Ivanhoe Estate Re-development SSD 17_8707

Biodiversity Assessment Report and Offset Strategy

Prepared for
Frasers Property Australia - Rhodes

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Abbreviations

Abbreviation	Description
BAR	Biodiversity Assessment Report
BBCC	BioBanking Credit Calculator Version 4.0
BC Act	NSW *Biodiversity Conservation Act 2016*
BOS	Biodiversity Offset Strategy
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environment Management Plan
DP&E	Department of Planning and Environment
Ecosystem credit	A measurement of the value of EECs, CEECs, and threatened species habitat for species that can be reliably predicted to occur within a PCT
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
EPBC Regulations	Commonwealth *Environment Protection and Biodiversity Conservation Regulations 2000*
FBA	Framework for Biodiversity Assessment
LAHC	NSW Land and Housing Corporation
LEP	Local Environment Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
NSW	New South Wales
PCT	Plant Community Type
SSD	State Significant Development
SSI	State Significant Infrastructure
STIF	Sydney Turpentine - Ironbark Forest
TEC	Threatened Ecological Community
the bilateral agreement	Bilateral agreement made under section 45 of the EPBC act relating to environmental assessment
the development site	lands within the existing Ivanhoe Estate subject to direct disturbance as a result of the proposed development
the Project	Re-development of the Ivanhoe Estate, Macquarie Park

Abbreviation	Description
TSC Act	NSW *Threatened Species Conservation Act 1995*

Executive summary

Eco Logical Australia Pty Ltd (ELA) was engaged to undertake a biodiversity assessment for the re-development of the Ivanhoe Estate, Macquarie Park (the development site). The proposed re-development of the Ivanhoe Estate (the project) has been declared a State Significant Development (SSD), and as such the environmental impacts of the proposal are to be assessed under Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*.

As a SSD, and in accordance with the Secretaries Environmental Assessment Requirements (SEARs) the impacts of the proposed re-development must be assessed under the Framework for Biodiversity Assessment (FBA; OEH 2014) and a Biodiversity Assessment Report (BAR) must be prepared. The purpose of this BAR is to assess the impacts to biodiversity, propose mitigating and ameliorating options, as well as calculate offsets for unavoidable impacts.

Stage 1 of the assessment involved assessing biodiversity values within the development site. The development site is currently developed for residential housing, roadways, and open space areas. There are remnant trees throughout the development, as well as a patch of remnant vegetation between the development site and Epping Road. There are two plant community types (PCTs) that occur within the development site:

- 1281 – Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion.
- 1841 - Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region

PCT 1281 in moderate – good condition within the development site conforms to the listing of Sydney Turpentine - Ironbark Forest (STIF). The STIF ecological community is listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and Critically Endangered under the NSW *Biodiversity Conservation Act 1995* (BC Act).

No threatened plants or fauna species were observed within the development site.

As part of Stage 2 of this BAR, avoidance measures to minimise impacts to biodiversity have been proposed, including siting of the project, alternative options, as well as methodologies to minimise impacts during construction and operation of the project.

This report includes a revised development site which acknowledges community and agency submissions to the Environmental Impact Statement which was exhibited from 24 April to 9 May 2018, and subsequently again which ended on 19 June 2019. In response to the submissions received, the proponent has, where possible, reduced the development footprint to minimise impacts to STIF which occurs in a narrow strip between the existing development and Epping Road. In particular, the following changes to the masterplan have been made, which significantly reduces the impacts to biodiversity:

- Consultation with the site owner, NSW Land and Housing Corporation, to reduce the impacts of site demolition on areas of CEEC from 0.19 ha to 0.03 ha
- Removal of the proposed slip lane and vehicle entry off Epping Road from the project
- Retention of the existing retaining wall (and ancillary existing structures) where possible
- Redesign of the proposed built form of the development to occur only in areas of existing developed land.

The revised footprint results in a reduction of the impacts to biodiversity, in particular a reduction from 0.41 ha proposed, down to 0.05 ha of STIF to be impacted which is a 88% reduction in the area of CEEC originally proposed to be impacted. The latest development (and demolition) plan will retain 94% of the existing CEEC within the development site. The total development footprint will impact up to 2.24 ha of native vegetation, predominately planted street trees within the existing development site. Of this 2.24 ha, 1.66 will be permanently removed due to impacts of the demolition or construction of the project. The remaining vegetation has been precautionarily considered impact, even though it will be part of a landscaped area along Shrimptons Creek.

Following consideration of minimisation methods, the unavoidable impacts of the project were calculated in accordance with the FBA by utilising the BioBanking Credit Calculator (BBCC). The BBCC calculated that eight (8) ecosystem credits are required to offset the 2.24 ha of unavoidable impacts of the project resulting from the development. This included two (2) ME041 credits and six (6) ME58 credits.

Landscaping impacts of the project, as a precautionary measure, may require up to eight (8) credits of ME58. Landscaping in open space areas will aim to retain significant trees, creation of usable recreation space, as well as include restoration of the Shrimptons Creek riparian area.

The total project will require 16 ecosystem credits.

The proponent will provide all offsets prior to construction, and no longer proposes to stage the offsetting requirement.

A Biodiversity Offset Strategy (BOS) to achieve the offset requirement has been proposed, and is included within Stage 3 of this document.

1 Introduction

Frasers Property Australia (Frasers) engaged Eco Logical Australia Pty Ltd (ELA) to undertake a biodiversity assessment for re-development of the Ivanhoe Estate, Macquarie Park (the Project).

1.1 Purpose

This Biodiversity Assessment Report (BAR) has been prepared as part of an Environmental Impact Statement (EIS) for the State Significant Development (SSD) of the Ivanhoe Estate. The Secretaries Environmental Assessment Requirements (SEARs) were issued on 25 September 2017. Impacts to flora and fauna under a SSD must be assessed using the Framework for Biodiversity Assessment (FBA).

This report responds specifically to Section 11 of the SEARs as they relate to biodiversity assessment as described in **Table 1**.

Table 1: Relevant SEARs addressed in this BAR

SEARs	Response
Provide a detailed assessment of any vegetation clearing on the site including the removal of trees, and any impact on threatened species, populations, endangered ecological communities or their habitat and potential for offset requirements.	This BAR has been prepared under the FBA (OEH 2014) for major projects. Under this framework a detailed assessment must be undertaken on the vegetation to be impacted within the development site, as well as any impacts to threatened species, populations, or endangered ecological communities. This BAR also outlines the offsetting requirement due to unavoidable impacts of the project.
In accordance with the transitional provisions of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*, biodiversity impacts are to be assessed and documented in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) and the *Framework for Biodiversity Assessment*, by a person accredited in accordance with section 142B(1)(c) of the *Threatened Species Conservation Act 1995*.	This BAR has been prepared in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) and the *Framework for Biodiversity Assessment*, by Alex Pursche, a person accredited (227) in accordance with section 142B(1)(c) of the *Threatened Species Conservation Act 1995*.

1.2 Report version history

This report presents a subsequent biodiversity assessment of the impacts of the Project, and presents a revised development site that acknowledges community and agency submissions to the proposal presented within the EIS which was exhibited twice with the latest exhibition period ending on 19 June 2019.

The updated masterplan for the Project has sought to further reduce impacts to biodiversity, particularly Threatened Ecological Communities which occur within the study area. The amended concept masterplan is shown in **Figure 1**, and a comparison of the development site boundaries between the EIS

development site (February 2018) and the revised development site (August 2019) is shown in **Figure 2**. Significant changes to the development footprint includes:

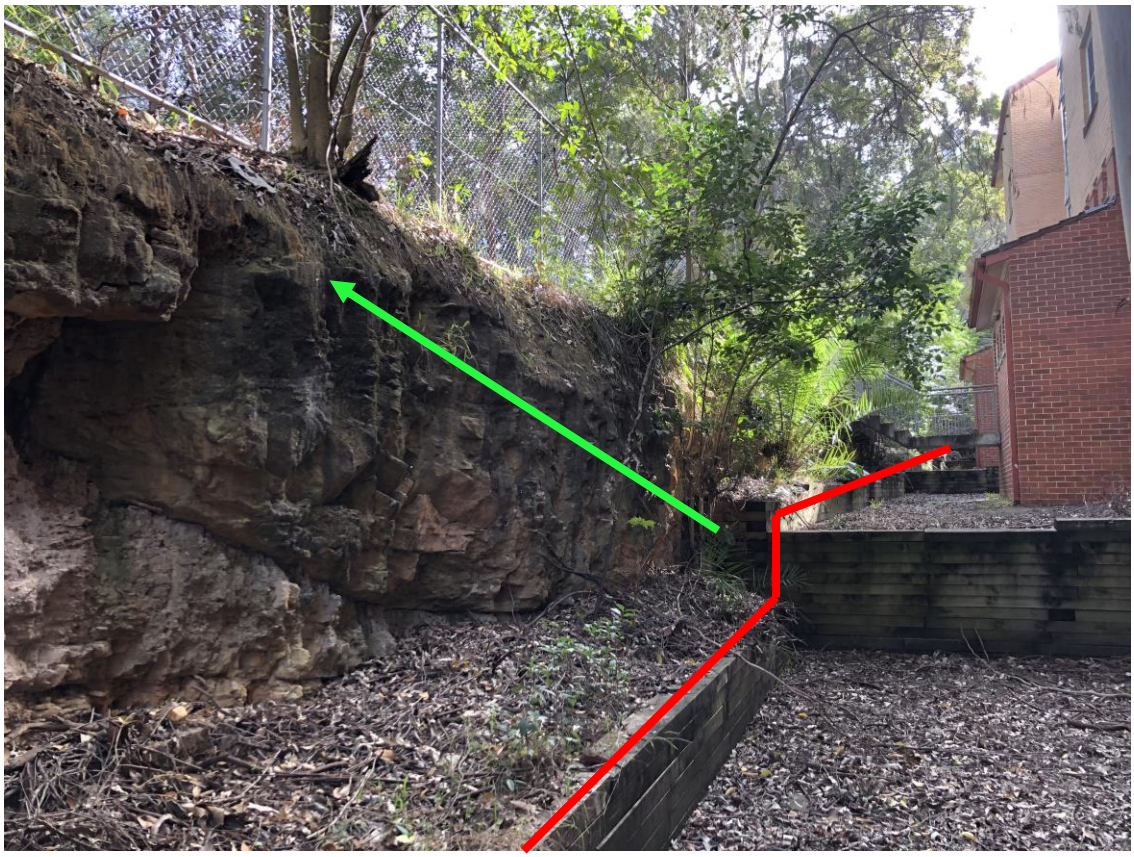
- Consultation with the site owner, NSW Land and Housing Corporation, to reduce the impacts of site demolition on areas of CEEC from 0.19 ha to 0.03 ha
- Removal of the proposed slip lane and vehicle entry off Epping Road from the project
- Retention of the existing retaining wall (and ancillary existing structures) where possible
- Redesign of the proposed built form of the development to occur only in areas of existing developed land.

When reviewing the figures presented in this report, it is pertinent to consider the following on-ground details when interpreting impact calculations:

1. The demolition footprint includes a 3m buffer around built forms to be removed. The actual impacts are likely to be less than those presented (for areas of native vegetation around the periphery). This is demonstrated along the northern boundary, where a significant amount of vegetation has been retained following demolition of adjacent buildings.
2. The development footprint includes a 2m buffer around the proposed earthworks. The actual impacts are likely to be less than those presented (for areas of native vegetation around the periphery). In particular, the interface of the proposed development against the CEEC boundary along Epping Road whereby there is likely to be minimal actual encroachment.
3. The retention of a retaining wall along the CEEC boundary will protect the occurrence of STIF onsite (Photograph 1).
4. Intermittently along the CEEC, alcoves are currently recessed into the landscape. Only two of these that occur at the CEEC interface will be removed.

In addition to the amended development plan, this report aims to clarify details within the original biodiversity assessment that were identified by agency submissions.

Photograph 1 Retaining wall to be retained (green arrow indicates retained vegetation)



Photograph 2 Retaining wall to be retained (green arrow indicates retained vegetation)

Photograph 3 Retaining wall (green arrow indicates retained vegetation) to be retained with weeds and planted Melia sp. in foreground

Photograph 4 Example image of alcove within the Ivanhoe Estate

1.3 Project description

1.3.1 Location

The suburb of Macquarie Park is located in the City of Ryde Local Government Area (LGA) in north-west Sydney. The Ivanhoe Estate (referred to in this report as "the development site") is located at the intersection of Epping Road, which forms the southern boundary, and Herring Road along the western boundary.

The Ivanhoe Estate is currently owned by the NSW Land and Housing Corporation (LAHC) and provides social housing for up to 259 residential dwellings. The site is approximately 8.95 ha in size and features double-storey units and a large patch of bushland along Epping Road. Shrimpton Creek is located along the eastern boundary and contains dense woody weeds and an example of remnant forest. Residential development forms the northern boundary. In the local vicinity, high-rise residential developments are in the process of construction and complement the commercial aspects of Macquarie Park, i.e. Macquarie Shopping Centre and Macquarie University.

1.3.2 Overview

LAHC has entered into arrangements to redevelop the site with the Aspire Consortium comprising development partners Frasers Property Australia and the community housing partner, Mission Australia Housing.

The Masterplan SSD DA will be a concept development application made pursuant to Section 83B of the Environmental Planning and Assessment Act 1979 (EP&A Act) that sets out the concept proposal for the Ivanhoe Estate. Specifically, the DA and will seek consent for:

- Allocation of uses across the site, including:
  - residential flat buildings comprising private, social and affordable housing
  - seniors house comprising residential care facilities and self-contained dwellings
  - a new school
  - child care centres
  - public open space and roads
  - minor retail development and
  - community uses
- Built form design principles and controls, including maximum building heights, and maximum gross floor areas (GFA) across the site, for each development block, and for specific uses
- Vehicular and pedestrian access arrangements
- Tree removal and
- Regeneration of RE1 zoned land along Shrimptons Creek.

Separate development applications will be lodged for the detailed design and construction of future stages of the development in accordance with the approved Masterplan SSD DA. The Masterplan SSD DA will be accompanied by a concurrent detailed DA for the first stage of development.

The Ivanhoe Estate Masterplan will provide for a mixed-use neighbourhood with buildings arranged to maximise residential amenity outcomes and a diverse open space network designed to create an inclusive community oriented public domain. The Concept Masterplan is shown at **Figure 1**.

The Masterplan concept is focussed on delivering an integrated community of private, affordable and social housing dwellings. In addition to this, the Masterplan also includes a range of other complimentary uses to support the future community, including seniors housing, a new school, retail and child care facilities.

The urban design framework that underpins the Masterplan will link the established bushland corridor with a series of high quality public open spaces. A new main street will be activated by community and retail uses, alongside a hard landscaped retail plaza, soft landscaped village green, amphitheatre, forest park and community hub. Shrimptons Creek will also be enhanced to provide a recreational and environmental green spine.

A key component of the Masterplan concept is establishing a street grid that allows connectivity through the site and to the surrounding areas for vehicles, pedestrians and cyclists. This includes a new crossing of Shrimptons Creek to connect to Lyonpark Road, creating new access points in the local road network.

1.3.3 Development site footprint identification

The development site has been largely selected as a re-development of the existing housing estate. Based on the indicative masterplan provided in **Figure 1**, the development site, including the construction and operational footprint, have been determined and are shown in the site map (**Figure 3**). The location map of the development site is shown in **Figure 4**. As part of the concept masterplan, there are two broad impact types that are likely to occur:

- *Direct impacts resulting from construction and operation of the Project*: The 'development site' as presented in Figure 2 and 3 includes the footprint of direct impacts of the proposal, being those unavoidable impacts to biodiversity through the removal of planted and remnant native vegetation.
- *Landscaping impacts within Shrimptons Creek*: The proposed redevelopment of the site also includes terracing and enhancement of the Shrimptons Creek riparian zone. This riparian zone is currently open recreation area with scattered trees, and includes exotic lawns, pathways with lighting, and a small skate park.

The site map (**Figure 3**) also includes a delineation between the 'development site' and the 'landscaping' areas. The future treatment of the site will involve enhancement works within the landscaping area, although the removal of native vegetation is to be minimised through ongoing design and negotiation. The likely impacts within this area may require the removal of trees due to ground disturbance from terracing, however the extent of works is not yet known. The proponent will aim to retain trees where possible.

Utilising the precautionary principle, ELA has included both the development site and landscaping areas with all impact assessment calculations (including within the BioBanking Credit Calculator; BBCC), acknowledging the level of uncertainty in the future use of the open space areas along Shrimptons Creek.

Other areas of native vegetation (in particular STIF which occurs along Epping Road) which are to be retained, have not been included within any calculators in the BBCC as they are scheduled to be retained and maintained onsite under a Vegetation Management Plan (VMP).

1.4 General description of the development site

1.4.1 Landform, geology & soils

Two soil landscapes have been mapped within the site. The upper section of the site falls within the Glenorie soil landscape group which is underlain by Wianamatta Group Ashfield Shale (Chapman and Murphy 1989). The soils have a distinct shale influence and generally occur on sloping terrain. The southern section of the site is located on Lucas Heights soil landscape which also exhibits shale influence within the soil profile. The soil landscape within the site is consistent with final determination for Sydney Turpentine – Ironbark Forest (STIF) which states that the STIF vegetation community is associated with Wianamatta Shale or Hawkesbury Sandstone with shale influence.

1.4.2 Vegetation

Native vegetation is confined to a narrow band between the existing development and Epping Road. The existing vegetation is highly impacted by indirect effects from proximity to residential development.

The canopy consists of: *Eucalyptus pilularis* (Blackbutt), *Eucalyptus resinifera* (Red Mahogany), *Eucalyptus saligna* (Sydney Blue Gum) and *Syncarpia glomulifera* (Turpentine). A tall mid-storey of *Allocasuarina torulosa* (Forest Oak) and *Pittosporum undulatum* (Native Daphne) is consistent throughout the vegetation patch. The northern section of native vegetation contained a small shrub layer including: *Bursaria spinosa* (Blackthorn), *Lissanthe strigosa* (Peach Heath) and *Hibbertia* sp. Native grasses *Themeda triandra* (Kangaroo Grass) and *Entolasia marginata* (Border Panic) are interspersed with native herbs *Dianella caerulea* (Blue Flax Lily), *Pseuderanthemum variabile* (Pastel Flower) and *Billardiera scandens* (Hairy Apple Berry). A variety of native sedges and ferns were also scattered throughout the site including *Lepidosperma laterale*, *Lomandra longifolia* (Spiny-headed Matt-rush) and *Pteridium esculentum* (Bracken).

Several planted species have also been recorded. These include planted species indigenous to the area, weeds and horticultural varieties. Eight weeds listed as noxious under the NSW *Noxious Weeds Act 1993* occur. Four weed species known to occur are also listed as Weeds of National Significance (WoNS).

1.4.3 Hydrology

The development site is currently extensively modified. All hydrological flows within the development site are managed via an existing stormwater system.

There is a natural creekline along the eastern boundary of the development site, Shrimptons Creek (**Figure 3**). This creek is classed as a second order stream, and is highly impacted by adjacent development. Shrimptons Creek flows northwards underneath a shopping centre, then continues for approximately 1.3 km where it meets the Lane Cove River.

Shrimptons Creek is currently in extremely poor condition and is subject to profuse rubbish dumping (including car seats, mattresses, numerous trolleys, plastic litter, and other household waste).

The riparian area of Shrimptons Creek is infested with weeds such as Lucidium sinense (Small-leaf Privet).

Photograph 5 Shrimptons Creek

1.4.4 Land uses

The development site is currently used as a public housing residential estate and includes dwellings and associated infrastructure. Within the eastern extent of the development site is a parkland area which includes benches, open space, and a skate bowl.

The majority of the development site is currently zoned B4 – Mixed Use under the Ryde Local Environment Plan (LEP) 2014. The parkland along the eastern boundary of the development site is zoned RE1 – Public Recreation under the LEP and the most eastern part of the site is zoned B7 – Business Park.

1.5 Data sources

1.5.1 Database review

The following databases were reviewed as part of this assessment:

- Atlas of NSW Wildlife (Bionet)
- Threatened Species Profile Database
- VIS Classification Database
- NSW Planning Portal
- EPBC Protected Matters Search Tool

1.5.2 Literature review

The following relevant ecological literature was reviewed during this assessment:

- Eco Logical Australia December 2014. *Revised Ivanhoe Estate Masterplan, Macquarie Park*. Prepared for UrbanGrowth NSW
- FBA (OEH 2014)
- Credit Calculator for Major Projects and BioBanking (OEH 2016)
- BioBanking Assessment Methodology and Credit Calculator Operational Manual (OEH 2016)
- NSW Biodiversity Offsets Policy for Major Projects (OEH 2014)

1.5.3 Aerial photography

Aerial imagery used in this assessment was taken from SIX Maps. The aerial was dated 2014.

2 Policies and legislation

2.1 New South Wales legislation

2.1.1 Environmental Planning and Assessment Act 1979

As part of an application for a Major Project under the EP&A Act, a proponent must prepare an Environmental Impact Statement (EIS). Before preparing an EIS, proponents must apply to the Secretary of the Department of Planning and Environment (DP&E) for the Secretary's Environmental Assessment Requirements (SEARs), which sets out matters to be addressed in the EIS.

2.1.2 NSW Biodiversity Offsets Policy for Major Projects

As the project is identified as a Major Project, under the NSW Biodiversity Offsets Policy for Major Projects, the SEARs require the proponent, unless otherwise specified, to apply the FBA to assess impacts on biodiversity. The FBA must be applied to identify reasonable measures and strategies that can be taken to avoid and minimise impacts to biodiversity. A BAR will describe the biodiversity values present on the development site and the impact of the Major Project on these values. If required, a BOS will outline how the proponent intends to offset the impacts of the Major Project. The BAR and BOS then form part of the EIS.

The SEARs may identify additional assessment requirements for biodiversity impacts not considered by the FBA, which must be documented separately within the EIS.

2.1.3 NSW *Biodiversity Conservation Act* 2016

In November 2016 the NSW parliament passed the NSW *Biodiversity Conservation Act 2016* (BC Act). This new legislation replaced the TSC Act on 25 August 2017.

However due to the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (described below), this project will be assessed under the previous biodiversity assessment requirements.

2.1.4 NSW *Threatened Species Conservation Act 1995*

The TSC Act aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The TSC Act is integrated with the EP&A Act and requires consideration of whether a development is likely to significantly affect threatened species, populations and ecological communities or their habitat.

The TSC Act has now been repealed, and all reference to threatened species, populations, or ecological communities has now transferred to the equivalent BC Act.

2.1.5 NSW Biodiversity Conservation (Savings and Transitional) Regulation 2017

In November 2016 the NSW parliament passed the NSW *Biodiversity Conservation Act 2016* (BC Act). This new legislation has now replaced the TSC Act. The BC Act commenced on 25 August 2017 along with the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. Under the provisions relating to biodiversity assessment and approvals under the EP&A Act, Part 7 of the regulation allows for pending or interim planning applications to be assessed under the former planning provisions rather than the new Biodiversity Conservation Act 2016. The regulation defines a '*pending or interim planning application*' as including:

> *"(d) an application for planning approval (or for the modification of a planning approval) made after the commencement of the new Act if an environmental impact statement is to be submitted in connection with the application and the Secretary of the Department of Planning and*

Environment determines in writing that the proponent had undertaken substantial environmental assessment in connection with the statement before the commencement of the new Act (but only if the application is made within 18 months after that determination)"

Biodiversity assessment of Ivanhoe Estate has been substantially commenced through inclusion of reference to the FBA within the SEARs.

2.2 Commonwealth legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Matters of National Environmental Significance (MNES) are protected. The FBA requires proponents to identify and assess the impacts on all nationally listed threatened species and threatened ecological communities that may be on the development site. Other MNES are not considered under the FBA.

One MNES has been identified within the development site, Turpentine Ironbark Forest of the Sydney Basin Bioregion.

2.2.2 Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy

This policy outlines the Australian Government's approach to the use of environmental offsets ('offsets') under the EPBC Act. It replaces the draft policy statement Use of environmental offsets under the EPBC Act (2007).

Offsets are defined as measures that compensate for the residual adverse impacts of an action on the environment. Where appropriate, offsets are considered during the assessment phase of an environmental impact assessment under the EPBC Act. This policy provides transparency around how the suitability of offsets is determined. The suitability of a proposed offset is considered as part of the decision as to whether or not to approve a proposed action under the EPBC Act.

2.2.3 Bilateral Assessment Agreement

Under the *Bilateral agreement made under section 45 of the EPBC act relating to environmental assessment* (the bilateral agreement; DotE 2015), a proposed action does not require assessment under Part 8 of the EPBC Act, if the action is to be assessed under Part 4 Division 4.1 or Part 5.1 of the EP&A Act, provided the assessment:

- Contains an assessment of all impacts the action has on each matter protected under the EPBC Act
- Contains enough information about the controlled action and its relevant impacts to allow the Commonwealth Minister to make an informed decision whether or not to approve the action
- Addresses all matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regs; DotE 2000)

The proposed action will be assessed via an EIS, which will involve several public consultation periods.

Stage 1 – Biodiversity Assessment

3 Landscape features

3.1 Landscape features

For all analysis of landscape features within this BAR, a 100 ha inner and 1000 ha outer assessment circle has been utilised.

3.1.1 Interim Biogeographic Regionalisation of Australia

Bioregions

The development site and outer assessment circle occur wholly within the Sydney Basin Bioregion.

The Sydney Basin Bioregion lies on the central east coast of NSW and covers an area of approximately 3,624,008 hectares. It occupies about 4.53% of NSW and is one of two bioregions contained wholly within the state. The bioregion extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. The bioregion is bordered to the north by the North Coast and Brigalow Belt South bioregions, to the south by the South East Corner Bioregion and to the west by the South Eastern Highlands and South Western Slopes bioregions. As well as Sydney itself, the Sydney Basin Bioregion encompasses the towns of Wollongong, Nowra, Newcastle, Cessnock, Muswellbrook and Blue Mountains towns such as Katoomba and Mt Victoria. It includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems, all of the smaller catchments of Lake Macquarie, Lake Illawarra, Hacking, Georges and Parramatta Rivers, and smaller portions of the headwaters of the Clyde and Macquarie Rivers.

Subregions

The development site is partially located within both the Cumberland and Pittwater IBRA sub-regions. The development site is more predominately situated within the Cumberland IBRA sub-region and as such this is the selected feature within the BBCC.

The Cumberland IBRA subregion is typified by the following characteristics:

- The geology is typified by Triassic Wianamatta groups shales and sandstone, a downwarped block on the coastal side of the Lapstone monocline, intruded by a small number of volcanic vents and partly covered by Tertiary river gravels and sands, and quaternary alluvium along the mains streams.
- The characteristic landforms include low rolling hills and wide valleys in a rain shadow area below the Blue Mountains, at least three terrace levels evident in the gravel splays, volcanics from low hills in the shale landscapes, and swamps and lagoons on the floodplain of the Nepean River.
- Typical soils include red and yellow texture contrast soils on slopes, becoming harsher and sometimes affected by salt in tributary valley floors, pedal uniform red to brown clays on volcanics, poor uniform stony soils, often with texture contrast profiles on older gravels, high quality loams on modern floodplain alluvium.
- Vegetation includes Grey Box, Forest Red Gum, Narrow-leaved Ironbark woodland with some Spotted Gum on the shale hills, Hard-leaved Scribbly gum, Rough-barked Apple and Old Man Banksia on alluvial sands and gravels, Broad-leaved Apple, Cabbage Gum and Forest Red Gum with abundant Swamp Oak on river flats and tall spike rush, and juncus with Parramatta Red Gum in lagoons and swamps.

The Pittwater IBRA subregion is typified by the following characteristics:

- The geology is typified by Triassic Hawkesbury Sandstone with thin ridge cappings of Ashfield Shale. Narrabeen sandstones are exposed in valleys and along the coast. Quaternary coastal sands also occur.
- The characteristic landforms on the Hornsby plateau includes quartz sandstone with occasional shale caps. Small beach, dune and lagoon barrier systems, as well as steep coastal cliffs and rock platforms also occurs.
- Soils are generally deep yellow earths or rocky outcrop on plateau tops, are uniform, and textures contrast soils on sandstones and shale slopes. Loamy sands occur in alluvium along creeks, clean quartz sands with moderate shell content on beaches and frontal dunes. Organic sands and muds occur in estuaries.
- Shale caps support tall forest of Sydney Blue Gum and Blackbutt or Turpentine and Grey Ironbark and on the sandstone plateau; Sydney Peppermint, Smooth-barked Apple, Scribbly Gum, Red Bloodwood, Yellow Bloodwood, with diverse shrubs and patches of heath. Blackbutt, Turpentine, Coachwood and water gum occur in deep sheltered gullies. Spotted Gum, Deane's Gum, Bangalow Palm, and Forest Oak occur on Narrabeen sandstone lower slopes. Banksia, tea-tree heath occurs on dunes. Bangalay, Swamp Mahogany, Cabbage Tree Palm, Swamp Oak, common reed and cumbungi occurs in fresh swamps. Mangrove and saltmarsh communities occur in quiet estuaries

3.1.2 Mitchell Landscapes

The outer assessment circle contains two Mitchell Landscapes; Pennant Hills Ridges, and Port Jackson Basin. The development site is predominately located within the Pennant Hills Ridges Mitchell Landscape.

Pennant Hills Ridges is characterised by:

- Rolling to moderately steep hills on horizontal Triassic shales and siltstones.
- General elevation 10 to 90 m, local relief 60 m.
- Deep red texture-contrast soils on narrow hillcrests, red and brown to yellow texture-contrast soils on slopes becoming slightly harsher in drainage lines.
- Tall open forest of *Eucalyptus saligna* (Sydney Blue Gum), *Syncarpia glomulifera* (Turpentine), *Eucalyptus pilularis* (Blackbutt), *Eucalyptus globoidea* (White Stringybark), *Eucalyptus paniculata* (Grey Ironbark), *Allocasuarina torulosa* (Forest Oak) and *Angophora floribunda* (Rough-barked Apple). Rainforest elements in protected moist gully heads with *Pittosporum undulatum* (Sweet Pittosporum), *Glochidion ferdinandi* (Cheese Tree), *Ficus coronata* (Sandpaper Fig) and *Callicoma serratifolia* (Black Wattle).

Port Jackson Basin Mitchell Landscape is characterised by:

- Deep elongated harbour with steep cliff margins on horizontal Triassic quartz sandstone, as well as small pocket beaches and more extensive Quaternary estuary fill of muddy sand at the head of most tributary streams.
- General elevation 0 to 80 m, local relief 10 to 50 m.
- Sandstone slopes and cliffs have patches of uniform or gradational sandy soil on narrow benches and within joint crevices that support forest and woodland of *Eucalyptus piperita* (Sydney Peppermint), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood) and *Eucalyptus pilularis* (Blackbutt). Sheltered gullies contain some *Syncarpia glomulifera* (Turpentine), *Ceratopetalum apetalum* (Coachwood) and *Tristaniopsis laurina* (Water Gum).

- Estuarine sands were originally dominated by saltmarsh but have been taken over by *Avicennia marina* (Grey Mangrove) in the past century.

3.1.3 Streams and rivers

Shrimpton Creek, and the Lane Cove River occur within the outer assessment circle and have been identified as a 2nd order and 5th order streams, respectively.

3.1.4 Wetlands

No wetlands are within the locality of the development site.

3.1.5 Native vegetation extent

Native vegetation within the outer assessment circle is confined to riparian corridor along Shrimpton Creek and into Lane Cover National Park. There is also a corridor of vegetation along Epping Road from the intersection of Herring Road east to Shrimptons creek.

Within the 1000 ha outer assessment circle native veg was mapped using the SIX Maps aerial imagery.

The layer was amended based on previous reporting and site inspections including:

- Site inspections in 2013 and 2014 by ELA staff as part of a constraints analysis.
- Site inspections on 27 June 2016 during surveying
- Site inspections in 2017 during additional surveying
- Aerial imagery (2019)

Native vegetation occupies approximately 221 ha within the outer assessment circle (22%), and is shown on **Figure 3**.

3.1.6 State or regionally significant biodiversity links

No state significant or regionally significant biodiversity links have been identified within a plan by the Chief Executive of the OEH. There are no 5th, or 6th order streams and no important or regionally significant wetlands within the development site.

The Lane Cove River occurs within the outer assessment circle and is identified as a 5th order stream using the Strahler Stream ordering system (Strahler 1952).

The development site occurs approximately 1.4 km from the Lane Cove River and as such will not impact on a regionally significant biodiversity link.

3.2 Landscape value score

3.2.1 Attributes

Percent Native Vegetation Cover

The current and future native vegetation cover was assessed in Geographic Information Systems (GIS) using increments of 5%. The project will result in the loss of 2.5 ha of native vegetation from the outer assessment circle.

Table 2: Current and Future Extent of Native Vegetation with the Inner and Outer Assessment Circles

Assessment Circle	Current Native Vegetation Extent			Future Native Vegetation Extent		
	Area (ha)	**% Cover**	**Category**	**Area (ha)**	**% Cover**	**Category**
Outer Assessment Circle	226	22.6	21 - 25	223.5	22.4	21 - 25
Inner Assessment Circle	19.45	19.45	16 - 20	16.52	16.52	16 - 20

Connectivity Value

Connectivity of the development site was assessed using Tables 11 – 14 in Appendix 4 of the FBA. The current and future connecting link widths and condition is shown in **Table 3** below.

Table 3: Current and Future Connecting Links with the Inner and Outer Assessment Circles

Connecting Link	Linkage Width			Linkage Condition			Connectivity Value
	Current	**Future**	**Classes Crossed**	**Current**	**Future**	**Classes Crossed**	**Score**
1	Narrow	Very Narrow	1	>50% of lower benchmark	>50% of lower benchmark	0	2

Patch Size

Patch size was calculated using available vegetation mapping. The patch size included all vegetation patches linked to the development site within the outer assessment circle. Patches within the development site were considered linked when the adjacent vegetation was:

- In moderate to good condition;
- Has a patch size of > 1 ha
- Is separated by a distance of < 100 m
- And is not separated by a large water body, dual carriageway, wider highway, or similar hostile link.

Based on the above criteria, patch size (6 ha) was considered to be small (<10 ha). The percent native vegetation cleared within the Pennant Hills Ridges Mitchell Landscape is 88%. Based on this information, the patch size score has been calculated to be 1.

3.2.2 Score

Based on the assessment of landscape attributes above, the Landscape Value Score has been calculated to be 3.

4 Native vegetation

4.1 Review of existing data

The following documents and databases were reviewed during assessment of native vegetation within the development site:

- VIS Classification Database
- SIX Maps – Vegetation Map Viewer
- Native vegetation of the Sydney Metropolitan Area map layer
- Previous surveys of the site by ELA staff

4.2 Surveys

Flora survey was undertaken within the development site on 27 June 2016 by a qualified, accredited assessor. Survey effort is shown in **Figure 4**. The assessment included obtaining an overview of the biodiversity values of the development site, as well as mapping of vegetation communities and floristic sampling. Areas of native vegetation were delineated using a handheld Global Positioning System (GPS). The assessment met the full requirements of the FBA including full floristic survey, as well as plot and transect survey within any PCTs identified within the development site.

In order to identify PCTs within the development site, plot based full floristic survey and plot and transect survey was undertaken within vegetation zones as identified in Table 1 of the FBA. Given the limited extent of existing vegetation within the development site, only five (5) full floristic plot, and plot and transect surveys were undertaken. Photographs and site notes were recorded.

The location of the surveys were chosen to occur within the approximate construction footprint of the proposal. The minimum number of plot and transect sites required, based on the condition and extent of each vegetation zone is shown in **Table 4**.

At the time of survey, the exact location of the development site was not known. As a result, plots were carried out within a contiguous patch of vegetation approximate to the development site location. As such, the location of the plots is outside of the development site, but given the lack of environmental variation within the vegetation patch, the approach is considered suitable for the purposes of the assessment.

At each survey site, the following information was collected:

- Site ID
- Name of recorder(s)
- Date
- Plot orientation, slope, and aspect
- Easting and Northing at either end of the 50 m transect
- Site photographs
- A plot-based full floristic survey and
- A plot and transect survey.

Table 4: Vegetation zone size and number of plots required

Vegetation Zone	PCT	Condition	Area within study area (ha)	Area to be removed	Minimum Plot and Transects Required	Number of Plot and Transects Completed
1	ME041	Moderate – Good	0.79	0.05	1	1
2	ME041	Low	1.24	1.1	1	1
3	ME58	Moderate – Good	0.29	0.23	1	2
4	ME58	Moderate – Good (poor)	1.08	0.86	1	1
	Cleared /exotic		5.54	--	0	0
Total			**8.95**	**2.24**	**4**	**5**

4.2.1 Plot-based full floristic survey

Within a 20 m x 20 m quadrat, the following data was collected at each plot-based full floristic survey site:

- **Species name**; Scientific name and common name
- **Cover**: an estimate of the appropriate cover measure for each recorded species: from 1-5 and then to the nearest 5%
- **Abundance**: A relative measure of the number of individuals or shoots of a species within the plot using the following intervals: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 50, 100, 500, 1000, or specify a number greater than 1000 if required
- **Form**: (T) Tree; (M) Mallee tree; (S) Shrub; (G) Tussock Grass (Poa/Themeda); (D) Sod grass (Couch/Kikuyu); (L) Vine/climber/scrambler; (V) Sedge (Cyperoid); (R) Rush (Restioid, Juncaceae); (F) Forb; (E) Fern; (P) Palm; (A) Cycad.

4.2.2 Plot and Transect Surveys

Within each plot and transect survey, the following information was collected:

- Within a 20 m x 20 m quadrat:
    - The number of native species present
- Along a 50 m transect every 5 m:
    - Native over-storey cover (%)
    - Native mid-storey cover (%)
    - Exotic over-storey cover (%) and
    - Exotic mid-storey cover (%)
- Along a 50 m transect every 1 m:
    - Native ground cover (grasses)
    - Native ground cover (shrubs)
    - Native ground cover (other) and
    - Exotic ground cover.

- Within a 50 m x 20 m quadrat:
    - Number of trees with hollows and
    - Total length of fallen logs > 10 cm width (m);
- Within whole vegetation zone:
    - All canopy species and
    - Proportion of regenerating canopy species.

4.2.3 Survey results

The results of full floristic plot and plot and transect surveys is shown in **Appendix A**.

4.3 Native vegetation extent

The study area is 8.95 ha in size which includes 3.41 ha of native vegetation as well as 5.54 ha of cleared land for infrastructure. Within the development site (the area of direct disturbance), there occurs 2.24 ha of native vegetation. The extent of native vegetation is shown on **Figure 5**. The extent of native vegetation was determined through aerial imagery, in conjunction with site assessments.

4.4 Identification of Plant Community Types

Identification of PCTs was determined by incorporating field data with available databases and mapping. PCTs within the development site were identified by incorporating the following hierarchy of factors in conjunction with site data:

- Occurrence of the PCT within the Sydney Metro IBRA subregion
- Vegetation formation
- Landscape position
- Dominant species

Two PCTs were identified within the development site:

- Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion.
- Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region

Both PCTs are heavily impacted by the current development of the site, and proximity to Epping Road. Vegetation along Epping Road has been allocated the condition 'moderate – good' due to the occurrence of canopy, mid-storey, and ground layer species indicative of each respective PCT. Vegetation within the existing development occurs as remnant trees interspersed with planted native and exotic flora. All vegetation within the existing development has been allocated the condition class 'moderate – good (poor)' as the understorey and mid-storey have been entirely removed.

Occurrences of exotic trees within the development are interspersed with native plantings, including species such as *Eucalyptus microcorys* (Tallowwood), *Eucalyptus robusta* (Swamp Mahogany), and *Lohpostemon confertus* (Brush Box), both of which are not likely to occur within the development site naturally. The canopy extent of these species has been included within the vegetation zones 'moderate – good (low)' for the purposes of the assessment, however patches of these species have not been included as part of any TEC mapping. Native flora within gardens and yards that are not canopy trees, have not been included within any vegetation zone. All exotic flora and cleared land has also been excluded from vegetation zone mapping.

Delineation of similar PCTs and vegetation zones was undertaken by reviewing soil characteristics within the development site. Soil was reviewed approximately every 10 m along a transect within the vegetation along Epping Road. Soil was inspected using methods modified from the *Australian Soil and Land Survey Field Handbook* (McDonald et. Al 1998). A bolus was formed using soil taken at a depth of 50 mm and assessed for plasticity and texture grade to determine the boundary between vegetation zones. Soils within the development site transition from west to east, from a shale cap on the top of the ridge, through exposed sandstone outcroppings along the slops, to enriched gully soils with high sand content along the eastern boundary. The delineation between vegetation zones was determined to occur at the base of the sandstone outcroppings, whereby sandy soils give way to enriched soils within the gully floor. The delineation identified within the vegetation corridor along Epping Road was extrapolated across the development site, as no remnant soil characteristics are present within the current development.

Following assessment of soil characteristics, landscape position, and vegetation surveys, the following criteria used to determine PCTs and vegetation zones within the development site as shown in **Table 5**.

Table 5: Selection Criteria for PCTs within the Development Site

PCT Code	PCT Name	Selection Criteria	Species Relied Upon for Assigning PCT
ME041 Moderate – Good	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	**IBRA Subregion:** Cumberland **Vegetation Formation:** Wet Sclerophyll Forests (Grassy sub-formation) **Landscape Position:** Occurs in moist sheltered gully heads on shale up to 500 m around the edge of the Cumberland Plain and in the lower Blue Mountains.	**Upper Stratum Species**: *Syncarpia glomulifera, Eucalyptus pilularis, Eucalyptus resinifera, Angophora costata* **Mid Stratum Species**: *Pittosporum undulatum, Acacia parramattensis, Allocasuarina torulosa, Leucopogon juniperina* **Ground Stratum Species**: *Lomandra longifolia, Microlaena stipoides*
ME041 Low	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	**IBRA Subregion:** Cumberland **Vegetation Formation:** Wet Sclerophyll Forests (Grassy sub-formation) **Landscape Position:** Occurs in moist sheltered gully heads on shale up to 500 m around the edge of the Cumberland Plain and in the lower Blue Mountains.	**Upper Stratum Species**: *Syncarpia glomulifera, Eucalyptus resinifera, Angophora costata* **Mid Stratum Species**: absent **Ground Stratum Species**: absent

PCT Code	PCT Name	Selection Criteria	Species Relied Upon for Assigning PCT
ME58 Moderate – good	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	**IBRA Subregion:** Cumberland **Vegetation Formation:** Wet Sclerophyll Forests (shrubby sub-formation) **Landscape Position:** Occurs on sheltered sandstone slopes and in gullies up to an altitude of 700 m.	**Upper Stratum Species**: *Syncarpia glomulifera , Angophora costata, Eucalyptus piperita* **Mid Stratum Species**: absent **Ground Stratum Species**: *Lomandra longifolia, Dianella caerulea*
ME58 Moderate – good (poor)	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	**IBRA Subregion:** Cumberland **Vegetation Formation:** Wet Sclerophyll Forests (shrubby sub-formation) **Landscape Position:** Occurs on sheltered sandstone slopes and in gullies up to an altitude of 700 m.	**Upper Stratum Species**: *Syncarpia glomulifera , Angophora costata, Eucalyptus piperita* **Mid Stratum Species**: absent **Ground Stratum Species**: absent

4.4.1 Threatened ecological communities

Sydney Turpentine - Ironbark Forest

Vegetation within the development site has been identified as a threatened ecological community (TEC) Sydney Turpentine – Ironbark Forest (STIF). STIF is characterised as an Open forest, with dominant canopy trees including *Syncarpia glomulifera* (Turpentine), *Eucalyptus punctata* (Grey Gum), *E. paniculata* (Grey Ironbark) and *E. eugenioides* (Thin-leaved Stringybark). In areas of high rainfall (over 1050 mm per annum) *E. saligna* is (Sydney Blue Gum) more dominant. The shrub stratum is usually sparse and may contain mesic species such as *Pittosporum undulatum* (Native Daphne) and *Polyscias sambucifolia* (Elderberry Panax). STIF occurs close to the shale/sandstone boundary on the more fertile shale influenced soils, in higher rainfall areas on the higher altitude margins of the Cumberland Plain, and on the shale ridge caps of sandstone plateaus. STIF typically occurs on areas with clay soils derived from Wianamatta Shale, or shale layers within Hawkesbury Sandstone.

Vegetation zones that are TECs

All moderate – good vegetation within ME041 has been identified as complying with the final determination for the TEC STIF. This vegetation community is also listed as Critically Endangered under the EPBC Act. An evaluation of ME041 against the EPBC Act criteria is shown in **Table 6**.

Table 6: Evaluation of ME041 against EPBC Act listing

Category	Threshold	ME041 Details
Patch size and canopy cover	Tree canopy cover >10% with patch area > 1ha or Tree canopy cover < 10% with patch area > 1ha and patch is located within native vegetation patch > 5ha	Tree canopy cover > 10% with patch size greater >1ha in 'moderate – good' vegetation only
Presence of structural layers	Must have canopy, mid-storey and ground cover layers present	Complete structural layers present in 'moderate – good' vegetation only

Occurrences of moderate-good (low) ME041 has not been determined to occur at the TEC within the vegetation zone. The Final Determination does identify remnant trees as conforming to the TEC listing for STIF, however, it is unlikely that any trees within the existing development are remnant.

Vegetation zones that are not TECs

PCT ME58 is not listed within the *VIS Classification Database* as conforming to a TEC. Exotic vegetation has also been excluded from any TEC mapping.

Summary of TECs within the development site

A summary of TECs within the development site is shown in **Table 7**.

Table 7: Threatened Ecological Communities identified within the development site

Vegetation Zone	PCT Name	Legislation	Threatened Ecological Community Name	Listing
1	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	BC Act	Sydney Turpentine-Ironbark Forest	Critically Endangered
		EPBC Act	Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered

Plate 1. ME041 Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (moderate/good condition) – BC Act CEEC, EPBC Act CEEC

Plate 2. ME041 Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion (low condition – planted vegetation)

Plate 3. ME58 Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region (moderate/good condition)

Plate 4. ME58 Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region (poor condition)

4.5 Vegetation zones

All vegetation within the development site was stratified into vegetation zones. As the development occurs within an area of disturbed vegetation, only four vegetation zones have been identified within the development site. A summary of vegetation zones occurring within the development site is shown in **Table 8**.

Table 8: Summary of Vegetation Zones within Development Site

Vegetation Zone	PCT	Condition	Area (ha)	Site Value Score
1	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	Moderate – Good	0.05	44.27
2	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	Low	1.10	11.46
3	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	Moderate – Good	0.23	32.64
4	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	Moderate – Good (poor)	0.86	19.79

5 Threatened species and populations

5.1 Review of existing data

The following resources were reviewed as part of the assessment of threatened species and populations:

- Atlas of NSW Wildlife (Bionet)
- Threatened Species Profile Database
- Eco Logical Australia December 2014. *Revised Ivanhoe Estate Masterplan, Macquarie Park*. Prepared for UrbanGrowth NSW

Information reviewed was incorporated into the assessment of candidate species.

5.2 Ecosystem credit species

The BBCC generates a list of predicted species known as 'ecosystem species'. These are threatened species that can be predicted at the site based on the habitat constraint criteria shown in **Table 9**.

Table 9: Ecosystem Species Constraints within Development Site

Habitat constraint	Development site
IBRA Subregion	Cumberland
Associated PCTs	ME041, ME58
Percent Native Vegetation within Outer Assessment Circle	21 – 25%
Condition of Vegetation	Moderate – Good
Patch Size	6 ha

For all vegetation zones within the development site, Black-chinned Honeyeater (eastern subspecies), Painted Honeyeater, Swift Parrot, and Varied Sittella were the ecosystem credit species with the lowest T_G value and these species only were included within the calculations. A complete list of all predicted ecosystem species is shown in **Table 10** below. No further assessment of ecosystem species was undertaken.

Table 10: Ecosystem Species Predicted within Development Site

Common Name	Species Name	T_G Value
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*	1.3
Bush Stone-curlew	*Burhinus grallarius*	2.6
Gang-gang Cockatoo	*Callocephalon fimbriatum*	2
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	1.8
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*	1.7
Little Eagle	*Hieraaetus morphnoides*	1.4

Common Name	Species Name	T_G Value
Little Lorikeet	*Glossopsitta pusilla*	1.8
New Holland Mouse	*Pseudomys novaehollandiae*	2.6
Painted Honeyeater	*Grantiella picta*	1.3
Speckled Warbler	*Chthonicola sagittata*	2.6
Swift Parrot	*Lathamus discolor*	1.3
Varied Sittella	*Daphoenositta chrysoptera*	1.3
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	2.2

5.3 Species credit species

Species credit species are threatened flora and fauna species that cannot be predicted by vegetation within the development site. The accredited assessor may determine that the habitat is unsuitable or too degraded for species credit species. These species do not require further assessment.

Species credit species that are likely to occur within the development site based on habitat assessment, must be surveyed to determine presence/absence, or an expert report provided.

5.3.1 Habitat present within development site

Habitat within the development site is highly modified due to the existing development and proximity to Epping Road. The mid-storey and ground layer of vegetation has been entirely removed across the majority of the site. Many large trees have been de-limbed due to safety concerns and there are limited hollow-bearing trees. There are no cliffs or caves, and no emergent aquatic vegetation. Bark and leaf litter accumulation is limited due to mowing, slashing, and garden maintenance typical of open space management.

A habitat assessment was undertaken within the site. The habitat assessment involved a traverse of the site identifying any:

- Hollow-bearing trees
- Rocks, caves, and culverts
- Wetlands
- Forests (natural and urban)
- Nests, roosts, eyries, or dreys.

The habitat assessment determined that the only fauna habitat present was hollow-bearing trees within the vegetation easement along Epping Road. The development site is predominately an urban environment with a mixture of exotic and native street trees.

Fauna habitat within the development site, including the location of hollow-bearing trees is shown on **Figure 8**.

5.3.2 Candidate species

A list of candidate species was generated by the BBCC and each species assessed for likelihood of occurrence within the development site. Candidate species are selected for each development site from the Threatened Species Profile Database based on the following criteria:

- The species is identified as a species credit species
- The geographic distribution of the species is known or predicted to include the IBRA subregion in which the development site is located
- The development site contains habitat features or components associated with the species
- Or previous surveys undertaken within the development site have identified the species is present

A complete assessment of the likelihood of species credit species is provided within **Table 11**. Based on the likelihood of occurrence of each species, the following candidate species were selected for further assessment: *Epacris purpurascens* subsp. *purpurascens, Pimelea curviflora* subsp. *curviflora*, and *Tetratheca glandulosa*.

Special consideration has been given to *Melaleuca deanei* (Deane's Wattle) which has been identified by the NSW Department of Planning, Industry, and Environment as potentially occurring within the development site. This species was not predicted to occur using the BBCC based on the PCTs present, IBRA subregion, or connectivity or adjacent areas. Despite this consideration has been given to the species, which has been recorded within the locality. This species was erroneously listed in the flora list in the original BAR for this development. This species was not identified on site during surveys, and does not occur within the development site.

5.3.3 Surveys

Surveys were undertaken to determine the presence of species requiring further assessment on 27 June and 28 July 2016. A subsequent site inspection was undertaken on 8 September 2017.

Surveys involved parallel meanders within suitable habitat for each species, namely patches of moderate – good vegetation along Epping Road.

Surveys were conducted at the correct time of year for each species and included a 1 hour survey by two ecologists on two separate occasions (total survey time 4 hours). No threatened species were identified during surveys across the development site.

As such no further assessment of species credit species is required.

Table 11: Likelihood of Occurrence of Species Credit Species

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Acacia prominens – endangered population	Acacia prominens (Gosford wattle) population, Hurstville and Kogarah local government areas	Grows mainly in wet sclerophyll forest and margins of rainforest, usually in moist, protected areas in loamy and clayey soils.	Yes	No, the listed population only occurs within the Hurstville and Kogarah LGAs
Acacia pubescens	Downy Wattle	Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone.	No	No, there are no gravelly soils or ironstone within the development site. The best quality vegetation within the site is dominated by a mid-storey matrix of *Lantana camara* and *Ligustrum sinense*, and is subject to extensive litter and trampling impacts from the neighbouring roadway and development site. Notwithstanding this assessment of condition, surveys have been conducted throughout the vegetation onsite and confirmed that this species does not occur within the site.

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Anthochaera phrygia	Regent Honeyeater	The Regent Honeyeater is a generalist forager, although it feeds mainly on the nectar from a relatively small number of eucalypts that produce high volumes of nectar. Key eucalypt species include Mugga Ironbark, Yellow Box, White Box and Swamp Mahogany. Other tree species may be regionally important. When nectar is scarce lerp and honeydew can comprise a large proportion of the diet. Insects make up about 15% of the total diet and are important components of the diet of nestlings.	No	No, the majority of eucalypt species within the development site are not known feed species. Occasional E. punctate are present, however it is unlikely to provide a forage resource for the species.
Caladenia tessellata	Thick Lip Spider Orchid	Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil.	No	No, the habitat is too degraded and modified for the species
Callocephalon fimbriatum population in the Hornsby and Ku-ring-gai Local Government Areas	Gang-gang Cockatoo population, Hornsby and Ku-ring-gai Local Government Areas	Occurs within a variety of forest and woodland types. Usually frequents forested areas with old growth attributes required for nesting and roosting purposes.	Yes	No, the endangered population only occurs within Hornsby and Ku-ring-gai LGAs
Camarophyllopsis kearneyi	Camarophyllopsis kearneyi	Gregarious to caespitose on soil or deep humus or amongst moss in very sheltered parts of cool temperate rainforest	No	No
Cercartetus nanus	Eastern Pygmy-possum	As per veg types and with an understorey with heath, banksias or myrtaceous shrubs including Leptospermum spp.	No	No, the vegetation is too degraded and there is a lack of both nesting sites and foraging habitat

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Epacris purpurascens subsp. *purpurascens*		Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts.	Yes	Yes
Grammitis stenophylla	Narrow-leaf Finger Fern	Occurs in eastern Queensland and eastern NSW. In NSW it has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabri. Grows in moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest.	No	No
Gyrostemon thesioides		Grows on hillsides and riverbanks and may be restricted to fine sandy soils.	No	No, the site is too degraded for the species and the soil types are not compliant for the species
Hibbertia puberula		Wide array of habitats, usually low heath, on sandy soil or rarely in clay, with or without rocks underneath.	No	No, there is no low heath within the development site
Hygrocybe anomala subsp. ianthinomarginata	Hygrocybe anomala subsp. ianthinomarginata	Occurs in gallery warm temperate forests dominated by Acmena smithii, Backhousia myrtifolia, Glochidion ferdinandi and Pittosporum undulatum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Subsrates include soil, humus, or moss	No	No

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Hygrocybe austropratensis	Hygrocybe austropratensis	Occurs in gallery warm temperate forests dominated by Acmena smithii, Backhousia myrtifolia, Glochidion ferdinandi and Pittosporum undulatum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Subsrates include soil, humus, or moss	No	No
Hygrocybe collucera	Hygrocybe collucera	Occurs in gallery warm temperate forests dominated by Acmena smithii, Backhousia myrtifolia, Glochidion ferdinandi and Pittosporum undulatum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Subsrates include soil, humus, or moss	No	No
Hygrocybe lanecovensis	Hygrocybe lanecovensis	Occurs in gallery warm temperate forests dominated by Acmena smithii, Backhousia myrtifolia, Glochidion ferdinandi and Pittosporum undulatum. Associated with alluvial sandy soils of the Hawkesbury Soil Landscapes with naturally low fertility and erodible. Subsrates include soil, humus, or moss	No	No

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Hygrocybe rubronivea		Occurs in gallery warm temperate forests dominated by *Acmena smithii* (Lilly Pilly), *Backhousia myrtifolia* (Grey Myrtle), *Glochidion ferdinandi* (Cheese Tree), and *Pittosporum undulatum* (Sweet Pittosporum). Associated with alluvial sandy soils of the Hawesbury Soil Landscapes. Associated with alluvial sandy soils of the Hawesbury Soil Landscapes	No	No, there are no rainforests within the development site
Melaleuca deanei	Deane's Paperbark	Occurs in ridgetop woodland.	No	No, the majority of mid-storey species within the study area are *L. lucidium* and *Lantana camara*. Potential habitat within remnant vegetation is significantly degraded, and will be retained under the current development plan.
Meridolum corneovirens	Cumberland Plain Land Snail	Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish	No	No, the development site is beyond the known extent of the distribution of the species, and habitats are too degraded via parkland management
Petaurus norfolcensis	Squirrel Glider	Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	No	No, there are no old growth box – ironbark woodlands within the development site. The existing hollows within the development site are >300mm in diameter and unsuitable for the species
Phascolarctos cinereus	Koala	As per Koala Food Tree Species listed in Appendix 2 of the NSW State Koala Recovery Plan (DECC 2008)	No	No, there are limited feed trees within the development site

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Pimelea curviflora subsp. *curviflora*		Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.	Yes	Yes
Pomaderris prunifolia – endangered population	Plum-leaf Pomaderris population, Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	Shale to sandstone, woodland habitats, often in gully lines or near smaller water courses.	Yes	No, the endangered population only occurs within the Parramatta, Auburn, Strathfield and Bankstown LGAs
Pterostylis saxicola	Sydney Plains Greenhood	Small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines, adjacent to sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.	No	No
Syzygium paniculatum	Magenta Lilly Pilly	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	No	No, there are no grey soils over sandstone, and there are no remnant stands of littoral rainforest. The best quality vegetation within the site is dominated by a mid-storey matrix of *Lantana camara* and *Ligustrum sinense*, and is subject to extensive litter and trampling impacts from the neighbouring roadway and development site. Notwithstanding this assessment of condition, surveys have been conducted throughout the vegetation onsite and confirmed that this species does not occur within the site.

Scientific name	Common name	Habitat requirement	Habitat present within development site	Species requires further assessment?
Tetratheca glandulosa		Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops.	Yes	Yes

Stage 2 – Impact Assessment

6 Measures to avoid and minimise impacts

6.1 Avoidance of impacts

6.1.1 Avoidance of direct impacts

Under the FBA the proponent must design the project to minimise impacts to biodiversity. Specifically, the FBA requires proponents to identify and avoid direct impacts to:

- Threatened Ecological Communities
- PCTs that contain threatened species habitat
- Threatened species that cannot be predicted by vegetation type
- Declared critical habitat
- Regional and state significant biodiversity links

A summary of the impact avoidance methods of the project are provided below.

Table 12: Avoidance of Direct Impacts

Direct Impact to be Avoided	Method to Avoid Impact
Impacts to Endangered Ecological Communities (EECs) and Critically Endangered Ecological Communities (CEECs)	The development site is located so as to minimise impacts upon CEECs identified. Impacts to CEECs have been minimised by locating the proposed development on land that is currently developed. The CEECs that will be impacted by the proposal are currently situated within an existing residential development or within an easement between residential development and a major arterial roadway.
Impacts to PCTs that contain threatened species habitat	All PCTs within the development site are identified as potential foraging habitat for highly mobile fauna species. There are limited hollow-bearing trees, no caves, and no rocky outcrops. The vegetation within the development site will be intermittently used by mobile fauna species, however will not be used as breeding or refuge habitat for threatened species.
Impacts to areas that contain habitat for Vulnerable, Endangered, or Critically Endangered threatened species or populations in accordance with Step 5 in Section 6.5 of the FBA	No threatened species have been identified within the development site and as such no species polygons and threatened species habitat has been identified within the development site.
Impacts to areas of land that the Minister for Environment has declared as critical habitat in accordance with s47 of the TSC Act	Critical habitat has not been identified within the development site.
Impacts to riparian areas of 4th order or higher streams and rivers, important wetlands and estuaries	The development site will not impact on riparian areas of rivers, wetlands, estuaries, or 4th order (or higher) streams

Direct Impact to be Avoided	Method to Avoid Impact
Impacts to state significant biodiversity links	No state significant biodiversity links have been identified within the development site

6.1.2 Site selection

Site selection was undertaken considering the extent of known biodiversity values, as well as the extent of current disturbance within the development site. A summary of considerations during the selection of the development site is shown in **Table 13**.

Table 13: Avoidance and minimisation of direct impacts through site selection

Site selection criteria	Method to avoid impact
Selecting a suitable development site for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species	A desktop and constraints analysis was conducted within the development site in 2015 to determine the areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species. Site inspections were accompanied by desktop assessments. Desktop assessment included: • Atlas of NSW Wildlife (Bionet) • Protected Matters Search Tool (PMST)
Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase.	Biodiversity values were identified within the development site by ELA (2015) identifying areas of key biodiversity significance within a constraints analysis. This constraints analysis was reviewed when planning the development footprint. The footprint has undergone several iterations, with the final footprint retaining as much EEC as possible.
The site/route selection process should include consideration and analysis of the biodiversity constraints of the proposed development site and consider the suitability of the Major Project based on the types of biodiversity values present on the development site	As identified above, a constraints analysis was conducted to determine areas of biodiversity constraints by ELA in 2015. The current masterplan reflects the retention, where possible, of existing biodiversity within the development site. Redesign of the project in 2019 has reduced all impacts to CEECs to as little as possible.

Site selection criteria	Method to avoid impact
When considering and analysing the biodiversity constraints for the purpose of selecting a development site, the following matters should be addressed: (a) whether there are alternative sites within the property on which the proposed development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values (b) how the development site can be selected to avoid and minimise impacts on biodiversity values as far as practicable I whether an alternative development site to the proposed development site, which would avoid adversely impacting on biodiversity values, might be feasible.	Given the nature of the proposed development, the site is largely situated within the existing development. Alternative locations were not considered during the site selection process. Given the nature of the existing uses within the development site, selection of an alternate site would not avoid any adverse impacts on biodiversity.
For linear projects, the route selection process must include consideration and an analysis of the biodiversity constraints of the various route options. In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits.	The proposal is not a linear project

6.1.3 Planning

Planning was considered during the selection of the development site. A summary of criteria utilised is shown in **Table 14**.

Table 14: Avoidance and Minimisation of Direct Impacts through Planning

Planning criteria	Method to avoid impact
Siting of the project – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC	The siting of the project is largely within the existing development.
Minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised, and/or in areas where other impacts to biodiversity will be the lowest	The project is located primarily within the existing development footprint to minimise vegetation clearing. Some impacts to vegetation will be required during construction, however some biodiversity values can be retained in open space areas.

Planning criteria	Method to avoid impact
Loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps	Connectivity within the development site will be reduced as part of the project from narrow to very narrow. The biodiversity corridor that currently exists is already highly modified and will be mostly retained within open space areas.

6.2 Measures to minimise impacts

The proponent will implement measures to minimise the impacts of the projects during both the construction and operational phase. A Biodiversity Management Plan (BMP) and Construction Environment Management Plan (CEMP) will be drafted for the site following approval of the project, which will aim to put in place mechanisms for reduction of impacts. The BMP will address impacts to flora and fauna such as delineation of clearing boundaries and minimising harm to fauna, whereas the CEMP will minimise other environmental impacts such as sediment control, dust, noise, lighting, and protection of waterways. The BMP will include operational measures to reduce impacts of the project such as:

- Pre-clearance surveys and clearance supervision
- Replanting and vegetation management
- Weeding and ongoing measures

Details of measures to minimise impacts during the construction and operational phase are described below.

6.2.1 Measures to minimise impacts during construction phase

Several considerations were given to minimising impacts to biodiversity during the construction phase of the project. These are detailed below in **Table 15**.

Table 15: Minimisation of impacts through during the construction phase

Matter considered to minimise impacts	Adopted matters within development site
Method of clearing – using a method of clearing during the construction phase that avoids damage to retained native vegetation and reduces soil disturbance. For example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations where partial clearing is proposed	Vegetation that is to be removed adjacent to retained vegetation will be removed using chain-saw rather than heavy machinery to avoid any additional impacts of the project.

Matter considered to minimise impacts	Adopted matters within development site
Clearing operations – minimising direct harm to native fauna during actual construction operations through onsite measures such as undertaking pre-clearing surveys, daily fauna surveys and the presence of a trained ecologist during clearing events	Clearing of vegetation will be undertaken via a two stage clearing process. Clearing will not be undertaken until a pre-clearance assessment is conducted and the results communicated by qualified ecologists. Ecologists will be present for all vegetation clearing. Stage 1 of the clearing process involved marking of habitat features, and removal of all vegetation except habitat features. Stage 2 involved removal of habitat features under the supervision of ecologists to relocate resident fauna. A detailed methodology of the two stage clearing process will be included within the BMP. All clearing staff will be briefed about the two stage clearing process, and their responsibilities to minimise impacts to biodiversity.
Timing of construction – identifying reasonable measures that minimise the impacts on biodiversity. For example, timing construction activities for when migratory species are absent from the site, or when particular species known to or likely to use the habitat on the site are not breeding or nesting, can minimise the impacts of construction activities on biodiversity	Timing of construction will not mitigate any impacts to biodiversity. The development site is occupied by limited fauna species and as such there is no specific timing constraints of the project.
Other measures that minimise inadvertent impacts of the Major Project on the biodiversity values – measures such as installing temporary fencing to protect significant environmental features such as riparian zones, promoting the hygiene of construction vehicles to minimise spread of weeds or pathogens, appropriately training and inducting project staff and contractors so that they can implement all measures that minimise inadvertent adverse impacts of the Major Project on biodiversity values.	Other measures to minimise the impacts of the project on biodiversity will be detailed within the CEMP. These measures will include at a minimum: • Temporary fencing to delineate clearing boundaries • Marking of trees for retention within open space areas • Cleaning of mobile plant prior to works to prevent the spread of weeds and pathogens • Sediment controls along Shrimptons Creek to prevent impacts downstream • Signage within the works area to advise contractors of responsibilities

6.2.2 Minimising indirect impacts during construction

In addition to the controls identified above the following management actions will be undertaken to minimise indirect impacts during construction as shown in **Table 16**.

Table 16: Minimisation of indirect impacts

Indirect impact	Method to avoid indirect impact
Sedimentation and run-off – sediment barriers or sedimentation ponds to minimise impacts of the Major Project on biodiversity values on land that is adjoining the development site, and waterways downstream of the development site	Installation of sediment barriers, sediment ponds, stormwater management systems, delineation of works zones
Noise, dust or light spill – adopting onsite measures that can minimise the impacts on biodiversity values from noise, dust or light spill during the construction phase. For example, only undertake construction during daylight hours to avoid impacts from light spill where this may be detrimental to species habitat on adjoining lands	Construction works are to occur during daylight hours only
Inadvertent impacts on adjacent habitat or vegetation – considering measures such as retaining vegetation on the development site as a buffer to protect significant environmental features (e.g. riparian zones, likely or known threatened species habitat)	Temporary fencing to be installed prior to works, to delineate boundaries and protect retained vegetation
Feral pest, weed and/or pathogen encroachment into vegetation on land adjoining the development site – one example is using protocols for hygiene that minimise the likelihood of construction vehicles spreading weeds or pathogens from the development site into native vegetation on land adjoining the development site	A weed management plan will be included within the BMP for the development site which will include cleaning and inspection of light vehicles and mobile plant
Impacts that are infrequent, cumulative or difficult to measure – where there are likely to be indirect impacts on biodiversity that are infrequent, cumulative or difficult to measure over time, consideration should be given to how an operational monitoring program can be used to assess the timing and/or extent of these impacts. A proposal for an operational monitoring program should be set out in the BAR. Development of a monitoring program may involve determining the base-line information that will be necessary to measure the impact over time. It should also consider how the results of the monitoring program could be used to inform ongoing operations in order to reduce the extent of indirect impacts	A monitoring program will be drafted within the BMP to measure infrequent and cumulative impacts of the project. The monitoring program will include baseline data capture to measure any effects of the project over time.

Indirect impact	Method to avoid indirect impact
Impacts during the operational phase – measures to avoid or minimise the indirect impacts on threatened species and threatened species habitat on land adjoining the development site, migratory species or flight pathways as a result of the operation of the development. Such measures may include those adopted to avoid and minimise: (i) trampling of threatened flora species (ii) rubbish dumping (iii) noise (iv) light spill (v) weed encroachment (vi) nutrient run-off (vii) increased risk of fire, and (viii) pest animals.	There are no threatened flora species within the development site Fences will be placed around key biodiversity areas to prevent rubbish dumping. Appropriate security measures will also be in place to reduce illegal dumping Post construction, noise impacts are unlikely to be increased from the current levels experienced by the development site and adjacent land Light spill will be managed by directing street lighting away from retained vegetation Weed encroachment, and nutrient run off will be managed by a weed management plan within the BMP, and sediment and stormwater controls within the CEMP

6.2.3 Measures to minimise impacts during operational phase

Table 17: Minimisation of impacts through during the operational phase

Operational phase impact	Method to avoid impact
Seasonal impacts – whether there are likely to be any impacts that occur during specific seasons. Minimisation measures may include amending operational times to minimise impacts on biodiversity during periods when seasonal events such as breeding or species migration occur	There are unlikely to be any additional seasonal impacts during operation of the residential development
Artificial habitats – using 'artificial habitats' for fauna where they may be effective in minimising impacts on such fauna. These include nest boxes, glider-crossings or habitat bridges.	Nest boxes can be installed to minimise impacts to arboreal mammals. One hollow bearing tree has the potential to be impacted. It is recommended to replace all removed hollows with artificial nest boxes at a ratio of 1:4 (removed:replaced). Nest boxes are to be installed within retained vegetation in Shrimptons Creek.

7 Matters for further consideration

Certain impacts on biodiversity values will require further consideration by the consent authority. These are impacts that are considered to be complicated or severe. A decision will be made by the consent authority on whether it is appropriate for these impacts to occur. The consent authority may determine:

- The Major project cannot be approved with that particular impact
- Modifications are required to the Major Project to reduce the severity of the impact
- The major Project can be approved but it will require additional offsets, supplementary measures or other actions to be undertaken with respect to that impact.

In accordance with Section 9.2 of the FBA, impacts on biodiversity values that require further consideration are:

- Impacts on landscape features, being:
  - impacts that will reduce the width of vegetation in the riparian buffer zone bordering significant streams and rivers, important wetlands or estuarine areas in accordance with Subsection 9.2.3, or
  - impacts that will prevent species movement along corridors that have been identified as providing significant biodiversity linkages across the state in accordance with Subsection 9.2.3, and
- Impacts on native vegetation that are likely to cause the extinction of an EEC/CEEC from an IBRA subregion or significantly reduce its viability in accordance with Subsection 9.2.4, and
- Impacts on critical habitat or on threatened species or populations that are likely to cause the extinction of a species or population from an IBRA subregion or significantly reduce its viability in accordance with Subsection 9.2.5.

Within the development site, Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion occurs. This ecological community is listed under the BC Act as an Critically Endangered Ecological Community, and under the EPBC Act as a Critically Endangered Ecological Community. As such any impacts on this community require further consideration by the consent authority as an ecological community is considered a CEEC if it is specified in Part 2 of Schedule 1A of the TSC Act and/or listed under Part 13, Division 1, Subdivision A of the EPBC Act. All further reference to the ecological community within this chapter is as a CEEC.

There are no other matters for further consideration within the development site.

7.1 Impacts on native vegetation

Impacts on native vegetation that require further consideration include impacts on:

- (a) any CEEC, unless the CEEC is specifically excluded by the SEARs
- (b) an EEC specifically nominated in the SEARs as an EEC that is likely to become extinct or have its viability significantly reduced in the IBRA subregion if it is impacted on by development.

An assessment of impacts to (C)EEC's that occur within the development site is shown below.

Table 18 Further consideration of impacts to CEECs within the development site

Matter for further consideration	Assessment of impacts
the area and condition of the CEEC or EEC to be impacted directly and indirectly by the proposed development	The project will remove approximately 0.05 ha of the CEEC.
the extent and overall condition of the CEEC or EEC within an area of 1000 ha and then 10,000 ha surrounding the proposed development footprint.	Extent and condition of the CEEC was determined using spatial data associated with the Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area (SM-CMA mapping). The condition of the CEEC within this area is considered to be in moderate – good condition. Within a 1,000 ha area surrounding the development site, there is approximately 14 ha of the CEEC. Within a 10,000 ha area surrounding the development site, there is approximately 331 ha of the CEEC.
an estimate of the extant area and overall condition of the CEEC or EEC remaining in the IBRA subregion after the impact of the proposed development has been taken into consideration	There is approximately 701 ha of the CEEC in the Cumberland IBRA sub-region. After removal of the 0.05 ha there would be approximately 700.95 ha.
the development proposal's impact on: • abiotic factors critical to the long-term survival of the CEEC or EEC. For example, will the impact lead to a reduction of groundwater levels or substantial alteration of surface water patterns? • characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants • the quality and integrity of an occurrence of the CEEC or EEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the CEEC or EEC.	The CEEC currently occurs immediately adjacent to a five lane roadway, and an existing residential development. The proposed development is downslopt of the CEEC and therefore the development will not alter surface water flows or groundwater. The proposed development will however increase shading of the CEEC. Outside of the direct footprint of the project, there is no proposal to alter functionally important canopy, mid-storey, or ground layer species. The occurrence of the CEEC is currently disturbed by residential housing, and the proposed development is unlikely to exacerbate this. The proposed development is for high rise buildings, and so there is unlikely to be an increased mobilisation of chemicals, fertilisers or other pollutants beyond what is currently experienced by the CEEC.
direct or indirect fragmentation and isolation of an important area of the CEEC or EEC.	The area of CEEC to be impacted is not identified in any recovery plan for the community, and the extent of the CEEC is relatively small compared to other remnant areas of the community.
the measures proposed to contribute to the recovery of the CEEC or EEC in the IBRA subregion.	The proposal will provide for management of retained areas of the CEEC under a BMP. The proposal will also

Matter for further consideration	Assessment of impacts
	provide for biodiversity offsets in accordance with the rules of the FBA.

8 Assessment and offsetting requirement for unavoidable impacts

8.1 Introduction

The project will involve impacts to native vegetation and fauna habitat throughout the entire extent of the development site. A summary of direct impacts is provided below.

8.2 Impacts resulting from changes to shading on native vegetation

Consideration has been given to the potential for impacts to retained native vegetation that may result from a changed shading regime. The current occurrence of the CEEC within the study area is shaded by the existing social housing development. The site is broadly orientated on a north-west to south-east axis, with the current extent of the CEEC shaded in the mornings by the existing development, and in sunlight in the afternoon.

The future development will involve high-rise buildings with spacing as shown in **Figure 1**. The final built form of the development will provide an indicative shading regime as shown in **Appendix B**.

The shading plans (BatesSmart, 2019) identified the likely shade profile of the proposed development at the summer, winter, and spring equinox. The shading plans visually identified that:

- In spring, the retained native vegetation will be temporarily, and partially shaded for up to 2 hours
- In summer, the retained vegetation will be temporarily, and partially shaded for up to 2 hours
- In winter, the retained vegetation will be partially shaded until 2pm each day.
- Gaps between the buildings will provide sunlight to portions of the CEEC during all seasons

Based on consideration of the shading diagrams, it is unlikely that the shade profile of the proposed development would change the integrity of the retained native vegetation, such that a measurable loss is evident. As such no additional loss has been calculated for this area of vegetation.

8.3 Impacts to fauna habitat

The proposed development will remove up to 2.24 ha of native vegetation, of which 1.33 ha is planted street vegetation. The latest development plan has potential to impact on one of the seven hollow-bearing trees that occur within the study area (**Figure 8**). This potential impact occurs immediately on the boundary of the proposed development and so there may be opportunities to retain this tree during the construction phase of the project (acknowledging the development site boundary shown includes a construction buffer). A pre-clearance survey should be undertaken for this tree to determine if any fauna species occupy this tree prior to felling (if required). All other hollow-bearing trees will be retained.

8.4 Direct loss of native vegetation

The proposal will unavoidably impact up to 2.24 ha of native vegetation, which includes vegetation communities listed under the TSC Act and EPBC Act. A summary of the areas to be directly impacted by the proposal is shown in **Table 19**. The summary below identifies the area of impact for both the demolition of the site (not part of this application), as well as the construction impacts and total impacts of the redevelopment.

Table 19: Direct loss of native vegetation

Vegetation zone	PCT name	BC Act	EPBC Act	Area to be removed (Demolition)	Area to be removed (Construction)	Landscaping (Precautionary estimate)	Total to be removed (ha)	Retained	**Total**
ME041 Moderate – Good	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	CEEC	CEEC	0.03	0.02	0.00	0.05	0.74	**0.79**
ME041 Moderate – Good (poor)	Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion			0.55	0.55	0.00	1.10	0.14	**1.24**
ME58 Moderate – good	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region			0.03	0.01	0.19	0.23	0.05	**0.28**
ME58 Moderate – good (poor)	Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region			0.09	0.38	0.39	0.86	0.13	**0.99**
Total				**0.70**	**0.96**	**0.58**	**2.24**	**1.06**	**3.30**

This assessment is required to identify all impacts and classify them under the following criteria:

- Impacts that the assessor is required to identify for further consideration by the consent authority
- impacts for which the assessor is required to determine an offset
- impacts for which the assessor is not required to determine an offset
- impacts that do not require further assessment by the assessor

A summary of the guidelines for these is provided in Table 4 of the FBA. A description of the impacts requiring offsetting as part of the project are shown in **Table 20**.

Table 20: Impact thresholds for landscape features, native vegetation, and threatened species and populations

Indirect impact	Present within the development site
Impacts that Require further consideration by consent authority	None identified within the SEARs. One PCT is identified as a CEEC under the EPBC Act.
Impacts for which the assessor is required to determine an offset	Impacts to EECs that are not specifically nominated as requiring further consideration within the SEARs: All ME041 Impacts to PCTs that are threatened species habitat and a site score ≥17: All ME041 and ME58
Impacts for which the assessor is not required to determine an offset	Impacts on PCTs that have a site score <17, or Impacts to PCTs that are not identified as CEECs/EECs
Impacts that do not require further assessment by the assessor	All cleared areas within the development site

8.5 Impacts requiring offsetting

8.5.1 Native vegetation

Up to 1.68 ha of native vegetation requiring offsetting will be removed as part of the construction and operation phase of the project. The offsetting requirement has been calculated using the BBCC. A summary of the vegetation zones, loss in landscape value, loss in site value, and ecosystem credits required to offset the impacts of the project are shown in **Table 21**. A copy of the BBCC report is shown in **Appendix B**. No staging of offsets is currently proposed.

Table 21: Offsetting requirements of the project

Zone	PCT	Loss in landscape value	Loss in site value	Required ecosystem credits
1	ME041	3.8	44.27	2
2	ME041 (low)	3.8	11.46	0
3	ME58	3.8	32.64	4
4	ME58 (poor)	3.8	19.79	10

Total	**16**

8.6 Impacts not requiring offsetting

One vegetation zone has been classified as low condition. Vegetation Zone 2, which comprises of ME041 Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion has a site value score of 11.46 which meets the definition of vegetation in low condition as it has a site value score less than 17.

In accordance with Table 4 of the FBA and as identified in **Table 20** above, impacts to vegetation zone 2 are not required to be offset.

All other native vegetation occurring within the development has been assessed and will be offset. All impacts to cleared land within the development site do not require offsetting.

Stage 3 – Biodiversity Offset Strategy

9 Objectives and policy framework of the Biodiversity Offset Strategy

9.1 Objectives of the Biodiversity Offset Strategy

The objective of this Biodiversity Offset Strategy (BOS) is to provide a pathway for delivery of a suitable offset to ameliorate the impacts of the project.

The purpose of determining offsets for the project is to achieve a long term biodiversity gain for threatened species, populations and ecological communities impacted by the project.

This BOS has been drafted to provide options for complying with the objectives of the NSW *Biodiversity Offsets Policy for Major Projects* (the NSW offsets policy), as well as the EPBC Act *Environmental Offsets Policy* (the Commonwealth offsets policy).

9.2 Policy framework of the offset strategy

This BOS is guided by policy frameworks under both NSW and Commonwealth legislation. The *NSW Biodiversity Offsets Policy for Major Projects* provides guidance for offsets to impacted threatened species, populations, and ecological communities under the TSC Act (now BC Act); and the *Environmental Offsets Policy* provides guidance for offsets to impacted Matters of National Environmental Significance (MNES) under the EPBC Act.

Both NSW and Commonwealth offsets policies are guided by principals to ensure the security, effectiveness, and transparency of offsets. These are discussed for both NSW and Commonwealth policies in **Section 9.3** and **Section 9.4** of this BOS.

9.3 NSW legislation

9.3.1 NSW Biodiversity Offsets Policy for Major Projects

For projects declared as SSD or State Significant Infrastructure (SSI), impacts of the project must be assessed under the FBA, and a BOS drafted under the NSW offsets policy to propose offsets for unavoidable impacts. The NSW offsets policy identifies that the suitability of offsets are guided by six principles. Details of how this BOS complies with the six principles of the NSW offsets policy are provided below.

Principle 1: Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

The project has been located within areas that are currently developed as residential housing. The location of the development has been sited within existing development to minimise impacts to biodiversity.

Within Chapter 6 of the BAR, measures to avoid and minimise direct and indirect impacts during both the construction and operation phase of the project have been detailed. Offsets have only been considered following consideration of avoidance measures. Details of avoidance measures proposed are detailed within the BAR.

Principle 2: Offset requirements should be based on a reliable and transparent assessment of losses and gains.

Offsets requirements have been assessed under the endorsed FBA. All losses of the project have been calculated using the BBCC. The BBCC is also the tool for measuring gains at any offset site providing for a transparent and reliable methodology for assessing the offsetting requirement of the project.

Principle 3: Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

Assessment of impacts of the project and the proposed offsets are provided under a 'like for like' methodology, whereby biodiversity credits of the same Plant Community Type (PCT) are assessed for the impacts and proposed for the offsets. Under the FBA there are variation rules proposed whereby the consent authority may approve the variation to the offset rules for matching ecosystem credits where like-for-like offsets are not available. The proponent may vary the biodiversity credits used to offset an impact with a BOS, provided the proponent can demonstrate to the consent authority that (in accordance with the FBA):

All reasonable steps to secure a matching ecosystem credit have been taken by the proponent, and

- *The required ecosystem credit is not for a PCT associated with a Critically Endangered Ecological Community (CEEC) under the TSC Act or an ecological community listed under the EPBC Act, and*
- *The PCT from the same vegetation formation has a percent cleared value of the PCT in the major catchment area equal to or greater than the percent cleared of the PCT to which the required ecosystem credit relates, or*
- *Where the required ecosystem credit is for a PCT that is associated with a CEEC/EEC, the PCT from the same formation is also associated with a CEEC/EEC*.

Principle 4: Offsets must be additional to other legal requirements.

Offsets proposed under the FBA must be sourced from Biobank sites established under a BioBanking Agreement. Since the TSC Act is now repealed, the proponent will source credits from a funded and managed site known as a Stewardship Site. A Stewardship Agreement is a voluntary scheme entered into by land holders for the purpose of managing the land for biodiversity. A Stewardship Agreement stipulates management actions that must be undertaken at the Stewardship site in perpetuity as guided by a Management Action Plan (MAP). The MAP guides management actions that are additional to all other legal requirements.

Standard management actions that are required at a Stewardship site include:

- Management of grazing for conservation
- Weed control
- Management of fire for conservation
- Management of human disturbance
- Retention of regrowth and remnant native vegetation
- Replanting or supplementary planting where natural regeneration will not be sufficient
- Retention of dead timber
- Erosion control
- Retention of rocks

Additional management actions that may apply at a Stewardship site includes:

- Control of feral and overabundant native herbivores
- Vertebrate pest management

- Nutrient control
- Control of exotic fish species
- Maintenance or reintroduction of natural flow regimes

Principle 5: Offsets must be enduring, enforceable and auditable.

A Stewardship Agreement entered into at the Stewardship site is a legally binding agreement that operates in perpetuity. Stewardship Agreements are guided by the MAP, which contains a reporting and review schedule. Management of the Stewardship site is funded through annual stipends to the landholder as determined within the Total Fund Deposit spreadsheet (TFD). The condition and compliance with the MAP at all Stewardship sites must be provided to the Biodiversity Conservation Trust (BCT) annually to ensure continued funding of the Stewardship site. If the landholder is found to be non-compliant with the MAP, BCT has the capacity to recommend to withhold funding to the landholder.

In addition to annual audits, the MAP is also reviewed every 5 years by both a qualified consultant as well as BCT to ensure the MAP remains applicable to the quantum of management required to improve biodiversity at the Stewardship site.

Principle 6: Supplementary measures can be used in lieu of offsets.

If the proponent can suitably demonstrate that offsets have cannot be provided for the impacts, in accordance with Section 10.5 of the FBA, then the proponent may propose the use of supplementary measures to compensate for impacts. In accordance with the FBA:

The consent authority may approve supplementary measures for ecosystem credits proposed within a BOS provided:

- *all reasonable steps have been taken by the proponent to secure a matching ecosystem credit, and*
- *the PCT to which a required ecosystem credit relates is associated with a CEEC/EEC or for which the impact of development does not require further consideration according to Subsection 9.2.4, and*
- *the supplementary measure applies to that CEEC/EEC, and*
- *the supplementary measure is carried out in accordance with the rules governing supplementary measures, including calculating the financial contribution of the supplementary measures in accordance with Appendix B of the NSW Biodiversity Offsets Policy for Major Projects.*

The consent authority may approve supplementary measures for species credits proposed within a BOS provided:

- The proponent can demonstrate that all reasonable steps have been taken to secure the number and types of species credits impacted on at the development site, and
- The species to which the species credit relates is not listed on the EPBC Act or listed as critically endangered on the TSC Act.

No supplementary measures are proposed within this BOS.

9.4 Commonwealth legislation

Under the *Bilateral agreement made under section 45 of the EPBC act relating to environmental assessment* (the bilateral agreement; DotE 2015), a proposed action does not require assessment under

Part 8 of the EPBC Act, if the action is to be assessed under Part 4 Division 4.1 (SSD) or Part 5.1 (SSI) of the EP&A Act, provided the assessment:

- Contains an assessment of all impacts the action has on each matter protected under the EPBC Act
- Contains enough information about the controlled action and its relevant impacts to allow the Commonwealth Minister to make an informed decision whether or not to approve the action
- Addresses all matters outlines in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations 2000; DotE 2000)

The proposed action will be assessed via an Environmental Impact Statement (EIS), which will involve several public consultation periods.

9.4.1 EPBC Act Environmental Offsets Policy 2012

For projects declared controlled actions under the EPBC Act, under the bilateral agreement impacts of the project are not required to be assessed by the Commonwealth. Whilst assessment may be undertaken via the exhibition of an EIS, the project must demonstrate the suitability of offsets under the Commonwealth offsets policy. The Commonwealth offsets policy is guided by eight principles. Details of how this BOS complies with the eight principles of the Commonwealth offsets policy are provided below.

1. Offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action

The project will impact on 0.05 ha of Turpentine Ironbark Forest of the Sydney Basin Bioregion, which complies with the listing as Critically Endangered under the EPBC Act. Under the FBA an offset must be calculated using the BBCC for all direct impacts to vegetation communities that are listed as EEC or CEEC under the TSC Act.

The BBCC calculates the offsets to provide for a net gain in biodiversity as a result of the project. The FBA also requires all impacts for species, populations, and ecological communities listed under the EPBC Act to be offset with 'like for like' biodiversity credits.

2. Offsets must be built around direct offsets but may include other compensatory measures

As described under Principle 6 in **Section 9.3.1** above, supplementary measures may be included as part of the BOS under Section 10.5 of the FBA.

3. Offsets must be in proportion to the level of statutory protection that applies to the protected matter

Offsets have been calculated using the BBAM which includes a threatened species multiplier within the calculation of the quantum of impacts. The threatened species multiplier increases the quantum of credits required for a project due to impacts to species, populations, and ecological communities.

4. Offsets must be of a size and scale proportionate to the residual impacts on the protected matter

The quantum of offsets required under the FBA is calculated using the BBCC which incorporates the size and scale of the impacts at the development site. Impacts to threatened species, populations, and ecological communities at the development site are adjusted by incorporating the impacts to connectivity, patch size, threatened species predicted, and vegetation type. The BBCC also incorporates the overall loss of vegetation within the locality as a result of the project.

5. Offsets must effectively account for and manage the risks of the offset not succeeding

Offsets proposed under the FBA must be secured through biodiversity credits which are generated at a Stewardship site, under a Stewardship Agreement. A Stewardship Agreement is legally binding, enforceable, audited, and enduring in perpetuity.

A Stewardship Agreement is the strongest voluntary covenant in NSW that can be placed on a parcel of land. The Stewardship Agreement can only be removed by the Minister, by certain mining and gas projects, or by offsetting the Stewardship Agreement via a highly inflated volume of Stewardship credits.

Under a Stewardship Agreement the risk of loss is considered to be the lowest of available on title covenants.

6. Offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6)

All Stewardship Agreements are additional to existing management requirements. Should any existing requirements be stipulated under NSW planning regulations or schemes, the BBCC reduces the quantum of Stewardship credits generated at a site commensurate to the existing requirements of a site.

7. Offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable

Stewardship Agreements are a scientifically robust offsetting mechanism that is calculated using the BBCC, protects the land in perpetuity from development, funds management actions, and is annually enforced by the BCT.

All direct impacts of the project will be offset prior to issue of construction certificates for the development site.

8. Offsets must have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

As discussed above, all Stewardship sites are annually inspected by the BCT to ensure biodiversity outcomes are managed appropriately. The quantum of Stewardship credits generated at a Stewardship site is calculated using the BBCC which is a transparent, standardised, repeatable method for measuring biodiversity values at a site.

9.5 Proposed offset measures

The proposed offset measures of the project are to acquire and retire the quantum of ecosystem credits required by the impacts of the project as calculated within the BBCC. The credits are proposed to be retired commensurate with each stage of development as per Section 8.3.1 above. Ecosystem credits can either be purchased from credit holders as identified on a public register, or by establishment of a Stewardship site.

All credits will be formally retired prior to construction of the project. Retirement of credits will be made prior to issue of the Construction Certificate for the development site.

9.6 EPBC Act NSW bilateral agreement

This BOS has been drafted to comply with both the NSW offsets policy, Commonwealth offsets policy, as well as the criteria for offsets within section 7.2 of the *Bilateral agreement made under section 45 of the Environment Protection and Biodiversity Conservation Act 1999 (Cth) relating to environmental assessment* (DotE, 2015).

This BOS complies with Section 7.2 of the bilateral agreement by under the following criteria:

- If the action is, or is part of, a major project as referred to in the NSW Biodiversity Offsets Policy, and the BAR for this action has been drafted under the FBA.
- The BAR addresses how section 127b of the TSC Act (the BBAM) has been applied

As such, the Commonwealth Minister may choose to approve the project without assessment by the DotE.

9.7 Additional information requirements of the BOS

The minimum information requirements for the BOS are described in Table 22 of the FBA. At the time of drafting this BOS, the following information was not known regarding the offset site:

- Location of the offset site, or
- Improvement in biodiversity values at the offset site, or
- Supplementary measures

As such this information has not been included within this BOS. All information regarding the location and improvement in biodiversity values at the offset site will be described in detail within the BAR for the Stewardship site (BSAR).

Figures

Figure 1 Updated concept masterplan of the project (August 2019)

Figure 2 Changes to the development site proposal

Figure 3 Site map

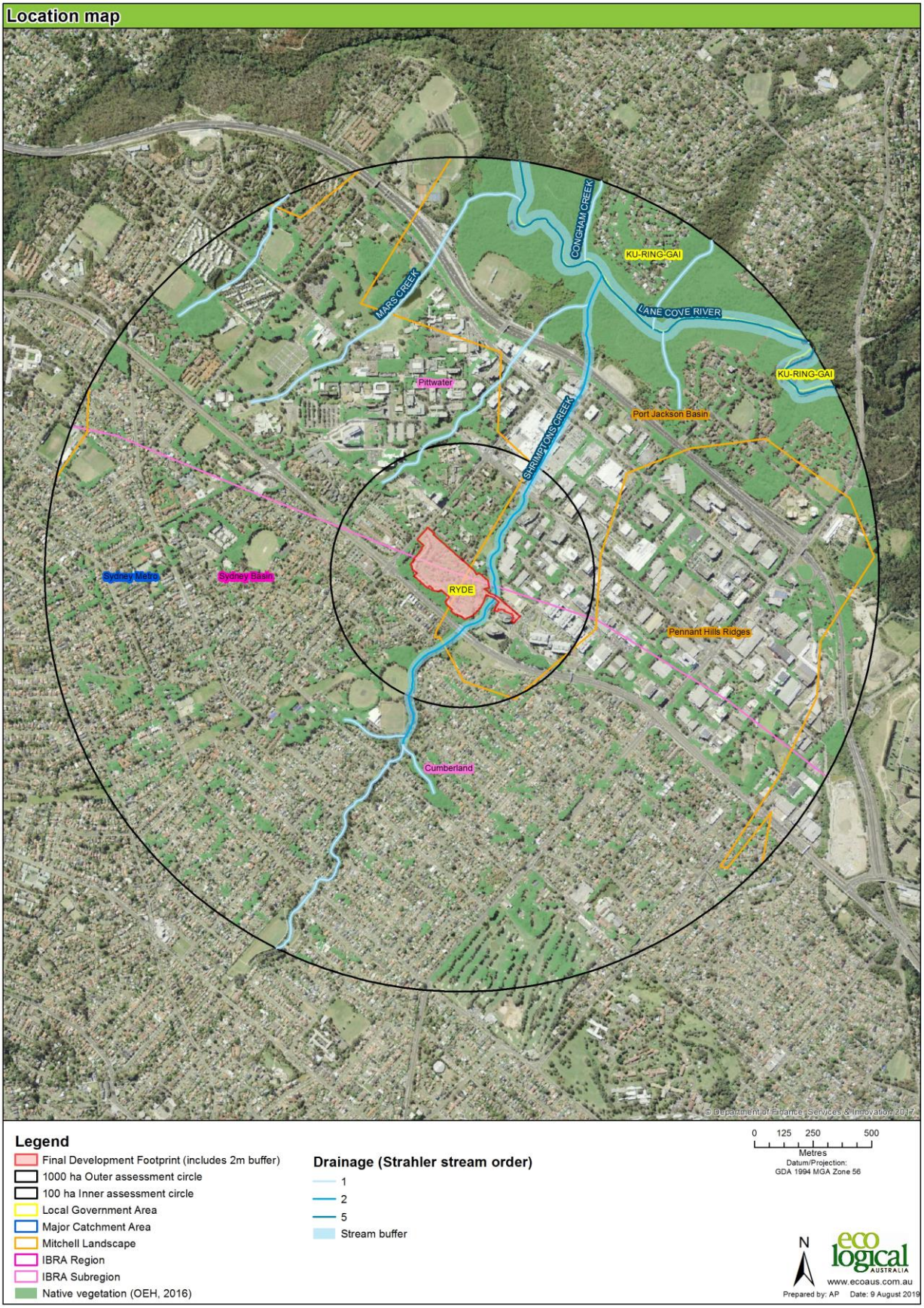


Figure 4 Location map

Figure 5 Survey locations

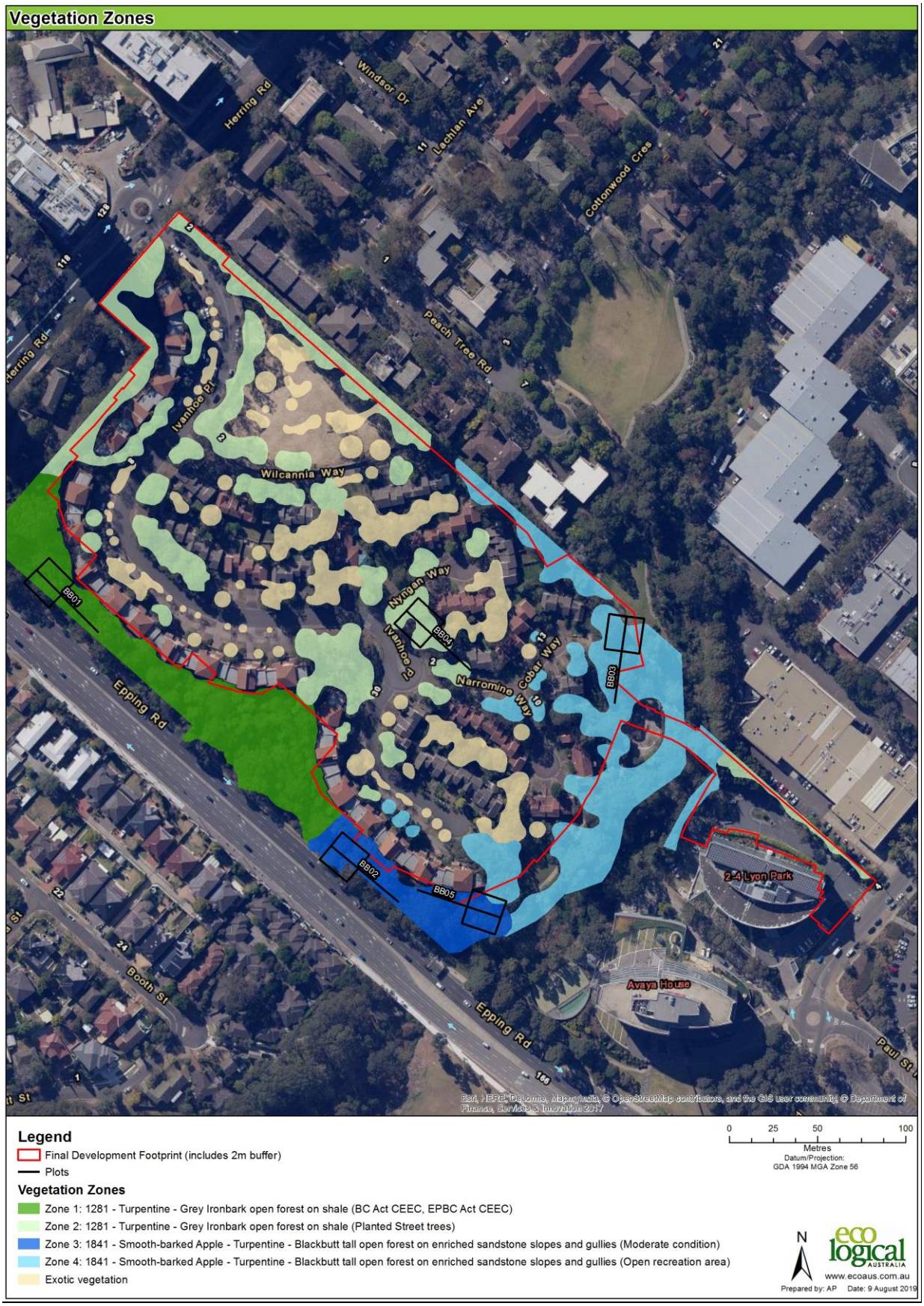


Figure 6 Vegetation zones

Figure 7 Threatened ecological communities

Figure 8 Fauna habitat

Figure 9 Areas of unavoidable impact

Figure 10 Occurrence of the EEC within a 10,000 ha radius

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Appendix A Plot and transect data

Stratum	Species Name	Common Name		Form	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
					C	**A**	**C**	**A**	**C**	**A**	**C**	**A**	**C**	**A**
Over-storey	*Acacia parramattensis*	Parramatta Green Wattle		S	2	20	2	2	5	1				
	Allocasuarina torulosa	Forest Oak		T	1	1								
	Angophora costata	Smooth-barked Apple		S	10	5	5	1	5	2				
	Casuarina glauca	Swamp Oak		T					10	10			5	2
	Cinnamomum camphor	Camphor Laurel	*	T			1	1						
	Corymbia citriodora	Lemon-scented Gum	N	T			1	1						
	Corymbia eximia	Yellow Bloodwood		T					5	5				
	Eucalyptus microcorys	Tallowwood		T							15	2		
	Eucalyptus resinifera	Red Mahogany		T							15	1		
	Eucalyptus robusta	Swamp Mahogany		T							10	1		
	Eucalyptus saligna	Sydney Blue Gum		T					3	2	10	1		
	Glochidion ferdinandi	Cheese Tree		T			1	1	5	1				
	Melaleuca decora	White Feather Honeymyrtle		T			1	1						
	Pittosporum undulatum	Native Daphne		T	5	20	1	1						
	Syncarpia glomulifera	Turpentine		T	1	1	1	1			5	1		
Mid-storey	*Acacia longifolia*	Sydney Golden Wattle		T	1	1								
	Acacia ulicifolia	Prickly Moses		T	1	1								
	Bursaria spinosa	Blackthorn		S	5	50	1	1						
	Grevillea robusta	Silky Oak	N	S					3	1				
	Lantana camara	Lantana	*	S	20	10	20	50						
	Leptospermum sp.	Tea Tree		S					5	10				
	Ligustrum lucidum	Large-leaf Privet	*	S	5	10			5	2			20	2
	Ligustrum sinense	Small-leaf Privet	*	S	5	10	10	100	3	1			40	12
	Melaleuca decora	White Feather Honeymyrtle		S									10	3

Stratum	Species Name	Common Name		Form	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5	
	Melaleuca nodosa	Prickly-leaved Paperbark		S					5	1				
	Notelaea sp.	Mock Olive	*	T	1	10								
	Pittosporum undulatum	Native Daphne		S									5	2
	Pteridium esculentum	Common Bracken		E	20	500								
Groundcover	*Acetosa* sp.	Rhubarb	*	F									5	20
	Araujia sericifera	Moth Vine	*	L									10	2
	Arctotheca calendula	Capeweed	*	F							20	100		
	Asparagus aethiopicus	Ground Asparagus	*	L	5	50	5	20						
	Blechnum nudum	Fishbone Fern		E	1	10								
	Dianella caerulea	Blue Flax Lily		F	1	50	1	10						
	Dichondra repens	Kidney Weed		F	1	100			20	100				
	Ehrharta erecta	Panic Veldtgrass	*	D			1	20	5	100			15	100
	Entolasia stricta	Wiry Panic		D	40	500	1	20						
	Glycine tabacina			L	1	20								
	Hypochaeris glabra	Smooth Catsear	*	F							15	100	15	100
	Imperata cylindrica	Blady Grass		D	20	500								
	Lomandra longifolia	Spiny-headed Mat-rush		R	1	50	1	1	5	10			10	6
	Microlaena stipoides	Weeping Grass		D	20	500	1	50						
	Oxalis sp.	Oxalis	*	F					5	100	20	1000		
	Pennisetum clandestinum	Kikuyu	*	G							70	1000		
	Pratia purpurascens	Whiteroot		F	1	500								
	Ranunculus repens	Creeping Buttercup	*	F					10	100			10	100
	Rubus sp.	Blackberry	*	L	1	5							10	20
	Sida rhombifolia	Paddy's Lucerne	*	F									5	20
	Tradescantia fluminensis	Wandering Jew	*	L					10	100			90	100
	Trifolium sp.	Clover	*	F					5	100	15	1000		

** denotes exotic, N denotes naturalised*

Appendix B Shading diagrams

APPENDIX D

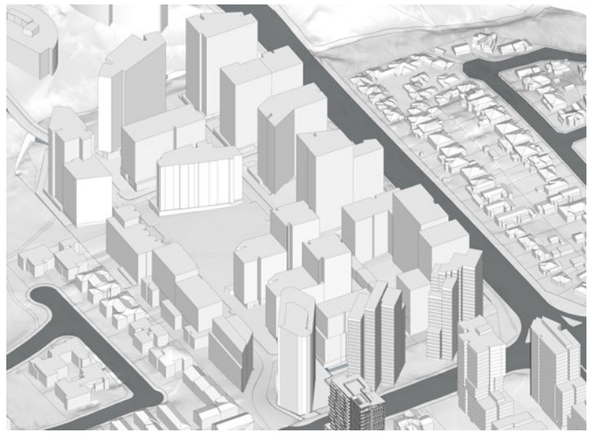
SOLAR ACCESS AND SHADOW ANALYSIS

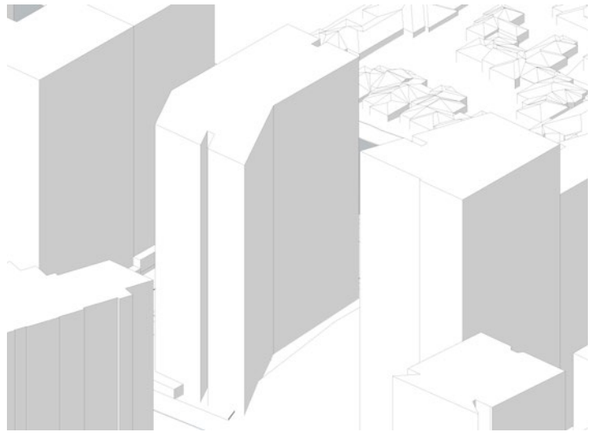
METHOD STATEMENT

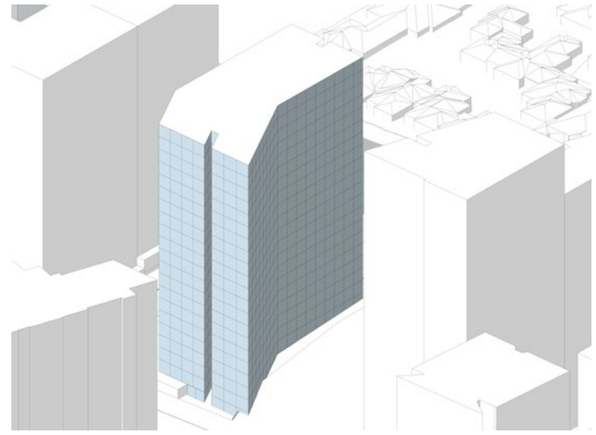
OVERVIEW

We have adopted a highly accurate parametric process to assess the solar access performance of the indicative reference scheme. The process has formed a vital tool in developing the masterplan design by allowing us to test the solar performance of numerous building configurations quickly while achieving highly accurate results which are able to be presented and understood in a very straightforward visual format.

The process involves the use of a propriety plug-in for Sketchup 2017 which calculates the number of hours a particular horizontal or vertical surface will receive solar access during a specified time window on a particular date and at a prescribed location. The results are then displayed both graphically and numerically.







METHODOLOGY:

The adjacent images illustrate the steps undertaken to assess whether 70% of apartments within the indicative reference scheme achieve a minimum of 2 hours of solar access to their living room and private open spaces between 9am and 3pm on 21st June in accordance with ADG requirements.

3D MODEL & CONTEXT:

A 3D aerial survey of the site and context area was purchased from the AAM group with a stated accuracy of 15 centimetres and was inserted into the context model using the inbuilt Geolocate function within Sketchup and cross referenced against 2D survey data to confirm the orientation of True North.

Our 3D model of the indicative reference scheme was then inserted.

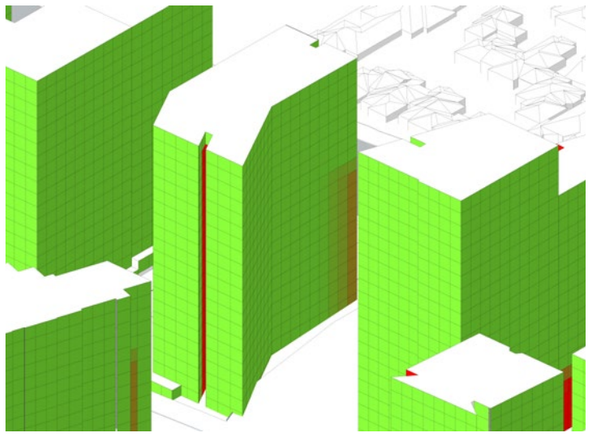
Settings for Sydney on 21st June are applied within the parametric tool to simulate solar access on the winter solstice during the hours of 9am and 3pm, the window specified within the ADG during which compliance is to be assessed.

BLOCK MASSING

The above image represents an example building, D3, as seen within the 3D site model prior to the test being undertaken. Building D4 is visble behind, and building D2 visible in the foreground.

GRID APPLIED

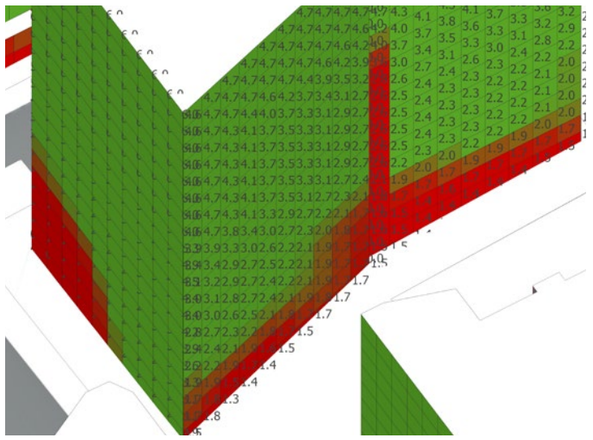
A 2 dimensional grid consisting of 3.1m x 3.1m squares is then applied to each building envelope to accurately reflect each storey height of 3.1m and a notional approximate room width of 3.1 metres.



VISUAL RESULTS

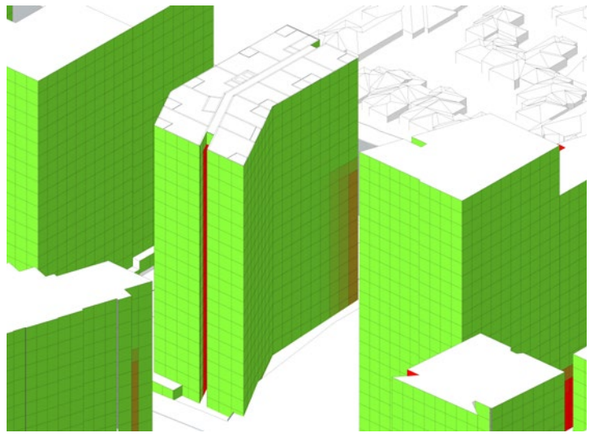
The parametric tool is then activated and solar access is simulated at 5 minute intervals between 9am and 3pm on 21st June, with a total of 72 measurements being undertaken on each square during the prescribed 6 hour window.

The results are shown in the above simple 2 dimensional graphic output. Squares which are coloured green are receiving in excess of 2 hours of solar access. Squares coloured red are receiving some solar access, but less than 2 hours. Squares shown as a mild red / green are achieving between 1.9 and 2.1 hours of solar access and require further investigation. Squares shown in grey are receiving no solar access on 21st June (not visible in the above view).



NUMERICAL RESULTS

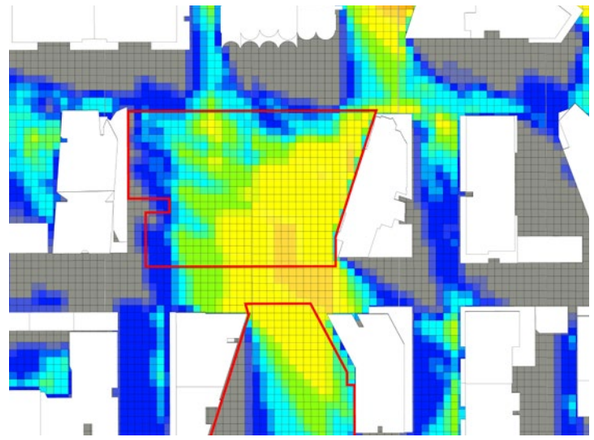
The graphical output is then supplemented by numerical output which indicates the actual number of sun hours being received by each square. This enables us to clearly distinguish between squares achieving 1.9, 2.0 or 2.1 hours and assess accordingly in the next step.



OVERLAY OF BUILDING PLAN

The 2D building plan of the indicative reference scheme is then applied onto the 3D model, identifying the location of each living room and private open space as visible in the above image. A manual count is then done to determine how many apartments per floor are receiving a minimum of 2 hours of solar access to both their living rooms and private open spaces, assessed by the colour of the facade interfacing with each plan and tabulated within a spreadsheet.

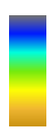
The output of our 3D parametric analysis for each building face is contained on the following pages.



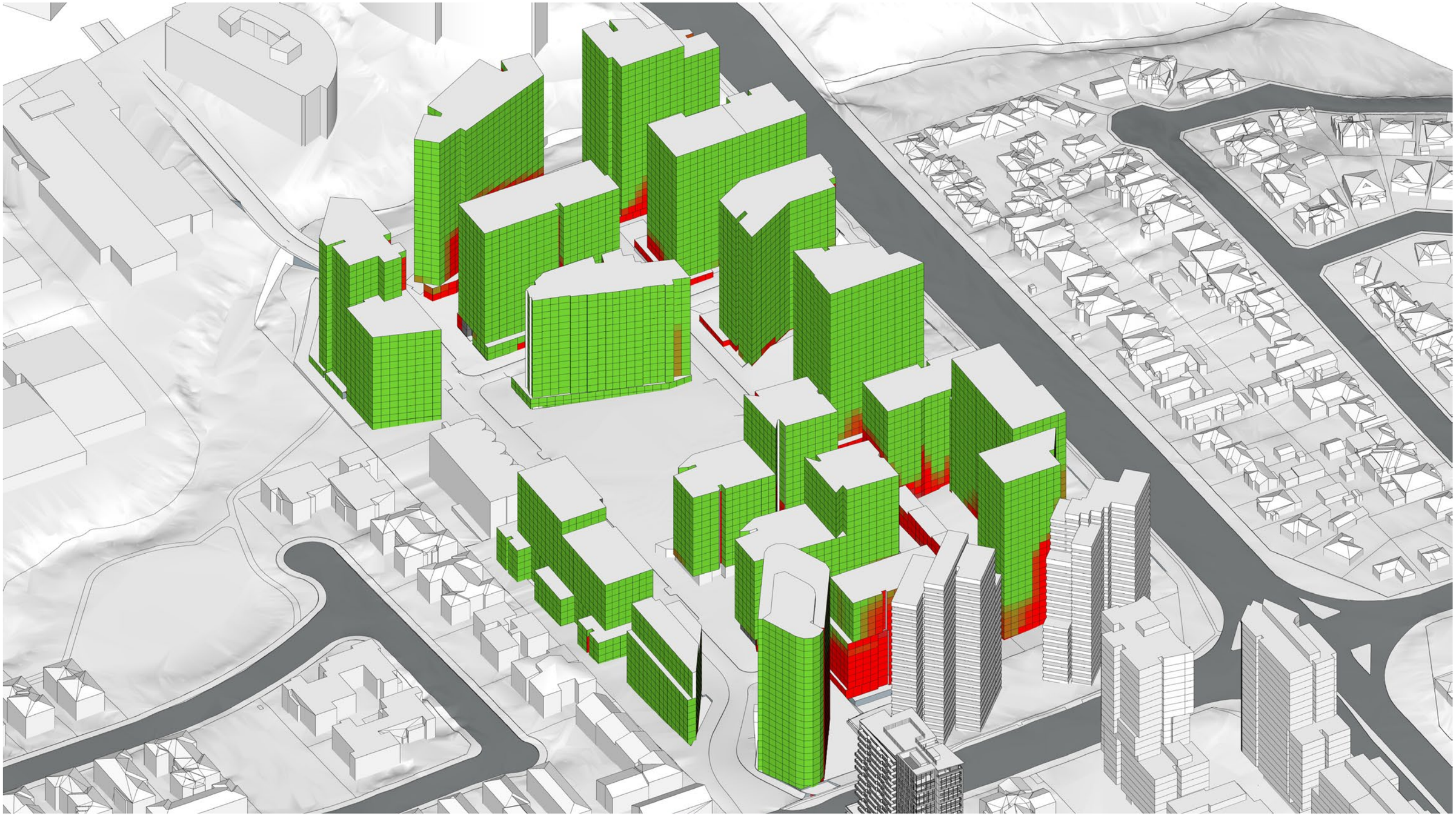
MEASUREMENT OF SOLAR ACCESS ON GROUNDPLANE

The same process has been adopted to determine the level of solar access received on the groundplane within the public domain. The 3.1 x 3.1m squares are mapped onto the groundplane and the parametric tool rerun. The output is displayed graphically, with colours identified in the key below reflecting the amount of sunlight received in each location. between 0 and 6 hours.

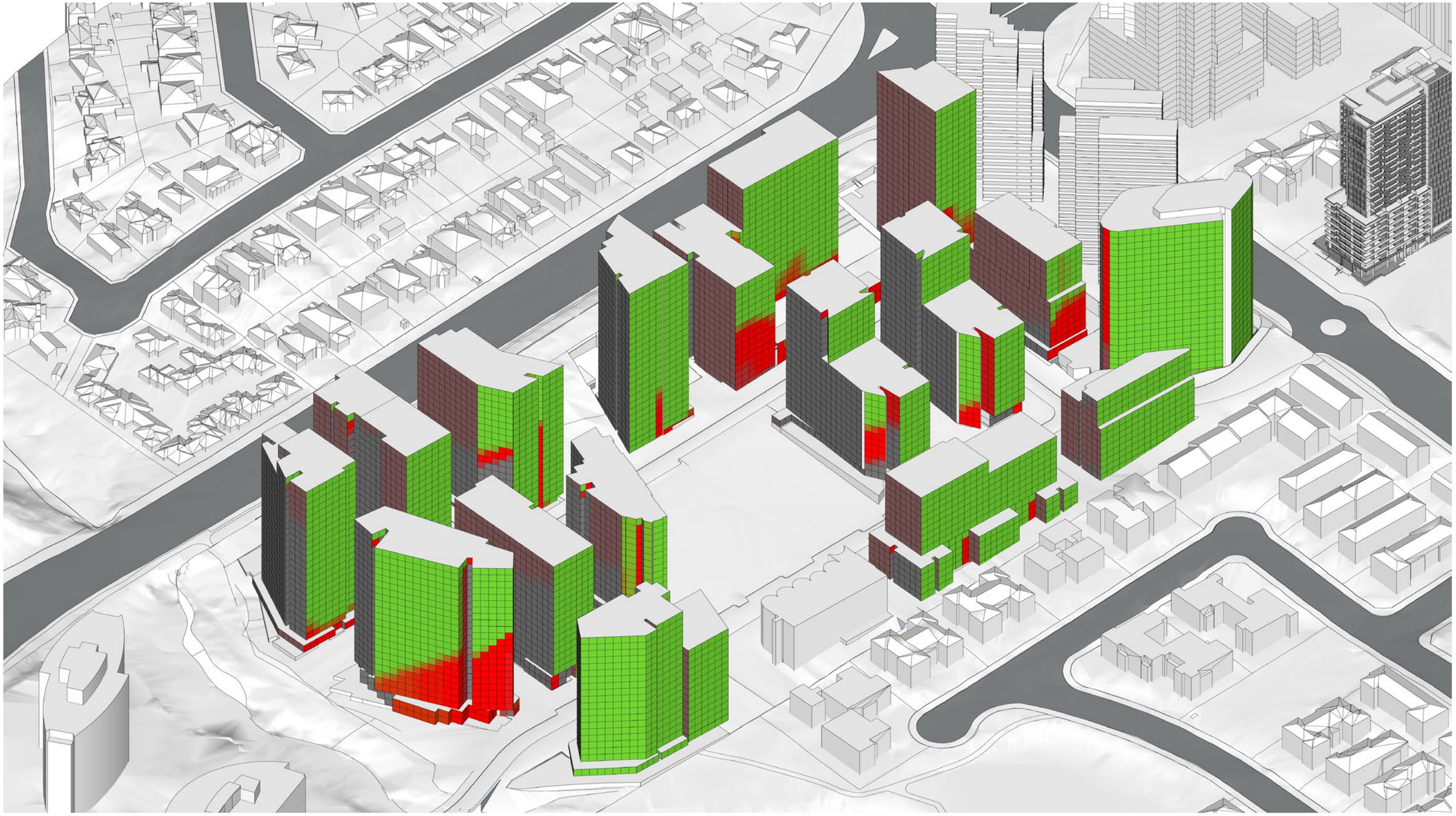
Studies for the entire masterplan are contained on the following pages and have been taken on 3 dates throughout the year, i) 21st June, the winter solstice, ii) 21st december, the summer solstice, and iii) 21st March / 21st September, the equinoxes which represent the average annual condition between the two solstices.



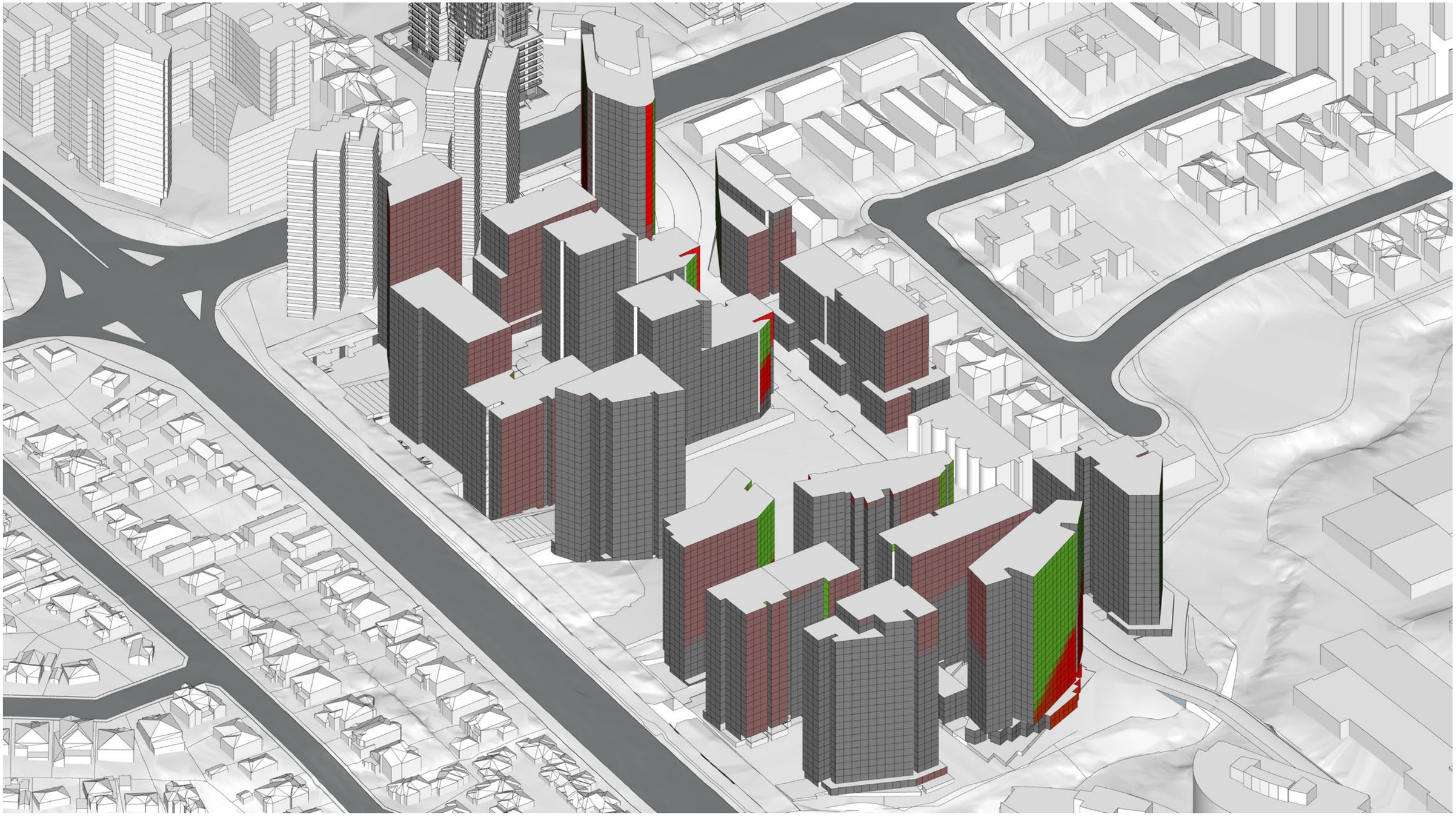
No direct sunlight
0 -1 hour
1- 2 hours
3 - 4 hours
5 - 6 hours
6+ hours



FACADE SOLAR ACCESS ANALYSIS: 21ST JUNE
VIEW FROM NORTH

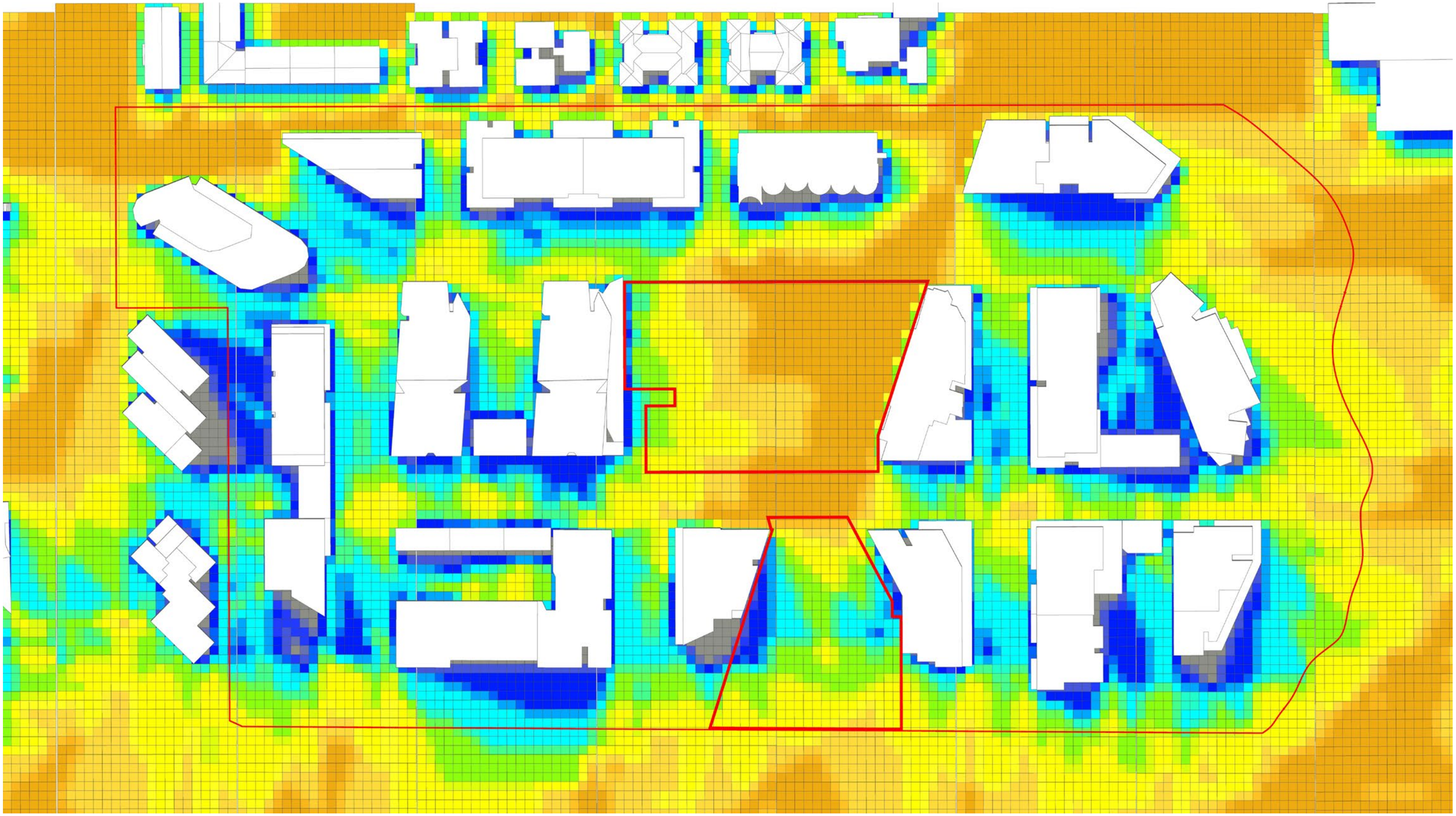


FACADE SOLAR ACCESS ANALYSIS: 21ST JUNE
VIEW FROM EAST



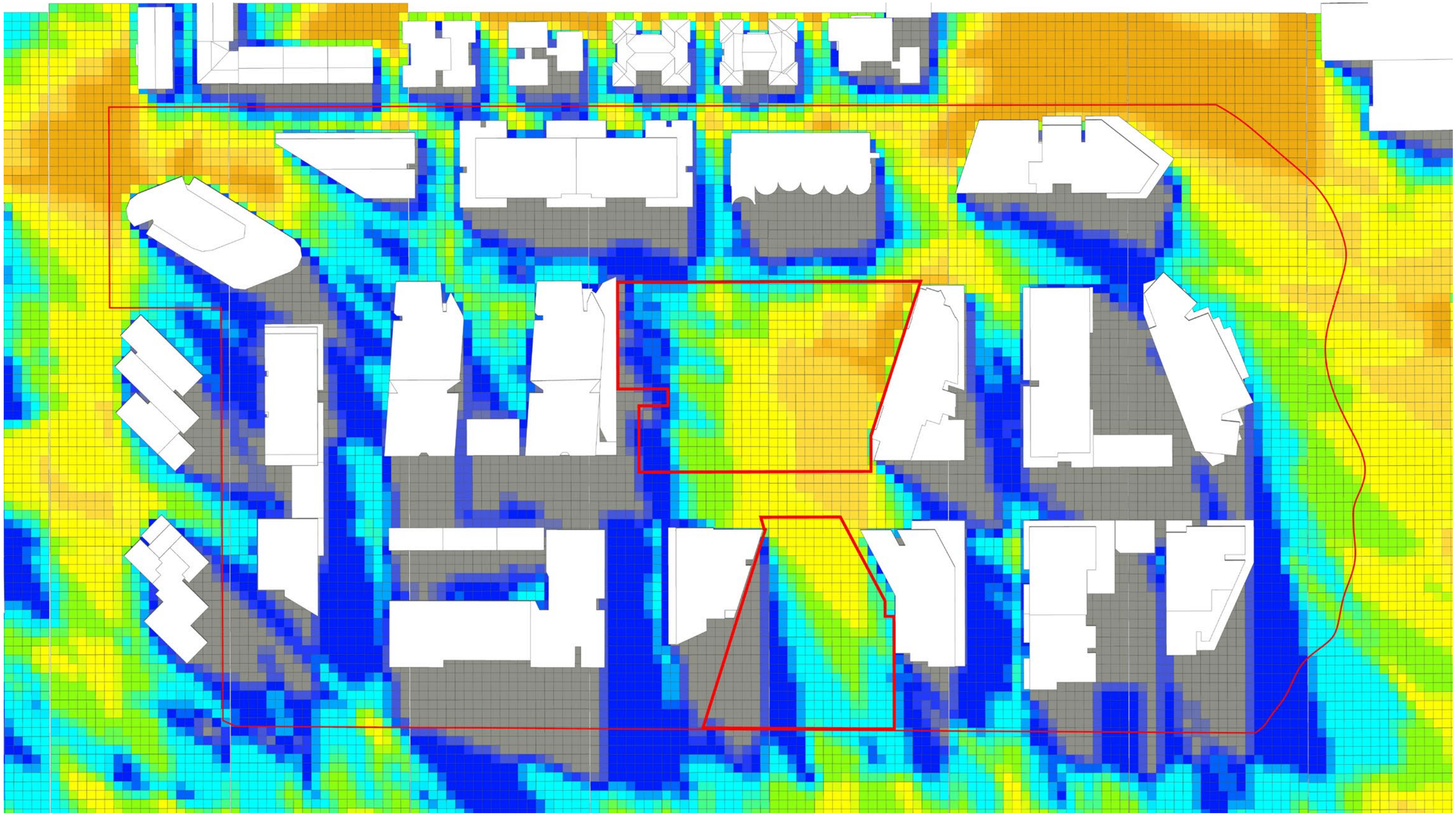
FACADE SOLAR ACCESS ANALYSIS: 21ST JUNE
VIEW FROM SOUTH

FACADE SOLAR ACCESS ANALYSIS: 21ST JUNE
VIEW FROM WEST



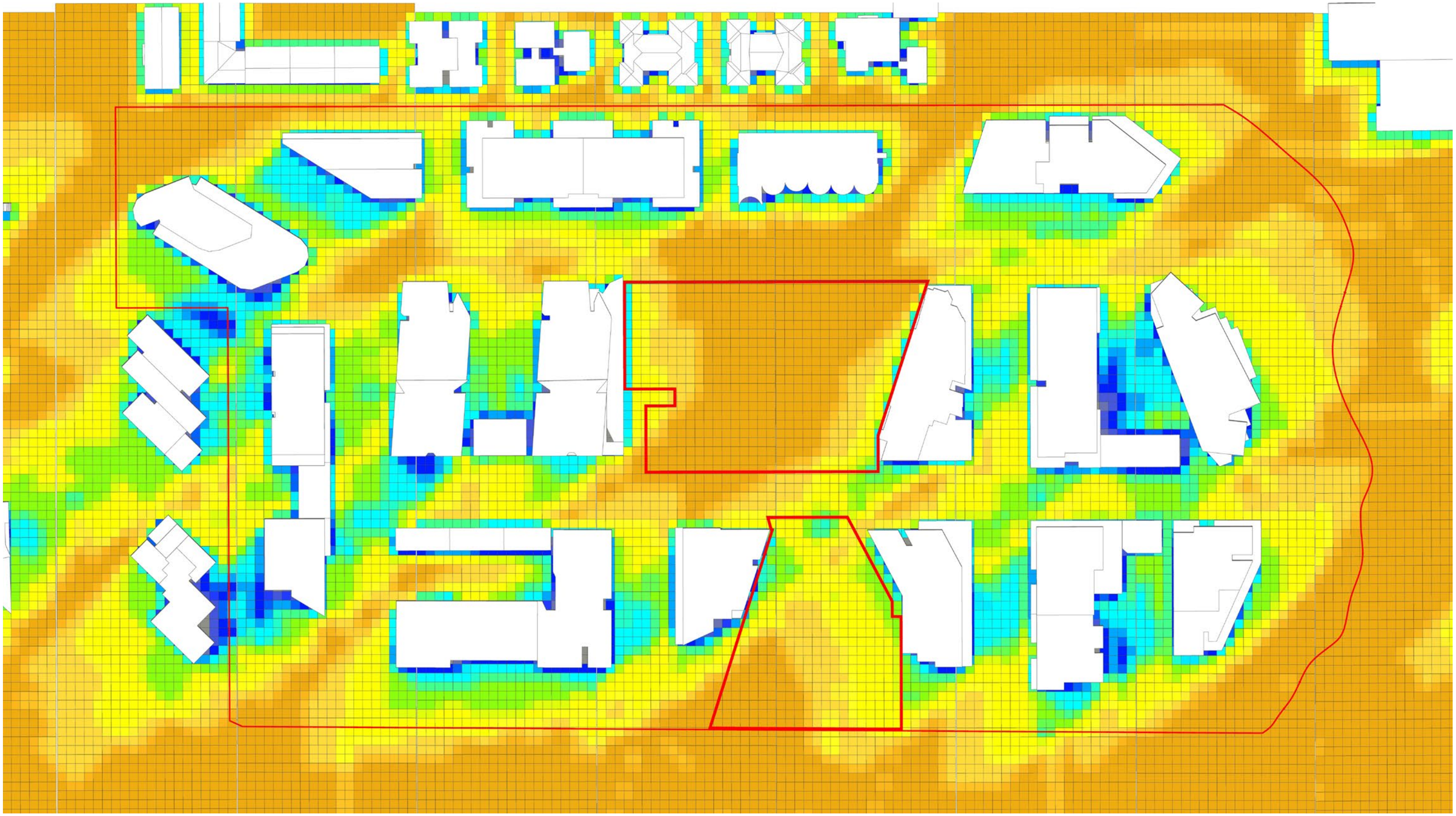
GROUND PLANE SOLAR ACCESS STUDY
21 MARCH / SEPTEMBER

No direct sunlight
0 -1 hour
1- 2 hours
3 - 4 hours
5 - 6 hours
6+ hours



GROUND PLANE SOLAR ACCESS STUDY
21 JUNE
84.5% of the Village Green recieves 2 hours solar access
65.7% of the Forest Playground recieves 2 hours solar access

No direct sunlight
0 -1 hour
1- 2 hours
3 - 4 hours
5 - 6 hours
6+ hours



GROUND PLANE SOLAR ACCESS STUDY
21 DECEMBER

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EPPING ROAD OVERSHADOWING STUDY METHOD STATEMENT

OVERVIEW

The purpose of this study is to analyse the extent of overshadowing to existing dwellings on the south side of Epping Road. It sets out to compare four scenarios:

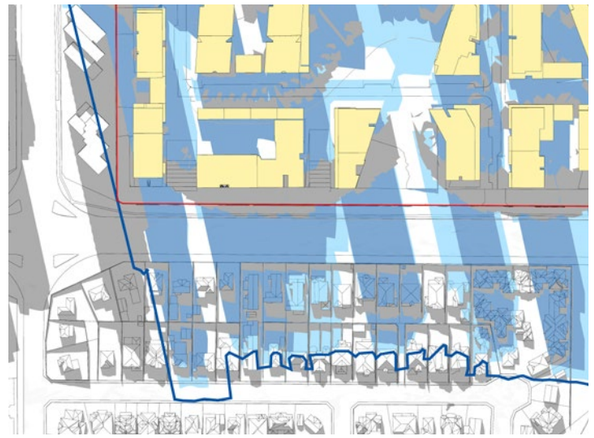
/ Existing situoation
/ Shadows cast be the LEP envelopes
/ Shadows cast by the proposed Indicative design scheme
/ Shadows cast by the proposed building envelopes.

METHODOLOGY

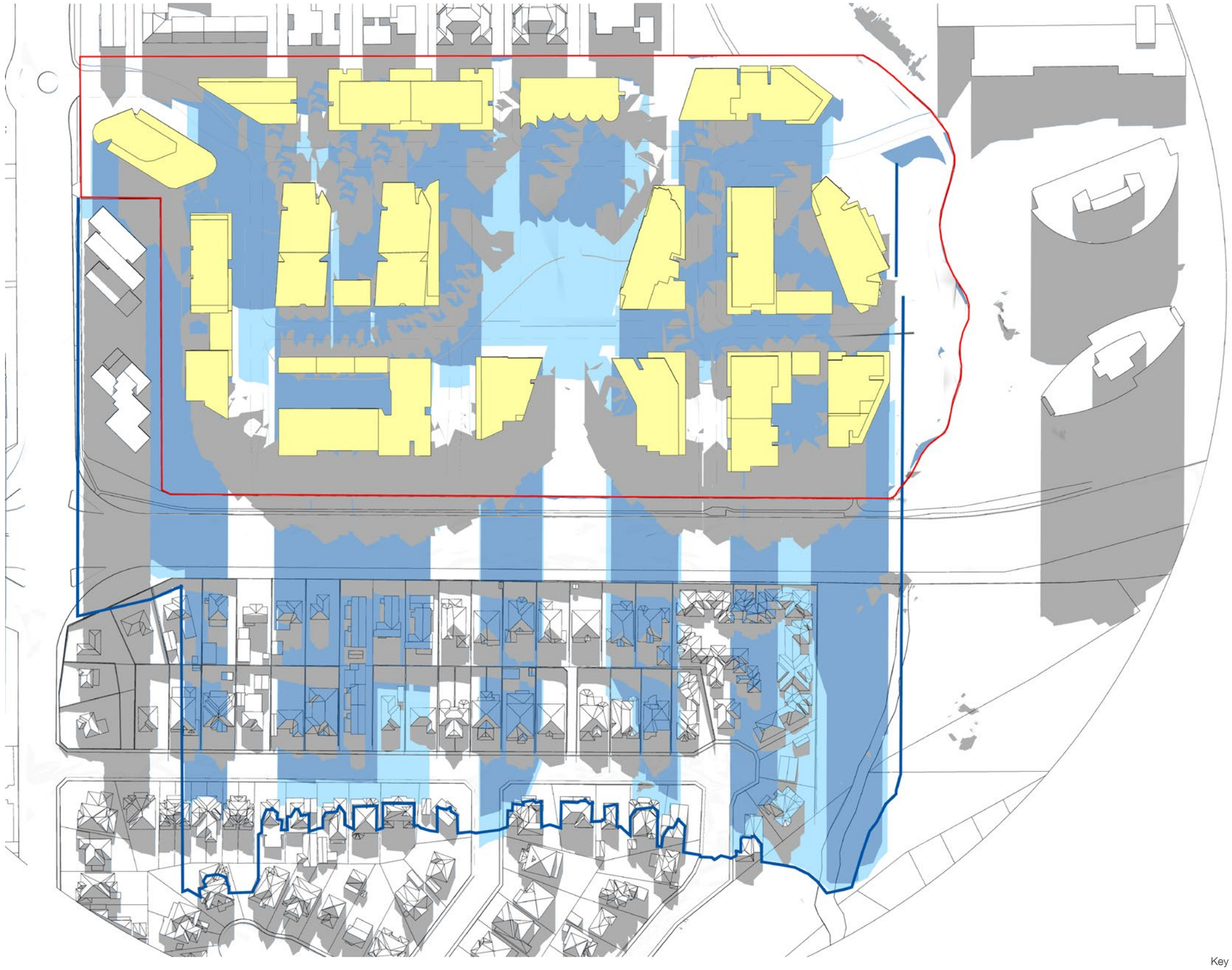
1. A 3D aerial survey of the site and context area was purchased from the AAM group with a stated accuracy of 15 centimetres and was inserted into the context model using the inbuilt Geolocate function within Sketchup and cross referenced against 2D survey data to confirm the orientation of True North.
2. To model the LEP envelopes, the existing ground profile was copied up 45m, 65m and 75m in the relevant areas, thent trimmed back 10m from the Epping Road frontage and side boundaries, and 5m from the 20m Riparian corridor offset.
3. A 3d model of the proposed envelopes was then inserted.
4. A 3d model of the indicative design scheme was then inserted
5. Shadow plans at each nominated date and time were then exported for each scenario.
6. The four shadow studies for each time were then imported into photoshop and superimposed to isolate the additional shadow cast by each scenario.
7. External images were then exported for inclusion in this appendix

3D MODEL & CONTEXT IN SKETCHUP

SHADOW PLAN EXPORTED FROM SKETCHUP



COMPOSITE PLAN EXPORTED FROM PHOTOSHOP

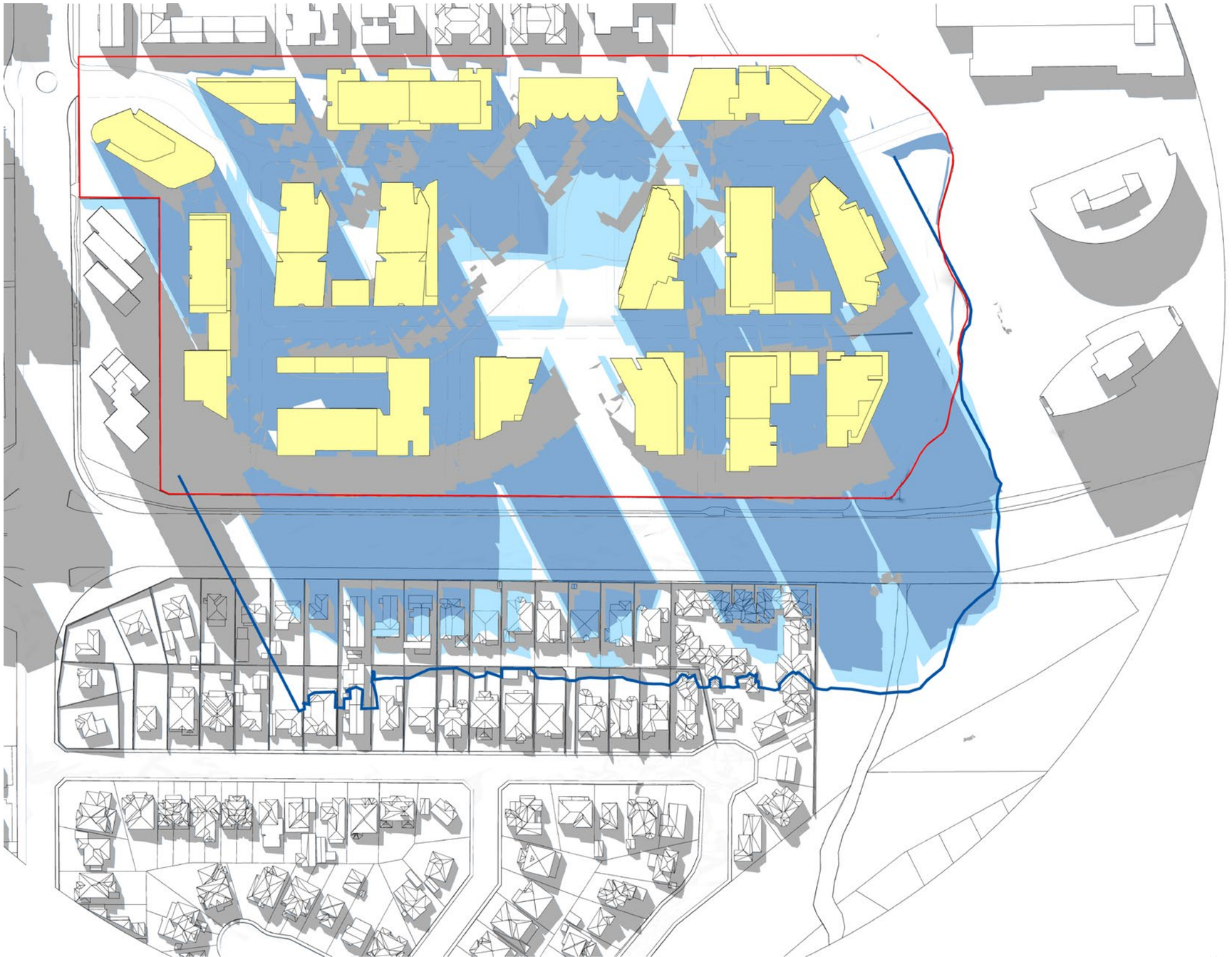


EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 9AM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

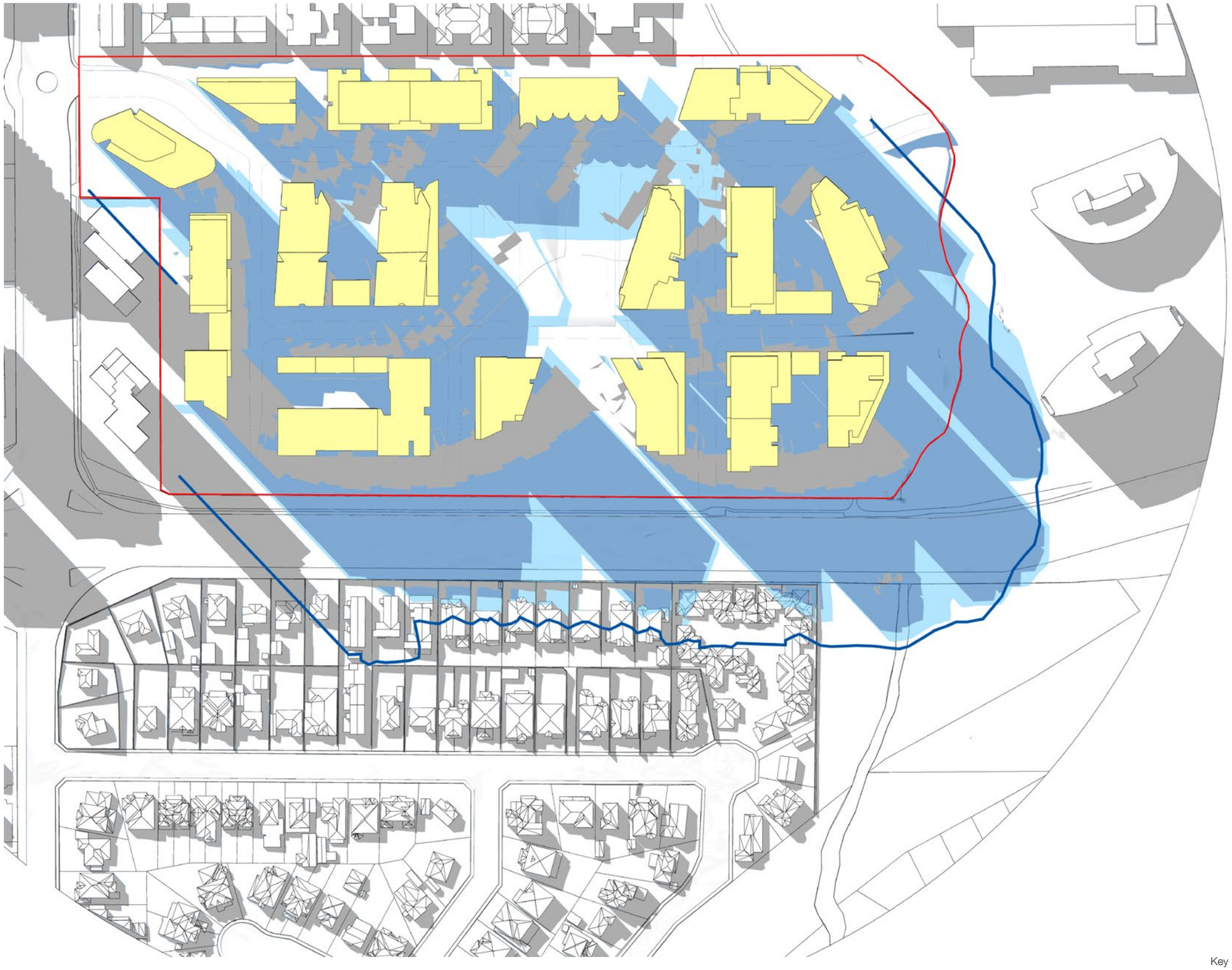
EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 10AM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing



EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 11AM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing



EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 12PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 1PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 2PM

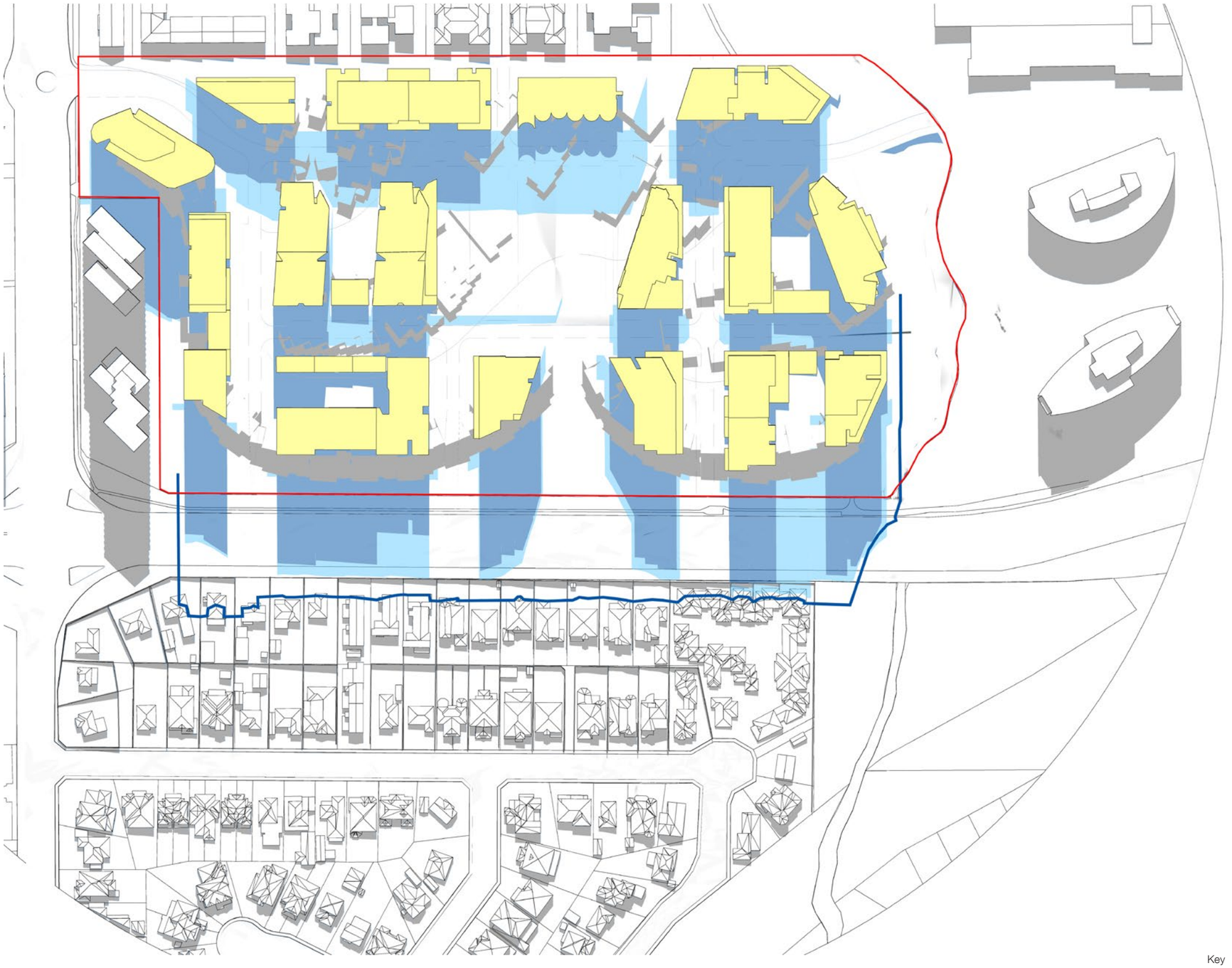
Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

EPPING ROAD SOLAR ACCESS STUDY
21 JUNE 3PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

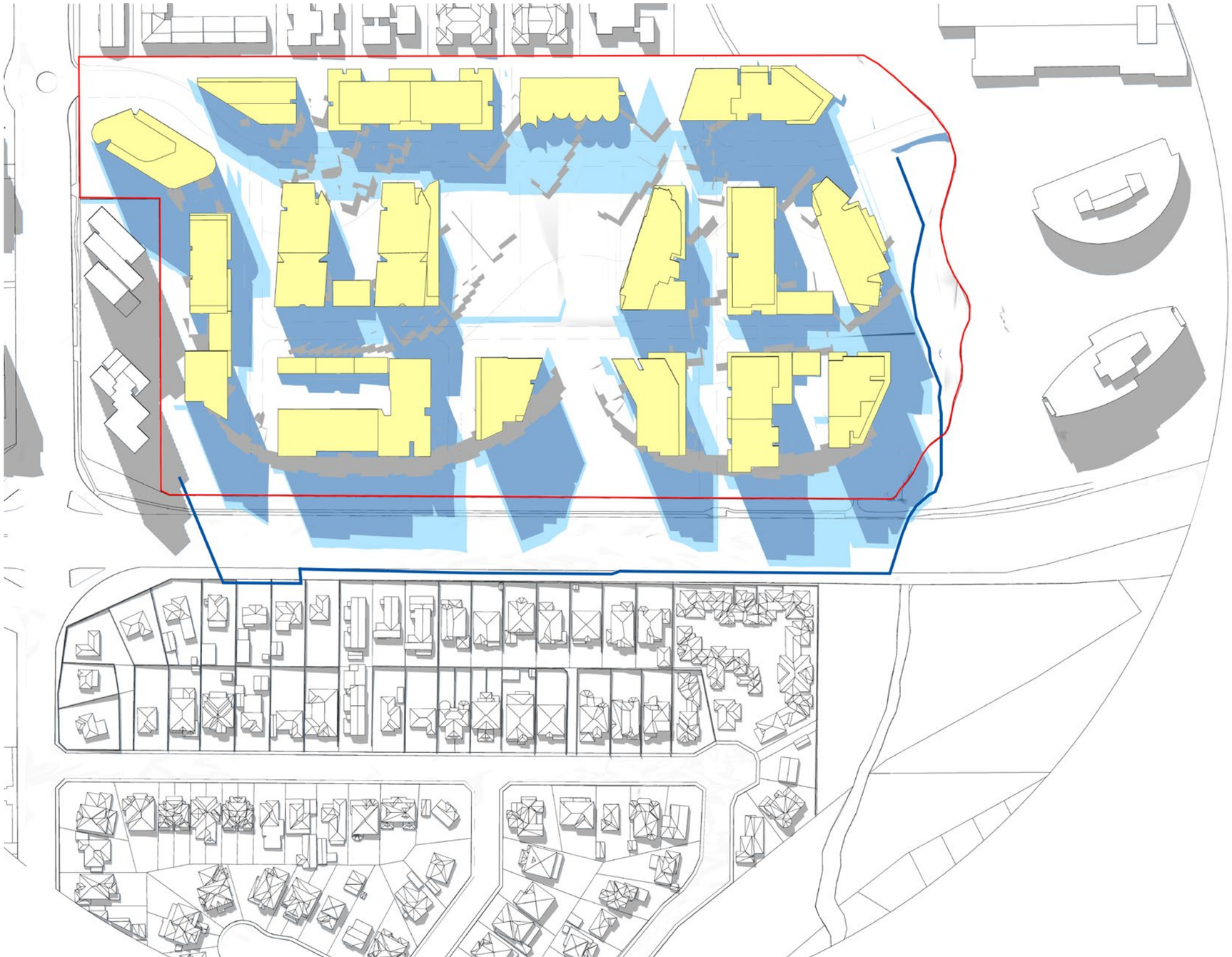
EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 9AM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing



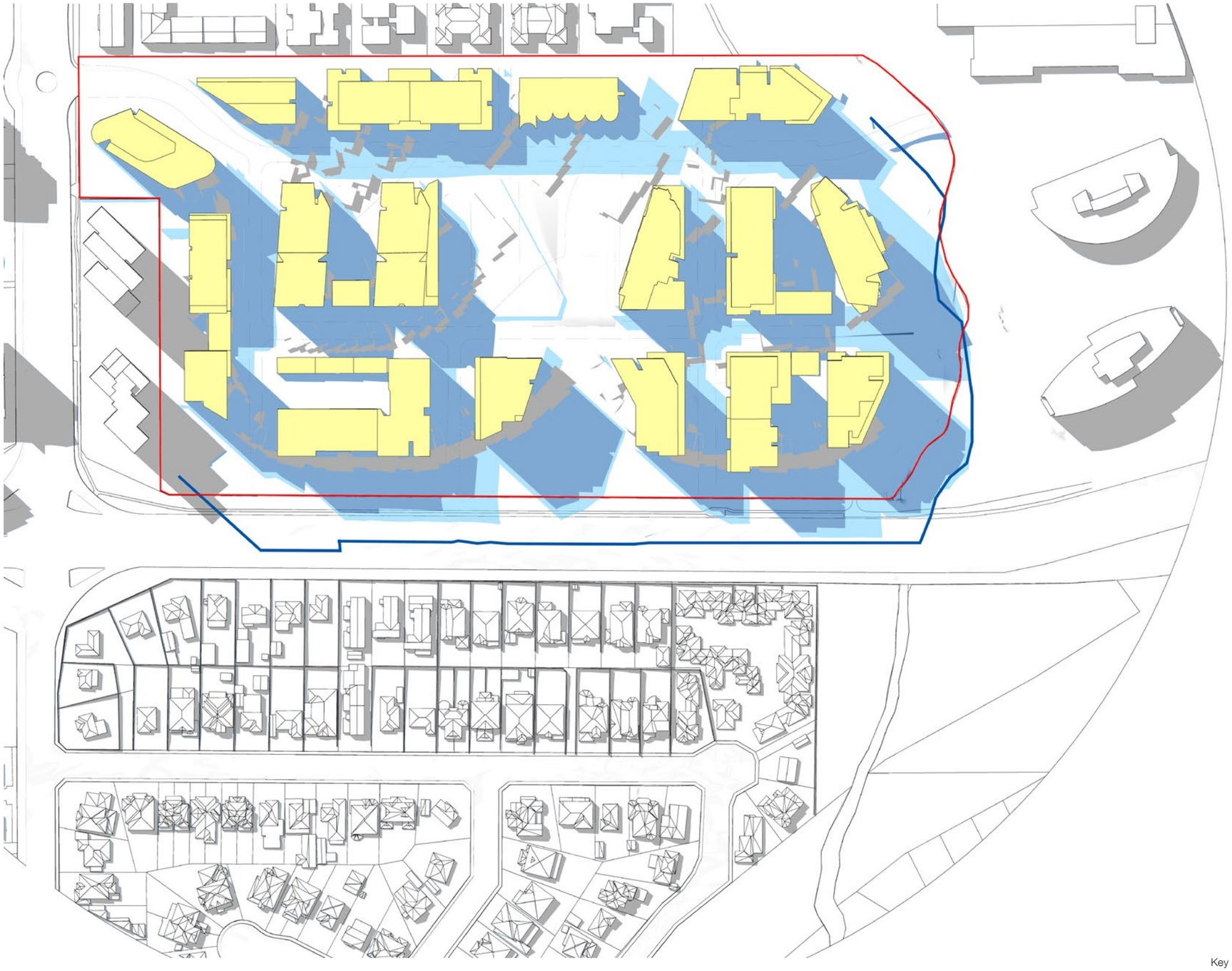
EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 10AM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing



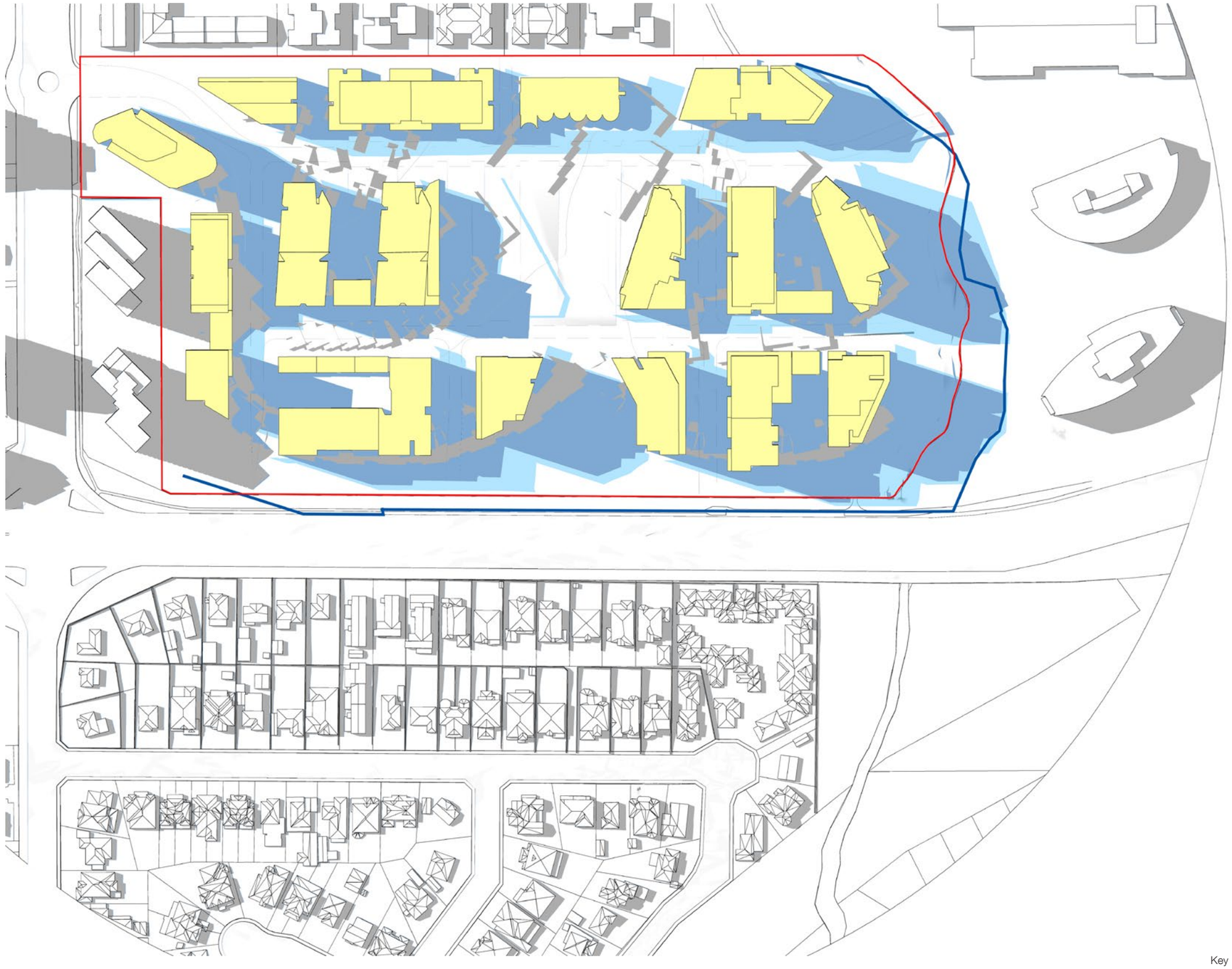
Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 11AM



EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 12PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing



EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 1PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 2PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

EPPING ROAD SOLAR ACCESS STUDY
21 MARCH/SEPTEMBER 3PM

Key
- Shadow Cast by LEP Height Plane
- Shadow Cast by Existing Building
- Additional Shadow Cast by Indicative Design Scheme
- Shadow Cast by Proposed Envelope
- Indicative Design Scheme Building Massing

Appendix C BioBanking Credit Calculator Report

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 9/08/2019 Time: 3:29:04PM Calculator version: v4.0

Major Project details

Proposal ID:	227/2016/3771MP
Proposal name:	Ivanhoe Re-development
Proposal address:	1 Ivanhoe Place Macquarie Park NSW 2113
Proponent name:	Frasers Property Australia
Proponent address:	PO Box 3307 Rhodes NSW 2138
Proponent phone:	02 9767 2000
Assessor name:	Alex Pursche
Assessor address:	Suite 28 & 29, Level 7 19 Bolton Street Newcastle NSW 2300
Assessor phone:	+61 2 4910 3406
Assessor accreditation:	227

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region	1.09	14.00
Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion	1.15	1.70
Total	2.24	16

Credit profiles

1. Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region, (ME58)

Number of ecosystem credits created	14
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region, (ME58)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (ME041)

Number of ecosystem credits created	2
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (ME041) Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

ecological AUSTRALIA

HEAD OFFICE
Suite 2, Level 3
668-672 Old Princes Highway
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 9542 5622

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 02 9542 5622

MELBOURNE
Level 1, 436 Johnston St
Abbotsford, VIC 3076
T 1300 646 131

SYDNEY
Suite 1, Level 1
101 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9542 5622

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 9542 5622

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2685
F 02 9542 5622

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 9542 5622

BRISBANE
Suite 1, Level 3
471 Adelaide Street
Brisbane QLD 4000
T 07 3503 7192

HUSKISSON
Unit 1, 51 Owen Street
Huskisson NSW 2540
T 02 4201 2264
F 02 9542 5622

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4302 1266
F 02 9542 5622

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1234
F 02 6372 9230

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1221
F 02 9542 5622

ADELAIDE
2, 70 Pirie Street
Adelaide SA 5000
T 08 8470 6650
F 02 9542 5622

1300 646 131
www.ecoaus.com.au