegetation. They have been mapped as low condition forms of the native vegetation types that are most likely to have occurred previously for the purposes of site stratification and sampling with plot/transects. These vegetation zones comprise potential habitat for some threatened species and feature some native over storey and mid storey cover but minimal native ground cover, no hollow-bearing trees, no woody debris, minimal natural regeneration and very low species richness. Each of these vegetation zones have a site value score calculated by the credit calculator of less than 17, which is below the threshold for which offsets must be calculated for impacts on potential threatened species habitat.

None of this vegetation comprises a local occurrence of a TEC or contains species credit type threatened species or their habitats. Therefore impacts on vegetation zones 10 to 12 in the project area do not require the calculation of offsets according to the FBA.

A more detailed description of this vegetation and justification for the decision to not provide offsets under the FBA is provided in Section 4.2.2.

6.5.4 Areas not requiring assessment

An assessor is not required to assess areas in a project area without native vegetation unless the SEARs for the project specifically require it.

The mapped area of ‘Cleared land or cropland’ does not comprise native vegetation within the meaning of the FBA. These areas comprise the condition class ‘cleared land’ according to the FBA (OEH, 2014) because they contain no native over storey or mid storey vegetation and greater than 50 per cent exotic ground cover cover or >90 per cent bare earth. This area includes gravel tracks, hardstand areas and other infrastructure with occasional plants associated with cracks or shallow soil deposits that clearly do not comprise native vegetation within the meaning of the FBA and do not require assessment.

These areas do not comprise native vegetation or threatened species habitat according to the FBA and so were not sampled with plot/transects. A more detailed description of these areas and justification for the decision for no further assessment under the FBA is provided in Section 4.2.2.

6.6 Biodiversity credits

The data summarised above were entered into Version 4.0 of the credit calculator to determine the number of biodiversity credits that would be required to offset the removal of vegetation and habitat in the Stage 1 Construction Impact Zone. The Biodiversity credit report is included in Appendix A and is summarised below.

6.6.1 Ecosystem credits

The ecosystem credits that would be required to offset the impacts of the airport on plants, animals and their habitat are shown in Table 44 along with potential offset options (i.e. the plant community types which can be used to offset these impacts according to the FBA/BioBanking credit trading rules).

Table 44 Ecosystem credits required to offset impacts of the airport

Plant community type name	Condition	TSC Act Status	EPBC Act Status	Management zone area	Ecosystem credit requirement	Offset options – Plant community types
Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good_High	CEEC	CEEC	105.8	6607	HN528
Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good_Poor	CEEC		110.5	3737	HN528
Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Moderate/ Good_Medium	CEEC		6.1	210	HN528
Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good	CEEC	CEEC	38.7	1800	HN529, HN528
Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Moderate/ Good_Poor	CEEC		15.3	592	HN529, HN528
Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/ Good	EEC		35.0	2092	HN526
Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Moderate/ Good_Poor	EEC		10.9	363	HN526
Good condition Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest (HN512)	Moderate/ Good	EEC	CEEC	5.2	399	HN512, HN513, HN604, HN556
Good condition artificial freshwater wetland on floodplain (HN630)	Moderate/ Good			32.1	909	HN630, HN520
Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528)	Low			530.7	0	n/a
Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529)	Low			42.3	0	n/a
Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526)	Low			43.9	0	n/a

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6.6.2 Species credits

The species credits that would be required to offset the impacts of the Stage 1 development on plants, animals and their habitat are shown in Table 45.

Table 45 Species credits required to offset impacts of the airport

Common name	Scientific name	Threatened species multiplier	Species credits required
Black Bittern	*Ixobrychus flavicollis*	1.3	224[1]
Cumberland Plain Land Snail	*Meridolum corneovirens*	1.3	2,480[2]
Dillwynia tenuifolia	*Dillwynia tenuifolia*	1.8	198
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora* subsp. *viridiflora* - endangered population	4.0	5,800
Pultenaea parviflora	*Pultenaea parviflora*	1.5	60
Southern Myotis roosting habitat	*Myotis macropus* roosting habitat	2.2	1639[3]
Spiked Rice-flower	*Pimelea spicata*	2.6	107,068

Notes: 1) this has reduced from an estimated 815 credits as presented in Appendix K2 to the EIS (GHD 2016a) because of refined habitat mapping completed in 2017 as described in Section 3.3.2 and Section 6.3.2. Riparian forest and freshwater wetland habitat that is remote from permanent water and/or that has little vegetation cover has been excluded.

2) this has increased from an estimated 1843 credits as presented in Appendix K2 to the EIS (GHD 2016a) because of refined habitat mapping completed in 2017 as described in Section 3.3.2 and Section 6.3.2 and especially updated mapping of the extent of EPBC Act Cumberland Plain Woodland as described in Section 4.5.1.

3) this has increased from an estimated 752 credits as presented in Appendix K2 to the EIS (GHD 2016a) because of refined habitat mapping completed in 2017 as described in Section 3.3.2 and Section 6.3.2. Potential roosting habitat in woodland vegetation that is close to permanent water has been included, whereas the credit calculations presented in GHD (2016a) included only roosting habitat in riparian forest.

7. Recommended management measures

Measures to mitigate biodiversity loss arising from the construction and operation of the airport are set out in Chapter 28 of the EIS. This section provides an overview of those measures.

7.1 Avoidance of impacts

The airport site was selected based on criteria such as site topography, surrounding topography, proximity to infrastructure, and the need to minimise potential environmental and social impacts. Given this range of selection criteria, the size of site required and the constraints associated with the safe operation of an airport, it would not have been possible to completely avoid impacts on biodiversity values. The airport site is rural and residential land that has been extensively modified by clearing for agriculture, dwellings and industry. Impacts on native flora and fauna, while significant, are substantially less than would be associated with an undisturbed 'green field' site. Construction of the Stage 1 development would result in direct impacts within a 1153.6 hectare disturbance footprint of which 359.6 hectares is native vegetation.

The opportunity to further modify the extent or layout of the airport is limited by constraints such as the length and position of the runway, size of terminal and parking required, access, security and the obstacle limitation surface that is required to ensure safe operation of the airport. As such, there is little opportunity to further avoid impacts on biodiversity values at the airport site.

A staged vegetation clearing process would be implemented during construction of Stage 1. This would provide opportunity for fauna that are resident in the Stage 1 Construction Impact Zone to seek refuge in alternative habitat in the Environmental Conservation Zone, long term development impact zone or outside the airport site. Clearing would commence in the north east of the site and proceed south and west. The clearing will be undertaken before the construction of the southern perimeter fence to allow fauna to relocate towards the Environmental Conservation Zone and off site. This approach will be taken to maximise the opportunity for resident fauna to vacate the clearing footprint via vegetated remnants and move toward alternative habitat.

7.2 Mitigation of impacts

Airport Plan Condition 7 requires the preparation of a Biodiversity CEMP to address the potential impacts of the airport on biodiversity values as discussed in Sections 5.3 and 6. The Biodiversity CEMP would require that the mitigation and management measures outlined in Chapter 28 of the EIS (GHD 2015b) be implemented and would include an assessment of the likely effectiveness and justification for identified mitigation and management measures. Many of the mitigation measures are best practice environmental management measures used on construction projects. Impact mitigation and management measures for threatened biota recommended in recovery plans or in the recovery strategies referred to in the threatened species profiles (OEH 2015b) have been identified where relevant.

The Biodiversity CEMP would identify the specific measures for the 'Pre-construction' and 'Construction' stages and would include work methods, contingencies, roles and responsibilities. The Biodiversity CEMP would specify, as a minimum, industry-standard measures for the management of environmental hazards and risks prepared with reference to the outline in Chapter 28 of the EIS (GHD 2015b). Further CEMPs, as required by Airport Plan Conditions 6 (Noise and Vibration Management), 8 (Soil and Water Management), 9 (Traffic and Access Management), 10 (Air Quality Management), 11 (Aboriginal Cultural Heritage Management), 12 (European and Other Heritage Management), 13 (Waste and Resources Management), 14 (Visual and Landscape Management) and 15 (Community and Stakeholder Engagement) would be prepared with additional detail relating to these specific environmental factors.

It should be noted that a precautionary approach has been adopted in the biodiversity assessment and that the assessment of residual impacts on biodiversity values at the airport site does not rely on the effectiveness of mitigation measures. For instance, residual impacts and biodiversity offsets have been calculated based on the removal of all threatened plants in the Stage 1 Construction Impact Zone whereas it is likely that a proportion of the resident populations would survive the proposed translocation programme.

Impacts would be further mitigated by the retention of around 117.1 hectares of land in the Environmental Conservation Zone, including around 47.6 hectares of better condition native vegetation and representative areas of most of the vegetation types at the airport site (see Figure 3). All or part of the 69.5 hectares of derived native grassland, exotic grassland, cleared land and cropland within the conservation zone could be revegetated.

7.3 Offsetting of impacts

A BODP will be prepared based on this Stage 1 BAR, the offset package included in the EIS (GHD 2015c) and the EPBC Act Offsets Policy in accordance with the Airport Plan biodiversity conditions. The BODP will be submitted and require approval prior to the commencement of Main Construction Works for the Stage 1 development of the airport. The BODP will identify the biodiversity offsets that will be implemented to compensate for residual significant impacts associated with the project, as well as an analysis of how the offset meets the requirements of the EPBC Act Offsets Policy (DSEWPaC 2012).

Biodiversity offsets would be required to compensate for residual impacts on Cumberland Plain Woodland, the Grey-headed Flying-fox, *Pimelea spicata*, Swift Parrot foraging habitat and plants, animals and their habitat in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012). The BODP will document how most biodiversity offsets for WSA will be delivered through protection and management of suitable offset sites and other offset mechanisms. The BODP will be prepared in accordance with Condition 30 of the Airport Plan and with reference to the biodiversity offset package, the EPBC Act Environmental Offsets Policy and this Stage 1 BAR.

The BODP will be submitted and require approval from the Environment Minister or a Senior Executive Service (SES) officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

At this stage of the planning and assessment for the airport, the intent is to deliver most biodiversity offsets through conservation of suitable offset sites. The offset sites will be secured by registration of a BioBanking agreement on the title of the relevant sites. The number and type of biodiversity credits would be purchased and retired from offset sites to match the airport's impacts on affected EPBC Act-listed biota as calculated by the offsets assessment guide. Additional biodiversity credits would be purchased to offset impacts on plants, animals and their habitat. The purchase of credits would secure the conservation covenant over the area of land that is linked to the biodiversity credits and provide funds for management in perpetuity.

There are a variety of alternative offsetting conservation mechanisms to BioBanking which may also be utilised in the BODP as other compensatory measures to meet offset requirements. Biodiversity offsets using these alternative mechanisms may be delivered through a variety of existing and future programmes, projects, and policies that may be appropriate under certain circumstances. This is particularly the case where such alternative options may be more practical, or achieve greater strategic benefits for biodiversity conservation in the region.

8. Independent verification

8.1 Overview

Condition 30(4)(c) of the Airport Plan requires that this Stage 1 BAR must have been independently verified by a person accredited in accordance with section 142B(1)(c) of the TSC Act and appointed in consultation with OEH.

Following consultation with OEH on the selection of an independent verifier, as required by Condition 30 of the Airport Plan, the Department engaged WSP to undertake the independent verification of the Stage 1 BAR. The appointed independent verifier, s. 47F(1) , is an accredited assessor under section 142B(1)(c) of the TSC Act (accredited assessor number 0058).

The appointed independent verifier assessed the biodiversity documentation and credit calculator information for adequacy in accordance with the FBA methodology. The independent verifier's review was based on:

- a desktop assessment of biodiversity values and likely constraints within the Stage 1 Construction Impact Zone and its locality;
- review of the Draft Stage 1 BAR and credit calculator files against a modified version of OEH's BioBanking statement review checklist; and
- a one-day site inspection on 8 June 2017 attended by s. 47F(1) (WSP) and s. 47F(1) (GHD) to verify the Stage 1 BAR findings, site data, vegetation zones and the results of the database searches.

GHD and the Department also held a workshop with the independent verifier and representatives from DoEE on May 4 2017. The purpose of this workshop was for GHD and the Department to give an overview of the updated biodiversity assessment and Stage 1 BAR completed in accordance with the Airport Plan conditions and to help define the scope and purpose of the independent verifier's review.

The methodologies used and recommendations derived from the verification are presented in a 'Western Sydney Airport BioBanking Assessment Review' memo as Appendix C to this Stage 1 BAR. Appendix C summarises the findings of the independent verification of all biodiversity documentation submitted by GHD and the Department.

GHD's response to the key independent verifier's review comments is presented below.

8.1 Response to independent verifier review

The independent verifier concluded that the Draft Stage 1 BAR provided a logical and succinct assessment of the airport in accordance with the FBA but that it would benefit from some additional information and clarification to address findings made during the desktop review and site inspection. The independent verifier's requests for additional information or ammendments to the Draft Stage 1 BAR are presented in Appendix C and were also discussed with GHD during the site inspection. GHD have responded to the independent verifier's review comments through updates to mapping, credit calculations and the description of biodiversity values included in this Stage 1 BAR where required.

GHD's response to the key independent verifier's review comments is summarised in Table 46 below along with cross references to the relevant section of this Stage 1 BAR or the credit calculations where each issue has been addressed.

Table 46 GHD response to key independent verifier comments

Comment	GHD response	Where addressed
Section 3.1 – key comments		
One additional threatened flora species *Dillwynia tenuifolia* (listed as under the Vulnerable under the NSW Threatened Species Conservation Act 1995 (TSC Act)) was identified as occurring within the study area. Approximately 150 individuals were recorded during the brief site inspection from within Shale Gravel Transition Forest (HN512 Broad-leaved Ironbark – Grey Box – *Melaleuca decora* grassy open forest) (Attachment A - Figure 1). It is recommended that additional targeted surveys for this species be undertaken in areas were potential habitat occurs in accordance with NSW Guide to Surveying Threatened Plants (OEH, 2016) and FBA to confirm the total number of individuals present.	A further 1.5 days (around 24 person hours) of dedicated *Dillwynia tenuifolia* survey was conducted in June 2017 after this population was detected.	Table 4
Following these targeted surveys, the BioBanking calculation and BAR document will need to be updated where required to reflect the find.	Updated based on the results of the targeted surveys.	Figure 4 Section 4.5.2 Section 6.3.2 Section 6.6.2
Areas of the Stage 1 development footprint occur within the proposed Environmental Conservation Zone. Further clarification is required in BAR to justify/clarify the overlap and removal of native vegetation within the proposed Environmental Conservation Zone.	Further detail has been provided regarding the area of overlap shown in the indicative site layout for the Stage 1 airport. The final layout of surface water management features will be confirmed during the detailed design process and the finalisation of the airport site layout, however, the intent is to not encroach on the conservation zone wherever possible.	Section 5.2.2
Field verification completed during the site inspection confirmed that the mapping of vegetation types and EPBC Act classifications of Cumberland Plain Woodland and Shale Gravel Transition Forest had a high degree of accuracy with only a few minor discrepancies identified. These discrepancies were largely limited to inaccuracies in the mapping of HN528 and HN529 based on canopy cover and patches (>10 per cent canopy cover required to comply with EPBC Act condition criteria) which were assessed using Aerial PhotographicInterpretation (API). During the site inspection it was discussed and agreed upon that the API analysis was too sensitive to be used solely for patch size	It was agreed that some smaller patches of moderate/good – high condition woodland with high canopy foliage cover that were mapped in a matrix of moderate/good – poor condition vegetation comprising derived native grassland or scrub with minimal canopy foliage cover would be better mapped together as a single patch. The resultant larger patches of moderate/good – high condition woodland have lower canopy foliage cover when averaged across the patch as a whole however still exceed 10 per cent cover and would meet the standard of EPBC Act Cumberland Plain Woodland.	Figure 3 Figure 4 Section 4.2.2 Section 4.5.1 Section 5 Section 6

Comment	GHD response	Where addressed
moderate/good – high condition and EPBC Act listed vegetation. Areas of native grassland/regrowth vegetation, mapped as moderate/good – poor condition, in proximity to the moderate/good – high condition contain a high native species diversity, cover and connectivity and therefore should be included in the moderate/good – high condition type. It was agreed upon that the boundaries of these patches would be revised and updated were appropriate		
Whilst the classification of EPBC Act threatened ecological communities were largely accurate, at present, it is difficult to determine which patches of vegetation are consistent or not consistent with the EPBC Act listing. The description in Section 4.5.1 clearly states that all derived grassland in the moderate/good – poor condition type do not meet the EPBC Act. This section is however unclear as to the distinction of which moderate/good – medium condition type patches are or are not EPBC Act listed. The BAR would benefit from further clarification on the EPBC Act classification assessment undertaken and perhaps splitting the moderate/good – medium condition type into two separate vegetation zones to distinguish between the EPBC Act listed and non-EPBC Act listed variants.	Section 4.5.1 has been modified to further explain the criteria that were used to define whether Moderate/good – medium condition patches comprised EPBC Act Cumberland Plain Woodland. As suggested by the independent verifer, some patches of better condition woodland have been split into 'Moderate/good – high' condition woodland that comprises EPBC Act Cumberland Plain Woodland and 'Moderate/good – medium' condition woodland that does not qualify because less than 30 per cent of the perennial understorey vegetation is composed of native plant species.	Section 4.5.1
Additionally it is recommended that a definition of a patch be included in the BAR to provide clarity such as 'A patch is defined as a discrete and continuous area that comprises the ecological community. A patch may include small-scale disturbances such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community – for instance the easy movement of wildlife or dispersal of plant spores and seeds' (DEWHA, 2010).	Section 4.5.1 has been modified to include a clearer explanation of how patches were defined for the purposes of this assessment.	Section 4.5.1
Alternatively, patch by patch analysis against the EPBC classification could be provided as an Appendix. It is acknowledged that given the scale of the site and high number of individual patches this may be impractical however undertaking this exercise for the moderate/good – medium condition patches with illustration on a Figure would improve clarity of the classification.	A patch by patch analysis could not be practically provided because of the scale of the study area and the number of individual patches.	n/a
Vegetation mapping deemed appropriate based on field validation site inspection.	Further detail provided in Section 3.3.2.	Section 3.3.2

Comment	GHD response	Where addressed
Section 3.3.2 'Vegetation surveys and mapping' described the methodology for mapping and confirming Plant Community Types (PCTs) as comparing plot/transect data with Tozer et al (2010) diagnostic species listed for equivalent vegetation map units. There are some inconsistences in the diagnostic species comparisons provided and the PCTs selected and mapped in Figure 3 and 4 in the BAR. For instance most plots appear to use the ratio of positive diagnostic species: total native species in order to determine the appropriate PCT however Plot 20 appears to utilise the ratio of actual: required positive diagnostic species to determine that the plot is HN529 as shown in Table 39 and Figure 3A and 4A. It is acknowledged that the PCTs determinations mapped are correct based on field observations and it is recognised that other resources were likely utilised to determine, confirm and map PCTs within the site such as topographical, soil and geology maps. The report would benefit from further justification in Section 3.3.2 as to the additional criteria other than Tozer analysis used to derive the PCTs mapped within the site.		
Field survey effort is largely deemed appropriate however the report may benefit from depicting targeted threatened flora and fauna survey effort visually on a figure. The survey effort is currently described in detail in Section 3 of the BAR however it is difficult to determine where these surveys were undertaken given the scale and nature of the site. A visual representation of targeted survey effort would aid in justifying that the survey effort is adequate and in accordance with the relevant guidelines.	Field survey effort is shown on Figure 2.	Figure 2
In addition a number of species have not been surveyed within the BioBanking Calculator 'survey time matrix' specified survey timing i.e. Pultenaea pedunculata, Pterostylis saxicola and Hypsela sessilifolia and Rosenberg's Goanna. Section 6.3.2 of the BAR notes that the presence of these species have been readily excluded from occurring on the site based on desktop assessments of on-site habitat. It is acknowledged that suitable habitat probably does not occur however to be compliant with the FBA additional targeted surveys or expert reports for these species would have to be completed. Further discussion and justification should be provided on these matters.	Appropriate survey effort for Rosenberg's Goanna was conducted in February in accordance with the survey time matrix. This survey effort comprised baited motion-activated camera trap surveys and active searches conducted for the EIS in February 2015. The continued application of these survey techniques through March and April 2015 is also likely to have contributed to the effective survey effort for the species even if not strictly in accord with the survey time matrix (pers. obs., noting that active individuals of the closely related Lace Monitor (*Varanus varia*) were observed on site during this period). Section 6 of the FBA outlines the process for assessing species credit species, including: "Step 1: Identify candidate species credit species, using data from the Threatened Species Profile Database, the	Section 6.3.2 Appendix A

Comment	GHD response	Where addressed
	assessor must identify a threatened species as a candidate species for the development site if…" inter alia "(c) the development site contains habitat features or components associated with the species, as identified in the Threatened Species Profile Database". "Step 3: Determine whether the candidate species is present", including targetted surveys in accordance with the survey time matrix, is only required for candidate species identified in Step 1. Appendix A has been amended to make it clearer that this is a list of 'Potential candidate threatened species' and only those with habitat present at the airport site are candidate species. Additional discussion and justification has been added to Section 6.3.2 to help confirm that these threatened plants would not occur in the Stage 1 Construction Impact Zone and as such are not candidate species for the assessment.	
There are inconsistences between the total number of BioBanking plots/transects completed in BAR report, figures and BioBanking calculator. Clarification of plots undertaken and included in the BioBanking calculator is required to confirm total number of plot/transects completed and their locations. For instance: Table 39 states that 62 plots/transects were completed however elsewhere in the report such as Section 3.3.2 Plots/transects' 60 plots/transects are stated as being completed whilst figures suggest that 92 were completed.	60 plots were completed as stated in Section 3.3.2. There was a data entry error in Table 39 that has been corrected. The 92 plot/transects shown on figures 3 and 4 in the Draft Stage 1 BAR included those sampled at the airport site but outside the Stage 1 Construction Impact Zone. These additional plot/transects were originally included to provide an indication of survey effort across the broader airport site but have been removed to avoid confusion. The total number of plot/transects entered in the credit calculator has increased to 62 because two rapid plot/transects have been included to allow credit calculations for the new vegetation zone 13 (Medium condition Grey Box - Forest Red Gum grassy woodland on flats (HN528).	Table 40 Figure 3 Figure 4
Vegetation zone nine in the BioBanking calculator has different plots/transects than detailed in Table 39.	This data entry error in the FBA credit calculator has been corrected.	FBA credit calculator.
Typographic errors and duplication of plot reference numbers on maps. Suggest that maps be reviewed and amended where required. Examples include: Figure 3A has duplicate plot labels for plot/transects including 12, 18, 19, 20, 21 etc.	Mapping errors have been corrected.	Figure 3 Figure 4
Figure 2E has rapid assessment points labelled with same reference numbers. For example there are two rapid assessments labelled '2' whilst others have no identification labels.	Mapping errors have been corrected.	Figure 3 Figure 4

Comment	GHD response	Where addressed
Aerial photographs on BAR figures do not contain data source references or dates of when they were taken. The majority of figures refer back to 'Digital Data Sources' on second page of the EIS.	Figures have been updated with references to digital data sources.	All figures.
The direction of plot/transects are not illustrated on figures. It is acknowledged that given the large nature of the site the direction of plots/transects will be unable to be shown at scale. BAR would benefit from having the plot/transects illustrated on a figure.	The direction of plot/transects has been added to the plot/transect data summarised in Appendix A.	Appendix A.
Figure 4 of the BAR appears to have a vegetation layer error. Some areas of EPBC Act and TSC Act listed Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest are lacking the shading associated with the TSC Act listing for the community (for instance southern potion of the site west of The Northern Road on Figure 4a and along the north eastern boundary on Figure 4D). Noted this may just require a layer turned on.	Mapping errors have been corrected.	Figure 3 Figure 4
The landscape assessment inner and outer circle assessments appear visually not to be centred on the area of native vegetation mostly impacted upon by the project. It is noted that the circles may be centred over the largest area of native vegetation (i.e. remnant and derived native grasslands) however landscape assessment shapefiles were not supplied and therefore could not be confirmed. Clarification and evidence is required to justify the landscape assessment circles positioning as it is currently unclear.	The 400 hectare landscape assessment circle was centred over the assumed area of greatest percentage change in vegetation cover based on a visual assessment (noting that this is not necessarily the largest area of native vegetation to be removed). In response to this comment, multiple assessment circles were created in GIS and multiple sets of calculations were performed to confirm the area of greatest percentage change in vegetation cover. As a result of this additional assessment, the 400 hectare circle was moved to capture a slightly greater change. This resulted in a 0.6 point change in the landscape score for the development.	Figure 6 Section 6.1
BioBanking Statement Review Checklist		
Maps are generally appropriate however Figure 4a is missing a legend reference for one threatened flora species (predicted to be *Pimelea spicata*) .	Mapping errors have been corrected.	Figure 3 Figure 4
Figure 7 is not available 'Updated species polygon mapping to be provided).	Completed Figure 7 has been provided.	Figure 7
Maps:	Boundary points and eastings and northings were not added to figures because of the scale of the site, complexity of the site boundary and	All figures.

Comment	GHD response	Where addressed
- None contain eastings and northings - this may be due to the site boundary following cadastre/zoning boundaries - Figures 1 and 6 provide aerial photograph data source but no date. Figures 2, 3, 4 and 5 do not provide the data source or date of aerial photographs instead refer to 'Digital Data Sources' on second page of EIS with no reference in BAR.	complexity of the GIS data already shown on figures. Also note that provision of eastings and northings on maps is a formal requirement of the BioBanking statement review checklist because of the form of legal agreement linked to a BioBanking statement and is not a requirement of the Airport plan conditions. Figures have been updated with references to digital data sources.	
Section 6.2 of BAR states that all vegetation involved in the Stage 1 development would be entirely removed. No partial clearing associated with Asset Protection Zones (APZs) has been taken into consideration. Justification as to why no APZs have been considered would provide clarity in the BAR. 3.4 Asset Protection Zones (APZs) Section 6.2 of BAR states that all vegetation involved in the Stage 1 development would be entirely removed. No partial clearing associated with APZs has been taken into consideration. Justification as to why no APZs have been considered would provide clarity in the BAR.	As stated in Section 6.2 it is assumed that all vegetation would be removed for the bulk earthworks and construction of surface water management features in the initial stages of the construction of the airport. Fuel-reduced areas such as APZs surrounding infrastructure will be accommodated within the Stage 1 Construction Impact Zone. Additional justification has been added to provide clarity in the Stage 1 BAR.	Section 5.2.2 Section 6.4.3
3.3 Assessment circles - Landscape assessment circles appear inappropriate based on Figure 6 of the BAR as the inner circle does not appear to be centred over the largest area of native vegetation mostly impacted upon by the project. Noted that calculations may be based on DNG and remnant vegetation however unclear based on figure. No landscape assessment shapefiles were provided and therefore unable to confirm. Suggest provided justification in BAR to detail how the positioning of the inner circle was determined. Unable to confirm per cent of native vegetation cover as no landscape assessment shapefiles were provided.	See above.	Figure 6 Section 6.1
3.9 BB Calculator (Vegetation Zones) - HN526 vegetation formation is listed as 'Grassy Woodland' (Veg zone 5 and 6) however should be 'Forested Wetlands'.	The vegetation formation for HN526 was listed in the PCT database as 'Grassy Woodland' at the time that the FBA credit calculations for the airport were started in 2015. OEH has since revised the vegetation formation to 'Forested Wetlands'. The credit calculator has been updated accordingly. Please note that the new vegetation formation (Forested Wetlands) was noted at the time that it changed and applied to planning for the	FBA credit calculator

Comment	GHD response	Where addressed
	delivery of biodiversity offsets, for instance through the application of the ecosystem credit trading rules.	
Adequate number of plots undertaken in accordance with areas of current vegetation zones. May require revising based on vegetation mapping changes recommended.	The minimum number of plot/transects required by the FBA were sampled within all vegetation zones except the new zone 13 (HN528 Moderate/good – medium condition) where two rapid plot/transects had to be counted towards the total. Rapid plot/transects where sampled according to the standard methodology except that only the 20 most dominant plant sepcies were recorded in the 20 m x 20 m plot instead of full plant species richness. To avoid underestimation of site condition, benchmark plant species richness data were entered in the credit calculator for these plots.	Section 3.3.2 Section 4.2.2 Section 6.2
There are however inconsistences with the total number of plots per vegetation type in the BB calculator and Table 39 of the BAR for instance HN529 has 5 in the BB calculator and 4 in Table 39. Inconsistences occur for vegetation zones 3, 5 and 10. Review of BB calculator (Site Values) shows that the plots entered into the calculator for some vegetation zones differ from what is presented in Attachment A plot/transect data table. For instance all plots in vegetation zone 9 (frog 9, frog 10, frog 8 and frog 11) differs in plot id and data provided in Appendix A table (65, 77, 80 and 81).	Errors in plot/transects entered in the credit calculator have been corrected.	Credit calculator.
3.11 Threatened species assessment– survey or assumed presence. Limited data available regarding targeted threatened flora surveys in BAR. BAR would benefit from further descriptions of methodology in reference to appropriate guidelines such as NSW Guide to Surveying Threatened Plants and mapping of threatened survey effort eg flora transects undertaken.	The majority of the targetted survey effort at the airport site was conducted in 2015, prior to the February 2016 publication of the NSW Guide to Surveying Threatened Plants (OEH 2016b) and was done with reference to the DEC (2004a) guidleines and various EIS guidleines for individual species. The consistency of survey effort with relevant guidleines is documented in Appendix Table 5 of Appendix K1 of the EIS. Targetted threatened plant surveys conducted in 2017 were performed in accordance with the OEH (2016b) guide, including parallel field traverses through areas of known or likely threatened plant habitat. Section 3.3.2 has been updated accordingly. It is not practical to map parallel field traverses in detail in a study area the scale of the airport site.	Section 3.3.2 Also see Appendix Table 5 of Appendix K1 of the EIS.
Report would benefit from clarifying targeted surveys of each threatened species identified by the BB calculator.	A table showing ‘Potential candidate species credit species and survey method and timing implemented’ has been added to Appendix A.	Appendix A.

9. Conclusion

This BAR for the Stage 1 development of the airport has been prepared to describe the biodiversity values present at the airport site. This Stage 1 BAR has been prepared in accordance with Environmental Condition 30(4) of the Airport Plan and has been independently verified by a person accredited under the *Threatened Species Conservation Act 1995* (TSC Act).

This Stage 1 BAR presents the results of an updated survey and assessment of the Stage 1 Construction Impact Zone outlined in the Airport Plan based on the methodology outlined in the NSW FBA.

The airport site comprises gently undulating, low hills on shale and broad flats on alluvium on the Cumberland Plain. It features remnant patches of grassy woodland and narrow corridors of riparian forest within extensive areas of derived grassland, cropland and cleared, developed land. The main land uses are agriculture and low density rural residential development.

The condition of native vegetation and habitat across the airport site varies as a result of previous land uses and grazing intensity. Areas that have been historically cleared and/or heavily grazed now contain regrowth vegetation in poorer condition. There is moderate to severe weed infestation throughout, with linear remnants along roads and isolated patches in agricultural land the most severely affected. Notwithstanding the generally poor condition of the airport site, it has high conservation significance as a result of the presence of threatened species and ecological communities and the generally limited extent and quality of similar environments in the Western Sydney region.

Construction of the Stage 1 development at the airport site would result in direct impacts within a 1153.6 hectare disturbance footprint, including 359.6 hectares of native vegetation. The majority of impacts for the Stage 1 development would be in areas that have previously been cleared for agricultural purposes. The Stage 1 Construction Impact Zone would be completely developed and converted to airport infrastructure or managed open space with minimal native vegetation cover. Native vegetation removal in the Stage 1 Construction Impact Zone would comprise land clearance as defined under the EPBC Act and would constitute a substantial increase in the operation of this Key Threatening Process in the locality and region. Impacts as a result of clearing of this vegetation would be permanent and irreversible.

Construction of Stage 1 would create a gap in habitat that is around 1153.6 hectares in area and about 1.5 kilometres wide from north to south and almost 7 kilometres long from east to west. This area would be mostly inhospitable to native species given the presence of cleared areas, fences, infrastructure, lights and aviation-related activities. The gap would create a barrier to ecological processes such as dispersal, pollination and seed fall. The airport would result in a substantial increase in the degree of habitat fragmentation in the locality and region.

Other direct and indirect impacts arising from the construction and operation of the airport would include harm to plants and animals during construction, alteration of the land surface and hydrology, the risk of bird and bat strike by aircraft and the potential for alteration of flows and water quality downstream.

The Stage 1 development would result in the following impacts on threatened biota and other biodiversity matters listed under the EPBC Act:

- permanent removal of 145.2 hectares of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the EPBC Act form of the critically endangered ecological community (CEEC);

- removal of local populations of the threatened plants *Pultenaea parviflora*, Spiked Rice-flower (*Pimelea spicata)*, and *Marsdenia viridiflora* subsp. *viridiflora* as well as minor impacts to a local population of *Dillwynia tenuifolia;*
- removal of up to 190.8 hectares of foraging habitat for the Grey-headed Flying-fox (*Pteropus poliocephalus*), which is listed as a vulnerable species under the EPBC Act and which has been observed flying over the airport site;
- removal of up to 190.8 hectares of potential winter foraging habitat for the Swift Parrot (*Lathamus discolor*), which is listed as a critically endangered species under the EPBC Act and which may occur at the airport site during annual migrations on an opportunistic basis;
- large-scale vegetation clearing and other signfificant impacts on plants in an area of Commonwealth Land;
- the long-term decrease or extinction of populations of small, less mobile animals such as frogs, reptiles and and other impacts on fauna in an area of Commonwealth Land; and
- removal and fragmentation of known and potential habitat for a range of threatened woodland birds and microchiropteran bat species listed under the TSC Act.

The airport site was selected based on criteria such as site topography, surrounding topography, proximity to infrastructure and the need to minimise potential environmental and social impacts. Given this range of selection criteria, the size of site required and the constraints associated with the safe operation of an airport, it would not have been possible to completely avoid impacts on biodiversity values. There will be no clearance of significant vegetation outside of the Construction Impact Zone prior to further approvals under the Airports Act where the vegetation is in the Environmental Conservation Zone; or comprises a threatened ecological community under the EPBC Act; or provides important or critical habitat for a listed threatened species under the EPBC Act. This approach means that impacts on biodiversity values would be avoided for as long as is practicable.

Biodiversity offsets would be required to compensate for significant residual impacts arising from the airport in accordance with the EPBC Act Offsets Policy (DSEWPaC 2012). A Biodiversity Offset Delivery Plan (BODP) will be prepared based on this Stage 1 BAR, the offset package included in the EIS (GHD 2015c) and the EPBC Act Offsets Policy in accordance with the Airport Plan biodiversity conditions. The BODP will be submitted and require approval prior to the commencement of Main Construction Works for the Stage 1 development of the airport.

The BODP will identify the biodiversity offsets that will be implemented to compensate for residual significant impacts including

- removal of 145.2 hectares of vegetation within the local occurrence of EPBC Act Cumberland Plain Woodland;
- removal of 190.8 hectares of foraging habitat for the Grey-headed Flying-fox and Swift Parrot; and
- removal of at least 4,118 clumps of *Pimelea spicata* and 2.94 hectares of occupied habitat.
- removal of up to 359.6 hectares of occupied or potential habitat for threatened biota listed under the TSC Act including the species credit species *Dillwynia tenuifolia*, *Pultenaea parviflora*, *Marsdenia viridiflora* subsp. *viridiflora*, Cumberland Plain Land Snail, Southern Myotis and Black Bittern.

The FBA credit calculations included in this Stage 1 BAR have expressed the requirement for biodiversity offsets for impacts on plants, animals and their habitats, including threatened biota listed under the TSC Act, in terms of biodiversity credits.

The BODP will include the conservation of habitat for the affected protected matters in suitable offset sites and other appropriate offsetting mechanisms. Offset sites would mainly be secured by the relevant site owners obtaining a Biodiversity Stewardship agreement that would ensure that they would be securely titled and managed for conservation as a Stewardship Site in perpetuity.

The BODP would be submitted to and require approval from the Environment Minister or an SES Officer in DoEE prior to the commencement of Main Construction Works for the Stage 1 development of the airport, ensuring that biodiversity offsets have been identified (and secured where possible) prior to the substantial impacts occurring.

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Appendices

Appendix A – Framework for Biodiversity Assessment data

Biodiversity credit report 217 LEX-21979

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 28/08/2017 Time: 4:45:28PM Calculator version: v4.0

Major Project details

Proposal ID:	073/2015/2144MP
Proposal name:	Western Sydney Airport
Proposal address:	The airport site Badgerys Creek NSW 2555
Proponent name:	Western Sydney Unit Department of Infrastructure and Regional Development
Proponent address:	GPO Box 594 Canberra ACT 2601
Proponent phone:	02 6210 6089
Assessor name:	s. 47F(1)
Assessor address:	Level 15 133 Castlereagh Street Sydney NSW 2000
Assessor phone:	s. 47F(1)
Assessor accreditation:	s. 47F(1)

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	5.20	399.15
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	89.80	2,455.47
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	753.10	10,554.60
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	96.30	2,392.30
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	32.10	909.00
Total	976.50	16,711

Credit profiles

1. Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)

Number of ecosystem credits created	10,555
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)

Number of ecosystem credits created	0
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)

Number of ecosystem credits created	2,392
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529) Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)

Number of ecosystem credits created	0
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, (HN528) Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion, (HN529)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

5. Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (HN512)

Number of ecosystem credits created	399
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (HN512) Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (HN513) Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (HN604) Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (HN556)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

6. Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion, (HN630)

Number of ecosystem credits created	909
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion, (HN630) Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion, (HN520)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

7. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)

Number of ecosystem credits created	2,455
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

8. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)

Number of ecosystem credits created	0
IBRA sub-region	Cumberland - Hawkesbury/Nepean

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (HN526)	Cumberland - Hawkesbury/Nepean and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Pultenaea parviflora	Pultenaea parviflora	4.00	60
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Marsdenia viridiflora subsp. viridiflora - endangered population	145.00	5,800
Cumberland Plain Land Snail	Meridolum corneovirens	190.80	2,480
Black Bittern	Ixobrychus flavicollis	17.20	224
Southern Myotis	Myotis macropus	74.50	1,639
Spiked Rice-flower	Pimelea spicata	4,118.00	107,068
Dillwynia tenuifolia	Dillwynia tenuifolia	11.00	198

Potential candidate species credit species and survey time matrix

Common name	Scientific name	Predicted by Credit calculator[1]	BioNet records in locality[2]	Date of most BioNet recent record	Jan[3]	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Candidate species / habitat at site ?[4]	Recorded at site ?
Allocasuarina glareicola	*Allocasuarina glareicola*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Austral Pillwort	*Pilularia novae-hollandiae*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Australasian Bittern	*Botaurus poiciloptilus*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Bargo Geebung	*Persoonia bargoensis*	Y	0	N/A	Y	Y	Y	Y	Y	N	N	N	N	N	N	Y	N	N
Black Bittern	*Ixobrychus flavicollis*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Brown Pomaderris	*Pomaderris brunnea*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Bynoe's Wattle	*Acacia bynoeana*	Y	0	N/A	Y	Y	Y	N	N	N	N	N	Y	Y	Y	Y	N	N
Camden White Gum	*Eucalyptus benthamii*	Y	159	1/10/2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Comb-crested Jacana	*Irediparra gallinacea*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Cumberland Plain Land Snail	*Meridolum corneovirens*	Y	275	25/09/2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dillwynia tenuifolia	*Dillwynia tenuifolia*	Y	55	6/11/2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Dillwynia tenuifolia (a shrub) population, Kemps Creek	*Dillwynia tenuifolia* - endangered population Kemps Creek	Y	41	13/11/2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Downy Wattle	*Acacia pubescens*	Y	11	17/03/2010	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Dwarf Kerrawang	*Commersonia prostrata*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	N	35	26/06/2016	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y
Eastern Pygmy-possum	*Cercartetus nanus*	Y	0	N/A	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local	*Callocephalon fimbriatum* population in the Hornsby and Ku-ring-gai Local Government Areas	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N

Common name	Scientific name	Predicted by Credit calculator[1]	BioNet records in locality[2]	Date of most BioNet recent record	Jan[3]	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Candidate species / habitat at site ?[4]	Recorded at site ?
Government Areas																		
Giant Burrowing Frog	*Heleioporus australiacus*	Y	4	16/04/2006	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	N	N
Green and Golden Bell Frog	*Litoria aurea*	Y	1	28/08/1999	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	N	N
Grey-headed Flying-fox	*Pteropus poliocephalus*	N	37	19/11/2015	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y
Gyrostemon thesioides	*Gyrostemon thesioides*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Hibbertia sp. Bankstown	*Hibbertia* sp. Bankstown	Y	0	N/A	N	N	N	N	N	N	N	N	Y[5]	Y[5]	Y	Y	N	N
Hypsela sessiliflora	*Hypsela sessiliflora*	Y	7	18/07/2002	N	N	N	N	N	N	N	N	Y[5]	Y[5]	Y	N	Y	N
Juniper-leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*	Y	93	2/12/2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Koala	*Phascolarctos cinereus*	Y	4	27/04/2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Large-eared Pied Bat	*Chalinolobus dwyeri*	N	9	17/10/2008	Y	Y	Y	Y	N	N	N	N	Y	Y	Y	Y	N	N
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora* subsp. *viridiflora* - endangered population	Y	50	7/05/2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Matted Bush pea	*Pultenaea pedunculata*	Y											Y[5]	Y[5]	Y		N	N
Micromyrtus minutiflora	*Micromyrtus minutiflora*	Y	2	15/07/2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Nodding Geebung	*Persoonia nutans*	Y	6	26/04/2001	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Pimelea curviflora subsp. *curviflora*	*Pimelea curviflora* subsp. *curviflora*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N

Common name	Scientific name	Predicted by Credit calculator[1]	BioNet records in locality[2]	Date of most BioNet recent record	Jan[3]	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Candidate species / habitat at site ?[4]	Recorded at site ?
Pultenaea parviflora	*Pultenaea parviflora*	Y	34	6/11/2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Red-crowned Toadlet	*Pseudophryne australis*	N	3	11/12/2013	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Regent Honeyeater	*Anthochaera phrygia*	Y	1	17/12/2009	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
Rosenberg's Goanna	*Varanus rosenbergi*	Y	0	N/A	Y	Y	N	N	N	N	N	N	N	N	Y	Y	Y	N
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*	Y	12	20/05/2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Southern Myotis	*Myotis macropus*	N	26	29/04/2014	Y	Y	Y	N	N	N	N	N	N	Y	Y	Y	Y	Y
Spiked Rice-flower	*Pimelea spicata*	Y	9	6/01/2005	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Squirrel Glider	*Petaurus norfolcensis*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N
Sydney Plains Greenhood	*Pterostylis saxicola*	Y	0	N/A	N	N	N	N	N	N	N	N	Y	Y[5]	Y[5]	N	N	N
Tall Knotweed	*Persicaria elatior*	Y	0	N/A	Y	Y	Y	Y	Y	N	N	N	N	N	N	Y	Y	N
Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	*Wahlenbergia multicaulis* - endangered population	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N
White-flowered Wax Plant	*Cynanchum elegans*	Y	0	N/A	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N

Notes: 1) Predicted by Credit calculator – Y indicates that the species was identified by the credit calculator as a candidate species based on the Threatened Species profile database. 2) BioNet records in the locality – the number of records of the species in the BioNet database, in the locality of the study area, in the last 20 years. 3) Y indicates that targeted surveys for the candidate species may be conducted in that month according to the BBAM. Shading indicates that targeted surveys for the species were conducted in that month. 4) Candidate species / Habitat at site? – Y indicates that the development site contains habitat features or components associated with the species, as identified in the Threatened Species Profile Database and/or the threatened species profile (OEH, 2016d) and other literature is present at the site. N means that specific habitat resources are not present as confirmed by habitat assessments conducted during the field surveys. 5) Supplementary surveys which only achieved partial coverage of the Stage 1 Construction Impact Zone.

Potential candidate species credit species and survey method and timing implemented

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
Allocasuarina glareicola	*Allocasuarina glareicola*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Austral Pillwort	*Pilularia novae-hollandiae*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Australasian Bittern	*Botaurus poiciloptilus*	N	Diurnal birds surveys conducted over 16 days and early morning birds surveys conducted over 10 mornings ((2-3 people for 1-2 hours on each morning) – 13 sites visited at least once) in February and May 2015	10/6/15	N
Bargo Geebung	*Persoonia bargoensis*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	10/6/15	N
Black Bittern	*Ixobrychus flavicollis*	Y	Diurnal birds surveys conducted over 16 days and early morning birds surveys conducted over 10 mornings ((2-3 people for 1-2 hours on each morning) – 13 sites visited at least once) in February and May 2015	10/6/15	Y
Brown Pomaderris	*Pomaderris brunnea*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017.	30/3/15	N

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
			Included a combination of plot/transects, opportunistic surveys and random meanders.		
Bynoe's Wattle	*Acacia bynoeana*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Camden White Gum	*Eucalyptus benthamii*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Comb-crested Jacana	*Irediparra gallinacea*	N	Diurnal birds surveys conducted over 16 days and early morning birds surveys conducted over 10 mornings (13 sites visited at least once) in February and May 2015	10/6/15	N
Cumberland Plain Land Snail	*Meridolum corneovirens*	Y	Active searches conducted for 11 days (35 sites, about 25 person hours)	23/3/17	Y
Dillwynia tenuifolia	*Dillwynia tenuifolia*	Y	Flora surveys conducted over 19 days between February and June 2015; 2 days in April 2016 and 9.5 days over March and April 2017 (of which 1.5 full days were dedicated *Dillwynia tenuifolia* surveys). Included a combination of plot/transects, opportunistic surveys, random meanders and systematic walked transects at five metre intervals through areas of occupied habitat.	14/6/17	Y
Dillwynia tenuifolia (a shrub) population, Kemps Creek	*Dillwynia tenuifolia* - endangered population Kemps Creek	N	Flora surveys conducted over 19 days between February and June 2015; 2 days in April 2016 and 9.5 days over March and April 2017 (of which 1.5 full days were dedicated *Dillwynia tenuifolia* surveys). Included a combination of plot/transects, opportunistic surveys and random meanders.	14/6/17	N

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
Downy Wattle	*Acacia pubescens*	Y	Flora surveys conducted over 19 days between February and June 2015; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Dwarf Kerrawang	*Commersonia prostrata*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	Y	Microchiropteran bat surveys (Anabat) conducted over 21 Anabat unit nights over 12 locations from February to April 2015.	30/3/15	Y
Eastern Pygmy-possum	*Cercartetus nanus*	N	Spotlighting conducted between February to April 2015 using 3 people on 5 nights (30 person hours) and a further 2 people on 4 nights (16 person hours). Infra-red cameras (2 cameras, each at two locations for 4 weeks each) Feb-April 2015	30/3/15	N
Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	*Callocephalon fimbriatum* population in the Hornsby and Ku-ring-gai Local Government Areas	N	Diurnal bird surveys conducted over 16 days between February and May 2015, and a a further 5 days between February and March 2017.	30/3/15	N
Giant Burrowing Frog	*Heleioporus australiacus*	N	Targeted frog surveys conducted between 2 people for 4 afternoons and nights (80 person hours). Included a combination of diurnal inspections of dams for basking frogs, and call playback and rapid aural surveys.	19/3/15	N
Green and Golden Bell Frog	*Litoria aurea*	N	Targeted frog surveys conducted between 2 people for 4 afternoons and nights (80 person hours). Included a combination of diurnal inspections of dams for basking frogs, and call playback and rapid aural surveys.	19/3/15	N
Grey-headed Flying-fox	*Pteropus poliocephalus*	Y	Spotlighting conducted between February to April 2015 using 3 people on 5 nights (30 person hours) and a further 2 people on 4 nights (16 person hours).	8/5/15	Y

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
Gyrostemon thesioides	*Gyrostemon thesioides*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Hibbertia sp. Bankstown	*Hibbertia* sp. Bankstown	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	n/a (entered as 23/3/2017)[1]	N
Hypsela sessiliflora	*Hypsela sessiliflora*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	n/a (entered as 23/3/2017)[1]	N
Juniper-leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Koala	*Phascolarctos cinereus*	N	Spotlighting conducted between February to April 2015 using 3 people on 5 nights (30 person hours) and a further 2 people on 4 nights (16 person hours) Infra-red cameras (2 cameras, each at two locations for 4 weeks each) Feb-April 2015	8/5/15	N
Large-eared Pied Bat	*Chalinolobus dwyeri*	N	Microchiropteran bat surveys (Anabat) conducted over 21 Anabat unit nights over 12 locations from February to April 2016	19/3/15	N
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	*Marsdenia viridiflora* subsp. *viridiflora* - endangered population	Y	Flora surveys conducted over 19 days between February and June 2015; 2 days in April 2016 (comprising dedicated *Marsdenia viridiflora* subsp. *viridiflora*	23/3/17	Y

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
			surveys in known habitat).and 9.5 days over March and April 2017 Included a combination of plot/transects, opportunistic surveys, random meanders and systematic walked transects at five metre intervals through areas of occupied habitat.		
Matted Bush pea	*Pultenaea pedunculata*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	19/3/15	N
Micromyrtus minutiflora	*Micromyrtus minutiflora*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Nodding Geebung	*Persoonia nutans*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Pimelea curviflora subsp. *curviflora*	*Pimelea curviflora* subsp. *curviflora*	N	Flora surveys conducted over 19 days between February and June 2015; 2 days over April 2016 and 9.5 days over March and April 2017 (including around 82 dedicated person hours comprising a team of two spending at least 1 hour per day on each of 5 days on site; 3 full days of dedicated *Pimelea spicata* surveys. Included a combination of plot/transects, opportunistic surveys and random meanders.	23/3/17	N
Pultenaea parviflora	*Pultenaea parviflora*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017.	19/3/15	Y

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
			Included a combination of plot/transects, opportunistic surveys, random meanders and systematic walked transects at five metre intervals through areas of occupied habitat.		
Red-crowned Toadlet	*Pseudophryne australis*	N	Targeted frog surveys conducted between 2 people for 4 afternoons and nights (80 person hours). Included a combination of diurnal inspections of dams for basking frogs, and call playback and rapid aural surveys.	19/3/15	N
Regent Honeyeater	*Anthochaera phrygia*	N	Diurnal bird surveys conducted over 16 days between February and May 2015, an a a further 5 days between February and March 2017	10/6/15	N
Rosenberg's Goanna	*Varanus rosenbergi*	Y	Infra-red cameras (2 cameras, each at two locations for 4 weeks each) Feb-April 2015	28/2/15	N
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	19/3/15	N
Southern Myotis	*Myotis macropus*	Y	Microchiropteran bat surveys (Anabat) conducted over 21 Anabat unit nights over 12 locations from February to April 2016	30/3/15	Y
Spiked Rice-flower	*Pimelea spicata*	Y	Flora surveys conducted over 19 days between February and June 2015; 2 days in April 2016 and 9.5 days over March and April 2017 (of which 3 full days were dedicated *Pimelea spicata* surveys). Included a combination of plot/transects, opportunistic surveys, random meanders and systematic walked transects at five metre intervals through areas of occupied habitat.	16/8/17	Y
Squirrel Glider	*Petaurus norfolcensis*	Y	Spotlighting conducted between February to April 2015 using 3 people on 5 nights (30 person hours) and a further 2 people on 4 nights (16 person hours).	19/3/15	N
Sydney Plains Greenhood	*Pterostylis saxicola*	N	Flora surveys conducted over 19 days between February and June 2015, 2 days	n/a (entered as 23/3/2017)[1]	N

Common name	Scientific name	Candidate species / habitat at site ?[4]	Survey method and timing implemented	Date of most recent survey consistent with survey time matrix	Recorded at site ?
			in April 2016; and 9.5 days over March and April 2017 (including 3 full days of dedicated *Pimelea spicata* surveys). Included a combination of plot/transects, opportunistic surveys and random meanders.		
Tall Knotweed	*Persicaria elatior*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	28/3/17	N
Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	*Wahlenbergia multicaulis* - endangered population	N	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	19/3/15	N
White-flowered Wax Plant	*Cynanchum elegans*	Y	Flora surveys conducted over 19 days between February and June 2015, 2 days in April 2016; and 9.5 days over March and April 2017. Included a combination of plot/transects, opportunistic surveys and random meanders.	28/3/17	N

Notes: The only surveys conducted that were consistent with the survey time matrix were supplementary surveys that only achieved partial coverage of the Stage 1 Construction Impact Zone.

Assessment of geographic / habitat features

Assessment of geographic and habitat features

Impact?[1]	Common name	Scientific name	Feature
☑	Cumberland Plain Land Snail	*Meridolum corneovirens*	land containing bark or leaf litter accumulation
☐	Large-eared Pied Bat	*Chalinolobus dwyeri*	land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels
☑	Camden White Gum	*Eucalyptus benthamii*	alluvial soils
☑	Green and Golden Bell Frog	*Litoria aurea*	land within 100 m of emergent aquatic or riparian vegetation
☑	Hypsela sessiliflora	*Hypsela sessiliflora*	Wet and damp areas only.
☑	Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	*Wahlenbergia multicaulis* - endangered population	land situated in damp, disturbed sites
☑	Black Bittern	*Ixobrychus flavicollis*	land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation
☐	Eastern Osprey	*Pandion cristatus*	land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters
☑	Austral Pillwort	*Pilularia novae-hollandiae*	periodically waterlogged sites (including table drains and farm dams)
☑	Rosenberg's Goanna	*Varanus rosenbergi*	land within 250 m of termite mounds or rock outcrops
☑	Giant Burrowing Frog	*Heleioporus australiacus*	land within 40 m of heath, woodland or forest
☑	Comb-crested Jacana	*Irediparra gallinacea*	land within 40 m of permanent wetlands with a good surface cover of floating vegetation
☑	Australasian Bittern	*Botaurus poiciloptilus*	land containing brackish or freshwater wetlands

Notes: 1) ticks indicate that the habitat feature is present at the development site.

Plot/transect and rapid plot/transect data

Vegetation Zone and Veg type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone	Bearing (°)
HN528	**Benchmark**	**29**	**20.5-25.5**	**25.5-30.5**	**26.8-30.8**	**0-5**	**14.8-18.8**	**0**	**> = 0**	**1**	**> = 0**				
1	2	25	31	0.2	8	0	32	30	0	1	4	288802	6248373	56	180
1	5	31	15.5	19	60	10	12	34	0	1	9	288973	6247709	56	180
1	6	24	23	31	62	8	44	14	0	1	0	288791	6247303	56	180
1	11	39	19	18.5	30	2	44	84	0	1	0	287178	6246508	56	180
1	12	30	24	20	40	2	46	21	0	1	7.5	287940	6247231	56	320
1	22	35	15.5	3	24	0	66	70	0	1	0	290384	6248799	56	140
1	23	33	13	0.5	30	0	52	20	0	1	0	290020	6248327	56	270
1	25	37	22	26.5	64	10	34	14	0	1	2	291230	6249070	56	180
1	31	28	30	6	50	4	16	40	0	1	55	288224	6248287	56	180
1	35	33	12.5	4	64	4	34	10	0	1	2	287696	6247808	56	50
1	R4[1]	15	19.5	27	36	18	14	12	0	1	7	291413	6248510	56	180
1	**Average**	**30.0**	**20.5**	**14.2**	**42.5**	**5.3**	**35.8**	**31.7**	**0.0**	**1.0**	**7.9**				
HN528	**Benchmark**	**29**	**20.5-25.5**	**25.5-30.5**	**26.8-30.8**	**0-5**	**14.8-18.8**	**0**	**> = 0**	**1**	**> = 0**				
2	3	9	0	0	50	0	2	64	0	1	0	288754	6248196	56	180
2	24	27	4.5	0	60	0	4	62	0	1	2	291274	6248951	56	180
2	28	20	0	22.5	62	2	16	64	0	1	0	287867	6248140	56	260
2	30	18	0	0	54	58	0	6	0	1	0	288269	6248478	56	180
2	37	9	0	0.7	72	0	2	38	0	1	0	286697	6247210	56	360
2	42	12	0	0	82	0	6	36	0	1	0	287673	6246850	56	130
2	53	7	0	0	66	0	0	42	0	1	0	289426	6248504	56	180
2	57	7	0	0	58	0	0	44	0	1	0	288972	6247964	56	180
2	59	12	0	0	78	0	4	24	0	1	0	289851	6248929	56	180
2	60	22	0	4.4	60	2	18	36	0	1	0	287254	6247490	56	180
2	78	9	0	0	50	0	2	64	0	1	0	288754	6248196	56	180
2	Average	14.3	0.5	2.8	64.2	6.2	5.2	41.6	0.0	1.0	0.2				
HN529	**Benchmark**	**29**	**18.5-23.5**	**20-30**	**23-31**	**0-5**	**11.8-19.8**	**0**	**> = 0**	**1**	**> = 0**				

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Vegetation Zone and Veg type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone	Bearing (°)
3	20	19	12.5	0	38	2	54	42	0	1	2	285969	6246951	56	300
3	21	20	27.5	1	32	0	48	44	1	1	23	286501	6246518	56	210
3	36	30	15	0.2	68	0	24	40	0	1	22	286260	6246850	56	250
3	38	15	13.5	9.5	88	0	28	24	0	1	23	286965	6246970	56	180
	R5[1]	16	14	0.1	54	0	20	26	3	1	5.5	286600	6246087	56	180
3	Average	20.0	16.5	2.2	56.0	0.4	34.8	35.2	0.8	1.0	15.1				
HN529	**Benchmark**	**29**	**18.5-23.5**	**20-30**	**23-31**	**0-5**	**11.75-19.75**	**0**	**> = 0**	**1**	**> = 0**				
4	39	15	0	0.5	62	0	6	40	0	1	0	286389	6246721	56	200
4	41	32	0	0	56	0	46	34	0	1	0	288059	6246493	56	130
4	71	13	0	0	50	0	2	46	0	1	1.5	286683	6246637	56	180
4	75	10	12	3.5	8	0	12	49	0	1	4.5	287669	6246986	56	230
4	**Average**	**17.5**	**3.0**	**1.0**	**44.0**	**0.0**	**16.5**	**42.3**	**0.0**	**1.0**	**1.5**				
HN526	**Benchmark**	**24**	**27.5-32.5**	**21-31**	**24.45-30.45**	**0-10**	**24.45-30.45**	**0**	**> = 1**	**1**	**> = 50**				
5	17	34	16	25	62	38	4	30	2	1	6	290999	6249167	56	180
5	26	27	18	19.5	16	70	0	30	0	1	32	288076	6248308	56	180
5	29	32	17	0.5	36	18	0	16	1	1	30	287987	6247873	56	180
5	33	15	6.5	49	40	0	26	32	1	1	0	291348	6247546	56	160
5	**Average**	**27.0**	**14.4**	**23.5**	**38.5**	**31.5**	**7.5**	**27.0**	**1.0**	**1.0**	**17.0**				
HN526	**Benchmark**	**24**	**27.5-32.5**	**21-31**	**24.45-30.45**	**0-10**	**24.45-30.45**	**0**	**> = 1**	**1**	**> = 50**				
6	27	34	0	4.8	48	60	0	6	0	1	5	287973	6247981	56	210
6	67	21	11	3.5	42	0	28	54	0	1	15	290769	6247157	56	180
6	79	30	64	20.5	64	0	28	38	0	1	30	290833	6248938	56	235
6	**Average**	**28.3**	**25.0**	**9.6**	**51.3**	**20.0**	**18.7**	**32.7**	**0.0**	**1.0**	**16.7**				
HN512	**Benchmark**	**38**	**15.1-25.6**	**13.8-30.3**	**14.7-24.6**	**0-10**	**14.7-24.6**	**0**	**> = 0**	**1**	**> = 0**				
7	51	14	19	13.5	6	4	24	78	0	1	3.5	291805	6249236	56	180
7	63	24	21	29	68	4	30	16	0	1	3	292015	6249134	56	180
7	64	27	7.5	17.5	60	2	36	32	0	1	13	291852	6248850	56	180
7	**Average**	**21.7**	**15.8**	**20.0**	**44.7**	**3.3**	**30.0**	**42.0**	**0.0**	**1.0**	**6.5**	**291848**	**6248951**	**56**	

Vegetation Zone and Veg type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone	Bearing (°)
HN630	**Benchmark**	**12**	**3-37**	**15-68**	**19-55**	**0-20**	**10-30**	**0**	**> = 0**	**1**	**> = 0**				
9	65	5	0	0	0	0	40	0	0	0	0	291827	6248697	56	220
9	77	10	0	0.5	10	0	60	10	0	0	0	287100	6247864	56	240
9	80	7	0	0	0	0	72	0	0	0	0	289976	6248352	56	180
9	81	5	0	0	70	0	0	6	0	0	0	288843	6247730	56	180
9	**Average**	**6.75**	**0**	**0.125**	**20**	**0**	**43**	**4**	**0**	**0**	**0**				
HN528	**Benchmark**	**29**	**20.5-25.5**	**25.5-30.5**	**26.8-30.8**	**0-5**	**14.8-18.8**	**0**	**> = 0**	**1**	**> = 0**				
10	4	14	0.5	0	20	0	2	88	0	0	0	288661	6247838	56	180
10	50	3	0	0	28	0	0	76	0	0	1	291912	6249381	56	180
10	52	5	0	0	4	0	4	100	0	0	0	291023	6249605	56	180
10	54	9	3	0	28	0	10	62	0	0	68	290162	6249420	56	140
10	56	1	0	0	18	0	0	94	0	0	0	288911	6248858	56	180
10	58	8	0	0	16	0	8	94	0	0	0	288055	6248612	56	180
10	61	2	0	0	8	0	0	96	0	0	2	289741	6248566	56	180
10	62	3	0	0	0	0	0	100	0	0	0	290472	6248266	56	180
10	76	3	0	0	30	0	10	90	0	0	0	286870	6247818	56	180
10	R1[1]	9.0	0	0	18	0	22	46	0	1	2	289926	6249791	56	180
10	**Average**	**5.7**	**0.4**	**0.0**	**17.0**	**0.0**	**5.6**	**84.6**	**0.0**	**0.1**	**7.3**				
HN529	**Benchmark**	**29**	**18.5-23.5**	**20-30**	**23-31**	**0-5**	**11.75-19.75**	**0**	**> = 0**	**1**	**> = 0**				
11	70	7	0	0	8	0	0	90	0	0.2	0	286529	6246273	56	180
11	72	12	0	0	4	0	0	92	0	0.2	0	286726	6246558	56	180
11	73	6	0	0	0	0	0	100	0	0.2	0	287162	6246886	56	360
11	74	7	0	0	20	0	0	100	0	0.2	0	287746	6247068	56	180
11	**Average**	**8.0**	**0.0**	**0.0**	**8.0**	**0.0**	**0.0**	**95.5**	**0.0**	**0.2**	**0.0**				
HN526	**Benchmark**	**24**	**27.5-32.5**	**21-31**	**24.45-30.45**	**0-10**	**24.45-30.45**	**0**	**> = 1**	**1**	**> = 50**				
12	55	3	0	1.5	8	0	0	100	0	0	0	289097	6248853	56	180
12	66	7	0	0	26	0	10	64	0	0	0	291104	6249348	56	180
12	68	8	0	0	12	0	4	90	0	0	0	290631	6246942	56	180

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Vegetation Zone and Veg type ID	Plot ID	Native plant species richness	Native over-storey cover	Native mid-storey cover	Native ground cover (grasses)	Native ground cover (shrubs)	Native ground cover (other)	Exotic plant cover	Number of trees with hollows	Over storey regeneration	Total length of fallen logs	Easting	Northing	Zone	Bearing (°)
12	69	15	0.5	0	10	2	6	94	0	0	0	291357	6247456	56	180
12	**Average**	**8.3**	**0.1**	**0.4**	**14.0**	**0.5**	**5.0**	**87.0**	**0.0**	**0.0**	**0.0**				
HN528	**Benchmark**	**29**	**20.5-25.5**	**25.5-30.5**	**26.8-30.8**	**0-5**	**14.8-18.8**	**0**	**> = 0**	**1**	**> = 0**				
13	53	18	6	1	6	0	22	82	0	1	30	290256	6249089	56	180
13	R2[2]	29[2]	6	0	20	0	0	86	0	1	0	290609	6248334	56	180
13	R3[2]	29[2]	15	0	4	0	4	98	0	1	0	290647	6248017	56	180
13	**Average**	**25.3**	**9.0**	**0.3**	**10.0**	**0.0**	**8.7**	**88.7**	**0.0**	**1.0**	**10.0**				

Notes: 1) rapid plot/ttransect data were not entered in the credit calculator (except for R2 and R3 as per point two below). 2) plant species richness was entered in the credit calculator at benchmark values for rapid plot/ttransects R2 and R3.

Appendix B – Field survey results

Plant species recorded within the Stage 1 Construction Impact Zone

Family	Scientific Name	Common Name	Exotic
Acanthaceae	*Brunoniella australis*	Blue Trumpet	
Acanthaceae	*Brunoniella pumilio*	Dwarf Blue Trumpet	
Adiantaceae	*Cheilanthes sieberi* subsp. *sieberi*	Rock Fern	
Adiantaceae	*Pellaea falcata*	Sickle Fern	
Alismataceae	*Damasonium minus*	Starfruit	
Alliaceae	*Agapanthus africanus*	Lily of the Nile	*
Alliaceae	*Agapanthus* sp.		*
Amaranthaceae	*Alternanthera angustifolia*		
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed	
Amaranthaceae	*Alternanthera pungens*	Khaki Weed	*
Amaranthaceae	*Gomphrena celosioides*	Gomphrena Weed	*
Amaranthaceae	*Nyssanthes diffusa*	Barbwire Weed	
Anthericaceae	*Caesia parviflora* var. *parviflora*		
Anthericaceae	*Caesia parviflora* var. *vittata*		
Anthericaceae	*Caesia* sp.		
Anthericaceae	*Tricoryne elatior*	Yellow Autumn-lily	
Apiaceae	*Centella asiatica*	Indian Pennywort	
Apocynaceae	*Araujia sericifera*	Moth Vine	*
Apocynaceae	*Marsdenia viridiflora* subsp. *viridiflora*[1]	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	
Arecaceae	*Phoenix canariensis*	Canary Island Date Palm	*
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper	*
Asparagaceae	*Asparagus officinalis*	Asparagus	*
Asphodelaceae	*Bulbine bulbosa*	Bulbine Lily	
Aspleniaceae	*Asplenium flabellifolium*	Necklace Fern	
Asteraceae	*Bidens pilosa*	Cobbler's Pegs	*
Asteraceae	*Bidens subalternans*	Greater Beggar's Ticks	*
Asteraceae	*Calotis lappulacea*	Yellow Burr-daisy	
Asteraceae	*Chrysanthemoides monilifera*		*
Asteraceae	*Cirsium vulgare*	Spear Thistle	*
Asteraceae	*Conyza bonariensis*	Flaxleaf Fleabane	*
Asteraceae	*Conyza sumatrensis*	Tall fleabane	*
Asteraceae	*Cymbonotus lawsonianus*	Bear's Ear	
Asteraceae	*Epaltes australis*	Spreading Nut-heads	
Asteraceae	*Euchiton sphaericus*	Star Cudweed	
Asteraceae	*Gamochaeta americana*	Cudweed	*
Asteraceae	*Gamochaeta calviceps*	Cudweed	*
Asteraceae	*Gamochaeta purpurea*	Purple Cudweed	*
Asteraceae	*Gamochaeta* sp.		*
Asteraceae	*Glossocardia bidens*	Cobbler's Tack	
Asteraceae	*Hypochaeris glabra*	Smooth Catsear	*

Family	Scientific Name	Common Name	Exotic
Asteraceae	*Hypochaeris radicata*	Catsear	*
Asteraceae	*Lactuca serriola*	Prickly Lettuce	*
Asteraceae	*Lagenophora stipitata*	Common Lagenophora	
Asteraceae	*Ozothamnus diosmifolius*	White Dogwood	
Asteraceae	*Senecio hispidulus*	Hill Fireweed	
Asteraceae	*Senecio madagascariensis*	Fireweed	*
Asteraceae	*Sigesbeckia orientalis* subsp. *orientalis*	Indian Weed	
Asteraceae	*Solenogyne bellioides*	Solengyne	
Asteraceae	*Sonchus oleraceus*	Common Sowthistle	*
Asteraceae	*Taraxacum officinale*	Dandelion	*
Asteraceae	*Vernonia cinerea*		
Asteraceae	*Vittadinia cuneata*	A Fuzzweed	
Asteraceae	*Vittadinia pustulata*	Fuzzweed	
Asteraceae	*Xanthium occidentale*	Noogoora Burr	*
Azollaceae	*Azolla* sp.		
Boraginaceae	*Echium plantagineum*	Patterson's Curse	*
Brassicaceae	*Lepidium* sp.	A Peppercress	*
Brassicaceae	*Rorippa palustris*	Yellow Cress	*
Brassicaceae	*Sisymbrium* sp.		*
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell	
Caryophyllaceae	*Stellaria media*	Common Chickweed	*
Chenopodiaceae	*Atriplex prostrata*		*
Chenopodiaceae	*Atriplex semibaccata*	Creeping Saltbush	
Chenopodiaceae	*Chenopodium album*	Fat Hen	*
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	
Chenopodiaceae	*Einadia nutans* subsp. *nutans*	Climbing Saltbush	
Chenopodiaceae	*Einadia polygonoides*	Knotweed Goosefoot	
Chenopodiaceae	*Einadia trigonos* subsp. *Trigonos*		
Chenopodiaceae	*Enchylaena tomentosa*	Ruby Saltbush	
Chenopodiaceae	*Maireana microphylla*	Small-leaf Bluebush	
Chenopodiaceae	*Salsola kali* var. *kali*	Buckbush	
Clusiaceae	*Hypericum gramineum*	Small St John's Wort	
Clusiaceae	*Hypericum perforatum*	St. Johns Wort	*
Commelinaceae	*Commelina cyanea*	Native Wandering Jew	
Commelinaceae	*Tradescantia fluminensis*	Wandering Jew	*
Convolvulaceae	*Convolvulus erubescens*	Pink Bindweed	
Convolvulaceae	*Dichondra repens*	Kidney Weed	
Crassulaceae	*Bryophyllum delagoense*	Mother of millions	*
Cyperaceae	*Bolboschoenus caldwellii*		
Cyperaceae	*Bolboschoenus fluviatilis*	Marsh Club-rush	
Cyperaceae	*Carex inversa*	Knob Sedge	
Cyperaceae	*Carex* sp.		
Cyperaceae	*Cyperus brevifolius*		*
Cyperaceae	*Cyperus difformis*	Dirty Dora	

Family	Scientific Name	Common Name	Exotic
Cyperaceae	*Cyperus eragrostis*	Umbrella Sedge	*
Cyperaceae	*Cyperus gracilis*	Slender Flat-sedge	
Cyperaceae	*Cyperus haspan* subsp. *haspan*		
Cyperaceae	*Cyperus polystachyos*		
Cyperaceae	*Cyperus sanguinolentus*		
Cyperaceae	*Cyperus* sp.		
Cyperaceae	*Eleocharis cylindrostachys*		
Cyperaceae	*Eleocharis sphacelata*	Tall Spike Rush	
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge	
Cyperaceae	*Schoenoplectus validus*		
Dilleniaceae	*Hibbertia diffusa*	Wedge Guinea Flower	
Ericaceae	*Astroloma humifusum*	Native Cranberry	
Ericaceae	*Lissanthe strigosa*	Peach Heath	
Ericaceae	*Melichrus urceolatus*	Urn Heath	
Fabaceae	*Acacia baileyana*	Cootamundra Wattle	
Fabaceae	*Acacia decurrens*	Black Wattle	
Fabaceae	*Acacia falcata*		
Fabaceae	*Acacia floribunda*	White Sally	
Fabaceae	*Chamaecytisus palmensis*	Tree Lucerne	*
Fabaceae	*Daviesia genistifolia*	Broom Bitter Pea	
Fabaceae	*Daviesia ulicifolia*	Gorse Bitter Pea	
Fabaceae	*Desmodium brachypodum*	Large Tick-trefoil	
Fabaceae	*Desmodium varians*	Slender Tick-trefoil	
Fabaceae	*Dillwynia sieberi*		
Fabaceae	*Dillwynia tenuifolia*[2]		
Fabaceae	*Glycine clandestina*	Twining glycine	
Fabaceae	*Glycine microphylla*	Small-leaf Glycine	
Fabaceae	*Glycine tabacina*	Variable Glycine	
Fabaceae	*Hardenbergia violacea*	False Sarsaparilla	
Fabaceae	*Indigofera australis*	Australian Indigo	
Fabaceae	*Pultenaea microphylla*	A Bush Pea	
Fabaceae	*Pultenaea parviflora*[3]		
Fabaceae	*Senna pendula var. glabrata*		*
Fabaceae	*Trifolium subterraneum*	Subterranean Clover	*
Fabaceae	Zornia dyctiocarpa var. dyctiocarpa	Zornia	
Fumariaceae	*Fumaria* sp.	Fumitory	*
Gentianaceae	*Centaurium erythraea*	Common Centaury	*
Gentianaceae	*Centaurium* sp.		*
Geraniaceae	*Geranium homeanum*		
Goodeniaceae	*Goodenia hederacea*	Ivy Goodenia	
Haloragaceae	*Myriophyllum* sp.		
Haloragaceae	*Myriophyllum variifolium*		
Hydrocharitaceae	*Ottelia ovalifolia* subsp. *ovalifolia*	Swamp Lily	
Hydrocharitaceae	*Vallisneria australis*	Eelweed	

Family	Scientific Name	Common Name	Exotic
Hypoxidaceae	*Hypoxis hygrometrica*	Golden Weather-grass	
Juncaceae	*Juncus acutus* subsp. *acutus*	Sharp Rush	*
Juncaceae	*Juncus subsecundus*	Finger Rush	
Juncaceae	*Juncus usitatus*		
Juncaginaceae	*Triglochin microtuberosa*		
Juncaginaceae	*Triglochin rheophila*		
Lamiaceae	*Ajuga australis*	Austral Bugle	
Lamiaceae	*Mentha satureioides*	Native Pennyroyal	
Lamiaceae	*Plectranthus parviflorus*		
Lemnaceae	*Lemna disperma*		
Lobeliaceae	*Isotoma fluviatilis*	Swamp Isotome	
Lobeliaceae	*Pratia purpurascens*	Whiteroot	
Lomandraceae	*Lomandra filiformis* subsp. *filiformis*		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	
Lomandraceae	*Lomandra multiflora* subsp. *multiflora*	Many-flowered Mat-rush	
Loranthaceae	*Amyema pendulum* subsp. *pendulum*		
Malvaceae	*Modiola caroliniana*	Red-flowered Mallow	*
Malvaceae	*Sida cunninghamii*	Ridge Sida	
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne	*
Malvaceae	*Sida* sp.		*
Marsileaceae	*Marsilea mutica*		
Myoporaceae	*Eremophila debilis*	Amulla	
Myrsinaceae	*Anagallis arvensis*	Scarlet Pimpernel	*
Myrtaceae	*Eucalyptus amplifolia* subsp. *Amplifolia*		
Myrtaceae	*Eucalyptus eugenioides*	Thin-leaved Stringybark	
Myrtaceae	*Eucalyptus fibrosa*	Red Ironbark	
Myrtaceae	*Eucalyptus moluccana*	Grey Box	
Myrtaceae	*Eucalyptus tereticornis*	Forest Red Gum	
Myrtaceae	*Kunzea ambigua*	Tick Bush	
Myrtaceae	*Melaleuca armillaris* subsp. *armillaris*	Bracelet Honey-myrtle	
Myrtaceae	*Melaleuca decora*		
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark	
Myrtaceae	*Melaleuca sieberi*		
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	
Nyctaginaceae	*Bougainvillea glabra*		*
Oleaceae	*Ligustrum lucidum*	Large-leaved Privet	*
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive	*
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose	
Onagraceae	*Ludwigia peruviana*		*
Oxalidaceae	*Oxalis corniculata*	Creeping Oxalis	*
Oxalidaceae	*Oxalis perennans*		
Oxalidaceae	*Oxalis* sp.		

Family	Scientific Name	Common Name	Exotic
Passifloraceae	*Passiflora edulis*	Common Passionfruit	*
Philydraceae	*Philydrum lanuginosum*	Frogsmouth	
Phormiaceae	*Dianella revoluta* var. *revoluta*	A Blue Flax Lily	
Phyllanthaceae	*Phyllanthus hirtellus*	Thyme Spurge	
Phyllanthaceae	*Phyllanthus similis*		
Phyllanthaceae	*Phyllanthus virgatus*	Wiry Spurge	
Phytolaccaceae	*Phytolacca octandra*	Inkweed	*
Pinaceae	*Pinus radiata*	Radiata Pine	*
Pittosporaceae	*Bursaria spinosa* subsp. *spinosa*	Native Blackthorn	
Plantaginaceae	*Plantago gaudichaudii*	Narrow Plantain	
Plantaginaceae	*Plantago lanceolata*	Lamb's Tongues	*
Plantaginaceae	*Plantago varia*		
Plantaginaceae	*Veronica plebeia*	Trailing Speedwell	
Poaceae	*Aristida ramosa*	Purple Wiregrass	
Poaceae	*Aristida vagans*	Threeawn Speargrass	
Poaceae	*Austrodanthonia racemosa*	Wallaby Grass	
Poaceae	*Austrodanthonia* sp.	A Wallaby Grass	
Poaceae	*Austrodanthonia tenuior*	A Wallaby Grass	
Poaceae	*Austrostipa ramosissima*	Stout Bamboo Grass	
Poaceae	*Austrostipa* sp.	A Speargrass	
Poaceae	*Axonopus fissifolius*	Narrow-leafed Carpet Grass	*
Poaceae	*Bothriochloa macra*	Red Grass	
Poaceae	*Briza minor*	Shivery Grass	*
Poaceae	*Briza subaristata*		*
Poaceae	*Bromus catharticus*	Praire Grass	*
Poaceae	*Chloris divaricata* var. *divaricata*	Slender Chloris	
Poaceae	*Chloris gayana*	Rhodes Grass	*
Poaceae	*Chloris* sp.		*
Poaceae	*Chloris truncata*	Windmill Grass	
Poaceae	*Chloris ventricosa*	Tall Chloris	
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	
Poaceae	*Cynodon dactylon*	Common Couch	
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	
Poaceae	*Digitaria aequiglumis*		*
Poaceae	*Digitaria* sp.	A Finger Grass	*
Poaceae	*Echinochloa crus-galli*	Barnyard Grass	*
Poaceae	*Echinopogon caespitosus*	Bushy Hedgehog-grass	
Poaceae	*Echinopogon ovatus*	Forest Hedgehog Grass	
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	*
Poaceae	*Entolasia marginata*	Bordered Panic	
Poaceae	*Entolasia stricta*	Wiry Panic	
Poaceae	*Eragrostis brownii*	Brown's Lovegrass	
Poaceae	*Eragrostis curvula*	African Lovegrass	*
Poaceae	*Eragrostis elongata*	Clustered Lovegrass	

Family	Scientific Name	Common Name	Exotic
Poaceae	*Eragrostis leptostachya*	Paddock Lovegrass	
Poaceae	*Eriochloa pseudoacrotricha*	Early Spring Grass	
Poaceae	*Microlaena stipoides* var. *stipoides*	Weeping Grass	
Poaceae	*Oplismenus aemulus*		
Poaceae	*Oplismenus imbecillis*		
Poaceae	*Panicum decompositum* var. *tenuius*		
Poaceae	*Panicum simile*	Two-colour Panic	
Poaceae	*Paspalidium distans*		
Poaceae	*Paspalum dilatatum*	Paspalum	*
Poaceae	*Paspalum distichum*	Water Couch	
Poaceae	*Pennisetum clandestinum*	Kikuyu Grass	*
Poaceae	*Poa affinis*		
Poaceae	*Poa annua*	Winter Grass	*
Poaceae	*Poa labillardierei*	Tussock	
Poaceae	*Setaria parviflora*		*
Poaceae	*Setaria pumila*	Pale Pigeon Grass	*
Poaceae	*Sporobolus africanus*	Parramatta Grass	*
Poaceae	*Sporobolus creber*	Slender Rat's Tail Grass	
Poaceae	*Sporobolus elongatus*	Slender Rat's Tail Grass	
Poaceae	*Themeda australis*	Kangaroo Grass	
Poaceae	*Urochloa panicoides*	Urochloa Grass	*
Polygonaceae	*Acetosella vulgaris*	Sheep Sorrel	*
Polygonaceae	*Persicaria decipiens*	Slender Knotweed	
Polygonaceae	*Persicaria hydropiper*	Water Pepper	
Polygonaceae	*Persicaria lapathifolia*	Pale Knotweed	
Polygonaceae	*Persicaria* sp.	Knotweed	*
Polygonaceae	*Rumex brownii*	Swamp Dock	
Polygonaceae	*Rumex crispus*	Curled Dock	*
Portulacaceae	*Portulaca oleracea*	Pigweed	
Potamogetonaceae	*Potamogeton crispus*	Curly Pondweed	
Ranunculaceae	*Clematis aristata*	Old Man's Beard	
Rosaceae	*Rubus fruticosus* sp. *agg.*	Blackberry complex	*
Rubiaceae	*Asperula conferta*	Common Woodruff	
Rubiaceae	*Galium gaudichaudii*	Rough Bedstraw	
Rubiaceae	*Opercularia aspera*	Coarse Stinkweed	
Rubiaceae	*Opercularia varia*	Variable Stinkweed	
Rubiaceae	*Richardia stellaris*		*
Santalaceae	*Exocarpos cupressiformis*	Cherry Ballart	
Santalaceae	*Exocarpos strictus*	Dwarf Cherry	
Sapindaceae	*Dodonaea viscosa* subsp. *cuneata*	Wedge-leaf Hop-bush	
Solanaceae	*Cestrum parqui*	Green Cestrum	*
Solanaceae	*Lycium ferocissimum*	African Boxthorn	*
Solanaceae	*Solanum nigrum*	Black-berry Nightshade	*
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	

Family	Scientific Name	Common Name	Exotic
Solanaceae	*Solanum pseudocapsicum*	Madeira Winter Cherry	*
Solanaceae	*Solanum pungetium*	Eastern Nightshade	
Solanaceae	*Solanum sisymbriifolium*		*
Solanaceae	*Solanum* sp.		*
Stackhousiaceae	*Stackhousia* sp.		
Stackhousiaceae	*Stackhousia viminea*	Slender Stackhousia	
Sterculiaceae	*Brachychiton populneus*	Kurrajong	
Thymelaeaceae	*Pimelea spicata*[4]	Spiked Rice-flower	
Typhaceae	*Typha orientalis*	Broad-leaved Cumbungi	
Verbenaceae	*Lantana camara*	Lantana	*
Verbenaceae	*Verbena bonariensis*	Purpletop	*
Verbenaceae	*Verbena gaudichaudii*	Verbena	
Verbenaceae	*Verbena hispida*	Rough Verbena	*
Verbenaceae	*Verbena quadrangularis*		*
Vitaceae	*Clematicissus opaca*	Pepper Vine	

Notes:
1 *Marsdenia viridiflora* subsp. *viridiflora* is listed under the TCS Act as an endangered population population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas.
2 *Dillwynia tenuifolia* is listed as a vulnerable species under the TSC Act.
3 *Pultenaea parviflora* is listed as an endangered species under the TSC Act and a vulnerable species under the EPBC Act.
4 *Pimelea spicata* is listed as an endangered species under the TSC and EPBC Acts.

Fauna species recorded within the airport site

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
Fish						
Eel	*Anguilla reinhardtii*			O		
Mosquito Fish	*Gambusia holbrooki*	*		W		
Frogs						
Bibron's Toadlet	*Pseudophryne bibronii*			O		
Broad-palmed Frog	*Litoria latopalmata*			O		
Brown-striped Frog	*Limnodynastes peronii*			W		
Common Eastern Froglet	*Crinia signifera*			OW	W	
Eastern Dwarf Tree Frog	*Litoria fallax*					O
Peron's Tree Frog	*Litoria peronii*			OW	W	
Smooth Toadlet	*Uperoleia laevigata*			W		
Spotted Grass Frog	*Limnodynastes tasmaniensis*			OW	O	W
Tyler's Tree Frog	*Litoria tyleri*					
Verreaux's Frog	*Litoria verreauxii*			W	W	
Wrinkled Toadlet	*Uperoleia rugosa*					W
Birds						
Australasian Darter	*Anhinga novaehollandiae*			O		W
Australasian Grebe	*Tachybaptus novaehollandiae*			O		
Australasian Shoveler	*Anas rhynchotis*			O		
Australian Hobby	*Falco longipennis*		OW			
Australian King-Parrot	*Alisterus scapularis*		O			
Australian Magpie	*Cracticus tibicen*		OW			W
Australian Owlet-nightjar	*Aegotheles cristatus*		O			
Australian Pelican	*Pelecanus conspicillatus*		O			
Australian Pipit	*Anthus novaeseelandiae*					O

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
Australian Raven	*Corvus coronoides*		O			O
Australian Reed-Warbler	*Acrocephalus australis*			O		
Australian Swiftlet	*Aerodramus terraereginae*					O
Australian White Ibis	*Threskiornis molucca*			O		
Australian Wood Duck	*Chenonetta jubata*			O		
Azure Kingfisher	*Ceyx azureus*			O		O
Bar-shouldered Dove	*Geopelia humeralis*				OW	
Bell miner	*Manorina melanophrys*		O		W	
Black Bittern	*Ixobrychus flavicollis*				O	
Black kite	*Milvus migrans*					O
Black Swan	*Cygnus atratus*			OW		
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*		O		O	
Black-fronted Dotterel	*Elseyornis melanops*			O		
Black-shouldered Kite	*Elanus axillaris*					O
Black-winged Stilt	*Himantopus himantopus*			O		
Blue-billed Duck	*Oxyura australis*			O		
Brown Falcon	*Falco berigora*		O			
Brown Goshawk	*Accipiter fasciatus*		W			
Brown Quail	*Coturnix ypsilophora*					O
Brown Songlark	*Cincloramphus cruralis*					
Brown Thornbill	*Acanthiza pusilla*		O			
Buff-banded Rail	*Gallirallus philippensis*		O			
Buff-rumped Thornbill	*Acanthiza reguloides*		O			
Cattle Egret	*Ardea ibis*			O		O
Chestnut Teal	*Anas castanea*			O		
Common Myna	*Sturnus tristis*	*	OW		O	
Common Starling	*Sturnus vulgaris*	*	W	O		

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
Crested Pigeon	*Ocyphaps lophotes*		OW		O	W
Double-barred Finch	*Taeniopygia bichenovii*		OW		O	
Dusky Moorhen	*Gallinula tenebrosa*		O	O		
Dusky Woodswallow	*Artamus cyanopterus*					O
Eastern Barn Owl	*Tyto javanica*		OW			
Eastern Barn Owl	*Tyto javanica*					
Eastern Great Egret	*Ardea modesta*			O		
Eastern Rosella	*Platycercus eximius*		O		O	
Eastern Shrike-tit	*Falcunculus frontatus frontatus*		O			
Eastern Spinebill	*Acanthorhynchus tenuirostris*		OW			
Eastern Yellow Robin	*Eopsaltria australis*		O		O	
Eurasian Blackbird	*Turdus merula*	*	O		O	
Eurasian Coot	*Fulica atra*			O	O	
European Goldfinch	*Carduelis carduelis*	*	O			
Fairy Martin	*Petrochelidon ariel*					W
Fan-tailed Cuckoo	*Cacomantis flabelliformis*				O	
Fuscous Honeyeater	*Lichenostomus fuscus*		W			
Galah	*Eolophus roseicapillus*		W	O		
Golden Whistler	*Pachycephala pectoralis*		O		O	
Golden-headed Cisticola	*Cisticola exilis*			O		W
Great Cormorant	*Phalacrocorax carbo*			O		
Grey Butcherbird	*Cracticus torquatus*		OW		OW	
Grey Fantail	*Rhipidura albiscapa*		O		O	
Grey Shrike-thrush	*Colluricincla harmonica*		OW		O	
Grey Teal	*Anas gracilis*			O	O	
Hardhead	*Aythya australis*			O		
Hoary-headed Grebe	*Poliocephalus poliocephalus*			O		

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
House Sparrow	*Passer domesticus*	*				O
Jacky Winter	*Microeca fascinans*		O			
Latham's Snipe	*Gallinago hardwickii*			O		
Laughing Kookaburra	*Dacelo novaeguineae*		O		O	
Little Black Cormorant	*Phalacrocorax sulcirostris*			O	O	
Little Corella	*Cacatua sanguinea*			W		
Little Eagle	*Hieraaetus morphnoides*		O			O
Little Lorikeet	*Glossopsitta pusilla*		O			
Little Pied Cormorant	*Microcarbo melanoleucos*			O	O	
Little Raven	*Corvus mellori*		W	W	W	OW
Little Wattlebird	*Anthochaera chrysoptera*		O			
Long-billed Corella	*Cacatua tenuirostris*		OW	O		W
Magpie-lark	*Grallina cyanoleuca*		OW	O	O	
Masked Lapwing	*Vanellus miles*				OW	W
Mistletoebird	*Dicaeum hirundinaceum*		O			
Nankeen Kestrel	*Falco cenchroides*					O
Nankeen Night Heron	*Nycticorax caledonicus*					
Noisy Friarbird	*Philemon corniculatus*		W			
Noisy Miner	*Manorina melanocephala*		OW		OW	
Olive-backed Oriole	*Oriolus sagittatus*		OW		O	
Pacific Black Duck	*Anas superciliosa*			OW	O	
Peaceful Dove	*Geopelia striata*		O			
Peregrine Falcon	*Falco peregrinus*		O			
Pied Cormorant	*Phalacrocorax varius*			O		
Pied Currawong	*Strepera graculina*		O			
Pink-eared Duck	*Malacorhynchus membranaceus*			O		
Purple Swamphen	*Porphyrio porphyrio*			O	OW	

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
Rainbow bee-eater	*Merops ornatus*					
Rainbow Lorikeet	*Trichoglossus haematodus*		OW			
Red Wattlebird	*Anthochaera carunculata*					
Red-browed Finch	*Neochmia temporalis*		O		O	O
Red-rumped Parrot	*Psephotus haematonotus*		O			
Red-whiskered Bulbul	*Pycnonotus jocosus*	*	O		OW	
Restless Flycatcher	*Myiagra inquieta*		O			
Rock Dove	*Columba livia*	*				
Rose Robin	*Petroica rosea*					
Royal Spoonbill	*Platalea regia*			O		
Rufous Fantail	*Rhipidura rufifrons*		O			
Rufous Whistler	*Pachycephala rufiventris*		O		O	
Sacred Kingfisher	*Todiramphus sanctus*					
Satin Bowerbird	*Ptilonorhynchus violaceus*		W			
Scarlet Honeyeater	*Myzomela sanguinolenta*		O			
Scarlet Robin	*Petroica boodang*		O			
Silvereye	*Zosterops lateralis*		OW		O	O
Spotted Pardalote	*Pardalotus punctatus*		W			
Spotted Turtle-Dove	*Streptopelia chinensis*	*	O			
Straw-necked Ibis	*Threskiornis spinicollis*			O		O
Striated Pardalote	*Pardalotus striatus*		W			
Striated Thornbill	*Acanthiza lineata*		O		O	
Sulphur-crested Cockatoo	*Cacatua galerita*				W	W
Superb Fairy-wren	*Malurus cyaneus*		O			
Tawny Frogmouth	*Podargus strigoides*		O		O	
Tawny Grassbird	*Megalurus timoriensis*					
Tree Martin	*Petrochelidon nigricans*					O

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
unidentified Flycatcher	*Myiagra sp.*		O			
Varied Sittella	*Daphoenositta chrysoptera*				O	
Wedge-tailed Eagle	*Aquila audax*					O
Weebill	*Smicrornis brevirostris*		O			O
Welcome Swallow	*Hirundo neoxena*			O		O
Whistling Kite	*Haliastur sphenurus*		O		O	O
White-bellied Sea-eagle	*Haliaeetus leucogaster*		O	O		
White-browed Scrubwren	*Sericornis frontalis*		W		OW	
White-faced Heron	*Egretta novaehollandiae*			O		
White-necked Heron	*Ardea pacifica*			OW		O
White-plumed Honeyeater	*Lichenostomus penicillatus*		O			
White-throated Gerygone	*Gerygone albogularis*		O		O	O
White-throated Needletail	*Hirundapus caudacutus*					O
White-throated Treecreeper	*Cormobates leucophaea*		O			
White-winged Chough	*Corcorax melanorhamphos*		WC			
Willie Wagtail	*Rhipidura leucophrys*		OW	O	O	
Yellow Thornbill	*Acanthiza nana*		O		OW	
Yellow-billed Spoonbill	*Platalea flavipes*			O		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*		O		O	
Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*					
Gastropods						
Asian trampsnail	*Bradybaena similaris*	*	O		O	
Common Southern Carnivorous Snail	*Austrorhytida cappillacea*		O			
Cumberland Plain Land Snail	*Meridolum corneovirens*		O		O	
Garden Snail	*Cantareus aspersa*	*	O	O	O	O
Mammals						
Black Rat	*Rattus rattus*	*	O			

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
Brown Hare	*Lepus capensis*	*	OC		O	
Cat	*Felis catus*	*				
Chocolate Wattled Bat	*Chalinolobus morio*		A			
Common Brushtail Possum	*Trichosurus vulpecula*		O		O	
Common Ringtail Possum	*Pseudocheirus peregrinus*				O	
Dog	*Canis lupus familiaris*	*				
East Coast Freetail Bat	*Mormopterus norfolkensis*		A			
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*					
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*					
Eastern Freetail Bat	*Mormopterus "Species 2"*		A			
Eastern Grey Kangaroo	*Macropus giganteus*					O
Fox	*Vulpes vulpes*	*	OC	O	O	
Goat	*Capra hircus*	*	O			
Gould's Long-eared Bat	*Nyctophilus gouldi*					
Gould's Wattled Bat	*Chalinolobus gouldii*		A			
Grey-headed Flying-fox	*Pteropus poliocephalus*				O	
House Mouse	*Mus musculus*	*				O
Large Forest Bat	*Vespadelus darlingtoni*					
Lesser Long-eared Bat	*Nyctophilus geoffroyi*					
Little Forest Bat	*Vespadelus vulturnus*					
Rabbit	*Oryctolagus cuniculus*	*	OC		O	O
Swamp Wallaby	*Wallabia bicolor*		OC		O	
White-striped Freetail-bat	*Tadarida australis*		OW		O	
	Nyctophilus sp.		A			
	Vespadelus sp.		A			
Reptiles						
Barred-sided Skink	*Eulamprus tenuis*					

Common Name	Scientific Name	Exotic	Woodland/paddock trees	Dams/Wetlands	Riparian Corridor	Grassland and Cleared Land
Dark-flecked Garden Sunskink	*Lampropholis delicata*					O
Eastern Blue-tongue	*Tiliqua scincoides*		O			O
Eastern Brown Snake	*Pseudonaja textilis*		O			O
Eastern Snake-necked Turtle	*Chelodina longicollis*			O		
Eastern Water Dragon	*Physignathus lesueurii*					
Eastern Water-skink	*Eulamprus quoyii*			O	O	
Elegant Snake-eyed Skink	*Cryptoblepharus pulcher*		O		O	
Jacky Lizard	*Amphibolurus muricatus*		O			
Lace Monitor	*Varanus varius*		O			
Pale-flecked Garden Sunskink	*Lampropholis guichenoti*					
Red-bellied Black Snake	*Pseudechis porphyriacus*			O		O

Notes: O=observed, W=heard, OW=observed and heard

Appendix C – Western Sydney Airport BioBanking Assessment Review (WSP 2017)

MEMO

TO:	s. 47F(1)
FROM:	s. 47F(1)
SUBJECT:	**Western Sydney Airport BioBanking Assessment Review**
OUR REF:	2270894A-ECO-MEM-REVA
DATE:	**19 June 2017**

1. INTRODUCTION

The Department of Infrastructure and Regional Development (DIRD) have engaged WSP to undertaken an independent verification of the Western Sydney Airport Stage 1 Development – Biodiversity Assessment Report (BAR), prepared by GHD on behalf of DIRD, conducted for a large parcel of land located at Badgerys Creek in Western Sydney (the site) (Attachment A Figure 1).

This memo summaries the verification of all biodiversity documentation submitted by GHD and DIRD. The verification assessed the biodiversity documentation and BioBanking credit calculator information supplied for adequacy in accordance with the NSW Framework for Biodiversity Assessment (FBA) (OEH, 2014) methodology and a modified version of the BioBanking statement review checklist.

The methodologies used and recommendations derived from the verification are presented in this memo and in reference to a modified version of the FBA review checklist attached (Attachment B).

2. METHODOLOGIES

2.1 DESKTOP REVIEW

A desktop review of likely constraints within the site and its locality was undertaken by the use of the following databases and report:

- Research papers, books and other published data
- Aerial photographs and topographic maps
- Existing broadscale mapping of the locality:
  - *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer et al., 2010)
  - *Native Vegetation of the Cumberland Plain, Western Sydney (NPWS, 2006)*
- OEH Vegetation Information System (VIS) Classification 2.1 (OEH, 2017)
- NSW Framework for Biodiversity (OEH, 2014)

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- Review of the site's BAR and BioBanking Credit Calculator files against a modified version of the BioBanking statement review checklist (Attachment B).

2.2 FIELD ASSESSMENT

The site was inspected during daylight hours on the 8 June 2017 by s. 47F(1) (WSP) and s. 47F(1) (GHD) to verify the BAR findings, site data, vegetation zones and the results of the database searches.

Specifically, the site inspection included a combination of random meander surveys and rapid data point (RPD) assessments to complete:

- Vegetation zone identifications and boundary confirmations
- Review of plot and transect locations
- Review of field data collection points
- Review of general site condition and habitat for threatened species.

A total of 23 RPDs were completed across the site. Figure 1 and Table A1 in Attachment A provides an overview of the locations of these RPDs and results from the site inspection.

3. REVIEW COMMENTS AND RECOMMENDATIONS

3.1 BIODIVERSITY ASSESSMENT REPORT

The BAR prepared by GHD (2017), for lands associated with Stage 1 Development of the Western Sydney Airport, provides a logical and succinct assessment of the proposed development in accordance with the FBA. However the BAR would benefit from some additional information and clarification to address findings made during the desktop review and site inspection.

A summary of the key comments include:

- One additional threatened flora species *Dillwynia tenuifolia* (listed as under the Vulnerable under the NSW *Threatened Species Conservation Act 1995* (TSC Act)) was identified as occurring within the study area. Approximately 150 individuals were recorded during the brief site inspection from within Shale Gravel Transition Forest (HN512 Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest) (Attachment A - Figure 1). It is recommended that additional targeted surveys for this species be undertaken in areas were potential habitat occurs in accordance with *NSW Guide to Surveying Threatened Plants* (OEH, 2016) and FBA to confirm the total number of individuals present. Following these targeted surveys, the BioBanking calculation and BAR document will need to be updated where required to reflect the find.
- Areas of the Stage 1 development footprint occur within the proposed Environmental Conservation Zone. Further clarification is required in BAR to justify/clarify the overlap and removal of native vegetation within the proposed Environmental Conservation Zone.
- Field verification completed during the site inspection confirmed that the mapping of vegetation types and EPBC Act classifications of Cumberland Plain Woodland and Shale Gravel Transition Forest had a high degree of accuracy with only a few minor discrepancies identified.

- These discrepancies were largely limited to inaccuracies in the mapping of HN528 and HN529 based on canopy cover and patches (>10% canopy cover required to comply with EPBC Act condition criteria) which were assessed using Aerial Photographic Interpretation (API). During the site inspection it was discussed and agreed upon that the API analysis was too sensitive to be used solely for patch size analysis defining the HN528 and HN529 moderate/Good – medium vegetation zones. This has resulted in an underestimation of the moderate/good – medium condition and EPBC Act listed vegetation. Areas of native grassland/regrowth vegetation, mapped as moderate/good – poor condition, in proximity to the moderate/good – medium condition contain a high native species diversity, cover and connectivity and therefore should be included in the moderate/good – medium condition type. It was agreed upon that the boundaries of these patches would be revised and updated were appropriate.

- Whilst the classification of EPBC Act threatened ecological communities were largely accurate, at present, it is difficult to determine which patches of vegetation are consistent or not consistent with the EPBC Act listing. The description in Section 4.5.1 clearly states that all derived grassland in the moderate/good – poor condition type do not meet the EPBC Act. This section is however unclear as to the distinction of which moderate/good – medium condition type patches are or are not EPBC Act listed. The BAR would benefit from further clarification on the EPBC Act classification assessment undertaken and perhaps splitting the moderate/good – medium condition type into two separate vegetation zones to distinguish between the EPBC Act listed and non-EPBC Act listed variants. Additionally it is recommended that a definition of a patch be included in the BAR to provide clarity such as '*A patch is defined as a discrete and continuous area that comprises the ecological community. A patch may include small-scale disturbances such as tracks or breaks or other small-scale variations in native vegetation that do not significantly alter the overall functionality of the ecological community – for instance the easy movement of wildlife or dispersal of plant spores and seeds*' (DEWHA, 2010).

- Alternatively, patch by patch analysis against the EPBC classification could be provided as an Appendix. It is acknowledged that given the scale of the site and high number of individual patches this may be in practical however undertaking this exercise for the moderate/good – medium condition patches with illustration on a Figure would improve clarity of the classification.

- Vegetation mapping deemed appropriate based on field validation site inspection. Section 3.3.2 '*Vegetation surveys and mapping*' described the methodology for mapping and confirming Plant Community Types (PCTs) as comparing plot/transect data with Tozer et al (2010) diagnostic species listed for equivalent vegetation map units. There are some inconsistences in the diagnostic species comparisons provided and the PCTs selected and mapped in Figure 3 and 4 in the BAR. For instance most plots appear to use the ratio of positive diagnostic species: total native species in order to determine the appropriate PCT however Plot 20 appears to utilise the ratio of actual : required positive diagnostic species to determine that the plot is HN529 as shown in Table 39 and Figure 3A and 4A. It is acknowledged that the PCTs determinations mapped are correct based on field observations and it is recognised that that other resources were likely utilised to determine, confirm and map PCTs within the site such as topographical, soil and geology maps. The report would benefit from further justification in Section 3.3.2 as to the additional criteria other than Tozer analysis used to derive the PCTs mapped within the site.

- Field survey effort is largely deemed appropriate however the report may benefit from depicting targeted threatened flora and fauna survey effort visually on a figure. The survey effort is currently described in detail in Section 3 of the BAR however it is difficult to determine where these surveys were undertaken given the scale and nature of the site. A visual representation of targeted survey effort would aid in justifying that the survey effort is adequate and in accordance with the relevant guidelines. In addition a number of species have not been surveyed within the BioBanking Calculator 'survey time matrix' specified survey timing i.e. *Pultenaea pedunculata, Pterostylis saxicola* and *Hypsela sessilifolia* and Rosenberg's Goanna. Section 6.3.2 of the BAR notes that the presence of these species have been readily excluded from occurring on the site based on desktop assessments of on-site habitat. It is acknowledged that suitable habitat probably does not occur however to be compliant with the FBA additional targeted surveys or expert reports for these species would have to be completed. Further discussion and justification should be provided on these matters.
- There are inconsistences between total number of BioBanking plots/transects completed in BAR report, figures and BioBanking calculator. Clarification of plots undertaken and included in the BioBanking calculator is required to confirm total number of plot/transects completed and their locations. For instance:
  - Table 39 states that 62 plots/transects were completed however elsewhere in the report such as Section 3.3.2 '*Plots/transects*' 60 plots/transects are stated as being completed whilst figures suggest that 92 were completed.
  - Vegetation zone nine in the BioBanking calculator has different plots/transects than detailed in Table 39.
- Typographic errors and duplication of plot reference numbers on maps. Suggest that maps be reviewed and amended where required. Examples include:
  - Figure 3A has duplicate plot labels for plot/transects including 12, 18, 19, 20, 21 etc.
  - Figure 2E has rapid assessment points labelled with same reference numbers for example there are two rapid assessments labelled '2' whilst others have no identification labels.
- Aerial photographs on BAR figures do not contain data source references or dates of when they were taken. The majority of figures refer back to 'Digital Data Sources' on second page of the EIS
- The direction of plot/transects are not illustrated on figures. It is acknowledged that given the large nature of the site the direction of plots/transects will unable to be shown at scale. BAR would benefit from having the plot/transects illustrated on a figure.
- Figure 4 of the BAR appears to have a vegetation layer error. Some areas of EPBC Act and TSC Act listed Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest are lacking the shading associated with the TSC Act listing for the community (for instance southern potion of the site west of The Northern Road on Figure 4a and along the north eastern boundary on Figure 4D). Noted this may just require a layer turned on.
- The landscape assessment inner and outer circle assessments appear visually not to be centred on the area of native vegetation mostly impacted upon by the project. It is noted that the circles may be centred over the largest area of native vegetation (i.e.

remnant and derived native grasslands) however landscape assessment shapefiles were not supplied and therefore could not be confirmed. Clarification and evidence is required to justify the landscape assessment circles positioning as it is currently unclear.

Yours sincerely.

s. 47F(1)

Team Manager, Ecology

REFERENCES

Department of the Environment, Water Heritage and the Arts, 2010, 'Cumberland Plain Shale Woodlands and Shale-gravel Transition Forest.

GHD, 2017, 'Western Sydney Airport – Stage 1 Development Biodiversity Assessment Report', prepared for NSW Department of Infrastructure and Regional Development.

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Office of Environment and Heritage, 2017, 'VIS Classification database', version 2.1, accessed online: http://www.environment.nsw.gov.au/research/Visclassification.htm.

National Parks and Wildlife Services, 2006, 'Native Vegetation of the Cumberland Plain.

Tozer MG, Turner K, Keith DA, Tindall D, Pennay C, Simpson C, MacKenzie B, Beukers P 2010. *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands*. Cunninghamia 11: 359-406.

ATTACHMENTS

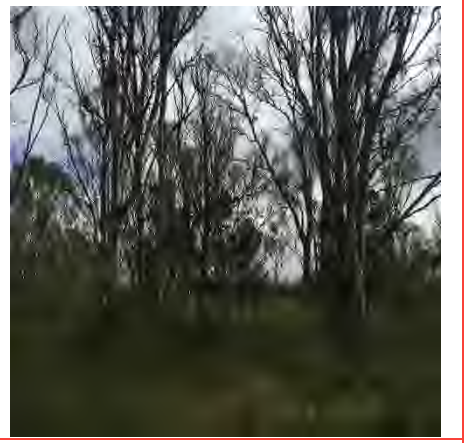
Attachment A – Rapid data point assessment details

Attachment B - BioBanking statement review checklist

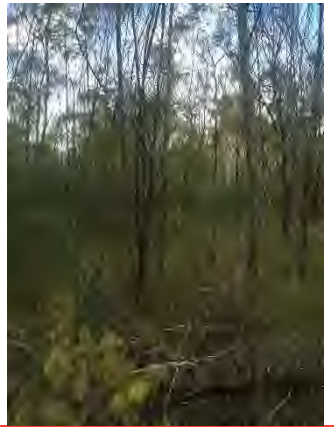
ATTACHMENT A – RAPID DATA POINT ASSESSMENT DETAILS

Table A1 Rapid point assessment of Western Sydney Airport independent audit

RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
1	8/06/2017, 9:55:01 AM AEST	6248008	288594	Road side vegetation containing *Marsdenia viridiflora subsp. viridiflora* population. Vegetation contains a native understorey with a canopy cover >10%.	
2	8/06/2017, 10:06:35 AM AEST	6247763	288579	Derived grassland in low condition comprised approximately of 80% exotic cover (*Paspalum dilatalum*).	n/a
3	8/06/2017, 10:24:05 AM AEST	6248186	288768	Derived grassland marginal approximately 50% native cover dominated by *Paspalum dilatalum* and *Themeda triandra*.	

RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
4	8/06/2017, 10:38:06 AM AEST	6247682	289065	Inaccuracy in mapping mapped as Grey Box - Forest Red Gum grassy woodland on flats (HN528 M/G – poor) however should be mapped M/G – medium. Consistent with EPBC condition criteria for Cumberland Plain Woodland as it contains >10 canopy cover and groundcover is >50% native. Noted that *Microlaena stipoides* may not have been included in cover due to dieback.	
5	8/06/2017, 11:00:56 AM AEST	6249140	289236	Forest Red Gum - Rough-barked Apple grassy woodland (HN526) confirmed. Dominated by *Eucalyptus tereticornis, Olea europaea subsp. cuspidata, Bursaria spinosa* and *Microlaena stipoides.*	
6	8/06/2017, 11:15:10 AM AEST	6248259	289813	Grey Box - Forest Red Gum grassy woodland on flats (HN528) medium condition confirmed. Canopy cover >10% and groundcover >50% native therefore consistent with EPBC condition criteria for Cumberland Plain Woodland.	

RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
7	8/06/2017, 11:20:45 AM AEST	6248327	290655	Grey Box - Forest Red Gum grassy woodland on flats (HN528) confirmed. Canopy cover >10% however understorey >50% exotic cover (*Paspalum dilatalum, Chloris gayana* and *Verbena bonariensis*) and therefore not consistent with EPBC Act listed Cumberland Plain Woodland.	
8	8/06/2017, 11:33:03 AM AEST	6248663	290575	Forest Red Gum - Rough-barked Apple grassy woodland (HN5265) confirmed. Dominated by *Eucalyptus terticornis* with an understorey comprised of >50% native species including *Juncus usitatus*.	
9	8/06/2017, 11:45:42 AM AEST	6249043	290292	Confirmed that vegetation contains >10% canopy cover. Groundcover however is dominated by exotic pasture species (>50% exotic). Dominated by *Setaria parvifolra, Paspalum dilatalum, Chloris gayana* and *Lycium ferocissimum*. Not consistent with EPBC Act condition criteria for Cumberland Plain Woodland.	
10	8/06/2017, 11:53:54 AM AEST	6248963	290375	Hazardous material waste (Asbestos) recorded.	n/a

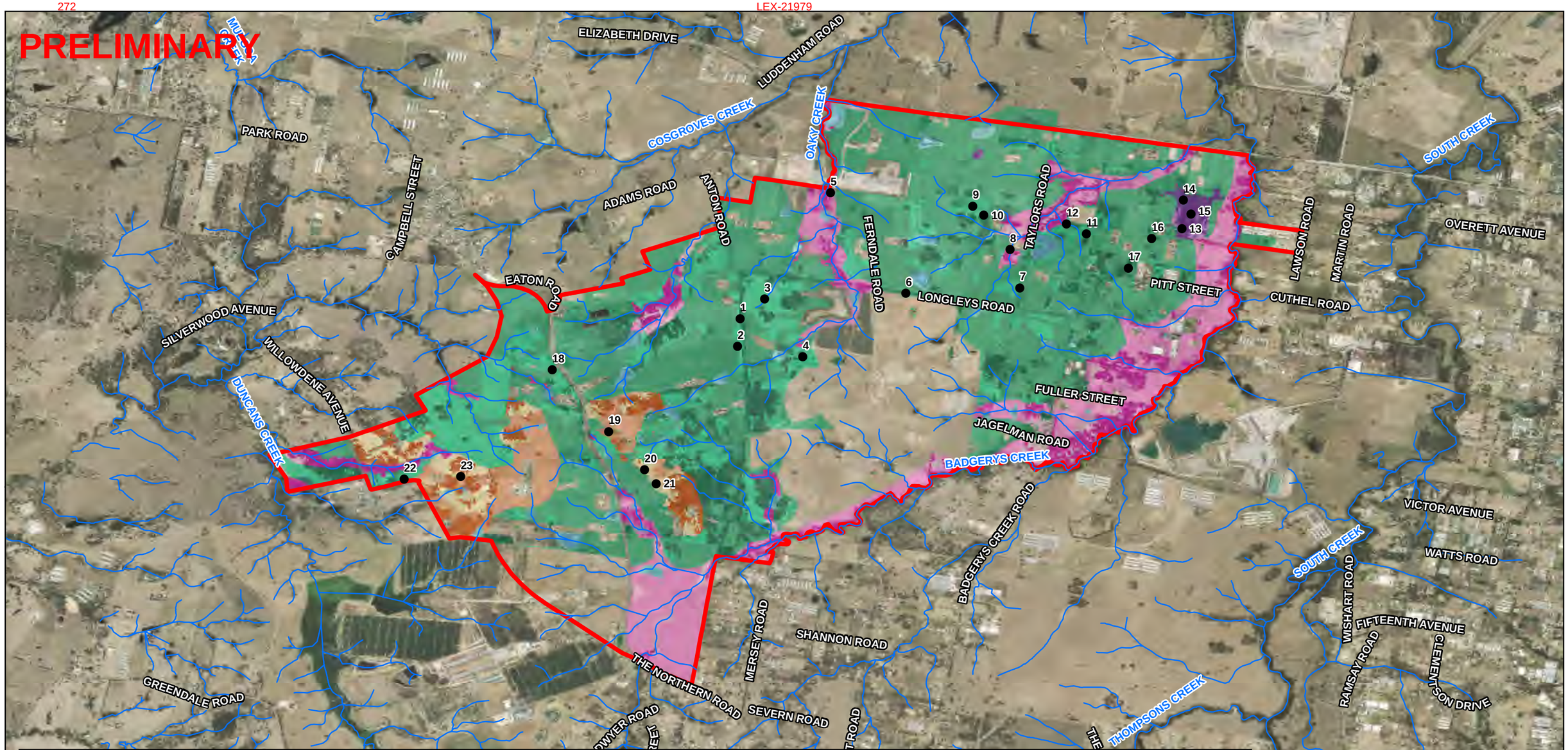
RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
11	8/06/2017, 12:06:44 PM AEST	6248815	291138	Mixture of native grassland/shrubland (*Acacia decurrens*). Groundcover and understorey consists of 90% native cover.	
12	8/06/2017, 12:22:46 PM AEST	6248900	290986	Canopy cover >10% cover and groundcover is >50% native therefore consistent with EPBC condition criteria for Cumberland Plain Woodland.	n/a
13	8/06/2017, 12:42:02 PM AEST	6248875	291843	Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512) confirmed and consistent with EPBC condition criteria for Shale Gravel Transition Forest. Dominated by *Melaleuca decora, Bursaria spinosa* and *Microlaena stipoides.*	
14	8/06/2017, 12:55:07 PM AEST	6249130	291848	Four *Dillwynia tenuifolia* individuals recorded.	

RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
15	8/06/2017, 1:11:32 PM AEST	6249006	291906	Greater than 50 *Dillwynia tenuifolia* individuals recorded.	
16	8/06/2017, 1:40:17 PM AEST	6248784	291620	Identified as Grey Box - Forest Red Gum grassy woodland on hills (HN529) not Grey Box - Forest Red Gum grassy woodland on flats (HN528). Patch is too small to be consistent with EPBC condition criteria for Cumberland Plain Woodland EEC.	n/a
17	8/06/2017, 1:51:18 PM AEST	6248519	291454	Ground layer is comprised of over 50% exotic cover. Groundcover dominated by *Setaria parviflora, Chloris gayana, Sida rhombifolia* and *Ehrharta erecta.*	

RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
18	8/06/2017, 2:19:32 PM AEST	6247522	287214	*Pimelea spicata* observed in flower within derived native grassland dominated by *Themeda triandra*.	
19	8/06/2017, 2:41:59 PM AEST	6246986	287642	Grey Box - Forest Red Gum grassy woodland on flats (HN528) confirmed. Canopy cover >10% and groundcover comprised of >50% exotic cover therefore not consistent with EPBC condition criteria for Cumberland Plain Woodland. Plot 75 in BAR.	n/a
20	8/06/2017, 2:52:12 PM AEST	6246651	287917	Understorey dominated by *Ligustrum* spp. and *Olea europaea subsp. cuspidata*. Groundcover dominated by exotic pasture grasses (>50%).	

RAPID SURVEY POINT (ID)	DATE CREATED	NORTHING	EASTING	DESCRIPTION	PHOTOS
21	8/06/2017, 2:55:47 PM AEST	6246531	288005	Grey Box - Forest Red Gum grassy woodland on hills (HN529) confirmed. Canopy cover > 10% and groundcover 50% native cover therefore consistent with EPBC condition criteria for Cumberland Plain Woodland.	
22	8/06/2017, 3:09:55 PM AEST	6246529	286138	Vegetation contains native vegetation groundcover >50% and regeneration of understorey species is present. Forms part of larger patch. Currently not mapped as consistent with EPBC Act listed Cumberland Plain however should be.	
23	8/06/2017, 3:18:23 PM AEST	6246561	286557	Grey Box - Forest Red Gum grassy woodland on hills (HN529) confirmed. Canopy cover > 10% and groundcover 50% native cover therefore consistent with EPBC condition criteria for Cumberland Plain Woodland.	

PRELIMINARY



Legend

- Rapid data point
- Watercourse
- Cleared land or cropland
- Good condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - medium)
- Poor condition Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest (HN512, Moderate/good - poor)
- Good condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - medium)
- Low condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Low)
- Poor condition Forest Red Gum - Rough-barked Apple grassy woodland (HN526, Moderate/good - poor)
- Good condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - medium)
- Low condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Low)
- Poor condition Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate/good - poor)
- Good condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - medium)
- Low condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Low)
- Poor condition Grey Box - Forest Red Gum grassy woodland on hills (HN529, Moderate/good - poor)
- Good condition artificial freshwater wetland on floodplain (HN630, Moderate/good)
- Western Sydney Airport biobank site boundary

Map: 2270894A_GIS_F001_A1	Author: MitchellEm
Date: 19/06/2017	Approved by: -

Data source: © Land and Property Information 2015

0 460 920 m

1:35,000

Coordinate system: GCS GDA 1994
Scale ratio correct when printed at A3

Western Sydney Airport - Stage 1 Development

Figure 1
Rapid data point assessment survey effort

Attachment B – BioBanking statement review checklist

FBA review checklist

ETS contact:
Ph:

REGIONAL contact:
Ph:

Name of development site: Western Sydney Airport Stage 1
Site Inspection (date and attendees): 8 June 2017
s. 47F(1) (WSP) and s. 47F(1) (GHD)

	Tasks		Ecosystems and Threatened Species Team (ETS)		Region	Log of actions and comments	Stop the clock (date)
1. RECEIPT OF APPLICATION							
1.1	BioBanking Assessor		Confirm the assessment was undertaken by an accredited BioBanking Assessor with a valid accreditation status (not suspended or removed) N:\ROG_EPB\6. EPS Section\ETS Team\Biobanking\BioBanking Contact Database		Assessment undertaken by an accredited BioBanking Assessor (s. 47F(1)). Refer to Table 8 of BAR.		
2. INITIAL REVIEW OF APPLICATION							
2.1	Have all the reports and maps for the assessment been submitted		Check all requirements have been submitted: ☐ Application form – signed ☐ Assessment report ☐ Maps and shapefiles Within the Assessment Report, check that the supporting documents listed in section 3 of the application form have been submitted: ☐ Credit calculator report ☐ Statement of onsite measures ☐ Maps including the following: ☐ map of the development site showing ☐ development footprint ☐ vegetation zones ☐ location of species credit species		BAR, map and shapefiles supplied. The BAR contains the following: - Credit Calculator report (Appendix A) - Onsite measures (Section 6.4 of BAR) - Maps of development site showing development footprint (referred to as Stage 1 construction impact zone' in BAR (Figure 1), Vegetation zones (Figure 3) and location of species credits (Figure 4 and Figure 5). Maps are generally appropriate however Figure 4a is missing a legend reference for one threatened flora species (predicted to be *Pimelea spicata*). Figure 7 is not		

	274 Tasks		Ecosystems and Threatened Species Team (ETS)	LEX-21979	Region	Log of actions and comments	Stop the clock (date)
			Maps (JPEG) and supporting GIS files showing (All maps must include the following information - eastings and northings, the date aerial photograph was taken, name of aerial photography, map projections and coordinate systems) Have additional supporting reports been submitted (delete those not applicable) ☐ more appropriate use of local data ☐ red flag variation ☐ expert report/s Request further information if required [bs_receipt_more info]. If additional information is provided but is still inadequate request further information/clarification [bs_receipt_more info again]. If additional information is adequate, notify landowner that review will now proceed [bs_receipt_more info adequate].		available 'Updated species polygon mapping to be provided). Additionally there are numerous topographical and GIS layer errors in Figures 3 and 4. Survey effort map does not have a figure title. These are discussed in more detail in Section 3.1 of the memo. It has also been suggested that an additional vegetation type be created for HN528 and HN529 to distinguish between EPBC Act listed EECs. Maps: - None contain eastings and northings this may be due to the site boundary following cadastre/zoning boundaries - Figures 1 and 6 provide aerial photograph data source but no date. Figures 2, 3, 4 and 5 do not provide the data source or date of aerial photographs instead refer to 'Digital Data Sources' on second page of EIS no reference in BAR. - All maps contain map projections and coordinate systems used. No local data used. No red flag variation - not relevant to major projects being assessed under the FBA. No expert reports submitted refer to Section 3.11 and 3.12 of this table for more details. Project offsets are detailed in the Offset Strategy and the Biodiversity Offset Delivery Plan (BODP) which forms part of the EIS. No offsetting delivery specifics nor the current progress is provided in BAR.		

	Tasks		Ecosystems and Threatened Species Team (ETS)		Region	Log of actions and comments	Stop the clock (date)
2.2	Inform local government (delete if Part 3A)		☐ email council to let them know an application has been received for biobanking statement and check if the development application (DA) has been approved (e.g. bb statement is issued prior to DA approval) [email template]		Land zoning of the site consists of: - RU1 Primary production - SP Special activities (Commonwealth Activities) - SP2 Infrastructure (Classified Road)		
2.3	Part 3A application (delete if not applicable)`		☐ For Part 3A development (where bb statement application is received prior to approval of the development) notify DPE at the public exhibition stage of the environmental assessment and seek further advice from DPE following the interagency protocol. ☐ For Part 3A project prepare briefing note to CE_OEH and standard letter to DG_ DPE regarding the concurrence with the development ☐ DoP contact: s. 47F(1) [ba_initial_DoP] (s. 47F(1) only works Monday & Tuesday)		EIS has been submitted and approved subject to conditions of approval.		
2.4	EPBC Act assessment		Check whether the assessment report refers to also seeking approval for species and communities listed under the EPBC Act. If the box has been checked on the biobanking statement application form, this does not always mean a referral is required. Check with the proponent and consultant as to whether they are referring the development to the Department of Environment. Only check with the DoE if referral is occurring. ☐ Check if the proponent has started the referral process with the DoE. The DoE contact for an early notification: s. 47F(1) @environment.gov.au		Yes project requires approval for impacting the following EPBC Act listed biodiversity: - Cumberland Plain Woodland - Shale Gravel Transition Forest - *Pultenaea parviflora* and *Pimelea spicata* individuals - Grey-headed Flying-fox and Swift Parrot habitat The applicant has prepared an EIS to gain project approval.		

	Tasks		Ecosystems and Threatened Species Team (ETS)		Region	Log of actions and comments	Stop the clock (date)
			Note, the bilateral agreement only applies to State Significant Development and State Significant Infrastructure.				
3. REVIEW OF ASSESSMENT							
3.1	Determine whether proposal has attempted to avoid and minimise impacts		☐ Check if footprint of proposal could be reconfigured to avoid or minimise biodiversity impacts ☐ Review on-site measures taken to minimise impact		Mitigation measures provided in Section 7 of the BAR. Noted that the site occurs on a mixture of rural and residential land which has been extensively modified and therefore impacts are likely to be less that a total greenfield site. Difficult to avoid/minimise impacts given the large size and nature of the project (safety concerns associated with constructing a runway). BAR would benefit from providing evidence of attempts to minimise/avoid impacts whether or not successful. Mitigation measures to reduce impacts are referred to in BAR as occurring within the EIS document (Chapter 28).		
3.2	Site history		☐ Perform a desktop assessment of site history (e.g. any previous survey results, disturbance history)		Desktop assessment confirms details provided in Section 4 of the BAR. Previous surveys - BAR has used data from the approved EIS (GHD, 2016), Environmental Field survey of Commonwealth land at Badgery's Creek Report (SMEC 2014) and Western Sydney Airport referral of proposal action (DIRD, 2014).		
3.3	Site reference data		☐ Check that the site reference data (easting and northing) submitted with the application for biobanking statement matches the GIS data. ☐ A site visit may be required to confirm boundaries of the development site.		No corner points of the proposed development were provided and therefore site reference data could not be checked against GIS data. The site boundary does however match the cadastre boundaries for the majority of the site aside from one		

	Tasks		Ecosystems and Threatened Species Team (ETS)		Region	Log of actions and comments	Stop the clock (date)
					exception where the Stage 1 development area extends north of Elizabeth Drive. Site inspection confirmed that the site boundary was as it appears in BAR figures.		
3.4	Asset Protection Zones (APZs)		☐ Check if APZs have been considered and mapped as well as provision of services (e.g. easements, roads etc.) ☐ Are APZs likely to meet RFS requirements		Section 6.2 of BAR states that all vegetation involved in the Stage 1 development would be entirely removed. No partial clearing associated with APZs has been taken into consideration. Justification as to why no APZs have been considered would provide clarity in the BAR.		
3.5	CMA region/subregion and Mitchell landscape		☐ Check that the CMA region/sub-region(s) and Mitchell Landscape are correct.		CMA region/sub-region (Hawkesbury Nepean / Cumberland) and Mitchell Landscapes (Cumberland Plain (Majority of the site) and Hawkesbury – Nepean Channels)) are correct.		
3.6	Assessment circles (100ha & 1000ha)		☐ Check correct number and placement of the assessment circles by performing desktop-based verification ☐ Check the correct 'percent native vegetation cover' class has been selected		Landscape assessment circles appear inappropriate based on Figure 6 of the BAR as the inner circle does not appear to be centred over the largest area of native vegetation mostly impacted upon by the project. Noted that calculations may be based on DNG and remnant vegetation however unclear based on figure. No landscape assessment shapefiles were provided and therefore unable to confirm. Suggest provided justification in BAR to detail how the positioning of the inner circle was determined. Unable to confirm percent of native vegetation cover as no landscape assessment shapefiles were provided.		

	Tasks		Ecosystems and Threatened Species Team (ETS)		Region	Log of actions and comments	Stop the clock (date)
3.7	Connectivity assessment		☐ Check connectivity assessment is accurate based on a desktop-based verification. If issues arise follow up site visit maybe necessary. ☐ Check if the assessment report includes an explanation of how connectivity assessment was undertaken		Connectivity assessment deemed appropriate. Explanation given regarding the connectivity assessment i.e. forms part of a regionally significant biodiversity link as the site contains a riparian buffer 20m either side of a 4th order stream (connectivity score of 9).		
3.8	Adjacent remnant vegetation area and patch size		Check determination of: ☐ adjacent remnant vegetation ☐ patch size		Adjacent remnant vegetation and patch size score deemed appropriate. Bar states that the Cumberland Plain is 89% cleared. The patch size of the site is 670 ha and continues outside of the site along Badgerys Creek and Duncans Creek to the north and west. Using Table 15 of the FBA this confirms that the site fits into the Extra Large category and that the patch size score equals 12. Unable to confirm patch size as no landscape assessment shapefiles were provided.		
3.9	Threatened species sub-zones/vegetation zones		Review threatened species sub-zones/vegetation zones for correct: ☐ identification of vegetation types and EECs ☐ delineation and mapping ☐ vegetation condition – low or moderate to good ☐ check for correct number of plots and that their placement is representative for each vegetation zone		**BB Calculator (Vegetation Zones) -** HN526 vegetation formation is listed as 'Grassy Woodland' (Veg zone 5 and 6) however should be 'Forested Wetlands'. Vegetation mapping and EEC classification assessments undertaken show a high degree of accuracy. There were however a few minor inaccuracies which were identified during the site inspection largely based around patches and mapping of EPBC Act listed Cumberland Plain Woodland and Shale Gravel Transition Forest – refer to technical memo for more details.		

	279 Tasks		Ecosystems and Threatened Species Team (ETS)	LEX-21979 Region	Log of actions and comments	Stop the clock (date)
				Adequate number of plots undertaken in accordance with areas of current vegetation zones. May require revising based on vegetation mapping changes recommended. There are however inconsistences with the total number of plots per vegetation type in the BB calculator and Table 39 of the BAR for instance HN529 has 5 in the BB calculator and 4 in Table 39. Inconsistences occur for vegetation zones 3, 5 and 10. Review of BB calculator (Site Values) shows that the plots entered into the calculator for some vegetation zones differ from what is presented in Attachment A plot/transect data table. For instance all plots in vegetation zone 9 (frog 9, frog 10, frog 8 and frog 11) differs in plot id and data provided in Appendix A table (65, 77, 80 and 81).		
3.10	Review site value scores		Review plot/transect data and score for each site attribute. Consider: ☐ variability between plots within the same vegetation zone ☐ extreme site attribute measurements ☐ contradictory attribute measurements ☐ plausibility	Plot/transect data are generally consistent aside from natural variability. Aside from minor vegetation classification alterations discussed above plot data is accurate based on observations made during the site inspection.		
3.11	Threatened species assessment – survey or assumed presence		☐ If sensitive species are present on the site ETS officer must ensure that any issued species credits associated with the sensitive species are not displayed on the Public Register.	No impacted species credits are listed as sensitive species. Geographic and habitat features deemed appropriate. Details provided only within the BB calculator.		

	280 Tasks		Ecosystems and Threatened Species Team (ETS)	LEX-21979	Region	Log of actions and comments	Stop the clock (date)
			☐ Check if the correct responses were provided for the Geographic and habitat features Review any surveys for species credits by determining if: ☐ the details for the survey effort and technique are appropriate for the threatened species ☐ the survey was performed in the appropriate season ☐ the person undertaking the survey was performed by an appropriate person. ☐ If the expert report is rejected, the applicant will have to carry out the survey for that species in accordance with the requirements of the methodology. ☐ map of the location of threatened species shows all the threatened species listed in the biobanking credit report ☐ Check if any threatened species present on the site are listed as sensitive species (under DECCW's Sensitive Species Policy) ☐ Inform ETS officer if any sensitive species are present on the site		Limited data available regarding targeted threatened flora surveys in BAR. BAR would benefit from further descriptions of methodology in reference to appropriate guidelines such as NSW Guide to Surveying Threatened Plants and mapping of threatened survey effort eg flora transects undertaken. Noted that targeted flora surveys were undertaken between over 19 days in February – May 2016 and 2017 by appropriately qualified ecologists. However further surveys or expert reports are required to comply with BB 'survey time matrix' for example *Pultenaea pedunculata* survey in BB calculator states survey time as 1/1/1901, *Hypsela sessiliflora* as 20/3/2015 and *Pterostylis saxicola* as 20/2/2015 where the BB survey matrix states survey periods for these species is between September and November. Additionally Rosenberg's Goanna was surveyed 20/3/2017 however survey matrix timing is November to February. Report would benefit from clarifying targeted surveys of each threatened species identified by the BB calculator. Field survey identified an additional threatened flora species as occurring within the site; *Dillwynia tenuifolia*. Additional targeted surveys should be undertaken for this species to confirm number and area of occurrence. Updates required to BB calculator on completion of surveys. Remaining targeted surveys deemed appropriate aside from those mentioned in		

	281 Tasks		Ecosystems and Threatened Species Team (ETS)	LEX-21979	Region	Log of actions and comments	Stop the clock (date)
					3.12 below which may require further discussion. Location of threatened credit species individuals/habitat areas are not provided in the BAR. Figure 7 Species Polygons in BAR states 'Updated species polygon mapping to be provided'.		
3.12	Threatened species assessment – expert report (if applicable)		☐ Review any expert report that assumes presence of a species in lieu of survey and determine if credit requirement is appropriate (section 4.5 of BB methodology) ☐ Review any expert report for a species in lieu of survey ☐ Assess validity of the report and confirm the expert's qualifications. ☐ Recommend whether expert report should be allowed or refused.		No expert reports provided however additional targeted surveys or expert reports/justification will be required for; ☐ *Pultenaea pedunculata* ☐ *Pterostylis saxicola* ☐ *Hypsela sessilifolira* ☐ Rosenbergs Gonna – clarification of survey effort required. Noted that Section 6.3.2 of BAR states that these species absence has been assessed based on a desktop assessment and on-site habitat assessments undertaken. The review agrees that these species are unlikely to occur Suggest that further justification as to why an expert report/targeted surveys are not required.		
3.13	Assess indirect impacts		☐ Review and verify if the appropriate on-site measures have been proposed to minimise the indirect impacts on biodiversity values ☐ Have the correct number of biodiversity credits been created to offset the remaining impacts (if required) Advise ETS team if the remaining indirect impacts cannot be mitigated or offset. This will means that the development cannot improve or maintain		On site mitigation measures are provided in Section 6.4 and 7 of the BAR which refers back to the project EIS for further details. It is acknowledged that the site has a history of extensive disturbance and given the scale and nature of the project minimising impacts is difficult. BAR would benefit from provided evidence as to what investigations have been undertaken to come to this conclusion. Mitigation measures refer back		

	Tasks		Ecosystems and Threatened Species Team (ETS)		Region	Log of actions and comments	Stop the clock (date)
			biodiversity values and hence biobanking statement cannot be issued.		to the EIS and development of a biodiversity section within the CEMP. Offsets calculated accurate of those vegetation zones/management zones in current BB calculator. Number of biodiversity credits will have to be revised and updated based on advised changes to these attributes as agreed upon during the site inspection and detailed in technical memo.		
4. REVIEW OF ADDITIONAL SITE ASSESSMENT COMPONENTS (strikethrough those not required)							
4.1	Use of more appropriate local data		☐ If the use of more appropriate local data is supported, prepare the approval using the More Appropriate Local Data (MALD) template the CE (delegated to ETS Senior Team Leader) ☐ If the use of local data is not supported, advise the applicant (during step 4 of 'Review summary & further actions') that their calculations must be revised using the data in the Credit Calculator Assess and provide advice on the use of more appropriate local data as follows: ☐ Review information supporting the request for the use of local data for vegetation types, benchmarks, or variation of percent cleared for a vegetation type. A visit may be required to the local reference site. ☐ Check if local threatened species data have been used in the assessment. If so, check if the local council has any local data that may be relevant to the site, particularly the known location on any threatened species. Review characteristics for the species.		No local data used.		

	283 Tasks		Ecosystems and Threatened Species Team (ETS)	LEX-21979	Region	Log of actions and comments	Stop the clock (date)
			☐ Staff from Science, or possibly those who contributed to the development of original benchmarks, may need to be referred to for greater expertise. ☐ Recommend whether the local data should be supported or not and provide reasons for the recommendation.				
4.2	Environmental contributions		☐ Include in briefing note for statement approval ☐ Verify the calculation of credits reduction as a result of environmental contributions. ☐ Review the BioBanking Agreement Credit Report		BioBanking Credit Report in consistent with details outlined in the BB calculator.		
4.3	Approval of equivalent site (if required)		Seek CE approval ☐ prepare briefing note ☐ Perform site visits on both sites to validate assessor's report ☐ Confirm that correct vegetation type/s and equivalent condition has been chosen adequately to the biodiversity values on the proposed development site. ☐ Make recommendation to the Biodiversity and Vegetation Programs Unit for approval/refusal of equivalent site use.		Site inspection confirmed that the vegetation classification has a high degree of accuracy. There were minor inaccuracies involving the EPBC Act listed Cumberland Plain Woodland and Shale Gravel Transition Forest EECs largely around patch sizes mapped via API. Inaccuracies require modifying vegetation condition and EPBC Act EECs in accordance with comments (refer to Section 3.1 of technical memo).		

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COMMENTS ON BODP

Biodiversity Assessment Report (and revised version)

Section	Page	Comment
1.2	2	More clarity around the vegetation that forms habitat for the Swift Parrot and Grey-headed Flying-fox should be provided. The Biodiversity assessments reports generally state that all native woodland and forest in the Orchard Hills offset site provide foraging habitat for these species. However: • This is not made clear in various tables across the BAR, revised BAR and Chapter 2 of the BODP. For example Tables 3.5 and 3.6 of the revised BAR, Table 14 of the original BAR and Table 3.1 of the Chapter 2 of the BODP. • We've inferred that habitat for these species includes the additional 35.9 ha of good quality HN526 and 6.1 ha of medium quality HN528. Please clarify the tables.
3.3.2	31	Text describing Cumberland Plains Woodland condition thresholds should include the following "or contiguous with a native vegetation remnant ≥1 ha".

Chapter 1 – Introduction

Section	Page	Comment
1.2	2	The statement 'The offset sites will be secured by mechanisms such as the registration of an appropriate conservation covenant on the title of the relevant property' should be clarified to note that the largest offset (Orchard Hills) will not be secured through such mechanisms and that it is protected via the CHL and TEC listing.
1.2	3-4	***Delivery of offsets:*** The Department acknowledges the delay in identifying and securing some offset properties and the BODP describes the process to identify offsetting opportunities. However, the proposed implementation of the BODP should be less open-ended and timeframes should be provided around field surveys and the delivery of offsets (staged or otherwise).
1.2	4	Point e – please clarify the 'Approver'.
1.6	15	The statement 'A secure conservation mechanism would be placed over offset sites…' should be revised as per the comments above. See comment 2 above. The BODP should demonstrate a greater commitment to delivering offsets within a reasonable timeframe. The EPBC Act Offsets Policy states that offsets must be timely and should

		be implemented either before or at the same time as the impact. As such, the BODP should provide completion timeframes for identifying and delivering offsets (rather than the proposal to report such more generally in ongoing audit reports).

Chapter 2 – Offset requirements for affected EPBC Act-listed Biota

Section	Page	Comment
All	All	Chapter 2 describes impacted EPBC habitats in the construction impact zone and is generally consistent with the Biodiversity Assessment report and the revised Biodiversity Assessment Report.
All	All	The chapter provides a comprehensive qualitative description of the relevant EPBC listed ecological communities and species with respect to area, vegetation type, fragmentation, weed cover and other site attributes that inform the site quality attributes (site condition, site context and species stocking rate). Quantitative weights and scores have been applied to the site quality attributes. However, further clarity regarding the determination of these values is required: • There appears to be a missing link between qualitative descriptions of the site quality attributes and the quantitative values. • This could be resolved with a scoring table that defines site quality attributes for specific scores or a scoring range.
2.2.1	10	***Identification of affected threatened biota:*** There is a general statement that Cumberland Plains Woodland was determined in accordance with the listing advice for this ecological community. More detail should be provided regarding: • how the ecological community meets the specific condition thresholds defined in the conservation advice along • the survey methodology and definitions of patch size and buffers is consistent with the conservation advice. Alternatively, specific references can be made to where this is provided in the BAR.
2.2.4	20	***Impacts to Pimelea spicata:*** Impacts on this species are based on area of occupied habitat rather than number of individuals. The Department has the following questions: • Given that the EPBC offsets calculator can determine offset requirements based on individuals, why has occupied habitat been chosen?

		• Figure 6A identifies clumps but lacks a polygon for the occupied habitat (noting that this is provided in Figure 4A of the original BAR). • How is occupied habitat defined and what will a potential offset look like? The Department notes a reference to potential habitat in Table 6.7 (Chapter 6) but it is unclear how this is defined and how polygons will be determined.

Chapter 3 – Offset requirements for plants, animals and their habitat

Section	Page	Comment
All	All	Chapter 3 describes impacted EPBC habitats in the construction impact zone and is generally consistent with the Biodiversity Assessment report and the revised Biodiversity Assessment Report.

Chapter 4 - Consultation and Chapter 5 – Biodiversity Experts Group

Section	Page	Comment
All	All	Chapters 5 includes advice of the Biodiversity Experts Group as required by condition 31(5) of the Airport Plan. This chapter also includes a summary of each member's advice and each component includes a paragraph on how this advice has informed development of the BODP. Chapter 5 should also reference the relevant sections of the BODP that were informed by the advice or provide a summary of how the advice was considered/informed the BODP.

Chapter 6 – Direct Offsets

Section	Page	Comment
6.1.2	21	This section refers to 'notable revisions to previous vegetation mapping at the site' (Orchard Hills): • Who made and endorsed the revisions? • What is the consequence of these revisions?
6.1.2	31-32	The text on page 31 indicates that Table 6.1 refers to Orchard Hills. However, the table appears to refer to offset sites more broadly. Please revise the text and/or table accordingly.
6.1.6	35	This section states that 'Defence would prepare an Offset Improvement Plan (OIP) within 18 months of the commencement date of the MoU'. The content of the future OIP is unenforceable given that

		the management actions are set out in Schedule 2 of the MoU. Accordingly, the BODP needs to set out: • The existing and additional management actions and monitoring/reporting/auditing requirements that are generally set out respectively in Schedules 2 and 4 of the MoU (as at 22 April 2018) and will be included in the OIP. The BODP currently lacks detail on existing management actions at Orchard Hills and inclusion of the point above should inform justification for site quality improvements.
6.1.7	36	This section indicates that additional biodiversity assessments are required for Orchard Hills. The Department's comments on this are: • Noting the revisions to vegetation mapping that have already occurred at the site (see comment 1), what additional information is being sought. • What is the level of confidence in the current vegetation assessment and to what extent could additional assessment change the value of Orchard Hills as an offset site?
6.1.7	36	The text indicates the presence of Grey-box – Forest Red Gum grassy woodland on hills, but this appears to be missing on Figure 10.
6.1.7	37-55	Similar comment to that provided for Chapter 2, comment 2. The chapter provides a comprehensive qualitative description of the relevant EPBC listed ecological communities and species with respect to area, vegetation type, fragmentation, weed cover and other site attributes that inform the site quality attributes (site condition, site context and species stocking rate). Quantitative weights and scores have been applied to the site quality attributes. However, it is unclear how these values were determined, i.e.: • There appears to be a missing link between qualitative descriptions of the site quality attributes and the quantitative values. This could be resolved with a scoring table that defines site quality attributes for specific scores or a scoring range.
6.1.7	37-55	The Department seeks further clarification of several of the input parameters used in the EPBC Offsets calculator (Tables 6.2-6.5). Specifically, these are: • Quantum of impact quality – consistent with the values in Chapter 2, but as per the Department's previous comment it is unclear how the value was determined. • Risk of loss with and without offset – The risk of averted loss (15%-8% = 7%) appears to be too high given the current circumstances associated with the site. The EPBC Offsets Policy defines risk of

		loss as total loss of value. The Department's view is that this is very unlikely and would suggest that both values are more realistically close to zero. Please provide supporting justification for the values by identifying the circumstances under which entire loss of value is foreseen. The 75% confidence in achieving an averted risk of loss also seems too high. • Start area and quality – please clarify how site quality has been quantified (see the second comment under Chapter 2). • Future area quality with offset – the increase in value requires justification with reference to existing management actions and the proposed additional management actions (which should be included in the BODP). • Future area quality without offset – how is loss of quality justified given existing management activities by Defence - what are the current management activities?
6.1.8	54	***Quantum of offsets:*** The statement that 'The biodiversity values of the Orchard Hills offset site will probably be assessed using the Biobanking methodology….' needs to be revised to provide a stronger commitment than 'probably'. This section states that the Orchard Hills offset will be quantified using the NSW Framework for Biodiversity Assessment. However, the requirement to have regard to the CPW condition thresholds should be added. Regarding the trade of 'like-for-like' ecosystem credits, this section should clarify that this can only occur where the relevant vegetation zones meet the EPBC condition thresholds for CPW.
6.1.8	54-55	***Pultenea parviflora:*** Please clarify whether the Orchard Hills offset site will meet the offset requirements for this species. This may or may not occur depending on whether offset requirements are based on individuals or habitat. As previously requested with respect to Pimelea spicata, please provide clarity around the justification of proposals to offset P. parviflora based on species habitat.
6.2.1	59	Please elaborate how biodiversity credits will be converted to hectares. An example to support this will be useful.

Chapter 7 – Other compensatory measures

Section	Page	Comment
7.4	80	***Longer term other compensatory measures:***

		Please provide indicative timeframes for delivery of the ‘other compensatory proposals’.

Chapter 8 – Offset proposal

Section	Page	Comment
All	All	***Implementation of the BODP:*** This section should include a commitment to implement the management actions and reporting/monitoring/auditing activities that will be included in the OIP (i.e. a strong link to the MOU).

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MEMORANDUM OF UNDERSTANDING

AGREEMENT TO CONSERVE AND MANAGE A BIODIVERSITY OFFSET AREA AT DEFENCE ESTABLISHMENT ORCHARD HILLS

BETWEEN

The Department of Defence

AND

The Department of Infrastructure, Regional Development and Cities

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ORCHARD HILLS SITE COVENANT AGREEMENT

Dated

Parties

This memorandum of understanding (**MOU**) is made between the following parties:

The Department of Defence ABN 68 706 814 312 (**Defence**) and

The Department of Infrastructure, Regional Development and Cities ABN 86 267 354 017 (**Infrastructure**)

Context

This MOU is made in the following context:

A. In accordance with the Airport Plan determined on 5 December 2016 that authorises development of Stage 1 of the Western Sydney Airport (**WSA**), Infrastructure is responsible for delivering biodiversity offsets in relation to the biodiversity impacts of the development and preparing a Biodiversity Offset Delivery Plan (**BODP**) for approval by Environment.

B. Defence Establishment Orchard Hills (the **Orchard Hills Site**) is an explosive ordinance depot located approximately 50 kilometres west of central Sydney that is owned, used and managed by Defence. The Orchard Hills Site is managed for Defence capability purposes, Defence training activities and the use and safe storage of explosives.

C. Approximately 1370 hectares of the Orchard Hills Site is recorded on the Commonwealth Heritage List as a Commonwealth Heritage Place for its natural heritage values including remnants and regenerating areas of Cumberland Plain Woodland and Sydney Coastal River Flat Forest (**CHL Area**).

D. Under this MOU, part of the Orchard Hills Site will be made available as a biodiversity offset for WSA and included in the draft BODP submitted to Environment for approval under the Airport Plan (**Offset Area**).

E. Nothing in this MOU is intended to negate, alter or affect Defence's use of the Orchard Hills Site or the status of the Orchard Hills Site. The parties intend that the Orchard Hills Site including the Offset Area will remain a Defence property and will continue to be a Commonwealth Place for Defence purposes including the purposes referred to in paragraph B.

F. In accordance with the terms of this MOU, the parties have agreed that:

a. subject to the terms of this MOU, the Offset Area will be permanently conserved;

b. an Offset Plan will be developed, funded and implemented to provide measurable ecological improvements to the Offset Area consistent with the *Environmental Offsets Policy*;

c. various monitoring, record keeping, reporting and auditing arrangements will be put in place during the Offset Improvement Period; and

d. following the Offset Improvement Period, the Offset Area will be maintained so as to retain the long term benefits of the Quality Improvements.

1. Interpretation

1.1. In this MOU, unless the contrary intention indicates otherwise a term in bold type has the meaning shown opposite it:

Additional Available Offset Area	means each of the areas shown as an additional available offset area in Part 2 of Schedule 1.
CHL Requirements	means the requirements of Division 3A of Part 15 of the EPBC Act and related regulations.
Commencement Date	means the date on which the last party signs this MOU.
Completion Ecological Survey	means the ecological survey to be undertaken under clause 11.
Core Offset Area	means the area shown as the core offset area in Part 2 of Schedule 1
Environment	means as the case requires, the Environment Minister, the Environment Department or an employee of the Environment Department.
Environment Department	means the Department responsible for the EPBC Act.
Environment Minister	means the Minister responsible for the EPBC Act.
Environmental Offsets Policy	means the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) Environmental Offsets Policy (2012).
EPBC Act	means the *Environment Protection and Biodiversity Conservation Act 1999.*
Initial Ecological Survey	means the ecological survey to be undertaken under clause 5.
Management Action	means the actions to be carried out on the Offset Area specified in the Offset Plan. A reference to a Management Action includes a reference to refraining from doing anything, whether or not that thing was being done beforehand.
Offset Objectives	means the objectives described in Part 1 of Schedule 2
Offset Area	means the Core Offset Area and any Additional Available Offset Area agreed to form part of the offset area as provided for in clause 4.

Offset Plan	means the offset plan to be developed and implemented under clause 7.
Offset Improvement Period	means the period commencing when the Offset Plan is approved and ending when the improvements provided for in the plan have been completed and all related monitoring, reporting and auditing requirements have been finalised.
Orchard Hills Site	means the land comprised in the titles listed in 1.1 of Part 1 of Schedule 1.
Quality Improvements	means the improvement in the Quality Score of the Offset Area delivered or to be delivered through implementation of the Offset Plan.
Quality Score	means the quality score of the Offset Area as measured under the offsets assessment guide that supports the Environmental Offsets Policy.
Relevant Biodiversity Value	the biodiversity values of the Offset Area that are required to be protected and improved under the Offset Plan for the purposes of the Airport Plan and BODP.

1.2. In this MOU, unless the contrary intention appears:

a. words in the singular include the plural and words in the plural include the singular;

b. clause headings are for convenient reference only and have no effect in limiting or extending the language of provisions to which they refer;

c. words importing a person include a partnership and a body whether corporate or otherwise;

d. if any word or phrase is given a defined meaning, any other part of speech or other grammatical form of that word or phrase has a corresponding meaning;

e. a reference to any statute or other legislation (whether primary or subordinate) is to a statute or other legislation of the Commonwealth as amended or replaced from time to time;

f. all references to dollars are to Australian dollars and this MOU uses Australian currency; and

g. a reference to writing is a reference to any representation of words, figures or symbols.

1.3. This MOU records the entire agreement between the parties in relation to its subject matter.

1.4. This MOU is not intended to create legally binding rights and obligations or to fetter the discretion of any Minister in right of the Commonwealth. However, the

parties will act and cooperate in good faith in accordance with the terms of this MOU as if they were separate legal entities.

2. Commencement and duration

2.1. This MOU commences on the Commencement Date.

2.2. This MOU will continue until the end of the Offset Improvement Period, unless it is terminated as provided for under clause 21 or 22.

2.3. Notwithstanding that the MOU has expired, Defence will, subject to clause 22, continue to comply with clauses 6 and 11.

3. Roles of Departments

Role of Environment

3.1. The Environment Minister or an SES Employee of the Environment Department is responsible for approving the BODP under the Airport Plan. Environment also administers the EPBC Act.

3.2. Nothing in this MOU is intended to limit or affect in any way any power, decision or discretion that Environment has under:

a. the EPBC Act;

b. the Airport Plan; or

c. any other legislation.

Role of Infrastructure

3.3. Infrastructure is, amongst other things, responsible for:

a. preparing and submitting the BODP to Environment for approval;

b. implementing the BODP once approved;

c. publishing the BODP;

d. arranging periodic audits of implementation of the BODP;

e. reviewing the BODP every 5 years to ensure it continues to meet the approval criteria set out in the Airport Plan; and

f. approving the Offset Plan.

Role of Defence

3.4. While this MOU provides for Defence to develop and implement an Offset Plan which is designed to meet certain requirements of the BODP, Infrastructure acknowledges that Defence does not have any direct statutory or other obligations under the Airport Plan or the BODP.

Administrative Arrangements Orders

3.5. If a Department that is a party to this MOU is abolished, changes its name or its functions so they no longer include the subject matter of this MOU as it relates

to that Department, the Department that is responsible for the relevant matter at the relevant time will be taken to be the party to this MOU.

4. Identifying the Offset Area

4.1. The Offset Area will include the Core Offset Area. The Core Offset Area is not less than 900 hectares.

4.2. The parties will discuss the potential to include any of the Additional Available Offset Area in the Offset Area. If any areas from the Additional Available Offset Area are agreed to form part of the Offset Area, the parties will each agree to this in writing.

4.3. Defence will arrange for a boundary survey of the Offset Area to confirm the detailed boundary alignment and will provide the survey to Infrastructure.

4.4. If following completion of the boundary survey or the Offset Plan, the parties consider that further parts of the Additional Available Offset Area could become part of the Offset Area, they will discuss arrangements for this to occur including any necessary ecological surveys, amendments to the Offset Plan and any necessary funding arrangements.

5. Initial Ecological Survey and shapefiles

5.1. The parties acknowledge that Infrastructure in consultation with Defence has undertaken preliminary ecological survey work of the Offset Area.

5.2. In order to support development of the Offset Plan and quantify the value of the Offset Area for the BODP, Infrastructure, in consultation with Defence and Environment, will at its cost arrange for a biodiversity assessment report ('**Initial Ecological Survey**') to be prepared by a suitably qualified ecologist (and independently verified) that:

a. demonstrates that the Offset Area would help deliver an overall conservation outcome that improves or maintains the viability of the EPBC Act protected matters consistent with the Environmental Offsets Policy and the protected matters under relevant NSW legislation as required by the BODP;

b. has had regard to the key diagnostic characteristics and condition thresholds specified in the Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (Threatened Species Scientific Committee 2008); and

c. identifies the equivalent biodiversity credits that would help to offset the impacts of the development of Stage 1 of WSA on biodiversity, determined in accordance with the Airport Plan conditions and relevant policies.

5.3. Infrastructure will also arrange for Shapefiles as required by Condition 30(9) of the Airport Plan to be prepared in relation to the Offset Area and provided to Environment in accordance with the BODP.

5.4. Infrastructure will provide copies of the Initial Ecological Survey and the shapefiles to Defence.

5.5. Defence will facilitate access to the Offset Area in accordance with clause 14 and relevant Defence personnel will assist with the conduct of the Initial Ecological Survey.

6. Requirements for conservation of the Offset Area

6.1. The parties acknowledge that Defence has obligations in relation to the use and management of the Offset Area, including its conservation during and beyond the Offset Improvement Period, in accordance with the requirements and protections specified in the EPBC Act including Parts 3, 13 and 15 (where applicable) of the EPBC Act.

6.2. Where Defence grants any third party an interest in the Orchard Hills Site, such interest will only be granted on terms not inconsistent with the BODP and Defence's obligations under this MOU.

7. Offset Plan

7.1. Defence will prepare the Offset Plan in accordance with clause 7.2.

7.2. The Offset Plan referred to in clause 7.1 must:

a. be based on the Initial Ecological Survey;

b. identify the Relevant Biodiversity Values of the Offset Area;

c. describe how Defence will:

i. achieve the objectives of the BODP, and the objectives specified in Schedule 2, in respect of the Offset Area; and

ii. carry out monitoring, record keeping, reporting and auditing of the Offset Plan in a manner which will enable Infrastructure to comply with its requirements under the Airport Plan in respect of the Offset Area (including at a minimum the matters set out in BODP);

d. describe how Defence will manage the Offset Area after the Offset Improvement Period in accordance with the objectives of the BODP to achieve the requirements of clause 11.

7.3. The Offset Plan will be prepared in consultation with Environment and Infrastructure, including provision of drafts of the Offset Plan for comment.

7.4. Within 18 months of the approval of the BODP, Defence will submit a final draft of the Offset Plan to Infrastructure for its approval.

8. Review and Update of the Offset Plan if required

8.1. Defence will review and update the Offset Plan every 5 years to ensure that it remains appropriate for the protection and improvement of the Relevant Biodiversity Values of the Offset Area.

8.2. In addition, the Offset Plan will be reviewed and updated in response to any recommendations arising from audits and reporting undertaken under clause 13.

8.3. Any substantive update or variation to the Offset Plan will:

a. be undertaken in consultation with Infrastructure and Environment;

b. be approved by Infrastructure;

c. unless otherwise agreed by Infrastructure, remain consistent with Schedule 2 and the BODP; and

d. will remain consistent with the budget referred to in clause 12.

8.4. The parties acknowledge that subject to clause 8.3, Defence will have full discretion in proposing updates to the Offset Plan.

9. Offset Plan to be complied with

9.1. Defence will:

a. implement or procure the implementation of; and

b. comply or procure compliance with,

the Offset Plan.

9.2. Until an Offset Plan is in place for the Offset Area, Defence will implement reasonably practicable precautions designed to maintain those biodiversity values of the Core Offset Area as are expected to be Relevant Biodiversity Values.

10. Commonwealth Heritage Listing

Consistency

10.1. The parties acknowledge that a portion of the Orchard Hills Site is subject to CHL Requirements and Defence has existing statutory obligations under the CHL Requirements.

10.2. To the extent that there is any inconsistency between this MOU and the CHL Requirements that cannot be reconciled by complying with both requirements, the CHL Requirements will prevail.

11. Arrangements following implementation of Offset Plan

11.1. When Defence considers that the Objectives have been met, it will arrange for a biodiversity assessment using equivalent parameters to the Initial Ecological Survey to demonstrate that Offset Objectives have been met (**Completion Ecological Survey**). Defence will provide a copy of this survey to Infrastructure.

11.2. Once the Offset Objectives have been met, Defence will continue to manage the Offset Area so as to maintain the long term benefits of the Quality

Improvements achieved at the completion of the Offset Plan as demonstrated in the Completion Ecological Survey.

11.3. For the avoidance of doubt, the cost of maintenance of the Quality Improvements is to be met by Defence.

12. Financial arrangements

Budget

12.1. The parties have developed a budget for development and implementation of the Offset Plan taking into account the following costs expected to be incurred by Defence ('**Offset Costs'**):

a. the cost of preliminary activities such as the boundary survey referred to in clause 4.3;

b. the cost of developing the Offset Plan, and reviewing it every 5 years;

c. the cost of implementing the Offset Plan (including without limitation capital costs such as fencing and machinery) to the extent that it provides for Management Actions or other requirements that are additional to existing management measures on the Offset Area as at the Commencement Date;

d. costs associated with monitoring, reporting and audit during and at completion of the Offset Improvement Period;

e. costs associated with the Completion Ecological Survey;

f. costs associated with managing access arrangements to the Offset Site for this MOU including development and implementation of the Offset Plan; and

g. Defence administrative costs associated with the above.

12.2. The budget has been calculated to take account of contingencies and cost escalations over a notional period of 20 years, anticipated to be the maximum period required to achieve the Objectives in the Offset Area.

Costs for FY 18/19

12.3. Infrastructure will reimburse Defence for Offset Costs to be incurred in Financial Year 2018/19 up to s. 47(1)(b) including/excluding GST]. Where practical, Defence may invoice Infrastructure for identified Offset Costs before they are incurred.

Costs for FY 19/20 and beyond

12.4. The parties intend that Infrastructure, in consultation with Defence, will develop a New Policy Proposal that, if approved, will result in Defence being appropriated an amount of s. 47(1)(b) including/excluding GST] to meet the Offset Costs for the period from 1 July 2019.

12.5. The parties agree that Defence's obligations (other than those funded under clause 12.3) under this MOU are conditional on the arrangements in clause

12.4 being implemented or an alternative arrangement satisfactory to both parties being put in place.

13. Monitoring, record keeping, reporting and auditing

13.1. Unless otherwise specified in this MOU, the monitoring, record keeping, reporting and auditing requirements will be set out in the Offset Plan and be designed to support Airport Plan and BODP requirements.

13.2. An annual report will be prepared in sufficient time to allow Infrastructure to prepare the annual report it is required to complete under the Airport Plan. The annual report will:

a. contain the results of monitoring, inspections, audits and other relevant requirements set out in the Offset Plan; and

b. assess the Offset Plan's ability to meet the requirements of Infrastructure's BODP.

13.3. Within three (3) months of each annual report being concluded, Infrastructure will:

a. advise Defence that it is satisfied with the progress of the Offset Plan against its BODP, or

b. advise Defence in writing of any deficiencies in the Offset Plan, together with a recommended plan for rectification.

14. Access, Safety and Security

14.1. The Offset Area is land on which military activities take place and Infrastructure acknowledges that:

a. the Offset Area includes an Explosive Ordnance Depot declared under Defence (Declared Explosive Ordnance) Instrument 2012 under subsection 71L(2) of the *Defence Act 1903*;

b. due to unexploded ordnance's inherently hazardous nature, all lands controlled by Defence that are associated with unexploded ordnance are managed so as to restrict public access;

c. public access is not permitted to the Offset Area;

d. Defence is permitted to access the Offset Area at any time itself and through its contractors (including subcontractors of any tier), servants and agents;

e. no other access is permitted to the Offset Area without prior approval of Defence, which may be given or withheld in Defence's absolute discretion having regard to Defence requirements; and

f. any access to the Offset Area is subject at all times to compliance with any conditions imposed from time to time by Defence including with respect to

safety and security and will be along permitted access routes as Defence specifies from time to time.

14.2. Subject to this clause:

a. the parties acknowledge that Infrastructure and its consultants will require access to the Offset Site from time to time for the purpose of observing the site, monitoring or conducting or verifying the Initial Ecological Survey mentioned in clause 5;

b. Infrastructure will provide at least 3 weeks' notice of any access requirement, the identity of the person(s) proposed to access and the nature and purpose of the access;

c. Defence will consider the request and where possible provide access as requested; and

d. If access cannot be provided due to Defence requirements, the parties will consult in order to agree alternative arrangements, such as an alternative time or date for access.

14.3. Infrastructure may propose to Defence other offset measures for the BODP that could be conducted at the Offset Site such as research. If Defence agrees to such a proposal, the parties will discuss the appropriate arrangements including work program, access requirements and insurance obligations.

15. Permits and approvals

15.1. Defence, or as relevant, its contractors (including subcontractors of any tier), servants and agents are responsible for obtaining all necessary licences, consents, authorisations, permits or approvals in order to implement the Offset Plan.

15.2. Where circumstances require, Infrastructure will provide assistance, information and assurances as necessary for Defence to obtain the necessary licences, consents, authorisations, permits or approvals required to implement this MOU.

16. Governance and cooperation

16.1. Defence and Infrastructure will form a working group that will meet at least quarterly or more frequently as required until the Offset Plan is in place and will continue to meet at least annually after the Offset Plan is in place to review annual reporting on progress against the Offset Plan.

16.2. Defence and Infrastructure will invite Environment to participate in such meetings as part of consultation for the Offset Plan if Environment wishes to do so.

16.3. Defence and Infrastructure will work together to identify complementary outcomes that can be achieved through development and implementation of the Offset Plan including Indigenous and local employment and potential collaboration with other complementary measures being pursued through the BODP.

17. Publication of Documents

17.1. The Parties agree that the following documents will be made available to the public, in each case with appropriate edits to remove information not appropriate for communication to the public (for example for Defence operational, safety and security reasons):

a. the finalised Offset Plan;

b. the annual report provide for in clause 13 and

c. documents required to be published under the Airport Plan or BODP.

17.2. If a party proposes to disclose the terms of this MOU to a person outside of the Commonwealth of Australia, it will obtain the agreement of the other party prior to doing so.

17.3. If a party is required to disclose the terms of this MOU to a person outside of the Commonwealth of Australia, it will, to the extent possible, notify the other party prior to doing so.

18. Notices

18.1. Unless otherwise notified by a party, notices under this MOU may be provided as follows:

Department of Defence:

[insert details]

Department of Infrastructure, Regional Development and Cities

[Insert detail]

19. Limitation of Claims

19.1. The parties acknowledge that Infrastructure has undertaken its own assessment of the Orchard Hills Site and is satisfied that the Offset Area is suitable to meet the objectives of the BODP and the Offset Plan.

20. Damage or destruction of the Offset Site

20.1. This clause applies if:

a. the whole or any part of the Offset Area is destroyed or substantially damaged such that its Relevant Biodiversity Values are destroyed or materially reduced; or

b. infrastructure constructed to implement the Offset Plan ('**Offset Infrastructure'**) is damaged or destroyed,

('**Damage'**).

20.2. Defence and Infrastructure will consider and assess the impacts on the Offset Area and determine any necessary work to reinstate the Relevant Biodiversity Values of the Offset Area or the Offset Infrastructure (**Reinstatement Work**);

20.3. If:

a. Defence and Infrastructure are unable to agree for the purposes of clause 20.2; or

b. Consider that there is insufficient information to proceed under clause 20.2,

Defence and Infrastructure will jointly engage an independent expert to assess the impacts on the Relevant Biodiversity Values of the Offset Area or the Offset Infrastructure and determine the Reinstatement Work.

20.4. If the parties agree that Reinstatement Work should proceed, Defence will carry out the Reinstatement Work.

20.5. If the parties determine that Reinstatement Work is not practical or appropriate, they will work together to consider alternative arrangements including, for example, access to other parts of the Orchard Hills Site.

Funding for Reinstatement Work or alternative sites

20.6. The parties acknowledge that decisions regarding Reinstatement Work or alternative offset sites will require consideration of funding arrangements. Sources of funding are expected to be:

a. amounts remaining in the funds appropriated to Defence as anticipated in clause 12;

b. amounts available through Comcover or third party claims in accordance with clause 20.8;

c. other amounts which the parties have available to support Reinstatement.

20.7. If necessary, the parties will work cooperatively to develop any submission to Government required to obtain funding for Reinstatement Work or alternative offset sites that cannot be addressed through available funding.

Comcover and other claims

20.8. The parties acknowledge that the Offset Site is intended to be covered through Comcover arrangements (or any successor Commonwealth insurance equivalent arrangements). If Damage occurs:

a. Defence will submit any available Comcover claims in relation to the Damage;

b. if Defence or Infrastructure has an available claim against a third party such as a contractor in relation to the Damage that has a reasonable prospect of success, they will make that claim; and

the proceeds of Comcover claims or third party claims will be made available for the purposes of agreed Reinstatement Works or alternative offset sites.

21. Termination and variation of the MOU

21.1. Subject to clause 22, the MOU may only be terminated or varied by the agreement of both parties.

22. Government Decisions

22.1. Infrastructure and Defence acknowledge that their compliance with the requirements of this MOU is subject to Australian Government decisions.

22.2. In the event that the Australian Government were to consider an alternative use for the Offset Area which is inconsistent with this MOU, the parties recognise that:

a. this MOU may need to be terminated or varied; and

b. submissions to Government would need to address the question of funding and responsibility for alternative offset arrangements for Stage 1 of the WSA Development should this be required.

23. Dispute resolution

23.1. If a dispute arises between Defence and Infrastructure in relation to this agreement:

a. representatives of Defence and Infrastructure will meet to seek to agree on a resolution of the dispute; and

b. if the parties' representatives do not reach agreement under paragraph a , then the matter will be referred to more senior decision makers within Defence and Infrastructure to endeavour to reach agreement.

Defence signature block to be inserted

Signature of Witness	**Signature of Delegate**
Print Name and Address of Witness	**Print Name of Delegate**
Date signed:	

Infrastructure signature block to be inserted

Signature of Witness	**Signature of Delegate**
Print Name and Address of Witness	**Print Name of Delegate**
Date signed:	

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DRAFT Provided to Department of Environment and Energy 31 July 2018

SCHEDULE 1 ORCHARD HILLS SITE AND OFFSET AREA

1. Land comprising the Orchard Hills Site

1.1. The Orchard Hills Site includes all the land forming part of Defence Establishment Orchard Hills, currently comprised of the following titles:

List of titles comprising the Orchard Hills Site	
Lot	**Deposited Plan**
1	238092
2	238092
3	238092
4	238092
9	238092
1	242968
2	242968
3	242968
4	242968
5	242968
6	242968
7	242968
8	242968
9	242968
10	242968
11	242968
12	242968
13	242968
14	242968
15	242968
16	242968
17	242968
6	578629
1	586093
2	586093
2	589479
11	598345
1	629326
1	819324

1.2. The location of the titles listed in Item 1.1 which comprise the Orchard Hills Site is shown in Map A below:

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DRAFT Provided to Department of Environment and Energy 31 July 2018

Map A: Titles comprising the Orchard Hills Site

2. Land comprising the Core Offset Area and the Additional Available Offset Areas

2.1. The Core Offset Area and the Additional Available Offset Areas are shown in Map B below:

SCHEDULE 2 OFFSET PLAN OBJECTIVES AND POTENTIAL MANAGEMENT ACTIONS

1. Offset Plan Objectives

1.1. The objectives for the purposes of clause 7.2.c.i are to improve the quality of habitat for the affected threatened biota and plants, animals and their habitat in the Offset Area in order to help meet the requirements of the BODP. Specifically the Offset Plan Management Actions must achieve the following objectives:

a. a 'Future quality with offset' score (for the purpose of the Offset Assessment Guide issues by Environment) that is two greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of Cumberland Plain Woodland in the Offset Area;

b. for the Swift Parrot and Grey-headed Flying-fox in the Offset Area; and

c. a 'Future quality with offset' score, as per the Offsets Assessment Guide under the EPBC Act Environmental Offsets Policy, for the area of poorer quality Cumberland Plain Woodland in the Offset Area that is at least:

i. as high as the quality score for the Cumberland Plain Woodland in the Stage 1 Construction Impact Zone (6 out of 10); and

ii. two greater than the 'Start quality' score that is defined in the Initial Ecological Survey for the area of poorer quality Cumberland Plain Woodland in the Offset Area.

2. Offset Plan Potential Management Actions

2.1. The relevant Management Actions will be set out in the Offset Plan. Defence will take an adaptive management approach in the Offset Plan and to the best of its ability, use actions such as the examples listed below to achieve the best outcome:

a. retention of regrowth and remnant native vegetation and habitat resources such as dead timber and rocks;

b. supplementation of habitat resources in revegetated and naturally regenerating areas. This will focus on provision of natural fallen timber, nesting hollows and other elements that will not naturally regenerate for very long time periods except in areas with mature old growth canopies;

c. management of human disturbance and exclusion of land uses that are inconsistent with biodiversity conservation (but noting the intention that the Orchard Hills Site continue to be used for Defence purposes as described in the Context);

d. management of light pollution from roads and facilities and its impacts on nocturnal fauna;

e. maintenance of fences, gates, signs and access tracks;

f. remediation of contaminated sites;

g. weed control including treatment of: patches of Blackberry, African Lovegrass and other exotic grasses in open areas; Juncus acutus in wetlands and drainage lines; African Olive and other noxious and environmental weeds in woodland and forest;

h. revegetation or supplementary planting where natural regeneration will not be sufficient to achieve management outcomes including areas of exotic grassland, bare earth or imported fill. Some areas would be maintained as native grassland to maintain the diversity of habitat types and to help maximise native plant species richness;

i. reintroduction of locally extinct native fauna that performed important ecosystem roles in natural communities of the Cumberland Plain such as bettongs and bandicoots, or threatened species that naturally form part of Cumberland Plain communities such as the koala;

j. management of fire for conservation with consideration of existing fire management plans and the need to maintain the diversity of habitat types and meet Defence operational and safety requirements;

k. mechanical removal of Native Blackthorn scrub to help restore a natural vegetation structure and native groundcover diversity in areas where it would not be possible to use fire to achieve this aim given the risk of damaging wildfire;

l. erosion remediation and control;

m. removal of barriers and reinstatement of natural flows in drainage lines (where consistent with track maintenance and other Defence activities);

n. feral cat and fox control and exclusion and control of feral herbivores such as rabbits and deer, coordinated with existing control programs in the locality;

o. management of over-abundant native herbivores (kangaroos and wallabies) with consideration of existing monitoring and control programs;

p. ongoing support for research programs and experimental ecosystem restoration projects at the Orchard Hills Site in support of achieving and improving the required offset outcomes. This would include testing and optimising reintroductions, nutrient cycling, revegetation techniques, soil rehabilitation, dieback treatments and habitat supplementation actions.

The parties acknowledge that the Offset Plan will take account of Defence safety and security requirements including the matters referred to in clause 14 and recognise the status of the Offset Site referred to in Recital E in relation to how and where the Management Actions are undertaken.

Robin Nielsen

From: s. 47F(1) @infrastructure.gov.au>
Sent: Wednesday, 15 August 2018 6:28 PM
To: Manning, Gregory
Cc: TAYLOR Garth; s. 47F(1)
Subject: For your attention - submission of Biodiversity Offset Delivery Plan for approval [DLM=For-Official-Use-Only]
Attachments: WSA BODP Submission Letter.pdf

Follow Up Flag: Flag for follow up
Flag Status: Flagged

Dear Greg,

On behalf of Garth Taylor, General Manager, Environment, Communications, Legal, please find attached correspondence notifying that the Infrastructure Department has submitted for approval a Biodiversity Offset Delivery Plan in accordance with Condition 30 of the Airport Plan for Western Sydney Airport.

The Biodiversity Offset Delivery Plan has been uploaded to our Department's secure file transfer website (accounting for the size of the document), which can be accessed via https://sft.infrastructure.gov.au and by entering the username and password below. The Biodiversity Offset Delivery Plan can be found in the folder labelled "Submitted Biodiversity Offset Delivery Plan".

WSUEnvironmentDOE	NrKRw5ru

If you have any queries in relation to the attached correspondence, please do not hesitate to contact me.

Thank you

Kind regards,

s. 47F(1)

Director – Environmental Conditions and Approvals Section
Communication, Environment and Legal Branch
Western Sydney Unit
Department of Infrastructure and Regional Development

s. 47F(1)

@infrastructure.gov.au

Disclaimer

Australian Government
Department of Infrastructure, Regional Development and Cities

Mr Greg Manning
Assistant Secretary
Assessments and Post Approvals
Department of the Environment and Energy
By email

Dear Mr ~~Manning~~ Greg

Western Sydney Airport Biodiversity Offset Delivery Plan submission

I am pleased to submit for approval a Biodiversity Offset Delivery Plan in accordance with Condition 30 of the Airport Plan for Western Sydney Airport. I acknowledge the work between our teams and the input provided by the Environment Department over the past four months in regards to the Infrastructure Department meeting all relevant Airport Plan requirements for developing a Biodiversity Offset Delivery Plan.

We look forward to working closely with Environment when reporting on implementation of the Biodiversity Offset Delivery Plan. Condition 39(3) of the Airport Plan requires the Infrastructure Department to report to the Environment Department every 12 months on the implementation of the BODP. We will also submit reports to Environment on the outcomes of regular independent audits to be carried out on the implementation of the Biodiversity Offset Delivery Plan, as required by Airport Plan Condition 30(11).

Consistent with Condition 42 of the Airport Plan, the Infrastructure Department will publish the Biodiversity Offset Delivery Plan on its website within one month of its approval.

If you have any queries in relation to this letter, please contact s. 47F(1) Director, Environmental Conditions and Approvals Section, by email to s. 47F(1)

Yours sincerely

Garth Taylor
General Manager, Environment, Communications, Legal
Western Sydney Unit
Department of Infrastructure, Regional Development and Cities

15 August 2018

From: s. 47F(1)
To: Manning, Gregory
Cc: s. 47F(1)
Subject: FW: Biodiversity Offsets Delivery Plan (BODP)- Western Sydney Airport [DLM=For-Official-Use-Only]
Date: Wednesday, 12 September 2018 10:16:52 AM
Attachments: Federal Labor - Election Commitment 2007.pdf
Federal Coalition Election Commitment 2007 - CCC.pdf
Importance: High

Hi Greg
It's useful that Garth has made us aware of this information, however nothing we need to engage with at this stage. A simple 'thanks, much appreciated' type response is all that is required if anything at all.
I expect it would be unlikely that Minister Price would receive representations/correspondence about this issue in the first instance – noting we did flag in our note to the MO just before the BODP was approved that while it was unlikely to generate much community interest, members of the BEG had previously raised particular preferences for offsets.
Cheers
s. 47F(1)

From: TAYLOR Garth [mailto:Garth.Taylor@infrastructure.gov.au]
Sent: Tuesday, 11 September 2018 8:00 PM
To: Manning, Gregory ; Farrant, Kim
Cc: s. 47F(1)
Subject: FW: Biodiversity Offsets Delivery Plan (BODP)- Western Sydney Airport [DLM=For-Official-Use-Only]
Importance: High

Greg and Kim
You should be aware of this email (attached).
s. 47F(1) was one of the BEG members and is obviously keen for the airport's offset program to invest in s. 47F(1) preferred Shanes Park rewilding project. We have no fixed view on whether the Shanes Park rewilding initiative is justified from an ecological or value for money perspective – that will be a matter for procurements to commence next year.
Just a few points on the email:

- The BODP proposes a significant investment to restore and improve the biodiversity values of the Orchard Hills facility – the election commitments attached to s. 47F(1) email are valid but are unrelated to such restoration activity.

- Shanes Park itself is also a conserved land parcel and registered as an offset – s. 47F(1) 'rewilding' proposal is in conservation terms almost precisely the same as that for Orchard Hills.

- Therefore, it appears that s. 47F(1) approves of the methodology (i.e. restoration or rewilding) but not the funding amount.

- For our (Infrastructure Department's) part, any funding has to represent both the like-for-like or additional offset outcomes and value for money, among other procurement criteria. Orchard Hills sits as an east-west land bridge between two north-south biodiversity corridors (namely OEH's priority conservation lands and the Cumberland Conservation Corridor) and it is, as s. 47F(1) notes, the largest such remnant of this type of woodland – this represents an excellent ecological and financial outcome.

- As a value for money comparison, the restoration activity at Orchard Hills will improve, over 20 years, more than 900 hectares of woodland at a cost of around $70 million. As an example of an alternative use of that funding, developer Mirvac recently purchased 54 hectares for $71 million in the vicinity of Western Sydney Airport. The investment in restoration at Orchard Hills therefore has a much greater multiplier and in a strategically important ecological corridor.

- Lastly, the Defence-Infrastructure MOU that underpins the Orchard Hills offset does refer to the potential for research on the Orchard Hills site in addition to the restoration activities. This MOU is intended to remain confidential between the parties; however, the Offset Plan to be delivered (by Defence to Infrastructure) within 18 months of the BODP approval is intended to be published, and will contain all agreed offset measures.

Kind regards

Garth Taylor
General Manager | Communications, Environment, Legal
Western Sydney Unit
t 02 6274 6510
w www.westernsydneyairport.gov.au | **w** www.infrastructure.gov.au

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

s. 22(1)(a)(ii)

From: Manning, Gregory
Sent: Wednesday, 22 August 2018 2:14 PM
To: s. 47F(1) @environment.gov.au>;s. 47F(1) <s. 47F(1) @environment.gov.au>
Cc: Swirepik, Jody <Jody.Swirepik@environment.gov.au>; Tregurtha, James <James.Tregurtha@environment.gov.au>;s. 47F(1) @environment.gov.au>; s. 47F(1) <s. 47F(1) @environment.gov.au>; Farrant, Kim <Kim.Farrant@environment.gov.au>; s. 47F(1) <s. 47F(1) @environment.gov.au>
Subject: Approval of the Western Sydney Airport Biodiversity Offset Delivery Plan [DLM=For-Official-Use-Only]

Hi s. 47F(1)

Re: Notification of intention to approve the Biodiversity Offset Delivery Plan for the Western Sydney Airport

Just wanted to let you know that on Friday this week I am intending to approve the Biodiversity Offset Delivery Plan associated with DIRDC's development of the Western Sydney Airport. The project has a high profile amongst affected Commonwealth Departments including PMC, DIRDC and Defence so I wanted to give you visibility.

Background

- The Airport Plan, prepared under the *Airports Act 1996*, is the authorising document for the development of the airport and contains specified conditions for the protection of the environment.
- Condition 30 of the Airport Plan requires the Infrastructure Department to prepare and submit to an Approver a Biodiversity Offset Delivery Plan in relation to impacts on protected matters under the *Environment Protection and Biodiversity Conservation Act* (EPBC Act).
- The Airport Plan identifies the 'Environment Minister or an SES employee of the Environment Department' as the Approver for the Biodiversity Offset Delivery Plan.
- The Airport Plan also requires that the Biodiversity Offset Delivery Plan has taken into account relevant sections of the Environment Impact Statement and consistent with the EPBC Act Offsets Policy.

Issues

- The Biodiversity Offset delivery Plan sets out the approach to offsetting impacts of the Western Sydney Airport to protected matters under the EPBC Act.
- Development of the Western Sydney Airport will impact on several protected matters, including critically endangered Cumberland Plains Woodland (141 ha), foraging habitat for the vulnerable Grey-headed Flying-fox (187.8 ha) and endangered Swift Parrot, and the endangered Spiked Rice-flower.
- Direct offsets to be delivered through the purchase of biodiversity credits under the NSW offsetting scheme, strategic land acquisition and restoration and rewilding programs will meet varying proportions of offsetting obligations for these protected matters.
- The bulk of the offset however will be secured via a large parcel of land (minimum of 900 ha) at Defence Establishment Orchard Hills, close to the Airport site and within the Cumberland conservation corridor.

- The Orchard Hills offset site will be conserved and managed through a Memorandum of Understanding (MoU) between the Infrastructure and Defence Departments. As Commonwealth land the site is unable to be legally secured through the commonly used state-based mechanisms, however the site has enduring protection through provisions of the EPBC Act including a Commonwealth heritage listing over area.
- The Biodiversity Offset Delivery Plan and MoU provide for the conservation of at least 900 ha of land, with significant funding to be provided by Defence to deliver measurable improvements to the biodiversity values at the site. The MoU also includes a commitment that the Defence and Infrastructure Departments will work together to undertake necessary action in the event of damage or destruction to the site.
- I am comfortable that the suite of proposed direct offsets has given due consideration to the Environmental Impact Statement and the EPBC Offsets Policy. The Biodiversity Offset Delivery Plan also proposes a range of other compensatory measures that will also benefit the protected matters.
- The Department is unaware of any recent community or political concern regarding the Western Sydney Airport and impacts to matters protected by the EPBC Act. Previously, two members of the Biodiversity Expert Group (for the Western Sydney Airport development) raised concerns with aspects of the offsets plan, particularly that securing Orchard Hills as an offset site would not deliver additional environmental benefits beyond the status quo.

Handling

- The Department committed to notifying the Infrastructure Department of a decision regarding approval of the Biodiversity Offset Delivery Plan by 24 August 2018 - 3 months from the date of submission of the complete draft plan and ahead of commencement of clearing.
- Once approved, the Infrastructure Department may plan an announcement associated with the plan and commencement of activity at the site. The Department will continue to work with Infrastructure as appropriate and update the Office of any planned events.