11-17 Mosbri Crescent, The Hill, Newcastle

Flora and Fauna Assessment

Crescent Newcastle

22 April 2021

Final

cumberland ecology

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The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or commendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

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Glossary

Abbreviation	Expansion
BAM	Biodiversity Assessment Method
BC Act	NSW Biodiversity Conservation Act 2016
Biosecurity Act	NSW Biosecurity Act 2015
BOS	Biodiversity Offsets Scheme
DA	Development Application
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DoEE	(former) Commonwealth Department of Environment and Energy
DPIE	NSW Department of Planning, Industry and Environment
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FFA	Flora and Fauna Assessment
FM Act	NSW Fisheries Management Act 1994
GIS	Geographic Information System
GPS	Global Positioning System
ha	hectares
LEP	Newcastle Local Environment Plan 2012
LGA	Local Government Area
LLSA	NSW Local Land Services Amendment Act 2016
m	metres
MNES	Commonwealth Matters of National Environmental Significance
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (now DPIE)
Project	Construction of the residential development and associated infrastructure
SEPP	State Environmental Planning Policy
subject land	the area of the Project (excluding some ancillary works) as defined by the boundary of Lot 1 DP 204077 as shown in **Figure 1**
study area	the area subject to the Project including the area to be impacted as alleged by the Second Respondent, as shown in **Figure 1**
TEC	Threatened Ecological Community

1. Introduction

1.1. Purpose

Cumberland Ecology Pty Ltd (Cumberland Ecology) has been commissioned by Stronach Property to provide a flora and fauna assessment (FFA) to support an Amended Development Application (DA) in relation to 11-17 Mosbri Crescent, The Hill (hereafter referred to as the 'subject land' and displayed in **Figure 1**). This report has been prepared to provide additional information responding to public submissions and address amendments to the DA to include mine grouting works.

Throughout this FFA, the area delineated by the boundary of Lot 1 DP 204077 is referred to as the 'subject land', as shown in **Figure 1**. The study area (**Figure 1**) encompasses the entire development site; however consideration is also made to the adjoining land, known as Arcadia Park (part Lot 7003 and part Lot 7004 DP 1077043, noting that Lot 7003 is identified as an unmade road reserve).

The FFA describes the current biodiversity values of the study area and assesses the potential impacts of the proposed earthworks on flora and fauna, particularly threatened species, populations and communities that are listed under the New South Wales (NSW) *Biodiversity Conservation Act 2016* (BC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2. Background

1.2.1. Site Description

The subject land, identified as all land within the lot boundary (Lot 1 DP 204077) is approximately 1.23 ha in area and is predominantly cleared (a total of 0.739 ha) and contains an existing business structure with adjoining carpark, satellite and landscaped areas with scattered native and planted trees as shown in **Figure 1**. The subject land is located within the Newcastle Local Government Area (LGA) and is bound by Arcadia Park to the East, roads to the West and North and residential development to the South.

The subject land is known to be located over abandoned workings in both the Yard Seam and the Borehole Seam.

1.2.2. Description of the Project

An amended DA has been prepared to be lodged Newcastle Council (Council) under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Specifically, the Amended DA includes:

- Demolition of all existing structures;
- Earthworks, including mine grouting;
- Construction of residential accommodation comprising 172 dwellings, being:
    - Eleven (11) two storey townhouse style dwellings fronting Mosbri Crescent, located above a basement car park containing 34 visitor spaces and 11 resident spaces;

- Three (3) residential flat buildings (Building A, B, and C) containing 161 dwellings, ranging from one to three bedrooms; being
  - Building A including a nine (9) storey east wing and six (6) storey west wing;
  - Building B comprising seven (7) storeys and a roof top communal open space, with (9) town house style dwellings facing the internal courtyard;
  - Building C comprising five (5) levels;
- Interconnected car parking for Building A, B & C located on the ground floor and first level, containing 1 visitor space and 196 resident spaces;
- Pedestrian path, providing connection from Mosbri Crescent to Kitchener Parade;
- Associated landscaping, communal open space, services and site infrastructure; and
- Strata subdivision (172 lots).

The Project Layout is shown on the Site Plan, reproduced in **Figure 2**.

The Mine Grouting Works are described in the Mine Subsidence Grouting Remediation Strategy Summary Report prepared by Coffey (2020) and Addendum Statement of Environmental Effects prepared by SLR (SLR Consulting 2021). In all cases, the mine workings will be drilled and grouted from within the subject site boundary, with any grouting that may be needed beyond the boundary to be completed using directional boreholes drilled from within the subject site targeting the mining bord at mine level at the desired location.

The land under which the Mine Grouting Works are proposed to take place is limited to Mosbri Crescent Park (Lot 20 / DP 216346), Arcadia Park (Lot 7003 / DP 1077043; Lot 7004 / DP 1077043), public roads (Mosbri Crescent and Kitchener Parade) and the subject site. As described in the Mine Subsidence Grouting Remediation Strategy Summary Report prepared by Coffey (2020), as the surface level of Arcadia Park is generally 5m or more above the subject site, the depth at which the grouting borehole enters below the park will be approximately 26m below the park at the property boundary.

1.3. Relevant Legislation

1.3.1. Environmental Planning and Assessment Act 1979

The EP&A Act is the overarching planning legislation in NSW. This act provides for the creation of planning instruments that guide land use. The EP&A Act also provides for the consideration of the environment and biodiversity values, which is addressed in Section 5A (Significant effect on species, populations or ecological communities or their habitats) should a land use change be proposed. This includes threatened species, communities, habitat and processes as listed under the BC Act and *Fisheries Management Act 1994* (FM Act).

1.3.2. Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the Australian Government's key piece of environmental legislation and is administered by the Commonwealth Department of Agriculture, Water and the Environment (DAWE) (formerly DoEE). It is designed

to protect national environmental assets, known as Matters of National Environmental Significance (MNES), which include threatened species of flora and fauna, threatened ecological communities, migratory species as well as other protected matters. Among other things, it defines the categories of threat for threatened flora and fauna, identifies key threatening processes and provides for the preparation of recovery plans for threatened flora, fauna and communities.

Under the EPBC Act, any action (which includes a development, project or activity) that is considered likely to have a significant impact on MNES must be referred to the Commonwealth Minister for the Environment.

1.3.3. Biodiversity Conservation Act 2016

Under the NSW Land Management and Biodiversity Conservation (LMBC) reform, the NSW Parliament passed the following two Acts in November 2016:

- *Biodiversity Conservation Act 2016* (BC Act), which replaces the *Threatened Species Conservation Act 1995*, the *Nature Conservation Trust Act 2001* and parts of the *National Parks and Wildlife Act 1974*; and
- *Local Land Services Amendment Act 2016* (LLSA Act), which replaces the *Native Vegetation Act 2003* and the Native Vegetation Regulation 2005.

These reforms commenced on 25 August 2017 and are now in force.

A key part of the reforms is the introduction of the Biodiversity Offsets Scheme (BOS). The BOS applies to local development (assessed under Part 4 of the EP&A Act) that is likely to significantly affect threatened species or communities or that triggers threshold levels for when assessment via the BOS is required. The threshold has three elements:

- Whether the amount of native vegetation being cleared exceeds a threshold area;
- Whether the area being cleared is mapped on the Biodiversity Values map published by the Minister for the Environment; and
- Whether the impact on threatened species or ecological communities is deemed significant.

An assessment of whether the project triggers these threshold levels is provided below.

The native vegetation clearing thresholds for each minimum lot size are defined in Part 7.2 of the *Biodiversity Conservation Regulation 2017*. The minimum lot size for the property is 0.4 ha, allowing native vegetation clearance of less than 0.25 ha without triggering the BOS. The native vegetation proposed to be cleared from within the subject land does not exceed 0.25 ha and therefore the BOS will not be triggered by this mechanism.

Under the BC Act the Biodiversity Values Map details sites which are considered to have significant environmental values where the preparation of a Biodiversity Development Assessment Report (BDAR) may be required. The subject land is not mapped on the Biodiversity Values Map and therefore the BOS will not be triggered by this mechanism.

Based on the results of the Tests of Significance presented within the appendices of this FFA, the project will not result in a significant impact to threatened species or communities and therefore the BOS threshold is not triggered by this mechanism.

As the project does not trigger any of the threshold levels outlined above, a BDAR is not required. Accordingly, this FFA is deemed suitable to accompany the Amended DA for the purpose of assessing the ecological impacts of the Project.

1.3.4. Biosecurity Act 2015

In NSW, problematic weeds are handled under the NSW *Biosecurity Act 2015* (Biosecurity Act). Under the Biosecurity Act all weeds are required to be controlled by all persons under a "General Biosecurity Duty". The General Biosecurity Duty means that all public and private land owners or managers and all other people who deal with weed species (biosecurity matters) must use the most appropriate approach to prevent, eliminate, or minimise the negative impact (biosecurity risk) of those weeds (DPI 2017).

Under the Biosecurity Act some weed species have been prioritised for management by specific regulations and controls under the Act. These are known as State Level Priority Weeds. The state has been divided into 11 regions (each covering a number of LGAs) under the Act. Within each region, additional weed species known as Regional Priority Weeds have been prioritised for management. A further set of weeds are identified within the Regional Strategic Weed Management Plans as being "other weeds of regional concern".

All land within the subject land occurs within the Greater Sydney Local Land Services region, and weed management within the region is to be undertaken under the direction of the South East Regional Strategic Weed Management Plan (LLS: Greater Sydney 2019). Appendix 1 of the Weed Management Plan outlines the State Priority Weeds, Regional Priority Weeds, and other weeds of regional concern.

1.3.5. Newcastle Local Environment Plan (2012)

The subject land and study area are located within the Newcastle Council LGA and is subject to the Newcastle Local Environmental Plan (LEP) 2012.

The subject land is currently zoned R3 Medium Density Residential under the Newcastle LEP. Further details of the Planning instruments applicable to the subject land, and study area, are outlined in the Addendum Statement of Environmental Effects (SLR Consulting 2021).

2. Methodology

2.1. Database Analysis and Literature Review

Database analysis was conducted for the locality using both the NSW Environment, Energy and Science (EES) Threatened Species Data Collection – BioNet (EES 2021) and the Commonwealth DAWE Protected Matters Search Tool (DAWE 2021). The locality is defined as the area within a 5 km radius of the subject land. The BioNet Database search was used to generate records of threatened flora and fauna species listed under the BC Act within the locality of the subject land. The Protected Matters Search Tool generated a list of Matters of National Environmental Significance listed under the EPBC Act potentially occurring within the locality of the subject land. For the purpose of this assessment fish, migratory wetland species and marine species were excluded. A list of threatened species recorded in the Locality is provided in **Appendix B**.

Literature reviewed in preparation of this report includes:

- Amended DA documents;
- Final Determination for Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions (NSW Threatened Species Scientific Committee 2012);
- Coast Ecology (2018a) Proposed Restoration of Arcadia Park, The Hill; Vegetation Management Plan. Prepared for The City of Newcastle;
- Coast Ecology (2018b) Proposed Restoration of Arcadia Park, The Hill; Biodiversity Assessment. Prepared for The City of Newcastle;
- Coast Ecology (2018c) Proposed Restoration of Arcadia Park, The Hill; Review of Environmental Factors. Prepared for The City of Newcastle;
- Geoscience Australia (2020) http://www.ga.gov.au/scientific-topics/water/groundwater/understanding-groundwater-resources/groundwater-dependant-ecosystems;
- Coffey (2020) Mine Subsidence Grouting Remediation Strategy Summary Report: Proposed Multi - Building Residential Development 11 - 17 Mosbri Crescent, The Hill, Newcastle. Prepared for Crescent Newcastle Pty Ltd;
- Coffey (2021) Proposed Development 11-17 Mosbri Crescent, The Hill, Newcastle: Groundwater Assessment. Prepared for Crescent Newcastle Pty Ltd; and
- Arcadia Landscape Architects (2021) Landscape Master Plan

2.2. Flora Survey

Flora surveys were undertaken across the study area by a botanist and an ecologist from Cumberland Ecology on 11 August 2020. An additional inspection of Arcadia Park was conducted on 28 October 2020 by Dr David Robertson for the preparation of this report. Surveys included vegetation mapping, random meander vegetation surveys, and targeted threatened flora searches, as described further below.

All vascular plants recorded or collected were identified using keys and nomenclature provided in Harden (Harden 1990-1993). Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust 2021).

2.2.1. Vegetation Mapping

Previous broad-scale vegetation mapping of the Lower Hunter and Central Coast region conducted by the former Department of Environment Climate Change and Water (DECCW (NSW) 2011), now part of Department of Planning, Industry and Environment (DPIE) was reviewed prior to undertaking the field survey.

The vegetation within the study area was then ground-truthed to examine and verify the mapping of the condition and extent of the different vegetation communities. Where vegetation community boundaries were found to differ from the regional mapping, records were made of proposed new boundaries using a hand-held Global Positioning System (GPS) and mark-up of aerial photographs.

The resultant information was synthesised using a Geographic Information System (GIS) to create a spatial database that was used to interpret and interpolate the data to produce a vegetation map.

2.2.2. Random Meander Survey

Random meander surveys were undertaken to detect flora species present within the study area. These surveys consisted of traversing all areas of the subject land and proximate parts of Arcadia Park and were undertaken within all vegetation communities present.

2.2.3. Targeted Threatened Flora Surveys

Targeted threatened flora searches via random meanders were undertaken within suitable habitat of threatened flora species known from the locality.

2.3. Fauna Investigations

Fauna investigations were undertaken within the study area by Cumberland Ecology on 11 August 2020. Investigations focussed on fauna habitat assessment but incidental observations of fauna observed during this work were recorded. Further details of each of the survey methods are provided below.

2.3.1. Habitat Assessments

A fauna habitat assessment was undertaken throughout the study area. The assessment included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock and wetland areas such as creeks and soaks. Structural features considered included the nature and extent of the understorey and ground stratum and extent of canopy. The survey also included an assessment of the presence of habitat features suitable for use by threatened fauna species known from the locality.

2.3.2. Incidental Observations

Any incidental fauna species that were observed, heard calling, or otherwise detected based on tracks or signs, were recorded and listed in the total species list for the study area.

2.4. Limitations

Vertebrate fauna and vascular flora of the locality are well known based upon a sizeable database of past records and various published reports. The surveys by Cumberland Ecology added to the existing database and helped to provide a clear indication of the likelihood that various species occur, or are likely to occur, within the subject land. The data obtained from database assessment and surveys of the study area furnished an appropriate level of information to support this assessment.

The weather conditions at the time of the flora surveys were generally favourable for plant growth and production of features required for identification of most species. Shrubs, grasses, herbs and creepers were readily identifiable in most instances. It is expected that not all flora species present would have been recorded during surveys. Despite this, it is considered that sufficient information has been collected to assess issues including conservation significance of the flora, condition and viability of bushland and likely impact on native vegetation. An assessment of the likelihood of occurrence of threatened flora species recorded within the locality of the subject land in the database searches was undertaken to supplement the flora survey.

No targeted fauna surveys were undertaken for this assessment, which relied on database analysis, fauna habitat assessment and incidental observations. In general, opportunistic observations of fauna provide a "snapshot" of some of the fauna present on site that was active during time of the surveys. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all vertebrate fauna species occurring within the subject land. Therefore, not all fauna utilising the subject land are likely to have been recorded during surveys. An assessment of the likelihood of occurrence of threatened and migratory fauna species recorded from the locality in the database searches was undertaken to supplement the fauna surveys. The combination of these techniques is considered appropriate for assessing the habitat values of the site for threatened fauna within the subject land.

The entire study area was not surveyed in detail, and random meander surveys were considered adequate to verify the vegetation communities present, and condition across the study area.

3. Results

3.1. Vegetation Communities

3.1.1. Subject Land

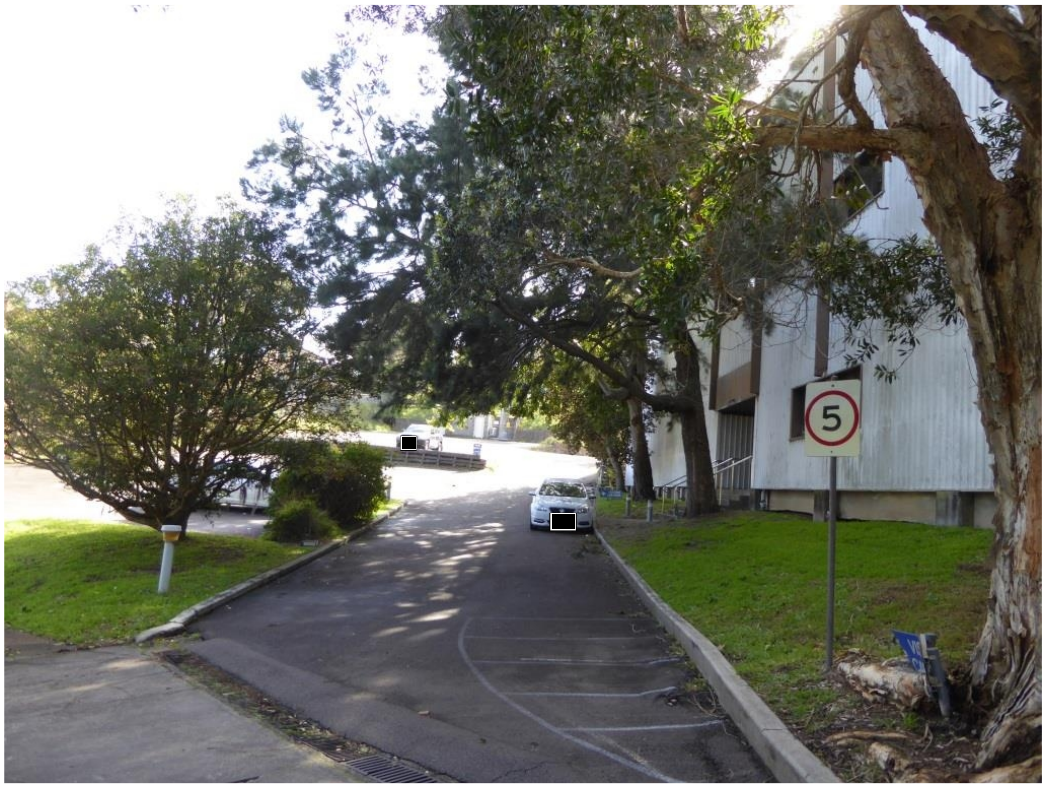
Vegetation of the subject land consists of landscape species that surround the existing buildings which predominate the site, as shown in **Photograph 1**.

Tree plantings within the site include the locally indigenous species *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Eucalyptus robusta* (Swamp Mahogany), *Eucalyptus botryoides* (Bangalay), *Casuarina glauca* (Swamp Oak), *Banksia integrifolia* (Coast Banksia), *Cupaniopsis anacardioides* (Tuckeroo), and *Tristaniopsis laurina* (Water Gum). Trees not indigenous to the locality include *Callistemon viminalis* (Weeping Bottlebrush), *Corymbia torelliana* (Cadaga), and *Eucalyptus scoparia* (Wallangarra White Gum).

A number of exotic and ornamental species occur, including; *Ficus microcarpa* var. *hillii* (Hill's Fig), *Lagunaria patersonii* (Norfolk Island Hibiscus), *Schefflera actinophylla* (Queensland Umbrella Tree), *Cinnamomum camphora* (Camphor Laurel), and *Phoenix canariensis* (Phoenix Palm).

The full list of tree species that occur on the subject land has been documented in the arborist assessment report (Tree Area Vet 2021). No native plant community types (PCTs) were identified.

Photograph 1 Native/Exotic Vegetation in building gardens (including *Melaleuca quinquenervia* in the foreground)



3.1.2. Vegetation of the Study Area - Arcadia Park

Arcadia Park appears to have been extensively cleared in the past, as is evident from the historical aerial photograph from 1976 (**Figure 3**) which shows that the study area was completely cleared prior to this time. It is likely that most of the vegetation occurring within the Park has been planted (**Photograph 2**), with some natural regeneration of some canopy species, as evident from the series of recent aerial photos dating from 1976 to 2020 (**Figures 3-6**).

Regional mapping has recognised two plant communities in the park: as Coastal Foothills Spotted Gum – Ironbark Forest and Coastal Plains Smooth-barked Apple Woodland (DECCW (NSW) 2011).

While native species are present, the combination of species does not match any naturally occurring vegetation community in the locality, and many of the species are planted in habitats in which they would not naturally occur. For example *Eucalyptus robusta* and *Melaleuca quinquenervia* are two of the most common species present in the canopy. These species commonly occur on coastal floodplains and other wet habitats and do not naturally occur on slopes. The majority of Arcadia Park consists of slopes, and the site generally has a relatively steep, western aspect.

There is the potential for some species to be naturally occurring and these include scattered *Allocasuarina littoralis* (Black Oak) trees, and a large *Ficus rubiginosa* in the north, though this could also have been planted. The small tree *Cupaniopsis anacardioides* (Tuckeroo) is common across the park, and may have naturally regenerated, as it is a common component of several naturally occurring communities in gullies and on slopes in the locality. Extensive revegetation has been undertaken in recent years of the shrub and ground layers.

With the exception of open grassy areas at higher elevations in the east of Arcadia Park, some small grassy areas in the central area of the Park, and the north of the Park in which it appears revegetation has not commenced yet, the remainder of Arcadia Park has been planted out with locally indigenous species, under the existing canopy of planted native trees (and occasional exotic trees).

The vegetation across the park. The slope in the south of the park with a northern aspect is dominated by *Syncarpia glomulifera* (Turpentine), *Eucalyptus robusta* (Swamp Mahogany), and *Casuarina cunninghamiana subsp. cunninghamiana* (River Oak). The central areas of the Park (**Photograph 2**) are dominated by old *Acacia binervia* plantings, with scattered occurrences of *Eucalyptus robusta* and *Melaleuca quinquenervia*. In the northern extent of the Park *Melaleuca quinquenervia* is the dominant canopy planting, and it co-occurs with dense occurrences of the exotic species *Olea europaea subsp. cuspidata* (African Olive), and a tall patch of *Phyllostachys aurea* (Golden Wattle). In the north-east of the Park there is a large *Ficus rubiginosa* and several plantings of *Eucalyptus grandis* (Flooded Gum). In the south-east there are a number of *Araucaria heterophylla* (Norfolk Island Pine) trees in an open grassy area of the park. Other canopy species present within the park as more isolated and scattered occurrences include the locally native *Banksia integrifolia* (Coast Banksia), *Pittosporum undulatum* (Sweet Pittosporum), *Eucalyptus botryoides* (Bangalay), and *Eucalyptus microcorys* (Tallowwood), the non-indigenous natives *Corymbia citriodora* (Lemon-scented Gum) and *Grevillea robusta* (Silky Oak), and the exotic *Phoenix canariensis* (Phoenix Palm).

The more recent revegetation works include a rich array of native shrubs and ground layer plants, most typical of sclerophyll Eucalypt forests, and some species more typical of rainforests. Revegetation species include

shrubs/small trees such as *Pultenaea flexilis* (Graceful Bush Pea), *Callistemon salignus* (Willow Bottlebrush), *Dodonaea triquetra* (Hop-bush), *Capparis arborea* (Native Pomegranite), *Diospyros australis* (Black Plum), *Myrsine variabilis, Melaleuca styphelioides* (Prickly-leaved Paperbark), and *Westringia fruticosa* (Coastal Rosemary). Ground layer plants include *Dianella caerulea var. producta, Lomandra longifolia, Carex appressa* (Tall Sedge), *Gahnia clarkei* (Tall Saw-sedge), *Themeda triandra* (Kangaroo Grass), and *Adiantum aethiopicum* (Maidenhair Fern).

Photograph 2 Vegetation in the central areas of Arcadia Park, with species typical of sclerophyll forest, dominated by *Eucalyptus robusta, Melaleuca quinquenervia and Acacia binervia*

The gully present on the northern side of Arcadia Park contains a well-defined overland flow path, which was observed to be flowing in a westerly direction during rain on 28 October 2020, and entering the constructed stormwater drain located within the easement at the eastern edge of the subject land, as shown in **Photograph 3**.

Photograph 3 Northern gully in Arcadia Park, showing the drainage line with flows entering the constructed drains (note the African Olive canopy layer, and large Phoenix Palm)

Vegetation within the gully in the north of Arcadia Park includes both native vegetation, and exotic vegetation, including planted and weed species. The understorey for the upper reaches of the gully is generally dominated by the exotic *Olea europaea* subsp. *cuspidata* occurring underneath the native *Melaleuca quinquenervia*. Additional species recorded in the northern gully include; *Phoenix canariensis*, non-indigenous native *Grevillea robusta*, and *Eucalyptus botryoides* (assumed to be planted).

Other woody species within the northern gully include; the native *Pittosporum undulatum* and *Acacia binervia*, and the exotic *Ochna serrulata* and *Cinnamomum camphora*. The ground layer is dominated by exotic species including *Megathyrsus maximus* var. *maximus*, *Tradescantia fluminensis* (Wandering Trad), and *Hedera helix*.

3.1.3. Threatened Ecological Communities

No Threatened Ecological Communities (TECs) were identified on the subject land.

Within the study area, both regeneration and extensive restoration works have occurred throughout Arcadia Park since it was cleared prior to 1976. Active restoration works have been documented by The City of Newcastle since 2018, and it is clear that planting has occurred very recently, as evident from the tree-guards remaining around several patches of saplings. As identified in the Vegetation Management Plan (VMP) (Coast Ecology 2018d), there has been a clear intention to plant species characteristic of Littoral Rainforest, which is

listed as endangered under the BC Act and EPBC Act (where minimum condition thresholds are reached), in the gullies present in Arcadia Park.

Littoral Rainforest has not been mapped as occurring within Arcadia Park, or adjoining lands, either by the Regional Mapping or by recent mapping for the *State Environmental Planning Policy (Coastal Management) 2018* – Littoral Rainforest.

The final determination for Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions describes the community as *'…The plant species in this ecological community are* ***predominantly rainforest species*** *with evergreen mesic or coriaceous leaves. Several species have compound leaves, and* ***vines*** *may be a major component of the canopy. These* ***features differentiate littoral rainforest from sclerophyll forest*** *or scrub, but while the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as Angophora costata, Banksia integrifolia, Eucalyptus botryoides and E. tereticornis occur in many stands (Paragraph 1) (****our emphasis****).*

Littoral Rainforest occurs on both sand dunes and on soils derived from underlying rocks… Most stands of Littoral Rainforest occur with within 2 km of the sea, but may occasionally be found further inland, but within reach of maritime influence (Paragraph 1 of the Final Determination).

The structure of the community is described as being a closed forest dominated by rainforest species in all strata. Although rainforest species are dominate in this community, stands often contain scattered emergent sclerophyll individuals such as Angophora costata, Banksia integrifolia, E. botryoides and E. tereticornis (Paragraph 1). As the community primarily exists in small stands due to fragmentation, most areas of Littoral Rainforest have considerably less species richness than the list identified in the Final Determination. Furthermore, northern occurrences of the community have typically higher species richness than those in the south (Paragraph 3).

The geology of Arcadia Park is characterised by Permian Newcastle Coal Measures - Moon Island Beach, Boolaroo and Lambton Subgroups—coal, tuff, conglomerate, sandstone and shale. Soils are moderately well-drained, highly permeable and consist of fine grain sandstone and mudstone (Matthei 1995). It is located within 2km of the sea, on a westerly facing slope. Therefore, the landscape position is appropriate for Littoral Rainforest.

The site investigation has found that a number of species characteristic of Littoral Rainforest occur, namely canopy and sub-canopy species; *Ficus rubiginosa* (Port Jackson Fig), *Eucalyptus botryoides* (Bangalay), *Capparis arborea* (Native Pomegranate), *Banksia integrifolia* (Coast Banksia), *Cupaniopsis anacardioides* (Tuckeroo), and *Melaleuca quinquenervia* (Broad-leaved Paperbark), and understorey species including; *Breynia australis*, *Acacia binervata* and *Lomandra longifolia*. However, there is a lack of vines and many of the species present in the gully areas (that were intended for planting as Littoral Rainforest, as per the VMP (Coast Ecology 2018d)) are also characteristic of sclerophyll eucalypt forest, which has been planted on the slopes. Nonetheless, the vegetation present in parts of Arcadia Park, conforms to the final determination for Littoral Rainforest, albeit as a simplified form of the community. Notwithstanding that, it can be expected that such rainforest will continue to develop as the dominant plants grow.

It is further noted that the planted vegetation throughout the park contains a high number of native species, but the species assemblage represent communities that would not all naturally occur in the location, based on soils, topography and nearby naturally occurring communities. Notwithstanding that, patches of forest plantings in the park have the characteristics of Littoral Rainforest and are developing and growing well. In future, over a period of decades, it is likely that such areas of the park will grow into a form of Littoral Rainforest.

Nonetheless, the vegetation present in discrete parts of Arcadia Park, conforms to the final determination for Littoral Rainforest, albeit a predominantly planted and highly disturbed example of the community.

3.2. Threatened Flora Species

No threatened flora species were recorded on the subject land or study area. A total of 20 threatened flora species have been recorded in the locality, although due to the distributed nature of the subject land, none are expected to occur, as identified in **Appendix B**.

3.3. Fauna and Fauna Habitats

Fauna habitats are limited in the study area. The subject land, and adjoining developed lands to the west of Arcadia Park contain scattered vegetation, which is predominantly exotic, in an highly urbanised environment, as evident in **Figure 1**. These gardens/landscaped zones provide some foraging habitat for fauna, mostly urban adapted species of birds, as a limited part of a stepping-stone corridor habitat, as is the case with street tree plantings within the surrounding road corridors. Potential foraging resources for nectivorous mammals and birds are primarily present within the varied planted flowering trees and shrubs, including ornamental exotics; Ficus microcarpa var hillii (Small-leaved Fig), and the occasional eucalypt, including; *Eucalyptus botryoides* (Bangalay) *Eucalyptus robusta* (Swamp Mahogany) present on the subject land.

Arcadia Park contains a patch of native vegetation within this highly urbanised environment, close to the centre of Newcastle city, and surrounded by development to the north and west and also large parklands (predominantly grassed), surrounded by roads, to the east and south. The entire area of Arcadia Park is considered vegetated and this equated to a patch of vegetation approximately 1.38 ha in area, and is not part of a local or regional wildlife corridor. No National Parks or significant conservation reserves adjoin or are proximate to the park. Due to the relatively small size of the patch, being in an urban environment, and with a lack of connectivity to other patches of vegetation, the habitat value is significantly reduced for the majority of fauna species known in the locality, and in particular for threatened species.

3.4. Threatened Fauna Species

No previous records of threatened fauna or migratory species are present within the subject land (DPIE, 2020). A total of 39 threatened fauna species listed under the BC Act and/or EPBC Act, as well as 6 migratory bird species listed under the EPBC Act, have been recorded in the locality or identified as having the potential to occur. However, as no habitat for these potentially occurring species will be modified or removed as a result of the development including the mine grouting earthworks, no further assessment is provided.

It is noted that one threatened fauna species; Powerful Owl (*Ninox strenua*) has been recorded from within Arcadia Park in recent years (2016 and 2018) (EES, 2021). Based on the infrequency of records, it is considered unlikely that a local population frequently utilises the habitats of the study area. The last records were in 2018.

The Powerful Owl is known to utilise a variety of vegetation types including woodland, open sclerophyll forest, tall open wet forest and rainforest. Typically the Powerful Owl utilises large areas of connected woodland or forest habitat, but it also occurs in fragmented habitats as well. Large eucalypt trees containing large hollows within dense vegetation are required for nesting and roosting, with preferred roosting sites being located in riparian areas high in catchment areas (Bain et al. 2014). It will utilise a variety of tree species for roosting as long as it is densely vegetated and provides adequate cover during the day. Required foraging habitat for the species consists of vegetation containing suitable hollows for prey such as the Greater Glider, Common Ringtail Possum and Sugar Glider (OEH 2017). Suitable foraging habitat for the species includes all patches of suitable habitat greater than 1ha (Bain et al. 2014).

It is clear that Powerful Owl nesting habitat is absent from the study area, due to the lack of large and high, hollows. The trees in the park have grown since 1976 and so are generally too young to support hollows large enough for nesting by the owl.

The small area of habitat in Arcadia Park, lack of dense vegetation, and distance to large and intact forest habitat is also likely to make the study area unsuitable as a regular roosting site. The closest area of suitable roosting and foraging habitat is located approximately 4 km to the south west of the study area, in Glenrock State Conservation Area, where a number of recent Powerful Owl records exist. However, it is likely that Powerful Owls forage in the study area, as part of a large home-range. The urban environment makes it suitable for foraging, with a relatively high abundance of preferred prey species, including possums. Possums are highly adapted to urban environments, and often thrive on the abundant resources provided by garden plantings and street trees, and these species are tolerant of human (and domestic animal) disturbances. It is not uncommon for Powerful Owls to even roost and nest in close proximity to urban development, as is found in Sydney, with a well-established population known from Lane Cove National Park, located within 15km of the CBD (EES, 2021) (Bain et al. 2014).

Due to the relatively recent clearing of vegetation in Arcadia Park, the trees present are mostly young regrowth, with few that are sufficient in size to develop hollows. A small number of small sized hollows have been recorded, although these are not of a large enough size to support the nesting or roosting of large fauna species such as owls.

4. Impact Assessment

4.1. Impacts of the Development on Vegetation Communities

4.1.1. Vegetation Removal on the Subject land

The vegetation present on the subject land consists of planted native and exotic species in a landscape setting, surrounding existing commercial buildings and does not conform to the description of any native vegetation community. No direct impacts to native vegetation communities will result from the development of the subject land, as shown in **Figure 7**.

4.1.2. Impacts on Vegetation Communities of Arcadia Park

No vegetation will be removed from Arcadia Park as a result of the proposed development, as shown in **Figure 7**. No impacts to the planted and regenerating native vegetation present in Arcadia Park, which has some patches of plant species characteristic of Littoral Rainforest, are likely to occur.

According to the Final determination the primary threat to Littoral Rainforest is from weed invasion, as indicated in this excerpt:

> *'Weed species that threaten the integrity of particular stands include Ambrosia artemisiifolia, Anredera cordifolia, Arecastrum romanzoffianum, Asparagus spp., Cardiospermum grandiflorum, Chrysanthemoides monilifera, Coprosma repens, Ehrharta spp., Gloriosa superba, Ipomoea spp., Impatiens walleriana, Lantana camara, Macfadyena unguis-cati, Rivina humilis, Pennisetum clandestinum, Schefflera actinophylla, Senna septemtrionalis, Solanum mauritianum Thunbergia alata and Tradescantia fluminensis (Paragraph 7).*

Arcadia Park contains a number of high threat weeds, including; *Asparagus aethiopicus* (Asparagus fern), *Chrysanthemoides monilifera subsp. rotundata* (Bitou Bush), *Ehrharta erecta* (Panic Veldtgrass), *Ipomoea indica* (Morning Glory), *Lantana camara* (Lantana), *Schefflera actinophylla* (Umbrella Tree), and *Tradescantia fluminensis* (Wandering Jew), have all been recorded in Arcadia Park. The development of the subject land will not act to exacerbate the impacts of these weed species in Arcadia Park. The boundary between the park and the future development site will be landscaped with native and non-invasive species (as indicated by the Landscape Plan). This will reduce the potential for further encroachment of high threat weeds into the park, which could impact on the establishment and persistence of Littoral Rainforest.

On review of the topography of the study area, with Arcadia Park being upslope of the subject land, it is considered implausible that overland flows will be altered in anyway by the downslope development. The gullies within Arcadia Park slope towards the subject land, and water is collected in stormwater drains present on the western boundary of Arcadia Park (**Photograph 3**). In this regard, potential indirect impacts, such as sedimentation, erosion and weed spread, which are primarily exacerbated by uncontrolled or increased stormwater flows entering an area of native vegetation are not relevant to the proposal, in relation to Arcadia Park.

4.2. Impacts to Arcadia Park from Changes to Hydrology

4.2.1. Impacts from Excavation

No significant impacts are likely to groundwater resources or to vegetation of Arcadia Park as a result of proposed excavation.

As identified in the Groundwater Assessment (Coffey 2021), there is a low probability that the influence of proposed development on groundwater in the upper ground profile in Arcadia Park will extend beyond 2 m from the eastern boundary of the site over the elevated areas (above 38 m AHD) and that within that zone, impacts would be limited to minor changes.

For the gully areas, there is a low probability that the influence of the proposed development on groundwater conditions would extend beyond 2 m from the boundary (Coffey, 2021), and therefore would be a low likelihood of impacts on groundwater conditions below the base of the residual soil horizon.

The proposed excavation is unlikely to impact the vegetation of Arcadia Park, as groundwater is deeper than the excavation and because there is no groundwater dependent vegetation present. According to the Groundwater Assessment (Coffey 2021), there may be perched aquifers but these are not likely to be impacted by the excavation of the study area. No vegetation that is reliant on them is likely to be impacted.

The vegetation in Arcadia Park is not mapped as groundwater dependent ecosystems (GDEs). According to Geoscience Australia (2020):

> "Ecosystems that rely on groundwater for some or all of their water requirements are classified as Groundwater Dependent Ecosystems (GDE). Not all GDEs draw on groundwater directly and not all are solely reliant on groundwater. However, in many cases groundwater commonly provides an important and reliable source of water to many ecosystems and can be the main factor controlling the distribution of ecosystem types. In many cases the groundwater provides baseflow in rivers that ecosystems depend on. The impact of changes in groundwater quantity and quality on GDEs is determined by the degree and nature of their groundwater dependency."

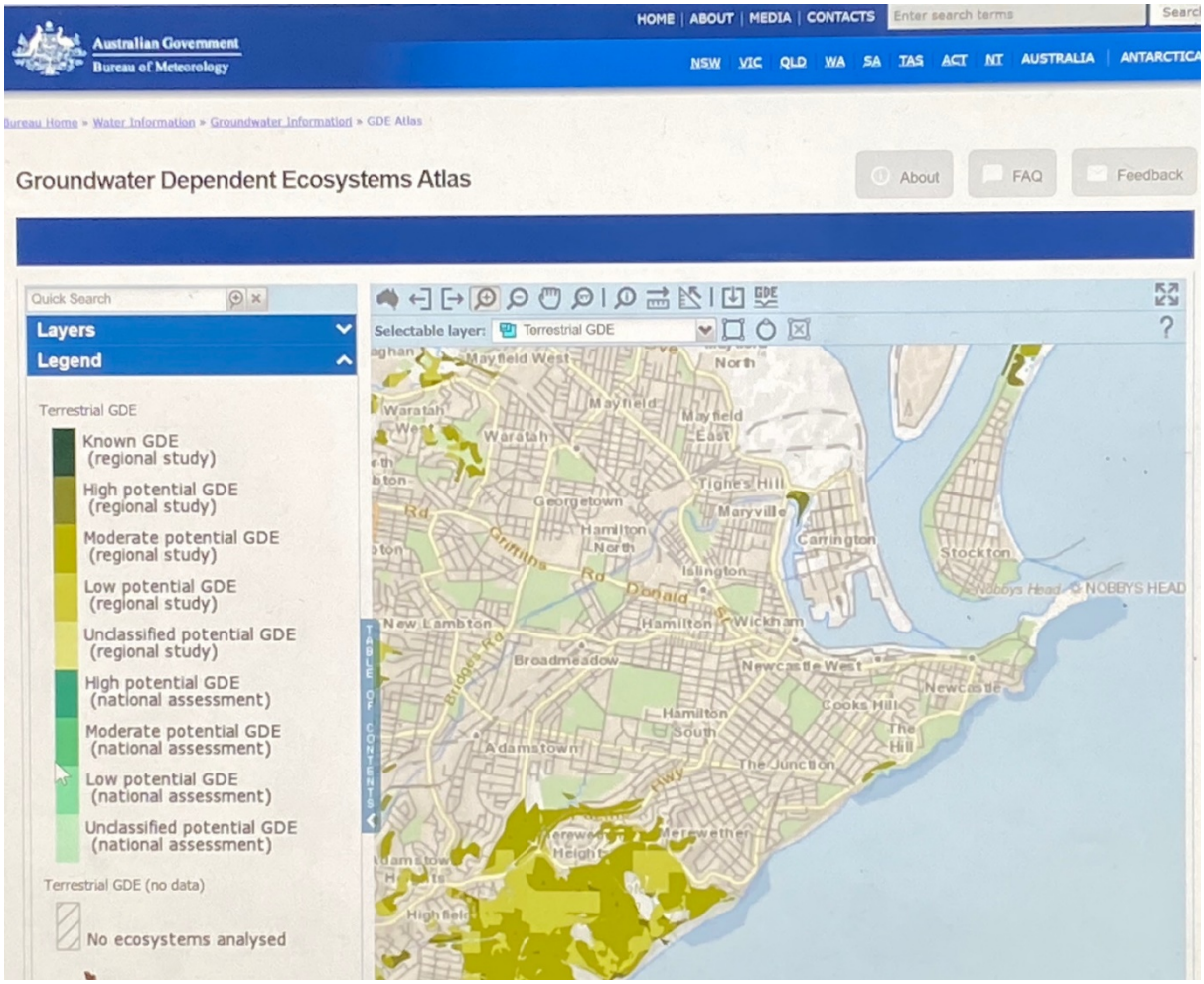
Six broad types of GDEs have been identified in Australia, and the likelihood of their presence is summarised in the table below: There is no evidence of any dependence of the vegetation in the park upon groundwater.

Table 1 Types of GDEs (Geosciences Australia, 2020)

Types of Groundwater Dependent Ecosystems (Geosciences Australia 2020)	Relevance to Arcadia Park?
terrestrial vegetation that relies on the availability of shallow groundwater	Not present. No shallow groundwater is present.
wetlands such as paperbark swamp forests and mound springs	Not present. No such vegetation present on site.

river baseflow systems where groundwater discharge provides a significant baseflow component to the river	Not present. No river systems.
aquifer and cave ecosystems where life exists independent of sunlight	Not relevant. No aquifers or caves.
terrestrial fauna, both native and introduced species, that rely on groundwater as a source of drinking water	Not relevant. No known occurrences of such species.
estuarine and near-shore marine systems, such as coastal mangroves, salt marshes and sea-grass beds, which rely on the submarine discharge of groundwater.	Not present. No such vegetation present on site.

The Bureau of Meteorology maps GDEs within Australia. The map of GDEs in the Newcastle area shows no GDEs in the vicinity of Arcadia Park. An excerpt of the map is shown below:



The proposed excavation adjacent to Arcadia Park is to be shallower than existing groundwater in the locality and so will not impact upon groundwater resources. In any case, there is no evidence that the vegetation in the park is groundwater dependant. For this reason, no significant impacts are expected to the vegetation in the park as a result of the excavation works proposed on the subject land.

4.2.2. Impacts from Alteration to Surface Water Flows

Surface water flows in Arcadia Park flow westward down a relatively steep slope and towards the subject land are captured by existing stormwater drains. For this reason, no impacts to surface water flows are likely as a result of the proposed development.

The proposed development will not result in any alteration of surface drainage within Arcadia Park. Stormwater will be entirely contained and treated on the subject land, as shown in the Civil Works Ground Floor Level ((Drawing DA-C20.10 Revision G) (Northrop 2021). Stormwater management will consist of the construction of new overland flow paths (surface drains) constructed on the northern and eastern boundary of the subject land, which connect to grated inlet drains and new and existing pipes installed along the southern and western boundary, and connected to On Site Detention (OSD) tanks.

No impacts to flora or fauna within Arcadia Park are likely as a result of alterations to drainage in relation to the proposed development.

4.3. Increase of Edge-effects on Remaining Vegetation and Habitats

Edge-effects can impact biodiversity through microclimatic changes in light, temperature, humidity and wind, which can favour a suite of different species and therefore cause significant changes to the ecology of the patch (Lindenmayer and Fischer 2006). This may lead to a change in native species composition and/or an increase of exotic species.

Of relevance to the study area, and in particular to Arcadia Park, is the potential for changes in microclimatic conditions, and the increased spread of weeds. These are discussed further below:

4.3.1. Changes in Microclimatic Conditions

Landscape species present on the subject land, including large Small-leafed Figs on the eastern boundary to Arcadia Park, provide shade and contribute to the microclimate experienced at the edges of Arcadia Park. The removal of this vegetation will act to alter the microclimate conditions, to some extent. However, planting of similar rainforest species along the eastern boundary is proposed, and will act to create similar microclimatic conditions.

Shadow diagrams provided for the proposed development indicate that shading of the vegetation of Arcadia Park will not occur throughout the morning and middle of the day (in June), although some shading will occur in the late afternoon between 4-5pm. As the vegetation is located on a westerly facing slope, it is already shaded, and consists of sclerophyll eucalypt forest species, many of which have a tolerance of shading, or partial shading, and some rainforest species, which are highly shade-tolerant. Shading alters the temperature and humidity and maintains the wet/mesic conditions suitable for these communities. It is therefore unlikely that the slight alteration in shadowing (beyond current conditions, as a result of the existing buildings) caused

by the proposed buildings would disrupt the life-cycle of these communities. Wind conditions are likely to remain static.

Artificial light has the potential to be increased, to a minor extent as a result of additional built-form that will include lighting, both internally and externally. However, the study area exists in a highly urbanised environment, and Arcadia Park is surrounded in all directions by lighting from existing residential buildings (including a multi-storey apartment building directly adjoining the park to the south of the subject land and the existing large commercial TV studio on the subject site), street lighting, and lighting within the parklands adjacent. The landscaping of the eastern boundary of the proposed development, which adjoins Arcadia Park will act to buffer the effects of lighting experienced in the park, and lighting types used will minimise direct spill of light into the park. The landscaping will include tall canopy species with a dense canopy, such as *Tristaniopsis laurina* (Water Gum) and *Angophora costata* (Sydney Red Gum) that will act to further reduce the light-spill entering the park.

4.3.2. Increases in Weeds

Vegetation removal (during construction) at the perimeter of the subject land has some potential to spread weeds, in particular during clearing operations, however, mitigation of such potential impacts is manageable as part of standard Construction Environmental Management Plan (CEMP) implementation. It is further noted that weeds present at the perimeter of Arcadia Park include African Olive, and this species is required to be managed by Council as it is a State Priority listed weed species. This should occur in accordance with the Arcadia Park VMP (Coast Ecology 2018a), regardless of the development of the subject land.

Nonetheless, the subject land occurs in a highly urbanised environment, and is located within a predominantly developed site, edge-effects are not likely to be exacerbated beyond current conditions. Furthermore, as outlined in **Section 4.1.2**, future landscaping at the eastern perimeter of the development site and Arcadia Park will include native and non-invasive species. This will reduce the potential impact of high-threat weeds spreading into the park, and act as a well-maintained buffer area. The existing impacts of weeds will continue within Arcadia Park, as per the current conditions.

For these reasons, edge-effects on Arcadia Park will not be significantly changed compared to current conditions, and is likely to involve more active management of weeds.

A.1. Impacts on Corridor Values

As outlined in Section 3.3, Arcadia Park is not part of a local or regional wildlife corridor. No National Parks or significant conservation reserves adjoin or are proximate to the park. Due to the relatively small size of the patch, being in an urban environment, and with a lack of connectivity to other patches of vegetation, the habitat value is significantly reduced for the majority of fauna species known in the locality, and in particular for threatened species.

The existing building on the subject land acts as a barrier to movement in an east to west direction. The proposed development will not act to further exacerbate the impacts on corridor values for fauna in the locality.

4.4. Impacts on Threatened Flora Species

No threatened flora species listed under the BC Act or EPBC Act were recorded from within the study area.

Given that the study area is highly modified, it is considered unlikely that any of the threatened species known from the locality area may occur there and no significant impact is considered likely to occur to any threatened flora species.

4.5. Impacts on Threatened Fauna Species

One threatened fauna species; Powerful owl, has previously been recorded from the study area. This species is likely to utilise the habitats present in Arcadia Park for foraging, as part of a broader home range, although no suitable roosting or nesting habitat is present. As such, the study area is unlikely to represent an important area of habitat for the species.

No area of habitat for Powerful Owls will be removed from the study area. This species is adapted to urban environments, and is unlikely to be significantly impacted by the proposal.

Additional threatened fauna species recorded in the locality, are listed in **Appendix B**. Some marginal potential foraging habitat occurs for nectarivorous species, although this resource will be retained in Arcadia Park, and no area of important habitat will be removed as a result of the development.

5. Mitigation Measures

As works occur within the site at the perimeter of Arcadia Park, a number of mitigation measures are recommended and are presented in subsequent subsections. Standard mitigation measures (e.g. Erosion control) are to be implemented via a Construction Environmental Management Plan (CEMP).

5.1. Weed Control Measures

Priority weed species occurring within the subject land should be managed in order to prevent further spread. Prior to any vegetation clearance, priority weeds in the canopy and shrub layers should be demarcated in order for these to be disposed of separately from native material. All ground cover should be disposed of as exotic as these cover a large portion of the subject land.

Methods for weed control should be consistent with the existing management plan for the restoration of Arcadia Park (Coast Ecology 2018a).

5.2. Landscaping

The planting schedule referred to in the Landscape Masterplan (Arcadia Landscape Architecture, 2021) incorporates a wider range of native plants, including Littoral Rainforest species (being species consistent with the vegetation management plan for Arcadia Park (Coast Ecology, 2018a)) to be planted in the landscaped zone adjoining the eastern boundary of the subject land and Arcadia Park.

6. Conclusion

No threatened flora species listed under the BC Act or EPBC Act were recorded from within the study area. Given that the study area is highly modified, it is considered unlikely that any of the threatened species known from the locality area may occur there and no significant impact is considered likely to occur to any threatened flora species.

One threatened fauna species; Powerful owl, has previously been recorded from the study area. This species is likely to utilise the habitats present in Arcadia Park for foraging, as part of a broader home range, although no suitable roosting or nesting habitat is present. As such, the study area is unlikely to represent an important area of habitat for the species. No area of habitat for Powerful Owls will be removed from the study area. This species is adapted to urban environments, and is unlikely to be significantly impacted by the proposal.

Additional threatened fauna species recorded in the locality have been considered in the report. Some marginal potential foraging habitat occurs for nectarivorous species, although this resource will be retained in Arcadia Park, and no area of important habitat will be removed as a result of the development.

Arcadia Park is vegetated by a mixture of forest and other vegetation types that have been replanted, and to a lesser extent, regenerated, over past decades. In 1976 Arcadia Park was largely grassland and was almost completely devoid of woody vegetation. Active restoration works have been documented by The City of Newcastle since 2018, and it is clear that planting has occurred very recently. As identified in the Vegetation Management Plan (VMP) (Coast Ecology 2018d), there has been a clear intention to plant species characteristic of Littoral Rainforest, which is listed as endangered under the BC Act and EPBC Act (where minimum condition thresholds are reached), in the gullies present in Arcadia Park. The planted vegetation throughout the park contains a high number of native species, but the species assemblage represent communities that would not all naturally occur in the location, based on soils, topography and nearby naturally occurring communities. Notwithstanding that, patches of forest plantings in the park have the characteristics of Littoral Rainforest and are developing and growing well. In future, over a period of decades, it is likely that such areas of the park will grow into a form of Littoral Rainforest. However, the proposed development will not entail clearing or development within the park, which is on steeply sloping land to the east of the development site. There is potential for minor edge effects, but these are considered manageable, without substantial impacts to the park vegetation.

A belt of vegetation on the eastern boundary of the subject land will be cleared as part of the development. Such vegetation has low diversity and will in part be replaced by landscape plantings of native plant species, and many of these are characteristic of Littoral Rainforest. The plantings are likely to help buffer the park vegetation against indirect impacts in the longer term and will be managed according to a management plan that will include, amongst other measures, weed management.

As identified in the formal Test of Significance (**Appendix C**), no significant impacts to threatened species or ecological communities listed under the BC Act or EPBC Act, associated with Arcadia Park, will occur as a result of the proposal.

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APPENDIX B :

Flora Species List - Arcadia Park

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Table 2 Flora Species Recorded in the Study Area (Arcadia Park)

Family	Scientific Name	Common Name	NSW Status	Comm. Status	Native	Exotic	High Threat Weed	Northern Gully - Arcadia Park	Central garden beds - Arcadia Park	Incidental Recordings
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair	Not Listed	Not Listed	YES				1	
Apiaceae	*Centella asiatica*	Indian Pennywort	Not Listed	Not Listed	YES				1	
Araliaceae	*Hedera helix*	English Ivy	Not Listed	Not Listed		YES	YES	1		
Araliaceae	*Schefflera actinophylla*	Umbrella Tree	Not Listed	Not Listed		YES	YES	1		
Araucariaceae	*Araucaria heterophylla*	Norfolk Island Pine	Not Listed	Not Listed		YES				1
Arecaceae	*Phoenix canariensis*	Canary Island Date Palm	Not Listed	Not Listed		YES	YES	1		
Asparagaceae	*Asparagus aethiopicus*	Asparagus Fern	Not Listed	Not Listed		YES	YES	1		
Asteraceae	*Chrysanthemoides monilifera subsp. rotundata*	Bitou Bush	Not Listed	Not Listed		YES	YES			1
Blechnaceae	*Blechnum sp.*		Not Listed	Not Listed	YES			1		
Capparaceae	*Capparis arborea*	Native Pomegranate	Not Listed	Not Listed	YES				1	
Casuarinaceae	*Allocasuarina littoralis*	Black She-Oak	Not Listed	Not Listed	YES					1
Casuarinaceae	*Casuarina cunninghamiana subsp. cunninghamiana*	River Oak	Not Listed	Not Listed	YES					1

Family	Scientific Name	Common Name	NSW Status	Comm. Status	Native	Exotic	High Threat Weed	Northern Gully - Arcadia Park	Central garden beds - Arcadia Park	Incidental Recordings
Commelinaceae	*Tradescantia fluminensis*	Wandering Jew	Not Listed	Not Listed		YES	YES	1		
Convolvulaceae	*Dichondra repens*	Kidney Weed	Not Listed	Not Listed	YES				1	
Cyperaceae	*Carex appressa*	Tall Sedge	Not Listed	Not Listed	YES				1	
Cyperaceae	*Gahnia clarkei*	Tall Saw-sedge	Not Listed	Not Listed	YES					1
Ebenaceae	*Diospyros australis*	Black Plum	Not Listed	Not Listed	YES				1	
Elaeocarpaceae	*Elaeocarpus reticulatus*	Blueberry Ash	Not Listed	Not Listed	YES					1
Fabaceae (Caesalpinioideae)	*Senna pendula var. glabrata*		Not Listed	Not Listed		YES				1
Fabaceae (Faboideae)	*Pultenaea flexilis*		Not Listed	Not Listed	YES				1	
Fabaceae (Faboideae)	*Pultenaea villosa*	Hairy Bush-pea	Not Listed	Not Listed	YES				1	
Fabaceae (Mimosoideae)	*Acacia binervia*	Coast Myall	Not Listed	Not Listed	YES			1		
Fabaceae (Mimosoideae)	*Acacia terminalis*	Sunshine Wattle	Not Listed	Not Listed	YES					1

Family	Scientific Name	Common Name	NSW Status	Comm. Status	Native	Exotic	High Threat Weed	Northern Gully - Arcadia Park	Central garden beds - Arcadia Park	Incidental Recordings
Goodeniaceae	*Goodenia ovata*	Hop Goodenia	Not Listed	Not Listed	YES				1	
Lamiaceae	*Westringia fruticosa*	Coastal Rosemary	Not Listed	Not Listed	YES				1	
Lauraceae	*Cinnamomum camphora*	Camphor Laurel	Not Listed	Not Listed		YES	YES	1		
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush	Not Listed	Not Listed	YES				1	
Luzuriagaceae	*Eustrephus latifolius*	Wombat Berry	Not Listed	Not Listed	YES				1	
Moraceae	*Ficus rubiginosa*	Port Jackson Fig	Not Listed	Not Listed	YES					1
Myrtaceae	*Angophora costata*	Sydney Red Gum	Not Listed	Not Listed	YES					1
Myrtaceae	*Callistemon salignus*	Willow Bottlebrush	Not Listed	Not Listed	YES				1	
Myrtaceae	*Callistemon viminalis*	Weeping Bottlebrush	Not Listed	Not Listed	YES					1
Myrtaceae	*Corymbia citriodora*	Lemon-scented Gum	Not Listed	Not Listed		YES				1
Myrtaceae	*Corymbia gummifera*	Red Bloodwood	Not Listed	Not Listed	YES				1	
Myrtaceae	*Corymbia sp.*		Not Listed	Not Listed	YES					1
Myrtaceae	*Corymbia torelliana*	Cadaghi	Not Listed	Not Listed		YES	YES			1
Myrtaceae	*Eucalyptus botryoides*	Bangalay	Not Listed	Not Listed	YES			1		
Myrtaceae	*Eucalyptus grandis*	Flooded Gum	Not Listed	Not Listed	YES					1
Myrtaceae	*eucalyptus microcorys*	Tallowwood	Not Listed	Not Listed	YES					1
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany	Not Listed	Not Listed	YES					1

Family	Scientific Name	Common Name	NSW Status	Comm. Status	Native	Exotic	High Threat Weed	Northern Gully - Arcadia Park	Central garden beds - Arcadia Park	Incidental Recordings
Myrtaceae	*Eucalyptus scoparia*	Wallangarra White Gum	Endangered	Vulnerable	YES					1
Myrtaceae	*Eucalyptus sideroxylon*	Mugga Ironbark	Not Listed	Not Listed	YES					1
Myrtaceae	*Leptospermum polygalifolium*	Tantoon	Not Listed	Not Listed	YES				1	
Myrtaceae	*Melaleuca quinquenervia*	Broad-leaved Paperbark	Not Listed	Not Listed	YES			1		
Myrtaceae	*Melaleuca styphelioides*	Prickly-leaved Tea Tree	Not Listed	Not Listed	YES				1	
Myrtaceae	*Syncarpia glomulifera*	Turpentine	Not Listed	Not Listed	YES					1
Myrtaceae	*Syzygium australe*	Brush Cherry	Not Listed	Not Listed	YES					1
Myrtaceae	*Tristaniopsis laurina*	Kanooka	Not Listed	Not Listed	YES					1
Ochnaceae	*Ochna serrulata*	Mickey Mouse Plant	Not Listed	Not Listed		YES	YES	1		
Oleaceae	*Olea europaea subsp. cuspidata*	African Olive	Not Listed	Not Listed		YES		1		1
Oxalidaceae	*Oxalis purpurea*		Not Listed	Not Listed		YES		1		
Phormiaceae	*Dianella caerulea var. producta*		Not Listed	Not Listed	YES				1	
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush	Not Listed	Not Listed	YES				1	
Pittosporaceae	*Pittosporum revolutum*	Rough Fruit Pittosporum	Not Listed	Not Listed	YES				1	

Family	Scientific Name	Common Name	NSW Status	Comm. Status	Native	Exotic	High Threat Weed	Northern Gully - Arcadia Park	Central garden beds - Arcadia Park	Incidental Recordings
Pittosporaceae	*Pittosporum undulatum*	Sweet Pittosporum	Not Listed	Not Listed	YES			1		
Poaceae	*Ehrharta erecta*	Panic Veldtgrass	Not Listed	Not Listed		YES	YES	1		
Poaceae	*Megathyrsus maximus var. maximus*		Not Listed	Not Listed		YES		1		1
Poaceae	*Phyllostachys aurea*	Fishpole Bamboo	Not Listed	Not Listed		YES	YES			1
Primulaceae	*Myrsine variabilis*		Not Listed	Not Listed	YES				1	
Proteaceae	*Banksia integrifolia*	Coast Banksia	Not Listed	Not Listed	YES				1	
Proteaceae	*Grevillea robusta*	Silky Oak	Not Listed	Not Listed	YES			1		
Sapindaceae	*Cupaniopsis anacardioides*	Tuckeroo	Not Listed	Not Listed	YES					
Solanaceae	*Solanum aviculare*	Kangaroo Apple	Not Listed	Not Listed	YES				1	
Ulmaceae	*Trema tomentosa*	Native Peach	Not Listed	Not Listed	YES				1	

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APPENDIX C :
Threatened Species Recorded in the Locality

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Table 3 Threatened Species Recorded in the Locality (BioNet) (EES, 2021)

Family	Scientific Name	Common Name	BC Act	EPBC Act	No. of Records (Bionet)
Flora					
Asteraceae	*Rutidosis heterogama*	Heath Wrinklewort	V	V	11
Apocynaceae	*Cynanchum elegans*	White-flowered Wax Plant	E	E	0
Broomrapes	*Euphrasia arguta*		CE	CE	0
Elaeocarpaceae	*Tetratheca juncea*	Black-eyed Susan	V	V	5
Fabaceae (Faboideae)	*Pultenaea maritima*	Coast Headland Pea	V		3
Malvaceae	*Commersonia prostrata*	Dwarf Kerrawang	E	E	0
Myrtaceae	*Rhodamnia rubescens*	Scrub Turpentine	CE		2
Myrtaceae	*Angophora inopina*	Charmhaven Apple	V	V	0
Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V	0
Myrtaceae	*Eucalyptus parramattensis subsp. decadens*	Earp's Gum, Earp's Dirty Gum	V	V	0
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V	0
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly, Magenta Cherry, Daguba, Scrub Cherry, Creek Lilly Pilly, Brush Cherry	E	V	0
Orchidaceae	*Diuris praecox*	Rough Doubletail	V	V	1836
Orchidaceae	*Caladenia tessellata*	Thick-lipped Spider-orchid, Daddy Long-legs	E	V	0
Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue-orchid	V	V	0

Family	Scientific Name	Common Name	BC Act	EPBC Act	No. of Records (Bionet)
Orchidaceae	*Phaius australis*	Lesser Swamp-orchid		E	0
Orchidaceae	*Prasophyllum sp. Wybong*	a leek-orchid		CE	0
Polygonaceae	*Persicaria elatior*	Knotweed, Tall Knotweed	V	V	0
Proteaceae	*Grevillea shiressii*		V	V	40
Proteaceae	*Grevillea parviflora subsp. parviflora*	Small-flower Grevillea	V	V	0
Fauna					
Accipitridae	*Circus assimilis*	Spotted Harrier	V		1
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	V		6
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V		1
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V		1
Accipitridae	*Pandion cristatus*	Eastern Osprey	V		8
Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	CE	V	0
Anseranatidae	*Anseranas semipalmata*	Magpie Goose	V		1
Apodidae	*Apus pacificus*	Fork-tailed Swift		C,J,K	3
Apodidae	*Hirundapus caudacutus*	White-throated Needletail		V	0
Ardeidae	*Botaurus poiciloptilus*	Australian Bittern	E	E	0
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	E		1
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		1
Castniidae	*Synemon plana*	Golden Sun Moth	E	CE	0

Family	Scientific Name	Common Name	BC Act	EPBC Act	No. of Records (Bionet)
Columbidae	*Ptilinopus magnificus*	Wompoo Fruit-Dove	V		1
Columbidae	*Ptilinopus superbus*	Superb Fruit-Dove	V		2
Cuculidae	*Cuculus optatus*	Oriental Cuckoo, Horsfield's Cuckoo		m	0
Dasyuridae	*Dasyurus maculatus*	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll		E	0
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V	-	1
Falconidae	*Falco hypoleucos*	Grey Falcon	E	V	0
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	0
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V		8
Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	CE	CE	0
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	V	0
Miniopteridae	*Miniopterus australis*	Little Bentwing-bat	V	-	31
Miniopteridae	*Miniopterus orianae oceanensis*	Large Bent-winged Bat	V		1
Molossidae	*Micronomus norfolkensis*	Eastern Coastal Free-tailed Bat	V		1
Monarchidae	*Myiagra cyanoleuca*	Satin Flycatcher		m	0
Motacillidae	*Motacilla flava*	Yellow Wagtail		m	0
Muridae	*Pseudomys novaehollandiae*	New Holland Mouse, Pookila		V	0
Muscicapidae	*Monarcha melanopsis*	Black-faced Monarch		m	0
Muscicapidae	*Monarcha trivirgatus*	Spectacled Monarch		m	0

Family	Scientific Name	Common Name	BC Act	EPBC Act	No. of Records (Bionet)
Muscicapidae	*Rhipidura rufifrons*	Rufous Fantail		m	0
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	0
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog, Southern Barred Frog	E	V	0
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		1
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V	5
Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V		1
Potoroidae	*Potorous tridactylus*	Long-nosed Potoroo	V	V	0
Pseudocheiridae	*Petauroides volans*	Greater Glider		V	0
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		2
Psittacidae	*Lathamus discolor*	Swift Parrot	E	CE	1
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		3
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	203
Strigidae	*Ninox strenua*	Powerful Owl	V		7
Tytonidae	*Tyto longimembris*	Eastern Grass Owl	V		1
Tytonidae	*Tyto tenebricosa*	Sooty Owl	V		1
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		1
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat, Large Pied Bat	V	V	0

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APPENDIX D :
Tests of Significance

D.1. Littoral Rainforest

Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions occurs in close proximity to the coast and is dominated by rainforest species along with scattered sclerophyll species including *Angophora costata*, *Banksia integrifolia*, *Eucalyptus botryoides* and *E. tereticornis*. Littoral Rainforest occurs on soils derived from underlying rocks and on sand dunes (NSW Threatened Species Scientific Committee 2012).

The geographic distribution of Littoral Rainforest is generally restricted to within 2 km of the coast or areas maintaining a maritime influence. As a whole, this community is relatively small and makes up only 1% of the area for all rainforests in NSW. The largest known stand of the community occurs within the Iluka Nature Reserve and is approximately 136 ha; however the community primarily occurs only as small stands due to fragmentation as a result of urban development. Furthermore, the majority of the stands remaining have low species richness, which declines even more the further south you go. The Littoral Rainforest within the Subject Site falls within the south-central extent of this community's distribution (NSW Threatened Species Scientific Committee 2012).

For the purposes of this Test of Significance, it is assumed that the patches of rainforest species within Arcadia Park are a form of Littoral Rainforest, though many of the species that would typically occur in such vegetation are not present.

It is also assumed for the purposes of this test that the "local occurrence" comprises the patches of Littoral Rainforest species within Arcadia Park.

a. *in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,*

Not applicable to an endangered ecological community.

b. *in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:*

    i. *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*

The proposed development will not entail clearing of any part of the Arcadia Park and will not clear patches of Littoral Rainforest species. There is very limited potential for indirect impacts upon the park vegetation:

    ii. *The proposed development is downslope of the Arcadia Park and is not likely to have an impact upon flows of surface water within the park.*

The construction of the building on the development site is unlikely to have a significant impact upon groundwater within Arcadia Park (Coffey, 2021).

The proposed development is also to the west of the Arcadia Park and may have a sheltering impact from westerly winds to a degree in future. This is not likely to have a detrimental impact upon any rainforest plantings in the park.

There is potential for edge effects as the proposed development is built, and for weed invasion from disturbed soils within the development site. As the development site is downslope of the park, this is not likely to be a significant issue. Additionally, there will be landscape plantings made using native plant species on the development site adjacent to the park and such vegetation will help to form a buffer to the vegetation in the park, including to rainforest species.

The local occurrence of Littoral Rainforest in Arcadia Park is not likely to be at risk of extinction as a result of either the construction or occupation of the proposed development.

iii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

For reasons set out in the point above, the proposed development will not have an adverse effect on the extent of the ecological community such that a local occurrence is at risk of extinction.

c. in relation to the habitat of a threatened species or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

No habitat will be removed.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

No habitat will become fragmented.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

The vegetation within the Arcadia Park has developed substantially since the 1970s, when it was largely clear. Currently, it comprises a range of well developed and diverse vegetation, amongst which are patches of plant species that are regenerating as a form of Littoral Rainforest. As such it is important vegetation of some local conservation significance.

No vegetation within the park will be cleared, removed, modified fragmented or isolated. There will therefore be no threat to the long term survival of Littoral Rainforest in the locality.

d. whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No area of outstanding biodiversity value has been declared by the Secretary of DPIE within or adjoining the development site.

e. whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The proposed development has some minor potential to impact Littoral Rainforest through the exacerbation of the key threatening process: 'Invasion of native plant communities by African Olive *Olea europaea ssp cuspidata*'.

The proposed removal of landscape vegetation at the perimeter of the development site and Arcadia Park has the potential to exacerbate the impact of this key threatening process, particularly in terms of the local occurrence of Littoral Rainforest. However, African Olive is already present in Arcadia Park, and therefore this key threatening process is unlikely to be exacerbated beyond current conditions.

The proposed landscaping of the development site adjacent to the park with native plant species will address the minor potential for the spread of weeds from the site into the park.

Conclusion

No significant impact is likely to occur for Littoral Rainforest in Arcadia Park from the proposed development.

D.2. Powerful Owl (Ninox strenua)

The Powerful Owl is listed as Vulnerable under the BC Act and is not listed under the EPBC Act. The Powerful Owl occurs primarily on the eastern side of the Great Dividing Range near coastal regions from south-west Victoria to McKay (NSW Scientific Committee 2004).

The Powerful Owl is known to utilise a variety of vegetation types including woodland, open sclerophyll forest, tall open wet forest and rainforest. Typically the Powerful Owl utilises large areas of connected woodland or forest habitat, but it also occurs in fragmented habitats as well. Large eucalypt trees containing large hollows within dense vegetation are required for nesting and roosting, with preferred roosting sites being located in riparian areas high in catchment areas (Bain et al. 2014). It will utilise a variety of tree species for roosting as long as it is densely vegetated and provides adequate cover during the day. Required foraging habitat for the species consists of vegetation containing suitable hollows for prey such as the Greater Glider, Common Ringtail Possum and Sugar Glider (OEH 2017). Suitable foraging habitat for the species includes all patches of suitable habitat greater than 1ha (Bain et al. 2014).

The Powerful Owl has been recorded from the study area. Foraging habitat, but no nesting/breeding habitat is present. Habitat for this species will be retained in Arcadia Park.

The following is to be taken into account for the purposes of determining whether a proposed development or activity is likely to significantly affect threatened species or ecological communities, or their habitats:

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction,

No area of known habitat for the Powerful Owl will be removed as a result of the proposed development. Indirect impacts to the species habitat due to edge-effects as result of; light-spill, increased noise and overshadowing, such impacts are not likely to be exacerbated beyond current conditions.

The Powerful Owl is a highly mobile species that has vast foraging ranges and the species is unlikely to rely on the small area of potential foraging habitat present within Arcadia Park. Any local population of the species that may access the vegetation of the study area would also have access to the much larger, higher quality foraging areas available within nearby public and private bushland to the south of the subject site around Mereweather. As such, the proposal is not considered to affect the life cycle of the Powerful Owl such that a viable local population is placed at risk of extinction.

(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable.

(c) in relation to the habitat of a threatened species or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species or ecological community in the locality,

No area of known habitat for the species is to be removed for the proposed development.

The study area consists of foraging habitat for the Powerful Owl, but does not include breeding habitat. The foraging habitat present occurs in a highly urban environment that has connectivity to areas of larger but similarly isolated patches of degraded planted native vegetation in Arcadia Park and other small patches of urban vegetation in the road reserves and pocket parks surrounding the study area. As such, the development will not isolate the existing habitat, and will only marginally fragment it further. The potential habitat in the study area represents only a very small area available to the species in the locality and as the species is highly mobile and accesses resources from across a vast foraging range, the proposal is not likely to decrease the movement of individuals and gene flow between areas of potential habitat throughout the locality or within or between local populations. Accordingly, the proposed development will not remove, modify, fragment or isolate important habitat.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),

No areas of outstanding biodiversity value (AOBV) are within the subject site or immediate surrounds and therefore no AOBVs will be directly or indirectly impacted by the proposed development.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.

The key threatening process of 'loss of roosting and foraging sites' could potentially impact habitat for this species further than current conditions. However, the vegetation of the study area is not considered to constitute significant habitat for the Powerful Owl. As potential habitat will remain in the vicinity of the subject site, including the adjoining Arcadia Park, the loss of a small area of degraded foraging habitat is not likely to significantly impact habitat for Powerful Owls.

Conclusion

No significant impact is likely to occur for Powerful Owl in Arcadia Park from the proposed development.

FIGURES

Legend

Subject Land

Study Area

Image Source:
Image © Nearmap (2020)
Dated: 30/06/2020

Coordinate System: MGA Zone 56 (GDA 94)

cumberland ecology

0 20 40 60 80 m

I:\...\20158\Figures\RP2\20201105\Figure 1. Location_Subject Land

Figure 1. Location of the subject land and study area over 2020 aerial

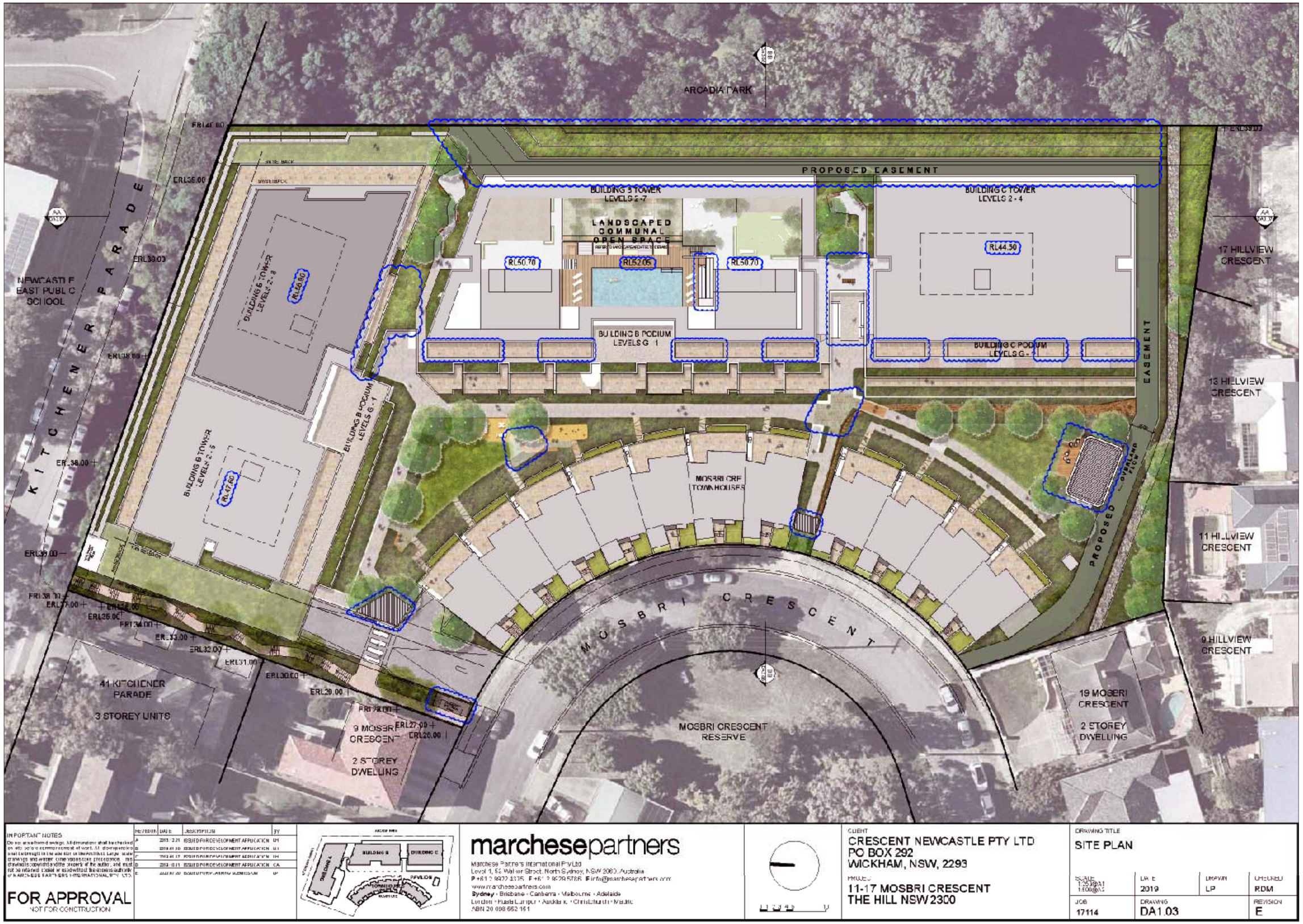


Figure 2. Project Layout

Image Source: Marchese Partners (2020)

I:\...\20158\Figures\RP2\20201105\Figure 2. Project Layout

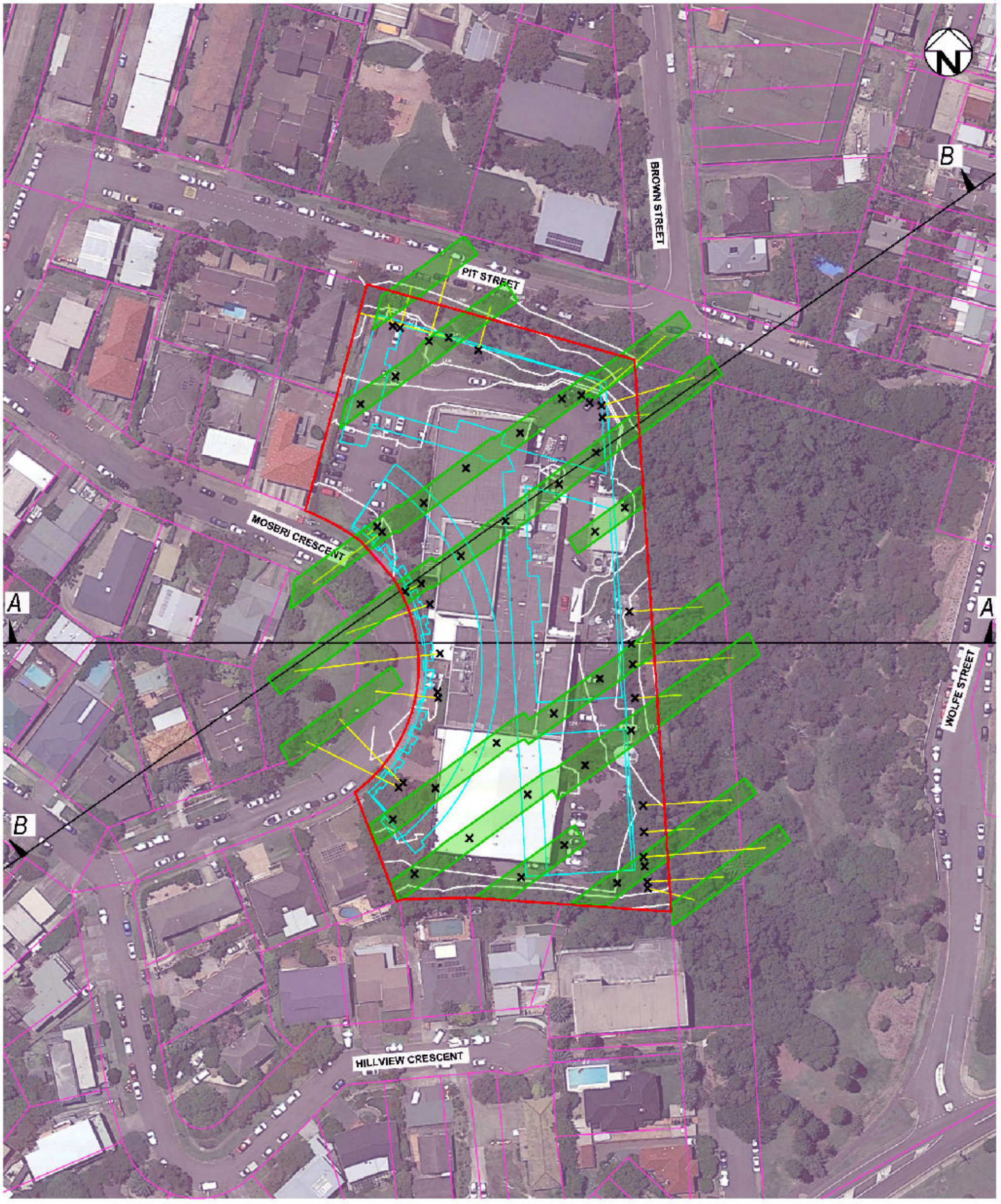
Figure 3. Historical aerial (1976) of the study area

Figure 4. Historical aerial (1984) of the study area

Figure 5. Historical aerial (1993) of the study area

Figure 6. Historical aerial (2001) of the study area

Figure 7. Project Impacts



revision no.	description	drawn	approved	date
A	ORIGINAL ISSUE	SJB	JD	24/08/2020
B	MINOR AMENDMENTS	SJB	JD	20/10/2020

LEGEND

- LOT BOUNDARIES
- SITE BOUNDARY
- PROPOSED BOREHOLE TRAJECTORY LINES
- SECTION LINES (DRAWING 5 AND 6)
- PROPOSED BUILDING OUTLINES
- PROPOSED GROUT LOCATIONS AT MINE LEVEL AND PRELIMINARY FLOW AT 1M VOID

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE © SINCLAIR KNIGHT MERZ 2014

10 0 10 30 50
Scale (metres) 1:1000

drawn	SJB
approved	JD
date	20/10/2020
scale	AS SHOWN
original size	A3

coffey

client:	CRESCENT NEWCASTLE PTY LTD
project:	PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE - 11-17 MOSBRI CRESCENT THE HILL MINE SUBSIDENCE ASSESSMENT
title:	PROPOSED BOREHOLE SEAM GROUT LAYOUT
project no:	754-NTLGE220504
drawing no:	DRAWING 1
rev:	A

I:\...\20158\Figures\RP2\20210422\Figure 8. Proposed Borehole Seam Grout Layout

Figure 8. Proposed Borehole Seam Grout Layout (Coffey, 2020)

Image Source: Coffey (2020)