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Towrie Development
Santos Limited
11-Dec-2020

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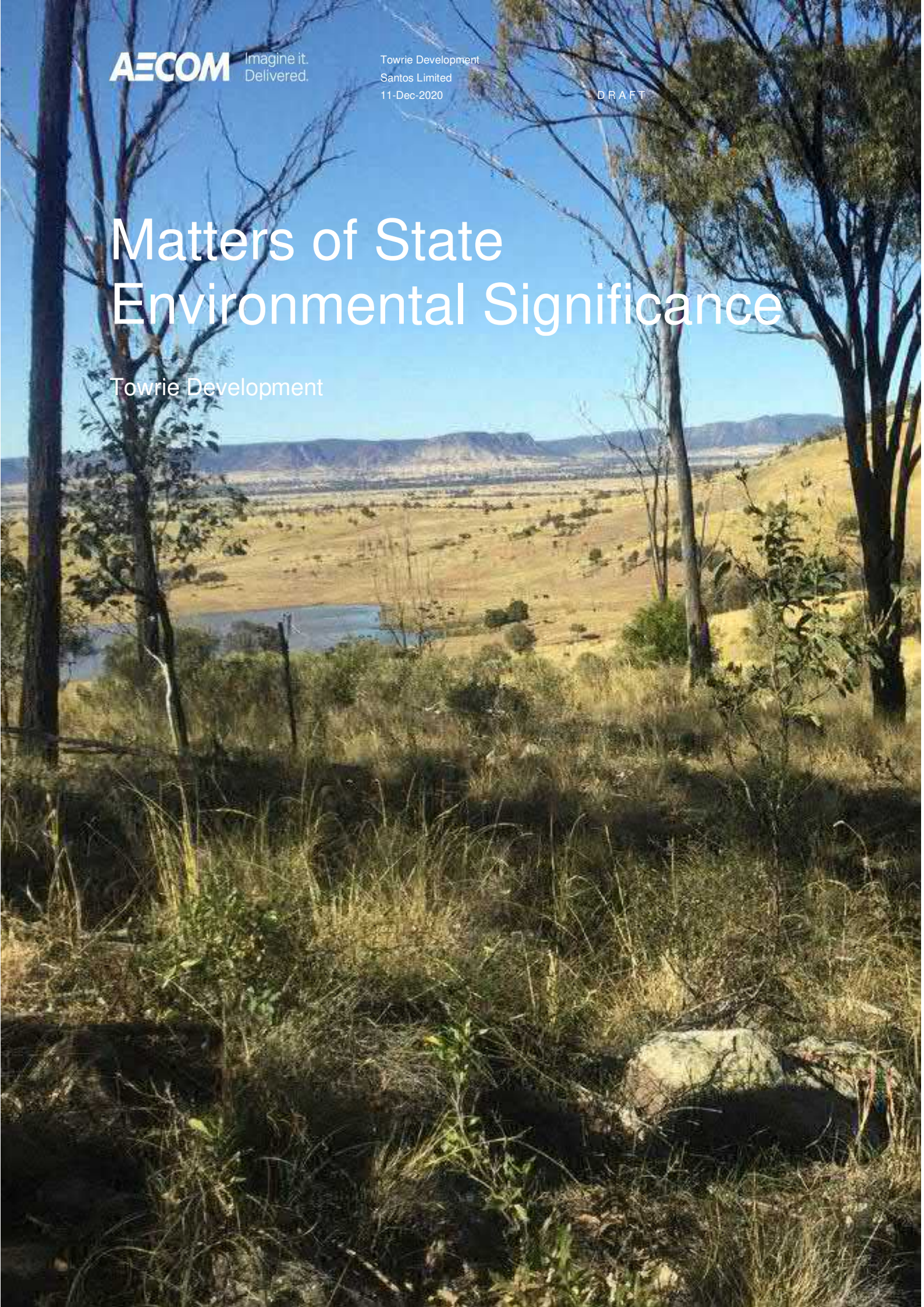
Matters of State Environmental Significance

Towrie Development



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Matters of State Environmental Significance

Towrie Development

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1.0 Introduction

1.1 Background

Santos CSG Pty Ltd (Santos) proposes to produce gas within its existing petroleum tenure (Authority to Prospect (ATP) 2033) subject to Petroleum Lease Application (PLA) 1059) known as the Towrie Development within the Bowen Basin of central southern Queensland (the Project).

The Project will involve progressive development, construction, operation, decommissioning and rehabilitation of up to 110 vertical wells, gas and water gathering networks and supporting infrastructure. The Project will rely on existing centralised gas and water processing infrastructure on adjoining tenures within Arcadia Valley.

The final configuration and location of infrastructure components will be determined by resource exploration and constraints planning undertaken throughout the life of the Project. This integrated approach to development reflects best practice gas field management designed to minimise disturbance footprint and impacts on environmental values including Matters of State Environmental Significance (MSES). The footprint of the Project will not be over the total area but rather will comprise discrete production wells, disturbance lines and tracks.

Surface infrastructure will directly impact a fraction of the Towrie tenure area (referred to as the Project Area, detailed below) and not all wells will be drilled and operational at once. Within the Project Area development and production activities will occur to maintain the target gas production rate. The rehabilitation and decommissioning of individual well sites will be undertaken in accordance with regulatory requirements and industry standards.

AECOM has prepared this MSES report to assess the potential impacts to MSES and to determine any potential constraints or offset triggers.

1.2 Project Area

The Towrie development tenure or Project Area coincides with the Authority to Prospect (ATP) 2033 and Petroleum Lease (PL) 1059 (under application) and covers an area of approximately 8,678 hectares (ha). It is comprised of ten lot and plans in the Arcadia Valley, located 350 kilometres (km) southwest of Gladstone in the Bowen Basin of central southern Queensland (Figure 1).

The Project Area occurs across two local government areas including Central Highlands Regional Council and Maranoa Regional Council local government areas (LGAs). Population centres within the region include Injune (approximately 60 km south), Rolleston (approximately 87 km north) and Bauhinia (approximately 90 km north east) of the Project Area.

The Project Area is predominantly rural land characterised by grasslands and some woodlands, used largely for agricultural development, including cattle grazing and limited cropping. Aerial imagery indicates that vegetation and fauna habitats within the local area are generally disturbed and fragmented as a result of land use practices, with areas of higher quality vegetation generally appearing in elevated areas. Within the Project Area, three main areas of likely high quality vegetation occur: the Public Reserve in the north-east, the western ridgeline and the large landform approximately 3 km long (henceforth referred to as ‘Middle Hill’). At their highest points, both the western ridgeline and Middle Hill are approximately 600 metres (m) Australian Height Datum (AHD), in contrast to the adjacent undulating plains which are generally between 300 m and 400 m AHD.

Several ephemeral watercourses traverse the Project Area. Arcadia Creek is the highest order watercourse (stream order 5) but occurs only in north-eastern corner within the Pubic Reserve. From the centre of the Project Area, six watercourses (stream order 1) traverse north east (all unnamed except Station Creek) towards Arcadia Creek. Within the Project Area, a wetland in the north east of the tenure (henceforth the ‘Wetland’) is the confluence of these watercourses including Station creek (stream order 3). From two sources below the western ridgeline, a single unnamed watercourse (stream order 2) converges in the southern Project Area (2SP200046) and travels directly east before exiting the Project Area and then re-entering in the centre of the eastern boundary and traversing north.

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Within the valley, the Project Area is surrounded by agriculture, coal seam gas operations and conventional gas operations. In the wider local area, a number of National Parks (NP) and State Forests (SF) occur within 20 km including Expedition (Limited Depth) NP to the east and south-east, Expedition NP to the south, Carnarvon NP to the north east and Boxvale SF to the west (Figure 2).

1.3 Scope of work

The purpose of this assessment is to describe the MSES values present within the Project Area, assess the potential impacts of the Project on these values, and present strategies to avoid, minimise or mitigate potential impacts.

To complete this scope, the assessment included the following tasks:

- Conduct a desktop review of available literature and previous studies in the vicinity of the Project Area, and conduct database searches for known or potentially occurring MSES
- Undertake an ecological assessment to:
  - document condition, extent and value of vegetation communities, habitat types and other ecological values within the Project Area
  - target potentially occurring flora and fauna listed under the *Nature Conservation Act 1992* (NC Act)
  - Confirm the extent of regulated vegetation as defined in the *Vegetation Management Act 1999* (VM Act)
  - identify habitat resources for known and potentially occurring threatened flora, fauna and special least concern species.
- Utilise field-based data in conjunction with aerial imagery and light detection and ranging (LIDAR) data to determine the likely extent of vegetation communities, habitat types and associated MSES values across the Project Area
- Undertake a likelihood of occurrence assessment to confirm known, likely or potential presence of MSES within the Project Area
- Complete an impact assessment for identified or potentially occurring MSES values, inclusive of recommended mitigation and management measures
- Determine the significance of identified impacts in accordance with the Queensland Environmental Offsets Policy Significant Residual Impact Guidelines (Department of the Environment and Heritage Protection, 2014) and quantify any significant impacts
- Identify potential offset requirements, if required.

This report does not address potential Project impacts specifically on Commonwealth Matters of National Environmental Significance (MNES). This is addressed in a standalone assessment: AECOM (2020) *Towrie Development: Matters of National Environmental Significance – Ecology Assessment*, with results summarised in Section 9.1.

AECOM

N 0 1 2 KMS

LEGEND

- Project Area (ATP2033)
- Property boundaries
- Roads and tracks
- Major watercourses
- Minor watercourses

Applicable Property Tenure

- Freehold
- Profit à Prendre
- Reserve

FIGURE 1
PROJECT AREA

SEROCOLD STATE FOREST

SEROCOLD STATE FOREST

BANDANA STATE FOREST

CARNARVON NATIONAL PARK

CARNARVON NATIONAL PARK

BOXVALE STATE FOREST

PRESHO STATE FOREST

EXPEDITION (LIMITED DEPTH) NATIONAL PARK

BELINGTON HUT STATE FOREST

EXPEDITION NATIONAL PARK

FORREST STATE FOREST

EXPEDITION (LIMITED DEPTH) NATIONAL PARK

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0 3.5 7 KMS

LEGEND

- Project Area
- Roads and Tracks

VM Act Watercourses

- Major
- Minor
- Existing Petroleum Leases

Protected Places

- National Park
- State Forest
- Reserve

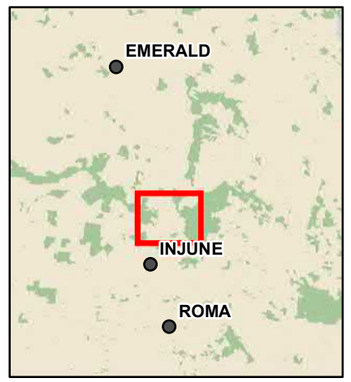

FIGURE 2
REGIONAL CONTEXT

2.0 Project description

The Project includes construction, operation, decommissioning and rehabilitation of up to 110 vertical wells, gas and water gathering networks and supporting infrastructure within the Project Area. A summary of the key components and activities of the construction, operation and decommissioning and rehabilitation phases of the Project is provided in the sections below.

Approved exploration and appraisal activities are currently underway within the Project Area to improve understanding of the available gas resources. As understanding of the gas resource increases, investment decisions will be made about the location, scale and timing of the field development. Development timing will also be determined by the proximity to, and synergies with, existing and planned facilities that have been previously approved.

Construction is scheduled to commence in early 2022.

2.1 Activities and proposed timing

2.1.1 Construction

2.1.1.1 Well lease for production well or monitoring bore

Up to 110 vertical wells will be drilled into the target coal seam. Well construction will comply with the *Code of Practice for the construction and abandonment of petroleum wells and associated bores in Queensland* (DNRME, 2019), which sets minimum standards to achieve long term well integrity.

A well lease will be developed to accommodate drilling and well completion equipment and support services. The size and layout of the well lease will vary depending on a number of factors such as the number of wells to be drilled (multi-well leases), the size and type of drilling rig, the number of hydraulic stimulation stages, the program for completion of the well(s) and the surrounding environment.

The lease size required to accommodate a typical vertical well is approximately 1 ha. Minimum disturbance leases (consisting of matting placed on the ground to create a hardstand surface) of less than 1 ha would be used where topography and vegetative cover allows. Where additional area is needed to accommodate infrastructure such as a water tank or native slope requires cut and fill construction, well leases may be up to approximately 1.5 ha in size.

Multi-well leases (up to approximately 2.5 ha) may be used to maximise gas recovery and/or accommodate landholder requirements. Multi-well leases result in a larger footprint per lease area but a reduced footprint per well.

Well construction will involve a drill rig and other equipment including flare, flare sump and storage for fuel, chemicals, drilling fluids, produced water and raw water supply. Hydraulic fracture stimulation will be used to complete the wells. On well completion, a pump will be installed to depressurise the coal seam and facilitate gas production. An operational production well lease will generally include gas and water metering, separation and filtering equipment, electrical and control systems and water and gas pipeline connections.

2.1.1.2 Access roads or tracks

Access tracks are required for construction and operational activities. Construction of a typical access track (8-15 m wide) will accommodate heavy and light vehicles associated with the activities. Wherever practicable, existing access tracks will be upgraded for use and new access tracks will be co-located with gas and water gathering network to reduce the overall construction footprint.

2.1.1.3 Gas and water flowlines and transmission pipelines

A gas and water gathering network including flowlines and pipelines will be constructed to transfer gas and water from each production well to main lines connecting to gas and water management facilities off tenure. A construction right-of-way approximately 10-25 m wide will be required for standard gathering line/pipeline construction including excavation of a trench, pipeline laying, backfilling the trench, and reinstatement of the right-of-way.

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2.1.1.4 Supporting infrastructure and activities

Other ancillary infrastructure and incidental petroleum activities required to support the construction and operation activities may include:

- Low hazard dams and storage tanks
- Power and communication lines
- Borrow pits
- Fencing
- Environmental monitoring equipment and management controls
- Geophysical, geotechnical, geological, topographic, cadastral and ecological surveys
- Supporting infrastructure, such as energy supply, water supply and communications.

In the rare event that foundation rock is encountered during construction, Santos may use blasting techniques to fragment the rock for removal. While unlikely to be required, any blasting will be conducted in accordance with a Blasting Management Plan, which will be developed prior to construction. Small amounts of waste rock may be generated and reused in the landscape.

Where landholders hold the appropriate licence to take water and supplies are abundant, landholders may agree to allow Santos to use water stored onsite in farm dams for construction purposes. Santos will only use water from agreed locations within the Project Area for construction purposes where available supplies provide continuity of habitat function.

2.1.2 Operation

Operations will occur for approximately 30 years.

Once completed and connected to gas and water gathering infrastructure, wells will operate continuously on a 24-hour basis. Operating wells will be monitored and controlled remotely. The wells will also have automated shutdown systems in the event of non-routine operating conditions. Ongoing activities at well sites during operations will include routine inspections and maintenance of wellhead infrastructure. Maintenance activities will include repair or replacement of downhole pumps and pump components, clearing of blockages from within the wells that may be limiting production capacity, and other actions as necessary to improve production efficiency.

Well maintenance activities usually require the use of a workover rig (which is smaller than a drilling rig) and are contained within the fenced lease area for the well.

Gas and water gathering lines and pipelines will also be monitored, inspected and maintained during operation. This will include:

- inspection of low point drains and high point vents as part of routine field maintenance activities
- pigging of high-pressure pipelines to remove build-up from within pipelines
- vegetation slashing within gathering line/pipeline operational right-of-ways.

2.1.3 Decommissioning and rehabilitation

Decommissioning and rehabilitation will occur post operational life until approximately 2077. All rehabilitation will be carried out in accordance with EA conditions which are expected to be consistent with the Draft Rehabilitation Monitoring Plan.

2.1.3.1 Wells

Wells will be decommissioned in accordance with the mandatory Code of Practice for the construction and abandonment of petroleum wells and associated bores in Queensland (DNRME, 2019). The primary objective of well decommissioning is to isolate hydrocarbon and water bearing formations and eliminate migration pathways (between the reservoir, other formation / aquifers and surface). This is done using cement or bridge plugs. Wells earmarked for decommissioning are subject to individual evaluation to determine the most appropriate decommissioning program.

Considerations when plugging and decommissioning the well include:

- isolate all formations that have hydrocarbon shows
- isolate formations with different pressure regimes
- set plugs across intermediate casing shoe (if present) to minimise the potential for cross flow between aquifer systems and hydrocarbon bearing intervals
- set plugs across surface casing shoe
- at the surface set a plug in the well prior to cutting off the surface casing bowl.

Final rehabilitation of the well and lease area will include removing the well head, surface infrastructure and fencing; capping the well; filling in pits; respreading topsoil (after preparation) and revegetating the site to match its pre-disturbance vegetation type. Infrastructure that is useful to the landowner (for example pits or hardstand areas) may be handed over to the landowner in accordance with Environmental Authority conditions.

2.1.3.2 Gas and water flowlines and transmission pipelines

At the cessation of production, gas and water gathering lines and pipelines will be isolated from the wellhead and connection points. Once isolated, gathering lines will be drained, vented and capped in accordance with the *Australian Pipeline Industry (APIA) Code of Environmental Practice for Onshore Pipelines* (2013) or applicable code in place at the time of decommissioning. Subsurface components of the gathering network will remain in-situ and the right-of-way rehabilitated.

2.1.3.3 Access tracks and incidental infrastructure

Access tracks and incidental infrastructure will be rehabilitated or handed over to the landowner in accordance with Environmental Authority conditions, when no longer required. If rehabilitation is required, the site of previous disturbance will generally be ripped and levelled to re-instate natural contours (including watercourses) and revegetated to match the surrounding land-use.

2.2 Constraints approach

Given the Project does not have a fully defined disturbance footprint, Santos will utilise the hierarchy of management principles to form the basis of siting for new petroleum activities within the Project Area that may result in land disturbance. These are:

1. Avoidance – avoiding direct and indirect adverse environmental impacts where practicable
2. Minimise – minimise direct and indirect adverse environmental impacts where these cannot be avoided
3. Mitigate – implement mitigation and management measures to minimise direct, indirect and cumulative adverse impacts
4. Remediation and rehabilitation – actively remediate and rehabilitate impacted areas to promote and maintain long-term recovery
5. Offset – provide suitable offsets for activities that result in significant residual impacts to MSES even with the implementation of the above principles.

Santos have employed a geographic information system (GIS) model that assesses the locations of MNES and MSES values identified in mapping sourced from government, other open-source datasets and Santos datasets (constraints mapping). The mapping of vegetation communities, habitat types and associated MNES and MSES values across the Project Area completed as part of this and the MNES assessment forms the primary constraints data source for the model. As additional information is collected in the future the model will be updated.

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3.0 Regulatory framework

3.1 Commonwealth legislation

3.1.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act) is administered by the Department of Agriculture, Water and the Environment (DAWE) and establishes a process for environmental assessment and approval of proposed actions that have, will have or are likely to have a significant impact on MNES or on Commonwealth land. MNES protected under the EPBC Act include:

- World Heritage Properties
- National Heritage Places
- Wetlands of International Importance (listed under the Ramsar Convention)
- Great Barrier Reef Marine Park
- Commonwealth Marine Areas
- Listed Threatened Ecological Communities (TECs)
- Listed Threatened Species
- Migratory Species (listed under international agreements)
- Nuclear Actions (including uranium mines)
- A Water Resource, in relation to coal seam gas development and large coal mining development.

Habitat for species listed as threatened or migratory under the EPBC Act may also be an MSES (i.e. protected wildlife habitat).

3.2 Queensland legislation

3.2.1 Nature Conservation Act 1992

The *Nature Conservation Act 1992* (NC Act) prohibits the taking or destruction, without authorisation, of protected flora and fauna species in the wild. All native plants and animals in Queensland are protected under Section 71 of the NC Act. This Act also provides for an integrated and comprehensive approach to conserving nature. It provides a legislative basis for research, community education, dedicating, declaring and managing protected areas, and protecting native wildlife and its habitat.

Conservation significant species are listed under the NC Act in the Nature Conservation (Plants) Regulation 2020 and the Nature Conservation (Animals) Regulation 2020 in the following categories:

- Near Threatened
- Vulnerable
- Endangered
- Extinct in the Wild.

Additionally, Special Least Concern species are protected under the NC Act for their cultural significance or their listing under international migratory bird agreements, and include:

- Short-beaked echidna (*Tachyglossus aculeatus*)
- Platypus (*Ornithorhynchus anatinus*)
- Migratory bird species listed under the Bonn Convention, JAMBA and CAMBA.

Appropriate authorisations or permits under the NC Act are required prior to clearing of listed conservation significant plant species, interfering with an animal breeding place, or removing protected animals unless the activity is exempt.

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An area of habitat (e.g. foraging, roosting, nesting or breeding habitat) for an animal that is endangered, vulnerable, near threatened or a special least concern animal under the NC Act is a MSES (i.e. protected wildlife habitat). Further an area that contains plants that are listed as endangered, vulnerable or near threatened under the NC Act is also considered protected wildlife habitat.

The presence of species listed endangered, vulnerable, near threatened or a special least concern animal under the NC Act within the Project Area is discussed in Section 5.12 and 5.12.2.

3.2.2 Vegetation Management Act 1999

The *Vegetation Management Act 1999* (VM Act) regulates the clearing of native vegetation in Queensland and is administered by the Department of Natural Resources, Mines and Energy (DNRME). The purpose of the VM Act is to regulate the clearing of vegetation in a way that:

a. conserves remnant vegetation

b. conserves vegetation in declared areas

c. ensures that clearing does not cause land degradation

d. prevents the loss of biodiversity

e. maintains ecological processes

f. manages the environmental effects of the clearing to achieve the matters mentioned in paragraphs (a) to (e)

g. reduces greenhouse gas emissions, and

h. allows for sustainable land use (refer s3(1) of the VM Act).

The VM Act categorises and defines native vegetation as remnant (category B), high-value regrowth (HVR) (category C), regrowth watercourse vegetation (category R) and non-remnant (category X). In addition, the VM Act recognises the same native vegetation categories as essential habitat for protected wildlife. Specifically, section 20AC, sub section 2 states ‘essential habitat, for protected wildlife, is a category A area, a category B area or category C area shown on the regulated vegetation management map -

a. that has at least 3 essential habitat factors for the protected wildlife that must include any essential habitat factors that are stated as mandatory for the protected wildlife in the essential habitat database; or

b. in which the protected wildlife, at any stage of its life cycle, is located’.

An area of essential habitat on the essential habitat map for an animal or plant that is endangered, vulnerable or near threatened wildlife is an MSES.

Regulated vegetation which contain a prescribed regional ecosystem (RE) constitute an MSES if the RE:

- is listed as ‘Endangered’, or ‘Of Concern’ under the VM Act
- intersects an area shown on the Vegetation Management Wetlands Map
- is within the defined distance of a watercourse defined under the VM Act.

The presence of MSES values protected under the VM Act within the Project Area is detailed in Section 6.0.

3.2.3 Environmental Protection Act 1994

Under the *Environmental Protection Act 1994* (EP Act) and the Environmental Protection Regulation 2019 (EP Regulation) certain environmental features are protected within petroleum lease areas. These are termed ‘Environmentally Sensitive Areas’ (ESAs) and include features such as national parks, conservation reserves, wetlands of international importance, heritage places and Endangered REs.

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The EP Act regulates Environmentally Relevant Activities (ERAs), which includes a resource activity that involves mining, geothermal, greenhouse gas storage or petroleum activities and others prescribed by the EP Regulation. Activities are classified within ERAs, based on the risk of environmental harm. The Queensland Department of Environment and Science (DES) assesses applications to undertake ERAs, and issues environmental authorities (EAs) that identify environmental conditions that must be met to prevent and / or minimise the likelihood of environmental harm caused by authorised ERAs.

The Project is within a petroleum lease and is classified as a resource activity. As such ESAs within the Project Area are protected under the EP Act. The EP Act and its subordinate EP Regulation place ESAs into two categories: Category A and Category B. Category A and B ESAs appear in Queensland legislation and are easily identified as they are typically based on land tenure. Category C ESAs are defined in DES (2016) Streamlined model conditions for petroleum activities; Category C ESA relevant to the Project Area include Of concern REs.

3.2.4 Biosecurity Act 2014

The *Biosecurity Act 2014* (Biosecurity Act) commenced on 1 July 2016. It ensures a consistent, risk-based approach to biosecurity in Queensland.

The Act provides biosecurity measures to safeguard Queensland's economy, agricultural and tourism industries and environment from:

- pests (e.g. wild dogs and weeds)
- diseases (e.g. foot-and-mouth disease)
- contaminants (e.g. lead on grazing land).

Under the Biosecurity Act, invasive plants and animals are categorised as either a 'prohibited matter' or a 'restricted matter'. The Biosecurity Act requires every local government in Queensland to develop a biosecurity plan for their area and also replaced the many separate pieces of legislation that were previously used to manage biosecurity. Decisions made under the Act will depend on the likelihood and consequences of the risk. The Biosecurity Regulation 2016 sets out how the Act is implemented and applied.

Listed fauna identified during field surveys were examined based on being a potential biosecurity threat. This allowed the opportunity to identify potential impacts to fauna values during the construction and operation of the Project Area.

3.2.5 Queensland Environmental Offsets Framework

The requirement to deliver State environmental offsets is provisioned under various environmental legislative acts and regulations in force in Queensland. Environmental offsets are not an assessment trigger and are only considered where an application for an approval is required, and the assessment considers the delivery of environmental offsets as a suitable and required outcome.

Upon triggering offset requirements, the conditioning and delivery of environmental offsets is directed under the Queensland offset framework consisting of the *Environmental Offsets Act 2014* (EO Act), Environmental Offsets Regulation 2014 (EO Regulations) and the Queensland Environmental Offset Policy 2017 (version 1.4). The EO Act provides the statutory platform that establishes the offset framework, co-ordinates the implementation of the framework in conjunction with other legislation, specifies the offset delivery and compliance process, and allows for the recognition of values that require protection through the delivery of offsets. The EO Regulations provide further details on aspects of the EO Act, including the activities and environmental matters to which the EO Act applies. The Queensland Environmental Offset Policy outlines how environmental offsets should be practically delivered to meet the requirements of the EO Act.

The environmental offset framework only applies when a prescribed activity is likely to have a significant residual impact on a prescribed environmental matter. Prescribed environmental matters include MSES, which for activities authorised under the EP Act are defined in the EO Regulations as the following:

- regulated vegetation – prescribed REs that:

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  - are Endangered REs
  - are Of Concern REs
  - intersect with an area shown as a wetland on a Vegetation Management Wetland map
  - are located within a defined distance of a relevant watercourse or drainage feature.
- connectivity areas
- wetlands and watercourses
- designated precinct in a strategic environmental area
- protected wildlife habitat including essential habitat
- protected areas
- highly protected zones of State marine parks
- fish habitat areas
- waterway providing for fish passage
- marine plants
- legally secured offset areas.

A 'prescribed activity' is also defined under the EO Regulation and includes activities requiring approval under the EP Act such as petroleum activities. Significant residual impacts are determined through the application of criteria outlined in the appropriate significant residual impact guidelines. MSES relevant to the Project Area have been identified (Section 6.0) and significant residual impacts assessed (Appendix F).

4.0 Assessment methodology

4.1 Desktop assessment

A desktop assessment was undertaken to characterise and identify ecological values that may be supported in the Project Area. The desktop assessment included a review of literature, and searches of publicly available datasets and online mapping. Desktop searches were initially undertaken in August 2019 and were repeated in February and June 2020. The following information sources were reviewed as part of this assessment:

- DAWE EPBC Act Protected Matters Search Tool (PMST), to identify MNES within a search area extending at least 10 km from the Project Area (Department of Agriculture Water and the Environment, 2020a) (Appendix A)
- The Queensland Wildlife Online search results for flora and fauna species records within a search area extending 25 km from the centre of the Project Area (Department of Environment and Science, 2020d)
- Atlas of Living Australia (ALA) for threatened flora and fauna species records (Australian Government, 2020)
- The Queensland Department of Natural Resources, Mines and Energy (DNRME) Regulated Vegetation mapping
- The Queensland Department of Environment and Science (DES) Regional Ecosystem (RE) mapping version 11 to determine the nature and extent of vegetation within and surrounding the Project Area
- DNRME VM Act watercourse mapping
- DES VM Act wetland mapping (Department of Environment and Science, 2020)
- DES map of Queensland wetland environmental values to identify wetlands of high ecological significance (HES) and general ecological significance (GES) (DES, 2020b)
- Queensland wetland classification mapping (DES, 2020c)
- The Queensland Department of Agriculture and Fisheries (DAF) Queensland waterways for waterway barrier works mapping (DAF, 2020)
- DES Protected Plants Flora Survey Trigger Map to identify the high risk areas for protected plants (DES, 2020b)
- Essential habitat mapping to identify vegetation in which a threatened species has been known to occur.
- Historical aerial imagery (Q Imagery, 2020)

Reviews of the above data sources were conducted based on the coordinates presented below in Table 1.

Table 1 Data source search parameters

Data source	Search coordinates	Search buffers
EPBC Act Protected Matters Search Tool	-25.250886, 148.712261, -25.244365, 148.824528, -25.336559, 148.830708, -25.340592, 148.75655, -25.282555, 148.750713, -25.283486, 148.733204, -25.268895, 148.732174, -25.269826, 148.714664, -25.250886, 148.712261	10 km

Data source	Search coordinates	Search buffers
Wildlife Online	-25.2913, 148.7868	25 km
All other mapping	Restricted to the bounds of the Project Area	0 km

4.2 Previous ecological assessments

Two ecological studies have previously been undertaken within or in proximity to the Project Area. These studies were reviewed to gain an understanding of the ecological values across the area as well as the methods utilised to determine possible presence of the conservation significant fauna and flora values. The methods adopted by each study are summarised below.

Boobook Ecological Consulting 2017 – Broad-scale Ecological Assessment Report

In 2017, Boobook Ecological Consulting completed a terrestrial ecology assessment on behalf of Santos to identify ecological values within the several properties in the Arcadia Valley. Specifically, the areas assessed consisted of parts of Lot and Plans 6TR11, 7TR39, 8TR15, 9TR17, 7TR22, 8TR23 and the Lonesome holding (807PH1979), within tenements PL234, PL420, PL421 and PL440. Some of these properties (7TR39, 8TR15 and 9TR17), occur directly east of the Project Area. The remaining properties assessed also occur east of the Arcadia Valley Road but to the north and south.

The assessment was completed in two parts, comprising a desktop review of publicly available data and previous surveys followed by site investigations in late October and early November 2017. Field investigations occurred at a number of sites across the aforementioned properties and included the following methods relevant to this assessment:

- Vegetation characterisation including Secondary, Tertiary and Quaternary assessments as per Neldner et al. (2019)
- Threatened Ecological Community (TEC) assessments
- Regional ecosystem assessment
- Microhabitat assessments
- Targeted threatened flora surveys
- Opportunistic observations.

Terrestria Pty Ltd 2018 – Brumby Regional Ecosystem Survey (Draft)

Terrestria Pty Ltd (Terrestria) conducted a one-day ecological survey at select areas within Lot and Plan 3TR12, on behalf of Santos in March 2019 to inform the locating of proposed gas infrastructure. The assessment comprised a desktop review of publicly available data, followed by a field survey which included vegetation characterisation and TEC assessments at Middle Hill.

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4.3 Field survey

A five-day field survey was conducted at select areas on Lot and plan 2TR13 and Lot and plan 3TR12, within the Project Area by two AECOM ecologists from 19 to 26 June 2020. Steve Wilson, an Australian reptile specialist, was also engaged for three of the five survey days.

The areas surveyed are henceforth referred to collectively as the Survey Area (Figure 3).

4.3.1 Flora

4.3.1.1 Vegetation community assessment

The extent, classification and condition of ground-truthed vegetation communities within the Survey Area was validated in accordance with the Methodology for Surveying and Mapping Regional Ecosystem and Vegetation Communities in Queensland (Neldner, et al., 2019). This included traversing the Survey Area undertaking tertiary and quaternary level assessments.

As per the Queensland Herbarium methodology (Neldner, et al., 2019), tertiary level site assessments were undertaken within a 10 by 50 m quadrat, collecting the following information:

- vegetation structure, species composition and percentage cover for each structural layer
- aspect and slope
- soil type
- landform
- disturbance type and severity
- RE and remnant status.

Quaternary-level sites were utilised to verify vegetation units and confirm dominant characteristic species. Structural analysis included recording the height class and life form of the dominant species within the mid and canopy strata as per (Neldner, et al., 2019). Several time-encoded digital photographs were taken at each tertiary and quaternary site assessment as a reference.

RE classification was determined based on the vegetation, soil and landform characteristics identified in the field, geological mapping for the region and the Regional Ecosystem Description Database (REDD). Condition status for woody vegetation was evaluated utilising the definitions of remnant vegetation under the VM Act. For the purposes of this assessment, vegetation was mapped into three categories:

- Remnant: woody vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has greater than 70% of the height and greater than 50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
- High-value Regrowth (HVR): areas previously cleared or disturbed (e.g. by wildfire) over 15 years ago and containing woody vegetation floristically and structurally consistent with the RE but typically less than 70% of the height and less than 50% density of the RE.
- Regrowth or non-remnant: areas previously cleared or otherwise significantly disturbed.

A total of 34 sites including 19 tertiary transects and 15 quaternary sites were undertaken within the Survey Area (Figure 3).

4.3.1.2 Functionality assessment

Vegetation communities assessed to comprise remnant or HVR vegetation and analogous to an RE with an endangered biodiversity status (under the Queensland EP Act), were also assessed for functionality. Four condition attributes as per Table 2 below were assessed to determine if the patch was considered functional.

Table 2 Minimum ecosystem attributes for functional non-grassland ecosystems

Attribute	Cut-off
Patch size	>0.5 ha
Total non-native perennial vegetative cover	<50%
Recruitment to EDL	Yes
Minimum median canopy height	>1/3 of the median benchmark

4.3.1.3 Targeted flora searches

Targeted searches for threatened flora species identified in the desktop assessment were undertaken in areas of potentially suitable habitat confirmed during vegetation community assessments across the Survey Area.

4.3.1.4 Specimen ID

Where plant species could not be identified in the field, fruiting and/or flowering specimens were taken to assist with identification. For those species not field identified during the surveys, samples were pressed and dried, and positive identifications of plant specimens were subsequently made under laboratory conditions.

4.3.1.5 Nomenclature

Taxonomic nomenclature used for the description of floral species is according to Census of the Queensland Flora 2018 (Bostock & Holland, 2018). Exotic flora species are signified in text by an asterisk (*). Field references used for the identification and description of floral species include: Anderson (2016); Brooker & Kleinig (2004); Lester (2008).

4.3.2 Terrestrial fauna

The baseline sampling of vertebrate fauna species was undertaken using standard methodologies for the systematic survey of terrestrial fauna in eastern Australia (Eyre et al., 2018). Methods employed during the field assessment included:

- Fauna habitat assessments
- Active searches
- Scat and sign searches
- Visual and auditory identification surveys of birds
- Incidental observations.

Further information regarding each of these methods and survey effort is detailed in Table 3 below. Fauna habitat assessment sites are displayed on Figure 3. At every fauna habitat assessment site, active searches, scat and sign searches and bird censusing was conducted.

D R A F T

Table 3 Fauna survey methods

Method	Target fauna	Description	Survey effort
Habitat assessment	Reptiles, mammals, amphibians and birds	Each habitat assessment site was one hectare (100 m x 100 m, or 200 m x 50 m). Habitat attributes recorded during the assessment included: • Vegetation structure and dominant species, including a description of canopy, shrub and ground layer structure and composition. • Soil composition and landform • Presence and abundance of tree hollows and stags. • Presence and abundance of woody debris such as habitat logs and ground timber. • Rocky habitat such as surface rocks, boulders, crevices, overhangs and caves. • Proximity to water (both permanent and ephemeral). • Disturbance from invasive weeds/pests. • Other disturbances such as grazing pressure, clearing, thinning or fire. Any other significant habitat features, or values present, such as leaf litter, gilgai, decorticating bark, dense grass/shrub shelter, seeding grass cover, fruiting plants, nectar and pollen producing plants (i.e. mistletoe), and koala food trees.	26 fauna habitat sites (Figure 3)
Active search	Reptiles, mammals, amphibians and birds	Searches included scanning the trees and ground, searching beneath microhabitat such as rocks, fallen timber and peeling bark, digging through leaf litter and soil at tree bases and flushing birds from areas with a dense or grassy ground cover. Physical disturbance to habitat features and reptiles was kept to a minimum.	
Scat and sign search	Reptiles, mammals, amphibians and birds	Searches included looking for signs of animal activity, including tracks, scats, scratches, bones, fur, feathers, nests, foraging holes and diggings.	
Diurnal bird survey	Birds	Roaming/meandering bird surveys using both visual and auditory identification. Surveys commenced at dawn and continued throughout the day.	Approximately 72-person hours
Incidental observations	Reptiles, mammals, amphibians and birds	All fauna observed incidentally within or in close proximity to the Survey Area were recorded, including those seen while travelling along roads and tracks.	

AECOM

0 0.6 1.2 KMS

LEGEND

- Project Area
- Survey Area
- Roads and Tracks
- Minor Watercourses

Survey Methods

- Tiertary site
- Quaternary site
- TEC assessment
- Vegetation functionality site
- Habitat assessment site
- Observation point

FIGURE 3
SURVEY AREA & SURVEY SITES

4.4 Aerial imagery and LIDAR assessment

Santos provided AECOM aerial imagery and LIDAR data (ground and non-ground) of the Project Area collected in 2020 to inform vegetation and habitat mapping for areas within the Project Area that were not surveyed. The characteristics of ground-truthed vegetation communities observable on aerial imagery (shape, colour, landform associations) were applied to identify and map other potential areas of the same vegetation community within the Project Area.

The mapping of non-field validated vegetation was further assisted through the generation of two digital elevation models (DEM). The first DEM was generated in ESRI GIS software ArcGIS Pro utilising both ground and non-ground LIDAR returns with a 2m horizontal resolution. The DEM was displayed as point clouds and overlain with the aerial imagery, creating a coloured three-dimensional view of the landscape. Tree density and average vegetation height was able to be determined using this data. Both these attributes allowed for the condition status of woody vegetation to be inferred based on the definitions of remnant vegetation under the VM Act. Historical aerial imagery was also used to assist this determination, particularly when differentiating between HVR and regrowth. HVR was identified from regrowth areas based on the persistence of the vegetation in imagery over the last 15 year period.

To identify and map habitat that is associated with terrain features (i.e. gilgai, creek lines, etc), a second DEM with a 60 centimetre (cm) resolution was generated in Global Mapper from ground-returns only. A hillshade effect (alteration of lighting and shadows based on the location of the sun) was applied to the DEM to enhance the appearance of depth and dimension.

4.5 Likelihood of occurrence

A likelihood of occurrence assessment for species listed under the NC Act identified during the desktop review was undertaken. Where possible, targeted assessments were undertaken in the field for species identified as either being likely to occur, or having potential to occur, within the Project Area, based on the desktop sources. The methodology was applied again after field surveys and LIDAR assessment to determine the likelihood of occurrence once site-based information became available.

Each species was assessed against the categories defined below.

- **Known**: Species was positively identified and recorded in the Project Area during the field surveys; or previous, reliable records occur within the Project Area
- **Likely**: Species was not recorded during the field surveys or previously, however there are known records within the nearby surrounding area and suitable habitat exists in the Project Area
- **Potential**: Species was not recorded during the field surveys or previously, however known records occur in the surrounding area and habitat in the Project Area is marginal or degraded
- **Unlikely**: Habitat in the Project Area might be suitable or marginal; however, species was not recorded during the field surveys, and no known records of the species exist within the surrounding area
- **No**: This is usually applied to marine species or seabirds for terrestrial sites.

4.6 Habitat mapping

Following the completion of the field survey, the likelihood of occurrence assessment and the aerial imagery and LIDAR assessment, mapping for the conservation significant flora and fauna known or having the potential to occur within the Project Area was undertaken.

Where available, information from publicly available databases were used as a basis to develop the ‘modelling rules’, including relevant species recovery plans (where available), referral guidelines, approved conservation advice, the Species Profile and Threats database (SPRAT), management plans and peer-reviewed journal articles. Habitat assessments collected during the field surveys, species records (previous and survey records), and Project vegetation mapping was used to map the potential habitat according to the modelling rules. These mapping rules, assumptions and GIS approach are detailed in Table 22 of Appendix D.

4.7 Significant residual impact assessment

A significant residual impact assessment in accordance with the criteria provided in the Significant Residual Impact Guidelines (Department of the Environment and Heritage Protection, 2014) has been undertaken for MSES identified within the Project Area.

Significant residual impact assessments for the relevant MSES values were completed using ground-truthed data. In the absence of ground truthed data, available State mapping was used over extrapolated LiDAR mapping. The only exception to this is habitat mapping that has been completed for potentially occurring Endangered, Vulnerable or Near Threatened (EVNT) species. The full approach and specific significant impact criteria utilised is outlined in Appendix F.

4.8 Limitations

4.8.1 Approach and land access

This assessment has been completed using a combination of field-validated data, desktop information and extrapolated field survey results. As such the results are subject to the level of accuracy and detail associated with this information. Interpretation of LIDAR and aerial imagery was completed visually, and as a result some degree of subjectivity occurs in the mapping completed via this method.

Due to land access restrictions, only a portion of the total Project Area was able to be surveyed (the Survey Area). This Survey Area occurs within an area, which based on aerial imagery, likely contains a higher percentage of non-remnant grazing land. As a result, not all vegetation communities potentially present within the Project Area have been field-validated. Furthermore, different land management practices are known to occur across the Project Area, which may create variations in the presence and or condition of vegetation communities and habitat types.

To address these limitations, a precautionary approach has been applied. Where potential suitable habitat for an EVNT species occurs, presence has been assumed and therefore included in the impact assessment.

4.8.2 Detectability

The general limitations to this ecology assessment conducted in the Project Area include the following:

- Species with large home ranges may not be present in the Project Area-part of their home range during the survey period.
- The difficulty in detecting certain species during the survey period (e.g. cryptic species and species present in the Project Area in low densities).
- Biological factors such as sex, age-class, and breeding biology which may influence species' habitat use and detectability during different times of year.

For those species not detected and with records nearby, habitat assessments were undertaken to determine the value of the Project Area to support such species. The absence of a species was not assumed because it was not detected.

A flora assessment has inherent limitations associated with the variability of vegetation communities across a survey location, and changes to the detectability and presence of species over time. The seasonal condition during which the survey was undertaken (winter) was not conducive to a high degree of detectable floral diversity. Furthermore, it is recognised that field studies undertaken over just one season cannot always account for 100% of potential floral diversity present across a survey location.

Field survey data collection to inform mapping was conducted using a hand-held iPad unit with aerial imagery. The accuracy of the iPad is generally <5 m and considered appropriate for the purpose of this assessment.

D R A F T

5.0 Ecological values

5.1 Regional context

5.1.1 Bioregion and subregion

The Project Area is primarily located within the Central Highlands Regional Council LGA, with small sections of the western ridgeline falling within the Maranoa Regional Council LGA. It is approximately 60 km north east of Injune and within the southern section of the Brigalow Belt Bioregion (BRB). The landscape of this bioregion is mixed, including hilly areas with low ridges and undulating plains within the lower flats and alluvial areas.

Except for some small areas in the south western corner considered part of the Carnarvon Ranges, the Project Area is situated within the Arcadia subregion of the BRB. The eastern, southern and western Arcadia subregion terrain is characterised as rugged on coarse sandstones with *Eucalyptus* spp. and *Corymbia* spp. woodland communities. The central area of the subregion is largely contained within a broad valley of undulating plains. Where clay soils occur, vegetation is dominated by *Acacia harpophylla* (brigalow) and some softwood scrub, and by *Eucalyptus populnea* (poplar box) where soils are alluvial (Sattler & Williams, 1999).

5.1.2 Surface geology and landzones

The DNRME Surat Basin regional surface geological mapping (1974) identified the Project Area to contain five different geology units (Department of Natural Resources Mines and Energy, 2020). Geology units are described in Table 4 below.

Table 4 Major surface geology units mapped within the Project Area

Unit Name	Map Symbology	Age	Lithology Summary	General location within Project Area
Alluvium Q-NSB	Q	Quaternary	Alluvium of older flood plains, sand, gravel, soil	East
Rewan Group	Rr	Early Triassic – Middle Triassic	Lithic sandstone, pebbly lithic sandstone, green to redish brown mudstone and minor volcanilithic pebble conglomerate (at base)	Centre
Clematis Group	Re	Middle Triassic	Medium to coarse-grained quartzose to sublabile, micaceous sandstone, mudstone and granule to pebble conglomerate	Western ridgeline (slope)
Moolayember Formation	Rm	Middle Triassic	Micaceous lithic sandstone, micaceous siltstone	Western ridgeline (upper plateau)
Precipice Sandstone	Jp	Early Jurassic	White to brown, poorly sorted, thick-bedded, cross-bedded, fine to very coarse-grained, pebbly quartzose sandstone; minor white to yellowish brown, laminated siltstone (in upper part), carbonaceous shale, lithic sublabile sandstone, granule conglomerate	Western ridgeline (upper plateau)

Land zones are categories that describe the major geologies, the associated landforms and geomorphic processes in Queensland, and are a critical component of the RE classification scheme. Land zones have been delineated across the Project Area based on the available surface geology

mapping. Three land zones (Table 5) have been identified and are broadly consistent with the surface geology mapping. Definitions are consistent with (Wilson & Taylor, 2012).

Table 5 Land zones and associated surface geologies present within the project site.

Land Zone	Description	Associated Geological Unit
3	Recent Quaternary alluvial systems, including closed depressions, paleo-estuarine deposits currently under freshwater influence, inland lakes and associated wave built lunettes. Excludes colluvial deposits such as talus slopes and pediments. Includes a diverse range of soils, predominantly Vertosols and Sodosols; also with Dermosols, Kurosols, Chromosols, Kandosols, Tenosols, Rudosols and Hydrosols; and Organosols in high rainfall areas.	Q, Rm
9	Fine grained sedimentary rocks, generally with little or no deformation and usually forming undulating landscapes. Siltstones, mudstones, shales, calcareous sediments, and labile sandstones are typical rock types although minor interbedded volcanics may occur. Includes a diverse range of fine textured soils of moderate to high fertility, predominantly Vertosols, Sodosols, and Chromosols.	Rr, Re
10	Medium to coarse grained sedimentary rocks, with little or no deformation, forming plateaus, benches and scarps. Includes siliceous (quartzose) sandstones, conglomerates and minor interbedded volcanics, and springs associated with these rocks. Excludes overlying Cainozoic sand deposits (Land Zone 5). Soils are predominantly shallow Rudosols and Tenosols of low fertility, but include sandy surfaced Kandosols, Kurosols, Sodosols and Chromosols.	Rr, Re, Rm, Jp

5.1.3 Climate

The climate of the region is sub-tropical, characterised by warm wet summers and mild dry winters. The nearest Bureau of Meteorology (BOM) station to the Project Area is located south in the township of Injune (station number 043015). Recorded mean maximum daily temperatures are highest from November through to February, ranging from 31.6°C to 33.8°C (BOM, 2020). In winter (June to August) mean minimum daily temperatures are at their lowest, and range from 3.3°C to 4.5°C.

The annual mean rainfall is 631.6 mm, with the wettest period occurring during the months of late spring and summer when, on average, 55% of the annual rainfall occurs.

5.2 Regulated vegetation

A review of the DNRME Regulated Vegetation mapping identified the presence of regulated vegetation at various locations within the Project Area. This includes the following regulated vegetation categories listed in Table 6. Large portions of the Project Area are mapped as Category X (non-remnant vegetation), with Category B vegetation restricted to the Public Reserve, the western ridgeline and Middle Hill. Category C vegetation also occurs within Middle Hill and directly adjacent, as well as along the western ridgeline and as an isolated patch in the northern Project Area. Only small patches of Category R vegetation occur, located in the valley area west of Middle Hill and within the Public Reserve.

Table 6 Regulated vegetation mapped within Project Area

VM Act vegetation category	Description
Category B	Remnant vegetation
Category C	HVR vegetation
Category R	Regrowth watercourse vegetation
Category X	Non-remnant

Three of the four categories of regulated vegetation were confirmed to occur within the Project Area using a combination of field-validated data and LiDAR modelling. Of the areas that have been ground-truthed during the field survey, some minor variation relative to the State mapped regulated vegetation was confirmed. Specifically, the extent of Category B regulated vegetation along the southern boundary of Public Reserve is less than what is delineated in the State mapping due to the presence of an access track.

5.2.1 Regulated vegetation within a defined distance of a watercourse

The DES 'MSES - Regulated vegetation - intersecting a watercourse' mapping was reviewed as part of the desktop assessment. Regulated vegetation intersecting a watercourse is mapped to occur within a Category B regulated vegetation area in five locations across the Project Area, including the Public Reserve, the western ridgeline and the southern extent of Middle Hill (Figure 4). As no ground-truthed data is available for these specific locations, it is assumed that the State regulated vegetation mapping is accurate.

5.3 Regional Ecosystems

DES RE mapping (Version 11.0) was reviewed as part of the desktop assessment to determine the classification and status of REs across the Category B and Category C regulated vegetation. Both homogenous and heterogenous polygons are mapped within the western ridgeline, Middle Hill and the Public Reserve, analogous to a total of nine REs (Table 7 below). Based on the status under the VM Act, of the mapped REs two are listed as Endangered (RE 11.9.5 and 11.9.5a), two as Of Concern (RE 11.3.2 and 11.9.4a) and the remaining are Least Concern. Desktop RE mapping is shown on Figure 4.

Results of the field survey confirmed the presence of six of the nine mapped REs as well as an additional RE (RE 11.3.1) not previously mapped (Table 7 and Table 8) within the Survey Area. Findings of the aerial imagery and LiDAR assessment determined the likely occurrence of the aforementioned field-validated REs in remnant, HVR and regrowth forms within the broader Project Area (i.e. outside of the Survey Area).

The extent, condition, dominant species and conservation significance of each vegetation community field validated and assessed via LiDAR is described below in Table 9, with representative site images (where available). The mapped extent of each vegetation community within the Project Area is shown in Figure 6. ESAs associated with mapped vegetation communities are shown on Figure 7.

Table 7 Desktop REs within the Project Area confirmed or unconfirmed via field or LiDAR validation

RE ID	Short Description	VM Act Status[1]	Biodiversity status[2]	Field-validated	LiDAR validated
11.3.2	*Eucalyptus populnea* woodland on alluvial plains	Of Concern	Of Concern	Yes	Yes
11.3.25	*Eucalyptus tereticornis* or *E. camaldulensis* woodland fringing drainage lines	Least Concern	Of Concern	Yes	Yes
11.3.39	*Eucalyptus melanophloia* +/- *E. chloroclada* open woodland on undulating plains and valleys with sandy soils	Least Concern	No concern at present	No	No
11.9.4a	Semi-evergreen vine thicket (SEVT)	Of Concern	Endangered	Yes	Yes
11.9.5	*Acacia harpophylla* and/or *Casuarina cristata* open forest on fine-grained sedimentary rocks	Endangered	Endangered	Yes	Yes
11.9.5a	Open forest of *Acacia harpophylla* +/- *Eucalyptus populnea*, *Casuarina cristata*, *Cadellia pentastylis* and *Brachychiton* spp. on sedimentary rocks	Endangered	Endangered	No	No
11.10.1	*Corymbia citriodora* woodland on coarse-grained sedimentary rocks	Least Concern	No concern at present	No	Based on previous ecological assessment only (Terrestria, 2017)
11.10.13a	*Eucalyptus cloeziana* +/- *E. melanoleuca* +/- *Corymbia bunites* +/- *E. sphaerocarpa* woodland to open forest	Least Concern	No concern at present	No	No
11.10.4	*Eucalyptus decorticans*, *Lysicarpus angustifolius* +/- *Eucalyptus* spp., *Corymbia* spp., *Acacia* spp. woodland on coarse-grained sedimentary rocks	Least Concern	No concern at present	Yes	Yes
Non remnant	Non remnant vegetation	-	-	Yes	Yes

1 Conservation status of the RE under the VM Act.
2 Biodiversity (BD) status under the EP Act of the RE based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem.

Table 8 Additional RE verified within the Survey Area not previously mapped

RE ID	Short Description	VM Act Status[1]	Biodiversity status[2]	Field-validated	LiDAR validated
11.3.1	*Acacia harpophylla* and/or *Casuarina cristata* open forest on alluvial plains	Endangered	Endangered	Yes	Yes

1 Conservation status of the RE under the VM Act.
2 Biodiversity (BD) status under the EP Act of the RE based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem.

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Table 9 Vegetation communities within the Project Area

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
Brigalow low open forest on alluvial plains	HVR 11.3.1	This vegetation community occurs on undulating plains, along shallow and narrow drainage lines within the Survey Area. In the wider Project Area it is also mapped in the northern central area of 2TR13 and eastern extent of 2SP200046. It comprises a low canopy layer ranging from 7 to 13 m dominated by *Acacia harpophylla* (brigalow), with *Eucalyptus populnea* (poplar box) or *Eucalyptus melanophloia* (silver-leaved ironbark) emergents (height ranging 13 to 17 m). The canopy often also contains *Lysiphyllum carronii* (red bauhinia). Canopy cover is generally mid-dense, averaging approximately 40 %. The sub-canopy is sparse (average cover 16 %) and also dominated by young brigalow, with *Geijera parviflora* (wilga) and red bauhinia often co-dominant. A low, often very sparse shrub layer of wilga, *Carissa ovata* (currant bush) and *Alectryon diversifolius* (scrub boonaree) is also present. The ground layer coverage is highly variable, ranging from 20 to 60 %. Areas of high cover were due to exotic grasses *Cenchrus ciliaris** (buffel grass) and *Urochloa mosambicensis** (sabi grass), although native grasses such as *Enteropogon ramosus* (curly windmill grass) and *Aristida sp.* were also sometimes present. In addition to the presence of exotic weed species, other disturbances include heavy stock grazing and historical clearing.	E / E	63.94 Ground-truthed: 12.83 Desktop only: 51.11	

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
Brigalow open forest on alluvial plains	11.3.1	This vegetation community was field-validated to occur in the Public Reserve and in patch along the unnamed tributary of Station Creek (eastern extent of Project Area). In the wider Project Area, scattered patches are considered to occur within 2TR13 while large connected tracts occur within 2SP200046, generally in association with mapped VM Act watercourses. Vegetation is dominated by brigalow with an average canopy height of 15 m and 35 % cover. Occasional poplar box forms an emergent canopy up to 16 m. A lower sub canopy to 9 m is often present and is composed of younger brigalow with the addition of *Atalaya hemiglauca* (whitewood) and wilga. A low, variable shrub layer also occurs, generally dominated by native species such as *Apophyllum anomalum* (broom bush) or *Maireana microphylla* (cotton bush), with occasional recruited wilga, brigalow, scrub boonaree and *Citrus glauca* (desert lime). Shrub cover is very sparse at or below 5 %. The coverage and composition of the ground layer is highly variable. Where this vegetation community occurs in the Public Reserve, cover is low (20 %) and largely comprised of native grasses and forbs including *Aristida sp.*, *Eragrostis sp.*, *Enteropogon ramosus* (curly windmill grass), *Dianella sp.* and *Lomandra longifolia*. In contrast, where it occurs along the unnamed creek, cover is 60 % and dominated by the exotic buffel grass. Disturbances for this vegetation community are limited in some areas, but include historical clearing, weed infestation and grazing.	E / E	200.43 Ground-truthed: 0.21 Desktop only: 200.22	
Eucalyptus populnea +/- *Eucalyptus melanophloi*	11.3.2	This vegetation community was confirmed along a shallow drainage line on low undulating plains at one location within the Survey Area. Within the wider Project Area, it is considered	OC / OC	26.86	

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
a open forest on alluvial plains		to also occur in two large patches on the eastern boundary and in six patches along a mapped watercourse in 2SP200046. The canopy is sparse (20 %) and dominated by poplar box with an average height of 16 m. The sub-canopy is dominated by poplar box and brigalow up to 10 m, as well as wilga and red bauhinia up to 6 m. A very sparse (<10%) low shrub layer comprised of the exotic species *Maireana microphylla* (cotton bush) is also present. The ground layer coverage is mid-dense (35 %) and dominated by the exotic grasses buffel grass and sabi grass. Disturbance due to grazing was found to be severe.		Ground-truthed: 0.97 Desktop only: 25.89	
Eucalyptus camaldulensis riparian woodland	11.3.25	This vegetation community occurs along the unnamed tributary of Station Creek that traverses the Project Area in the east. It is also considered to occur along Arcadia Creek, in the north east of the Project Area. The canopy is dominated by *Eucalyptus camaldulensis* (river red gum) with an average height of 22 m. Other species also recorded in the canopy were *Corymbia tessellaris* (Moreton Bay ash) poplar box and *Eucalyptus melanophloia* (silver-leaved ironbark). Canopy cover averaged 30%. A sparse (15%) sub-canopy layer is present and generally dominated by brigalow up to 10 m. Poplar box, Moreton Bay ash, *Acacia salicina* (Sally wattle), wilga and red bauhinia were also occasionally recorded in the sub-canopy. A very sparse shrub layer (>10%) is present and largely comprises young wilga, red bauhinia, *Acacia excelsa* (ironwood) up to 2 m, with occasional *Maireana microphylla* (cotton bush). The ground layer is generally variable with sparse cover (25%) due to cattle grazing. Although native grasses such as *Aristida sp.* and	OC / LC	26.51 Ground-truthed: 16.82 Desktop only: 9.69	

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
		Bothriochloa bladhii are present, the exotic grasses buffel grass) and sabi grass frequently dominate. The main source of disturbance in this community is historical thinning and cattle grazing, with soil compaction leading to areas of severe stream bank erosion.			
SEVT with brigalow understorey	11.9.4a	Within the Survey Area this vegetation community was confirmed on a steep low hill just north of Middle Hill. In the wider Project Area. On the low hill, the canopy layer coverage is sparse (15%) and dominated by *Acacia harpophylla* (brigalow) followed by *Geijera parviflora* (wilga) with an average height of 5 m. A very sparse (5% cover) emergent canopy is present, dominated by *Lysiphyllum carronii* (red bauhinia) with occasional *Atalaya hemiglauca* (whitewood) up to 15 m. The sub-canopy is also very sparse, primarily comprised of wilga with some *Brachychiton rupestris* (narrow-leaved bottle tree) and *Casuarina cristata* (belah). The shrub layer is the ecologically dominant layer (EDL) with a cover of 20% recorded. It is dominated by *Eremophila mitchellii* (false sandalwood) with *Croton insularis* (silver croton) also frequently occurring. Other species present in the shrub layer include *Alectryon diversifolia* (scrub boonaree), *Carissa ovata* (currant bush) and *Diospyros humilis* (Queensland ebony). The ground layer coverage is sparse (10%) and dominated by the exotic grass *Cenchrus ciliaris** (buffel grass). Other ground layer species include *Abrus precatorius* (crab eye creeper), *Cheilanthes sieberi* and *Pandorea jasminoides.* Exotic weed species, heavy stock grazing and historical clearing are the primary disturbances in this community.	E / OC	0.71 Ground-truthed: 0.71 Desktop only: 0.0	

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
SEVT	11.9.4	This community was confirmed within the western ridgeline during the field survey, and identified within Middle Hill by Terrestria. Within the western ridgeline, this community had a variable mid-dense canopy dominated by either *Eucalyptus orgadophila*, belah or *Brachychiton rupestris*. On the lower slopes, this community may be dominated by brigalow in the canopy. Cover provided by the understorey and shrub was mid-dense to dense, and greater than recorded on the low hill (RE 11.9.4.a) likely due to the lack of disturbance in this location (only evidence of fire and some historical thinning). Due to limited access and topography, understorey species could not be confirmed but are considered likely to include *Flindersia collina*, *Backhousia angustifolia*, brigalow, *Excoecaria dallachyana* and *Brachychiton rupestris*, with shrub species including *Gossia bidwillii*, *Glossocarya hemiderma*, *Acalypha eremorum*, *Croton insularis*, *Pittosporum spinescens* and currant bush. The ground layer is likely dominated by currant bush or *Einadia nutans*. Although some exotic grasses may occur, their cover will be low.	E / OC	613.20 Ground-truthed: 0.00 Desktop only: 613.20	
SEVT regrowth	HVR 11.9.4	This community occurs on the exterior and lower slopes of the western ridgeline and Middle Hill. Outside of these areas, an additional four small patches are mapped to the north in 2TR13. A review of historical aerial imagery indicates that historical clearing has occurred in these areas, and as such the vegetation is likely to be in HVR condition. Areas of this vegetation community are likely to contain canopy vegetation as described above (remnant RE 11.9.4), however cover is likely to be considerably lower. The sub-canopy and shrub layer is likely to be variable although predominately sparse to very sparse, and only contain a fraction of usually	E / OC	48.21 Ground-truthed: 2.12 Desktop only: 46.09	

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Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
		occurring species. Exotic grasses such as buffel grass may dominate the ground layer.			
Brigalow low open forest on sedimentary rock	HVR 11.9.5	This vegetation community was confirmed to occur in scattered patches on low hills within the Survey Area. In the wider Project Area, scattered patches are also mapped to occur in the western extent, especially within the 2SP200046 property south of Middle Hill. It has a low canopy dominated by brigalow and occasionally wilga with an average height of 6.5 m. Other species recorded in the canopy include of whitewood, poplar box, *Eremophila mitchellii* (false sandalwood), red bauhinia and *Owenia acidula* (emu apple). Canopy cover is generally mid-dense, averaging approximately 37.5 %. An emergent canopy is sometimes present, comprised of poplar box, silver-leaved ironbark or red bauhinia up to 16.5 m. The sub-canopy is sparse (average cover 10 %) and highly variable, dominated by brigalow, wilga, false sandalwood or red bauhinia with heights ranging from 3 to 6 m. A shrub layer is usually absent, although where present is very sparse (>5%) and comprised of currant bush, young brigalow or *Clerodendrum floribundum* (lolly bush). The ground layer is dominated by the exotic buffel grass and generally sparse (average of 30 %). The native forb *Abutilon oxycarpum* and other exotic grasses such as *Echinochloa colona* (barnyard grass) and *Megathyrsus maximus* (guinea grass) were also present. In addition to the presence of exotic weed species, other disturbances include heavy stock grazing and historical clearing.	E / E	45.37 Ground-truthed: 1.47 Desktop only: 43.9	
Brigalow low open forest	HVR 11.9.5a	This community was not encountered during the field survey however is expected to occur as small discrete patches in the northern Project Area, based on the findings of the aerial	E / E	3.01	-

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
with SEVT understorey		imagery and LiDAR assessment. The following RE description has been taken from the REDD database. Brigalow predominates and forms a fairly continuous canopy (10-18m high). Other tree species such as poplar box, *Casuarina cristata* (belah), *Cadellia pentastylis* (ooline) and *Brachychiton spp.* may also be present in some areas and form part of the canopy or emerge above it. Scattered *Eucalyptus orgadophila* may occur, especially on upper slopes and crests. A dense tall shrub layer dominated by a range of species is usually present, while a more open low shrub layer often occurs. Common species in these layers include *Croton insularis*, *Denhamia oleaster*, *Apophyllum anomalum*, *Croton phebalioides*, *Alectryon diversifolius* and currant bush. The ground layer is sparse, most frequently composed of *Ancistrachne uncinulata* and *Eragrostis megalosperma* and varies with the density of the shrub layers. Occurs on undulating plains and rises formed mainly on shales. The soils are predominantly cracking clay soils, which are strongly alkaline at or near the surface and acidic beneath, or dark brown and grey-brown gradational soils, with a coarse-textured surface grading into an alkaline, clayey subsoil.		Ground-truthed: 0.00 Desktop only: 3.01	
Brigalow open forest on sedimentary rock	11.9.5	This community was not encountered during the field survey however is expected to occur as scattered patches across the Project Area, primarily in the western extent of 2SP200046 based on the findings of the aerial imagery and LiDAR assessment. The following RE description has been taken from the REDD database. Open forest dominated by brigalow and/or belah (10-20m) or brigalow with a semi-evergreen vine thicket understorey. A	E / E	48.15 Ground-truthed: 0.00 Desktop only: 48.15	--

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
		prominent low tree or tall shrub layer dominated by species such as wilga and false sandalwood, and often with semi-evergreen vine thicket species is often present. The latter include *Flindersia dissosperma*, *Brachychiton rupestris*, *Excoecaria dallachyana*, *Macropteranthes leichhardtii* and *Acalypha eremorum* in eastern areas, and species such as currant bush, emu apple, *Croton insularis*, *Denhamia oleaster* and *Notelaea microcarpa* in south-western areas. *Melaleuca bracteata* may be present along watercourses.			
Corymbia citriodora woodland on coarse-grained sedimentary rocks	11.10.1	This community was not encountered during the field survey however is expected to occur within Middle Hill based on the findings of the Terrestria assessment and State vegetation mapping. The following RE description has been taken from the REDD database. *Corymbia citriodora* (spotted gum) predominates and forms a distinct but discontinuous woodland (to open forest) canopy (20-30m high). On rocky slopes, *Eucalyptus crebra* (narrow-leaved ironbark) and *C. hendersonii* (Henderson's bloodwood) may be scattered throughout the canopy or locally abundant. On flats and footslopes, scattered narrow-leaved ironbark, *C. clarksoniana* (Clarkson's bloodwood) and Moreton Bay ash may occur. *Corymbia trachyphloia* (brown bloodwood) and *E. cloeziana* often occur on crests and plateaus while *E. apothalassica* and *E. longirostrata* sometimes occur in moister microhabitats. Scattered tall to low shrubs, such as *Acacia leiocalyx*, *Acacia spp.*, *Bursaria spinosa subsp. spinosa*, *Persoonia falcata*, *Alphitonia excelsa*, *Petalostigma pubescens* and *Xanthorrhoea johnsonii* are usually present and sometimes form a conspicuous layer. The ground layer varies	NCAP / LC	2.52 Ground-truthed: 0.00 Desktop only: 2.52	-

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
		from sparse to moderately dense (depending on the rockiness) and is dominated by perennial grasses.			
Eucalyptus decorticans open forest on sedimentary rock	11.10.4	This vegetation community occurs within the Project Area on fine-grained sedimentary rocks along the steep hill slopes of the western ridgeline. The canopy is dominated by *Eucalyptus decorticans* (gum-top ironbark) with an average height of 22 m. The canopy coverage is mid-dense with 40% recorded. Gum-top ironbark up to 14 m also dominates the sub-canopy. The shrub layer is variable, with very sparse (<10%) areas dominated by *Acacia leiocalyx* and *Pittosporum spinescens* up to 2.5 m and mid-dense areas of tall *Acacia bancroftiorum* primarily where the substrate comprises large rock slabs. Other species present in the shrub layer include currant bush, whitewood and desert lime. The ground layer is dominated by the native grass *Arundinella nepalensis* with a generally mid-dense cover (30 to 70% recorded). Also common are the native grasses *Aristida sp.* and *Paspalidium sp.,* while *Enneapogon sp.* and *Lomandra multiflora* occur occasionally. Evidence of disturbance in this community was low, restricted to fire (at least 5 years ago) and limited historical thinning near access tracks and fence lines.	NCAP / LC	795.34 Ground-truthed: 0.00 Desktop only: 795.34	

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
Regrowth	-	Small patches of regrowth vegetation were observed across the Survey Area, largely beside tracks and along drainage lines. Vegetation was usually dominated by brigalow up to 6 m or *Alstonia constricta* (bitter bark) up to 7 m which formed a low sparse canopy. Where bitter bark dominated, other softwood scrub species occasionally occurred in the canopy including *Acacia fasciculifera, Flindersia collina* (leopard ash), *Cassia tomentella* (velvet cassia) and *Petalostigma pubescens* (quinine tree). Both brigalow and softwood scrub regrowth had a low and sparse shrub layer of currant bush. The ground layer is dominated by buffel grass although variable in cover, with areas of bare ground common.	NA/NR	406.46 Ground-truthed: 4.03 Desktop only: 403.85	
Modified wetlands	-	Permanent waterbodies comprising modified wetlands occurred in scattered locations across the Survey Area, many of which were associated with mapped watercourses. Waterbodies generally had raised banks on one or two sides, with scattered occurrences of the shrub *Maireana microphylla* (cotton bush) higher up on the top of the bank the only woody vegetation. Canopy tree species were absent. Ground cover is sparse and is dominated by *Cenchrus ciliaris** (buffel grass), but chenopod species, notably *Salsola australis* (Roly-poly) were also observed on the upper banks. In the low lying areas close to the water's edge, *Juncus usitatus* (common rush) sometimes formed a uniform ground layer up to 0.5 m. Interspersed with the common rush were scattered *Leptochloa digitata* (umbrella cane grass). Exotic weeds such as *Xanthium pungens* (Noogoora burr) and *Cirsium vulgare* (spear thistle) were also noted in low lying areas forming extensive dense stands. Aquatic flora species are largely absent with *Spirodela punctata* (thin duckweed) the only species recorded. An unknown green alga was the only other organisms noted within the water.	NA/NR	167.66 Ground-truthed: 33.90 Desktop only: 133.76	

D R A F T

Vegetation Community	RE	Description	BD[1]/ VM Act[2] Status	Area (ha) (Ground-truthed / Desktop-only)	Image
		Cattle pugging at the water's edge was a common disturbance in these areas. However, the large wetland adjacent to the Public Reserve appeared to be higher quality with limited impacts from cattle.			
Cleared exotic pasture	-	Large portions of the Survey Area comprise historically cleared pasture dominated by exotic buffel grass. Cover in many areas was dense due to the restricted access to cattle. Within 2TR13, occasional stands of planted *Leucaena leucocephala* formed a sparse shrub layer. Occasional stands of mature poplar box, red bauhinia or brigalow trees also occur largely beside tracks and near stock yards.	NA/NR	6,097.44	

1 Biodiversity (BD) status of the RE based on an assessment of the condition of remnant vegetation in addition to the pre-clearing and remnant extent of a regional ecosystem. NCAP=No Concern at Present; OC=Of Concern; E=Endangered
2 Conservation status of the RE under the VM Act; NR=Non-remnant; LC=Least Concern; OC=Of Concern; E=Endangered.

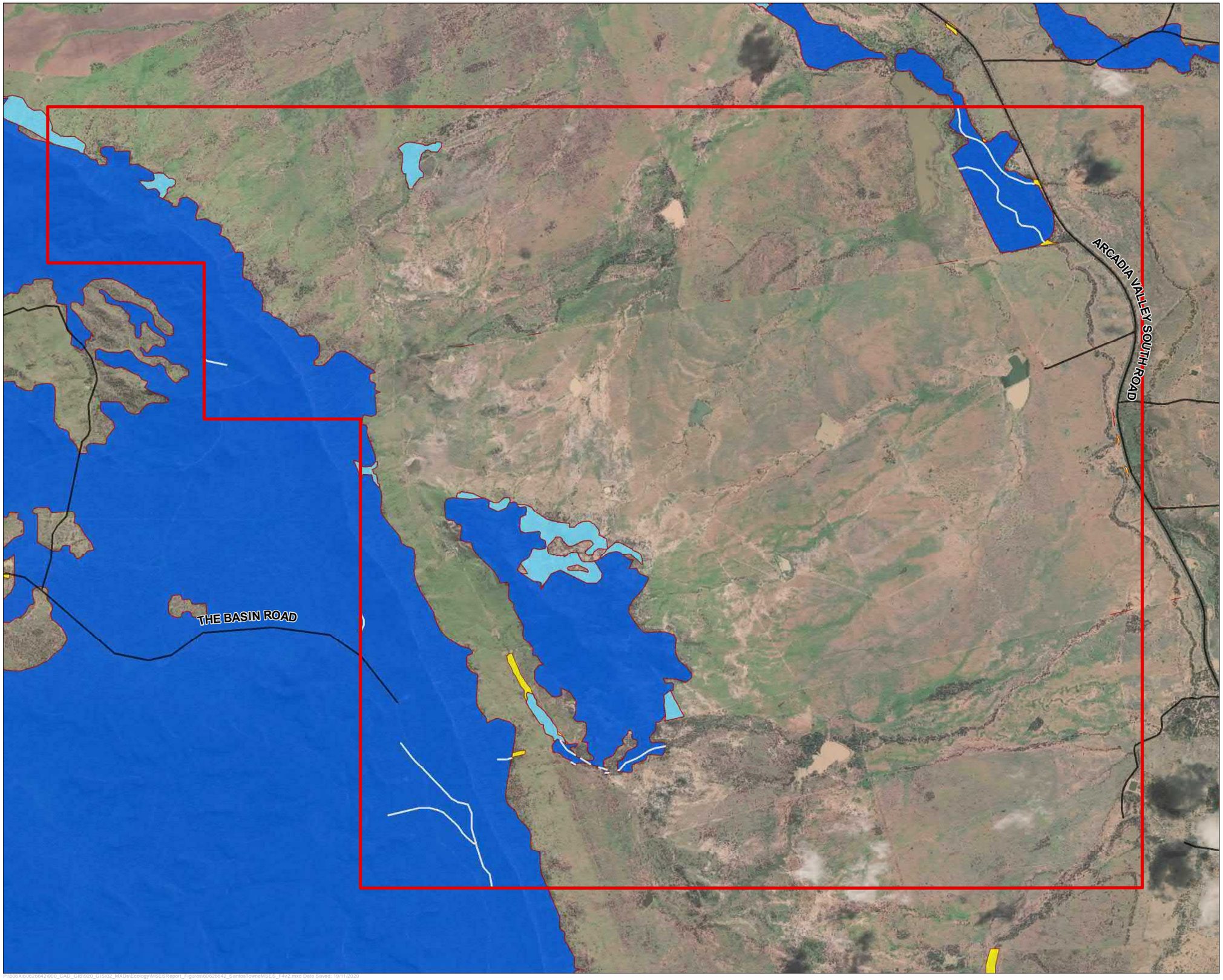
5.4 Flora diversity

The field survey identified the presence of 82 taxa representing 31 families and 65 genera. Families represented by three or more genera comprised Poaceae (17), Myrtaceae (7), Mimosaceae (8). Genera represented by three or more species comprised *Acacia* (6 species) and *Eucalyptus* (6).

No threatened flora species were identified. The full flora species list is provided in Table 23 of Appendix E.

5.5 Introduced flora species

A total of 11 exotic species were recorded from the Project Area during the field survey, including one species which is considered to be a 'Restricted Matters' under the *Biosecurity Act 2014* and a Weed of National Significance (WoNS): *Opuntia tomentosa** (prickly pear).



AECOM

0 0.55 1.1
KMS

LEGEND

- Project Area
- Roads and Tracks
- Regulated vegetation intersecting a watercourse (Category B area only)

Regulated Vegetation Management Map

- Category B area
- Category C area
- Category R area
- Category X area

FIGURE 4
REGULATED VEGETATION MANAGEMENT MAP

AECOM

0 0.55 1.1
KMS

LEGEND

- Project Area
- VM Act Watercourses
- Roads and Tracks

DES Regional Ecosystem Map

- Category A or B area containing endangered
- Category A or B area containing of concern
- Category A or B area that is least concern
- Category C or R area containing endangered
- Category C or R area containing of concern
- Category C or R area that is of least concern
- Non-remnant

FIGURE 5
DESKTOP VEGETATION MAPPING

AECOM

0 0.6 1.2 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Vegetation Communities

- Brigalow low open forest on alluvial plains (HVR 11.3.1)
- Brigalow open forest on alluvial plains (RE 11.3.1)
- Brigalow low open forest on sedimentary rock (HVR 11.9.5)
- Brigalow open forest on sedimentary rock (RE 11.9.5)
- Brigalow low open forest with SEVT understorey (HVR 11.9.5a)
- *C.citriodora* woodland on sedimentary rock (RE 11.10.1)
- *E.decorticans* open forest on sedimentary rock (RE 11.10.4)
- *E.populnea +/- E.melanophloia* open forest on alluvial plains (RE 11.3.2)
- Open <TIA>E.camaldulensis</ITA> riparian woodland (RE 11.3.25)
- SEVT (RE 11.9.4)
- SEVT regrowth (HVR 11.9.4)
- SEVT with Brigalow understorey on sedimentary rocks (HVR 11.9.4a)
- Softwood scrub regrowth (Non-remnant)
- Brigalow regrowth (Non-remnant)

FIGURE 6
ASSESSED RE EXTENT

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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AECOM

0 0.6 1.2 KMS

Ironbark Creek

Arcadia Creek

Station Creek

ARCADIA VALLEY SOUTH ROAD

Wallaroo Creek

THE BASIN ROAD

LEGEND

- Project Area
- Minor Watercourses
- Roads and Tracks
- Category B ESA
- Category C ESA

FIGURE 7
ASSESSED ESA EXTENT

5.6 Fauna habitat types

The landscape assessed during the survey was generally found to have been significantly altered from its original state due to broad-scale land clearing and cattle grazing. The exception to this being the Public Reserve, Middle Hill, and the western ridgeline, which are all considered to comprise large contiguous tracts of remnant vegetation.

Notwithstanding the aforementioned areas, fauna habitat within the Survey Area was found to occur in disjunct patches of vegetation in regrowth or advanced regrowth form, with remnant areas generally limited and associated with modified wetlands or mapped watercourses and drainage lines. Fauna habitat that does persist has been subject to disturbance from cattle grazing, selective clearing, weeds and pests. This has led to a general lack of native understorey growth, microhabitat features such as fallen woody debris and reduced structural complexity across the habitats. Despite signs of habitat degradation, several fauna habitat values still exist.

At least nine fauna habitat types are considered to occur within the Project Area based on both field validated data and the LiDAR assessment (Table 10). A description of these communities and the key fauna habitat opportunities is provided below.

Table 10 Fauna habitat types

Habitat No.	Habitat Type	Analogous REs	Area (ha)
1	Brigalow low open forest on alluvial plains and sedimentary rock	HVR 11.3.1 & HVR 11.9.5 & HVR 11.9.5a	112.33
2	Eucalypt open woodland on alluvial plains	11.3.2 11.3.25	53.37
3	SEVT	11.9.4 HVR 11.9.4 11.9.4a	662.12
4	Brigalow open forest on alluvial plains and sedimentary rock	11.3.1 11.9.5	248.58
5	Eucalypt open forest on coarse-grained sedimentary rock	11.10.1 & 11.10.4	797.86
6	Modified wetlands	Non-remnant	166.24
7	Gilgai	Non-remnant	133.60
8	Brigalow and soft wood scrub regrowth	Non-remnant	406.46
9	Cleared exotic pasture	Non-remnant	6,097.44

Brigalow low open forest on alluvial plains and sedimentary rock

Within the Survey Area, this habitat commonly occurs as small scattered patches on the undulating plains. Due to a high level of disturbance from ongoing cattle grazing, weeds, thinning and historical clearing, habitat was generally considered low quality.

No reptiles were recorded in this habitat during the field survey. However, occasional microhabitat features such as stones and rocks, woody debris or small fallen logs and thin leaf-litter cover do occur. Gilgai was not recorded, however outside of the Survey Area gilgai may occur within intact patches that have limited disturbance.

Foraging opportunities for foliage-gleaning and nectar-feeding bird species occur largely as a result of flowering brigalow trees containing flowering and fruiting mistletoe. Mistletoe was common and two different species occurred; one of which was grey mistletoe (*Amyema quandang*), a known foraging resource of the threatened painted honeyeater (*Grantiella picta*). Bird species recorded in this habitat include the olive-backed oriole (*Oriolus sagittatus*), ground cuckoo-shrike (*Coracina maxima*), apostlebird (*Struthidea cinerea*) and the bar-shouldered dove (*Geopelia humeralis*).

The koala food tree *Eucalyptus populnea* does occasionally occur and as such this habitat may facilitate koala (*Petauroides volans*) movement across the landscape. Hollow-bearing trees and stags were rare however, indicating nesting opportunities for hollow-dependent species are limited.

No mammals were recorded within this habitat type during the field surveys. Small patches of grass in the understory are likely to provide some foraging opportunities for macropods such as the eastern grey kangaroo (*Macropus giganteus*), however due to the general openness of the understorey minimal sheltering habitat for small ground-dwelling mammals is present.

No amphibians were recorded in this habitat and opportunities for this fauna group are considered limited due to the lack of available water.

Eucalypt open woodland on alluvial plains

This habitat occurs largely as linear patches along or within proximity to watercourses (Plate 1). Although disturbance from weeds, cattle grazing and some stream bank erosion is present, habitat is likely to provide an important corridor for fauna movement across the landscape.

Watercourses associated with this habitat were commonly found to have ponding or slow flowing water, suggesting that water availability is moderate and likely to be greater during the wet season. Such conditions create suitable habitat for a range of common amphibian species. Banks were generally steep however, indicating that habitat is unlikely to be suitable for reptile species such as turtles. Other opportunities for reptiles in this habitat are limited to the occasional woody debris, small to medium fallen logs and small areas of thin leaf litter. No reptiles were recorded in this habitat during the field survey.

Tall, koala food trees dominate the canopy and occasionally had birds such as the black-shouldered kite (*Elanus axillaris*) nesting within. Given the proximity to water, koalas may utilise habitat as refuge when water availability in the landscape is low. Mistletoe was only rarely recorded, nonetheless suitable foraging conditions for a range of nectar-feeding and foliage-gleaning birds occurs. Bird species recorded include the weebill (*Smicrornis brevirostris*), thornbills (*Acanthiza sp.*), brown honeyeater (*Lichmera indistincta*), white-plumed honeyeater (*Lichenostomus penicillatus*) and noisy friarbird *(Philemon corniculatus*). A group of double-barred finches (*Taeniopygia bichenovii*) were also observed drinking from a pool of water.

Hollow-bearing tress (usually *Eucalyptus camaldulensis*) and stags were common. Hollows were generally medium in size and therefore potentially suitable for the threatened greater glider. Despite the relatively open understorey, microbat species such as the threatened south-eastern long eared bat (*Nyctophilus corbeni*) may utilise the flyway created by the creek line and roost in the tree hollows. The areas of grassy ground layer provide dispersal opportunities for small ground-dwelling mammals and foraging opportunities for large mammals such as macropods.

D R A F T

Plate 1 Eucalypt open woodland on alluvial plains

Semi-evergreen Vine Thicket

This habitat occurs as scattered patches within the gullies and steep slopes of the western ridgeline and Middle Hill, as well as the low hills in the western extent of the Project Area. Within the western ridgeline and Middle Hill, habitat is expected to be high quality due to the overall lack of historical disturbance.

Water availability is higher in this habitat than adjacent woodlands and forests due to the more shaded aspect and terrain, channelling water to lower elevations (Plate 2). However, no known permanent water sources occur and as such habitat opportunities occur only for some specialised amphibians.

Although no birds were recorded during the field survey, a variety of species are likely to utilise the structurally complex vegetation of this habitat for refuge, and forage on the high diversity of flowering and fruiting plants.

Microhabitat features such as woody debris, stones, fallen logs and areas of leaf litter are abundant on the lower slopes and suitable for a range of reptile species including the eastern mulch-slider (*Lerista fragilis*) and the eastern striped skink (*Ctenotus robustus*) which were recorded. Areas of thick leaf litter and rock piles are expected to be common especially in the lower gullies. In the upper slope areas, larger stones and boulders occur and potentially provide denning opportunities for the threatened northern quoll (*Dasyurus hallucatus*).

The ground layer also contained a mid-dense cover of native grasses, which in addition to the shrubby understorey provides refuge and dispersal opportunities for small ground-dwelling mammals such as the exotic house mouse (*Mus musculus**) which was recorded under a large stone on the lower slopes. Larger mammals such as macropods may forage on the native grasses. Opportunities for arboreal mammals however are limited; koala habitat trees and hollow-bearing trees are largely absent.

A number of threatened flora, fauna and migratory species are known to occur in SEVT communities, including ooline (*Cadellia pentastylis*), *Bertya opponens*, rufous fantail (*Rhipidura rufifrons*) and northern quoll.

Plate 2 Semi-evergreen Vine Thicket

Brigalow open forest on alluvial plains and sedimentary rock

This habitat occurs in small to moderately sized patches in the northern and southern extents of the Project Area. The largest patch occurs in the Public Reserve where quality is considered high due to the overall lack of historical disturbance, fragmentation, and close proximity to permanent water. Where this habitat occurs in the southern extent of the Project Area, habitat quality is also likely to be moderate to high quality due to its connected nature.

Microhabitat features such as stones and rocks, woody debris and thin leaf-litter cover are occasional to commonly present and provide some opportunities for reptiles. In the higher quality areas of this habitat (the Public Reserve) where disturbance is limited, these features are more prevalent and other features also occur including decorticating bark suitable for the velvet gecko (*Oedura sp.*) which was recorded, and medium to large fallen logs potentially suitable for the threatened yakka skink (*Egernia rugosa*). Soil cracks are rare and no gilgai was recorded, however in other intact areas of this habitat outside of the Survey Area these features may occur.

During the field survey, flowering brigalow trees were frequently observed containing flowering and fruiting mistletoe. Mistletoe was common and two species were recorded, one of which was grey mistletoe, a known foraging resource of the threatened painted honeyeater. These features also provide foraging opportunities for foliage-gleaning bird species such as striated pardalote (*Pardalotus striatus*) and rufous whistler (*Pachycephala rufiventris*), and nectar-feeders including the pale-headed

rosella (*Platycercus adscitus*) and spiny-cheeked honeyeater (*Acanthagenys rufogularis*) which were recorded.

The koala food tree *Eucalyptus populnea* (poplar box) occasionally occurs within this habitat and may help facilitate koala movement to larger, more suitable patches of habitat. Stags and mature poplar box trees commonly bore small to medium sized hollows, which provide nesting opportunities for hollow-dependent microbats and birds such as parrots and nocturnal species such as owls and nightjars. However, hollow-bearing trees were less common in areas of low open forest comprised of advanced regrowth vegetation.

Small patches of grass in the understory are likely to provide some foraging opportunities for macropods such as the eastern grey kangaroo which was frequently observed. As grass tussocks were generally uncommon, minimal sheltering habitat for small ground-dwelling mammals is present.

Habitat opportunities for amphibians are restricted to the overflow areas of adjacent wetlands and associated watercourses. The only amphibian recorded during the field survey, the spotted marsh frog (*Limnodynastes tasmaniensis*), was recorded within this habitat.

Eucalypt open forest on coarse-grained sedimentary rock

This habitat occurs within the western ridgeline and Middle Hill, largely connected to smaller patches of SEVT habitat. Where assessed, this habitat was found to be of high quality due to the overall lack of disturbance, with only evidence of fire, some weeds and historical thinning observed. Within the western ridgeline especially, this habitat is highly connected to contiguous likely remnant vegetation to the west and north west.

Within the western ridgeline, this habitat provides a variety of shelter / cover opportunities for reptiles and small ground-dwelling fauna including common native grass tussocks, an abundance of medium stones and large boulders, shallow leaf litter and occasional to common fallen logs and decorticating bark (Plate 3). Reptiles recorded within this community include the Bynoe's gecko (*Heteronotia binoei*), fence skink (*Cryptoblepharus virgatus*) and fire-tailed skink (*Morethia taeniopleura*). Given the complexity of the ground layer, this habitat is suitable for multiple threatened brigalow belt reptiles including the yakka skink, collared delma (*Delma torquata*) and Dunmall's snake (*Furina dunmalli*). Habitat opportunities for amphibians are limited due to the lack of water resources.

One mammal was recorded within this habitat: the short-beaked echidna (*Tachyglossus aculeatus*) which is listed Special Least Concern under the NC Act. However, given the occurrence of large boulders and fallen logs, suitable denning and foraging opportunities for the threatened northern quoll also occur. As *Eucalyptus sp.* dominates the canopy, this habitat type is also likely suitable for koala.

Opportunities for birds within this habitat type include foraging habitat for canopy gleaners and nectar-feeders. As both the western ridgeline and Middle Hill comprise a mosaic of at least two remnant vegetation communities (Eucalypt open forest and SEVT), suitable foraging habitat for the red goshawk (*Erythrotriorchis radiatus*) is present. Small and medium hollows were also recorded in canopy trees and stags, suitable for hollow dependent birds and flying mammals such as the threatened south-eastern long eared bat. Birds recorded in this habitat include the straited pardalote, Lewin's honeyeater (*Meliphaga lewinii*), white-eared honeyeater (*Lichenostomus leucotis*) and rufous whistler.

Within Middle Hill, habitat comprises open forest of spotted gum and narrow-leaved ironbark. Vegetation is likely to have a moderate level of structural complexity with a developed canopy and spare shrubby understorey. Given the lack of historical disturbance, canopy trees and stags are likely large and hollow-bearing, and the ground layer is likely to contain an abundance of microhabitat features including deep leaf litter, boulders, rock piles and logs. These habitat features indicate suitability for a range of threatened and migratory fauna species, including but not limited to koala, greater glider, red goshawk, south-eastern long-eared bat and adorned delma.

Plate 3 Eucalypt open forest on coarse-grained sedimentary rocks

Brigalow and softwood scrub regrowth

Within the Survey Area, scattered patches of young brigalow regrowth of 2 to 6 m and softwood scrub regrowth (generally dominated by bitter bark) up to 7 m occur, largely located near modified wetlands and along tracks. Within the wider Project Area (specifically the northern Project Area), large areas of brigalow regrowth especially are expected to occur primarily on lower rises in the western extent with smaller patches generally associated with shallow drainage lines.

Habitat opportunities for fauna was found to be generally limited (Plate 4). Refuge for reptiles and small ground-dwelling mammals is provided by the grassed ground layer with occasional small stones. As clay-based soils occur across the Survey Area, intact brigalow regrowth areas that have limited disturbance may also contain gilgai microrelief habitat suitable for the threatened ornamental snake (*Denisonia maculata*). The brigalow and softwood scrub regrowth vegetation may also provide suitable refuge and dispersal for some small birds such as fairy-wrens, and the threatened squatter pigeon (southern) (*Geophaps scripta scripta*).

Plate 4 Regrowth habitat

Gilgai

Following review of the pre-clear RE mapping, aerial imagery and LiDAR DEM, areas of gilgai habitat were mapped within the Project Area. In the eastern extent of Lot and plan 3TR12, two areas of gilgai occur within approximately 200 m of each-other, covering a combined area of approximately 103.06 ha. Although condition of the gilgai is unknown, the surrounding area comprised cleared pasture dominated by the exotic grass species *Cenchrus ciliaris** (buffel grass). Another five patches of gilgai habitat occur to the north within 2TR13 and one to the south within 2SP200046. These areas of habitat are considerably smaller and associated with young regrowth brigalow.

The onset of early wet season rains is generally expected to trigger the breeding of burrowing frogs and other species within the gilgai. The available water, tadpoles and frogs are expected to attract a diversity of predators including birds, reptiles and ground-dwelling mammals. All areas of gilgai habitat within the Project Area are therefore considered suitable for the ornamental snake and the Australian painted snipe (*Rostratula australis*), listed vulnerable and endangered respectively under the EPBC Act.

Modified wetlands

A total of 36 permanent water sources in the form of modified wetlands occur in scattered locations within the Project Area. Within the Survey Area, some wetlands were small in size and generally had minimal fauna habitat value due to the steep man-made banks, extensive cattle pugging at the water's edge and little to no aquatic or canopy vegetation. Common ducks such as the grey teal (*Anas gracilis*) and Pacific black duck (*Anas superciliosa*) were frequently recorded at these locations.

Elsewhere, the modified wetlands were larger and associated with naturally occurring watercourses and drainage lines (Plate 5). These wetlands usually had raised banks on one or two sides and were also regularly accessed by cattle. However, small areas of wetland vegetation were commonly present on the low-lying fringes and riparian zones of the associated drainage line, providing refuge and foraging opportunities for species such as the white-necked heron (*Ardea pacifica*), black swan (*Cygnus atratus*), black-fronted dotterel (*Elseyornis melanops*), Australasian grebe (*Tachybaptus novaehollandiae*) and masked lapwing (*Vanellus miles*), all of which were recorded in low numbers.

The wetland located adjacent to the Public Reserve (the Wetland) in the north east of the Project Area, provides high quality wetland habitat for a variety of fauna species. This wetland is expansive, and the largest in the local valley area indicating that it is likely to be an important resource throughout the year. Undisturbed brigalow open forest vegetation flanks a large portion of the wetland's eastern boundary, providing dispersal and refuge for ground-dwelling mammals and reptiles that access the wetland to drink. Tall trees provide perching opportunities for raptors foraging over the water.

Although some historical modification has occurred primarily along the western boundary, the banks of the wetland are gentle slopes and large areas of shallow water with aquatic fringing vegetation occur especially in the south. Narrow, low-lying vegetated islands are also present within the body of the wetland. These areas specifically are likely to provide ideal foraging conditions for wader birds including the EPBC Act listed endangered Australian painted snipe and migratory Latham's snipe (*Gallinago hardwickii*).

A diversity of bird species, some of which in moderate numbers, were recorded at the Wetland including: the Australasian darter (*Anhinga novaehollandiae*), eastern great egret (*Ardea alba modesta*), emu (*Dromaius novaehollandiae*), white-bellied sea eagle (*Haliaeetus leucogaster*), black-winged stilt (*Himantopus himantopus*), Australian pelican (*Pelecanus conspicillatus*), unidentified tern, black swan, white-necked heron and masked lapwing.

Plate 5 Modified wetland

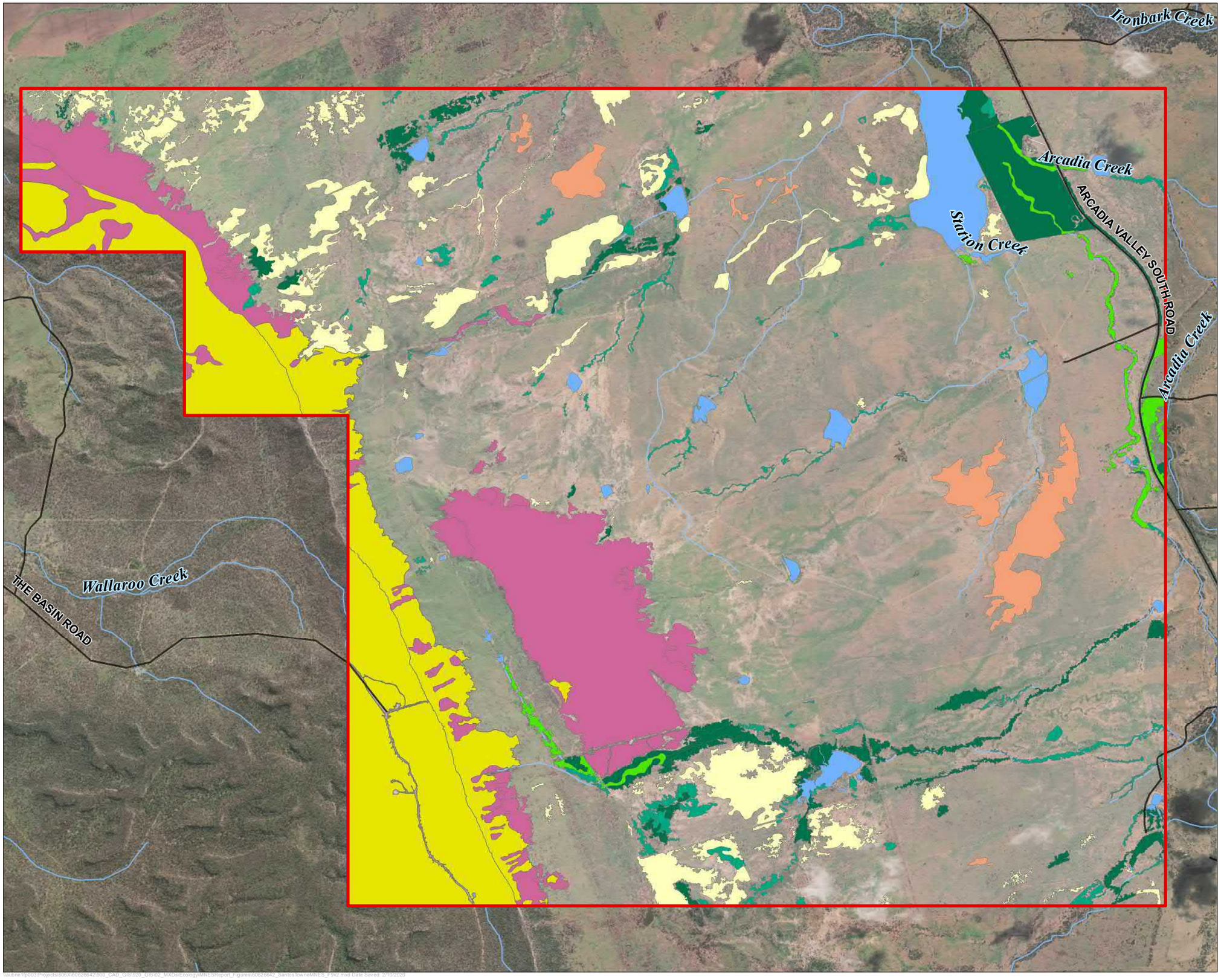
Other non-remnant vegetation (cleared pasture and cropping)

Other non-remnant vegetation (cleared pasture and cropping) as a result of historical clearing, cattle grazing and fodder cropping (*Leucaena leucocephala*) covers large areas in the centre, as well as smaller areas in the north and south Project Area.

Habitat values in this community were limited but included occasional stands of paddock trees, some sparse shrubby *Leucaena* and an abundance of exotic grass in the ground layer where grazing had been restricted (Plate 6). Cleared pasture and cropping may provide some dispersal opportunities for small mammals and reptiles. Small birds such as fairy-wrens may use the *Leucaena* for refuge. Raptors, granivorous birds and larger mammal species such as the grey kangaroo were also observed foraging in this habitat.

D R A F T

Plate 6 Exotic pasture



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LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Habitat Types

- Brigalow low open forest on alluvial plains and sedimentary rock
- Brigalow open forest on alluvial plains and sedimentary rock
- Eucalypt open forest on coarse-grained sedimentary rocks
- Eucalypt open woodland on alluvial plains
- SEVT
- Gilgai
- Brigalow and softwood scrub regrowth
- Modified wetlands
- Cleared exotic pasture

FIGURE 8
HABITAT TYPES

D R A F T

5.7 Fauna diversity

The field survey recorded a total of 90 fauna species including 73 birds, 8 mammals, 8 reptiles and 1 amphibian, none of which are listed under the NC Act.

5.7.1 Birds

Birds were the primary fauna group observed throughout the survey. A total of 73 bird species were recorded.

A variety of nectar-feeding birds (honeyeaters and parrots) were recorded in the Eucalypt woodland and brigalow open forest habitats of the Survey Area, with the high level of activity likely the result of flowering Acacia trees and generally abundant and flowering mistletoe. Honeyeaters were especially common, with ten species recorded including the spiny-cheeked honeyeater (*Acanthagenys rufogularis*), blue-faced honeyeater (*Entomyzon cyanotis*), brown honeyeater (*Lichmera indistincta*), white-eared honeyeater (*Lichenostomus leucotis*), white-plumed honeyeater (*Lichenostomus penicillatus*), singing honeyeater (*Lichenostomus virescens*), yellow-throated miner (*Manorina flavigula*), Lewin's honeyeater (*Meliphaga lewinii*), little friarbird (*Philemon citreogularis*) and noisy friarbird *(Philemon corniculatus*). Parrot species were less abundant and included the pale-headed rosella (*Platycercus adscitus*), rainbow lorikeet (*Trichoglossus haematodus*) and red-winged parrot (*Aprosmictus erythropterus*).

Small woodland birds, including weebills (*Smicrornis brevirostris*), straited pardalotes (*Pardalotus striatus*) and thornbills (*Acanthiza sp.*) were restricted but relatively common within the Eucalypt woodland habitat on alluvial plains. Other small birds, including finches (*Taeniopygia* spp.) and fairy-wrens (*Malurus* spp.) occurred in the regrowth brigalow, brigalow woodlands, Eucalypt-dominated woodland and in disturbed fringes however their occurrence was generally low.

Other more disturbance tolerant bird species were recorded across the Survey Area, including the apostlebird (*Struthidea cinerea*), pied butcherbird (*Cracticus nigrogularis*), magpie lark (*Grallina cyanoleuca*) and crested pigeon (*Ocyphaps lophotes*).

Raptors were also relatively abundant within the Survey Area and surrounds, primarily observed perching in canopy trees or foraging in the cleared pasture areas and along Arcadia Valley Rd directly adjacent to the Project Area. Nine species were recorded including the wedge-tailed eagle (*Aquila audax*), spotted harrier (*Circus assimilis*), black-shoulder kite (*Elanus axillaris*), brown falcon (*Falco berigora*), nankeen kestrel (*Falco cenchroides*), Australian hobby (*Falco longipennis*), white-bellied sea eagle (*Haliaeetus leucogaster*), whistling kite (*Haliastur sphenurus*) and black kite (*Milvus migrans*).

A range of waterbird species are supported by the presence of multiple farm dams and the Wetland. Species such as the pacific black duck (*Anas superciliosa*), masked lapwing (*Vanellus miles*), grey teal (*Anas gracilis*) and Australian wood duck (*Chenonetta jubata*) were frequently recorded across all the different water sources, while others such as the eastern great egret (*Ardea modesta*), black-winged stilt (*Himantopus himantopus*) and black-fronted dotterel (*Elseyornis melanops*) were rare occurrences and located only at the higher quality waterbodies.

5.7.2 Mammals

Excluding introduced species, a total of five mammal species were recorded during the field survey. One mammal recorded, the short-beaked echidna (*Tachyglossus aculeatus*) is listed Special Least Concern under the NC Act however not listed under the EPBC Act.

Macropods were the most commonly encountered mammal, observed foraging in the tall grass of the other non-remnant vegetation within the Survey Area and along Arcadia Valley Rd directly adjacent. Three macropod species were recorded including the eastern grey kangaroo (*Macropus giganteus*), whiptail wallaby (*Macropus parryi*) and the red-necked wallaby (*Macropus rufogriseus*).

The common brushtail possum (*Trichosurus vulpecula*) was also determined to occur within the brigalow open woodland on alluvial plains habitat based on indirect evidence (a skull).

5.7.3 Reptiles and amphibians

Eight reptile species and one amphibian species were recorded during the field survey. The single amphibian recorded was the spotted marsh frog (*Limnodynastes tasmaniensis*), which was heard along a grassy drainage line connecting to a farm dam.

Of the seven reptiles recorded five were skinks and three were geckos. The chain-backed dtella (*Gehyra catenata*) and indirect evidence (shed skin) of a velvet gecko (*Oedura sp.*) were located under decorticating bark within the brigalow open woodland habitat while the Bynoe's gecko (*Heteronotia binoei*) was located under a rock in the Eucalyptus open forest habitat of the western ridgeline. Recorded skinks also occurred within these habitats, and include the elegant snake-eyed skink (*Cryptoblepharus pulcher*), fence skink (*Cryptoblepharus virgatus*), eastern striped skink (*Ctenotus robustus*), eastern mulch-slider (*Lerista fragilis*) and fire-tailed skink (*Morethia taeniopleura*).

Plate 7 Eastern striped skink (*Ctenotus robustus*)

5.8 Introduced fauna species

Four introduced fauna species were recorded during the field survey, two of which are listed as restricted matters under the Biosecurity Act:

- European rabbit (*Oryctolagus cuniculus**) – Listed as a category 3, 4, 5, 6 restricted matter
- Dingo/dog (*Canis lupus**) – Listed as a category 3, 4, 5, 6 restricted matter
- House mouse (*Mus musculus**)
- Common myna (*Sturnus tristis**).

Other introduced fauna species restricted under the Biodiversity Act are likely to occur within the Project Area including the cane toad (*Rhinella marina**), feral cat (*Felis catus**), European fox (*Vulpes vulpes**) and black rat (*Rattus rattus*).

5.9 Essential habitat

A review of the DES Essential Habitat mapping indicates that no essential habitat occurs within the Project Area. Small patches of essential habitat are mapped to the east and north west of the Project Area, as follows:

- Large-eared pied bat (*Chalinolobus dwyeri*); east on Lot and plan 5TR18
- Squatter pigeon (southern) (*Geophaps scripta scripta*); east on Lot and plan 5TR18
- Ornamental snake (*Denisonia maculata*); east on Lot and plan 9TR17
- Ooline (*Cadellia pentastylis*); north west on Lot and plan 1TR8.

5.10 Wetlands and watercourses

Wetland mapping reviewed as part of the desktop assessment included the DES Queensland Wetland mapping, MSES High Ecological Significance (HES) wetland mapping and Vegetation management wetland mapping. DAF waterways for waterway barrier works mapping was also reviewed.

The Project Area contains several watercourse features considered waterways for waterway barrier works. Watercourses have stream orders ranging from one to five. Arcadia Creek is the highest order watercourse (stream order 5) within the Project Area, but traverses only a small section of the Public Reserve in the north-eastern corner before exiting to the north. Arcadia Creek is a ‘Major’ (purple) waterway at risk of barrier works.

From the centre of the Project Area, six watercourses (stream order 1) traverse north east (all unnamed except Station Creek) towards Arcadia Creek. These watercourses are associated with five of the larger wetlands within the Project Area. The largest wetland in the north east of the Project Area (the Wetland’) is the confluence of these watercourses including Station Creek (stream order 3). As per the waterways for waterway barrier works map, Station Creek is a ‘High’ (red) risk waterway while the unnamed watercourses (stream order 2) are ‘Moderate’ (amber) and ‘Low’ (green) risk (stream order 1).

From two sources below the western ridgeline, a single unnamed watercourse (stream order 2) converges in the southern Project Area (2SP200046) and travels directly east before exiting the Project Area. This watercourse then re-enters the Project Area from the centre of the eastern boundary and flows north through the Public Reserve and into the Wetland.

The Wetland is approximately 1.5 km long and 1 km wide, and at least double the size of all other wetlands within the Project Area. It is flanked by remnant brigalow open forest along large portions of the eastern length and contains narrow linear vegetative islands as well as muddy margins with low fringing vegetation on the southern boundary. Further information regarding the habitat values associated with this wetland are discussed in Section 5.6. The Wetland as well as nine other waterbodies (generally the largest waterbodies within the Project Area) are considered lacustrine wetlands as per the Queensland Wetland mapping. Mapped vegetation associated with the Public

Reserve, the unnamed watercourse along the eastern boundary and areas east of Arcadia Valley Road are considered riverine wetland systems.

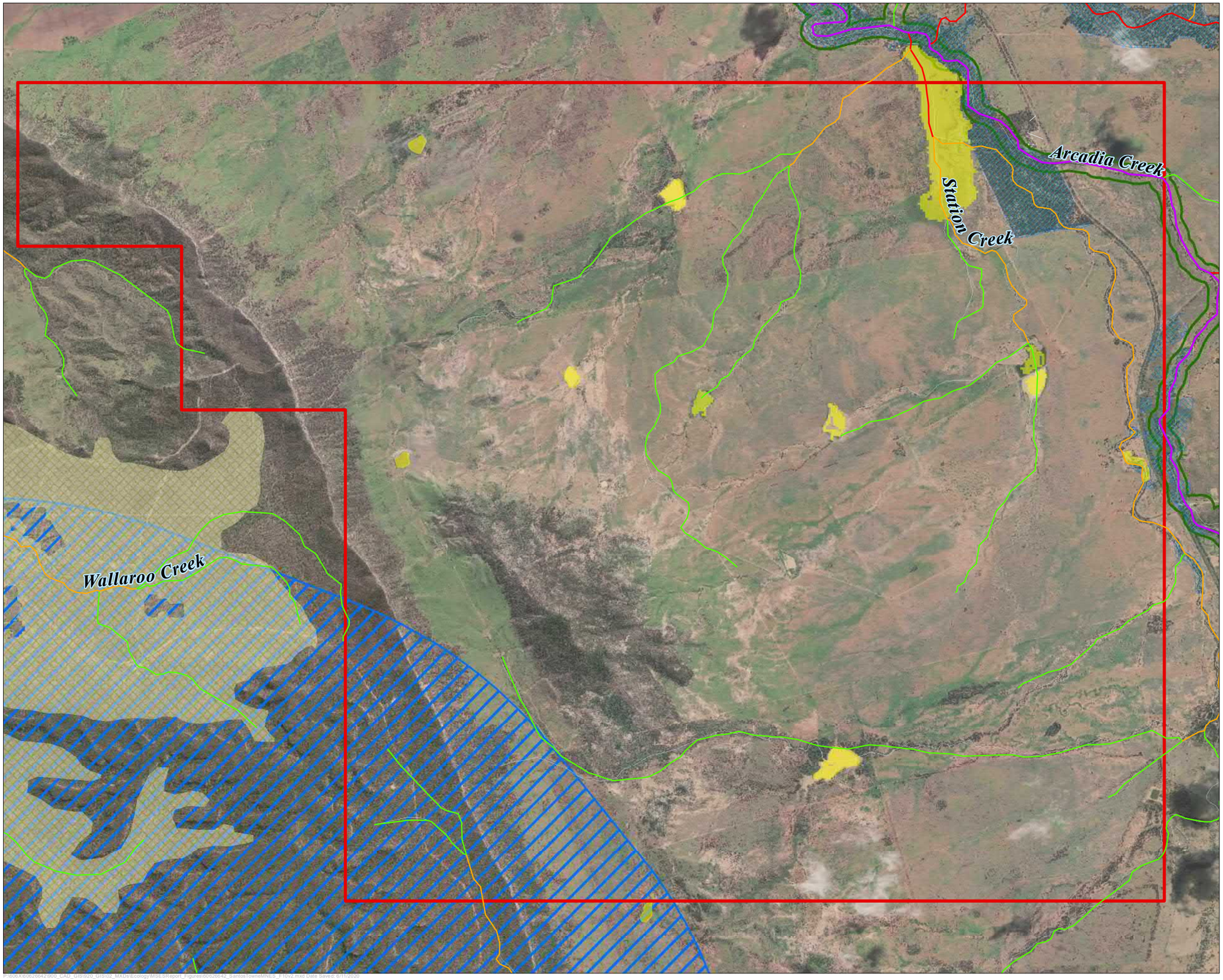
No waterbodies within the Project Area are mapped VM Act wetlands or HES wetlands, and are therefore not considered MSES. Based on aerial imagery a number of smaller, permanent waterbodies (farm dams) also occur within the Project Area although not identified in wetland mapping. Wetlands and watercourses within the Project Area are shown on Figure 9.

5.11 Landscape connectivity

A review of DES BPA corridor mapping identified Regional and State and local-level biodiversity areas occur within the Project Area (see Figure 9). In the south-eastern extent of the Project Area, a state significant corridor occurs in association with the western ridgeline and adjacent Carnarvon Ranges. A regionally significant corridor is mapped along Arcadia Creek, although only a small portion of this falls within the north east Project Area.

Fauna movement in the centre of the Project Area is largely restricted due to the lack of woody vegetation as a result of broad-scale land clearing. Although not identified in the DES BPA mapping, narrow riparian vegetation associated with the mapped watercourses (especially the unnamed tributary of Station Creek) provide the only movement opportunities for fauna across the landscape and are therefore highly important. Although disturbed, vegetation associated with these watercourses provides connection to areas of higher quality habitat including the Wetland and Public Reserve in the north east, as well as Middle Hill in the south west of the Project Area. Connectivity between Middle Hill and the western ridgeline is limited, restricted to small fragmented patches of vegetation that would provide only ‘stepping stone’ movement opportunities.

Due to their high level of connectivity, linear vegetation patches east and west of Arcadia Valley Road are also considered important for the movement of fauna within the valley due to the overall high level of broadscale clearing in adjacent areas.



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LEGEND

- Project Area
- VM Act Watercourses

DAF Waterways for waterway barrier works

Risk of Impact

- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major

DES Wetland Mapping

- Lactustrine wetland (Waterbody based)
- Riverine wetland (RE based)
- Coastal/ Sub-coastal floodplain tree swamps (RE based)

BPA Corridors

- Regional
- State

FIGURE 9

WETLANDS, WATERCOURSES & BIODIVERSITY CORRIDORS

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5.12 Likelihood of occurrence

5.12.1 Listed EVNT species

The desktop assessment identified 24 species listed as endangered, vulnerable or near threatened (EVNT) and one species listed as Special Least Concern (SLC) (non-migratory) under the NC Act as potentially occurring within the Project Area. No NC Act listed flora or fauna species were recorded during the field surveys.

A likelihood assessment was conducted for the identified species to determine which species are possible or unlikely to occur within the Project Area. This evaluation was based on an understanding of the preferred habitats of the species, knowledge of the type and condition of habitats present within the Project Area as well as the proximity of nearby records.

Of the 24 EVNT species and one SLC identified by the desktop assessment, findings of the likelihood of occurrence assessment (Table 20 of Appendix C) determined three (3) threatened flora and 15 threatened fauna species and one SLC fauna species were 'potential' or 'likely' to occur within the Project Area, as described below.

Potential or likely threatened flora species:

- *Apatophyllum teretifolium*
- Ooline (*Cadellia pentastylis*)
- *Xerothamnella herbacea*

Potential or likely threatened fauna species:

- Adorned delma (*Delma torquata*)
- Ornamental snake (*Denisonia maculata*)
- Yakka skink (*Egernia rugosa*)
- Red goshawk (*Erythrotriorchis radiatus*)
- Grey falcon (*Falco hypoleucos*)
- Dunmall's snake (*Furina dunmalli*)
- Squatter pigeon (southern) (*Geophaps scripta scripta*)
- Painted honeyeater (*Grantiella picta*)
- White-throated needletail (*Hirundapus caudacutus*)
- Australian painted snipe (*Rostratula australis*)
- Large-eared pied bat (*Chalinolobus dwyeri*)
- South-eastern long-eared bat (*Nyctophilus corbeni*)
- Greater glider (*Petauroides volans*)
- Koala (*Phascolarctos cinereus*)
- Golden-tailed gecko (*Strophurus taenicauda*)
- Short-beaked echidna (*Tachyglossus aculeatus*).

A description of the habitat areas and the extent of habitat within the Project Area for the listed species is provided in Table 11 below. For threatened fauna species this includes a breakdown of utilisation across potential habitat areas supported by the Project Area. Potential habitat for threatened species within the Project Area is shown on Figure 10 to Figure 26.

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Table 11 Potential habitat areas, utilisation and extent for NC Act listed species

Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Habitat Types (Table 10)[2]	Area ground-truthed (ha)[1]	Area LiDAR assessed (ha)	Project Area total (ha)
Plants							
Apatophyllum teretifolium	Near Threatened	Potential	Suitable habitat for this species occurs within the areas of Eucalypt open forest on coarse sedimentary rock at Middle Hill and along the western ridgeline.	5	-	797.86	797.86
Cadellia pentastylis Ooline	Vulnerable	Likely	Suitable habitat for this species occurs across the Project Area, specifically remnant areas of Brigalow open forest on sedimentary rock and SEVT vegetation communities. HVR areas of Brigalow low open forest on sedimentary rock, as well as regrowth areas of brigalow and softwood scrub are also potential habitat for ooline.	1, 3, 4, 8	-	1,130.65	1,130.65
Xerothamnella herbacea	Endangered	Likely	Suitable habitat for this species occurs across remnant areas of Brigalow open forest on alluvial plains and on sedimentary rock, as well as HVR areas of Brigalow low open forest on alluvial plains and on sedimentary rock	1, 6	-	338.85	338.85
Birds							
Red goshawk	Endangered	Potential	**Foraging only** All habitat types in remnant condition provide suitable habitat to support an abundance of prey species for red goshawk.	2, 3, 4, 5	18.71	1,694.69	1,713.40
Grey falcon	Vulnerable	Potential	**Breeding and foraging** Eucalypt riparian open woodlands in remnant condition are considered to provide suitable breeding and foraging habitat. Tall trees with bird nests were observed in this habitat and may be utilised by this species when breeding.	2	16.82	9.69	26.51

Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Habitat Types (Table 10)[2]	Area ground-truthed (ha)[1]	Area LiDAR assessed (ha)	Project Area total (ha)
			Foraging only All areas of regrowth and remnant vegetation that occur within the lowlands of the Project Area.	1, 2, 3, 4, 5, 8	20.41	750.68	771.09
Squatter pigeon (southern)	Vulnerable	Potential	**Dispersal only** The Project Area contains numerous modified wetlands which may be used by squatter pigeon (southern), however connecting vegetation is largely non-remnant with heavy clay soils. All remnant, HVR and regrowth habitat types are considered to provide only dispersal habitat for the species.	1, 2, 3, 4, 5, 8	40.06	2,241.55	2,281.61
Painted honeyeater	Vulnerable	Potential	**Foraging and dispersal only** Although the majority of the Project Area comprises non-remnant grazing land, regrowth and remnant woodland areas, particularly brigalow dominated habitats generally had an abundance of mistletoe (at least two species recorded). Brigalow open and low open forest on alluvial and sedimentary rock as well as brigalow regrowth habitats are considered to provide foraging and dispersal habitat for the species.	1, 2, 4, 8	10.23	740.78	751.01
White-throated needletail	Special Least Concern	Potential	**Roosting and foraging** Eucalypt open forest on coarse grained sedimentary rock habitat associated with the western ridgeline and middle hill provides the suitable launching point / height for individuals roosting in canopy trees.	5	-	797.86	797.86
			Foraging only This species may exist in the airspace above the Project Area. All habitat types in remnant and HVR condition provide suitable habitat to support an abundance of foraging resources for white-throated needletail.	1, 2, 3, 4, 5, 8	40.06	1,443.69	1,483.75
	Vulnerable	Potential	**Breeding**	Portions of 6	-	95.53	95.53

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Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Habitat Types (Table 10)[2]	Area ground-truthed (ha)[1]	Area LiDAR assessed (ha)	Project Area total (ha)
Australian painted snipe			Modified wetland habitat within the Project Area comprising of a large water bodies with areas of low fringing vegetation in margins or exposed islands (i.e. wetland area on 2TR13) are considered to provide potential breeding habitat.				
			Foraging and roosting All modified wetland habitat (including some farm dams) within the Project Area is considered to provide potential foraging and roosting habitat.	6	33.55	34.90	68.45
			Temporary foraging and dispersal only Gilgai habitat is considered to provide temporary foraging habitat for the species when inundated with water	7	-	137.94	137.94
Mammals							
Large-eared pied bat	Vulnerable	Likely	**Roosting** Only the western ridgeline comprises sandstone cliffs that could be suitable roosting habitat for the species.	5	-	1,003.85	1,003.85
			Foraging only All remnant and HVR habitats in the valley floor within the Project Area provide potential foraging habitat for potential individuals roosting in the adjacent ridgeline	1, 2, 3, 4	31.53	829.19	860.72
South-eastern long-eared bat	Vulnerable	Likely	**Roosting and foraging** All remnant habitats (with the exception of SEVT) are considered to contain hollow bearing trees or sufficient decorticating bark to provide roosting opportunities for the species	2, 4, 5	16.82	1,081.49	1,098.31
			Foraging only SEVT and all other habitats in HVR condition have been identified as only foraging habitat due to the	1, 3	14.41	751.56	765.97

D R A F T

Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Habitat Types (Table 10)[2]	Area ground-truthed (ha)[1]	Area LiDAR assessed (ha)	Project Area total (ha)
			lack of hollow-bearing trees or extensive decorticating bark.				
Greater glider	Vulnerable	Potential	**Breeding and denning** The Eucalypt open forest on alluvial plains and Eucalypt open forest on coarse-grained sedimentary rock habitat associated with the ridgeline and middle hill are considered to contain sufficient density of hollow-bearing trees to support denning individuals. These areas are also contiguous patches of habitat.	2, 5	14.78	832.33	847.11
			Foraging and dispersal only The Eucalypt open forest on alluvial plains that is contiguous but field validated to not contain sufficient hollow-bearing tree density is considered to provide only foraging and dispersal habitat.	2	2.05	-	2.05
Koala	Vulnerable	Potential	**Refuge and foraging** Contiguous areas of Eucalypt open forest on alluvial plains and Eucalypt open forest on coarse-grained sedimentary rock habitat associated with the ridgeline and middle hill are considered to contain a sufficient dominance of koala food trees. The Eucalypt open forest on alluvial plains is also considered to have access to a higher soil moisture content.	2, 5	16.82	832.33	849.15
			Dispersal only Brigalow open forest on alluvial plains habitat contains emergent Eucalypt canopy trees and provides a linkage along drainage lines that could be utilised by koalas dispersing across the Project Area.	4	0.21	199.23	199.44
Short-beaked echidna	Special Least Concern	Likely	**Breeding, foraging and dispersal** All remnant, HVR and regrowth vegetation with a variety of sheltering opportunities available and sufficient supply of ants and termites.	1, 2, 3, 4, 5, 7, 8, 9	40.06	8,471.7	8,511.76

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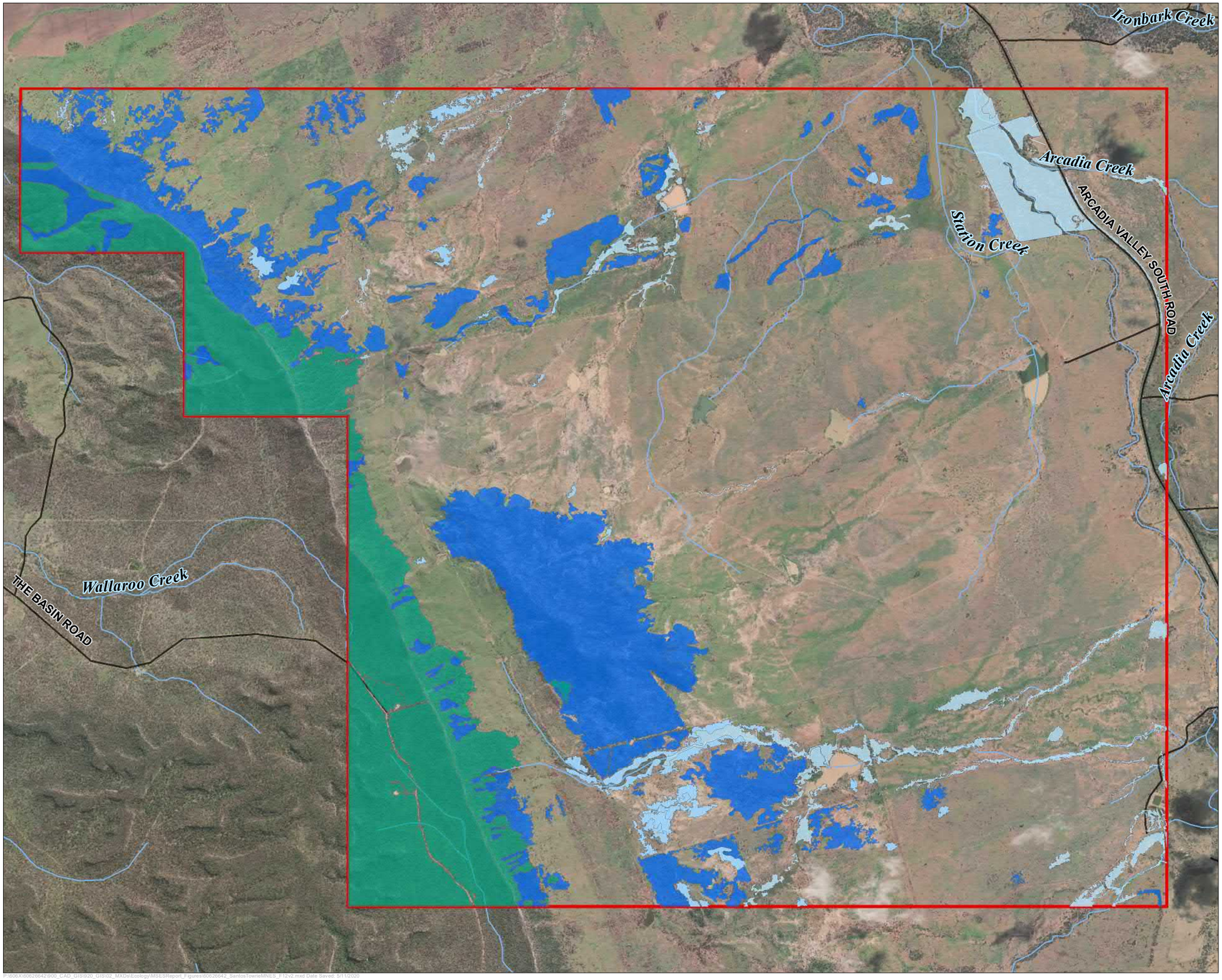
Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Habitat Types (Table 10)[2]	Area ground-truthed (ha)[1]	Area LiDAR assessed (ha)	Project Area total (ha)
Reptiles							
Adorned delma	Vulnerable	Potential	**Breeding and foraging** The majority of the Project Area is likely to have a high level of disturbance and low abundance of ground layer microhabitat features that would be unsuitable for adorned delma. High quality habitat is mainly restricted to the Eucalypt open forest on coarse-grained sedimentary rock on the western ridgeline.	5	-	795.34	795.34
Ornamental snake	Vulnerable	Potential	**Breeding and foraging** Areas of gilgai habitat as well as Brigalow open forest and low open forest on alluvial plains and sedimentary rock may provide suitable microhabitat features to support the species. This also includes some large patches of Brigalow regrowth habitat.	1, 4, 7, 8	-	492.11	492.11
Yakka skink	Vulnerable	Potential	**Breeding and foraging** Suitable habitat is most likely to be restricted to less disturbed woodland. This includes remnant Brigalow open forest on alluvial plains, Eucalypt open forest on coarse-grained sedimentary rock and portions of Eucalypt open woodland on alluvial plains that is not subject to regular flooding (i.e. RE 11.3.2).	2, 4, 5,	-	1,023.97	1,023.97
Dunmall's snake	Vulnerable	Potential	**Breeding and foraging** Suitable habitat restricted to less disturbed woodland and regrowth areas. Includes Eucalypt open forest on coarse grained sedimentary rock associated with the ridgeline as well as Eucalypt woodland on alluvial plains and brigalow open forest and low open forest on alluvial plains and sedimentary rock habitat.	1, 2, 4, 5	-	1,177.15	1,177.15
Golden-tailed gecko	Near Threatened	Likely	**Breeding and foraging**	2, 4, 5	16.82	1,081.49	1,098.31

D R A F T

Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Habitat Types (Table 10)[2]	Area ground-truthed (ha)[1]	Area LiDAR assessed (ha)	Project Area total (ha)
			All remnant habitats (with the exception of SEVT) that are considered to contain hollow bearing trees or decorticating bark to provide refuge opportunities for the species.				

[1] Excludes the other non-remnant vegetation (cleared pasture and cropping).

[2]Not areas classified as a specific habitat type in Figure 8 will be suitable for a given species. Individual species maps should also be consulted to determine potential habitat across the Project Area



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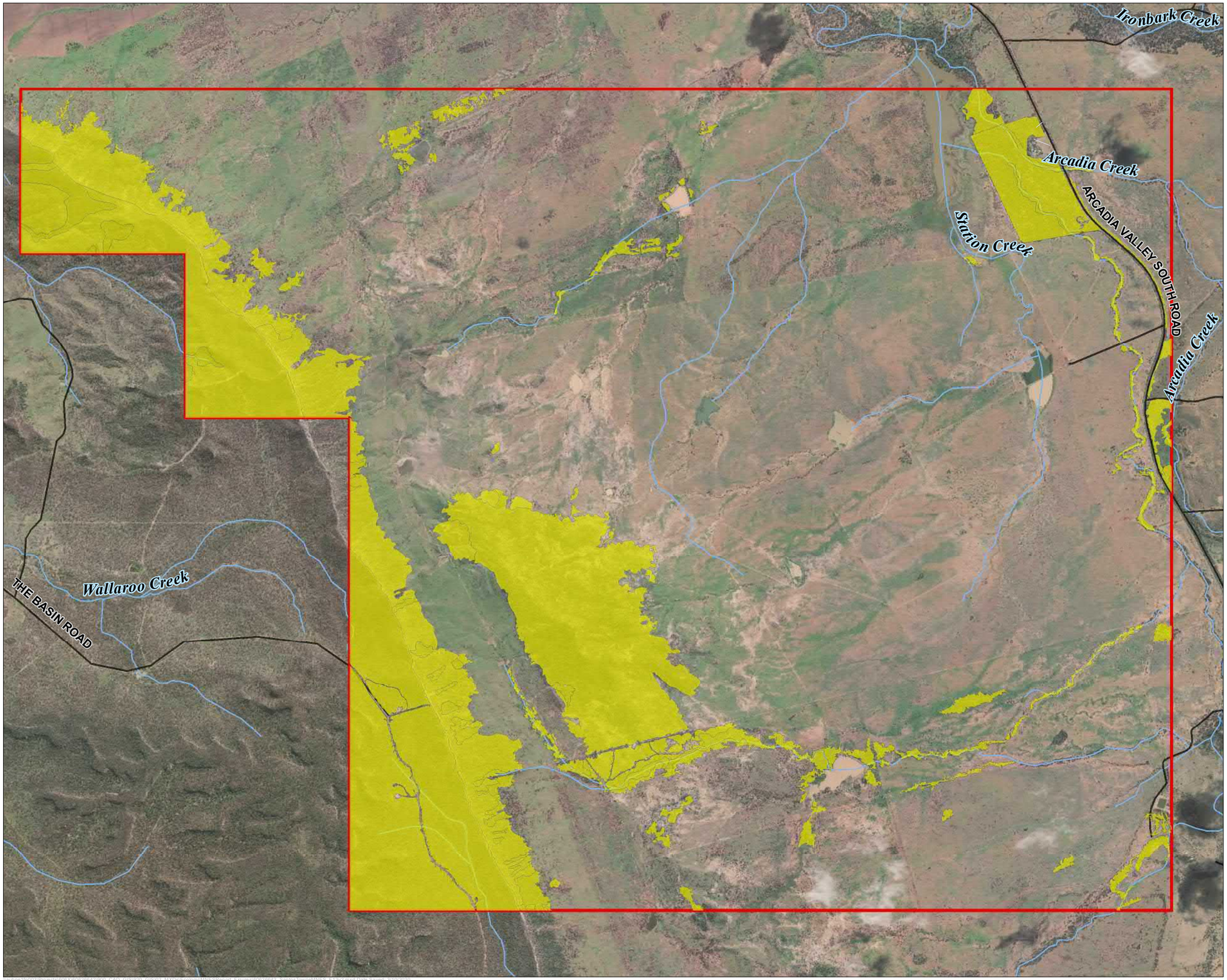
LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses
- Potential *Xerothamnella herbacea* Habitat
- Potential *Apatophyllum teretifolium* Habitat
- Potential Ooline Habitat

FIGURE 10
POTENTIAL THREATENED FLORA HABITAT



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LEGEND

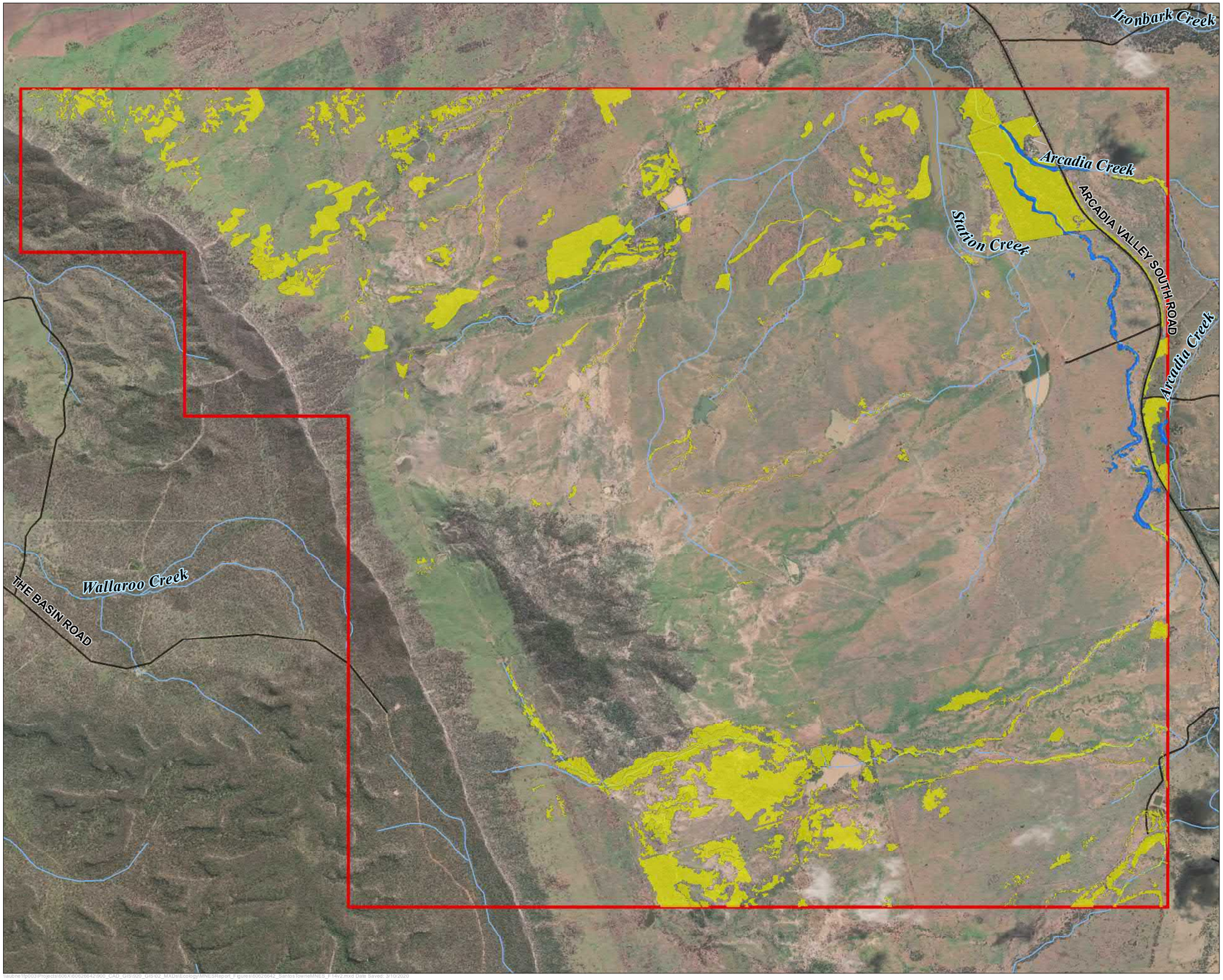
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Red Goshawk Habitat

- Foraging only

FIGURE 10

POTENTIAL RED GOSHAWK HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

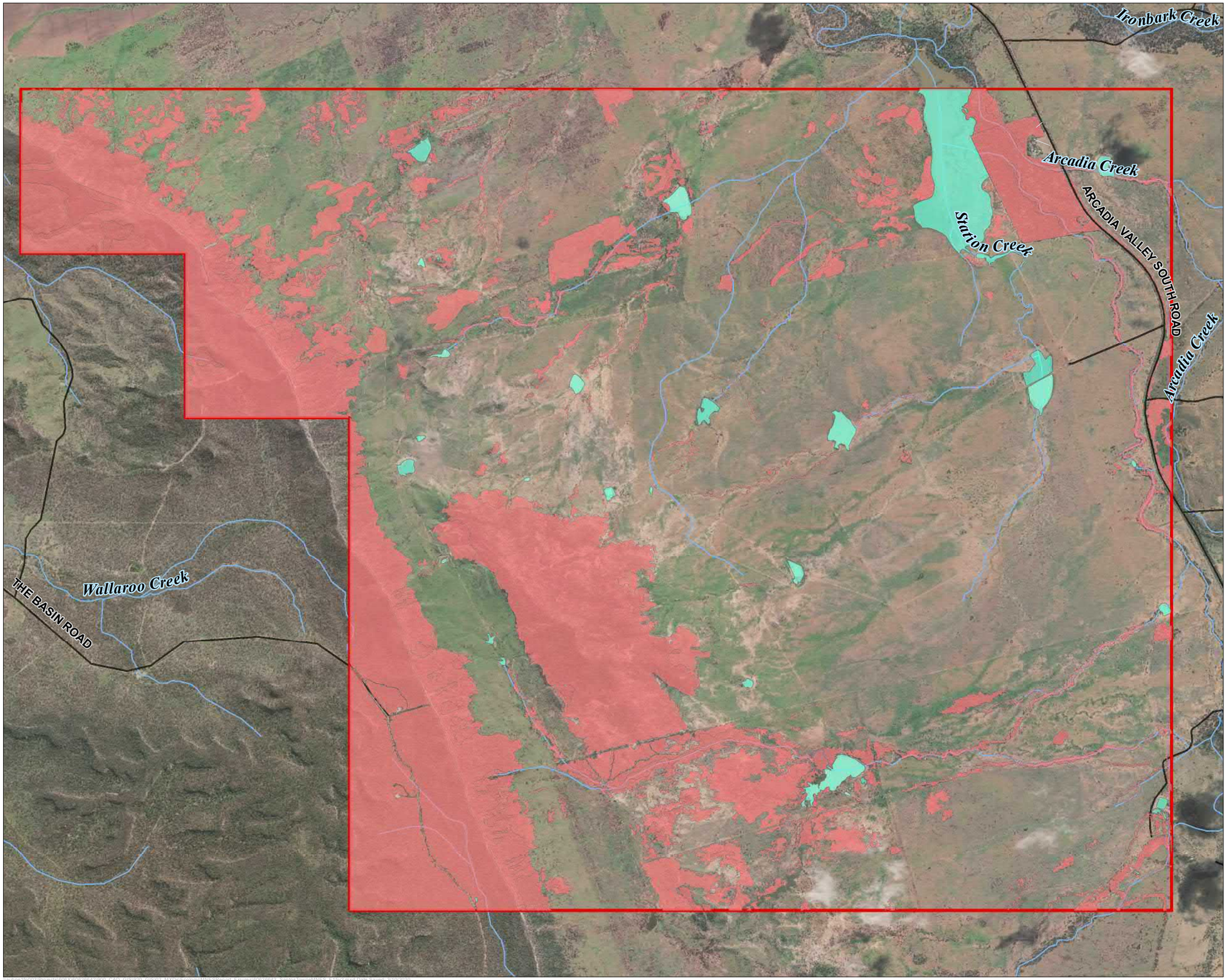
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Grey Falcon Habitat

- Breeding / foraging
- Foraging

FIGURE 11

POTENTIAL GREY FALCON HABITAT



AECOM

0 0.55 1.1 KMS

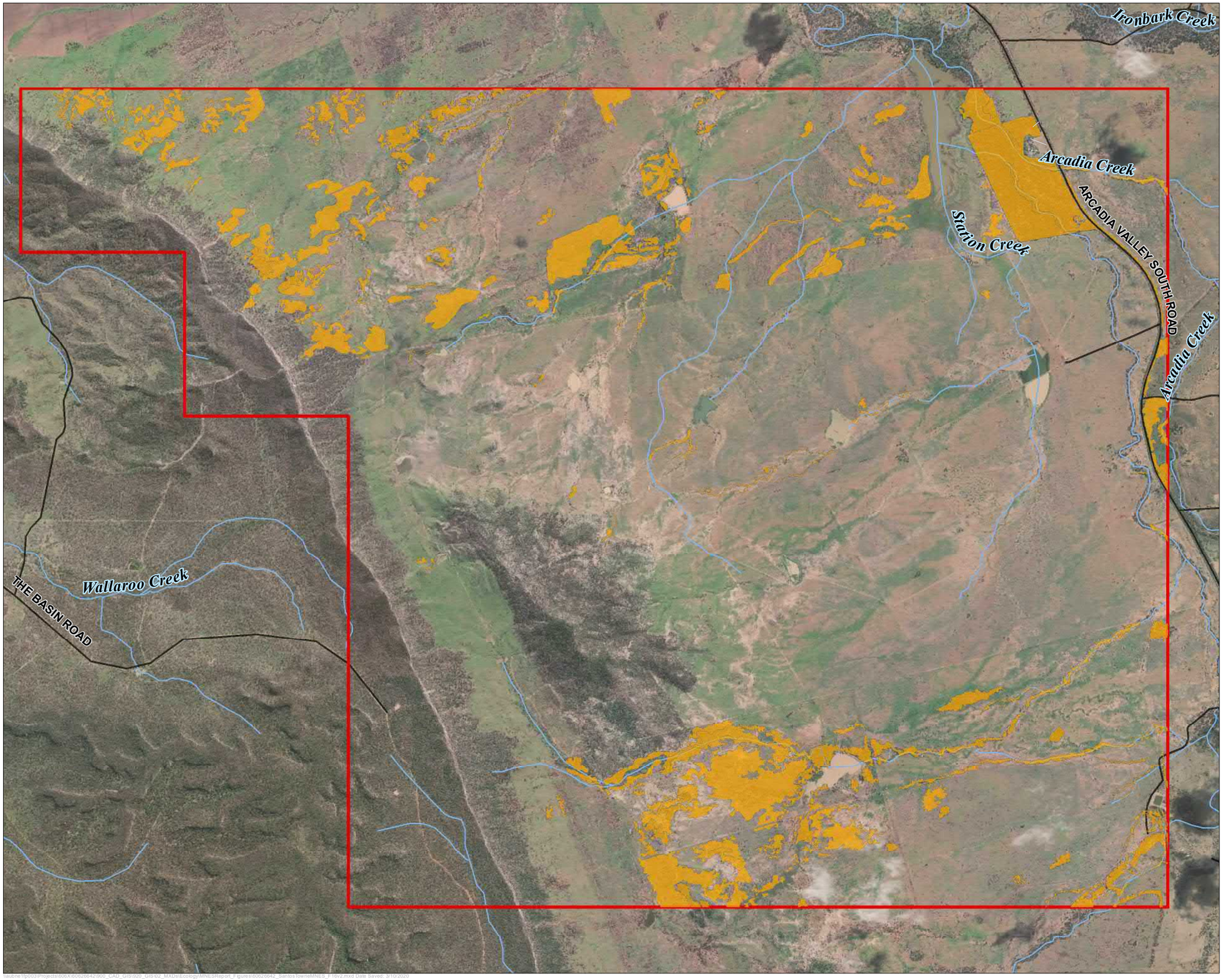
LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Squatter Pigeon (Southern) Habitat

- Dispersal
- Water source

FIGURE 13
POTENTIAL SQUATTER PIGEON (SOUTHERN) HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

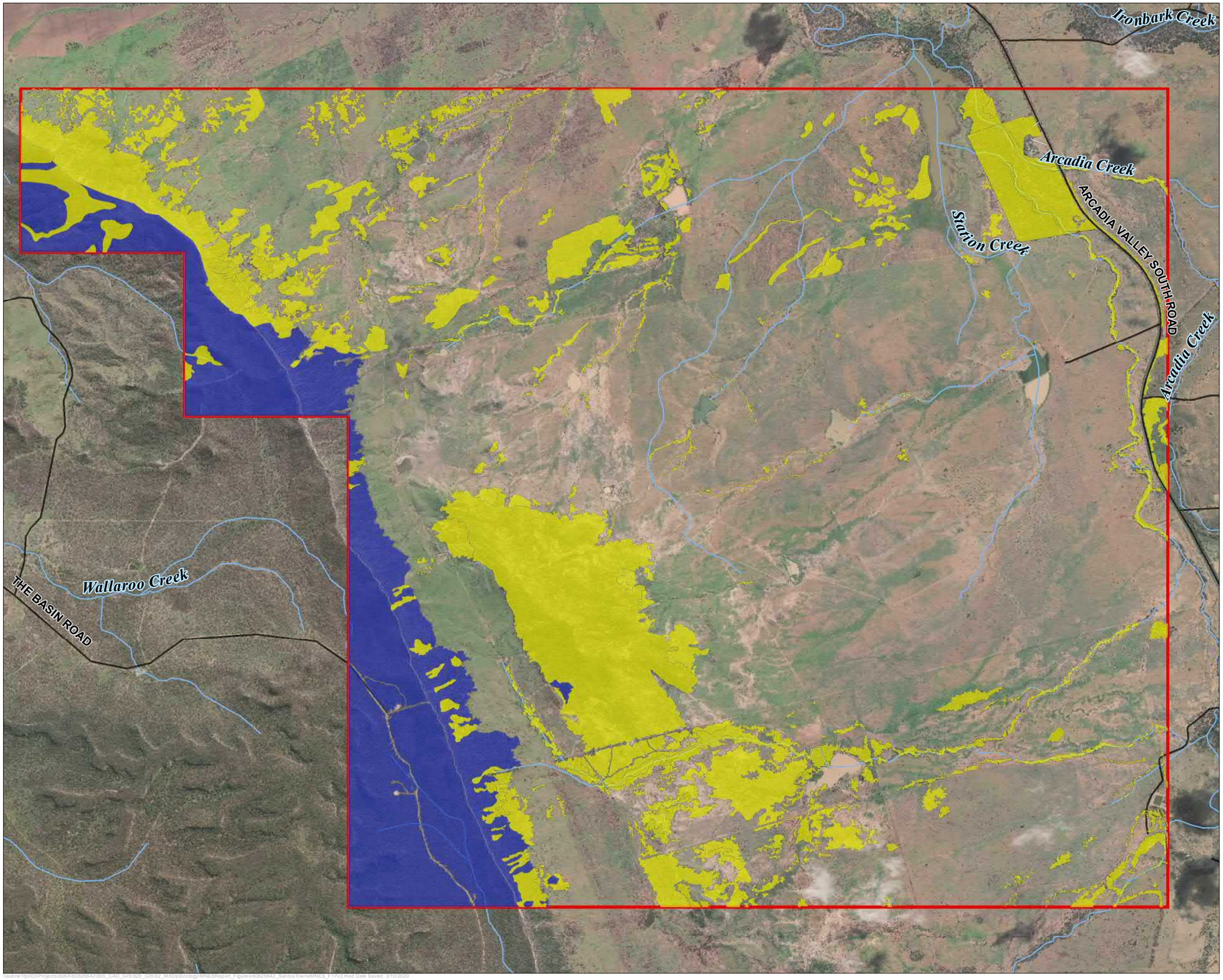
Potential Painted Honeyeater Habitat

- Foraging & dispersal

FIGURE 14

POTENTIAL PAINTED HONEYEATER HABITAT

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential White-throated Needletail Habitat

- Roosting & foraging
- Foraging only

FIGURE 15

POTENTIAL WHITE-THROATED NEEDLETAIL HABITAT

AECOM

0 0.55 1.1 KMS

LEGEND

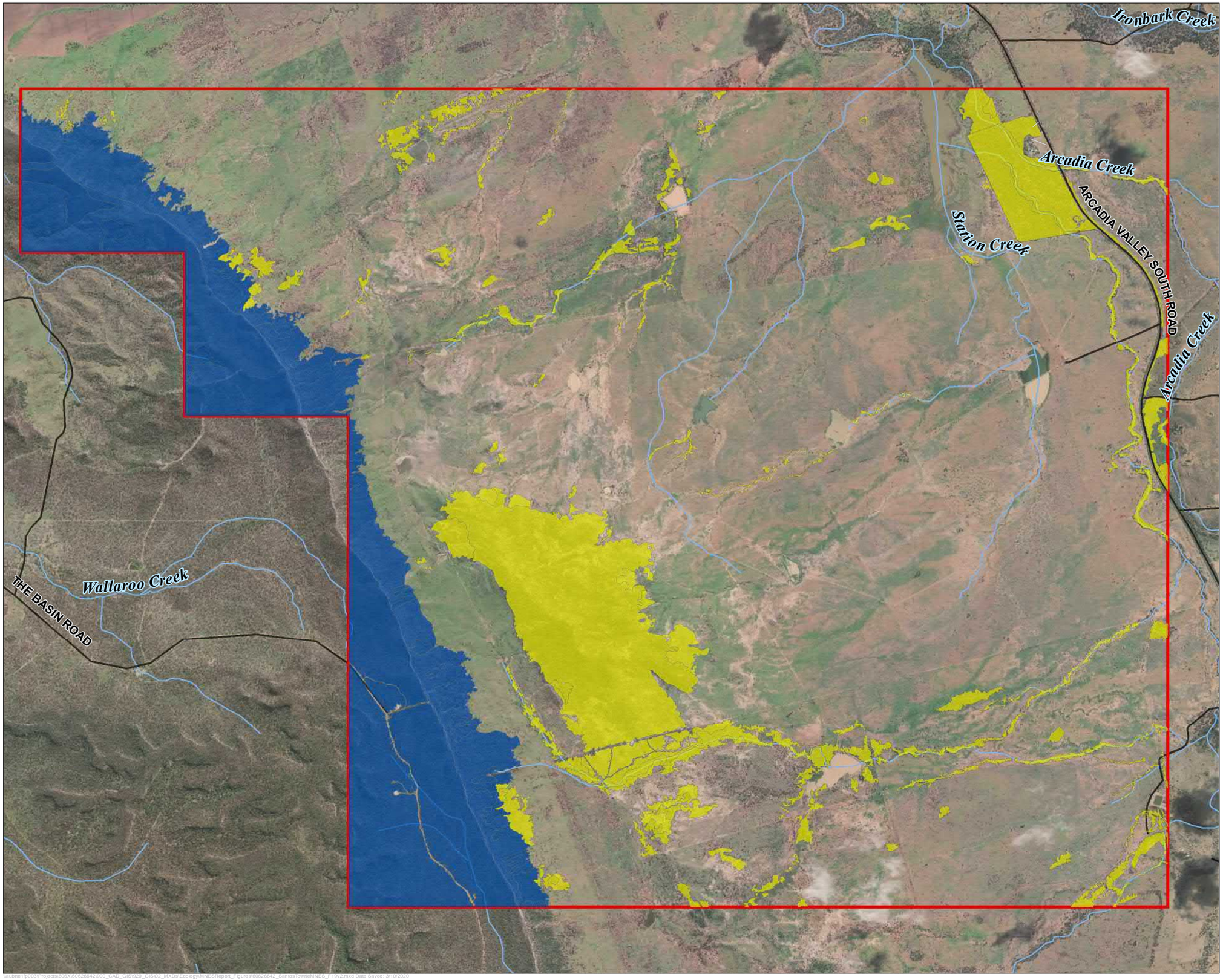
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Australian Painted Snipe Habitat

- Breeding
- Foraging & roosting
- Temporary foraging & dispersal

FIGURE 16

POTENTIAL AUSTRALIAN PAINTED SNIPE HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

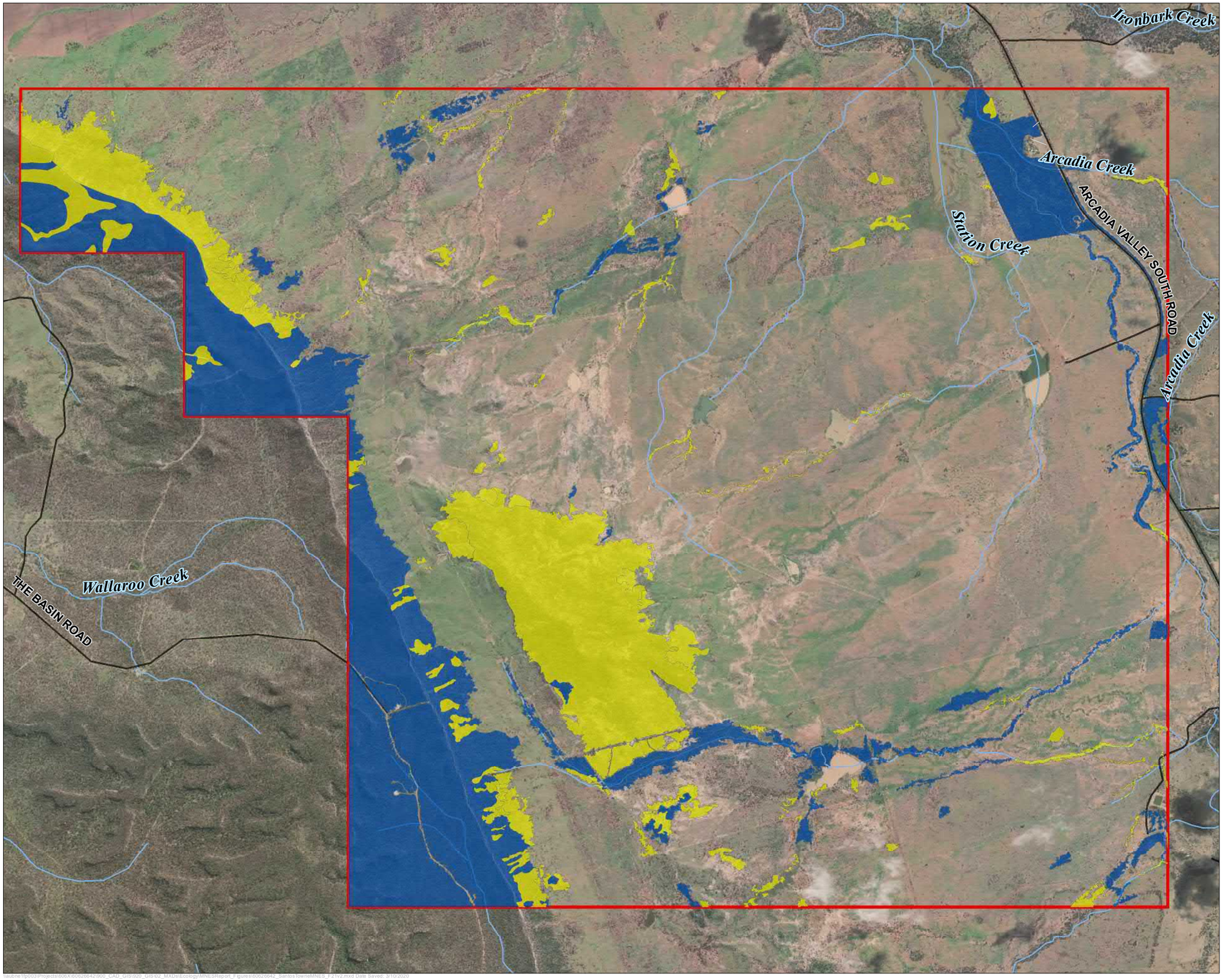
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Large-eared Pied Bat Habitat

- Roosting
- Foraging

FIGURE 17

POTENTIAL LARGE-EARED PIED BAT HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

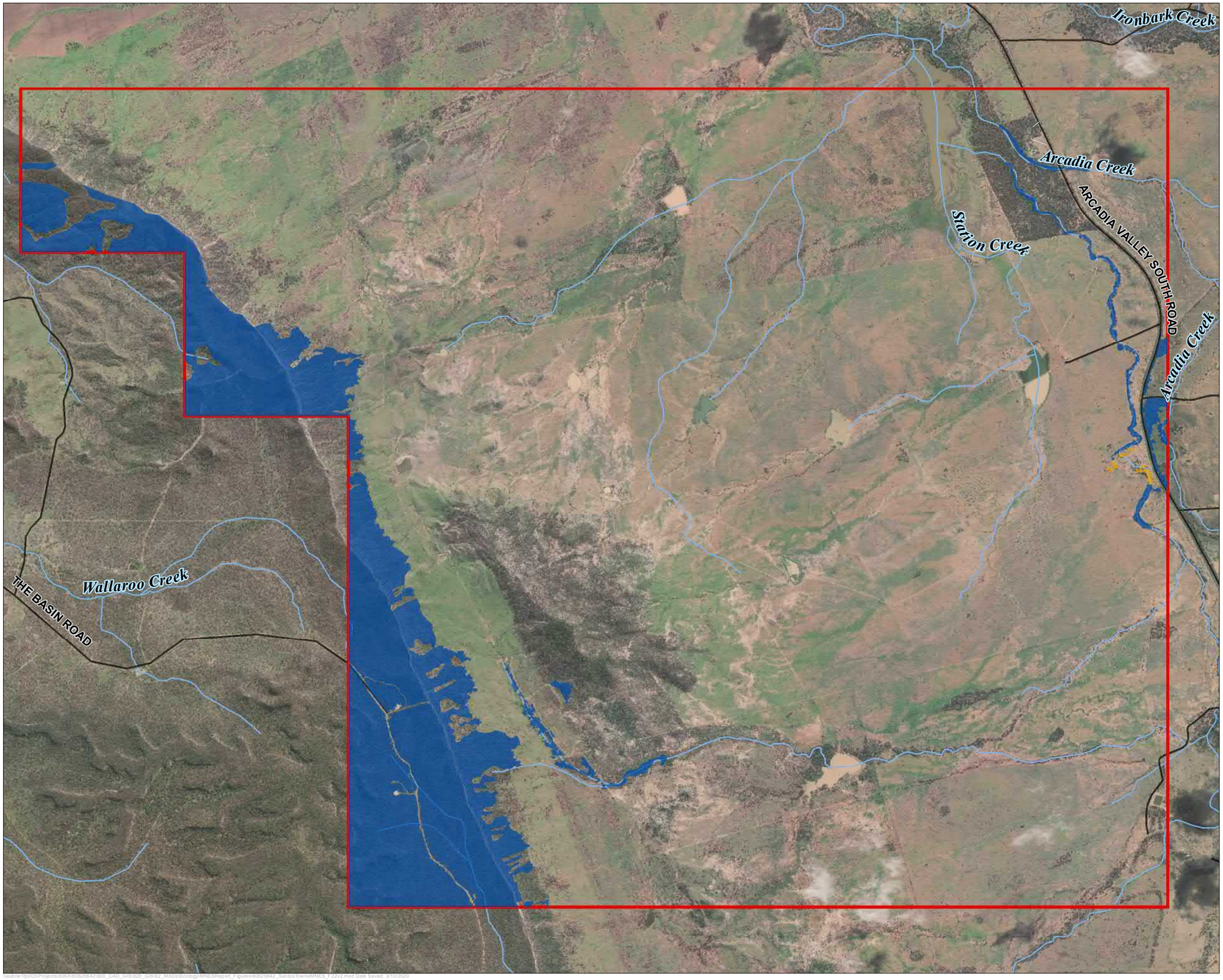
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential South-eastern Long-eared Bat Habitat

- Roosting & foraging
- Foraging only

FIGURE 18

POTENTIAL SOUTH-EASTERN LONG-EARED BAT HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Greater Glider Habitat

- Breeding, denning & foraging
- Foraging & dispersal

FIGURE 19

POTENTIAL GREATER GLIDER HABITAT

AECOM

0 0.55 1.1 KMS

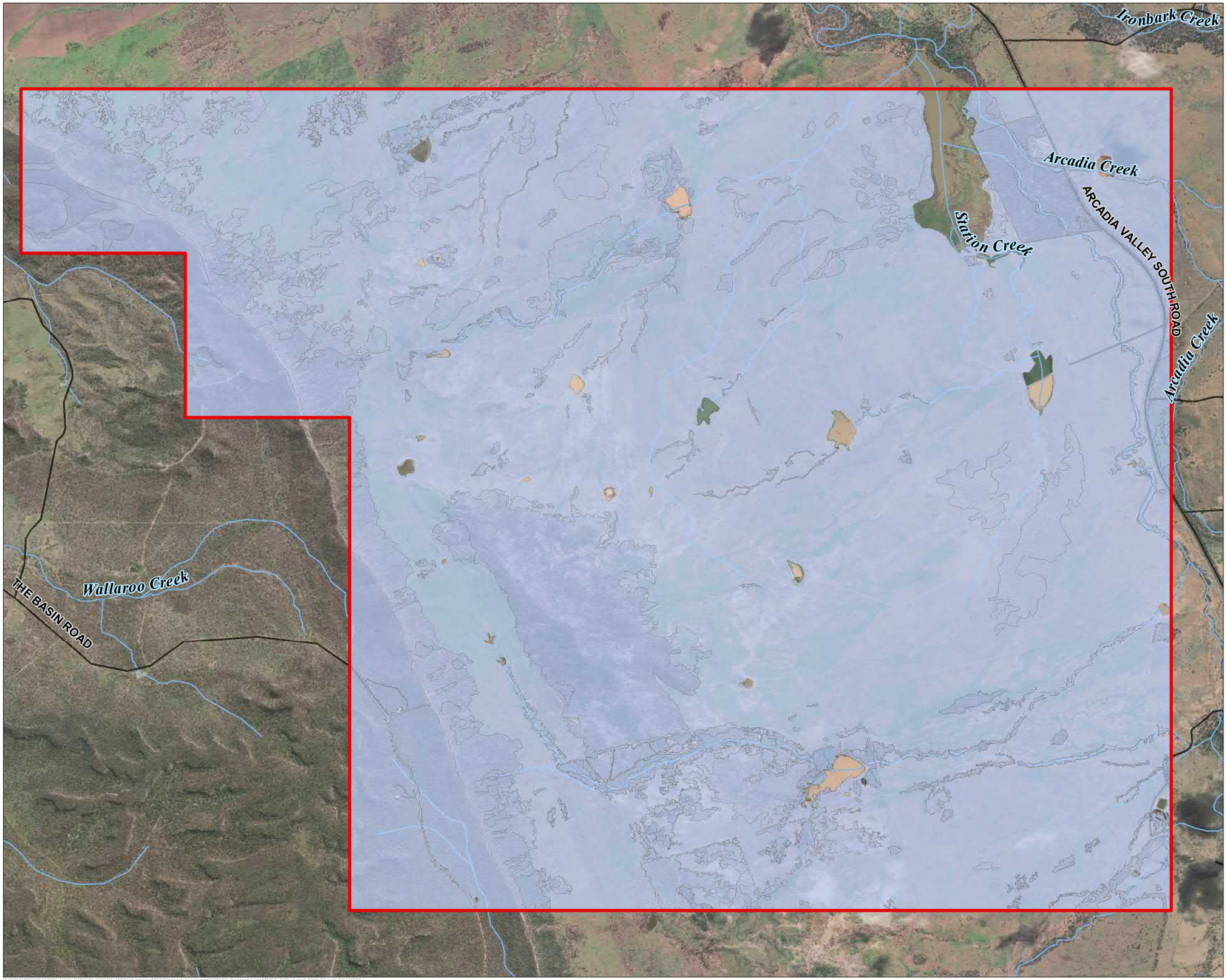
LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Koala Habitat

- Refuge & foraging
- Dispersal

FIGURE 20
POTENTIAL KOALA HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Short-beaked Echidna Habitat

- Breeding, foraging & dispersal

FIGURE 21

POTENTIAL SHORT-BEAKED ECHIDNA HABITAT

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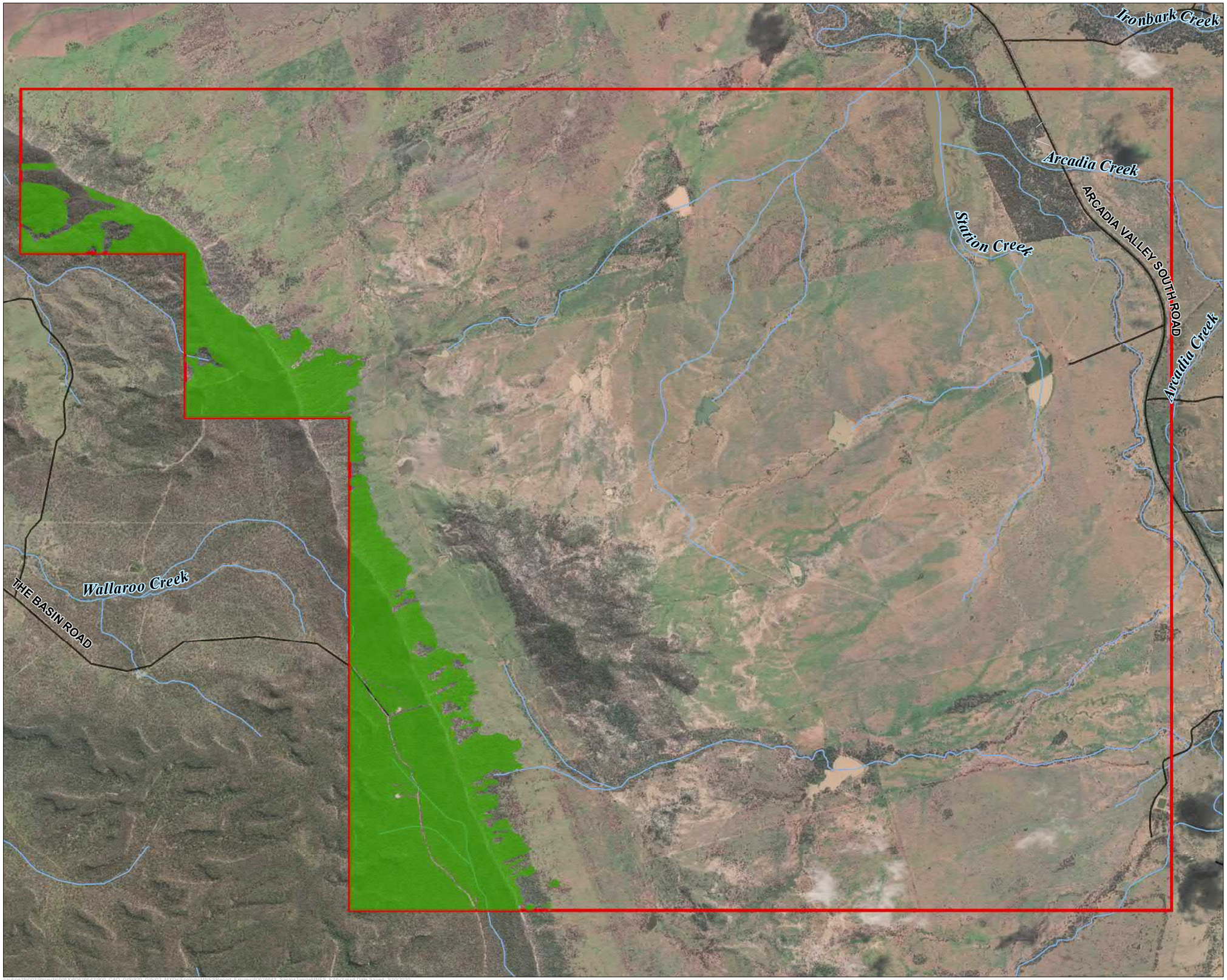


AECOM

0 0.55 1.1 KMS

LEGEND

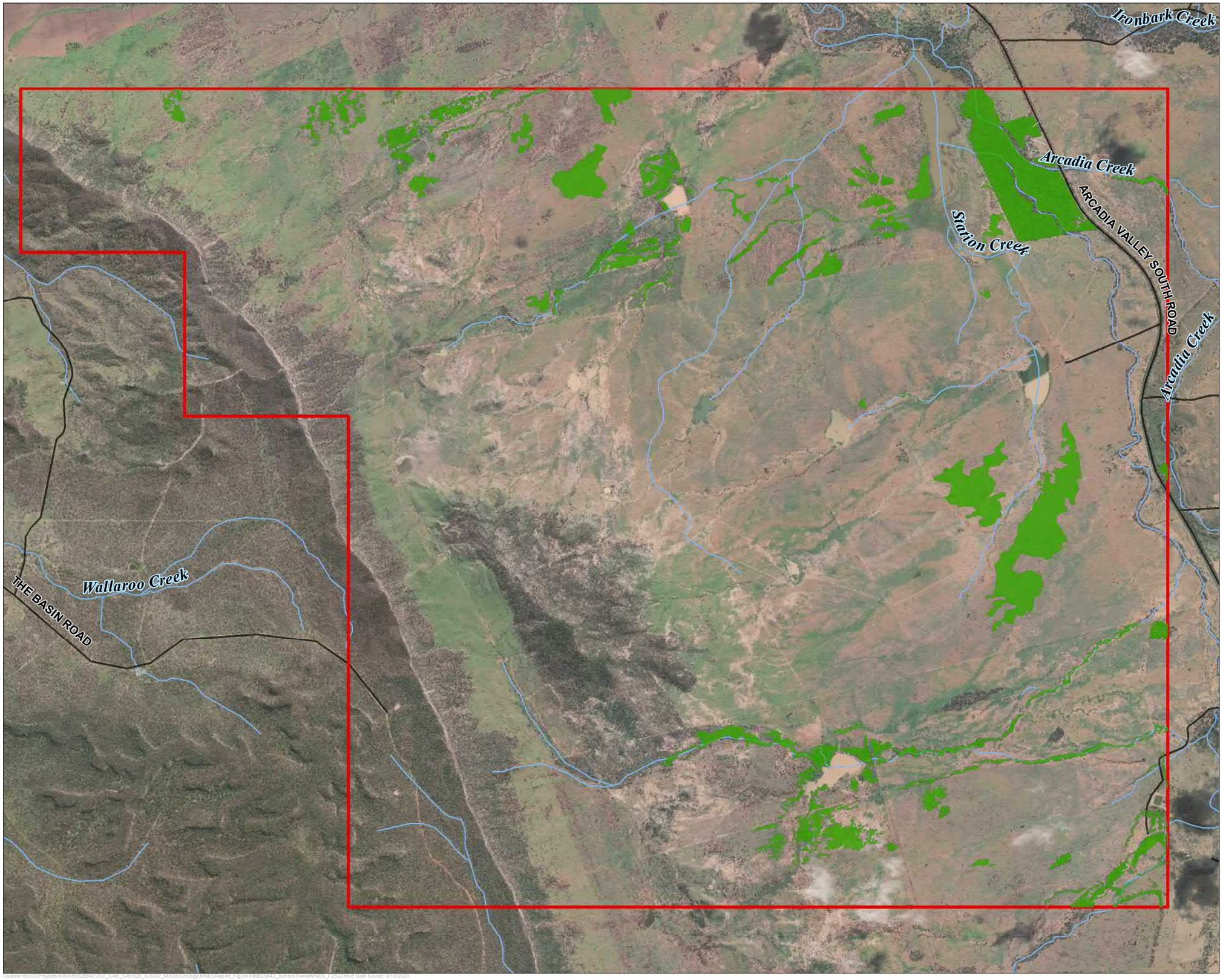
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Collared Delma Habitat

- Breeding & foraging

FIGURE 22

POTENTIAL COLLARED DELMA HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

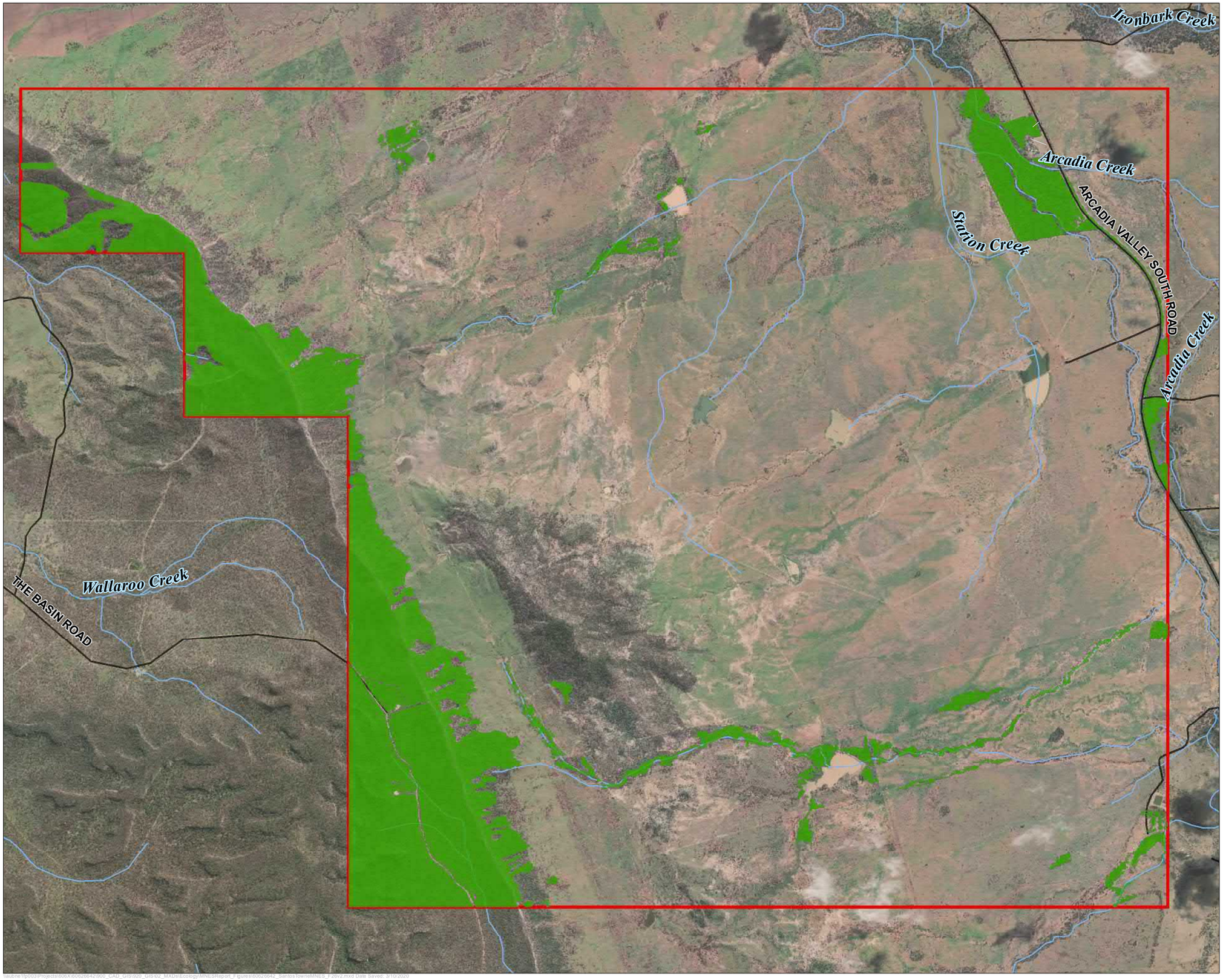
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Ornamental Snake Habitat

- Breeding & foraging

FIGURE 23

POTENTIAL ORNAMENTAL SNAKE HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Yakka Skink Habitat

- Breeding & foraging

FIGURE 24

POTENTIAL YAKKA SKINK HABITAT

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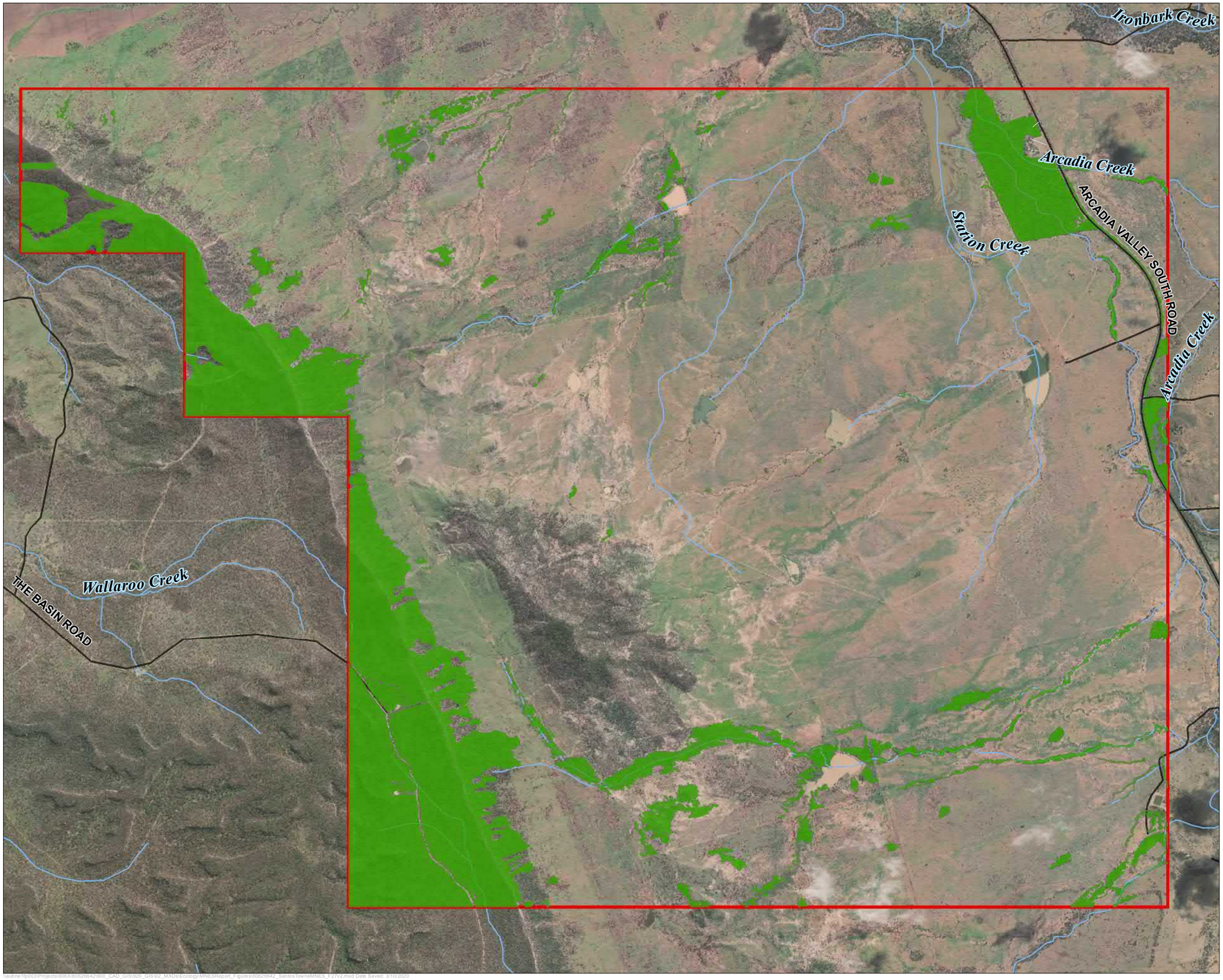


AECOM

0 0.55 1.1 KMS

LEGEND

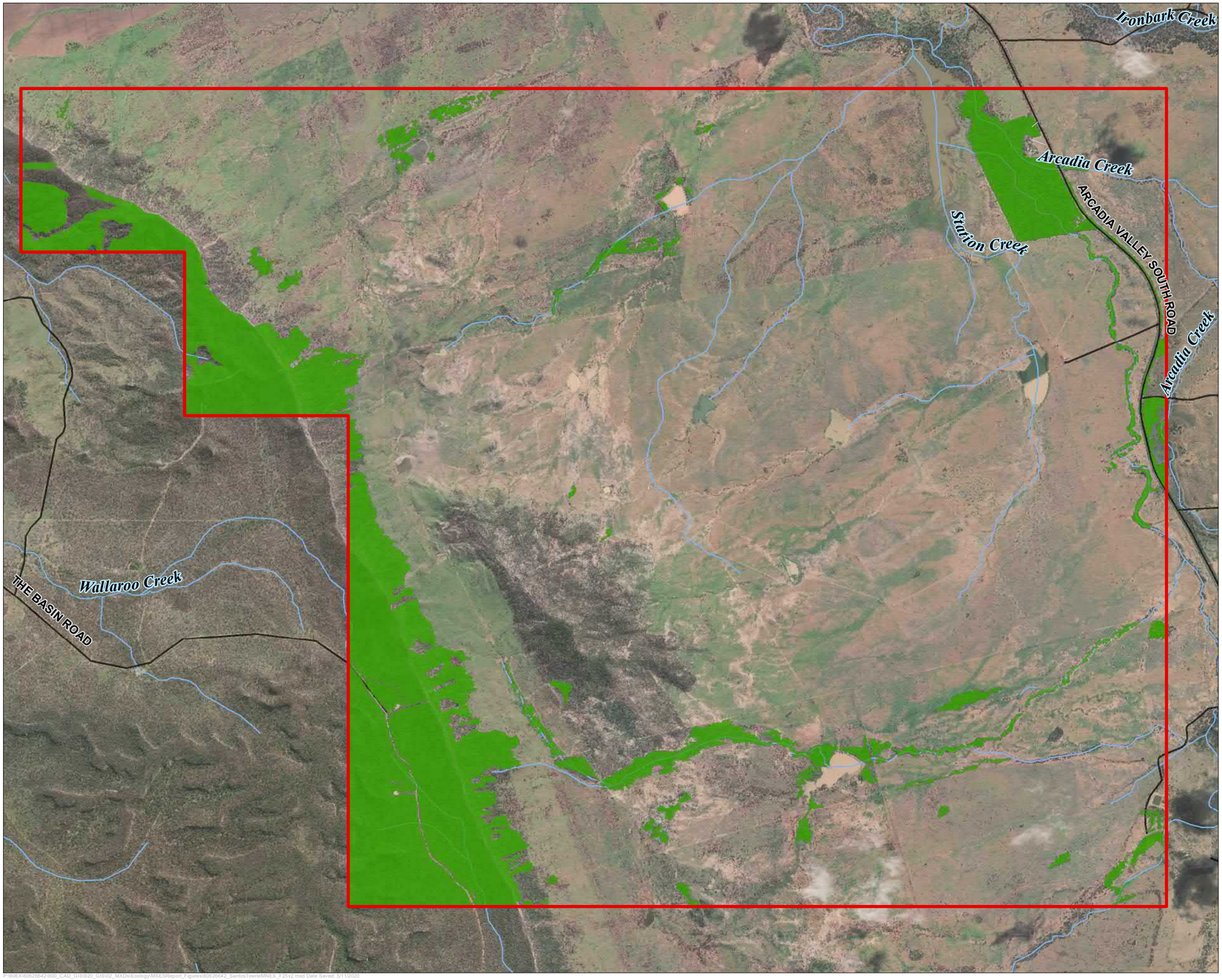
- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Dunmall's Snake Habitat

- Breeding & foraging

FIGURE 25

POTENTIAL DUNMALL'S SNAKE HABITAT



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Golden-tailed Gecko Habitat

- Breeding & foraging

FIGURE 26

POTENTIAL GOLDEN-TAILED GECKO HABITAT

5.12.2 Listed SLC migratory species

Excluding EVNT species, the desktop assessment identified an additional ten migratory species listed as SLC under the NC Act, as potentially occurring within the Project Area and surrounds. No SLC migratory species were recorded within the Project Area during the field surveys, however the glossy ibis (*Plegadis falcinellus*) and rufous fantail (*Rhipidura rufifrons*) were recorded in the local area in 2017 by Boobook Consulting.

A likelihood assessment was conducted for the identified species to determine which species are known, possible or unlikely to occur within the Project Area. This evaluation was based on an understanding of the preferred habitats of the species, knowledge of the type and condition of habitats present at the Project Area as well as the proximity of nearby records.

Of the ten migratory species identified, the likelihood of occurrence assessment (Table 21 of Appendix C) determined six species were 'potential' or 'likely' to occur within the Project Area:

- Fork-tailed swift (*Apus pacificus*)
- Glossy ibis (*Plegadis falcinellus*)
- Oriental cuckoo (*Cuculus optatus*)
- Satin flycatcher (*Myiagra cyanoleuca*)
- Rufous fantail (*Rhipidura rufifrons*)
- Latham's snipe (*Gallinago hardwickii*)

A description of the habitat areas and the extent of habitat within the Project Area for these species list provided in Table 12 below, including a breakdown of habitat utilisation where applicable.

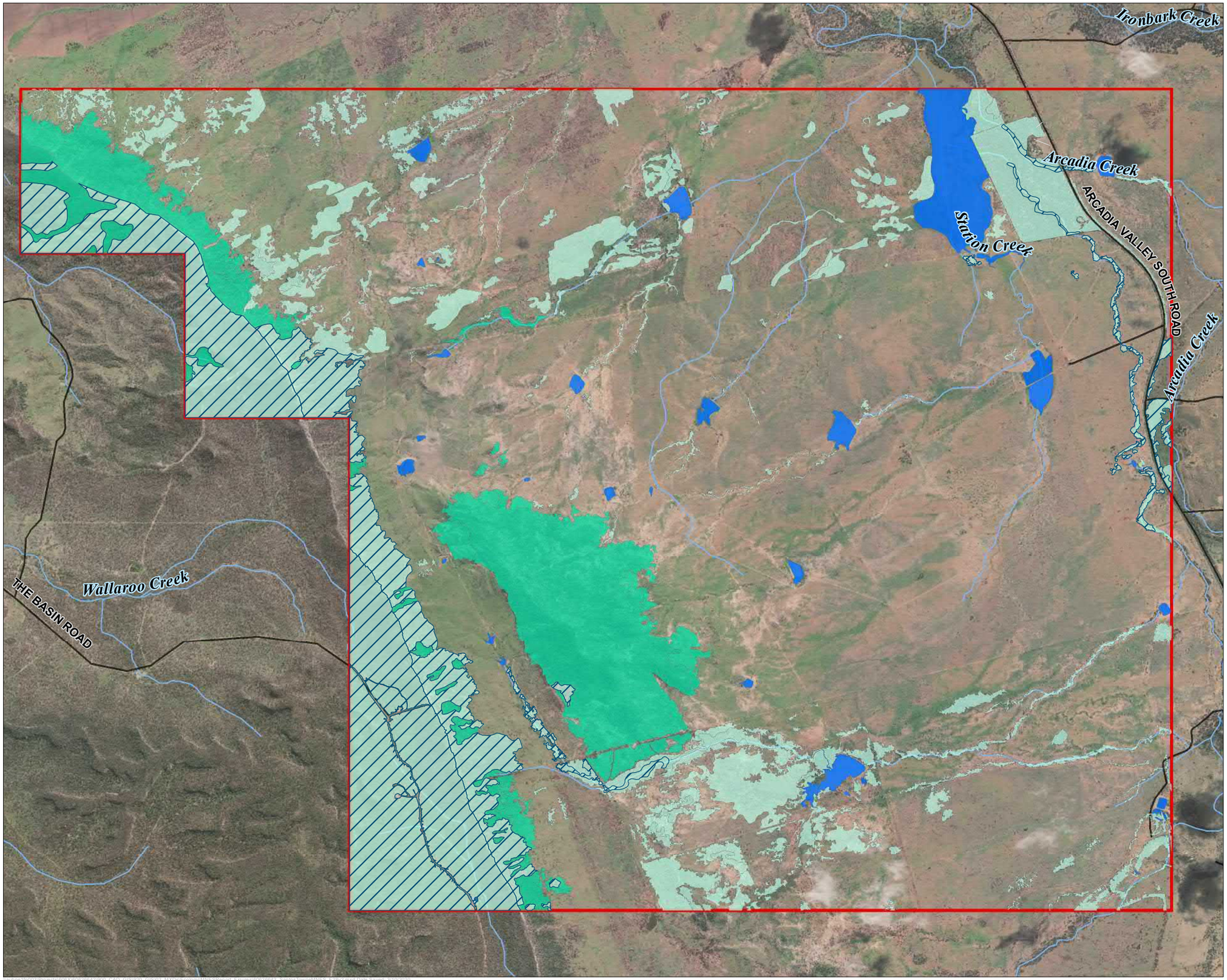
Potential SLC migratory bird habitat within the Project Area is displayed on Figure 27.

Table 12 Potential habitat areas, utilisation and extent for NC Act listed special least concern species

Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Fauna Habitat Types (Table 10)[1]	Area ground-truthed (ha)	Area LiDAR assessed (ha)	Project Area total (ha)
Migratory marine birds							
Fork-tailed swift	Special Least Concern	Potential	**Foraging and dispersal** This species may exist in the airspace above the Project Area. All habitat types in remnant condition provide suitable habitat to support an abundance of foraging resources.	1, 2, 3, 4, 5	40.06	2,241.55	2,281.61
Glossy ibis	Special Least Concern	Likely	**Foraging and dispersal** All modified wetland habitat (including some farm dams) within the Project Area is considered to provide potential foraging and dispersal habitat.	6	33.56	130.44	164.00
Migratory terrestrial species							
Oriental cuckoo	Special Least Concern	Potential	**Foraging and dispersal** Eucalypt open forest on coarse-grained sedimentary rock associated with the ridgeline and middle hill as well as the Eucalypt open forest on alluvial plains habitat.	2, 5	17.79	833.44	851.23
Satin flycatcher	Special Least Concern	Potential	**Foraging and dispersal** Eucalypt open forest on coarse-grained sedimentary rock associated with the ridgeline and middle hill as well as the Eucalypt open forest on alluvial plains habitat.	2, 5	17.79	833.44	851.23
Rufous fantail	Special Least Concern	Likely	**Breeding, foraging and dispersal** SEVT associated with the ridgeline and middle hill as well as Brigalow open forest on sedimentary rock habitat.	3	2.82	659.30	662.12
			Foraging and dispersal Eucalypt open forest on coarse-grained sedimentary rock associated with the ridgeline and middle hill as well as the Eucalypt open forest on alluvial plains	1, 2, 4, 5, 8	34.35	1,572.51	1,606.86

Species	Status (NC Act)	Likelihood of occurrence	Habitat and utilisation within the Project Area	Indicative Fauna Habitat Types (Table 10)[1]	Area ground-truthed (ha)	Area LiDAR assessed (ha)	Project Area total (ha)
			habitat. Brigalow open forest and low open forest on alluvial plains and sedimentary rock habitat as well as brigalow regrowth is considered foraging and dispersal habitat.				
Migratory wetland species							
Latham's snipe	Special Least Concern	Potential	**Foraging and dispersal** All modified wetland habitat (including some farm dams) within the Project Area is considered to provide potential foraging and dispersal habitat.	6	33.56	130.44	164.00

[1]Not areas classified as a specific habitat type in Figure 8 will be suitable for a given species. Individual species maps should also be consulted to determine potential habitat across the Project Area



AECOM

0 0.55 1.1 KMS

LEGEND

- Project Area
- Roads and Tracks
- Minor Watercourses

Potential Oriental Cuckoo & Satin Flycatcher Habitat

- Foraging & dispersal

Potential Glossy Ibis & Latham's Snipe Habitat

- Foraging & dispersal

Potential Rufous Fantail Habitat

- Breeding, foraging & dispersal
- Foraging & dispersal

FIGURE 27
POTENTIAL SPECIAL LEAST CONCERN / MIGRATORY BIRD HABITAT

DRAFT

6.0 Matters of state environmental significance

MSES include certain environmental values that are protected under Queensland legislation including:

- NC Act
- *Marine Parks Act 2004*
- *Fisheries Act 1994*
- EP Act
- *Regional Interests Planning Act 2014*
- VM Act
- EO Act.

MSES that occur within the Project Area and may be affected by the Project are presented in Table 13 below.

Table 13 MSES values within the Project Area

MSES	Description	Present in the Project Area
Regulated vegetation (Endangered / Of Concern REs)	Regional ecosystems which: • are listed in schedule 1 of the Vegetation Management Regulation 2012 • are listed in schedule 1 of the Vegetation Management Regulation 2012 • occur within a Category B area on the regulated vegetation management map • fit the description for the regional ecosystem contained in the Regional Ecosystem Description Database.	**Yes** Regulated vegetation (Endangered and Of Concern REs) as per the MSES description occurs within the Project Area (742.84 ha).
Regulated vegetation (within the defined distance of a watercourse)	Regional ecosystems which: • occur within a Category B area on the regulated vegetation management map; and • intersect or occur within a wetland area as identified on the vegetation management wetlands map. • are located within the defined distance from the defining banks of a relevant watercourse or relevant drainage feature (being those that are identified on the vegetation management watercourse and drainage feature map).	**Yes** Regulated vegetation (intersecting a watercourse) as per the MSES description occurs within the Project Area (52.43 ha).
Regulated Vegetation (within a Vegetation Management Wetland Area)	Regional ecosystems which: • are mapped as a Category B area on the regulated vegetation management map; and • identified as a wetland on the vegetation management wetlands map.	**No** No wetlands as per the MSES description are mapped in the Project Area.
Wetland and Watercourses	Means an area shown as a wetland: • in a wetland protection area; or • of high ecological significance on the Map of Referrable Wetlands	**No** No wetland or watercourse protection areas occur within the Project Area.

D R A F T

MSES	Description	Present in the Project Area
	• or watercourse in high ecological value waters (as defined under the Environmental Protection (Water) Policy 2009, schedule 2.	
Connectivity areas	Areas which consist of vegetation mapped as prescribed regional ecosystem that: • are of sufficient size or configured in a way that maintains ecosystem functioning; and • will remain despite a threatening process within the meaning of the NC Act.	**Yes** Connectivity areas occur within the Project Area as per the MSES description.
Protected wildlife habitat	Protected wildlife habitat includes: • an area of Essential Habitat on the Essential Habitat map for an animal or plant that is endangered or vulnerable wildlife • a high-risk area on the flora survey trigger map which also contains endangered, vulnerable or near threatened (EVNT) plant species • an area which contains EVNT plants and is not shown on the flora survey trigger map • an area of habitat (e.g. foraging, roosting, nesting or breeding habitat) for an animal that is endangered, vulnerable or a special least concern animal (non-migratory).	**Yes** Potential habitat for state listed species occurs within the Project Area, including: Three EVNT plant species: • *Apatophyllum teretifolium* • Ooline (*Cadellia pentastylis)* • *Xerothamnella herbacea* Fifteen endangered, vulnerable, near threatened or SLC (non-migratory) fauna species: • Adorned delma (*Delma torquata*) • Ornamental snake (*Denisonia maculata*) • Yakka skink (*Egernia rugosa*) • Red goshawk (*Erythrotriorchis radiatus*) • Grey falcon (*Falco hypoleucos*) • Dunmall's snake (*Furina dunmalli*) • Squatter pigeon (southern) (*Geophaps scripta scripta*) • Painted honeyeater (*Grantiella picta*) • White-throated needletail (*Hirundapus caudacutus*) • Australian painted snipe (*Rostratula australis*) • Large-eared pied bat (*Chalinolobus dwyeri*) • South-eastern long-eared bat (*Nyctophilus corbeni*) • Greater glider (*Petauroides volans*) • Koala (*Phascolarctos cinereus*) • Golden-tailed gecko (*Strophurus taenicauda*) • Short-beaked echidna (*Tachyglossus aculeatus*).

D R A F T

MSES	Description	Present in the Project Area
Protected areas	This relates to protected areas as declared under the NC Act, including: • National parks • National parks (Aboriginal land) • National parks (Torres Strait Islander land) • National parks (Cape York Peninsula Aboriginal land) • Regional parks • Nature refuges.	**No** No protected areas as per the MSES definition are present within the Project Area.
Fish Habitat Areas and Highly Protected Zones of State marine parks	An area declared under the *Fisheries Act 1994* to be a fish habitat area.	**No** No state marine parks or fish habitat areas occur within the Project Area.
Waterway providing for fish passage	Any part of a waterway providing for passage of fish if the construction, installation or modification of waterway barrier works carried out under an authority will limit the passage of fish along the waterway.	**Yes** Waterways which provide for fish passage are present within the Project Area. The detailed design of the Project will determine if construction, installation or modification of waterway barrier works within these waterways will limit the passage of fish.
Marine plants	A marine plant within the meaning of the *Fisheries Act 1994.*	**No** Marine plants do not occur within the Project Area.
Legally secured offset area under State legislation	An offset area approved by the administering authority associated with a legislative or policy requirement for the provision of an offset.	**No** No legally secured offset areas are present within the Project Area.

D R A F T

7.0 Potential impacts

Information on the potential impacts associated with the Project are outlined below. Proposed mitigation measures to minimise the potential impacts on MSES values are outlined in Section 8.0.

To determine worst-case scenario direct impacts, a preliminary Project Footprint considered to represent the maximum impact area and extent has been developed. It should be noted that this footprint is not final and subject to change based on available gas resources, future validation of environmental values within the Project Area and approvals.

7.1 Construction phase

The greatest risk of potential impact on MSES values from the Project will occur during the construction phase. The construction activities to support the installation of wells, associated distribution gathering lines and access tracks will involve vegetation clearing, trenching or excavation and ground reinstatement. Direct and indirect impacts potentially associated with this are described below.

7.1.1 Direct impacts

Vegetation clearing is a direct impact that can result in the loss of vegetation values and habitat, with the severity of impacts more pronounced in habitats that provide values for conservation significant species and communities. Potential impacts resulting from clearing native vegetation can include:

- reduced patch size of vegetation communities potentially compromising the viability of the community and associated habitat
- loss of habitat causing a reduction of biological diversity or loss of local populations and genotypes
- loss of or disturbance to microhabitat features such as tree hollows, leaf litter, ground timber, dense shrubs and hollows
- loss of floristic diversity and the food resources this provides such as foliage, flowers, nectar, fruit and seeds
- fragmentation of habitats resulting in reduced dispersal opportunities for fauna
- destruction of abiotic features necessary to support vegetation communities and habitat types.

Pre-clearance surveys will identify any potentially occurring threatened flora species within the Project Area. Should threatened flora species be identified, these individuals will be demarcated and avoided by construction. No development including vegetation clearing will be permitted within 100 m of individuals without further assessment as per the *Flora Survey Guidelines* (Department of Environment and Science, 2019a). As such, no direct impacts to threatened flora species are likely to occur.

As per the State regulated vegetation mapping, Category B Regulated Vegetation areas within the Project Area are restricted to the Public Reserve, Middle Hill and the western ridgeline. The Project Footprint will largely avoid these areas, with direct impacts limited to patch edges at these locations. The extent of clearing impacts to MSES regulated vegetation values and ESAs are detailed in Table 14.

Table 14 Direct impacts on MSES Regulated Vegetation

Regulated Vegetation MSES	Area (ha)
Prescribed REs that are listed Endangered and Of Concern under the VM Act	0.05
Prescribed REs within the defined distance of a watercourse	>0.01
Category B ESA	3.02
Category C ESA	0.48

Direct impacts to MSES protected wildlife habitat are anticipated (Table 15). Large portions of potential MSES habitat within the Project Area consist of small fragmented patches, which are likely to be already disturbed due to historical clearing and thinning, exotic weeds and cattle grazing. Connectivity across the Project Area is already compromised. However, further fragmentation of these patches, or fragmentation of the infrequent larger intact patches may occur via vegetation clearing, as required namely for the construction of the linear components of the Project. Vegetation clearing can fragment and disconnect vegetation communities, creating or further isolating patches which can impact on the success of seed dispersal, species recruitment and ultimately the long-term viability and persistence of a habitat within the landscape. Creating isolated patches and barriers for fauna movement which can impact on species recruitment, genetic flow and ultimately the long-term viability and persistence of fauna populations within the landscape.

MSES that are most susceptible to fragmentation impacts as a result of the construction of the Project includes greater glider, koala and yakka skink. All other threatened and SLC species are either highly mobile, adapted to fragmented landscapes or are known to still traverse cleared or modified areas without significant risk.

Table 15 Direct impacts on MSES protected wildlife habitat associated with the Project

MSES	Status (NC Act)	Habitat and utilisation within the Project Area	Total area (ha)
Birds			
Red goshawk	Vulnerable	Foraging only	**1.46**
Grey falcon	Vulnerable	Breeding and foraging or Foraging and dispersal	**12.18**
Squatter pigeon (southern)	Vulnerable	Dispersal only	**12.68**
Painted honeyeater	Vulnerable	Foraging and dispersal only	**11.70**
White-throated needletail	Vulnerable	Roosting and foraging or Foraging only	**12.18**
Australian painted snipe	Endangered	Foraging and roosting or Temporary foraging and dispersal only	**4.92**
Fork-tailed swift	Special Least Concern	Foraging and dispersal	**12.18**
Glossy ibis	Special Least Concern	Foraging and dispersal	**0.73**
Oriental cuckoo	Special Least Concern	Foraging and dispersal	**12.18**
Satin flycatcher	Special Least Concern	Foraging and dispersal	**12.18**
Rufous fantail	Special Least Concern	Foraging and dispersal	**12.18**
Latham's snipe	Special Least Concern	Foraging and dispersal	**0.73**
Mammals			
Large-eared pied bat	Vulnerable	Roosting only	**0.00**
		Foraging only	**3.24**
South-eastern long-eared bat	Vulnerable	Roosting and foraging or Foraging only	**3.24**
Greater glider	Vulnerable	Foraging and dispersal or Breeding, foraging and dispersal	**0.48**
Koala	Vulnerable	Foraging only, Dispersal only or Refuge and foraging	**1.79**
Short-beaked echidna	Special Least Concern	Breeding, foraging and dispersal	**343.83**

MSES	Status (NC Act)	Habitat and utilisation within the Project Area	Total area (ha)
Reptiles			
Adorned delma	Vulnerable	Breeding and foraging	**0.30**
Ornamental snake	Vulnerable	Breeding and foraging	**2.68**
Yakka skink	Vulnerable	Breeding and foraging	**1.67**
Dunmall's snake	Vulnerable	Breeding and foraging	**2.21**
Golden-tailed gecko	Near Threatened	Breeding and foraging	**1.44**

Fauna mortality is another direct impact that may occur to MSES species during the construction phase. Fauna may be injured or killed during construction principally through:

- strike from moving vehicles/machinery/blasting – key issue for ground dwelling species, particularly those with poor mobility
- entrapment in habitat during removal – key issue during tree felling for species that use tree hollows or hollow logs for roosting and denning
- entrapment in trenches/holes – key issue for ground dwelling species (reptiles and small mammals), particularly those that are active at night and cannot detect trenches to avoid.

7.1.2 Indirect impacts

The loss of vegetation and habitat as well as the construction activities required to be undertaken to clear vegetation or complete construction, can potentially result in indirect or secondary impacts to the associated MSES values. This includes:

- increased edge effects reducing the condition of quality of remaining vegetation communities and habitat types. This would occur primarily in the few locations where larger intact patches may be disturbed as the majority of the Project Area consist of small fragmented patches, which are likely to be already impacted by edge effects.
- although exotic weeds are likely to be abundant across the Project Area, further disturbance can permit the establishment and spread of exotic species that may displace native species, native habitat resources and alter fire regimes
- soil exposure resulting in an increased risk of erosion and sedimentation of water bodies, reducing water quality and degrading aquatic habitats
- increased risk of contamination associated with activities such as refuelling or storage of chemicals
- changes in hydrology from installation of infrastructure creating a barrier to surface flow and increasing stormwater run-off
- generation of dust emissions leading to excessive deposition of dust on plants suppressing photosynthesis and growth
- increased noise and light levels affecting foraging and breeding behaviour for some fauna species or resulting in complete avoidance and displacement from habitats
- periodic burst of elevated noise levels and increased dust that occur as a result of blasting may startle and disorientate fauna species within proximity
- proliferation of pests.

All MSES species are susceptible to these indirect impacts to some degree; however, some are known to be more highly susceptible than others, are more relevant or have been identified as key threatening processes for the MSES. The susceptibility of the specific MSES values identified within

the Project Area to the potential indirect impacts is outlined in Table 16. Whilst the Project will not have any direct impacts on threatened flora, potential indirect impacts have been considered.

Table 16 MSES at risk to indirect impacts associated with the Project

Indirect Impact	Relevant MSES	Potential Impact
Edge effects causing habitat degradation	Ooline	Species is known to be affected by changes in micro-climate and insect attack (when exposed). Therefore edge effects as a result of the Project, especially in large connected areas such as Middle Hill and the western ridgeline, could threaten the health and viability of retained individuals. However it is noted that development of Middle Hill and the western ridgeline is not proposed as part of the Project.
Weed and pest incursion	Threatened flora	Encroachment of exotic pasture grass could result in an increase of fuel loads and more incidence of high intensity fires within retained threatened flora habitat. Increased pest animals, particularly ungulates such as feral pigs, horses and cattle, would trample, overgraze and damage the understorey and recruiting potential of threatened flora species potentially occurring in the Project Area.
	Squatter pigeon	Only dispersal habitat identified within the Project Area. Individuals utilising the Project Area to disperse will be highly susceptible to an increase in pest predator species such as feral cats and foxes.
	Grey falcon	This species may roost on areas of bare ground within the Project Area during the night. As such, this species is considered highly susceptible to an increase in pest predator species such as feral cats and foxes.
	Australian painted snipe and other wetland birds	Quality and availability of foraging resources are directly related to condition of aquatic habitat and therefore increased weed incursion could impact on species habitat in the Project Area. Species are also high susceptible to predation.
	Koala	Any potential increase in wild dog populations as a result of the Project could threaten any potential koala populations within the Project Area.
	Short-beaked echidna	An increase in wild dog or feral cat populations may increase predatory pressure on young or young adult short-beaked echidnas.
	Threatened reptiles	Potential breeding, foraging and dispersal habitat identified within the Project Area. Individuals utilising the Project Area will be highly susceptible to an increase in pest predator species such as feral cats, cane toads and foxes.
Erosion, sedimentation and reduced water quality	Australian painted snipe and other wetland birds	Quality and availability of foraging resources are directly related to condition of aquatic habitat and therefore any reduction in water quality could impact on species habitat in the Project Area.
	Ornamental snake	Quality and availability of foraging resources (frogs) are directly related to condition of gilgai habitat and therefore any reduction in water quality could impact on species habitat in the Project Area.
	Ooline	Species is known to be affected by tunnel and sheet erosion, therefore potential erosion impacts as a result of the Project could threaten the health and viability of retained individuals.
Soil and water contamination	Australian painted snipe and other wetland birds	Quality and availability of foraging resources are directly related to condition of aquatic habitat and therefore an impact to water quality could impact on species habitat in the Project Area.

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Indirect Impact	Relevant MSES	Potential Impact
	Ornamental snake	Quality and availability of foraging resources (frogs) are directly related to condition of gilgai habitat and therefore any water contamination could impact on species habitat in the Project Area.
Altered hydrology	Australian painted snipe and other wetland birds	Quality and availability of foraging resources are directly related to condition of aquatic habitat and therefore alteration to hydrology could impact on species habitat in the Project Area.
	Ornamental snake	Quality and availability of foraging resources (frogs) are directly related to condition of gilgai habitat and therefore alteration of hydrology could impact on species habitat in the Project Area.
Elevated dust	Ooline	Deposition of dust as a result of the Project could threaten the health and viability of retained individuals.
Noise and light disturbance	Australian painted snipe and other wetland birds	Most species are known to be easily startled. Noisy activities directly adjacent to potential habitat within the Project Area may disturb foraging individuals.
	Threatened plants	Increased lighting within or adjacent to potential foraging habitat within the Project Area could increase predation of the species by visual predators
	Greater glider	Increased lighting within or adjacent to potential foraging and denning habitat within the Project Area could increase predation of the species by visual predators.
	Ornamental snake and Dunmall's snake	Increased lighting within or adjacent to potential foraging and denning habitat within the Project Area could increase predation of the species by visual predators.
	Yakka Skink	This species is easily startled and increase noise levels may impact on important functional requirements such as basking.

7.2 Operation phase

Impacts on MSES associated with the operation phase of the Project are considered to be very low as activities will be limited to periodic maintenance. Traversing maintenance vehicles may inadvertently introduce weeds and potentially collide with ground dwelling MSES resulting in injury or mortality.

7.3 Decommissioning and rehabilitation phase

Temporary and localised increases in noise and potentially dust may occur, but will be managed using the same methods used during construction. Traversing vehicles required to complete decommissioning or rehabilitation activities or manage dust may inadvertently introduce weeds and potentially collide with ground dwelling MSES species resulting in injury or mortality.

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8.0 Mitigation measures

The hierarchy of management principles will be implemented throughout all phases of the Project, including the siting of infrastructure within the Project Area. Further information regarding each principle is detailed in Section 8.1 to 8.3 below. A Draft Rehabilitation Monitoring Plan is included as an attachment to the EA application.

The following key environmental objectives relevant to biodiversity will be implemented for the Project:

- Avoid or minimise impacts on terrestrial and aquatic ecosystems and associated flora, fauna and habitat of state and national significance
- Avoid or minimise habitat loss and fauna mortality
- Prevent introduction and control spread of weed and pest plant and animal species
- To rehabilitate land significantly disturbed by project activities to a condition that is stable, non-polluting and safe to humans and wildlife
- To rehabilitate significant disturbances within remnant vegetation areas to a condition that allows return of pre-disturbance biodiversity values
- To rehabilitate significant disturbances within non-remnant areas to match the surrounding agricultural land-use (or other use as determined by the landholder).

8.1 Avoidance

Santos has employed a GIS model that assesses the locations of MSES values identified in the constraints mapping completed as part of this assessment to ensure maximum avoidance of such values. Infrastructure will preferentially be sited in areas that have previously been cleared and impacted by ongoing cattle grazing activities. Nonetheless, some direct impacts to MSES values (primarily wildlife habitat as detailed in Section 7.1.1) will occur. Direct impact areas detailed in Section 7.1.1 represent the upper maximum disturbance limit.

Pre-clearance surveys will identify and demarcate any identified threatened flora species to ensure complete avoidance and no direct impacts.

8.2 Minimise

Development of the Project within the Project Area will occur progressively. By doing this, only a small subset of the Project Area will be impacted at one time. Indirect impacts resulting from the construction of the Project will be localised and temporary.

Field assessment surveys will be conducted prior to construction and opportunities to microsite gas field infrastructure to avoid habitat features will be investigated. Following confirmation of the Project footprint, pre-clearance surveys will ensure no unidentified MSES values will be impacted and impacts will not exceed disturbance limits discussed in Section 7.1.1. Throughout construction, clearing will only be completed as deemed necessary.

8.3 Mitigate

Both general and species-specific mitigation and management measures have been developed for the Project, as detailed below.

8.3.1 General mitigation measures

The key general mitigation measures include:

- Prior to construction, the occurrence and extent of MSES will be identified and delineated within the Project Footprint.
- Exclusion areas will be delineated to avoid unauthorised disturbance and access of areas of threatened species habitat.

- When siting infrastructure, existing breaks between patches of MSES will be utilised as much as practical to minimise habitat fragmentation.
- Movement within the Project Area will be via approved access tracks only with speed limits enforced. The requirement to enter and traverse the Project Area will be minimised where possible and limited to those required for essential Project activities.
- All clearing within remnant or HVR vegetation will be conducted with a suitably qualified spotter catcher present. Fauna will be relocated to an undisturbed location.
- Where approved, Santos may extract water from select farm dams for construction purposes. Santos will only take water where available supplies provide continuity of habitat function and quality.
- Exclusion zones will be established around identified active breeding places and any fauna habitat features to be retained (eg mature trees, inactive breeding places) and appropriately marked out. Active breeding places will be monitored to ensure the breeding site has been vacated prior to the exclusion zone being removed.
- Night works within or adjacent to areas of MNES will be avoided where possible. Where night works are required, lights will be directed to minimise light spill into adjacent habitats.
- Microhabitat features such as large fallen logs will be relocated to adjacent areas of undisturbed vegetation prior to vegetation clearing where practicable.
- Dust suppression measures will be implemented as required i.e. on high wind days during dry periods.
- Undertake refuelling and chemical storage in designated containment areas and follow emergency response procedures in the event of a spill. Containment areas will be designed and managed in accordance with relevant regulatory requirements and standards.
- Threat of wildfire caused by Santos activities will be minimised through maintenance of firebreaks around ignition sources as appropriate.
- Weed and pest management strategies to be implemented for controlling the spread of weeds and pests, particularly vehicles traversing the Project Area. This includes:
  - Wash down protocols are required for any vehicles or machinery entering and leaving the Project Area.
  - Ongoing monitoring of the Project Area to identify any new incidence of weed and pest infestation.
- Disturbed areas will be assessed and progressively rehabilitated in accordance with the Draft Rehabilitation Monitoring Plan.

8.3.2 Species-specific mitigation measures

Mitigation measures specific to the potentially occurring EVNT species are detailed in Table 17 below.

Table 17 Species-specific mitigation measures

MSES	Mitigation measure
Koala	• Clearing must be carried out in a way that ensures any koala present have time to move out of the clearing site without human intervention.
Grey falcon	• Retain tall trees especially where located along watercourses, where possible.
Painted honeyeater	• Retain trees that contain mistletoe where possible
Ground-dwelling MSES fauna	• Open trenches will be checked for trapped fauna in the morning and at the end of the day by a spotter catcher • Trench ladders, ramps, sticks, ropes and the use of moist hessian sacks at regular intervals (or similar) will be utilised to help trapped fauna escape and/or survive until removed by a fauna spotter-catcher.

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MSES	Mitigation measure
Ornamental snake	• Clearing works that occur in areas of potential ornamental snake habitat will prioritise avoiding gilgai formations

9.0 Significant residual impacts

9.1 MNES significant impact assessment

The presence of MNES within the Project Area was assessed using a combination of field-validated data, desktop information and extrapolated field survey results. This process identified a total of 28 known, likely or potentially occurring MNES including three TECS, four threatened flora species, fifteen (15) threatened fauna species and six migratory species.

An impact assessment was completed to determine potential Project impacts on known, likely, or potential MNES. Following this assessment, a risk assessment of potential Project impacts was undertaken and MNES identified to be at 'potential' risk of impact were further investigated via a significant impact assessment (SIA). This risk assessment process and results are outlined further in Appendix G.

Based on the risk assessment results, SIAs were undertaken in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines: Matters of National Environmental Significance (Department of Environment, 2013b) for five MNES values, outlined below:

- Endangered Species and Communities:
  - Brigalow threatened ecological community
- Vulnerable Species
  - Koala
  - Painted honeyeater
  - Ornamental snake
  - Yakka skink.

SIA, relevant criteria, detailed assessments and supporting documents are detailed in Appendix H, with a summary presented in Table 18. Findings of the SIA determined that the Project is unlikely to result in a significant impact any of the known or potential MNES values within the Project Area. Full details are provided within the MNES Report (AECOM, 2020).

Table 18 Summary of SIA assessment for MNES within the Project Area

MNES	SIA result	Primary justification
Endangered Species and Communities		
Brigalow TEC	No significant impact	Potential clearing of Brigalow TEC was assessed against EPBC Act criteria. The 1.68 ha of Brigalow TEC which may be cleared as part of the Project, equates to less than 1% of Brigalow TEC identified within the Project Area. This amount of clearing is not expected to result in any of the outcomes listed in the Significant Impact Guidelines for this MNES Avoidance, mitigation and management measures will also be undertaken to limit the extent of clearing of Brigalow TEC. This includes pre-clearance surveys to accurately locate the presence and extent of Brigalow TEC and further micro-siting of infrastructure to avoid areas, where possible.
Vulnerable Species		
Koala	No significant impact	The Project may result in 1.79 ha of koala habitat to be cleared within the Project Area that includes habitat likely to be utilised by the species for refuge, foraging and dispersal purposes. This equates to less than 1% of koala habitat within the Project Area. Assessing significance of impacts to the koala is a twostep process and involves assessing whether Project impacts will:

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MNES	SIA result	Primary justification
		1. Substantially interfere with the recovery of the species; or 2. Adversely affect habitat critical to the survival of the species Assessment of point number 1 concluded the Project is unlikely to result in the following within habitat critical to the survival of the koala (in accordance with the EPBC Act Referral Guidelines for the Vulnerable Koala): • Increase in koala fatalities due to dog attacks • Increase in koala fatalities due to vehicle strikes • Facilitating the introduction or spread of disease or pathogens likely to significantly reduce the reproductive output of koalas or reduce the carrying capacity of the habitat • Creating a barrier to movement to the koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala • Changing hydrology which degrades habitat critical to the survival of the koala to the extent that the carrying capacity of the habitat is reduced in the long-term. Habitat critical to the survival of the koala was identified following assessment of the Project Area using the habitat assessment tool. Following this confirmation, a full SIA was completed under the Significant Impact Guidelines Policy Statement 1.1 (Department of the Environment, 2013b), allowing assessment of point number 2. This SIA concluded that the Project is considered unlikely to result in the outcomes outlined under the Significant Impact Guidelines for this MNES.
Painted honeyeater	No significant impact	This species is highly nomadic with only dispersing and foraging individuals expected to utilise potential habitat within the Project Area. Direct impacts to potential habitat are limited to clearing of 11.70 ha of foraging and dispersal habitat, with 739.31 ha remaining outside of this area. Further, any population utilising the Project Area is not considered an important population. Assessment of Project impacts on this species paired with mitigation and avoidance methods outlined in Appendix G and the MNES Report (AECOM, 2020), it is concluded that proposed actions are not expected to result in any of the outcomes outlined in the Significant Impact Guidelines for this MNES.
Ornamental snake	No significant impact	DAWE considers that the occurrence of 'important habitat' for the ornamental snake is a surrogate for an 'important population' of the species. While modelled habitat may be considered 'important', habitat within the Project Area is highly modified and degraded by historical clearing and cattle grazing and unlikely to contain the important habitat features to support the species. The Project may result in clearing of 2.68 ha or less than 1% of habitat that could be utilised by the species for breeding, foraging and dispersal purposes. Given this level of clearing paired with mitigation and avoidance methods outlined in Appendix G and the MNES Report (AECOM, 2020), SIA concluded that proposed actions are not expected to result in any of the outcomes outlined in the Significant Impact Guidelines for this MNES.

MNES	SIA result	Primary justification
Yakka skink	No significant impact	Across the site 1,023.97 ha of potential breeding and foraging habitat was identified for the yakka skink, with 1.67 ha of potentially impacted by the Project itself. High quality habitat for this species is located within the Public Reserve on the western ridgeline, with any potential impacts to this habitat restricted to the lower quality, marginal edges only ensuring habitat maintains its ecological functionality for the species to persist (if present). Additionally, the Project will be developed in stages, with only a portion of the potential habitat may be impacted at one time. Paired with the use of mitigation and avoidance methods outlined in Appendix G and the MNES Report (AECOM, 2020), the SIA concluded that proposed actions are not expected to result in any of the outcomes outlined in the Significant Impact Guidelines for this MNES.

9.2 MSES significant residual impact assessment

As discussed in Section 6.0, the following MSES are found within the Project Area (some of which have already been assessed under the EPBC Act):

- Regulated vegetation:
  - Prescribed REs that are listed Endangered and Of Concern under the VM Act
  - Prescribed REs within the defined distance of a watercourse.
- Protected wildlife habitat:
  - Short-beaked echidna
  - Golden-tailed gecko
  - Koala
  - Painted honeyeater
  - Ornamental snake
  - Yakka skink
- Connectivity areas
- Waterways providing fish passage.

A significant residual impact (SRI) assessment in accordance with the criteria provided in the Significant Residual Impact Guidelines (Department of the Environment and Heritage Protection, 2014) has been undertaken for the Project (Appendix F).

SRI assessments were completed using a Project Footprint considered to represent the maximum impact area. The outcomes of these assessments and the associated justification is summarised in Table 19 below. After considering potential impacts, mitigation measures and the state significant residual impact criteria, the Project will not have a significant residual impact on any MSES values.

Table 19 Summary of SRI assessment for MSES within the Project Area

MSES	SRI expected?	Primary justification
Regulated vegetation: Endangered and Of Concern REs	No	The Project Footprint avoids the majority of mapped Category B areas except in one location (the Public Reserve). The maximum impact area width within an Endangered or Of Concern prescribed RE will be 10 metres. As such, the predicted impact does not exceed the impact threshold.

MSES	SRI expected?	Primary justification
Regulated vegetation: Prescribed REs within the defined distance of a watercourse	No	The Project Footprint avoids the majority of the prescribed REs that occur within a defined distance of a watercourse, except for at the Public Reserve. The impacted area comprises a single RE, and covers a total area less than 0.01 ha. This impact does not exceed the impact threshold.
Connectivity areas	No	The Project Footprint avoids the majority of the State mapped regulated vegetation. The LFC tool determined no significant impacts to connectivity areas on a site or local scale.
Protected wildlife habitat	No	• Worst-case scenario impacts to short-beaked echidna will result in a loss of approximately 343.83 ha of potential habitat. This area constitutes approximately 4% of the available potential habitat within the Project Area. This loss of habitat relative to the amount of habitat that will be retained within the Project Area, as well as the extensive areas of potential habitat in the local area is considered minimal. • Worst-case scenario impacts to the golden-tailed gecko will result in a loss of approximately 1.44 ha of potential habitat within the Project Area. This area constitutes approximately 1% of the available potential habitat within the Project Area. This loss of habitat relative to the amount of habitat that will be retained within the Project Area, as well as the extensive areas of potential habitat in the local area is considered minimal. MSES concerns also assessed as MNES: • Worst-case scenario impacts to koala will result in a loss of approximately 1.79 ha of potential habitat. This area constitutes approximately 0.17 % of the available potential habitat within the Project Area. This loss of habitat relative to the amount of habitat that will be retained within the Project Area, as well as the extensive areas of potential habitat in the local area is considered minimal. • Worst-case scenario impacts to painted honeyeater will result in a loss of approximately 11.70 ha of potential habitat. This area constitutes approximately 1.55 % of the available potential habitat within the Project Area. This loss of habitat relative to the amount of habitat that will be retained within the Project Area, as well as the extensive areas of potential habitat in the local area is considered minimal. • Worst-case scenario impacts to ornamental snake will result in a loss of approximately 2.68 ha of potential habitat. This area constitutes approximately 0.54 % of the available potential habitat within the Project Area. This loss of habitat relative to the amount of habitat that will be retained within the Project Area, as well as the extensive areas of potential habitat in the local area is considered minimal. • Worst-case scenario impacts to yakka skink will result in a loss of approximately 1.67 ha of potential habitat. This area constitutes approximately 0.16 % of the available potential habitat within the Project Area. This loss of habitat relative to the amount of habitat that will be retained within the Project Area, as well as the extensive areas of potential habitat in the local area is considered minimal.

MSES	SRI expected?	Primary justification
		•
• Waterways providing for fish passage	• No	• Once a footprint for the Project is finalised, the detailed design will determine if construction, installation or modification of waterway barrier works within the waterways of the Project Area will limit the passage of fish. Any works involving the construction or raising of waterway barrier works will be an accepted development and comply with all the requirements within the relevant accepted development specification. If the development is anticipated to not comply, it is assessable development and a development application will be lodged.

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10.0 Conclusions and recommendations

This assessment describes the MSES values known or likely to occur within the Project Area, assesses the impacts of the Project on these values, and presents strategies to avoid, minimise or mitigate potential impacts. This includes an assessment of significant residual impacts that could trigger the provision of offsets.

Using a combination of field-validated data, desktop information and extrapolated field survey results, the potential presence and extent of MSES values within the Project Area was determined. A total of 25 MSES species were considered likely or potentially occurring including three threatened flora species, sixteen (16) threatened or special least concern fauna species and six special least concern (migratory) species. Other MSES values within the Project Area include regulated vegetation, connectivity areas and waterways for waterway barrier works.

For all MSES values that had not previously been assessed under the EPBC Act Significant Impact Assessment Guidelines (Department of the Environment, 2013), significant residual impact assessments were completed in accordance with the Significant Residual Impact Guidelines (Department of the Environment and Heritage Protection, 2014) (see Appendix F).

With the implementation of mitigation measures detailed in Section 8, findings of the assessment determined that the Project is unlikely to result in a significant residual impact on any of the known, likely or potential MSES values within the Project Area.

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11.0 References

AECOM (2020) *Towrie Development: Matters of National Environmental Significance – Ecology Assessment*. Unpublished report for Santos CSG Pty Ltd.

Anderson, E. (2016). *Plants of Central Queensland, Identification and Uses of Native and Introduced Species*. CSIRO Publishing.

Australian Government. (2020). Atlas of Living Australia. Retrieved from Atlas of Living Australia website: http://www.ala.org.au/about-the-atlas/

BOM. (2020). Bureau of Meteorology - Climate Statistics.

Bostock, P. D., & Holland, A. E. (2018). *Introduction to the Census of the Queensland Flora 2018*. Brisbane: Queensland Department of Environment and Science.

Brooker, I., & Kleinig, D. (2004). *Field Guide to Eucalypts - Northern Australia* (2nd Editio). Blooming Books, Melbourne.

Cogger, H. G. (2014). *Reptiles and Amphibians of Australia* (Seventh Ed). Victoria: CSIRO Publishing.

Department of Agriculture Water and the Environment. (2020a). Protected Matters Search Tool. Retrieved from http://www.environment.gov.au/epbc/protected-matters-search-tool

Department of Agriculture Water and the Environment. (2020b). *Species Profile and Threats Database*. Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Department of Environment and Science. (2018). *Queensland Environmental Offset Policy (Version 1.6)*. Queensland Government.

Department of Environment and Science. (2019a). *Flora Survey Guidelines - Protected Plants Nature Conservation Act 1992*.

Department of Environment and Science. (2019b). Species profile - Apatophyllum teretifolium. Retrieved October 22, 2020, from https://apps.des.qld.gov.au/species-search/details/?id=26373

Department of Environment and Science. (2020a). *Map of Queensland wetland environmental values*. Queensland Government.

Department of Environment and Science. (2020b). Protected plants flora survey trigger map. Retrieved from https://environment.des.qld.gov.au/licences-permits/plants-animals/protected-plants/clearing/flora-survey-trigger-map/index.php

Department of Environment and Science. (2020c). Species profile - Cadellia pentastylis (Ooline). Retrieved August 26, 2020, from QLD Wildlife Data API website: https://wetlandinfo.des.qld.gov.au/wetlands/ecology/components/species/?cadellia-pentastylis

Department of Environment and Science. (2020d). Wildlife Online Species List.

Department of Natural Resources Mines and Energy. (2020). Regional geology 1974 - Surat Basin. Retrieved from http://qldspatial.information.qld.gov.au/catalogue//

Department of Sustainability, Environment, Water, P. and C. (2013). *Approved Conservation Advice for Rostratula australis (Australian painted snipe)*. In effect under the EPBC Act from 15-May-2013.

Department of Sustainability Environment Water Population and Communities. (2011a). *Draft Referral guidelines for the nationally listed Brigalow Belt reptiles*. Retrieved from www.environment.gov.au/epbc/.

Department of Sustainability Environment Water Population and Communities. (2011b). *Threat abatement plan for the biological effects, including lethal toxic ingestion, caused by cane toads*. Retrieved from http://cutlass.deh.gov.au/biodiversity/threatened/publications/tap/pubs/marine-debris-background-paper.rtf

D R A F T

Department of the Environment. (2013). *Significant Impact Guildelines 1.1: Matters of National Environmental Significance*. Canberra.

Department of the Environment. (2014a). *Approved Conservation Advice for Acacia grandifolia*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/3566-conservation-advice.pdf

Department of the Environment. (2014b). *EPBC Act Referral Guidelines for the Vulnerable Koala*. Commonwealth of Australia.

Department of the Environment. (2015). *Referral guideline for 14 birds listed as migratory species under the EPBC Act*. Retrieved from http://www.environment.gov.au/system/files/resources/c05f5b87-0a99-4998-897e-7072c236cf83/files/migratory-birds-draft-referral-guideline.pdf

Department of the Environment. (2016). *EPBC Act Referral Guidelines for the Endangered Northern Quoll Dasyurus hallucatus*. Retrieved from http://www.environment.gov.au/system/files/resources/d7e011a7-bf59-40ed-9387-9afcb8d590f8/files/referral-guideline-northern-quoll.pdf

Department of the Environment and Energy. (2015). *Threat abatement plan for predation, habitat degradation, competition and disease transmission by feral pigs (Sus scrofa)*. (February).

Department of the Environment and Energy. (2017). *EPBC Act Policy Statement 3.21: Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*. Retrieved from Commonwealth of Australia website: http://www.environment.gov.au/system/files/resources/67d7eab4-95a5-4c13-a35e-e74cca47c376/files/bio4190517-shorebirds-guidelines.pdf

Department of the Environment and Heritage Protection. (2014). *Queensland Environmental Offsets Policy Significant Residual Impact Guideline*. Retrieved from https://www.ehp.qld.gov.au/assets/documents/pollution/management/offsets/significant-residual-impact-guide.pdf

Department of the Environment Water Heritage and the Arts. (2008a). *Approved Conservation Advice for Delma torquata (Collared Delma)*.

Department of the Environment Water Heritage and the Arts. (2008b). *Approved Conservation Advice for Xerothamnella herbacea*. Retrieved from https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=4146

Department of the Environment Water Heritage and the Arts. (2008c). *Threat abatement plan for predation by the European red fox*. Retrieved from https://www.environment.gov.au/system/files/resources/1846b741-4f68-4bda-a663-94418438d4e6/files/tap-fox-report.pdf

Department of the Environment Water Heritage and the Arts. (2009). *THREAT ABATEMENT PLAN for DISEASE IN NATURAL ECOSYSTEMS CAUSED BY PHYTOPHTHORA CINNAMOMI*. Retrieved from http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Threat+abatement+plan+for+disease+in+natural+ecosystems+caused+by+Phytophthora+cinnamomi#2%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:THREAT+ABATEMENT+PLAN+for+DISEASE+IN+

DotE. (2013). *Significant Impact Guidelines 1.1: Matters of National Environmental Significance*. Retrieved from http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Eyre, T. J., Ferguson, D. J., Hourigan, C. l., Smith, G. C., Mathieson, M. T., Kelly, A. L., … Rowland, J. (2018). *Terrestrial Vertebrate Fauna Survey Guidelines*. Brisbane.

Ferguson, D., & Mathieson, M. (2014). *Yakka skink, Egernia rugosa. Targeted species survey guidelines*. Brisbane: Department of Environment and Science.

D R A F T

Lester, N. (2008). *Woodland to Weeds : Southern Queensland brigalow belt* (2nd Editio). Brisbane, QLD: CopyRight Pub.

Neldner, V., Wilson, B., Dillewaard, H., Ryan, T., Butler, D., McDonald, W. J. F., … Appelman, C. (2020). *Methodology for survey and mapping of regional ecosystems and vegetation communities in Queensland Version 5.1*. Queensland Department of Environment and Science, Brisbane.

Q Imagery. (2020). QImagery - Queensland Government. Retrieved November 29, 2019, from https://qimagery.information.qld.gov.au/

Sattler, P., & Williams, R. (1999). *The Conservation Status of Queensland's Bioregional Ecosystems* (R. Sattler, P., Williams, Ed.). Brisbane: Environmental Protection Agency, Queensland Government.

Schoenjahn, J. (2018). *Adaptations of the rare endemic Grey Falcon Falco hypoleucos that enable its permanent residence in the arid zone of Australia*. The University of Queensland.

The Commonwealth of Australia. (2015). *Threat abatement plan for predation by feral cats*. Retrieved from https://www.environment.gov.au/system/files/resources/78f3dea5-c278-4273-8923-fa0de27aacfb/files/tap-predation-feral-cats-2015.pdf

Threatened Species Scientific Committee. (2008). *Approved Conservation Advice for Egernia rugosa (Yakka Skink)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/publications/tsday08-skink.html

Threatened Species Scientific Committee. (2012). *Approved Conservation Advice for Phascolarctos cinereus (combined populations of Queensland, New South Wales and the Australian Capital Territory)(koala northern disignatable unit)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/197-conservation-advice.pdf

Threatened Species Scientific Committee. (2014). *Approved Conservation Advice for Denisonia maculata (ornamental snake)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/1193-conservation-advice.pdf

Threatened Species Scientific Committee. (2015a). *Conservation Advice, Grantiella picta, Painted Honeyeater*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf

Threatened Species Scientific Committee. (2015b). *Conservation Advice, Nyctophilus corbeni, south-eastern long-eared bat*. Threatened Species Scientific Committee.

Threatened Species Scientific Committee. (2015c). *Conservation Advice - Squatter Pigeon (Geophaps scripta scripta)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/64440-conservation-advice-31102015.pdf

Threatened Species Scientific Committee. (2016a). *Conservation Advice - Petauroides volans, greater glider*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/254-conservation-advice-20160525.pdf

Threatened Species Scientific Committee. (2016b). *Conservation Advice Rhinolophus robertsi greater large-eared horseshoe bat*. Retrieved from http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Threatened Species Scientific Committee. (2019). *Conservation Advice: Hirundapus caudacutus (white-throated needletail)*. Retrieved from http://www.environment.gov.au/biodiversity/threatened/species/pubs/682-conservation-advice-04072019.pdf

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Threatened Species Scientific Committee. (2020). *Conservation Advice for grey falcon*. Canberra.

WetlandInfo. (2019). Dichanthium setosum. Retrieved from Department of Environment and Science website: https://wetlandinfo.des.qld.gov.au/wetlands/ecology/components/species/?dichanthium-setosum

Wilson, P. R., & Taylor, P. M. (2012). *Land Zones of Queensland*. Department of Science, Information Technology, Innovation and the Arts.

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Appendix A

PMST Report

Australian Government
Department of the Environment and Energy

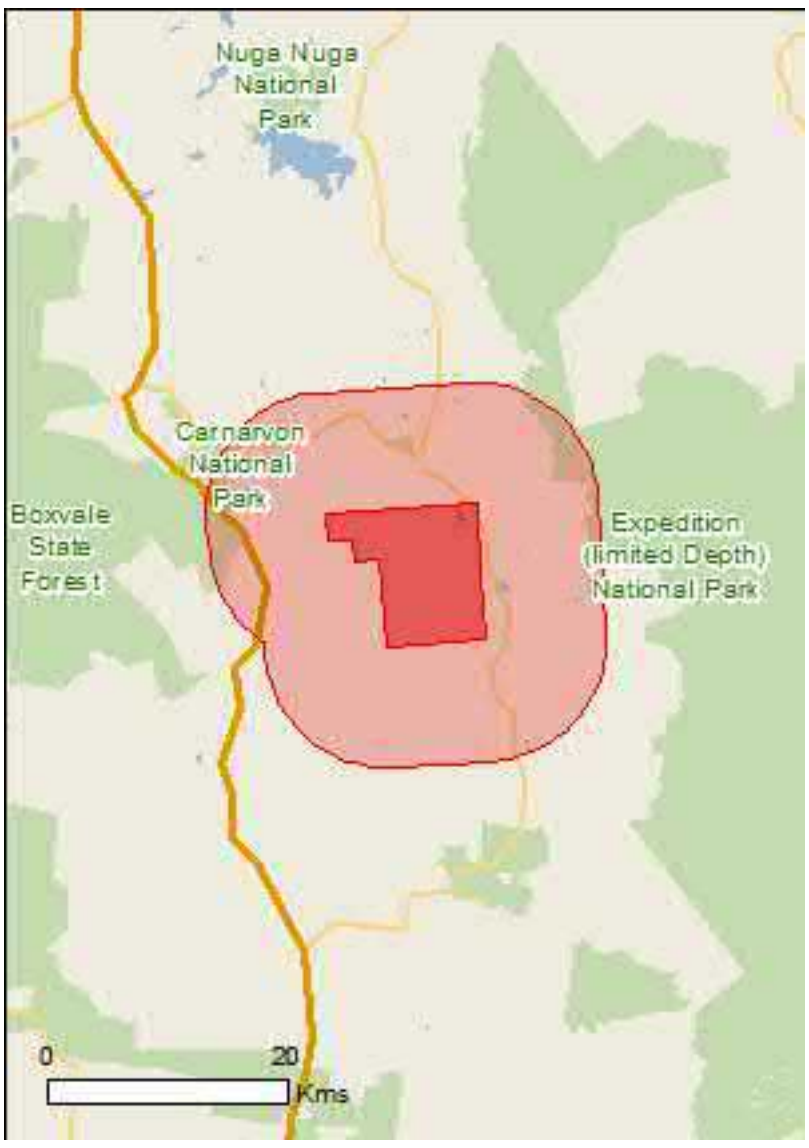
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 23/09/20 11:37:04



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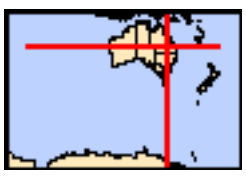

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	26
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	15
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Brigalow (Acacia harpophylla dominant and co-dominant)	Endangered	Community known to occur within area
Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions	Endangered	Community may occur within area
Poplar Box Grassy Woodland on Alluvial Plains	Endangered	Community likely to occur within area
Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions	Endangered	Community likely to occur within area
Weeping Myall Woodlands	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Geophaps scripta scripta Squatter Pigeon (southern) [64440]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Neochmia ruficauda ruficauda Star Finch (eastern), Star Finch (southern) [26027]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		

Name	Status	Type of Presence
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Vulnerable	Species or species habitat known to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Acacia grandifolia [3566]	Vulnerable	Species or species habitat likely to occur within area
Arthraxon hispidus Hairy-joint Grass [9338]	Vulnerable	Species or species habitat likely to occur within area
Cadellia pentastylis Ooline [9828]	Vulnerable	Species or species habitat known to occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat may occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat may occur within area
Tylophora linearis [55231]	Endangered	Species or species habitat may occur within area
Xerothamnella herbacea [4146]	Endangered	Species or species habitat likely to occur within area
Reptiles		
Delma torquata Adorned Delma, Collared Delma [1656]	Vulnerable	Species or species habitat may occur within area
Denisonia maculata Ornamental Snake [1193]	Vulnerable	Species or species habitat may occur within area
Egernia rugosa Yakka Skink [1420]	Vulnerable	Species or species habitat known to occur within area
Elseya albagula Southern Snapping Turtle, White-throated Snapping Turtle [81648]	Critically Endangered	Species or species habitat likely to occur within area
Furina dunmalli Dunmall's Snake [59254]	Vulnerable	Species or species habitat may occur within area
Rheodytes leukops Fitzroy River Turtle, Fitzroy Tortoise, Fitzroy Turtle, White-eyed River Diver [1761]	Vulnerable	Species or species habitat likely to occur

Name	Status	Type of Presence within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]		
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Carnarvon	QLD
Expedition (Limited Depth)	QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina		
Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus		
Horse [5]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus		
House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cryptostegia grandiflora Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area
Vachellia nilotica Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-25.25089 148.71226,-25.24436 148.82453,-25.33656 148.83071,-25.34059 148.75655,-25.28255 148.75071,-25.28349 148.7332,-25.2689 148.73217,-25.26983 148.71466,-25.25089 148.71226

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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Appendix B

Wildlife Online Report

Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: Since 1980
Latitude: -25.2913
Longitude: 148.7868
Distance: 25
Email: jessie.mckee@aecom.com
Date submitted: Wednesday 23 Sep 2020 14:00:04
Date extracted: Wednesday 23 Sep 2020 14:10:01

The number of records retrieved = 913