Attachment 8B – Terrestrial Flora and Fauna Survey

Works Approval Application

Fulton Hogan Construction PTY LTD

25 FEBRUARY 2025

→ **The Power of Commitment**

Technical Memorandum

24 September 2021

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Copy to	[redacted]	**Email**	[redacted]
From	[redacted]	**Ref. No.**	12525136
Subject	Flora and Fauna Survey – Enabling Works Areas		
Reference	R8129_CKIAF_SWD_EN_MM_CD_3006		

1 Introduction

1.1 Background

The Department of Defence is proposing to upgrade the Cocos (Keeling) Islands (CKI) airfield. The airfield is a Commonwealth of Australia asset falling under the jurisdiction of the Department of Infrastructure, Transport, Regional Development and Communications and managed by Toll Remote Logistics Pty Ltd. Upgrades to the CKI airfield are required to enable the Royal Australian Air Force to support P-8A Poseidon capability on the runway, reduce the safety risks associated with operating Code D aircraft on the airfield and address non-compliances identified by the Civil Aviation Safety Authority. To support the delivery of the CKI airfield upgrade works, enabling infrastructure is also required.

1.2 Scope of works and purpose of this memorandum

GHD Pty Ltd (GHD) was engaged by Fulton Hogan Construction Pty Ltd (Fulton Hogan) to conduct an inspection of the enabling infrastructure land-based work areas (as advised by Fulton Hogan) to provide information on the existing terrestrial flora and fauna values present. This memorandum provides a summary of the methods and results from the inspections completed during site visits conducted in September 2020 and June 2021.

1.3 Investigation areas

The investigation areas for the inspections are located on West Island and included:

- Quarantine (Q) Station – two adjacent lots located along Sydney Highway, approximately 1 km northwest from the CKI Airport, referred to as Q Station.
- Rumah Baru – areas adjacent to the existing port facilities office, the Stilling Basin, public boat ramp and adjacent beach areas. Also included are proposed access roads between the Materials Offloading Facility (MOF) and Stilling Basin, and between the Stilling Basin and Rumah Baru Road.
- Mahoon Road – Mahoon Road and adjacent beach/foreshore areas.
- Access tracks – four access track options connecting Sydney Highway to the north end of the CKI airfield.
- Laydown areas including two laydown areas adjacent to the CKI airfield.

The project locality and investigation areas are shown in Figures 1 to 7, Attachment 1.

1.4 Limitations and assumptions

This memorandum has been prepared by GHD for Fulton Hogan and may only be used and relied on by Fulton Hogan for the purpose agreed between GHD and Fulton Hogan as set out in Section 1.2 of this memorandum.

GHD otherwise disclaims responsibility to any person other than Fulton Hogan arising in connection with this memorandum. GHD also excludes implied warranties and conditions, to the extent legally permissible. The services undertaken by GHD in connection with preparing this memorandum were limited to those specifically detailed in the memorandum and are subject to the scope limitations set out in the memorandum.

The opinions, conclusions and any recommendations in this memorandum are based on conditions encountered and information reviewed at the date of preparation of the memorandum. GHD has no responsibility or obligation to update this memorandum to account for events or changes occurring subsequent to the date that the memorandum was prepared. The opinions, conclusions and any recommendations in this memorandum are based on assumptions made by GHD described in this memorandum. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this memorandum on the basis of information provided by Fulton Hogan 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 memorandum which were caused by errors or omissions in that information.

2. Methodology

2.1 Desktop assessment

Prior to each site visit a desktop assessment was undertaken to identify relevant flora and fauna information pertaining to the investigation areas. The desktop assessment involved a review of:

- Previous reports relevant to the investigation areas including:
  - Cocos (Keeling) Islands Airport Runway Refurbishment Project flora, avifauna and intertidal fauna assessment (GHD 2009)
  - Cocos (Keeling) Islands Airfield Upgrade Environmental Report (AECOM 2019)
- The Commonwealth Department of Agriculture, Water and the Environment (DAWE) Protected Matters Search Tool (PMST) to identify communities and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within the investigation areas (DAWE 2020a).
- The Department of Biodiversity, Conservation and Attractions (DBCA) *NatureMap* database for Threatened and Priority Ecological Communities (TECs and PECs) and flora and fauna species (including those listed under the Western Australian (WA) *Biodiversity Conservation Act 2016* (BC Act) or as a Priority by the DBCA) previously recorded from the investigation areas (DBCA 2007–).

2.2 Field survey

GHD senior ecologist Jordan Tindiglia (Flora collection licence: FB62000201) completed surveys of the investigation areas on 8-11 September 2020 and 19-22 June 2021. The surveys were undertaken to identify and describe the dominant vegetation types, fauna habitats and their condition. Inventories of vascular flora and terrestrial vertebrate fauna species were also recorded at the time of survey.

The survey methodology employed by GHD was undertaken with reference to the WA Environmental Protection Authority (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) and *Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2020).

2.2.1 Vegetation and flora

Field survey methods involved traversing the inspection areas by foot and recording vegetation type and condition as well as taking representative photographs. Vegetation types were identified and boundaries delineated using field data/observations and confirmed by viewing aerial imagery. The vegetation condition was assessed and mapped in accordance with the vegetation condition rating scale for the Eremaean and Northern Botanical Provinces (EPA 2016). A flora inventory was compiled from opportunistic records made throughout the investigation areas. Species were identified in the field and by the use of taxonomic literature and online electronic databases. The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium 1998–) and the EPBC Act Threatened species database provided by DAWE (2020b). Nomenclature used in this report follows that used by the WA Herbarium as reported on *FloraBase*.

2.2.2 Fauna

Field survey methods involved traversing the survey area by foot and recording fauna habitat types as well as taking representative photographs. A fauna inventory was compiled from opportunistic records made throughout the investigation areas. This included fauna observed, heard and noted from secondary evidence such as tracks, scats etc. Identification of fauna species was made in the field using available field guides and electronic guides (e.g. Morcombe 2004). Nomenclature used in this report follows that used by the WA Museum and the DBCA *NatureMap* database (DBCA 2007–) with the exception of birds, whereby Christidis and Boles (2008) was used.

3. Results

3.1 Q Station

3.1.1 Site description

Q Station is situated between Sydney Highway and the coastline along the west side of West Island. Overall, the investigation area at Q Station was relatively flat, however, the southwest corner sloped towards the west and was partially inundated (assumed tidal influence) at the time of survey (September 2020) (Plate 1). The majority of the Q Station investigation area was surrounded by cyclone fencing, but, access to the area was available via open gates.

Plate 1 ***Q-Station investigation area, southwest corner partially inundated and eastern boundary with fencing.***

3.1.2 Vegetation types and condition

The majority of the Q Station investigation area has been historically cleared and therefore is considered highly modified with very little vegetation remaining. Two vegetation types were recorded at the Q Station

investigation area including grasslands and mixed trees (Table 1). The majority of the area comprised grasslands and herbfields, mostly of introduced origin. The mixed trees comprised sparsely spread *Cocos nucifera* and isolated clumps/stands of *Guettarda speciosa* and *Morinda citrifolia*; occasionally shrubs of *Scaevola taccada* were also present. The most significant vegetation is found on the fence line northwest corner of the southern lot. This vegetation includes a clump of *Casuarina equisetifolia* var. *incana* (Beach sheoak) which is part of the littoral zone near the beach, and the Beach sheoaks are examples of uncommon species on West Island (Plate 2). Further south on the fence line are more examples of littoral vegetation, including a couple of large trees of *Hernandia nymphaeifolia*.

The vegetation condition at the Q Station investigation area was rated Degraded to Completed Degraded. The area has been historically cleared and is described as parkland cleared. Where native species are present, the vegetation structure has been severely impacted. A number of weed species are also present throughout the area.

Table 1 *Vegetation types recorded at Q Station investigation area*

Vegetation type description	Representative photograph
Mixed Trees *Cocos nucifera, Guettarda speciosa, Morinda citrifolia* and *Scaevola toccata* over lawn. Sparsely spread *Cocos nucifera* and isolated clumps/stands of trees usually comprising only one or two species over grasslands.	
Grasslands **Cynodon radiates, *Cynodon dactylon* and *Cenchrus ciliaris* low to mid closed grassland with emergent *Boerhavia diffusa, *Cyanthillium cinereum, *Tridax procumbens* and *Euphorbia cyathophora* low sparse herbland.	

Plate 2 *Stand of Casuarina equisetifolia var. incana (Beach sheoak)*

3.1.3 Flora

Twenty flora species were recorded from the Q Station investigation area (Table 2). This total included 11 introduced (weed) species and nine native species. No species listed under the EPBC Act, BC Act or as Priority by DBCA were recorded at the Q Station investigation area. The Q Station investigation area is considered to have low floristic diversity.

Table 2 *Flora species recorded at Q Station investigation area*

Family	Taxon	Status
Arecaceae	*Cocos nucifera*	
Asteraceae	*Tridax procumbens*	*
Boraginaceae	*Argusia argentea*	
Casuarina	*Casuarina equisetifolia*	
Euphorbiaceae	*Euphorbia cyathophora*	*
Goodeniaceae	*Scaevola taccada*	
Hernandiaceae	*Hernandia nymphaefolia*	
Nyctaginaceae	*Boerhavia diffusa*	*
Passifloraceae	*Turnera ulmifolia*	*
Poaceae	*Cenchrus ciliaris*	*
Poaceae	*Chloris barbata*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Cynodon radiates*	*

Family	Taxon	Status
Poaceae	*Eleusine indica*	*
Poaceae	*Thuarea involuta*	
Rubiaceae	*Guettarda speciosa*	
Rubiaceae	*Morinda citrifolia*	
Rubiaceae	*Oldenlandia corymbosa*	*
Rubiaceae	*Spermacoce assurgens*	*
Sapindaceae	*Dodonaea viscosa*	

* indicates introduced species.

3.1.4 Fauna habitats

The Q Station investigation area comprised two fauna habitats, mixed trees and grasslands (Table 3). Both habitats are highly modified and provided limited value to fauna. The fauna habitats align with the mapped vegetation types.

Table 3 Fauna habitats recorded at Q Station investigation area

Fauna habitat description	Representative photograph
Mixed Trees This habitat is highly modified and comprises scattered or isolated stands of trees with minimal to no understorey. Leaf litter and branches may be present at the base of some tree stands. The habitat provides low value to fauna. It may be used by bird species for foraging and may also provide some nest habitat. This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	
Grasslands This habitat has been cleared, is highly modified and comprises introduced grasses and herbs. The habitat provides low value to fauna as no structural diversity and limited cover (i.e. scarce leaf litter and no understorey vegetation). The habitat may be used by bird species for foraging and by avian and ground dwelling species as corridors. This habitat may provide nesting habitat for listed species including *Ardenna pacifica* (Wedge-tailed shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	

3.1.5 Fauna

Two fauna species were observed at the Q Station investigation area, the White tern (*Gygis alba*) and Green jungle fowl (*Gallus varius*). White terns were observed overflying over the area, whilst Green jungle fowl were observed on the road verge adjacent to the area as well as foraging within the grasslands. White terns are known to nest in large trees in the nearby beach areas; no nest trees were observed with the Q Station investigation area.

3.2 Rumah Baru

3.2.1 Site description

The Rumah Baru investigation area comprised hardstand areas with buildings (the port office and public bathrooms), an equipment compound and carparks, as well as surrounding grassed areas, beach foreshore and a large stilling basin. The stilling basin is used to dump/store dredged material that has been removed from the Rumah Baru Port (Plate 3). The topography is flat and soils are white beach sand.

Plate 3 Stilling basin at Rumah Baru investigation area

3.2.2 Vegetation types and condition

The majority of Rumah Baru investigation area has been historically cleared and therefore is considered highly modified with very little vegetation remaining. Three vegetation types were records at the Rumah Baru investigation area including Cocos closed forest, grasslands and beach/tidal zone (Table 4). The majority of the area comprised grasslands and herbfields, mostly of introduced origin. The stilling basin was surrounded by Cocos closed forest and contained small patches of this vegetation type (between the stilling basin and foreshore area and the stilling basin and equipment compound). The remainder of the stilling basin comprised grasslands (and weeds) as well as bare sand (often in mounds) or weeds. The beach/tidal zone at the Rumah Baru investigation area contained bare sands and scattered Coconut palms. A single tree of *Calophyllum ionphyllum* was located on the grassed area adjacent to the public boat ramp.

The small strips of Cocos closed forest were rated Good in condition. The strips had structural diversity, however, weed incursion was noted. The remaining areas at the Rumah Baru investigation area were rated Completely Degraded; these areas have been historically cleared and/or do not contain vegetation.

Table 4 *Vegetation types recorded at the Rumah Baru investigation area*

Vegetation type description	Representative photograph
Cocos closed forest *Cocos nucifera* with scattered *Morinda citrifolia, Terminalia catappa* and *Guettarda speciosa* mid forest over *Scaevola taccada* and *Turnera ulmifolia* tall shrubland over *Ipomoea macrantha, *Euphorbia cyathophora* and *Tridax procumbens* low open herbland.	
Grasslands **Cynodon radiates, *Cynodon dactylon* and *Cenchrus ciliaris* low to mid closed grassland with emergent *Boerhavia diffusa, *Cyanthillium cinereum, *Tridax procumbens* and *Euphorbia cyathophora* low sparse herbland.	
Beach/Tidal zone Areas devoid of vegetation and comprising bare sands and shingle.	

3.2.3 Flora

Sixteen flora species were recorded from the Rumah Baru investigation area (Table 5). This total included eight introduced (weed) species and eight native species. No species listed under the EPBC Act, BC Act or as Priority by DBCA were recorded at the Rumah Baru investigation area. The Rumah Baru investigation area is considered to have low floristic diversity.

Table 5 *Flora species recorded at Rumah Baru investigation area*

Family	Taxon	Status
Arecaceae	*Cocos nucifera*	
Asteraceae	*Cyanthillium cinereum*	*
Asteraceae	*Tridax procumbens*	*
Calophyllaceae	*Calophyllum inophyllum*	
Combretaceae	*Terminalia catappa*	

Family	Taxon	Status
Convolvulaceae	*Ipomoea pes-caprae*	
Cyperaceae	*Cyperus javanicus*	
Cyperaceae	*Cyperus sp.*	
Euphorbiaceae	*Euphorbia cyathophora*	*
Nyctaginaceae	*Boerhavia diffusa*	*
Passifloraceae	*Turnera ulmifolia*	*
Poaceae	*Cenchrus ciliaris*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Cynodon radiates*	*
Rubiaceae	*Guettarda speciosa*	
Rubiaceae	*Morinda citrifolia*	

* indicates introduced species.

3.2.4 Fauna habitats

The Rumah Baru investigation area comprised three fauna habitats, mixed shrubland and trees, grasslands and beach (Table 6). The fauna habitats align with the mapped vegetation types. The habitats provided low to moderate value to fauna.

Table 6 Fauna habitats recorded at the Rumah Baru investigation area

Fauna habitat description	
Mixed shrubland and trees This habitat contains areas of shrubland and trees (e.g. Coconut Palms). This habitat is varied and can range from monocultures of Coconut Palms to closed forest with increased structural layers and diversity. Canopy cover is generally high and this habitat tends to open up beneath the canopy, comprising a tangle of branches and trunks. Abundant leaf litter is present, with fallen branches and occasional small hollows. At Rumah Baru this habitat provides moderate value to fauna and may be used by avian and ground dwelling species for foraging and nesting. This habitat may provide nesting habitat for listed species including Lesser Frigatebird (*Fregata ariel*), Great frigatebird (*Fregata minor*), Oriental cuckoo (*Cuculus saturatus*). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	
Grasslands This habitat has been cleared, is highly modified and comprises introduced grasses and herbs. The habitat provides low value to fauna as no structural diversity and limited cover (i.e. scarce leaf litter and no understorey vegetation). The habitat may be used by avian species for foraging and by avian and ground dwelling species as corridors. This habitat may provide nesting habitat for listed species including *Ardenna pacifica* (Wedge-tailed shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	

Fauna habitat description	
Beach This habitat is a narrow strip of sand that lies between the grasslands and/or mixed shrubland and trees and lagoon/marine areas. It contains scattered vegetation (shrubs and palms), with vegetative debris, (e.g. branches coconuts etc.). At Rumah Baru this habitat has low value (due to the adjacent anthropogenic usage, e.g. public boat ramp, passenger ferry terminal). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail).	

3.2.5 Fauna

Three fauna species were observed at the Rumah Baru investigation area, the While tern (*Gygis alba*), Green jungle fowl (*Gallus varius*) and Land crab (*Cardisoma carnifex*). While terns were observed overflying over the area, whilst Green jungle fowl were observed foraging in the grasslands adjacent to the port office. While terns are known to nest in large trees in the nearby beach areas; no nest trees were observed with the Rumah Baru investigation area. Evidence of Land crabs were also observed grasslands adjacent to beach and mixed shrubland and tree areas (Plate 4).

Plate 4 *Evidence of Land crabs (Cardisoma canifex) burrows at Rumah Baru.*

3.3 Mahoon Road

3.3.1 Site description

Mahoon Road is a gravel road that extends from Sydney Highway east to the lagoon. The existing road is approximately 5-10 m wide along its length and is adjacent to both existing cleared areas and vegetated areas.

3.3.2 Vegetation types and condition

Three vegetation types were recorded along Mahoon Road, Cocos closed forest, grasslands and beach/tidal zone (Table 7). Cocos closed forest occurred adjacent to Mahoon Road from approximately halfway along its length to the lagoon. At the end of Mahoon Road, the Cocos closed forest transitioned into Beach/Tidal zone; a small patch of grasslands was also present. Several trees/large shrubs of *Calophyllum lonphyllum* were observed on the beach.

The Cocos closed forest was rated Good in condition adjacent to Mahoon Road. The vegetation had structural diversity, however, weed incursion was noted. The grasslands were rated Completely Degraded; this area has been historically cleared.

Table 7 *Vegetation types recorded at Mahoon Road investigation area*

Vegetation type description	Representative photograph
Cocos closed forest *Cocos nucifera* with scattered *Morinda citrifolia, Terminalia catappa* and *Guettarda speciosa* mid forest over *Scaevola taccada* and *Turnera ulmifolia* tall shrubland over *Ipomoea macrantha, *Euphorbia cyathophora* and *Tridax procumbens* low open herbland.	
Grasslands **Cynodon radiates, *Cynodon dactylon* and *Cenchrus ciliaris* low to mid closed grassland with emergent *Boerhavia diffusa, *Cyanthillium cinereum, *Tridax procumbens* and *Euphorbia cyathophora* low sparse herbland.	

Vegetation type description	Representative photograph
Beach/Tidal zone Areas devoid of vegetation and comprising bare sands and shingle.	

3.3.3 Flora

Fourteen flora species were recorded from the Mahoon Road investigation area (Table 8). This total included eight introduced (weed) species and six native species. No species listed under the EPBC Act, BC Act or as Priority by DBCA were recorded at the Mahoon Road investigation area. The investigation area is considered to have low floristic diversity.

Table 8 Flora species recorded from Mahoon Road investigation area

Family	Taxon	Status
Arecaceae	*Cocos nucifera*	
Asteraceae	*Chromolaena odorata*	*, DP
Boraginaceae	*Argusia argentia*	
Calophyllaceae	*Calophyllum inophyllum*	
Campanulaceae	*Hippobroma longiflora*	*
Lythraceae	*Pemphis acidula*	
Malvaceae	*Hibiscus tiliaceus*	
Passifloraceae	*Turnera ulmifolia*	*
Poaceae	*Chloris barbata*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Cynodon radiates*	*
Rubiaceae	*Morinda citrifolia*	
Rubiaceae	*Spermacoce assurgens*	*
Verbenaceae	*Stachytarpheta jamaicensis*	*

* indicates introduced species, DP= Declared Plant under the *Biosecurity and Agriculture Management Act 2007.*

3.3.4 Fauna habitats

Three fauna habitats, mixed shrubland and trees, grasslands and beach were recorded from the Mahoon Road investigation area (Table 9). The fauna habitats align with the mapped vegetation types. The habitats provided low to moderate value to fauna.

Table 9 *Fauna habitats recorded at the Mahoon Road investigation area*

Fauna habitat description	Representative photograph
Mixed shrubland and trees This habitat contains areas of shrubland and trees (e.g. Coconut Palms). Canopy cover is generally high and this habitat tends to open up beneath the canopy, comprising a tangle of branches and trunks. Abundant leaf litter is present, with fallen branches and occasional small hollows. This habitat provides moderate value to fauna and may be used by avian and ground dwelling species for foraging and nesting. This habitat may provide nesting habitat for listed species including Lesser frigatebird (*Fregata ariel*), Great frigatebird (*Fregata minor*), Oriental cuckoo (*Cuculus saturatus*) and *Ardenna pacifica* (Wedge-tailed shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	
Grasslands This habitat has been cleared, is highly modified and comprises introduced grasses and herbs. The habitat provides low value to fauna as no structural diversity and limited cover (i.e. scarce leaf litter and no understorey vegetation). The habitat may be used by avian species for foraging and by avian and ground dwelling species as corridors. This habitat may provide nesting habitat for listed species including *Ardenna pacifica* (Wedge-tailed shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	
Beach This habitat is a narrow strip of sand that lies between the mixed shrubland and trees and lagoon/marine areas. It contains scattered vegetation (shrubs and palms), with vegetative debris, (e.g. branches coconuts etc.). This habitat has low to moderate value to fauna and may be used by avian and ground dwelling species for foraging and nesting. The habitat may also be used by crabs. This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow) and *Motacilla flava* (Yellow wagtail).	

3.3.5 Fauna

Three fauna species were observed at the Mahoon investigation area, the White-breasted waterhen (*Amauronis phoenicurus*), Green jungle fowl (*Gallus varius*) and Land crab (*Cardisoma carnifex*). Green jungle Fowl and White-breasted waterhen were observed foraging along Mahoon Road, and Land crabs were observed in the Mixed shrubland and trees habitat type.

3.4 Access tracks

3.4.1 Site description

Four potential access track options are located adjacent to the northern end of the CKI airfield. Access track options 1-3 comprise existing gravel tracks, with option 4 being sealed for part of its length.

3.4.2 Vegetation types and condition

Three vegetation types were recorded along the potential access tracks, Cocos closed forest, grasslands and mixed trees (Table 10). Cocos closed forest occurred adjacent to access tracks (options 1, 2 and 3) and was rated Good in condition. This vegetation had structural diversity, however, weed incursion was noted. Within this vegetation type, the density of *Scaevola taccada* was greater adjacent to the tracks. Mixed trees occurred along access track option 4 and grasslands occurred within and adjacent to all access tracks. Both mixed trees and grasslands vegetation types were rated Completely Degraded in condition.

Table 10 Vegetation types recorded at access tracks investigation area

Vegetation type description	Representative photograph
Cocos closed forest *Cocos nucifera* with scattered *Morinda citrifolia*, *Terminalia catappa* and *Guettarda speciosa* mid forest over *Scaevola taccada* and *Turnera ulmifolia* tall shrubland over *Ipomoea macrantha*, **Euphorbia cyathophora* and **Tridax procumbens* low open herbland.	 
Grasslands **Cynodon radiates*, **Cynodon dactylon* and **Cenchrus ciliaris* low to mid closed grassland with emergent **Boerhavia diffusa*, **Cyanthillium cinereum*, **Tridax procumbens* and **Euphorbia cyathophora* low sparse herbland.	

Vegetation type description	Representative photograph
Mixed Trees *Cocos nucifera* and *Terminalia catappa* isolated trees over weedy grassland and/or herbland.	

3.4.3 Flora

Twenty-four flora species were recorded from the access tracks investigation area (Table 11). This total included 17 introduced (weed) species and seven native species. No species listed under the EPBC Act, BC Act or as Priority by DBCA were recorded at the access tracks investigation area. The access tracks investigation area is considered to have low floristic diversity.

Table 11 Flora species recorded from the access tracks investigation area

Family	Taxon	Status
Arecaceae	*Cocos nucifera*	
Asteraceae	*Cyanthillium cinereum*	*
Asteraceae	*Tridax procumbens*	*
Combretaceae	*Terminalia catappa*	
Cyperaceae	*Cyperus polystachyos*	*
Euphorbiaceae	*Euphorbia cyanthophora*	*
Euphorbiaceae	*Euphorbia hirta*	*
Fabaceae	*Desmodium triflorum*	*
Fabaceae	*Macroptilium atropurpureum*	*
Fabaceae	*Stylosanthes sp.*	*
Goodeniaceae	*Scaevola taccada*	
Lauraceae	*Cassytha filiformis*	
Malvaceae	*Hibiscus tiliaceus*	
Muntingiaceae	*Muntingia calabura*	*
Passifloraceae	*Turnera ulmifolia*	*
Poaceae	*Cenchrus ciliaris*	*
Poaceae	*Chloris barbata*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Cynodon radiates*	*
Poaceae	*Eleusine indica*	*
Poaceae	*Eragrostis elongata*	*
Rubiaceae	*Guettarda speciosa*	
Rubiaceae	*Oldenlandia corymbosa*	*
Verbenaceae	*Premna serratifolia*	

* indicates introduced species.

3.4.4 Fauna habitats

Three fauna habitats, mixed shrubland and trees, grasslands and palms were recorded from the access tracks investigation area (Table 9). The fauna habitats align with the mapped vegetation types. The habitats provided low to moderate value to fauna.

Table 12 Fauna habitats recorded at the Mahoon Road investigation area

Fauna habitat description	Representative photograph
Mixed shrubland and trees This habitat contains areas of shrubland and trees (e.g. Coconut Palms). Canopy cover is generally high and this habitat tends to open up beneath the canopy, comprising a tangle of branches and trunks. Abundant leaf litter is present, with fallen branches and occasional small hollows. This habitat provides moderate value to fauna and may be used by avian and ground dwelling species for foraging and nesting. This habitat may provide nesting habitat for listed species including Lesser frigatebird (*Fregata ariel*), Great frigatebird (*Fregata minor*), Oriental cuckoo (*Cuculus saturatus*) and *Ardenna pacifica* (Wedge-tailed shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	
Grasslands This habitat has been cleared, is highly modified and comprises introduced grasses and herbs. The habitat provides low value to fauna as no structural diversity and limited cover (i.e. scarce leaf litter and no understorey vegetation). The habitat may be used by avian species for foraging and by avian and ground dwelling species as corridors. This habitat may provide nesting habitat for listed species including *Ardenna pacifica* (Wedge-tailed shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	
Trees This habitat is highly modified and comprises scattered or isolated trees with minimal to no understorey. Leaf litter and branches may be present at the base of some palm stands. The habitat provides low value to fauna. It may be used by avian species for foraging and may also provide some nest habitat. This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	

3.4.5 Fauna

Three fauna species were observed at the access tracks investigation area, the White tern (*Gygis alba*), Green jungle fowl (*Gallus varius*) and Land crab (*Cardisoma carnifex*). White terns were observed overflying over the access tracks area, and the Green jungle fowl and Land crab were observed along

access tracks. While terns are known to nest in large trees in the nearby beach areas; no nest trees were observed with the access tracks investigation area.

3.5 Laydown areas

3.5.1 Site description

The laydown investigation area comprises two potential laydown areas which are existing cleared areas adjacent to the western side of the CKI airfield.

3.5.2 Vegetation types and condition

One vegetation type was recorded at the other investigation area, grasslands (Table 13). The vegetation comprised introduces species only and was rated Completely Degraded in condition.

Table 13 Vegetation type recorded from the other investigation area

Vegetation type description	Representative photograph
Grasslands **Cynodon radiates, *Cynodon dactylon* and **Chloris barbata* low to mid closed grassland with emergent **Cyanthillium cinereum and *Tridax procumbens* low sparse herbland.	

3.5.3 Flora

Seven flora species were recorded from the other investigation area (Table 14). This total included five introduced (weed) species and two native species. The two native species occurred as single individuals planted at the western and eastern ends of the communications location. No species listed under the EPBC Act, BC Act or as Priority by DBCA were recorded at the other investigation area. The other investigation area is considered to have low floristic diversity.

Table 14 Flora species recorded from the other investigation area

Family	Taxon	Status
Arecaceae	*Cocos nucifera*	
Asteraceae	*Tridax procumbens*	*
Asteraceae	*Cyanthillium cinereum*	*
Poaceae	*Chloris barbata*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Cynodon radiates*	*
Verbenaceae	*Premna serratifolia*	

* indicates introduced species.

3.5.4 Fauna habitats

One fauna habitat was recorded from the other investigation area (Table 15). The fauna habitats align with the mapped vegetation type. The habitat provided low value to fauna.

Table 15 Fauna habitat recorded at other investigation area

Fauna habitat description	Representative photograph
Grasslands This habitat has been cleared, is highly modified and comprises introduced grasses and herbs. The habitat provides low value to fauna as no structural diversity and limited/no cover (i.e. no understorey vegetation). The habitat may be used by avian species for foraging and by avian and ground dwelling species as corridors. This habitat may provide nesting habitat for listed species including *Ardenna pacifica* (Wedge-tailed Shearwater). This habitat may provide foraging habitat for listed species including *Hirundo rustica* (Barn swallow), *Motacilla flava* (Yellow wagtail) and *Motacilla cinerea* (Grey wagtail).	

3.5.5 Fauna

No fauna species were observed in the other investigation area.

4. Discussion and Conclusions

Four vegetation types were identified during the flora and fauna surveys as well as disturbed areas. These vegetation types align with those previously identified and described by AECOM (2019) and GHD (2009). Overall, the vegetation types recorded from the investigation areas are representative of the vegetation across West Island. Woodroffe and Berry (1994) state that the 'human impact on the CKI has been most devastating on the South Keeling Islands (the southern atoll), where the vegetation has been almost totally altered to coconut plantation.' This is also supported by Williams (1994) who stated that CKI 'pre-settlement vegetation has been extensively modified for coconut plantations, except for certain parts of North Keeling'. Based on these statements, it could be suggested that much of the vegetation recorded during the surveys is representative of highly modified vegetation as *Cocos nucifera* was a common species, recorded from the investigation areas.

Vegetation condition across the investigation areas ranged from Good to Completely Degraded. The vegetation largely lacked structural diversity and weed incursion was noted at most locations. Other disturbances included tracks and clearing; storm and swell events are also likely to impact vegetation in coastal locations.

Overall, species diversity on CKI is considered low and the isolated location of CKI is likely to contribute to reduced diversity. Renvoize (1979) noted that low habitat diversity of CKI has led to a flora characterised by very low endemicity with indigenous taxa of pantropical or Indo-Pacific distribution dominating. Only one endemic species of flora is recorded from CKI, *Pandanus tectorius* var. *cocosensis*; this species has not been recorded during any of the surveys. No listed flora species were recorded within the investigation areas during the survey. The species recorded during the surveys are common and widespread over West Island.

Four fauna habitat types were identified during the flora and fauna surveys. The fauna habitats recorded during the survey align closely with the vegetation types described, as well as those previously identified and described by AECOM (2019) and GHD (2009). Overall, the fauna habitat types recorded from the investigation areas are representative of the habitats across West Island.

The diversity of terrestrial fauna on CKI is limited, largely due to the lack of diversity in habitats as well as human impact. While there was a lack of habitat diversity recorded from the investigation areas, the habitats present likely provide nesting and foraging habitat for the fauna species recorded during the survey. Fauna recorded during the survey included avian species as well as crabs. Crab species were conspicuous in the intertidal and littoral zones throughout the investigation areas. No significant fauna

species were recorded within the investigation areas during the survey. However, the habitats present within the investigation areas may provide nesting and foraging habitat for a number of listed species.

Regards

[redacted]

Senior Environmental Scientist

References

AECOM Australia Pty Ltd (AECOM) 2019, Cocos (Keeling) Islands Airfield Upgrade Environmental Report, unpublished report prepared for Department of Defence.

Christidis L and Boles WE 2008, Systematics and Taxonomy of Australian Birds, Melbourne, CSIRO Publishing

Department of Biodiversity, Conservation and Attractions (DBCA) 2007–, NatureMap: Mapping WA's Biodiversity, retrieved September 2020, from http://naturemap.dpaw.wa.gov.au/default.aspx/.

Department of Agriculture, Water and the Environment (DAWE) 2020a, Environmental Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool Results, retrieved September 2020, from http://www.environment.gov.au/epbc/pmst/index.html.

Department of Agriculture, Water and the Environment (DAWE) 2020b, Environment Protection and Biodiversity Act 1999 List of Threatened Flora, retrieved September 2020, from http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora.

Environmental Protection Authority (EPA) 2016, Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment, EPA, WA.

Environmental Protection Authority (EPA) 2020, Technical Guidance – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment, EPA, WA.

GHD Pty Ltd (GHD) 2009, Cocos (Keeling) Islands Airport Runway Refurbishment Project, Ecology Report, unpublished report prepared for Attorney General's Department.

Morcombe M 2004, Field Guide to Australian Birds, Queensland, Australia, Steve Parish Publishing Archer Field.

Renvoize SA 1979, The origins of Indian Ocean floras, in Plants and Islands (ed. D Bramwell), pp 107-129, Academic Press, London.

WA Herbarium 1998–, FloraBase–the Western Australian Flora, Department of Biodiversity, Conservation and Attractions, retrieved September 2020, from http://florabase.dpaw.wa.gov.au/.

Williams DG 1994, Vegetation and Flora of the Cocos (Keeling) Islands. National Museum of Natural History, Smithsonian Institution, Washington DC, USA.

Woodroffe CD and Berry PF 1994, Scientific Studies in the Cocos (Keeling) Islands: An Introduction. National Museum of Natural History, Smithsonian Institution, Washington DC, USA.

Attachment 1

Figures

DEPARTMENT OF DEFENCE

R8129 COCOS KEELING ISLAND AIRFIELD UPGRADE

LOCALITY PLAN

EXTRACTED FROM GOOGLE EARTH PRO 2020

A	15.09.20	CS	A	HB	CO	ISSUED FOR REVIEW - 30%
No	DATE	DRAFTING CHECK	DESIGN REVIEW	PROJ. ENGR	APPD.	AMENDMENT

CAUTION

Fulton Hogan | GHD

Australian Government
Department of Defence
Defence Support Group

DRAWING No: R8129_CKIAF_SWD_GC_DR_CD_0001

PROJECT: R8129 COCOS KEELING ISLAND AIRFIELD UPGRADE

SURVEY DATE: JULY 2020

SCALE: NOT TO SCALE

AMDT: A

TITLE: FIGURE 1

A1

Figure 2 Q Station Investigation Area

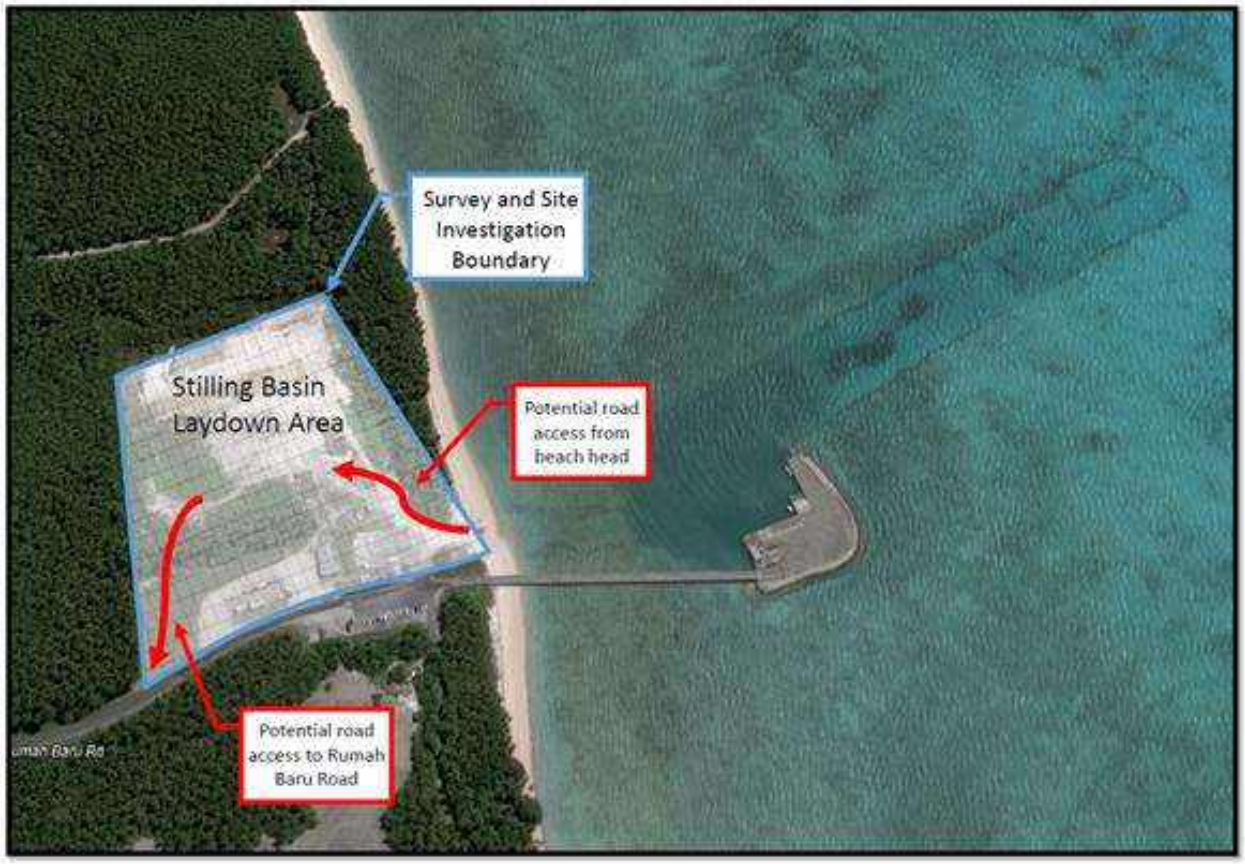

Figure 3 Rumah Baru Investigation Area

Figure 4 *Mahoon Road Investigation Area*

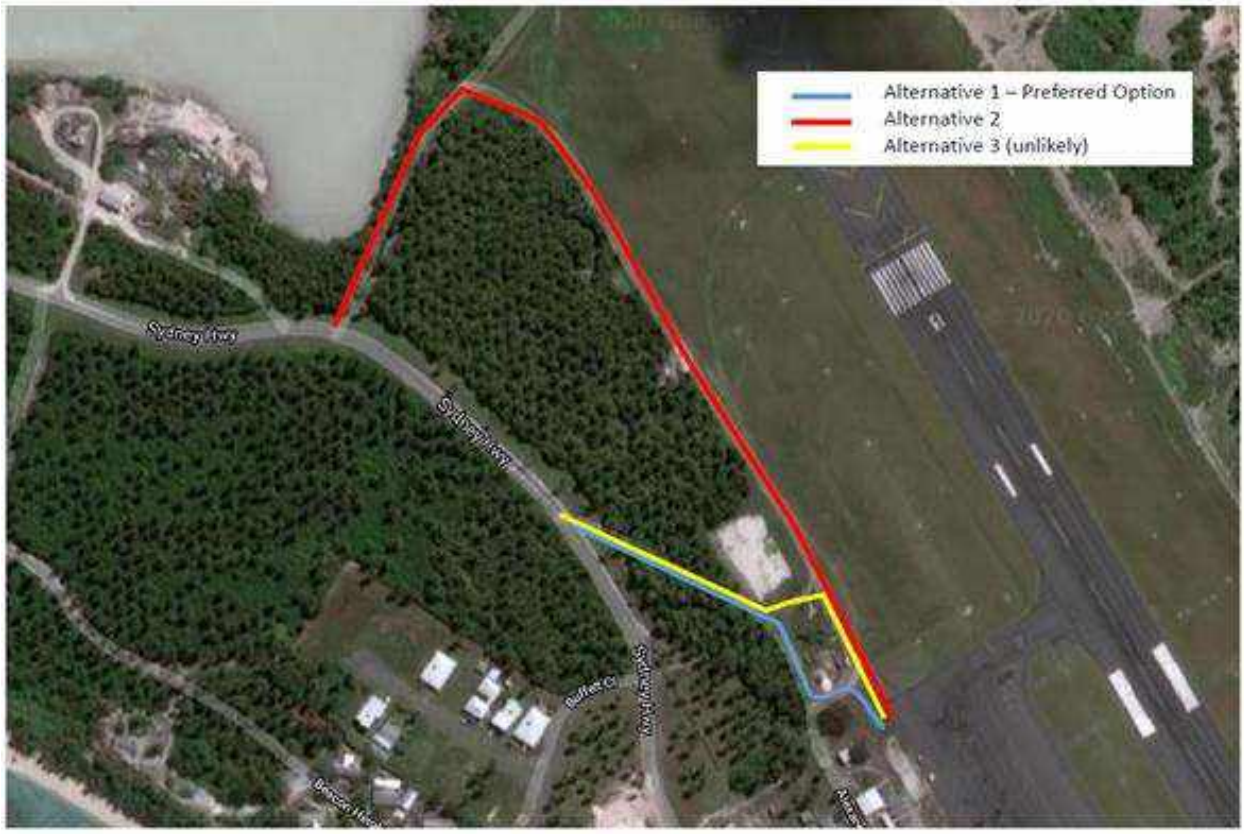

Figure 5 *Access tracks (options 1, 2 and 3) investigation area*

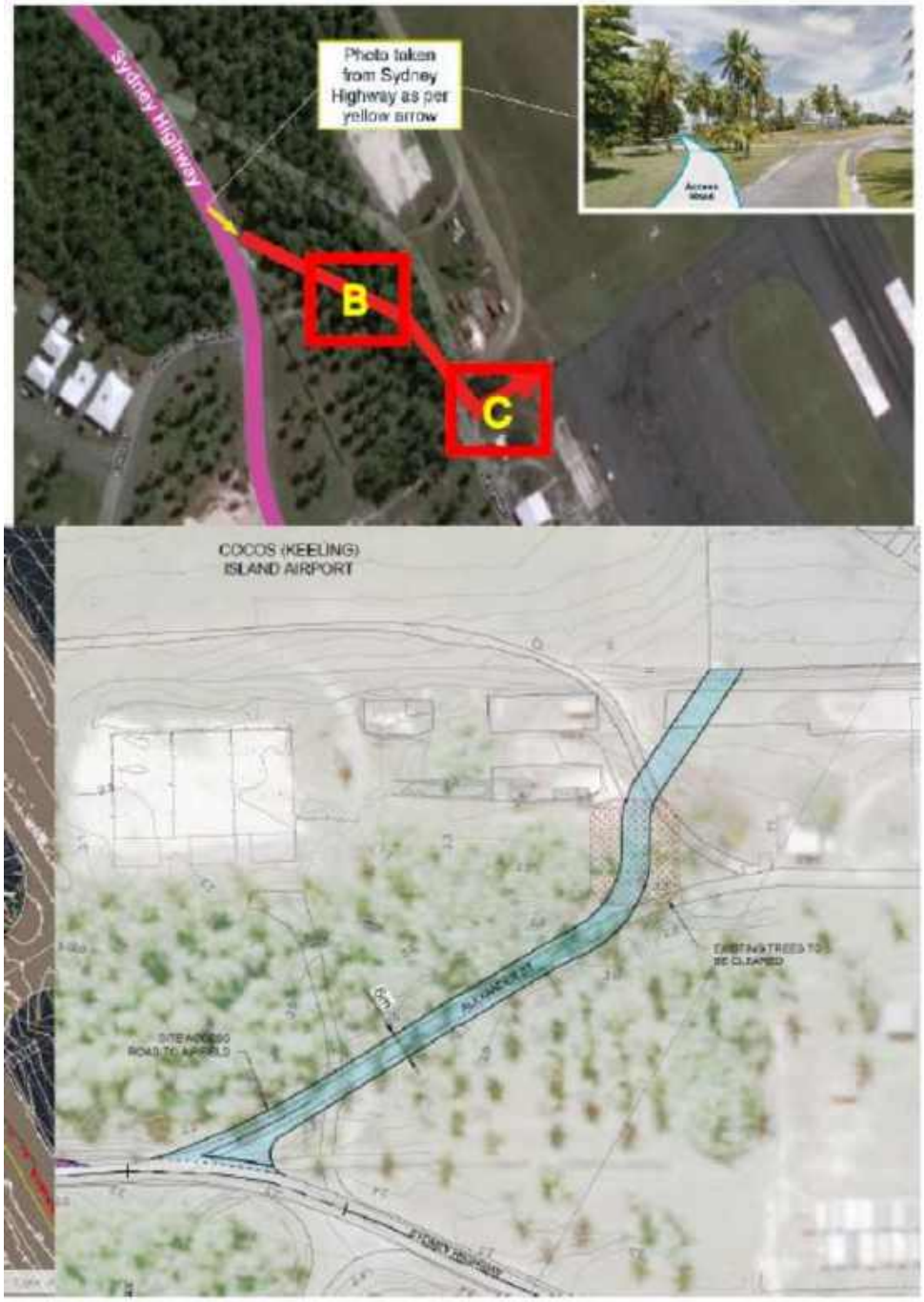

Figure 6 *Access tracks (option 4) investigation area*

Figure 7 *Laydown Investigation Area*