FPDplanning

13 July 2023

Brendon Roberts
Agile Planning
Department of Environment and Planning
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Re: Lourdes Retirement Village Planning Proposal – EHG Response

Dear Brendon,

I refer to your request to prepare a response to the issues raised by the Department's Environment and Heritage Group (EHG) in its letter dated 29 May 2023.

To respond to the issues raised the applicant has engaged Ecological Australia to undertake a further peer review of the Biodiversity Development Assessment Report (BDAR) previously completed by ACS Environmental. Ecological Australia's peer review included site inspections of remnant vegetation, validation of Plant Community Types (PCTs) and substantial consultation with the incumbent ecologists, ACS Environmental.

In consultation with Ecological Australia, ACS undertook additional site inspections of remnant vegetation surrounding the subject land to further justify and validate the PCTs and potential Threatened Ecological Communities (TECs). They also completed site inspections of other local sites which have Sydney Turpentine Ironbark Forest to compare against the subject land and further substantiate and justify their findings.

This has informed a review of the master plan as well as an updated BDAR report. As a result, the following changes have been made to the master plan to further avoid significant vegetation, including:

- Relocation and realignment of the western entrance, enabling the retention of the subject land's remaining *Syncarpia glomulifera* (turpentine) trees and areas mapped as comprising the critically endangered Sydney Turpentine Ironbark Forest
- Redesign and reduction of southern townhouses to retain more mature native vegetation along the southern boundary and thereby minimising impacts to Swift Parrot feed trees (adjacent mapped important habitat area for the species) and reduced clearing of PCT 3952
- Modification of the north eastern Independent Living Apartment Building to avoid and minimise impact on the adjacent vegetation to the north, include native vegetation allocated to the critically endangered Sydney Turpentine Ironbark Forest.

This has resulted in an overall reduction in clearing of PCT vegetation from 0.58 ha to 0.25 ha (i.e. a further avoidance of 0.33 ha of PCTs achieved).

The BDAR deals with the matters raised by EHG in its letter dated 29 May 2023 and appropriately responds to the key issues including:

- Justification for selected Plant Community Types (PTCs)
- Appropriate assessment and justification for the threatened ecological communities
- Appropriate assessment of and justification of Serious and Irreversible Threats
- Accurately details the measure the applicant has completed for the avoidance of Biodiversity Impacts.

To support this response the following updated documents are provided:

- Updated BDAR report to address all issues raised by EHG (dated 13 July 2023) & Letter from Ecological Australia including the outcomes of their site report (dated 12 July 2023)
- Updated Arboricultural Impact Assessment to reflect the amended master plan (Naturally Trees dated 16 June 2023)
- Preliminary Geotechnical Investigation Report (dated 29 September 2022)
- Addendum Urban Design document with updated master plan and landscape plans (Plus Architecture and Arcadia dated 4 July 2023)
- Letter from Blackash bushfire consultants advising that the proposed tree retention and landscaping is consistent with the bushfire management requirements for the site, and providing detail around how the bushfire requirements for the site have informed the Master Plan including the proposed access arrangements (dated 4 July 2023).

We would now like to seek EHGs further review and consideration of the updated documentation.

We look forward to continuing to work with you in finalising the Planning Proposal. Please contact me if you require any clarification.

Yours sincerely,

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Responses to letter issued by dated EHG 6/06/2023

Key Deficiencies & Technical Comments

A summary of the key information and assessment deficiencies within the BDAR is provided below. Specific technical advice relating to the amended BDAR is also provided as Attachment 2.

Key Deficiency 1: Insufficient Justification for selected Plant Community Types (PCTs)	Response	Action Undertaken
The submitted BDAR has allocated all native vegetation on the Subject Land to the one PCT being PCT 3592 Sydney Coastal Enriched Forest without adequate justification. The selection of this PCT contradicts a previous BDAR submitted with the Planning Proposal which identified PCT 1281 (now PCT 3262) Sydney Turpentine Ironbark Forest (STIF) which is a Critically Endangered Ecological Community along with PCT 1776 Coastal Enriched Sandstone Dry Forest (now PCT 3592) and PCT 1250 Coastal Sandstone Gully Forest (now PCT 3595) as occurring on the Subject Site.	The BDAR (November 2022) previously submitted identifies: the 'potential' for these communities to occur in a highly modified condition, or patches of landscaped vegetation may represent elements of these communities. The BDAR (May 2023) superseded earlier assumptions in response to feedback from EHG. EHG requires a better understanding of what vegetation on the subject land was of likely native (remnant) origin, The amended allocation to PCTs was informed by additional investigation of the site's history, the reliability of vegetation and landscape mapping and ground truthing of the subject land and surrounding environs. The July 2023 BDAR has undertaken: additional PCT mapping validation Engagement of Peer Reviewer Eco Logical Australia (ELA) who attended the site to undertake individual further analysis of plot data and soils, mapped some of the vegetation in the vicinity and have provided a letter of describing their PCT selection (provided in Appendix D of the July 2023 BDAR).	Update made to BDAR to (as far as practical) use the Department's BDAR template. Relevant sections that addressing Key Deficiency 1: - 2.2 Native vegetation, TECs and vegetation integrity (methods) - 4. 1. Native vegetation extent - 4.2. Planted native vegetation - 4.3. Plant community types - Figures 10, 11 and 12
The BDAR advises that the PCT that occurs on the Subject Land was identified by using the PCT Analysis Program (referenced as DPE 2023) to analyse the data that was collected from the four BAM floristic plots. It further advises that this analysis indicated that the closest or best fit PCT was Sydney Coastal Enriched Sandstone Forest (PCT 3592). However, the data put into this program/tool and the outcomes of the analysis have not been provided to justify this conclusion. Nor is it clear as to whether the reference to the PCT Analysis Program is a reference to the Eastern NSW Plot to PCT Assignment Tool or another PCT Tool.	The PCT Analysis Program should have referred correctly to the (Bionet) Vegetation Classification Database – PCT filter tool. DPE 2023 is assumed to refer to the custodian of the tool and the date it was most recently updated. 1. Data input into this program is described and provided 2. The current version of the PCT filter tool has been used	- BDAR updated. Refer section - 2.2 Native vegetation, TECs and vegetation integrity (methods) - 4. 1. Native vegetation extent - 4.2. Planted native vegetation - 4.3. Plant community types - Tables 4, 8 and 9

Key Deficiency 2: Insufficient assessment and justification for the unlikely occurrence of threatened ecological communities	Response	Action Undertaken

In terms of ruling out the presence of Threatened Ecological Communities (TEC) Section 3.4 of the BDAR makes conclusions about the absence of any TECs on the Subject Land without providing any evidence supporting this claim. When identifying TECs on the Subject Land using an online tool, it is not adequate justification to automatically accept the PCT with the highest number of diagnostic species present. This appears to be what has occurred in the discussion in section 3.3 of the BDAR. The identification of TECs should occur through careful examination of Part 1 and 2 of the Final Determination and comparison to the site characteristics. The BDAR contains no discussion of the potential presence of STIF and Blue Gum High Forest or any other potential TEC considering Part 1 and 2 of the final Determinations. The only reason given was "PCT3592 was found to contain more diagnostically positive species than other mapped PCTs …".	The allocation of the most likely PCTs (and in turn whether TECs occurred within the subject land) was undertaken in accordance with BAM Section 4.2, using the NSW PCT classification as described in the BioNet Vegetation Classification.
	The site history and dominance of planted vegetation made it difficult to identify the original PCT and/or 'best fit' PCT. Due to the extent of disturbance and clearing, it was difficult to determine the original best fit PCT. In response to Key Deficiency 1: the PCT allocation was informed by investigation of the site's history, the reliability of vegetation and landscape mapping and ground truthing of the subject land and surrounding environs.
	
	Additional evidence has been added to the BDAR to justify the conclusion of the selected PCTs.The July 2023 BDAR has provided a detailed assessment of PCT extents, validation of PCTs present and discusses the absence of Blue Gum High Forest within the subject land..
		- BDAR updated. Refer section
		  - 2.2 Native vegetation, TECs and vegetation integrity (methods)
		  - 4. 1. Native vegetation extent
		  - 4.3. Plant community types
		  - 4.4. TECs

Key Deficiency 3: Insufficient Assessment of Species Credit Species Assessment	Response	Action Undertaken

No information regarding the timing of surveys for fauna species credit species has been provided as such it is unclear as to whether surveys for fauna species were completed within required survey periods.
In addition, the extent of survey effort for microbats and bird species is not adequate to exclude microbats and bird species from the list of Species Credit Species.
	Section 2.4 outlines that No candidate threatened fauna species were maintained in the BAM-C for further investigation due to the absence of microhabitat for species credit species and absence of breeding habitat for dual credit species.
	Despite the lack of microhabitat and breeding habitat identified, diurnal bird census' (as per DEC 2004 guidelines) were undertaken during vegetation surveys and a microchiropteran survey also undertaken.
		- BDAR updated. Refer section
		  - 2.3 Threatened flora species method
		  - 2.4 Threatened fauna species survey
		  - 6. Prescribed impacts

In addition, the Swift Parrot Important Area map partially covers the Subject Land. This is not acknowledged in the submitted BDAR which advises that the Important Area map occurs on adjacent land, however, the important habitat map clearly crosses into the Subject Land in several locations. It is noted that the Swift Parrot is listed as a Serious and Irreversible Impact (SAII) species. Adequate assessment is required to be included within the BDAR. This would include either adequate survey or an assumption of presence and a species polygon delineating habitat within the Subject Land having regard to the Important Habitat Map.	The updated BDAR has reviewed the important mapped habitat area for the endangered swift parrot, which extends 0.24ha over the subject land., including part of the sealed boundary road, areas of exotic and non-native planted gardens and landscaping and canopy cover from the adjacent bushland.
	The updated BDAR contemplates the Swift Parrot as an entity at risk of SAII and planning revisions have been undertaken to amend the western access roadways and southern apartment building footprints to substantially reduce and avoid impacts to these areas of overlap with the important mapped habitat for the Swift Parrot.
		- BDAR updated. Refer section
		  - 5.1 Identification of threated species for assessment
		  - 5.2 presence of candidate species credit species
		  - 5.3 threatened species surveys
		  - 5.6.1 Swift Parrot Important Habitat
		  - 7. Avoid and minimise impacts
		  - 9.1 Serious and irreversible impacts
		- 11.2 Species credits

Key Deficiency 4:	Response	Action Undertaken

Insufficient assessment of and justification for discounting the presence of SAII entities
As previously advised under Key Deficiency 2 insufficient information and justification has been provided for discounting the presence of and impacts to STIF and Blue Gum High Forest from the Subject Land, both of which are SAII entities. In addition, the presence of mapped Important Habitat for the Swift parrot on the Subject Land which is also a SAII entity has not been acknowledged in the submitted BDAR. As such impacts to SAII entities in association with the planning proposal have not been adequately assessed by the submitted BDAR.
	The updated BDAR has re-evaluated the presence of STIF and the swift parrot as entities identified to be at risk of serious and irreversible impacts.
	This was determined through additional floristic data being taken by ACS, écologique and peer review ecologist ELA.
	
	A 0.17 ha portion of site comprised of three small patches was previously allocated to PCT 3592 (Sydney Coastal enriched sandstone). After further onsite review and collaboration with ELA this has been 'conservatively' amended to PCT 3262 (STIF). This portion of the subject land was previously allocated to 3592 as there is significant overland between the constituent species and the prevalence of non-local planted native species.
	
	The updated BDAR provides SAII assessments for both STIF and the Swift parrot.
		- BDAR updated. Refer section
		  - 4.4. TECs
		  - 5.1 Identification of threated species for assessment
		  - 5.2 presence of candidate species credit species
		  - 5.3 threatened species surveys
		  - 5.6.1 Swift Parrot Important Habitat
		  - 7. Avoid and minimise impacts
		  - 9.1 Serious and irreversible impacts
		  - 11.2 Species credits

Regardless of whether any subsequent development applications are State Significant Development, the applicant is required under the Biodiversity Assessment Method (BAM) 2020 to demonstrate how they have avoided and mitigated impacts to Biodiversity Values on the Subject Land. This requirement is especially highlighted when the Biodiversity Values are those that are at risk of Serious and Irreversible Impacts. This would be the case regardless of whether the applications was submitted under part 4 of the EP&A Act or as an SSD having regard to the existing R2 Zone that applies to the site	In response to the classification of PCT 3262 STIF and the Important Mapped Areas for Swift Parrots, several project design amendments have been made to further avoid areas of biodiversity value. These are outlined in table 39.	- BDAR updated. Refer section - 7. Avoid and minimise impacts

Key Deficiency 5:	Response	Action Undertaken
Avoidance of Biodiversity Impacts - Given identified concerns with the identification of PCTs, the likely occurrence of threatened ecological communities and a lack of consideration of the Important Habitat Map for the Swift parrot, the assessment of the avoidance of impacts within Section 6 and associated subsections of the BDAR is incomplete and will require revision once adequate information of the biodiversity values on the site has been provided. In addition, it is unclear if the native vegetation and trees identified for retention on the Subject Land can in fact be retained.	As above, a revision of the data and additional investigations were undertaken to determine PCTs on site. The ecologists used not only plot data but the use of the BioNet VIS PCT filtering tool and an independent peer review by ELA. Review against the final determination for STIF has been provided in table 23 (section 4.3.2).	- BDAR updated. Refer section - 5.1 Identification of threated species for assessment - 5.2 presence of candidate species credit species - 5.3 threatened species surveys - 5.6.1 Swift Parrot Important Habitat - 7. Avoid and minimise impacts - 9.1 Serious and irreversible impacts - 11.2 Species credits

Technical Comments	Response	Action Undertaken
There is not enough accurate information within the Biodiversity Development Assessment Report (BDAR) to be able to understand basic ecological site constraints for planning purposes.	The requirements of the Biodiversity Assessment Method (BAM) and the associated reporting requirements are understood and complies with Appendix K of the BAM. The amended BDAR has used the BDAR template as recommended.	- Update made to BDAR to (as far as practical) use the Department's BDAR template.
The applicant's ecologist should consider the use of the BDAR template published by DPE to assist in understanding the requirements of the Biodiversity Assessment Method (BAM) and the associated reporting requirements.	The BDAR template has been used and all existing and additional data has been provided to support the justifications made within the updated BDAR	- Update made to BDAR to (as far as practical) use the Department's BDAR template.
It remains unclear where native trees occur on the site given inconsistencies between Figure 3-1, 6-1 and 7-1.	Additional figures are provided in the updated BDAR to make it clearer where native vegetation, landscaping and exotic vegetation occur: Where Figure 3-1 previously showed SMA & SVTM mapping and the extent of PCTs determined within the subject land, this has been separated into the following: - Figure 3. Which shows the location of individual tree specimens and whether they are local or non-local native, or exotic species - Figures 10 shows SMA mapping - Figure 11 shows SVTM mapping	- Updated BDAR figures provided

	- Figure 12 shows the extent of PCTs determined within the subject land. Where Figure 6-1 previously showed vegetation being clearing and vegetation being retained., this has been separated into the following: - Figure 13 PCT clearing - Figure 17. Avoidance of vegetation Where Figure 7-1 previously showed both vegetation clearing that required offsetting and that doesn't require offsetting, this has been separated into the following: - Figure 21. Offsets required - Figure 22. Offsets not required	
The Plant Community Type (PCT) has not been adequately justified. The previously submitted BDAR dated 30 November 2022 stated in section 4.3.1 that "A total of 27 individual locally - occurring native trees and shrubs are proposed to be removed from the 63 individuals occurring within the nominal mapped PCT 1281 (STIF) area of the subject site (43%) (Figure 6 Zone 1) (Scales 2021). Section 4.3.3.2 states "This ecological community may be considered to be represented by patches of remnant individuals of such species as Turpentine, Blackbutt, Sydney Red Gum, Coast Banksia and possibly (though unlikely) Spotted Gum, within the construction envelope at Zone 2 (Figure 6) of the subject site (Figures 6, 9B & 14)." Figure 6 within this BDAR shows that zone 1 which was mapped as Sydney Turpentine Ironbark Forest (STIF) occurs along the northern third of the Subject Land. It is clear within the BDAR dated 30 November 2022 that STIF was considered as a likely PCT within the Subject Land. Further comments within the updated BDAR dated 4 May 2023 provide alternative viewpoints as to the likely PCTs, however, the justification does not provide sufficient evidence to support the PCT allocation. The updated BDAR states that "A small area of Sydney Turpentine Ironbark Forest (PCT 3262) had previously been mapped for a patch of vegetation at the north-western corner of the subject land but this patch is not present on more recent, updated versions of the mapping (Figure 3-1)". However, both Figure 3-1 and the most up-to-date State Vegetation Mapping (SVTM) contain small patches of STIF. The mapping shown supports the presence of STIF rather than supporting the	Amendments were made due to the changes in masterplan between iteration 1 & 2 based on feedback and clarification provided by EHG, as such the prior BDAR (November 2022) should not be used as a reference and is considered obsolete.	- BDAR updated. Refer section - 4.4. TECs - 5.1 Identification of threated species for assessment - 5.2 presence of candidate species credit species - 5.3 threatened species surveys - 5.6.1 Swift Parrot Important Habitat - 7. Avoid and minimise impacts - 9.1 Serious and irreversible impacts - 11.2 Species credits

claim it is not present, so it is unclear why this statement was made in Section 3.4 of the updated BDAR.		
Section 3.3.1 of the BAM states that "Table 3-5 provides a summary of the selection process for the allocation of PCT 3592". No Table 3-5 can be found in the BDAR. The following Table 3-4 provides no summary for the selection process for any PCT. Table 3-4 appears to be a summary of the characteristics of PCT 3592. Again, the justification for how the PCT allocation was conducted is absent from the BDAR.	This was an error. The reference to Table 3-4 should have read Table 3-5 which immediately followed this text. Table 3-4 provided the outputs of the PCT filter tool, including: - IBRA Region/ Subregion - Vegetation formation / class - Confirmation that the PCT was evident in vegetation mapping (OEH 2016 and DPE 2022) - Native species present and the % frequency in which they were found in the plots that form the benchmark data in Bionet Vegetation Classification Database. The BDAR template has been used and the table numbering amended along with details of additional investigations completed and PCT allocation methods and outcomes. The discussion and justification of PCTs within the subject land is described in Section 4.3 of the updated BDAR (July 2023).	- BDAR updated. Refer section - 4.3 Plant community types
Section 3.4 of the BDAR makes conclusions about the absence of any Threatened Ecological Communities (TECs) on the Subject Land without providing any evidence supporting this claim. When identifying TECs on the Subject Land using the online tool, it is not adequate justification to automatically accept the PCT with the highest number of diagnostic species present. This appears to be what has occurred in the discussion in section 3.3 of the BDAR. The identification of TECs should occur through careful examination of Part 1 and 2 of the Final Determination and comparison to the site characteristics. The BDAR contains no discussion of the potential presence of STIF and Blue Gum High Forest or any other potential TEC considering Part 1 and 2 of the final Determinations. The only justification given was "PCT3592 was found to contain more diagnostically positive species than other mapped PCTs …".	Refer above response to Key Deficiency 2.	Refer above response to Key Deficiency 2.

When using the Plot data found in Appendix A (BDAR 4 May 2023) and the Vegetation Information System (VIS) PCT Filter Tool, the STIF (PCT3262) contains either one of the highest, second or third highest number of positive diagnostic species in all 4 plots. This has not been presented as a result on the analysis of the plot data within the BDAR nor used as discussion to justify the final allocation of PCTs. Due to the lack of discussion in the BDAR it is unclear how the PCT was derived. Please note given the lack of Plot data submitted with the BDAR (including the raw filed data) EHG was unable to analysis the plot data using the East Coast Plot to PCT Assignment Tool.
 	
While the number of diagnostically positive species can be helpful in providing an idea of the likelihood of one PCT over another, it is not the only aspect that determines the likelihood of the occurrence of a PCT or a TEC. Even the Final Determinations give a list of the Assemblage of species in Part 1 but also with several caveats such as characteristic species may be abundant or rare and comprise only a subset of the complete list of species recorded in known examples of the community. However, this must be looked at considering Part 2 also which includes information regarding the area occupied by the ecological community.
For assistance in the identification of TECs, the NSW Scientific Committee has provided Guidelines for interpreting listing criteria for species, populations and ecological communities refer to the links below.
NSW Threatened Species Scientific Committee publications | NSW Environment and Heritage
Guidelines for interpreting Guidelines for interpreting listing criteria for species, populations and ecological communities under the NSW Threatened Species Conservation Act
The definition of an ecological community has been provided in section 4 of the guidance on page 40. It states:
The BC Act (section 1.6) defines an ecological community as 'an assemblage of species occupying a particular area'. This definition closely follows modern scientific texts (e.g., Begon et al. 2006) and embodies three requirements (Preston & Adam 2004a):
i) the constituents of a community must be species;
ii) the species need to be brought together into an assemblage; and
iii) the assemblage of species must occupy a particular area.
	The BDAR has been updated to provide a detailed description of the inputs and outcomes from using the Vegetation Classification Database PCT filter tool, including limitations.
	
	The main limitation being that there is very little difference between the habitat present, climate (elevation, rainfall etc) and the assemblage of species for PCT 3262 and 3592.
	
	Additional investigations and photo plates provided of STIF proximal to the subject land are also provided in the BDAR.
		- BDAR updated. Refer section
		  - 2.2.8 Vegetation classification database
		  - 4.3 Plant community types

Please note that the definition refers to the species, their assemblage and it's occupying a particular area. These are the characteristics that define our ecological communities, and it is how we are to identify them. Importantly, the species, their assemblage and the area they occupy are outlined within Parts 1 and 2 of the Final Determinations and these are used to determine and justify the allocation of PCTs that are TECs on any site. The final Determinations also contain additional information to assist in their identification. None of these characteristics have been discussed in the BDAR. To say that there is no TEC on the Subject Land has not been adequately justified.		
It remains unclear why Plot 3 was located within an area that is primarily mapped as Landscaping instead of within locations mapped as native vegetation	Floristic data has been provided to represent all areas. As is done when providing evidence that a cleared pasture does not contain derived native grasses. The location of Plot 3 was undertaken to represent all areas in determining planted vs native vegetation.	- BDAR updated. Refer section - 2.2.5 plot-based vegetation survey

No maps of vegetation zones have been provided to distinguish between the higher integrity zones along the northern portion of the site and the areas where native canopy species are the dominant characteristic of the site. Nor is it clear how the vegetation zones on the site were identified.	The BDAR presents the vegetation integrity plots which coincide with Plots 1-4 in section 2.2.6 and the mapping is provided in Appendix B.
	
	The plots and transects were taken in compliance with the BAM data collection requirements and are shaped to avoid areas of hardstand.
	
	The vegetation integrity plots were conducted and compliance with the minimum number of plots required (i.e., 1 plot per zone <2ha).
		- Updated BDAR and additional mapping figures provided in the updated BDAR. Refer sections:
		  - 2.2.6 Vegetation Integrity Assessment
		  - Appendix B

Table 4-1 and 4-2 do not contain adequate information to determine how the assessment of ecosystem credit species was undertaken. The BDAR template provides guidance as to how you can provide adequate information to demonstrate how decisions were made to include or exclude ecosystem credits. It is assumed that all species within table 4-1 were retained within the BAM-C calculations and that all species listed in table 4-2 were excluded from the BAM-C. However, table 4-2 only provides a description of general habitat requirements and not a justification as to why it was removed due to habitats observed on the Subject Land. It is noted that the lists of ECS generated by the BAM-C will be in error if the correct PCTs have not been identified on the Subject Land.	The BDAR template has been used to populate the ecosystem credit calculations. The ecosystem credit and species credit species tables have been updated to include additional species listed under PCT 3262 (that were not listed under PCT 3592) and what species were excluded and included has been made clear.	- Updated BDAR threatened species assessment (ecosystem and species credit species) tables . Refer section 5.

Section 4.1.2 of the BDAR describes the Species Credit Species assessment. It is assumed that the reference to table 4-2 is in error and it is referring to Table 4-3. It states that the table contains the PCTs in which each species is predicted to occur however this information is not listed anywhere within table 4-3. No details have been provided to justify the timing of any surveys other than for flora species within table 4-5. This table does not report whether surveys were conducted in the correct season. It is unknown whether any fauna surveys were completed within the required survey period. The conclusions within this section of the BDAR cannot be verified.	The BDAR has been updated to provide additional information about the surveys and their timings. No candidate threatened fauna species were maintained in the BAM-C for further investigation due to the absence of microhabitat for species credit species and breeding habitat for dual credit species. Despite the lack of microhabitat and breeding habitat identified, diurnal bird census (as per DEC 2004 guidelines) was undertaken during vegetation surveys and a microchiropteran survey also undertaken.	- BDAR updated. Refer section - 2.4 threatened fauna species survey - Tables 10-14 - Tables 29-36
The number of trap nights for microchiropteran bats is not compliant with the requirements stated within the 'Species credit' threatened bats and their habitats: NSW survey guide for the Biodiversity Assessment Method (OEH 2018). The minimum number of acoustic detection trap nights is	Microchiropteran bat species were initially not maintained in the BAM -C as requiring further assessment. Additional assessment has found that the subject land is located just under 2km from potential escarpment habitat and therefore additional anabat surveys will be undertaken in Summer 2023-2024.	- BDAR updated. Refer section - 5.1 Identification of threatened species for assessment
Similarly, the amount of survey effort for birds would not be adequate to be able to exclude any species from the list of SCS. The Swift Parrot Important Area map partially covers the Subject Land. The BDAR has claimed that the Important Area map occurs on land adjacent, however, the map clearly crosses into the Subject Land in several places along the boundary. It is noted that the Swift Parrot is listed as a SAII species. Adequate assessment is required to be included within the BDAR. This would include either adequate survey or an assumption of presence and a species polygon delineating habitat within the Subject Land. Habitat for the Swift Parrot on the Subject Land should be avoided. It is noted that the lists of SCS generated by the BAM-C will be in error if the correct PCTs have not been identified on the Subject Land	Refer response to Key deficiency 3 and 4.	Refer response to Key deficiency 3 and 4.
Given identified concerns with the identification of PCTs and the identified unlikely occurrence of threatened ecological communities as well as a lack of consideration of the Important Habitat Map for the Swift parrot the assessment of the avoidance of impacts within Section 6 and associated subsections is incomplete and will need to be revised.	Refer response to Key Deficiencies 2, 3 and 4.	Refer response to Key Deficiencies 2, 3 and 4.

Similarly, the identification of direct and indirect impacts is unclear and needs to be revised once adequate information of the biodiversity values on the site has been provided. There appears to be inconsistency between Figures 3-1, 6-1 and 7-1. Some areas appear to be native vegetation but have not been included as such within Figure 3-1 and have not been included as exotic trees within Figure 6-1. Some areas have been mapped as landscaping within Figure 3-1 then not mapped as an exotic tree in Figure 6-1 but also included as an area requiring offset in Figure 7-1. The inconsistency in the mapping is required to be corrected to provide an accurate understanding of the presence of native vegetation on the site to be able to then understand the extent of the impacts	Figures 3-1, 6-1 and 7-1 have been separated out into several new figures as responded to technical comment (third row).	- BDAR updated - Figures 3-1, 6-1 and 7-1 have been separated out into several new figures as responded to technical comment (third row).
Given the Swift Parrot Important Area Map occurs on the Subject Land and the presence of intact bushland to both the north and south, it would be reasonable to suggest that the Subject Land could form movement corridors. Consideration of this should be included within the discussion of Prescribed Impacts in accordance with the BAM.	The BDAR has been updated to discuss the prescribed impacts and habitat connectivity and the swift parrot has been evaluated as an SAII. Prescribed impacts are discussed in Section 6 of the July 2023 BDAR. Section 8.3.4 of the July 2023 BDAR discusses connectivity on the subject land.	- BDAR updated. Refer section - 8.3.4 Habitat Connectivity
The BDAR has assumed that there will be no impacts to water quality, water bodies and hydrological processes. While these impacts can be minimised through mitigation measures, the impact is not completely avoided. Consideration should be given to both the construction and operation of the proposal in terms of the prescribed impacts to the hydrological processes that sustain threatened entities.	The prescribed impacts section has been updated to include detail around the waterbodies, water quality and hydrological processes. The proposed design will have stormwater detention system to comply with council's requirements. The concept plan involves discharging the stormwater through existing connections onsite. The overall outcome results in a lower overall discharge rate from the site as well as more treated stormwater into the system.	- BDAR updated. Refer section - 8.3.3 Waterbodies, water quality and hydrological processes
Given the lack of information regarding the presence of biodiversity values on the site, it is difficult to be able to provide an adequate identification of measures to mitigate of manage these impacts and will need to be revised.	An updated mitigation measures table has been populated including mitigated impacts to biodiversity values. These mitigations, including amendments to the development layout and planning proposal masterplan have been considered and actioned to reduce impact to biodiversity impacts.	- BDAR updated. Refer section - 7.1.3 Project Design

Any assessment of SAII entities cannot take place until the identification of PCTs, ECS and SCS on the Subject Land has been undertaken in accordance with the BAM.	The BDAR has been updated and is compliant with the BAM requirements. SAII assessments have been undertaken for Swift Parrot and STIF.	- BDAR updated. Refer section - 9 Serious and Irreversible Impacts

Naturally Trees

'Expert Arboricultural planning, advice and care since 1998'

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Arboricultural Impact Appraisal and Method Statement

(Revision C)

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Prepared for
Lourdes Retirement Village

16 June 2023

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Summary

The proposed development is to demolish a number of single and two-story buildings and replace them with a number of multi-story buildings and a single-story chapel. The proposed development also involves the re-arrangement of some of the surrounding roadways and associated services. I have inspected all the trees that could be affected and list their details in Appendix 2. Based on this information, I provided guidance to project architect on the constraints these trees impose on the use of the site.

Sixty-two high category trees and one hundred and fifty-three low category trees will be lost because of this proposal. However, sixty-nine of the low category trees are exempt from Ku-Ring-Gai Council's Tree Preservation Order and a comprehensive landscaping scheme to mitigate these losses is proposed that will include the planting of new trees.

The proposed changes may adversely affect a further one hundred and two high category trees and sixty-two low category trees if appropriate protective measures are not taken. However, if adequate precautions to protect the retained trees are specified and implemented through the arboricultural method statement included in this report, the development proposal is expected to have a moderate to high impact on the contribution of trees to local amenity or character.

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1. INTRODUCTION

1.1 **Instruction:** I am instructed by Levande Lourdes to inspect the tree population at 95 Stanhope Road, Killara and to provide an arboricultural report to accompany a development application. This report investigates the impact of the proposed development on trees and provides the following guidelines for appropriate tree management and protective measures:

- a schedule of the relevant trees to include basic data and a condition assessment;
- an appraisal of the impact of the proposal on trees and any resulting impact that has on local character and amenity;
- a preliminary arboricultural method statement setting out appropriate protective measures and management for trees to be retained

1.2 **Purpose of this report**: This report provides an analysis of the impact of the development proposal on trees with additional guidance on appropriate management and protective measures. Its primary purpose is for the council to review the tree information in support of the planning submission and use as the basis for issuing a planning consent or engaging in further discussions towards that end. Within this planning process, it will be available for inspection by people other than tree experts, so the information is presented to be helpful to those without a detailed knowledge of the subject.

1.3 **Qualifications and experience:** I have based this report on my site observations and the provided information, and I have come to conclusions in the light of my experience. I have experience and qualifications in arboriculture and include a summary in Appendix 1.

1.4 **Documents and information provided:** Levande Lourdes provided me with copies of the following documents:

- Survey Plan, Dwg No. 21388 (Sheet S1 to S11), by Norton Survey Partners dated 22 April 2015; and
- Master Plan, Dwg No. 20576, by Plus Architecture dated 16 June 2023.

1.5 **Scope of this report:** This report is only concerned with three hundred and seventy-nine trees located within and adjacent to the subject site. It takes no account of other trees, shrubs or groundcovers within the site unless stated otherwise. It includes a preliminary assessment based on the site visit and the documents provided, listed in 1.4 above.

2. THE LAYOUT DESIGN

2.1 **Tree AZ method of tree assessment:** The TreeAZ assessment method determines the worthiness of trees in the planning process. TreeAZ is based on a systematic method of assessing whether individual trees are important and how much weight they should be given in management considerations. Simplistically, trees assessed as potentially important are categorised as '**A**' and those assessed as less important are categorised as '**Z**'. Further explanation of TreeAZ can be found in Appendix 3.

In the context of new development, all the Z trees are discounted as a material constraint in layout design. All the A trees are potentially important and they dictate the design constraints. This relatively simple constraints information is suitable for use by the architect to optimise the retention of the best trees in the context of other material considerations.

2.2 Site visit and collection of data

2.2.1 **Site visit:** I carried out an unaccompanied site visit on 24 May 2021 and 28 March 2023. All my observations were from ground level and I estimated all dimensions unless otherwise indicated. Aerial inspections, root or soil analysis, exploratory root trenching and internal diagnostic testing was not undertaken as part of this assessment. I did not have access to trees on other private properties and have confined observations of them to what was visible from within the property. The weather at the time of inspection was clear and dry with good visibility.

2.2.2 **Brief site description:** 95 Stanhope Road is located in the residential suburb of Killara (refer figure 1). The site is on the southern side of the road and surrounded by residential development. The property consists of the existing Lourdes Retirement Village that is currently occupied. A variety of ornamental, coniferous and local indigenous trees are scattered throughout the site and around the site boundaries.

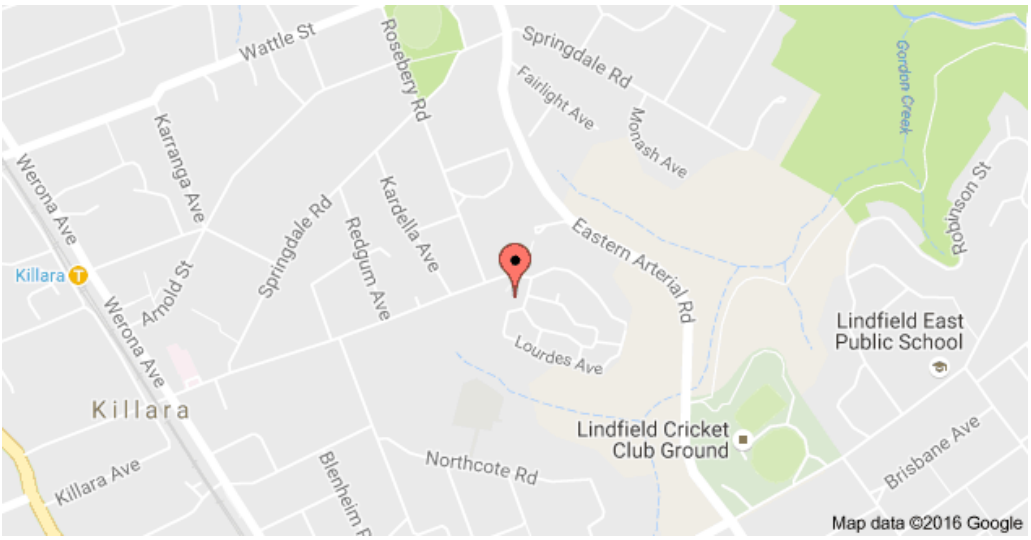

Figure 1: The location of the subject site (www.googlemaps.com).

2.2.3 **Collection of basic data:** I inspected each tree and have collected information on species, height, diameter, maturity and potential for contribution to amenity in a development context. I have recorded this information in the tree schedule included, with explanatory notes, in Appendix 2. Each tree was then allocated to one of four categories (**AA**, **A**, **Z** or **ZZ**), which reflected its suitability as a material constraint on development.

2.2.4 **Identification and location of the trees:** I have illustrated the locations of the significant trees on the Tree Management Plan (Plan TMP01) included as Appendix 8. This plan is for illustrative purposes only and it should not be used for directly scaling measurements.

2.2.5 **Advanced interpretation of data:** Australian Standard *Protection of trees on development sites* (AS4970-2009), recommends that the trunk diameter measurement for each tree is used to calculate the tree protection zone (TPZ), which can then be interpreted to identify the design constraints and, once a layout has been consented, the exclusion zone is to be protected by barriers.

2.2.6 **Plan updates:** During my site visit, I noted five trees (Trees 121, 175, 176, 200 and 236) that were not shown on the land survey. I have illustrated their approximate locations on plan TMP01 but these positions have not been accurately surveyed. I do not consider that this has affected the conclusions of this report but if their locations are considered important, they should be accurately surveyed. Additionally, a number of trees were no longer present on site and have been removed from the plan.

2.3 **The use of the tree information in layout design:** Following my inspection of the trees, the information listed in Appendix 2 was used to provide constraints guidance based on the locations of all the A trees. All the Z trees were discounted because they were not considered worthy of being a material constraint. This guidance identified two zones of constraint based on the following considerations:

- **The tree protection zone** (TPZ) is an area where ground disturbance must be carefully controlled. The TPZ was established according to the recommendations set out in AS4970-2009 and is the radial offset distance of twelve (x12) times the trunk diameter. In principle, a maximum encroachment of 10% is acceptable within the TPZ and a high level of care is needed during any activities that are authorised within it if important trees are to be successfully retained.

- **The structural root zone** (SRZ) is a radial distance from the centre of a tree's trunk, where it is likely that structural, woody roots would be encountered. The distance is calculated on trunk flare diameter at ground level. The SRZ may also be influenced by natural or built structures, such as rocks and footings. The SRZ only needs to be calculated when major encroachment (>10%) into a TPZ is proposed.

3. ARBORICULTURAL IMPACT APPRAISAL

3.1 **Summary of the impact on trees:** I have assessed the impact of the proposal on trees by the extent of disturbance in TPZs and the encroachment of structures into the SRZ (as set out briefly in 2.3 above and more extensively in Appendix 2). All the trees that may be affected by the development proposal are listed in Table 1

Table 1: Summary of existing trees and trees that may be affected by development

Impact	Reason	Important trees		Unimportant trees	
		AA	A	Z	ZZ
Retained trees that may be affected through disturbance to TPZs	Removal of existing surfacing/structures/ landscaping and/or installation of new surfacing/structures/ landscaping	TOTAL 18	TOTAL 84	TOTAL 52	TOTAL 10
Trees to be removed	Building and civil construction and/or level variations within TPZ	TOTAL 5	TOTAL 57	TOTAL 130	TOTAL 23

3.2 **Detailed impact appraisal**

3.2.1 **Category AA and A trees to be removed:** The proposed development will necessitate the removal of sixty-two high category trees. These trees will be directly or indirectly impacted by the proposed works and are considered moderate to high significance with good health and condition. In order to compensate for loss of amenity, consideration should be given to replacement planting within the site.

3.2.2 **Category AA and A trees that could potentially be adversely affected through TPZ disturbance:** One hundred and two category A and AA trees could potentially be adversely affected through disturbance to their TPZs as follows:

- **Trees 8, 9, 10, 22, 25, 32, 41, 46, 60, 103, 108, 118, 123, 124, 125, 165, 175, 176, 189, 196, 201, 231, 232, 262, 263, 264, 280, 283, 309, 319, 320, 322, 325, 332, 338, 358, 368, 369 and 371:** These are important trees with a high potential to contribute to amenity so any adverse impacts on them should be minimised. The proposed demolition and construction works will come within close proximity to these and will cause harm if not carried out with care. I have reviewed the situation carefully and my experience is that these trees could be successfully retained without any adverse effects if appropriate protective measures are properly specified and controlled through a detailed arboricultural method statement.

- **The Remaining Trees:** The remaining high category trees are positioned away from the proposed development. Although, the changes may cause harm if not carried out with care, I have reviewed the situation carefully and my experience is that these trees could be successfully retained without any adverse effects if appropriate protective measures are properly specified and controlled through a detailed arboricultural method statement.

3.2.3 **Low category trees to be retained:** Sixty-two low category trees remain outside the works areas and can be retained successfully retained without any adverse effects if appropriate protective measures are properly specified and controlled through a detailed arboricultural method statement.

3.2.4 **Low category trees to be removed:** The proposed development will necessitate the removal of one hundred and fifty-three trees of low and very low retention value. None of these trees are considered significant or worthy of special measures to ensure their preservation. It should be noted that Trees 2, 15, 23, 35, 49, 50, 51, 76, 85, 87, 88, 91, 92, 93, 94, 98, 99, 100, 130, 132, 134, 143, 145–161, 171, 188, 191, 207, 209, 210, 214, 215, 216, 217, 220–228, 234, 235, 247, 250, 251, 254, 255, 260, 270, 293, 330 and 331 are exempt from Ku-Ring-Gai Council's Tree Preservation Order.

3.3 Proposals to mitigate any impact

3.3.1 **Protection of retained trees:** The successful retention of trees within the site will depend on the quality of the protection and the administrative procedures to ensure protective measures remain in place throughout the development. An effective way of doing this is through an arboricultural method statement that can be specifically referred to in the planning condition. An arboricultural method statement for this site is set out in detail in Section 4.

3.3.2 **New planting:** In the context of the loss of trees, a comprehensive new landscaping scheme is proposed including semi-mature trees to be planted within available areas in prominent locations. The new trees should have the potential to reach a significant height without excessive inconvenience and be sustainable into the long term, significantly improving the potential of the site to contribute to local amenity and character.

3.3.3 **Summary of the impact on local amenity:** Sixty-two high category trees and one hundred and fifty-three low category trees will be lost because of this proposal. However, sixty-nine of the low category trees are exempt from Ku-Ring-Gai Council's Tree Preservation Order and a comprehensive landscaping scheme to mitigate these losses is proposed that will include the planting of new trees. The proposed changes may adversely affect a further one hundred and two high category trees and sixty-two low category trees if appropriate protective measures are not taken. However, if adequate precautions to protect the retained trees are specified and implemented through the arboricultural method statement included in this report, the development proposal is expected to have a moderate to high impact on the contribution of trees to local amenity or character.

4. ARBORICULTURAL METHOD STATEMENT

4.1 Introduction

4.1.1 **Terms of reference:** The impact appraisal in Section 3 identified the potential impacts on trees caused by proposed development. Section 4 is an arboricultural method statement setting out management and protection details that must be implemented to secure successful tree retention. It has evolved from Australian Standard AS4970-2009 *Protection of trees on development sites*.

4.1.2 **Plan TMP01:** Plan TMP01 in Appendix 8 is illustrative and based entirely on provided information. This plan should only be used for dealing with the tree issues and all scaled measurements must be checked against the original submission documents. The precise location of all protective measures must be confirmed at the pre-commencement meeting before any demolition or construction activity starts. Its base is the existing land survey, which has the proposed layout superimposed so the two can be easily compared. It shows the existing trees numbered, with high categories (A) highlighted in green triangles and low categories (Z) highlighted in blue rectangles. It also shows the locations of the proposed protective measures.

4.2 Tree protection with fencing and ground protection

4.2.1 **Protection fencing:** Tree protection fencing must comply with AS4970 (section 4.3) recommendations. An illustrative guide is included as Appendix 4. The approximate location of the barriers and the TPZs is illustrated on plan TMP01. The precise location of the fencing must be agreed with the project Arborist before any development activity starts.

4.2.2 **Ground protection:** Any TPZs outside the protective fencing must be covered in ground protection based on AS4970 recommendations until there is no risk of damage from the demolition and construction activity. An illustrative specification for this ground protection is included as Appendix 5. On this site, it must be installed near retained trees as illustrated on plan TMP01 before any demolition and construction starts.

4.3 **Precautions when working in TPZs:** Any work in TPZs must be done with care as set out in Appendix 6. On this site, special precautions must be taken near the trees that are in close proximity to the development of the buildings and new roadways as illustrated on plan TMP01 and summarised below:

- **Removal of existing surfacing/structures and replacement with new surfacing/structures:** Retained trees, including •Trees 8, 9, 10, 22, 25, 60, 103, 165, 175, 176, 189, 196, 201, 231, 232, 262, 263, 264, 280, 283, 309, 319, 320, 322, 325, 332, 338, 358, 368, 369 and 371, may be adversely affected by the demolition and construction works or the installation of a small area of new surfacing. Any adverse impact must be minimised by following the guidance set out in Appendix 6.

- **Installation of new soft landscaping:** All landscaping activity within TPZs has the potential to cause severe damage and any adverse impact must be minimised by following the guidance set out in Section 7 of Appendix 6.

- **Installation of new services or upgrading of existing services:** It is often difficult to clearly establish the detail of services until the construction is in progress. Where possible, it is proposed to use the existing services into the site and keep all new services outside TPZs. However, where existing services within TPZs require upgrading or new services have to be installed in TPZs, great care must be taken to minimise any disturbance. Trenchless installation should be the preferred option but if that is not feasible, any excavation must be carried out by hand according to the guidelines set out in Section 6 of Appendix 6. If services do need to be installed within TPZs, consultation must be obtained from the project Arborist and/or council before any works are carried out.

- **Damage to street trees:** Any damage to street trees as a result of erection of hoardings, scaffolding or due to the loading/unloading of vehicles adjacent the site must be immediately reported to the Council's Street Tree Contract Coordinator, in order to determine the appropriate action for maintaining the health and structural integrity of any damaged street tree.

4.4 Other tree related works

4.4.1 **Site storage, cement mixing and washing points:** All site storage areas, cement mixing and washing points for equipment and vehicles must be outside TPZs unless otherwise agreed with the project Arborist and/or council. Where there is a risk of polluted water run off into TPZs, heavy-duty plastic sheeting and sandbags must be used to contain spillages and prevent contamination.

4.4.2 **Pruning:** Any pruning that is required to accommodate hoardings, scaffolding or to accommodate the unloading/loading of vehicles and has been approved by Council shall be carried out by a qualified Arborist (AQF3) and must be in accordance with AS4373 Australian Standards 'Pruning of Amenity Trees'.

4.5 Programme of tree protection and supervision

4.5.1 **Overview:** Tree protection cannot be reliably implemented without arboricultural input. The nature and extent of that input varies according to the complexity of the issues and the resources available on site. For this site, a summary of the level of arboricultural input that is likely to be required is set out in Appendix 7. The project arborist must be instructed to work within this framework to oversee the implementation of the protective measures and management proposals set out in this arboricultural method statement.

The framework in Appendix 7 must form the basis for the discharge of planning conditions through site visits by the project arborist. These supervisory actions must be confirmed by formal letters circulated to all relevant parties. These permanent records of each site visit will accumulate to provide the proof of compliance and allow conditions to be discharged as the development progresses. The developer must instruct the project arborist to comply with the supervision requirements set out in this document before any work begins on site.

4.5.2 **Phasing of arboricultural input:** Trees can only be properly budgeted for and factored into the developing work programmes if the overall project management takes full account of tree issues once consent is confirmed. The project arborist must be involved in the following phases of the project management:

1. **Administrative preparation before work starts on site:** It is normal for a development proposal to vary considerably from the expectations before consent as the detailed planning of implementation evolves. The early instruction of the project arborist ensures that tree issues are factored into the complexities of site management and can often help ease site pressures through creative approaches to tree protection. Pre-commencement discussions between the project arborist and the developer's team is an effective means of managing the tree issues with difficult constraints.

2. **Pre-commencement site meeting:** A pre-commencement meeting must be held on site before any of the demolition and construction work begins. This must be attended by the site manager and the project arborist. Any clarifications or modifications to the consented details must be recorded and circulated to all parties in writing. This meeting is where the details of the programme of tree protection will be agreed and finalised by all parties, which will then form the basis of any supervision arrangements between the project arborist and the developer.

3. **Site supervision:** Once the site is active, the project arborist must visit at an interval agreed at the pre-commencement site meeting. The supervision arrangement must be sufficiently flexible to allow the supervision of all sensitive works as they occur. The project arborist's initial role is to liaise with developer to ensure that appropriate protective measures are designed and in place before any works start on site. Once the site is working, that role will switch to monitoring compliance with arboricultural conditions and advising on any tree problems that arise or modifications that become necessary.

4.6 **Site management:** It is the developer's responsibility to ensure that the details of this arboricultural method statement and any agreed amendments are known and understood by all site personnel. Copies of the agreed documents must be kept on site at all times and the site manager must brief all personnel who could have an impact on trees on the specific tree protection requirements. This must be a part of the site induction procedures and written into appropriate site management documents.

5. HOW TO USE THIS REPORT

5.1 **Limitations:** It is common that the detail of logistical issues such as site storage and the build programme are not finalised until after consent is issued. As this report has been prepared in advance of consent, some of its content may need to be updated as more detailed information becomes available once the post-consent project management starts. Although this document will remain the primary reference in the event of any disputes, some of its content may be superseded by authorised post-consent amendments.

5.2 **Suggestions for the effective use of this report:** Section 4 of this report, including the relevant appendices, is designed as an enforcement reference. It is constructed so the council can directly reference the detail in a planning condition. Referencing the report by name and relating conditions to specific subsections is an effective means of reducing confusion and facilitating enforcement in the event of problems during implementation. More specifically, the following issues should be directly referenced in the conditions for this site:

1.	Pre-commencement meeting	4.5
2.	Protection fence	4.2.1 and Appendix 4
3.	Ground protection	4.2.2 and Appendix 5
4.	Removal of surfacing/structures	4.3 and Appendix 6 (Section 4)
5.	Installation of surfacing/structures	4.3 and Appendices 6 (Section 5)
6.	Services	4.3 and Appendix 6 (Section 6)
7.	Landscaping	4.3 and Appendix 6 (Section 7)
8.	Programming of tree protection	4.5 and Appendix 7
9.	Arboricultural supervision	4.5 and Appendix 7

Each of the above matters shall be supervised by the project arborist and the relevant conditions can only be discharged once that supervision has been confirmed in writing to the relevant parties. The last column of the table in Appendix 7 is to be used so that the various supervision issues can be recorded as they are confirmed by supervision letters. It is intended to act as a summary quick reference to help keep track of the progress of the supervision.

6. OTHER CONSIDERATIONS

6.1 **Trees subject to statutory controls:** The subject trees (excluding Trees 2, 15, 23, 35, 49, 50, 51, 76, 85, 87, 88, 91, 92, 93, 94, 98, 99, 100, 130, 132, 134, 143, 145–161, 171, 188, 191, 207, 209, 210, 214, 215, 216, 217, 220–228, 234, 235, 247, 250, 251, 254, 255, 260, 270, 293, 330 and 331) are legally protected under Ku-ring-gai Council's Tree Preservation Order, it will be necessary to consult the council before any pruning or removal works other than certain exemptions can be carried out. The works specified above are necessary for reasonable management and should be acceptable to the council. However, tree owners should appreciate that the council may take an alternative point of view and have the option to refuse consent.

6.2 **Trees outside the property:** Trees located in the adjacent properties effectively out of the control of the owners of 95 Stanhope Road, Killara. It will not be possible to easily carry out the recommended works without the full co-operation of the tree owners. The implications of non-cooperation require legal interpretation and are beyond the scope of this report.

7. BIBLIOGRAPHY

7.1 **List of references:**

Australian Standard AS4373-2007 *Pruning of Amenity Trees*.
Standards Australia.

Australian Standard AS4970-2009 *Protection of trees on development sites*.
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Barrell, J (2009) Draft for Practical Tree AZ version 9.02 A+NZ
Barrel Tree Consultancy, Bridge House, Ringwood BH24 1EX

Brooker, M. Kleinig, D (1999) Field guide to eucalypts – South eastern Aust.
Blooming Books, Hawthorn Vic.

Matheny, N.P. & Clark, J.R. (1998) Trees & Development: A Technical Guide to Preservation of Trees During Land Development
International Society ofArboriculture, Savoy, Illinois.

Mattheck, Dr. Claus R., Breloer, Helge (1995) The Body Language of Trees - A Handbook for Failure Analysis;
The Stationery Office, London. England.

Robinson, L (1994) Field Guide to the Native Plants of Sydney
Kangaroo Press, Kenthurst NSW

8. DISCLAIMER

8.1 Limitations on use of this report:

This report is to be utilized in its entirety only. Any written or verbal submission, report or presentation that includes statements taken from the findings, discussions, conclusions or recommendations made in this report, may only be used where the whole of the original report (or a copy) is referenced in, and directly attached to that submission, report or presentation.

ASSUMPTIONS

Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible: however, Naturally Trees can neither guarantee nor be responsible for the accuracy of information provided by others.

Unless stated otherwise:

- *Information contained in this report covers only those trees that were examined and reflects the condition of those trees at time of inspection: and*
- *The inspection was limited to visual examination of the subject trees without dissection, excavation, probing or coring. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the subject trees may not arise in the future.*

Yours sincerely

Andrew Scales
Dip. Horticulture
Dip. Arboriculture AQF5

APPENDIX 1

Brief qualifications and experience of Andrew Scales

1. Qualifications:

Associate Diploma Horticulture	Northern Sydney Institute of TAFE	1998
Certificate in Tree Surgery	Northern Sydney Institute of TAFE	1998
Diploma of Horticulture (Arboriculture)	Northern Sydney Institute of TAFE	2006
Diploma of Arboriculture AQF5	Northern Sydney Institute of TAFE	2019

2. Practical experience:

Being involved in the arboricultural/horticultural industry for in excess of 20 years, I have developed skills and expertise recognized in the industry. Involvement in the construction industry and tertiary studies has provided me with a good knowledge of tree requirements within construction sites.

As director of Naturally Trees, in this year alone I have undertaken hundreds of arboricultural consultancy projects and have been engaged by a range of clients to undertake tree assessments. I have gained a wide range of practical tree knowledge through tree removal and pruning works.

3. Continuing professional development:

Visual Tree Assessment (Prof. Dr. Claus Mattheck)	Northern Sydney Institute of TAFE	2001
Wood Decay in Trees (F.W.M.R.Schwarze)	Northern Sydney Institute of TAFE	2004
Visual Tree Assessment (Prof. Dr. Claus Mattheck)	Carlton Hotel, Parramatta NSW	2004
Tree A-Z / Report Writing (Jeremy Barrell)	Northern Sydney Institute of TAFE	2006
Up by Roots – Healthy Soils and Trees in the Built Environment (James Urban)	The Sebel Parramatta NSW	2008
Tree Injection for Insect Control (Statement of Attainment)	Northern Sydney Institute of TAFE	2008
Quantified Tree Risk Assessment (QTRA) Registered Licensee #1655	South Western Sydney Institute TAFE	2011
Practitioners Guide to Visual Tree Assessment	South Western Sydney Institute TAFE	2011
Quantified Tree Risk Assessment (QTRA) Registered Licensee #1655	Richmond College NSW TAFE	2014
VALID Approach to Likelihood of Failure (David Evans)	Centennial Park NSW	2017

APPENDIX 2

Tree schedule

NOTE: Colour annotation is AA & A trees with green background; Z & ZZ trees with blue background; trees to be removed in red text.

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
1	*Cedrus deodara*	12	9	500	**6**	80%	M	Nil	Grass	Nil	M	**A1**
2	*Acer negundo*	4	3	200	**2.4**	70%	S	Topped	Garden bed	Adjacent building	L	**Z3**
4	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
5	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
7	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Co-dominant	Garden bed	Nil	M	**A1**
8	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
9	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
10	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
11	*Phoenix canariensis*	8	5	500	**6**	90%	M	Nil	Garden bed	Nil	M	**A1**
12	*Phoenix canariensis*	8	5	500	**6**	90%	M	Nil	Garden bed	Nil	M	**A1**
13	*Phoenix canariensis*	8	5	500	**6**	90%	M	Nil	Garden bed	Nil	M	**A1**
14	*Phoenix canariensis*	8	5	500	**6**	90%	M	Nil	Garden bed	Nil	M	**A1**
15	*Acer negundo*	4	3	100	**1.2**	60%	S	Nil	Garden bed	Nil	L	**ZZ1**
16	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
17	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
18	*Araucaria heterophylla*	12	5	300	**3.6**	80%	S	Nil	Garden bed	Nil	M	**A1**
19	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
20	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
21	*Melaleuca quinquenervia*	14	7	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
22	*Araucaria heterophylla*	20	9	500	**6**	80%	M	Nil	Garden bed	Nil	H	**A1**
23	*Gordonia axillaris*	4	4	100	**1.2**	70%	M	Nil	Grass	Nil	L	**Z1**
24	*Liquidambar styraciflua*	26	26	1200	**14.4**	80%	M	Lopped crown, Large epicormic growth	Grass	LV wires	H	**Z9**
25	*Corymbia gummifera*	12	5	300	**3.6**	70%	S	Nil	Garden bed	Nil	M	**A1**
26	*Araucaria heterophylla*	28	10	700	**8.4**	80%	M	Nil	Grass	Nil	H	**AA1**
27	*Magnolia grandiflora*	9	8	500	**6**	80%	M	Nil	Garden bed	Nil	M	**A1**
28	*Syncarpia glomulifera*	16	14	400	**4.8**	90%	M	Four similar trees	Garden bed	Nil	M	**A1**
29	*Phoenix canariensis*	8	5	500	**3**	90%	M	Nil	Garden bed	Nil	M	**A1**
30	*Araucaria heterophylla*	20	9	500	**6**	80%	M	Nil	Garden bed	Nil	H	**A1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
31	*Cupressus sp.*	18	9	700	**8.4**	50%	O	Major failure, Leaning	Garden bed	LV wires	M	**ZZ9**
32	*Corymbia gummifera*	8	5	300	**3.6**	80%	M	Nil	Grass	Nil	L	**A1**
33	*Melaleuca linariifolia*	8	6	300	**3.6**	80%	M	Nil	Grass	Nil	L	**A1**
34	*Corymbia gummifera*	9	5	300	**3.6**	80%	M	Nil	Grass	Nil	L	**A1**
35	*Olea europaea*	5	6	250	**3**	80%	M	Nil	Garden bed	Nil	L	**Z3**
37	*Jacaranda mimosifolia*	4	4	200	**2.4**	60%	S	Lopped under powerlines	Grass	LV wires	L	**ZZ9**
38	*Acacia baileyana*	4	3	150	**1.8**	50%	S	Lopped under powerlines, Borer	Grass	LV wires	L	**ZZ9**
39	*Corymbia gummifera*	7	8	300	**3.6**	70%	M	Lopped under powerlines	Grass	LV wires	M	**Z10**
40	*Eucalyptus robusta*	8	7	300	**3.6**	70%	M	Nil	Grass	Nil	L	**Z10**
41	*Melaleuca linariifolia*	8	6	300	**3.6**	80%	M	Nil	Grass	Nil	L	**A1**
42	*Eucalyptus robusta*	8	7	300	**3.6**	70%	M	Nil	Grass	Nil	L	**A1**
43	*Melaleuca linariifolia*	8	6	300	**3.6**	80%	M	Nil	Grass	Nil	L	**A1**
44	*Syncarpia glomulifera*	10	6	350	**4.2**	70%	M	Lopped central leader	Grass	Nil	M	**ZZ9**
45	*Pittosporum undulatum*	5	5	250	**3**	70%	M	Nil	Grass	Nil	L	**Z1**
46	*Syncarpia glomulifera*	12	10	400	**4.8**	80%	M	Nil	Grass	Underground services	M	**A1**
47	*Syncarpia glomulifera*	10	8	350	**4.2**	70%	M	Nil	Grass	Nil	M	**A1**
48	*Jacaranda mimosifolia*	5	3	100	**1.2**	70%	S	Nil	Garden bed	Nil	L	**Z1**
49	*Syagrus romanzoffiana*	9	3	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**Z10**
50	*Syagrus romanzoffiana*	9	3	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**Z10**
51	*Syagrus romanzoffiana*	9	3	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**Z10**
52	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
53	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
54	*Melaleuca quinquenervia*	6	3	200	**2.4**	80%	S	Nil	Garden bed	Nil	L	**Z1**
55	*Acer palmatum*	5	6	250	**3**	90%	M	Nil	Garden bed	Nil	L	**Z1**
56	*Jacaranda mimosifolia*	12	9	350	**4.2**	80%	M	Nil	Grass	Nil	M	**A1**
57	*Jacaranda mimosifolia*	10	7	300	**3.6**	80%	M	Nil	Grass	Nil	M	**A1**
59	*Araucaria heterophylla*	14	6	350	**4.2**	80%	M	Nil	Grass	Nil	M	**A1**
60	*Liquidambar styraciflua*	16	12	400	**4.8**	80%	M	Nil	Grass	Nil	M	**A1**
61	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
62	*Allocasuarina torulosa*	6	5	300	**3.6**	80%	M	Nil	Garden bed	Nil	L	**Z1**
63	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
64	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
65	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
66	*Pittosporum undulatum*	7	5	250	**3**	70%	M	Nil	Garden bed	Nil	L	**Z1**
67	*Eucalyptus pilularis*	20	20	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**AA1**
68	*Syzygium paniculatum*	7	5	250	**3**	80%	S	Nil	Garden bed	Adjacent structure	M	**Z1**
69	*Syzygium paniculatum*	7	5	250	**3**	80%	S	Nil	Garden bed	Adjacent structure	M	**Z1**
70	*Syzygium paniculatum*	7	5	250	**3**	80%	S	Nil	Garden bed	Adjacent structure	M	**Z1**
71	*Syzygium paniculatum*	7	5	250	**3**	80%	S	Nil	Garden bed	Adjacent structure	M	**Z1**
72	*Cupressus sp.*	14	9	400	**4.8**	80%	M	Co-dominant	Garden bed	Adjacent structure	M	**A1**
73	*Phoenix canariensis*	6	4	600	**7.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
74	*Corymbia citriodora*	12	6	300	**3.6**	80%	M	Nil	Garden bed	Nil	L	**A1**
75	*Melaleuca stypheliodes*	7	5	250	**3**	70%	M	Nil	Garden bed	Nil	L	**Z1**
76	*Pittosporum undulatum*	3	3	100	**1.2**	50%	S	Borer, Failures throughout canopy	Garden bed	Nil	L	**ZZ10**
77	*Lophostemon confertus*	10	5	300	**3.6**	80%	M	Nil	Steep slope	Nil	M	**A1**
78	*Eucalyptus pilularis*	12	6	300	**3.6**	80%	M	Nil	Steep slope	Nil	M	**A1**
79	*Angophora costata*	14	7	350	**4.2**	80%	M	Nil	Steep slope	Nil	M	**A1**
80	*Angophora costata*	14	7	350	**4.2**	80%	M	Nil	Steep slope	Nil	M	**A1**
81	*Corymbia citriodora*	10	6	300	**3.6**	80%	M	Nil	Garden bed	Nil	L	**A1**
82	*Sapium sebiferum*	7	7	400	**4.8**	80%	M	Nil	Garden bed	Nil	M	**A1**
83	*Jacaranda mimosifolia*	10	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
84	*Jacaranda mimosifolia*	8	5	250	**3**	70%	M	Nil	Garden bed	Nil	L	**Z10**
85	*Camellia sp.*	3	3	100	**1.2**	80%	S	Nil	Garden bed	Nil	L	**Z1**
87	*Brugmansia sp.*	3	3	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**ZZ1**
88	*Melaleuca quinquenervia*	8	5	250	**3**	80%	S	Nil	Garden bed	Adjacent building	L	**Z10**
89	*Melaleuca quinquenervia*	12	8	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
90	*Phoenix canariensis*	8	7	600	**7.2**	90%	M	Nil	Grass	Nil	M	**A1**
91	*Callistemon sp.*	2	2	100	**1.2**	40%	S	Topped	Grass	Nil	L	**ZZ1**
92	*Callistemon sp.*	2	2	100	**1.2**	40%	S	Nil	Grass	Nil	L	**ZZ1**
93	*Prunus sp.*	3	3	100	**1.2**	70%	M	Nil	Grass	Nil	L	**ZZ1**
94	*Callistemon sp.*	4	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
95	*Robinia pseudoacacia*	9	9	300	**3.6**	70%	M	Co-dominant, Topped upper canopy	Grass	Nil	M	**Z9**
96	*Callistemon sp.*	5	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
97	*Callistemon sp.*	5	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
98	*Callistemon sp.*	4	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
99	*Callistemon sp.*	2	2	100	**1.2**	40%	S	Topped	Grass	Nil	L	**ZZ1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
100	*Callistemon sp.*	2	2	100	**1.2**	40%	S	Topped	Grass	Nil	L	**ZZ1**
101	*Sapium sebiferum*	9	7	250	**3**	80%	M	Nil	Grass	Nil	L	**Z10**
102	*Cupressus sp.*	12	10	400	**4.8**	80%	M	Nil	Garden bed	Nil	M	**A1**
103	*Angophora costata*	22	16	400	**4.8**	80%	M	Nil	Natural ground	Nil	H	**AA1**
104	*Acer palmatum*	3	4	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**Z1**
105	*Melaleuca quinquenervia*	8	8	350	**4.2**	90%	M	Nil	Garden bed	Nil	M	**A1**
106	*Melaleuca armillaris*	9	8	250	**3**	80%	M	Nil	Garden bed	Nil	M	**A1**
107	*Melaleuca quinquenervia*	12	8	400	**4.8**	80%	M	Nil	Garden bed	Nil	M	**A1**
108	*Corymbia maculata*	18	14	450	**5.4**	90%	M	Nil	Garden bed	Adjacent building	H	**A1**
109	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
110	*Casuarina cunninghamiana*	20	16	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**A1**
111	*Melaleuca quinquenervia*	10	6	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
112	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
113	*Melaleuca quinquenervia*	7	4	250	**3**	80%	S	Nil	Garden bed	Nil	L	**Z1**
114	*Corymbia maculata*	24	14	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
115	*Eucalyptus pilularis*	26	12	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
116	*Eucalyptus pilularis*	26	12	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
117	*Melaleuca quinquenervia*	10	6	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
118	*Eucalyptus pilularis*	20	15	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
120	*Jacaranda mimosifolia*	12	8	250	**3**	80%	M	Co-dominant base	Gravel	Nil	M	**Z9**
121	*Banksia integrifolia*	12	7	300	**3.6**	90%	M	Nil	Garden bed	Nil	M	**A1**
123	*Araucaria heterophylla*	14	7	300	**3.6**	80%	S	Nil	Garden bed	Nil	M	**A1**
124	*Angophora costata*	20	12	450	**5.4**	70%	M	Nil	Garden bed	Nil	H	**A1**
125	*Grevillea robusta*	22	10	500	**6**	80%	M	Nil	Garden bed	Nil	H	**A1**
126	*Leptospermum petersonii*	8	6	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**Z10**
127	*Lophostemon confertus*	18	14	500	**6**	90%	M	Nil	Garden bed	Adjacent building	H	**A1**
128	*Lophostemon confertus*	18	14	450	**5.4**	90%	M	Nil	Garden bed	Adjacent building	H	**A1**
129	*Pittosporum undulatum*	7	5	250	**3**	60%	M	Borer	Garden bed	Nil	L	**Z1**
130	*Prunus sp.*	4	3	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**Z1**
131	*Corymbia gummifera*	16	9	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
132	*Schefflera actinophylla*	5	3	100	**1.2**	80%	S	Nil	Garden bed	Adjacent building	L	**Z3**
133	*Cupressus sp.*	7	3	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
134	*Magnolia × soulangeana*	3	3	100	**1.2**	70%	M	Nil	Garden bed	Nil	L	**Z1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
136	*Callistemon sp.*	5	5	100	**1.2**	70%	M	Nil	Grass	Nil	L	**Z1**
137	*Prunus sp.*	5	4	200	**2.4**	70%	M	Nil	Garden bed	Nil	M	**Z3**
138	*Angophora costata*	10	10	450	**5.4**	90%	M	Nil	Garden bed	Adjacent structure	M	**A1**
139	*Allocasuarina torulosa*	10	6	300	**3.6**	70%	M	Nil	Garden bed	Adjacent building	M	**Z10**
140	*Callistemon sp.*	5	3	100	**1.2**	70%	M	Nil	Garden bed	Nil	L	**Z1**
141	*Melaleuca armillaris*	8	6	250	**3**	80%	M	Nil	Garden bed	Nil	M	**A1**
142	*Melaleuca armillaris*	8	6	250	**3**	80%	M	Nil	Garden bed	Nil	M	**A1**
143	*Camellia sp.*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
144	*Eucalyptus haemastoma*	8	6	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
145	*Schefflera actinophylla*	3	3	100	**1.2**	80%	S	Nil	Garden bed	Nil	L	**Z1**
146	*Schefflera actinophylla*	3	3	100	**1.2**	80%	S	Nil	Garden bed	Nil	L	**Z1**
147	*Cotoneaster sp.*	5	7	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z3**
148	*Callistemon sp.*	4	3	100	**1.2**	70%	M	Nil	Garden bed	Nil	L	**Z1**
149	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
150	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
151	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
152	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
153	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
154	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
155	*Buckinghamia celsissima*	3	3	100	**1.2**	90%	S	Nil	Garden bed	Nil	L	**Z1**
156	*Camellia sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
157	*Prunus sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
158	*Camellia sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
159	*Camellia sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
160	*Duranta repens*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
161	*Hibiscus sp.*	2	2	100	**1.2**	60%	M	Nil	Garden bed	Nil	L	**Z1**
162	*Melaleuca quinquenervia*	16	10	500	**6**	80%	M	Co-dominant	Grass	Adjacent building	H	**A1**
163	*Melaleuca quinquenervia*	10	7	250	**3**	70%	M	Nil	Grass	Nil	L	**Z10**
164	*Melaleuca quinquenervia*	16	10	500	**6**	80%	M	Nil	Grass	Adjacent building	H	**A1**
165	*Melaleuca quinquenervia*	16	10	500	**6**	80%	M	Nil	Grass	Adjacent building	H	**A1**
166	*Melaleuca quinquenervia*	7	3	200	**2.4**	80%	S	Nil	Grass	Nil	L	**Z1**
167	*Archontophoenix alexandrae*	7	3	200	**2.4**	90%	M	Nil	Garden bed	Nil	L	**Z1**
168	*Archontophoenix alexandrae*	7	3	200	**2.4**	90%	M	Nil	Garden bed	Nil	L	**Z1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
169	*Ulmus glabra*	5	5	150	**1.8**	60%	M	Lopped, Epicormic growth	Garden bed	Adjacent structure	L	**Z9**
170	*Melaleuca quinquenervia*	9	5	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
171	*Cyathea cooperi*	4	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
172	*Melaleuca quinquenervia*	9	5	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
173	*Eucalyptus piperita*	18	16	450	**5.4**	80%	M	Cambium damage, Borer throughout base	Natural ground	Nil	H	**Z9**
174	*Angophora costata*	20	16	400	**4.8**	80%	M	Nil	Natural ground	Nil	H	**A1**
175	*Casuarina cunninghamiana*	16	9	450	**5.4**	80%	M	Nil	Garden bed	Adjacent structure	H	**A1**
176	*Casuarina cunninghamiana*	16	9	450	**5.4**	80%	M	Nil	Garden bed	Adjacent structure	H	**A1**
177	*Melaleuca armillaris*	8	4	100	**1.2**	70%	M	Nil	Garden bed	Nil	L	**Z10**
178	*Pittosporum undulatum*	8	6	250	**3**	70%	M	Nil	Garden bed	Nil	L	**Z10**
179	*Melia azedarach*	7	4	200	**2.4**	70%	M	Nil	Garden bed	Nil	L	**Z1**
180	*Pittosporum undulatum*	6	5	100	**1.2**	70%	S	Nil	Garden bed	Nil	L	**Z1**
181	*Pittosporum undulatum*	6	5	100	**1.2**	70%	S	Nil	Garden bed	Nil	L	**Z1**
182	*Acacia elata*	18	9	400	**4.8**	80%	M	Nil	Garden bed	Nil	H	**A1**
183	*Angophora costata*	20	18	500	**6**	90%	M	Nil	Garden bed	Nil	H	**A1**
185	*Melia azedarach*	10	7	300	**3.6**	70%	M	Nil	Garden bed	Nil	M	**Z10**
186	*Allocasuarina torulosa*	8	5	250	**3**	70%	M	Nil	Garden bed	Nil	L	**Z10**
187	*Ficus benjamina*	5	3	200	**2.4**	50%	M	Lopped, Epicormic growth	Garden bed	Adjacent building	L	**ZZ9**
188	*Prunus sp.*	3	3	100	**1.2**	80%	M	Nil	Grass	Nil	L	**Z1**
189	*Melaleuca quinquenervia*	18	14	600	**7.2**	80%	M	Nil	Garden bed	Adjacent driveway	H	**A1**
190	*Cupressus sp.*	8	5	200	**2.4**	70%	M	Co-dominant	Garden bed	Adjacent driveway	L	**Z10**
191	*Callistemon sp.*	2	2	100	**1.2**	70%	M	Nil	Garden bed	Nil	L	**ZZ1**
192	*Macadamia sp.*	5	4	100	**1.2**	90%	M	Nil	Grass	Nil	L	**Z1**
193	*Melaleuca quinquenervia*	10	6	350	**4.2**	80%	M	Lopped at 2m, Epicormic growth only	Garden bed	Nil	M	**Z9**
194	*Melaleuca quinquenervia*	10	6	350	**4.2**	80%	M	Lopped at 2m, Epicormic growth only	Garden bed	Nil	M	**Z9**
195	*Melaleuca quinquenervia*	10	6	350	**4.2**	80%	M	Lopped at 2m, Epicormic growth only	Garden bed	Nil	M	**Z9**
196	*Melaleuca quinquenervia*	8	5	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
197	*Melaleuca quinquenervia*	10	6	350	**4.2**	80%	M	Lopped at 2m, Epicormic growth only	Garden bed	Nil	M	**Z9**
198	*Melaleuca quinquenervia*	6	4	150	**1.8**	70%	M	Nil	Garden bed	Nil	L	**Z1**
199	*Melaleuca quinquenervia*	6	4	150	**1.8**	70%	M	Nil	Garden bed	Nil	L	**Z1**
200	*Melaleuca quinquenervia*	6	4	150	**1.8**	70%	M	Nil	Garden bed	Nil	L	**Z1**
201	*Melaleuca quinquenervia*	16	9	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
202	*Melaleuca quinquenervia*	16	9	400	**4.8**	80%	M	Nil	Garden bed	Nil	H	**A1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
203	*Casuarina cunninghamiana*	14	6	250	**3**	80%	M	Nil	Garden bed	Nil	M	**Z10**
204	*Melaleuca quinquenervia*	16	9	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
205	*Melaleuca quinquenervia*	16	9	400	**4.8**	80%	M	Nil	Garden bed	Nil	H	**A1**
206	*Acer palmatum*	5	6	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
207	*Unknown shrub*	4	4	100	**1.2**	70%	M	Co-dominant	Garden bed	Nil	L	**Z1**
208	*Callistemon sp.*	6	6	200	**2.4**	70%	M	Nil	Garden bed	Nil	L	**Z1**
209	*Citrus × sinensis*	2	3	100	**1.2**	80%	M	Nil	Grass	Nil	L	**Z1**
210	*Citrus × sinensis*	2	3	100	**1.2**	80%	M	Nil	Grass	Nil	L	**Z1**
211	*Jacaranda mimosifolia*	7	7	200	**2.4**	70%	M	Lopped at 1m, Epicormic growth only	Garden bed	Nil	M	**Z9**
212	*Melaleuca quinquenervia*	14	9	600	**7.2**	80%	M	Nil	Grass	Adjacent driveway	H	**A1**
213	*Pittosporum eugenioides 'Variegatum'*	6	4	100	**1.2**	70%	M	Borer	Garden bed	Adjacent building	L	**Z4**
214	*Camellia sp.*	5	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
215	*Camellia sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
216	*Camellia sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
217	*Camellia sp.*	3	3	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
218	*Corymbia gummifera*	20	14	400	**4.8**	80%	M	Nil	Garden bed	Adjacent building	H	**A1**
219	*Alnus jorullensis*	12	12	450	**5.4**	80%	M	Nil	Garden bed	Adjacent structure	M	**Z3**
220	*Tibouchina sp.*	4	4	100	**1.2**	90%	M	Nil	Grass	Nil	L	**Z1**
221	*Callistemon sp.*	2	2	100	**1.2**	60%	S	Lopped at 2m	Garden bed	Nil	L	**ZZ1**
222	*Callistemon sp.*	5	4	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**Z1**
223	*Magnolia × soulangeana*	3	4	100	**1.2**	70%	M	Nil	Garden bed	Nil	L	**Z1**
224	*Elaeocarpus reticulatus*	4	3	100	**1.2**	80%	S	Nil	Garden bed	Nil	L	**Z1**
225	*Pittosporum eugenioides 'Variegatum'*	2	2	100	**1.2**	50%	M	Topped	Garden bed	Nil	L	**ZZ1**
226	*Callistemon sp.*	2	2	100	**1.2**	50%	M	Topped	Garden bed	Nil	L	**ZZ1**
227	*Callistemon sp.*	2	2	100	**1.2**	50%	M	Topped	Garden bed	Nil	L	**ZZ1**
228	*Citrus × sinensis*	2	3	100	**1.2**	80%	M	Nil	Grass	Nil	L	**Z1**
229	*Yucca sp.*	5	3	200	**2.4**	80%	M	Nil	Garden bed	Nil	L	**Z1**
231	*Angophora costata*	20	14	450	**5.4**	80%	M	Nil	Natural ground	Nil	H	**A1**
232	*Lophostemon confertus*	12	10	300	**3.6**	70%	M	Nil	Grass	Nil	M	**A1**
233	*Callistemon sp.*	5	4	200	**2.4**	80%	M	Nil	Garden bed	Nil	L	**Z1**
234	*Citrus × sinensis*	2	3	100	**1.2**	80%	M	Nil	Grass	Nil	L	**Z1**
235	*Callistemon sp.*	2	2	100	**1.2**	50%	M	Topped	Garden bed	Nil	L	**ZZ1**
236	*Banksia serrata*	5	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
237	*Casuarina cunninghamiana*	12	8	350	**4.2**	70%	M	Splits along upper boughs	Garden bed	Adjacent structure	M	**Z9**
238	*Banksia serrata*	5	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
239	*Acacia sp.*	5	6	250	**3**	80%	M	Nil	Garden bed	Nil	L	**Z1**
240	*Banksia serrata*	5	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
241	*Banksia serrata*	7	5	250	**3**	80%	M	Nil	Garden bed	Nil	L	**Z1**
242	*Camellia sp.*	5	4	100	**1.2**	90%	M	Nil	Garden bed	Nil	L	**Z1**
243	*Callistemon sp.*	6	5	200	**2.4**	80%	M	Nil	Garden bed	Nil	M	**Z1**
244	*Angophora floribunda*	22	16	600	**7.2**	80%	M	Nil	Grass	Adjacent building	H	**AA1**
245	*Angophora costata*	16	14	500	**6**	80%	M	Nil	Garden bed	Adjacent building	H	**A1**
246	*Callistemon sp.*	4	3	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**Z1**
247	*Grevillea spinosa*	3	3	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**Z1**
248	*Cupressus sp.*	6	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
249	*Tibouchina sp.*	5	5	100	**1.2**	90%	M	Nil	Grass	Nil	L	**Z1**
250	*Acer negundo*	5	5	200	**2.4**	80%	M	Nil	Grass	Adjacent structure	L	**Z1**
251	*Ficus benjamina*	3	3	100	**1.2**	50%	M	Topped	Garden bed	Nil	L	**ZZ9**
252	*Syzygium paniculatum*	12	9	400	**4.8**	90%	M	Nil	Garden bed	Nil	M	**A1**
253	*Eucalyptus haemastoma*	9	12	700	**8.4**	80%	M	Cambium damage	Garden bed	Adjacent building	M	**Z9**
254	*Acer negundo*	9	10	350	**4.2**	80%	M	Nil	Garden bed	Adjacent structure	M	**Z3**
255	*Acer negundo*	9	10	350	**4.2**	80%	M	Nil	Garden bed	Adjacent structure	M	**Z3**
256	*Corymbia gummifera*	20	14	500	**6**	80%	M	Nil	Garden bed	Nil	H	**A1**
257	*Callistemon sp.*	5	5	100	**1.2**	80%	M	Nil	Garden bed	Adjacent building	L	**Z1**
258	*Banksia serrata*	5	4	150	**1.8**	80%	M	Nil	Garden bed	Nil	L	**Z1**
259	*Callistemon sp.*	6	5	200	**2.4**	80%	M	Nil	Garden bed	Nil	L	**Z1**
260	*Citrus × sinensis*	2	3	100	**1.2**	80%	M	Nil	Grass	Nil	L	**Z1**
261	*Callistemon sp.*	6	5	200	**2.4**	80%	M	Nil	Garden bed	Nil	L	**Z1**
262	*Corymbia gummifera*	22	12	400	**4.8**	80%	M	Nil	Garden bed	Nil	H	**A1**
263	*Lophostemon confertus*	22	14	450	**5.4**	80%	M	Nil	Grass	Nil	H	**A1**
264	*Lophostemon confertus*	20	10	300	**3.6**	80%	M	Nil	Grass	Adjacent driveway	M	**A1**
265	*Liquidambar styraciflua*	18	14	450	**5.4**	90%	M	Nil	Garden bed	Adjacent structure	H	**A1**
266	*Liquidambar styraciflua*	14	10	400	**4.8**	80%	M	Nil	Grass	Nil	M	**A1**
268	*Jacaranda mimosifolia*	10	9	250	**3**	80%	M	Co-dominant	Grass	Nil	M	**A1**
269	*Eucalyptus haemastoma*	22	14	600	**7.2**	80%	M	One dead bough, should be ok	Garden bed	Nil	H	**A1**
270	*Cinnamomum camphora*	8	8	300	**3.6**	70%	M	Lopped under powerlines, Epicormic growth	Garden bed	LV wires	M	**ZZ9**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
271	*Corymbia gummifera*	20	8	350	**4.2**	70%	M	Heavily pruned from powerlines, Slender habit	Garden bed	HV wires	M	**Z10**
272	*Lophostemon confertus*	14	9	300	**3.6**	70%	M	Nil	Garden bed	HV wires	M	**A1**
273	*Lophostemon confertus*	14	9	300	**3.6**	70%	M	Nil	Garden bed	HV wires	M	**A1**
274	*Eucalyptus scoparia*	8	5	200	**2.4**	70%	M	Nil	Garden bed	Nil	L	**Z10**
275	*Tristaniopsis laurina*	6	4	150	**1.8**	70%	M	Nil	Garden bed	HV wires	L	**Z1**
276	*Lophostemon confertus*	14	10	350	**4.2**	80%	M	Co-dominant	Garden bed	Nil	M	**A1**
278	*Banksia serrata*	5	3	200	**2.4**	70%	M	Nil	Garden bed	Nil	L	**Z1**
279	*Banksia serrata*	5	3	200	**2.4**	70%	M	Nil	Garden bed	Nil	L	**Z1**
280	*Lophostemon confertus*	16	14	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
282	*Eucalyptus botryoides*	14	8	250	**3**	60%	M	Heavily pruned from powerlines	Garden bed	HV wires	M	**ZZ9**
283	*Lophostemon confertus*	10	7	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
284	*Eucalyptus robusta*	18	16	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**A1**
285	*Acacia elata*	7	5	250	**3**	30%	O	Borer	Garden bed	Nil	L	**ZZ4**
286	*Eucalyptus robusta*	22	14	400	**4.8**	70%	M	Nil	Garden bed	Nil	M	**A1**
287	*Acacia elata*	7	5	250	**3**	30%	O	Borer	Garden bed	Nil	L	**ZZ4**
288	*Eucalyptus sp.*	20	14	350	**4.2**	70%	M	Nil	Garden bed	Nil	H	**A1**
289	*Eucalyptus robusta*	14	7	300	**3.6**	80%	M	Nil	Steep slope	Nil	M	**A1**
290	*Allocasuarina torulosa*	7	4	200	**2.4**	60%	M	Failures	Steep slope	Nil	L	**Z10**
291	*Corymbia gummifera*	18	12	400	**4.8**	80%	M	Nil	Garden bed	Adjacent structure	H	**A1**
292	*Cupressus sp.*	6	1	100	**1.2**	80%	M	Nil	Garden bed	Nil	L	**Z1**
293	*Washingtonia robusta*	2	2	200	**2.4**	90%	S	Nil	Garden bed	Nil	L	**Z1**
294	*Banksia serrata*	6	5	150	**1.8**	80%	S	Nil	Garden bed	Adjacent building	L	**Z1**
295	*Acacia baileyana*	7	5	200	**2.4**	80%	M	Nil	Garden bed	Nil	L	**Z1**
296	*Eucalyptus botryoides*	22	14	500	**6**	80%	M	Nil	Grass	Nil	H	**A1**
297	*Eucalyptus botryoides*	16	8	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
298	*Eucalyptus haemastoma*	4	4	150	**1.8**	80%	S	Nil	Grass	Nil	L	**Z1**
299	*Eucalyptus botryoides*	10	5	200	**2.4**	80%	S	Nil	Garden bed	Nil	L	**Z1**
300	*Eucalyptus botryoides*	16	8	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
301	*Pittosporum undulatum*	4	4	150	**1.8**	70%	S	Failures	Garden bed	Nil	L	**Z1**
302	*Casuarina cunninghamiana*	6	4	150	**1.8**	70%	S	Nil	Garden bed	Nil	L	**Z1**
303	*Casuarina cunninghamiana*	6	4	150	**1.8**	70%	S	Nil	Garden bed	Nil	L	**Z1**
304	*Elaeocarpus reticulatus*	6	3	100	**1.2**	80%	S	Nil	Garden bed	Nil	L	**Z1**
305	*Corymbia gummifera*	9	3	100	**1.2**	10%	S	Failures	Garden bed	Nil	L	**ZZ4**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
306	*Corymbia gummifera*	10	4	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
307	*Corymbia gummifera*	10	4	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
308	*Acacia implexa*	8	3	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
309	*Eucalyptus microcorys*	12	7	250	**3**	80%	M	Nil	Grass	Nil	M	**A1**
310	*Eucalyptus scoparia*	10	6	150	**1.8**	70%	S	Nil	Garden bed	Nil	M	**A1**
311	*Eucalyptus microcorys*	12	7	250	**3**	80%	M	Nil	Grass	Nil	M	**A1**
312	*Eucalyptus sp.*	8	7	250	**3**	0%	O	Nil	Garden bed	Nil	L	**ZZ4**
313	*Eucalyptus microcorys*	12	7	250	**3**	80%	M	Nil	Grass	Nil	M	**A1**
314	*Eucalyptus microcorys*	12	7	250	**3**	80%	M	Nil	Grass	Nil	M	**A1**
315	*Eucalyptus microcorys*	9	5	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
316	*Eucalyptus microcorys*	9	5	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
317	*Eucalyptus microcorys*	9	5	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
318	*Eucalyptus microcorys*	9	5	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
319	*Eucalyptus microcorys*	18	12	400	**4.8**	80%	M	Nil	Garden bed	Nil	H	**A1**
320	*Eucalyptus microcorys*	24	14	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**AA1**
321	*Eucalyptus microcorys*	9	5	150	**1.8**	80%	S	Nil	Grass	Nil	L	**Z1**
322	*Eucalyptus microcorys*	24	14	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**AA1**
323	*Eucalyptus microcorys*	24	14	450	**5.4**	80%	M	Co-dominant	Garden bed	Nil	H	**AA1**
324	*Eucalyptus microcorys*	24	16	500	**6**	80%	M	Included bark	Garden bed	Nil	H	**Z9**
325	*Eucalyptus microcorys*	24	16	500	**6**	80%	M	Nil	Garden bed	Nil	H	**AA1**
326	*Eucalyptus pilularis*	24	16	600	**7.2**	80%	M	Nil	Grass	Adjacent building	H	**AA1**
327	*Corymbia gummifera*	14	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
328	*Eucalyptus saligna*	20	12	350	**4.2**	80%	M	Nil	Garden bed	Nil	H	**A1**
330	*Acer negundo*	8	8	300	**3.6**	80%	M	Nil	Grass	Adjacent building	M	**Z3**
331	*Cinnamomum camphora*	7	5	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z3**
332	*Eucalyptus saligna*	22	12	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**A1**
333	*Casuarina cunninghamiana*	14	9	350	**4.2**	80%	M	Included bark	Garden bed	Adjacent building	M	**ZZ5**
334	*Casuarina cunninghamiana*	14	6	300	**3.6**	80%	M	Splits throughout base	Garden bed	Nil	M	**Z9**
335	*Casuarina cunninghamiana*	14	6	300	**3.6**	80%	M	Splits throughout base	Garden bed	Nil	M	**Z9**
336	*Corymbia maculata*	9	4	200	**2.4**	80%	S	Nil	Garden bed	Nil	M	**Z1**
337	*Casuarina cunninghamiana*	16	7	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
338	*Casuarina cunninghamiana*	16	7	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
339	*Casuarina cunninghamiana*	14	6	300	**3.6**	80%	M	Splits throughout base	Garden bed	Nil	M	**Z9**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
340	*Corymbia gummifera*	14	6	300	**3.6**	70%	M	Heavily pruned	Garden bed	Nil	M	**A1**
341	*Corymbia gummifera*	24	14	500	**6**	0%	O	Nil	Garden bed	Nil	H	**ZZ4**
342	*Angophora costata*	14	9	350	**4.2**	60%	M	Borer, Heavily pruned	Garden bed	HV wires	M	**Z10**
343	*Eucalyptus sp.*	8	5	250	**3**	80%	S	Nil	Garden bed	Nil	M	**Z1**
345	*Casuarina cunninghamiana*	14	6	300	**3.6**	80%	M	Splits throughout base	Garden bed	Nil	M	**Z9**
346	*Eucalyptus saligna*	24	12	450	**5.4**	80%	M	Major storm failures	Garden bed	Nil	H	**ZZ4**
347	*Eucalyptus saligna*	24	12	400	**4.8**	80%	M	Major storm failures	Garden bed	Nil	H	**ZZ4**
348	*Banksia serrata*	5	3	150	**1.8**	80%	S	Nil	Garden bed	Nil	L	**Z1**
349	*Corymbia gummifera*	18	12	400	**4.8**	80%	M	Nil	Garden bed	Kerb	M	**A1**
350	*Eucalyptus paniculata*	24	10	400	**4.8**	70%	M	Heavily pruned	Garden bed	HV wires	H	**A1**
351	*Angophora costata*	10	5	200	**2.4**	70%	S	Borer	Garden bed	Nil	L	**Z4**
352	*Angophora costata*	16	12	350	**4.2**	60%	M	Nil	Garden bed	Nil	M	**A1**
353	*Eucalyptus saligna*	22	7	250	**3**	70%	M	Borer in base, Slender habit	Garden bed	Nil	M	**Z9**
354	*Eucalyptus paniculata*	24	14	450	**5.4**	80%	M	Included bark at co-dominant	Garden bed	HV wires	H	**Z9**
355	*Eucalyptus saligna*	20	8	200	**2.4**	80%	S	Slender habit	Garden bed	Nil	M	**A1**
356	*Eucalyptus saligna*	22	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	H	**A1**
357	*Eucalyptus saligna*	22	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	H	**A1**
358	*Angophora costata*	18	12	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
359	*Eucalyptus saligna*	9	4	100	**1.2**	80%	S	Nil	Garden bed	Nil	L	**Z1**
360	*Eucalyptus pilularis*	28	26	1000	**12**	80%	M	Nil	Garden bed	Nil	H	**AA1**
361	*Eucalyptus microcorys*	26	22	800	**9.6**	80%	M	Co-dominant	Garden bed	HV wires	H	**AA1**
362	*Allocasuarina torulosa*	4	4	150	**1.8**	0%	O	Dead tree	Garden bed	Nil	L	**ZZ4**
363	*Eucalyptus microcorys*	26	22	800	**9.6**	80%	M	Co-dominant	Garden bed	HV wires	H	**AA1**
364	*Eucalyptus microcorys*	18	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
365	*Eucalyptus microcorys*	14	7	200	**2.4**	70%	S	Nil	Garden bed	Nil	M	**Z1**
366	*Eucalyptus microcorys*	18	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
367	*Eucalyptus microcorys*	20	18	600	**7.2**	70%	M	Topped, Central leader removed, Leaning across road	Garden bed	HV wires	H	**Z10**
368	*Eucalyptus microcorys*	18	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
369	*Eucalyptus microcorys*	18	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
370	*Eucalyptus microcorys*	14	7	200	**2.4**	70%	S	Cambium damage	Garden bed	Nil	M	**Z10**
371	*Eucalyptus microcorys*	30	26	800	**9.6**	80%	M	Nil	Garden bed	Nil	H	**AA1**
372	*Eucalyptus microcorys*	28	20	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**AA1**

No.	Genus species	Height	Spread	DBH	TPZ	Foliage cover	Age Class	Defects	Location	Services	Significance	Tree AZ
373	*Eucalyptus microcorys*	18	9	350	**4.2**	80%	M	Nil	Garden bed	Nil	M	**A1**
374	*Eucalyptus microcorys*	30	22	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**AA1**
375	*Eucalyptus microcorys*	30	22	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**AA1**
376	*Eucalyptus microcorys*	22	14	400	**4.8**	80%	M	Nil	Garden bed	Nil	H	**AA1**
377	*Eucalyptus microcorys*	24	16	450	**5.4**	80%	M	Nil	Garden bed	Nil	H	**AA1**
378	*Eucalyptus microcorys*	30	22	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**AA1**
379	*Eucalyptus microcorys*	30	22	600	**7.2**	80%	M	Nil	Garden bed	Nil	H	**AA1**
380	*Eucalyptus microcorys*	14	7	200	**2.4**	80%	S	Nil	Garden bed	Nil	M	**A1**
381	*Eucalyptus saligna*	22	12	500	**6**	50%	M	Heavily pruned, Only one lateral branch remaining	Garden bed	HV wires	M	**ZZ10**
382	*Eucalyptus microcorys*	20	18	600	**7.2**	70%	M	Topped, Central leader removed, Leaning across road	Garden bed	HV wires	H	**Z10**
383	*Eucalyptus microcorys*	20	18	600	**7.2**	70%	M	Topped, Central leader removed, Leaning across road	Garden bed	HV wires	H	**Z10**
384	*Eucalyptus microcorys*	14	10	350	**4.2**	70%	M	Topped, Central leader removed, Leaning across road	Garden bed	HV wires	M	**Z10**
385	*Eucalyptus microcorys*	28	14	400	**4.8**	80%	M	Nil	Garden bed	HV wires	H	**AA1**
386	*Eucalyptus microcorys*	18	9	300	**3.6**	80%	M	Nil	Garden bed	Nil	M	**A1**
387	*Eucalyptus saligna*	30	28	1100	**13.2**	80%	M	Bracket fungi in base, Further investigation required	Garden bed	Nil	H	**AA2**
388	*Eucalyptus sp.*	12	3	500	**6**	0%	O	Nil	Garden bed	HV wires	L	**ZZ4**
389	*Eucalyptus robusta*	26	20	1000	**12**	80%	M	Co-dominant	Garden bed	HV wires	H	**AA1**
390	*Eucalyptus sp.*	20	16	400	**4.8**	70%	M	Nil	Garden bed	Nil	H	**A1**
391	*Eucalyptus sp.*	14	10	300	**3.6**	70%	M	Nil	Garden bed	HV wires	M	**A1**
392	*Eucalyptus robusta*	16	8	300	**3.6**	70%	M	Nil	Garden bed	HV wires	M	**A1**
393	*SUGAR GUM*	14	9	300	**3.6**	60%	M	Heavily pruned	Garden bed	HV wires	M	**Z4**
394	*Angophora costata*	14	6	250	**3**	70%	S	Heavily pruned, Hazard beam	Garden bed	HV wires	M	**Z9**

Explanatory Notes

- **Measurements/estimates:** All dimensions are estimates unless otherwise indicated. Measurements taken with a tape or clinometer are indicated with a '*'. Less reliable estimated dimensions are indicated with a '?'.
- **Species:** The species identification is based on visual observations and the botanical name. In some instances, it may be difficult to quickly and accurately identify a particular tree without further detailed investigations. Where there is some doubt of the precise species of tree, it is indicated with a '?' after the name in order to avoid delay in the production of the report. The botanical name is followed by the abbreviation sp if only the genus is known. The species listed for groups and hedges represent the main component and there may be other minor species not listed.
- **Tree number:** relates to the reference number used on site diagram/report.
- **Height:** Height is estimated to the nearest metre.
- **Spread:** The average crown spread is visually estimated to the nearest metre from the outermost tips of the live lateral branches.
- **DBH:** These figures relate to 1.4m above ground level and are recorded in millimetres. If appropriate, diameter is measured with a diameter tape. 'M' indicates trees or shrubs with multiple stems.
- **Foliage Cover:** Percent of estimated live foliage cover for particular species range.
- **Age class:**

Y	Young = recently planted
S	Semi-mature (<20% of life expectancy)
M	Mature (20-80% of life expectancy)
O	Over-mature (>80% of life expectancy)

- **TPZ:** The Tree Protection Zone (TPZ) is the radial offset distance of twelve times the trunk diameter in meters.
- **Tree AZ:** See reference for Tree AZ categories in Appendix 3.
- **Significance:** A tree's significance/value in the landscape takes into account its prominence from a wide range of perspectives. This includes, but is not limited to neighbour hood perspective, local perspective and site perspective. The significance of the subject trees has been categorized into three groups, such as: High, Moderate or Low significance.

APPENDIX 3

TreeAZ Categories (Version 10.04-ANZ)

Z Category Z: Unimportant trees not worthy of being a material constraint

Local policy exemptions: Trees that are unsuitable for legal protection for local policy reasons including size, proximity and species

Z1	Young or insignificant small trees, i.e. below the local size threshold for legal protection, etc
Z2	Too close to a building, i.e. exempt from legal protection because of proximity, etc
Z3	Species that cannot be protected for other reasons, i.e. scheduled noxious weeds, out of character in a setting of acknowledged importance, etc

High risk of death or failure: Trees that are likely to be removed within 10 years because of acute health issues or severe structural failure

Z4	Dead, dying, diseased or declining
Z5	Severe damage and/or structural defects where a high risk of failure cannot be satisfactorily reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, overgrown and vulnerable to adverse weather conditions, etc
Z6	Instability, i.e. poor anchorage, increased exposure, etc

Excessive nuisance: Trees that are likely to be removed within 10 years because of unacceptable impact on people

Z7	Excessive, severe and intolerable inconvenience to the extent that a locally recognised court or tribunal would be likely to authorise removal, i.e. dominance, debris, interference, etc
Z8	Excessive, severe and intolerable damage to property to the extent that a locally recognised court or tribunal would be likely to authorise removal, i.e. severe structural damage to surfacing and buildings, etc

Good management: Trees that are likely to be removed within 10 years through responsible management of the tree population

Z9	Severe damage and/or structural defects where a high risk of failure can be temporarily reduced by reasonable remedial care, i.e. cavities, decay, included bark, wounds, excessive imbalance, vulnerable to adverse weather conditions, etc
Z10	Poor condition or location with a low potential for recovery or improvement, i.e. dominated by adjacent trees or buildings, poor architectural framework, etc
Z11	Removal would benefit better adjacent trees, i.e. relieve physical interference, suppression, etc
Z12	Unacceptably expensive to retain, i.e. severe defects requiring excessive levels of maintenance, etc

NOTE: Z trees with a high risk of death/failure (Z4, Z5 & Z6) or causing severe inconvenience (Z7 & Z8) at the time of assessment and need an urgent risk assessment can be designated as ZZ. ZZ trees are likely to be unsuitable for retention and at the bottom of the categorisation hierarchy. In contrast, although Z trees are not worthy of influencing new designs, urgent removal is not essential and they could be retained in the short term, if appropriate.

A Category A: Important trees suitable for retention for more than 10 years and worthy of being a material constraint

A1	No significant defects and could be retained with minimal remedial care
A2	Minor defects that could be addressed by remedial care and/or work to adjacent trees
A3	Special significance for historical, cultural, commemorative or rarity reasons that would warrant extraordinary efforts to retain for more than 10 years
A4	Trees that may be worthy of legal protection for ecological reasons (Advisory requiring specialist assessment)

NOTE: Category A1 trees that are already large and exceptional, or have the potential to become so with minimal maintenance, can be designated as AA at the discretion of the assessor. Although all A and AA trees are sufficiently important to be material constraints, AA trees are at the top of the categorisation hierarchy and should be given the most weight in any selection process.

TreeAZ is designed by Barrell Tree Consultancy (www.treeaz.com/tree_az/)

APPENDIX 4

Tree protection fencing and signs - Illustrative specification

Protective fencing: Protective 1.8m high fencing should be installed at the location illustrated on the Tree Management Plan before any site works start. All uprights should be fixed in position for the duration of the development activity. The fixings must be able to withstand the pressures of everyday site work.

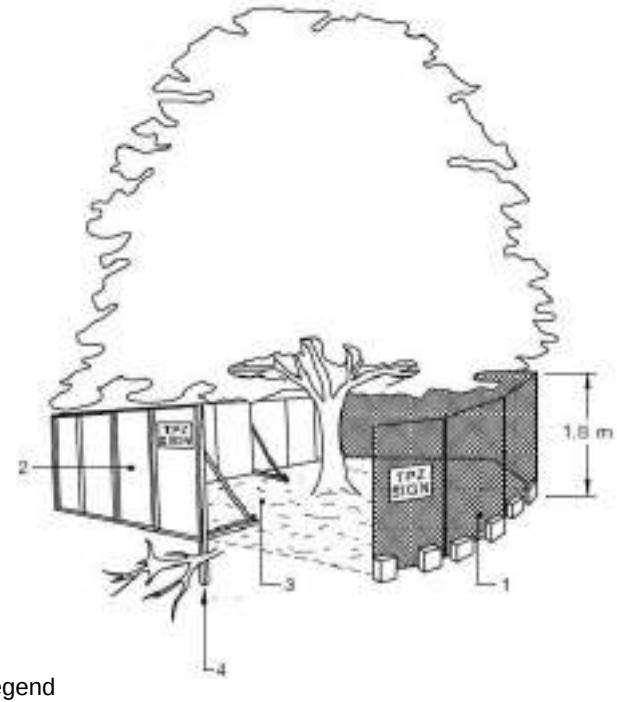
Inside the protective fencing, the following rules must be strictly observed:

- **No vehicular access**
- **No storage of excavated debris, building materials or fuels**
- **No excessive cultivation for landscape planting**
- **No fires**
- **No mixing of cement**
- **No service installation or excavation**

Once erected, protective fencing must not be removed or altered without consulting first with the project Arborist.

Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter and liquids into the protected area and signage must be attached to outside of fencing.

Signage: All signs are to provide clear and readily accessible information to indicate that a TPZ has been established. Signage identifying the TPZ must be attached to outside of fencing and be visible from within the development site.



Signage example:

Legend

1. Chain wire mesh panels with shade cloth (if required) attached, held in place with concrete feet.
2. Alternative plywood or wooden paling fence panels. This fencing material also prevents building materials or soil entering the TPZ.
3. Mulch installation across surface of TPZ (at the discretion of the project arborist). No excavation, construction activity, grade changes, surface treatment or storage of materials of any kind is permitted within the TPZ.
4. Bracing is permissible within the TPZ. Installation of supports should avoid damaging roots.

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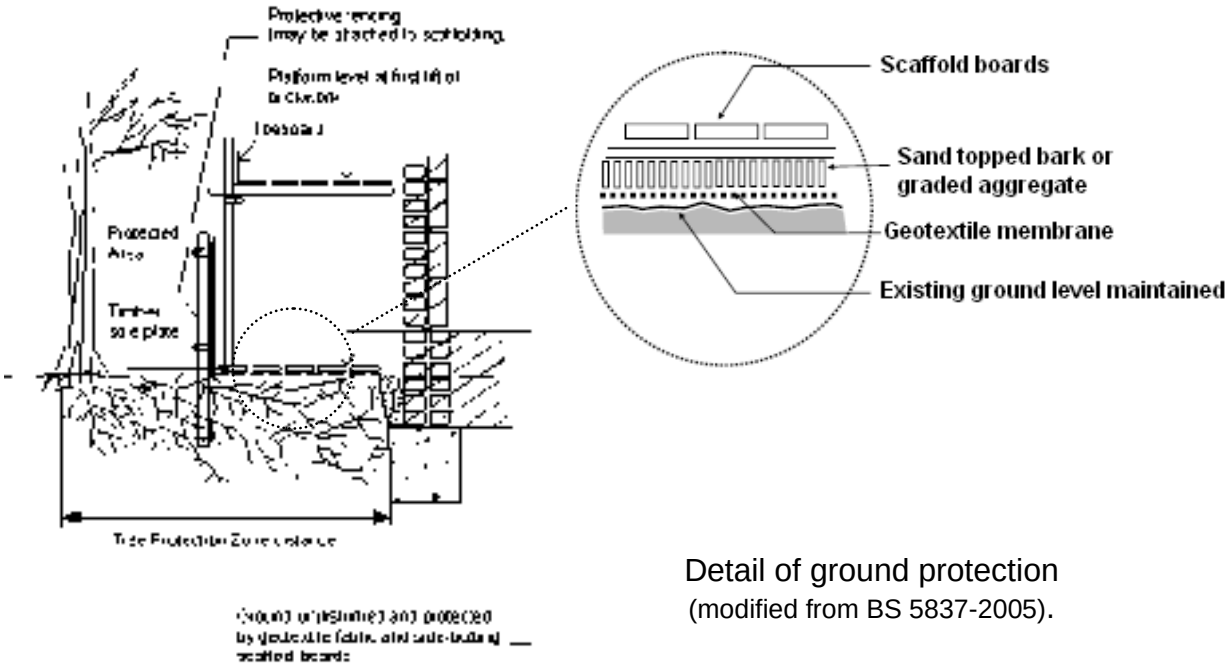
APPENDIX 5

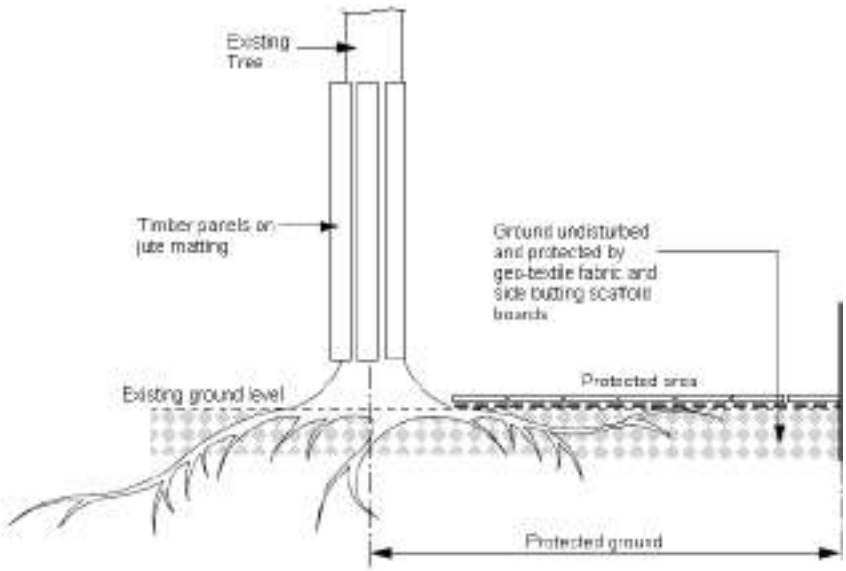
Root zone and trunk protection - Illustrative specification

Root zone protection: Where necessary, access through the TPZ can be achieved by laying aggregate and timber boards (or similar) over the root zone to protect roots. The ground beneath the boarding should be left undisturbed and should be protected with a porous geo-textile fabric covered with sand or mulch.



Detail of ground protection
(modified from BS 5837-2005).

Trunk protection: Where fencing cannot be installed, the vertical trunk of exposed trees shall be protected by the placement of 3.6m lengths of 50 x 100mm hardwood timbers, spaced vertically, at 150mm centres and secured by 2mm wire at 300mm wide spacing over suitable protective padding material e.g. Jute Matting. The trunk protection shall be maintained intact until the completion of all work on site.



Detail of trunk protection.

APPENDIX 6

General guidance for working in TPZ

1 PURPOSE OF THIS GUIDANCE

This guidance sets out the general principles that must be followed when working within a TPZ. Where more detail is required, it will be supplemented by illustrative specifications in other appendices in this document (refer Appendix 4 and 5).

This guidance is based on the Australian Standards (2009) AS4970: *Protection of Trees on Construction Sites*.

Once the site works start, this guidance is specifically for the site personnel to help them understand what has been agreed and explain what is required to fully meet their obligations to protect trees. All personnel working in TPZs must be properly briefed about their responsibilities towards important trees based on this guidance.

This guidance should always be read in conjunction with the Tree Management Plan (TMP01) illustrating the areas where specific precautions are necessary. Each area where precautions are required is explained on the plan as identified on the legend. All protective measures should be installed according to the prevailing site conditions and agreed as satisfactory by the Project Arborist before any demolition or construction work starts.

2 TREE PROTECTION

2.1 Tree Protection Zone (TPZ)

The TPZ is a radial setback, extending outwards from the centre of the trunk, where disturbance must be minimised if important trees are to be successfully retained. The TPZ area is illustrated on the Tree Management Plan (TMP01) accompanying this guidance.

- The TPZ is a radial setback extending outwards from the centre of the trunk equal to the DBH x 12.
- This area shall be protected by tree protective fencing (refer Appendix 4).
- Any part of the TPZ outside of the tree protective fencing area must be isolated from the work operations by protective barriers and/or root zone protection for the duration of the work (refer Appendix 5).
- The Project Arborist shall approve the extent of the TPZ prior to commencement of works.
- The TPZ shall be mulched to a depth of 90mm with approved organic mulch e.g. leaf and wood chip where possible.
- Supplementary watering shall be provided in dry periods to reduce water or construction stress, particularly to those trees which may incur minor root disturbance.

The following activities shall be excluded within the TPZ:

- Excavation, compaction or disturbance of the existing soil.
- The movement or storage of materials, waste or fill.
- Soil level changes
- Disposal/runoff of waste materials and chemicals including paint, solvents, cement slurry, fuel, oil and other toxic liquids
- Movement or storage of plant, machinery, equipment or vehicles.
- Any activity likely to damage the trunk, crown or root system.

2.2 Arboricultural supervision

Any work within TPZs requires a high level of care. Qualified arboricultural supervision is essential to minimise the risk of misunderstanding and misinterpretation. Site personnel must be properly briefed before any work starts. Ongoing work must be inspected regularly and, on completion, the work must be signed off by the Project Arborist to confirm compliance by the contractor.

2.3 Tree protection fencing, root zone and trunk protection

Prior to site establishment, tree protection fencing and root zone and trunk protection shall be installed to establish the TPZ for trees to be retained in accordance with site conditions. These protective barriers shall be maintained entire for the duration of the construction program (refer Appendix 4 and 5).

Tree protection fencing and trunk and root zone protection shall be removed following completion of construction. The mulch layer in the TPZ shall be retained and replenished where required to maintain a 75mm thickness

2.4 Pruning

All pruning work required (including root pruning) should be in accordance with Australian Standard No 4373-1996 - Pruning of Amenity Trees.

2.5 Tree Damage

In the event of damage to a tree or the TPZ, the Project Arborist shall be engaged to inspect and provide advice on remedial action. This should be implemented as soon as practicable and certified by the Project Arborist.

2.6 Post construction maintenance

In the event of any tree deteriorating in health after the construction period, the Project Arborist shall be engaged to provide advice on any remedial action. Remedial action shall be implemented as soon as practicable and certified by the Project Arborist.

3 EXCAVATION AND FILL IN TPZ

3.1 Excavation within TPZ

If excavation within the TPZ is required the following shall be applied to preserve tree root systems:

- Excavation within TPZ must be carried out under the instruction and supervision of the Project Arborist.
- A root mapping exercise is to be undertaken and certified by the Project Arborist. Root mapping shall be undertaken by either ground penetrating radar, air spade, water laser or by hand excavation using hand tools, taking care not to damage the bark and wood of any roots.
- The purpose of the root mapping shall be to locate woody structural roots greater than 40mm in diameter. Where possible, flexible clumps of smaller roots, including fibrous roots, should be retained if they can be displaced temporarily or permanently beyond the excavation without damage.
- If digging by hand, a fork shall be used to loosen the soil and help locate any substantial roots.
- Once roots have been located, the trowel shall be used to clear the soil away from them without damaging the bark.
- Exposed roots to be removed shall be cut cleanly with a sharp saw or secateurs.
- Roots temporarily exposed shall be protected from direct sunlight, drying out and extremes of temperature by appropriate covering.

3.2 Fill within TPZ

Placement of fill material within the Tree Protection Zone of trees to be retained should be avoided where possible. However, where fill cannot be avoided:

- All fill material to be placed within the TPZ should be approved by Project Arborist and consist of a course, gap-graded material to provide aeration and percolation to the root zone. Materials containing a high percentage of 'fines' is unacceptable for this purpose.
- The fill material should be consolidated with a non-vibrating roller to minimise compaction of the underlying soil.
- No fill material should be placed in direct contact with the trunk.

4 DEMOLITION OF SURFACING/STRUCTURES IN TPZ

4.1 Definitions of surfacing and structures

For the purposes of this guidance, the following broad definitions apply:

• **Surfacing:** Any hard surfacing used as a vehicular road, parking or pedestrian path including tarmac, solid stone, crushed stone, compacted aggregate, concrete and timber decking.

• **Structures:** Any man-made structure above or below ground including service pipes, walls, gate piers, buildings and foundations. Typically, this would include drainage structures, services, car-ports, bin stores and concrete slabs that support buildings.

4.2 Demolition and access

Roots frequently grow adjacent to and beneath existing surfacing/structures so great care is needed during access and demolition. Damage can occur through physical disturbance of roots and/or the compaction of soil around them from the weight of machinery or repeated pedestrian passage. This is not generally a problem whilst surfacing/structures are in place because they spread the load on the soil beneath and further protective measures are not normally necessary. However, once they are removed and the soil below is newly exposed, damage to roots becomes an issue and the following guidance must be implemented:

- No vehicular or repeated pedestrian access into TPZ permitted unless on existing hard surfacing or root zone protection.
- Regular vehicular and pedestrian access routes must be protected from compaction with temporary root zone protection as set out in Appendix 5.
- Where a TPZ is exposed by the work, it must be protected as set out in AS4970 until there is no risk of damage from the development activity.

4.3 Removal of surfacing/structures

Removing existing surfacing/structures is a high-risk activity for any adjacent roots and the following guidance must be observed:

- Appropriate tools for manually removing debris may include a pneumatic breaker, crow bar, sledgehammer, pick, mattock, shovel, spade, trowel, fork and wheelbarrow.
- Machines with a long reach may be used if they can work from outside the TPZ or from protected areas within the TPZ.
- Debris to be removed from the TPZ manually must be moved across existing hard surfacing or temporary root zone protection in a way that prevents compaction of soil. Alternatively, it can be lifted out by machines provided this does not disturb the TPZ.
- Great care must be taken throughout these operations not to damage roots.

5 INSTALLATION OF SURFACING/STRUCTURES IN TPZ

5.1 Basic principles: New surfacing/structures in a TPZ are potentially damaging to trees because they may disturb the soil and disrupt the existing exchange of water and gases in and out of it. Adverse impact on trees can be reduced by minimising the extent of these changes within the TPZ.

- **Surfacing:** Suitable surfacing should be relatively permeable to allow water and gas movement, load spreading to avoid localised compaction and require little or no excavation to limit direct damage. The actual specification of the surfacing is an engineering issue that needs to be considered in the context of the bearing capacity of the soil, the intended loading and the frequency of loading. The detail of product and specification are beyond the scope of this guidance and must be provided separately by the appropriate specialist.

- **Structures:** Where possible structures are to be constructed above ground level on piled supports and redirecting water to where it is needed. The detailed design and specification of such structures is an engineering issue that should be informed and guided by the Project Arborist. Conventional strip foundations in the TPZ for any significant structure may cause excessive root loss and are unlikely to be acceptable. However, disturbance can be significantly reduced by supporting the above ground part of the structures on small diameter piles/piers or

cast floor slabs set above ground level. The design should be sufficiently flexible to allow the piles to be moved if significant roots are encountered in the preferred locations.

5.2 Establishing the depth of roots

The precise location and depth of roots within the soil is unpredictable and will only be known when careful digging starts on site. Ideally, all new surfacing within a TPZ should be no-dig, i.e. requiring no excavation whatsoever, but this is rarely possible on undulating surfaces.

New surfacing normally requires an evenly graded sub-base layer, which can be made up to any high points with granular, permeable fills such as crushed stone or sharp sand. This sub-base must not be compacted as would happen in conventional surface installation. Some limited excavation is usually necessary to achieve this and need not be damaging to trees if carried out carefully and large roots are not cut.

Tree roots and grass roots rarely occupy the same soil volume at the top of the soil profile, so the removal of a turf layer up to 50mm is unlikely to be damaging to trees. It may be possible to dig to a greater depth depending on local conditions but this would need to be assessed by the Project Arborist.

6 SERVICES IN TPZ

For the purposes of this guidance, services are considered as structures. Excavation to upgrade existing services or to install new services within a TPZ may damage retained trees and should only be chosen as a last resort. In the event that excavation emerges as the preferred option, the decision should be reviewed by the Project Arborist before any work is carried out. If excavation is agreed, all digging should be done carefully and follow the guidance set out in 3.1 above.

7 SOFT LANDSCAPING IN TPZ

For the purposes of this guidance, soft landscaping includes the re-profiling of existing soil levels and covering the soil surface with new plants or an organic covering (mulch). It does not include the installation of solid structures or compacted surfacing.

Soft landscaping activity after construction can be extremely damaging to trees.

No significant excavation or cultivation shall occur within the TPZ (e.g. planting holes). Where new designs require levels to be increased to tie in with new structures or surrounding ground level, good quality and relatively permeable top soil should be used for the fill. It should be firmed into place but not over compacted in preparation for turfing or careful shrub planting.

All areas close to tree trunks should be kept at the original ground level and have a mulched finish rather than grass to reduce the risk of mowing damage.

APPENDIX 7

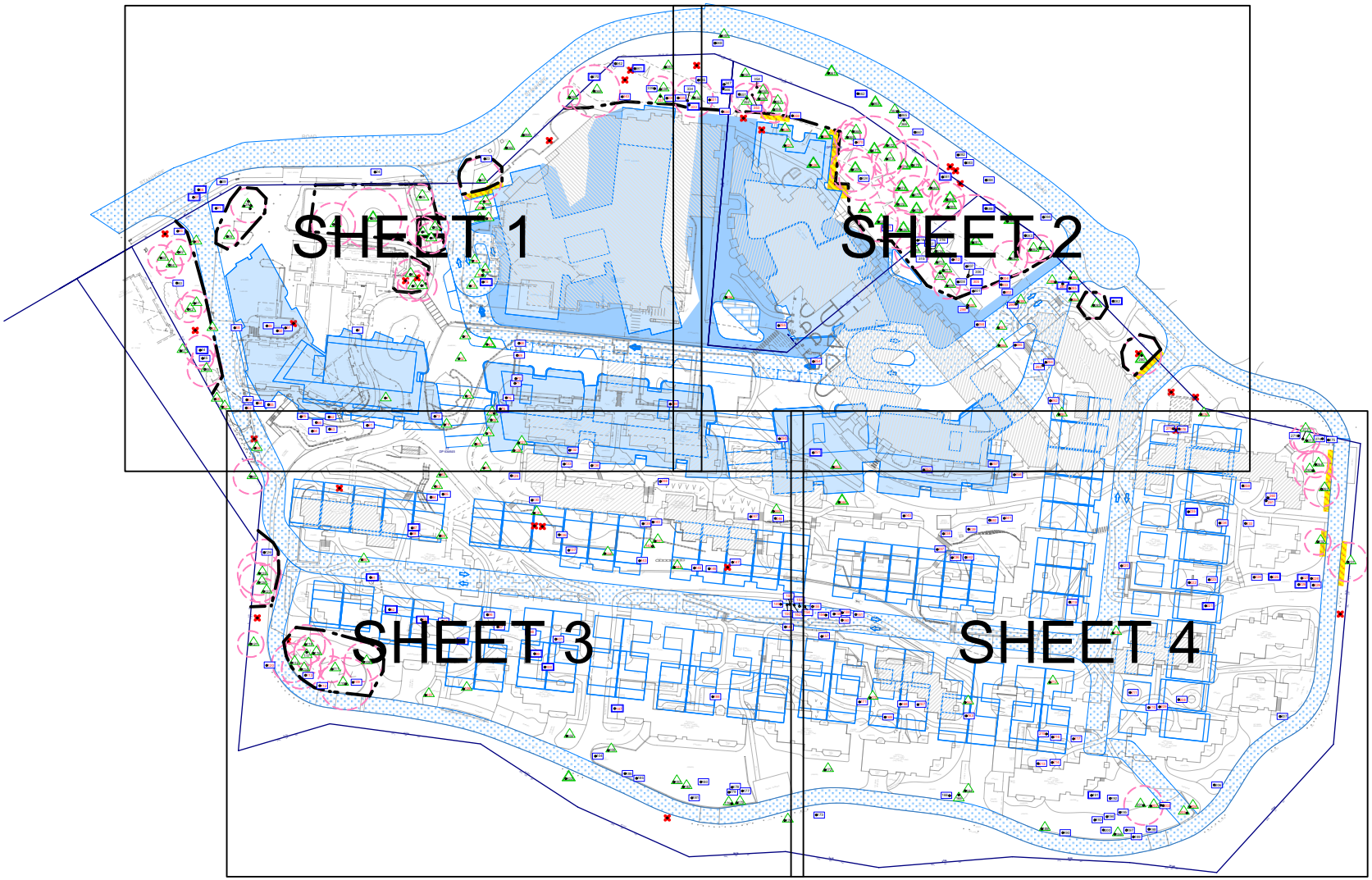
Schedule of works and responsibilities

Hold Point	Task	Responsibility	Certification	Timing of Inspection
1	Indicate clearly (with spray paint) trees approved for removal only	Principal Contractor	Project Arborist	Prior to demolition and site establishment
2	Establishment of tree protection fencing and additional root, trunk and/or branch protection	Principal Contractor	Project Arborist	Prior to demolition and site establishment
3	Supervise all excavations works proposed within the TPZ	Principal Contractor	Project Arborist	As required prior to the works proceeding adjacent to the tree
4	Inspection of trees by Project Arborist	Principal Contractor	Project Arborist	Monthly during construction period
5	Final inspection of trees by Project Arborist	Principal Contractor	Project Arborist	Prior to the issue of Occupation Certificate

APPENDIX 8

Tree management plan

-refer attached Tree Management Plan, Dwg No. TMP01,
by Naturally Trees dated 16 June 2023



LEGEND:

- 01 Category AA — Trees worthy of being a constraint
- 01 Category A
- 01 Category Z — Trees not worthy of being a constraint
- 01 Category ZZ
- Existing layout
- Proposed layout
- Tree protection zone (TPZ) boundaries
- Protective fencing and TPZ area within
- TPZ where ground protection must be installed. Retain all existing levels.
- 01 Tree to be removed
- Tree no longer on site

N

ISSUE	DATE	REVISION

NOTE DO NOT SCALE FROM DRAWING. USE FIGURED DIMENSIONS ONLY.
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PROJECT
95 Stanhope Road, Killara NSW

CLIENT
Lourdes Retirement Village

DRAWING
Tree Management Plan

Naturally Trees

PROJECT # | DWG # | REV

DATE 16/06/2023

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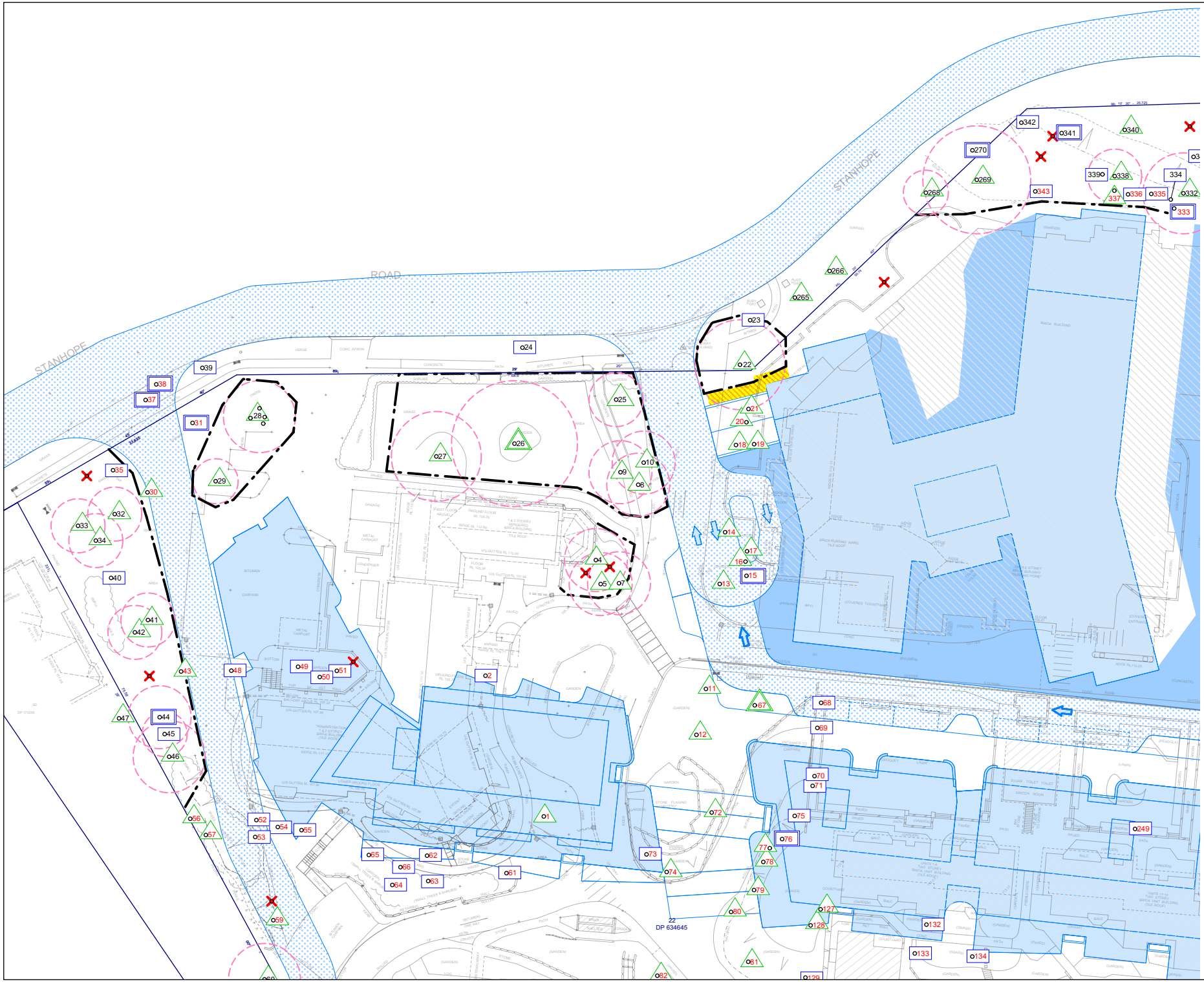
TMP01 C

Cover Sheet

Naturally Trees Arboricultural Consulting
PO Box 5085 Elanora Heights NSW 2101 Australia
T: 0417 250 420 **W**: www.naturallytrees.com.au **E**: info@naturallytrees.com.au



LEGEND:

- Category AA (01) — Trees worthy of being a constraint
- Category A (01)
- Category Z (01) — Trees not worthy of being a constraint
- Category ZZ (01)
- Existing layout
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N

0 10 20m

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95 Stanhope Road, Killara NSW

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Tree Management Plan

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Sheet 1 of 4

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PO Box 5085 Elanora Heights NSW 2101 Australia
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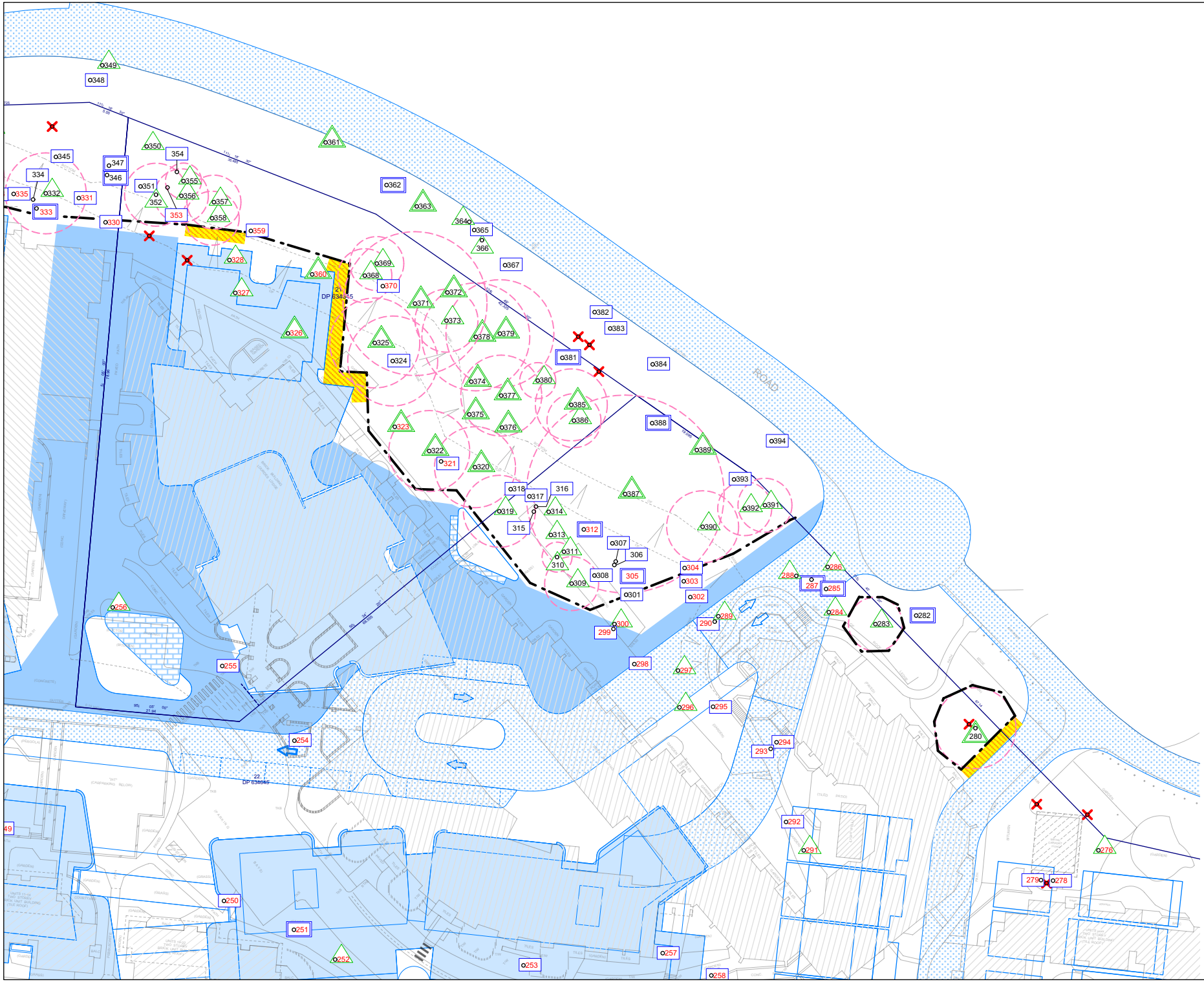

LEGEND:

- Category AA (01) — Trees worthy of being a constraint
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0 10 20m

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Tree Management Plan

Naturally Trees

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TMP01 C

Sheet 2 of 4

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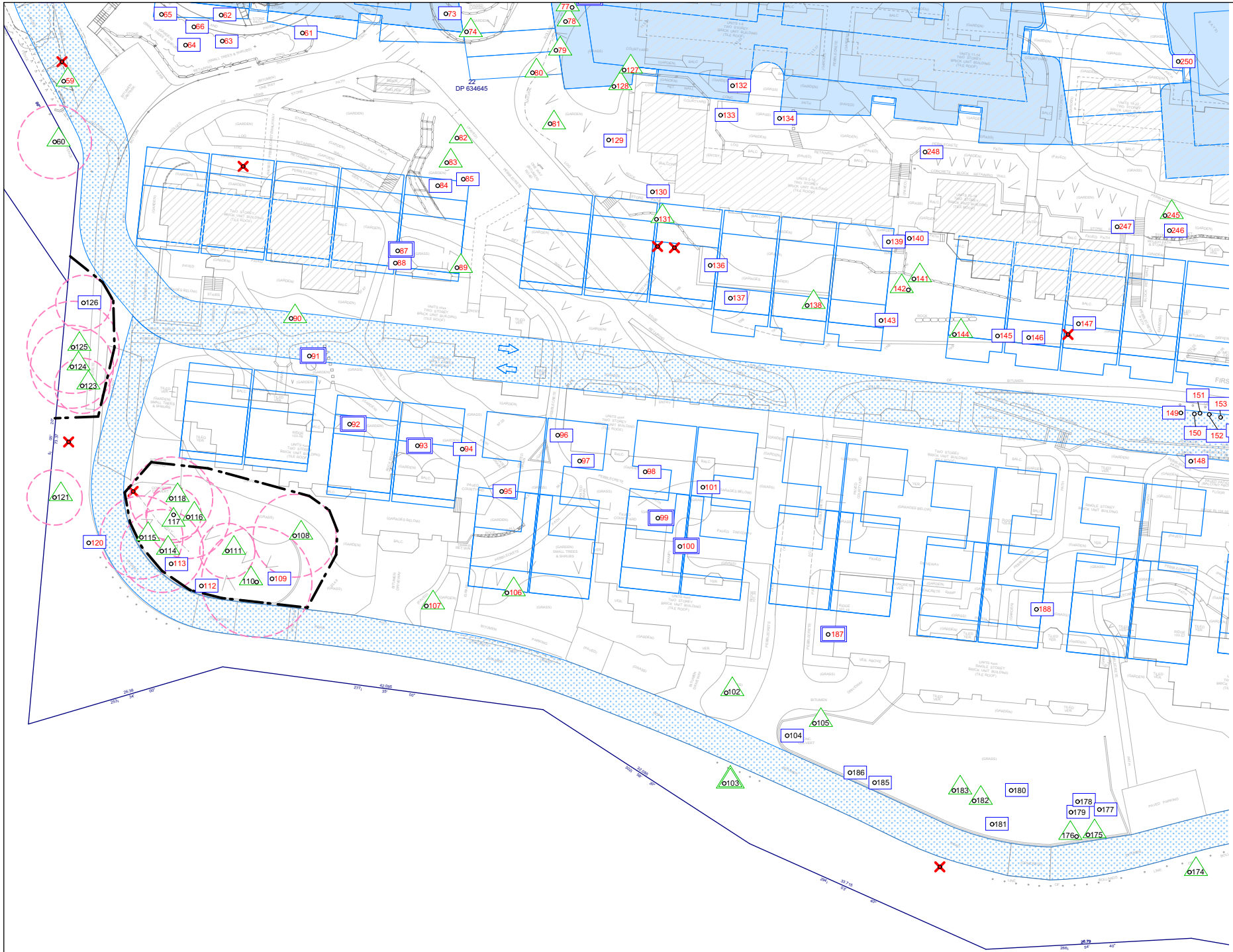

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CLIENT
Lourdes Retirement Village

DRAWING
Tree Management Plan

Naturally Trees

PROJECT # | DWG # | REV

DATE 16/06/2023

SCALE @ A1 **1:650**

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TMP01 C

Sheet 3 of 4

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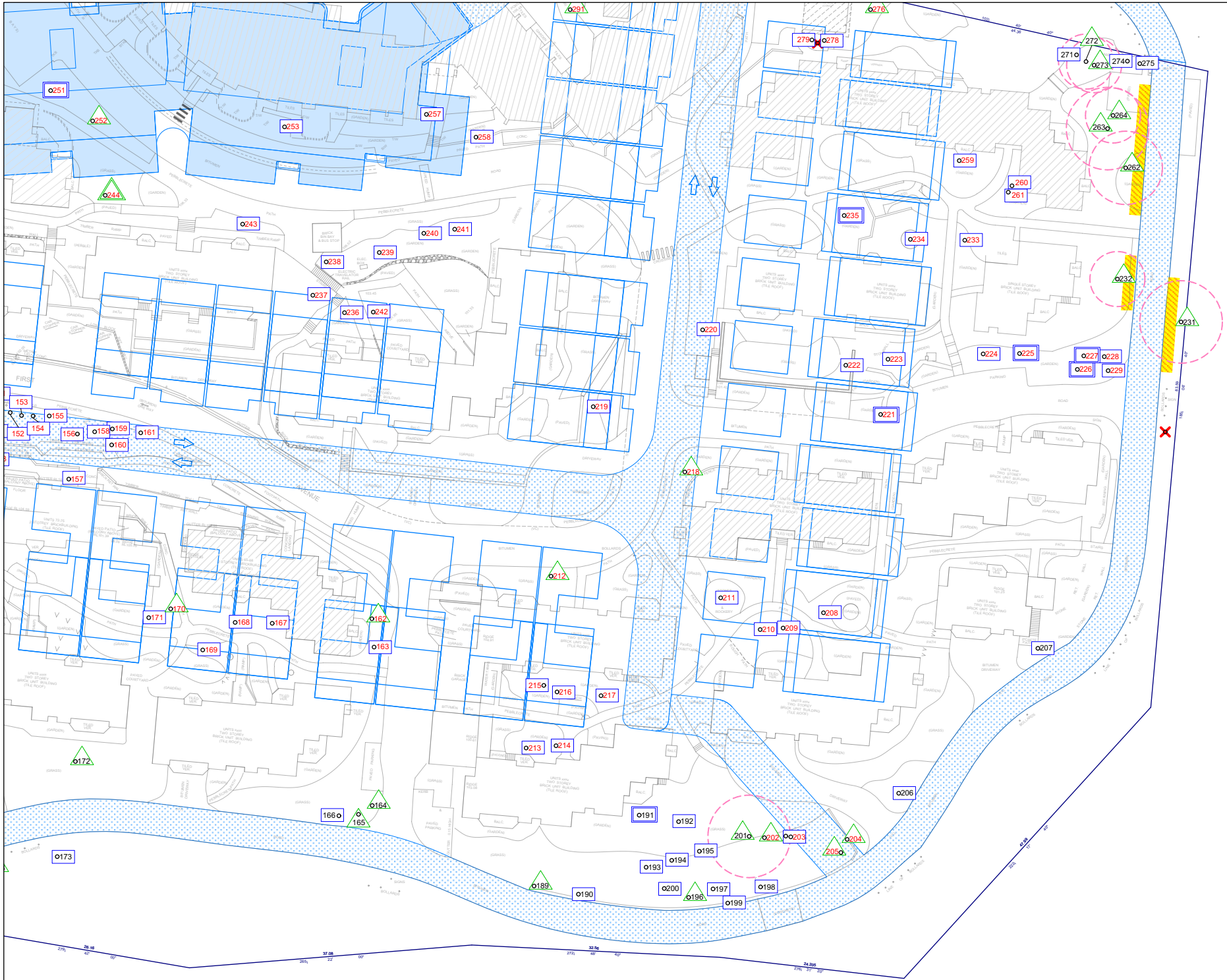

LEGEND:

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CLIENT

Lourdes Retirement Village

DRAWING

Tree Management Plan

Naturally Trees

PROJECT #	DWG #	REV
	TMP01	C

DATE 16/06/2023

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Sheet 4 of 4

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LOURDES RETIREMENT VILLAGE
95 STANHOPE ROAD, KILLARA

Biodiversity Development Assessment Report

Prepared by :
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Final Report July 2023

Angophora costata on sandstone outcropping | First Avenue, Lourdes Retirement Village

Lourdes Retirement Village - Biodiversity Development Assessment Report

prepared for

Levande Pty Ltd

C/- Bec Mahoney
Project Manager
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Revision Schedule

Rev No	Date	Details	Issued to
1	04.05.2023	BDAR for submission	Levande Pty Ltd
2	13.07.2023	BDAR amended in response to EHG submission	Levande Pty Ltd

Summary

ACS was engaged by Levande to prepare a Biodiversity Development Assessment Report (BDAR) for the proposed development at Lourdes Retirement Village in Killara. The subject land is the assessable area which includes Lot 21 and Lot 22 in Deposited Plan 634645, in the Ku-ring-gai Local Government Area (LGA).

The proposed development will redevelop the site, retaining its use as a retirement village with retirement aged care facilities, and introduce new town houses. The development is classified as a State Significant Development under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

This BDAR has followed the Biodiversity Assessment Method 2020 (BAM, established under Section 6.7 of the NSW *Biodiversity Conservation Act 2016* (BC Act) and has been completed using the *Biodiversity Development Assessment Report Template* (2022).

This BDAR describes the biodiversity values within the subject land and development site, describes the impacts and outlines the measures to be taken to avoid, minimise and mitigate impacts to the Plant Community Types and threatened species habitat present within the subject land, development footprint and development site.

The BDAR provides the number of biodiversity credits that would be required to be retired to offset the residual loss of biodiversity from the impacts of the development as described.

The proposed development involves direct impacts to the biodiversity values within the development footprint, and indirect impacts within the development site. Following avoidance and mitigation, the residual direct impacts were calculated in accordance with the BAM by utilising the BAM Credit Calculator.

Requirements of the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), applicable State Environmental Planning Policies have been addressed in this report.

This BDAR directly addresses the Response to Submissions from EHG received on 29/05/2023.

This BDAR and response matrix outlines the detailed responses to the matters raised regarding PCT allocations and Threatened Ecological Communities. The key issues addressed are:

- Absent justification for selected Plant Community Types (PCTs)
- Insufficient evidence and justification for why any threatened ecological communities have not been identified on a site where it has been mapped and previously identified
- Insufficient/non-compliant assessment for Species Credit Species
- Absent information regarding the two entities on site that may constitute Serious and Irreversible Impacts (SAII)
- Lack of avoidance of impacts to significant biodiversity values.

Ecologique and Eco Logical Australia were both engaged to provide peer review and advice to ACS to respond to the key issues above.

Responses to each key deficiency raised are addressed in this BDAR, against the corresponding template section. Specific reference can be found in the RTS response table provided.

Development background

This BDAR has been prepared to support a Planning Proposal that will amend the current zoning to enable the proposed redevelopment of the Lourdes Retirement Village (the Village).

Redevelopment of the Village is necessary as the existing aging buildings (originally constructed in the early 1980s) do not provide services and facilities that are competitive with market demand nor compliant with current Building Codes, Senior Living or Bushfire standards.

The proposed development footprint will involve the following:

- Demolition of single and two storey residential buildings;
- Construction of multi-storey independent Living units and town houses buildings
- restoration of the existing single storey chapel;
- Construction of new access roadways and realignment of internal roadways;
- Associated services;
- Vegetation clearing; and
- Landscaping.

If the Planning Proposal is endorsed, the proposal will be assessed by the Department of Planning and Environment (DPE) as State significant development (SSD) under Part 4 of the EP&A Act.

SSDs are required to assess any biodiversity impacts associated with the development in accordance with the *Biodiversity Conservation Act 2016* and the Biodiversity Assessment Method (OEH 2020), including the preparation of a Biodiversity Development Assessment Report (BDAR), unless a waiver is granted, or the site is on biodiversity certified land.

Measures to avoid and minimise

Given the significant landholding and obligations to house existing residents during the redevelopment, alternate sites were not considered appropriate nor feasible for the proposal objectives.

The proposal has been located within the existing developed footprint and as far as practical has avoided impacts on the site's biodiversity values. In accordance with Section 7.1.2 of the BAM the proposal's unavoidable impacts will occur in areas that have no biodiversity values and in vegetation areas that are in the poorest condition, and/or do contain habitat for threatened species.

During the design development, various possibilities were explored regarding the development layout of the site. This comprehensive evaluation considered the potential opportunities and constraints presented by the location, aiming to develop a place-based master planned renewal of the village suitable for seniors living.

Since the previous Response to Submissions from EHG (This has been achieved through the following strategies:

- Relocation and realignment of the western entrance, enabling the retention of the subject land's remaining *Syncarpia glomulifera* (turpentine) trees and areas mapped as comprising the critically endangered Sydney Turpentine Ironbark Forest;
- Redesign and reduction of southern townhouses to retain more mature native vegetation along the southern boundary and thereby minimising impacts to Swift Parrot feed trees (adjacent mapped important habitat area for the species) and reduced clearing of PCT 3952;
- Modification of the Northeastern Independent Living Apartment Building to avoid and minimise impact on the adjacent vegetation to the north, include native vegetation allocated to the critically endangered Sydney Turpentine Ironbark Forest.

The outcome of design amendments more specifically includes:

- Exotic vegetation being the most impacted (at 1.01 ha);
- 1.07 ha out of 1.77 ha of native vegetation avoided, with most native vegetation cleared comprising landscaping;
- An overall reduction in clearing of PCT vegetation from 0.58 ha to 0.25 ha (i.e., a further avoidance of 0.33 ha of PCTs achieved).
- Approximately 0.05 ha of remnant and planted native vegetation allocated to PCT 3262 (a CEEC) impacted with 0.17 ha avoided;

- Approximately 0.20 ha of remnant and planted native vegetation allocated to PCT 3592 (not threat listed) impacted with approximately 0.70 ha avoided;
- Potential impacts to threatened species habitat is limited to marginal foraging habitat only, which is unlikely to be preferred over the intact bushland adjacent to the subject land's east and south.

Plant community types and threatened ecological communities

Two plant community types (PCTs) have been allocated to remnant and planted native vegetation with the subject land:

- Sydney Turpentine Ironbark Forest - PCT 3262
- Sydney Coastal Enriched Sandstone Forest - PCT 3592

PCT 3262 relates to the threatened ecological community (TEC) Sydney Turpentine Ironbark Forest in the Sydney Bioregion, which is listed under both the NSW BC act and Commonwealth EPBC Act. The condition of PCT 3262 allocated vegetation in the subject land does not meet the condition required to be considered the nationally listed community but has been maintained as a TEC in NSW within the BAM calculator.

PCT 3592 is not associated with any TECs.

Important habitat mapping for the threatened Swift Parrot is located along the southern and southeastern periphery of the subject land. The Swift Parrot is also listed as a threatened species under the EPBC Act. A very small area of planted semi-mature native trees will be cleared from within the mapped habitat area for this species.

While it is considered unlikely that this impact would be of any significance to the species, the area of clearing has been included as an impact requiring an offset in the BAM calculator.

The subject land is located marginally within a 2km radius of potential breeding habitat for the Large-eared pied bat, which is a candidate species credit species and also listed under the EPBC Act. This species has been included as an ecosystem credit species to allow for potential foraging habitat within the subject land.

Impact assessment

Approximately 0.25 ha of native vegetation associated with PCTs and 0.01 ha of mapped important habitat area for the Swift Parrot will be directly impacted on by the proposal

Direct impact	Extent (ha)
Clearing of native vegetation allocated to PCT 3592	0.20 ha
Clearing of native vegetation allocated to PCT 3262	0.05 ha
Clearing of native vegetation located in an area of mapped Swift Parrot important habitat area clearing	0.01 ha

PCT 3262 and the Swift Parrot are identified Serious and Irreversible Impact (SAII) entities and an SAII assessment in accordance with Section 9.1.1 of the BAM is provided to assist the consent authority to evaluate the nature of an impact on a potential entity at risk of a serious and irreversible impact.

Prescribed impacts have been assessed in accordance with Section 8.3 of the BAM and the likelihood of the proposal to result in a prescribed impact is considered a low risk.

This assessment has determined that the proposed development is unlikely to have a significant impact on any of the MNES and a referral under the EPBC Act is not required.

Mitigation measures

Mitigation of indirect impacts on biodiversity values during construction will be specified within a project Construction and Environmental Management Plan (CEMP), which at a minimum shall include the following:

- Erosion and sediment controls;
- Dust and noise suppression;
- Pre-clearance and clearance processes to achieve the following, but not limited to, objectives:
  - protection of retained native vegetation and habitat
  - prevention of injury/mortality to all fauna
  - prevention of the spread and/or introduction of weeds and pathogens
- Mitigation of operational indirect impacts on biodiversity values will be integrated into the detailed design of the proposal, which includes, but may not be limited to:
  - Stormwater management and protection of downstream aquatic ecosystems
  - Light spill into the adjacent bushland and native fauna habitat
  - Landscape management (including native landscaping establishment and ongoing weed control)

Offset requirements

Two (2) ecosystem credits and one (1) ecosystem credit must be retired to offset the clearing of PCTs 3592 and 6262 respectively as determined by the BAM calculator. An additional one (1) species credit must be retired to offset the clearing of native vegetation within the important mapped habitat area for the Swift Parrot.

Impacts that require an offset – ecosystem credits

Vegetation zone	PCT name	TEC	Impact area (ha)	Number of ecosystem credits required
PCT 3592 - MANAGED	Sydney Coastal Enriched Sandstone Forest	NO	0.20	2
PCT 3262 - MANAGED	Sydney Turpentine Ironbark Forest	YES	0.05	1

Impacts that require an offset – species credits

Common name	Scientific name	Loss of habitat (ha)	Number of species credits required
Swift Parrot	*Lathamus discolor*	0.01	1

Future development assessment

Prior to commencement of the proposed development, development consent is required. As the proposed development including seniors living housing, the development application will be submitted as a State Significant Development (SSD).

An updated BDAR will be prepared for submission with the SSD application. At this time, further detail will be possible as it relates to mitigation and management of impacts in accordance with BAM Sections 8.4 and 8.5 and the minimum information requirements in Appendix K of the BAM.

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Shortened forms

BAM	Biodiversity Assessment Method (NSW)
BAM-C	BAM calculator
BC Act	*Biodiversity Conservation Act 2016* (NSW)
BC Reg.	*Biodiversity Conservation Regulation 2017* (NSW)
BDAR	Biodiversity Development Assessment Report
Biosecurity Act	*Biosecurity Act 2015* (NSW)
BOAMS	Biodiversity Offsets and Agreement Management System
BOS	Biodiversity Offsets Scheme
CEEC	Critically Endangered Ecological Community
CEMP	Construction Environmental Management Plan
DA	Development Application
DBH	Diameter at breast height
DCP	Development Control Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Cwlth)
DPE	Department of Planning and Environment (NSW)
EHG	Environment and Heritage Group of the DPE
EPBC Act	*Environment Protection Biodiversity and Conservation Act 1999* (Cwlth)
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
FM Act	*Fisheries Management Act 1994* (NSW)
HTW	High threat weed
IBRA	Interim Biogeographic Regionalisation of Australia
KTP	Key threatening process
LEP	Local Environment Plan
LGA	Local Government Area
MNES	Matters of National Environmental Significance
PCT	Plant community type
SAII	Serious and Irreversible Impact
SEARs	Secretary's Environmental Assessment Requirements
SEPP	State Environment Protection Policy (NSW)
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection

Declarations

i. Certification under clause 6.15 *Biodiversity Conservation Act 2016*

The following signatories certify that this report has been prepared based on the requirements of, and information provided under, the Biodiversity Assessment Method and clause 6.15 of the *Biodiversity Conservation Act 2016* (BC Act).

Name: **PETER STRICKER**

Date: 13 July 2023

BAM Assessor Accreditation no: **BAAS18125**

Name: **KATHRYN DUCHATE**L

Date: 13 July 2023

BAM Assessor Accreditation no: **BAAS17054**

This BDAR has been prepared to meet the requirements of BAM 2020. Appendix A provides an assessment of compliance with the minimum information requirements outlined in BAM Appendix K.

ii. Details and experience of author/s and contributors

Authors and contributors

Name	Position/Role	Tasks performed	Relevant qualifications
Peter Stricker	Director, ACS Environmental Pty Ltd	BAM field surveys PCT analysis BAM-C analysis Report preparation	BSc. (Hons) (Syd) BAAS18125
Kathryn Duchatel	Director, écologique	BAM field surveys PCT analysis Report preparation	BSc. Env. (Macq) BAAS17054 EIANZ CEnvP #601
Amy Rowles	Director, Corymbia Ecology	Microbat survey	B. Sc. (Hons) Ecology PhD Candidate 'Seasonal Migration of Australian Tree Roosting Microbats'

iii. Conflict of interest

I, PETER STRICKER, declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest**.**

This declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

Signature:

Date: 13 July 2023

BAM Assessor Accreditation no: **BAAS18125**

I, KATHRYN DUCHATEL, declare that I have considered the circumstances and there is no actual, perceived or potential conflict of interest.

This declaration has been made in the interests of full disclosure to the decision-maker. Full disclosure has also been provided to the client.

Signature:

Date: 13 July 2023

BAM Assessor Accreditation no: **BAAS17054**

Stage 1: Biodiversity Assessment

1. Introduction

1.1 Proposed development

1.1.1 Development overview

Lourdes Retirement Village (the Village) is nestled beside bushland at the end of Stanhope Road, Killara. The site has been developed throughout various uses since the 1910's with construction of the current Village arrangement commenced in 1983 and continued throughout the 1980's.

The Village now requires significant renewal to provide modern seniors housing. The existing housing is dated, has limited accessibility with many of the dwellings not having lift access and the gradient of streets and pathways provide poor pedestrian connectivity.

From a bushfire perspective, the renewal of the site as envisaged by the Planning Proposal will deliver a significantly enhanced bushfire safety outcome for the existing and future residents through improved access/egress from the site, improved bushfire construction of new buildings, and the location of vulnerable seniors housing residents further from the bushfire risk. In particular, the additional access points to the site are required to support evacuation during a bushfire event (if necessary) and have been located to avoid Biodiversity values to the greatest extent possible.

Levande Pty Ltd (the proponent) proposes to redevelop the Village to bring the facility into the modern era and expand the current facility to meet the growing demand for seniors' accommodation.

This Biodiversity Development Assessment Report (BDAR) has been prepared to support the Planning Proposal that will amend the current zoning to enable the proposed redevelopment.

If the Planning Proposal is endorsed, the proposed redevelopment will be assessed by the Department of Planning and Environment (DPE) as State significant development (SSD) under Part 4 of the EP&A Act, for the proposed development

1.1.2 Location

The Village is located approximately 12 kilometres north the Sydney Central Business District. Relevant site details are summarised below and are illustrated in Figure 1.

Street address	95 Stanhope Road, Killara
Legal identification	Lot 21 DP 634645 & Lot 22 DP 634645
Local Government Area (LGA)	Ku-ring-gai
Local Government	Ku-ring-gai Council
Environmental Planning Instrument	Ku-ring-gai Council Local Environment Plan 2015
Site area	Approximately 5.6 ha

Legend

Subject land

N

0 30 60 120

m

Lourdes Retirement Village

Figure 1. Subject land

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 20 June 2023

Data drawn: 18 July 2023

1.1.3 Proposed development

The proposed development footprint is shown in Figure 2 and will involve the following:

- Demolition of single and two storey residential buildings;
- Construction of multi-storey residential buildings and a single storey chapel;
- Construction of new access roadways and realignment of internal roadways;
- Associated services;
- Vegetation clearing; and
- Landscaping.

At this early planning stage of the proposal, specific details of associated infrastructure works required to support operations of the proposal and temporary infrastructure required during construction (e.g., park up areas, stockpiles, waste or storage zones, temporary buildings) are yet to be finalised.

Figure 2. Proposal layout

1.1.4 The subject land

Historical landuse

Before its current use as the present-day Lourdes Retirement Village complex, the subject land was historically used as follows:

- Headfort School, which:
  - Opened in 1918 and by 1921 contained two connected two-storey buildings, surrounding gardens, a tennis court,
  - Contained two full playing fields, a smaller field, swimming pool and a mini rifle range by 1923, and
  - Operated until 1935 (under ownership of the Congregational Union 1927-1935)
- NSW Australian Women's Army Service (AWAS), who used the site as:
  - A training course for AWAS recruits, and
  - A training school for AWAS NCOs until 1944
- Hospital:
  - From 1946 to 1967 as a tuberculosis hospital, and
  - An acute after-care facility for patients from the Mater Hospital North Sydney

An assessment of historical and heritage imagery (as relevant to biodiversity) is provided in Section 2.2.4 and imagery provided in Appendix C.

Current setting

The subject land currently operates as a retirement village, consisting of numerous residential (independent living) dwellings, a nursing home and an amenities building including an administration centre, swimming pool and spa areas.

Natural vegetation structure and species composition have been extensively modified due to historical clearing and land use and both historical and contemporary landscaping (i.e., historical landscaping refers to non-locally occurring native species that are evident in historical imagery as far back as 1950).

More recent landscaping (i.e., that associated with the existing development) has been planted mainly along the surrounding boundaries of internal roadways and grassy garden areas and include local and non-local native species as well as exotic ornamental species.

Topography

Based on the supplied survey plans, the maximum elevation relief across the site, between the northern relatively level portion and the lower lying southernmost road is about 14m. Beyond the southern and eastern site boundaries, the steep bushland covered hillsides grade between 15° and 45° (JK Geotechnics 2023).

The site's elevation is described by prensa (2023) as: steep, falling between 104m AHD on the northern boundary and 95m AHD on the southern boundary; and between 105m AHD on the western boundary, rising to approximately 108m AHD, before declining to approximately 99m AHD on the eastern boundary.

JK Geotechnics (2022) describe the site further as follows:

- Along the northern and north eastern site boundaries, batter slopes grading between 26° and 35° and up to 3m high were present. Beyond the toes of the batter slopes, the ground surface gently graded between 2° and 3° towards Stanhope Road (the location of unmapped native vegetation).
- To the south and east of the northern relatively level portion of the site, surface levels typically fall at grades between 2° and 12°. This portion of the site is terraced by numerous retaining

walls, up to 3m high. Batter slopes generally between 10° and 25° and up to approximately 2.5m high were also present across the lower sloping portion of the site.

- The neighbouring property to the west of the site (91 Stanhope Road) contained a two-storey brick residence, which was set back approximately 1m from the common boundary. The neighbouring surface level was about 0.4m lower than the subject site.

Soils and geologies

The 1:100,000 geological map of Sydney (Geological Survey of NSW, Geological Series Sheet 9130) indicates the site to be underlain by Hawkesbury Sandstone. Generally, boreholes drilled by JK Geotechnics (2022) encountered pavements and/or fill, overlying residual clays, then sandstone bedrock at relatively shallow depths.

Soil landscape mapping indicates the north-western site portion as 'residual 'Lucas Heights' Soil landscape series that is characterised by gently undulating crests and ridges on plateau surfaces of the Mittagong Formation where rock outcropping is usually absent (Chapman & Murphy 1989).

The lower and eastern sections of the subject land appear to be more associated with Hawkesbury Sandstone sediments where the colluvial 'Hawkesbury' Soil Landscape Series is characterised by rolling hills on Hawkesbury Sandstone including rock outcropping with rocky benches, broken scarps and boulders (Chapman & Murphy 1989).

JK Geotechnics (2023) found sandstone rock outcrops and exposed sandstone cut faces between 1.2m and 1.6m high are exposed across the site.

1.2 Biodiversity Offsets Scheme entry

The Biodiversity Conservation Regulation 2017 (BC. Reg.) sets out threshold levels for when the Biodiversity Offsets Scheme will be triggered. The threshold has 2 elements:

- Whether the amount of native vegetation being cleared exceeds an area threshold
- Whether the impacts occur on an area mapped on the Biodiversity Values Map published by the Environment Agency Head.

If clearing and other impacts, including biodiversity impacts prescribed by clause 6.1 of the BC. Reg., exceed either trigger, the Biodiversity Offsets Scheme applies to the proposal.

1.2.1 Area threshold

The minimum lot size under the Ku-ring-gai LEP for both lots is 850m^2 (noting that the smallest lot size is used when determining the area threshold).

The area threshold for Lots smaller than 1 ha in size is 0.25 ha (i.e., clearing of native vegetation 0.25 ha or more exceeds the Scheme's area threshold).

The total area of native vegetation that is identified as potentially remnant and is proposed to be cleared is marginally less than 0.25ha in extent (not including planted native vegetation to be cleared).

1.2.2 Biodiversity Values Map

The initial design footprint resulted in clearing of native vegetation from land mapped as containing Biodiversity Values (BV).

Design iterations (refer Section 7) have avoided clearing vegetation from BV mapped land and therefore this trigger no longer applies to the proposed development.

1.2.3 State significant development

Regardless of whether the proposed development triggers the Scheme's threshold, as it will be assessed as SSD, Secretary Environmental Assessment Requirements (SEARs) will be issued. The SEARs will require that potential impacts on biodiversity values be assessed through application of the BAM and a BDAR be prepared.

1.3 Matters of national environmental significance

Four matters of national environmental significance have been identified as potentially occurring on or utilising the subject land (see Table 1).

Table 1. EPBC Act matters of national environmental significance

MNES	Description	Significant Impact upon a MNES likely? (Y/N)
PCT 3262 Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Occurrences of the Turpentine–Ironbark Forest in the Sydney Basin Bioregion ecological community are part of the nationally listed TEC if patches are in good condition. Good condition is generally determined as: ▪ the vegetation has some characteristic components from all structural layers (tree canopy, small tree/shrub midstorey, and understorey); and ▪ the tree canopy cover is greater than 10%; and ▪ the patch size is greater than 1 ha.	No. The patch size is not >1 ha (refer Section 4.4).
PCT 3136 Blue Gum High Forest in the Sydney Basin Bioregion	Occurrences of the Blue Gum High Forest of the Sydney Basin Bioregion ecological community are part of the nationally listed TEC if they are greater than one hectare in size and: ▪ have a canopy cover greater than 10%; or ▪ have a canopy cover less than 10% and occur in areas of native vegetation more than 5 ha	No. Floristic survey did not find evidence of this TEC occurring within the subject land (refer Section 4.1).
Chalinolobus dwyeri Large-eared pied bat	Vulnerable species	No. The species was not identified during surveys (refer Section 5.6).
Lathamus discolor Swift Parrot	Critically endangered species	No. A very small area (140m^2) of BAM mapped important habitat for this species will be impacted (refer Section 5.6)

This assessment has determined that the proposed development is unlikely to have a significant impact on any of the MNES listed in Table 1 and a referral under the EPBC Act is not required. (Assessment of MNES is provided in Section 4.4 .

1.4 Information sources

The following information sources were used in the preparation of this BDAR:

1.4.1 Data and Imagery

- Imagery:
  - Aerial imagery: NearMap 16 March 2023
  - NSW Spatial Services – Historical imagery viewer: 1943 to 1985
  - NSW Soil landscapes\ Sydney_SL100K_v1_GDA94.shp
- Australian Government Department of Climate Change, Energy, Environment and Water
  - Species Profiles and Threats Database (SPRAT) http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl
  - Interim Biogeographic Regionalisation for Australia (IBRA) version 7.0
- NSW Department of Planning and Environment (DPE)
  - NSW (Mitchell) Landscapes – version 3.1
  - BVMap_BV152_Web.gdb
  - The Native Vegetation of the Sydney Metropolitan Area (SMA) - Version 3_1 (OEH, 2016) VIS_ID 4489 (SydneyMetroArea_v3_2016_E_4489)
  - NSW State Vegetation Type Mapping (SVTM) (OEH, 2022)
  - BioNet Vegetation Classification Database and Threatened Biodiversity Data Collection
  - Biodiversity Investment Opportunities Map: Mapping Priority Investment Areas for the Cumberland Subregion (2018)

1.4.2 Reports

- Australian Government Department of Climate Change, Energy, Environment and Water
  - Approved Conservation Advice for Turpentine-Ironbark Forest in the Sydney Basin Bioregion (11 April 2014)
  - Significant Impact Guidelines 1.1 – Matters of National Environmental Significance (Department of the Environment, Water, Heritage, and the Arts, 2013 EPBC Act Policy Statement)
  - SPRAT Profile for Turpentine–Ironbark Forest in the Sydney Basin Bioregion. Available at: http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=38&status=Critically+Endangered
- NSW Threatened Species Scientific Committee
  - CEEC final determination for Sydney Turpentine Ironbark Forest in the Sydney Basin Bioregion (31 May 2019)
- NSW DPE Environment Heritage Group (EHG)
  - Advice PP-2022-658 95-97 Stanhope Road Killara_Ref-1539 (1) (27 September 2022)
  - Advice PP-2022-658 95-97 Stanhope Road Killara Amended Plans (28 March 2023)
  - EHG Advice PP-2022-658 95 Stanhope Road Killara Amended Information (6 June 2023)

- FPD Planning (23 December 2022) Lourdes Retirement Village Planning Proposal - Response to Submissions
- FPD Planning (22 February 2023) Planning Proposal PP 2022-658
- GML Heritage (May 2017) Headford House 95 Stanhope Road Killara Heritage Significance Assessment. Report prepared for Stockland 11 May 2017
- JK Geotechnics (September 2022) Preliminary Geotechnical Investigation for the proposed redevelopment at Lourdes Retirement Village
- Naturally Trees (16 June 2023) Lourdes Retirement Village Arborist Report - Rev C
- Plus Architecture (02 August 2022) - Urban Design Report to support planning proposal
- Plus Architecture (29 June 2023) Lourdes Retirement Village – Urban Design Report, Response to Council.
- Prensa (4 July 2023) Preliminary Site Investigation, 95 Stanhope Road, Killara, NSW.

2. Methods

2.1 Site context

2.1.1 Landscape assessment

In accordance with Sections 3.1 and 3.2 of the BAM (2020), landscape features relevant to the proposal have been assessed from within a 1500m buffer zone around the subject land (the BDAR assessment area).

Assessment and mapping of the following landscape features was undertaken using ArcMap v10.8.2 and Nearmap imagery from March 2023 (EPSG7856_Date20230316 Lat-33.767336 Lon151.1766 Mpp1.194.jpg):

- IBRA bioregions and subregions;
- NSW (Mitchell) landscapes;
- Rivers and streams classified according to stream order;
- Wetlands within, adjacent to and downstream of the site;
- Connectivity of different areas of habitat;
- Geological features;
- Areas of outstanding biodiversity value occurring on the subject land and assessment area; and
- Percent native vegetation cover in the assessment area (see Section 2.1.2).

2.1.2 Native vegetation cover

Native vegetation cover on the subject land must be assessed in relation to native vegetation cover across a broader area. The cover of native vegetation in the BDAR assessment area, was assessed as follows:

- Clipping the extent of SydneyMetroArea_v3_2016_E_4489 (OEH, 2016) shapefile within the BDAR assessment area using ArcMap v10.8.2.

  Note the more recent NSW State Vegetation Type Map (DPE 2022) shapefile was also clipped and reviewed, but OEH (2016) mapping was found to better represent the extent of native vegetation cover.
- Editing the shapefiles to:
  - Remove areas of vegetation no longer evident due to clearing,
  - Increase polygon areas where vegetation has increased in extent, and
  - Create additional polygons identifying areas of vegetation not represented in mapping.
- Exporting the clipped shapefile data attribute table for analysis.

2.2 Native vegetation, threatened ecological communities and vegetation integrity

2.2.1 Existing information

Native vegetation within the subject land was assessed with reference to the following resources:

- Arboricultural assessment;
- Native vegetation mapping;
- Historical imagery;
- Site survey/floristic data collection;
- The BAM streamlined assessment module for planted native vegetation; and
- The BioNet Vegetation Classification database.

2.2.2 Arboricultural assessment

Naturally Trees (2023) assessed 379 individual tree specimens from seventy-two (72) different species in the subject land:

- 17 local native species
- 10 local native species not expected to occur at the site (i.e., habitat for the species absent);
- 15 non-local native species; and
- 30 exotic species.

Figure 3shows the location of trees assessed by Naturally Trees (2023) and Table 2 lists all native species identified, whether they are local or non-local species and their habitat requirements. Distribution and habitat requirements have been sourced from the Flora of New South Wales (PlantNET).

The data collected by Naturally Trees (2023) informed the categorisation of native vegetation within the subject land (refer Section 2.2.3).

Table 2. Subject land native tree species

Botanical name	Scientific name	Habitat or distribution
Local native		
Acacia implexa	Hickory wattle	Widespread, grows in a variety of communities
Allocasuarina littoralis	Black Sheoak	Understorey species in open forest, on moderate-nutrient soils and drier moisture situations
Allocasuarina torulosa	Forest oak	Understorey species in open forest to tall open forest, on higher-nutrient soils and moister situations
Angophora costata	Smooth-barked apple	Locally abundant, on deep sandy soils or sandy soils on sandstone; often coastal
Banksia integrifolia	Coastal banksia	Widespread, chiefly from coastal sites to the ranges on a broad range of habitats
Banksia serrata	Old-man banksia	Usually in dry sclerophyll forest or woodland on sandstone or consolidated sand dunes
Corymbia gummifera	Red bloodwood	Abundant, in dry sclerophyll forest or woodland on low fertility sand or sandstone
Corymbia maculata	Spotted gum	Community dominant, in open forest on infertile and drier sites on shales and slates
Elaeocarpus reticulatus	Blueberry ash	Mostly in gullies or along watercourses, often in tall eucalypt forest or in or near rainforest
Eucalyptus haemastoma	Scribbly gum	Locally frequent, in dry sclerophyll woodland on shallow infertile sandy soil on sandstone
Eucalyptus paniculata	Grey ironbark	Dry sclerophyllous woodland, locally found on shale capped ridges and plateaus, on heavy shale derived soil
Eucalyptus pilularis	Blackbutt	Widespread and often dominant, in wet sclerophyll or grassy coastal forest on lighter soils of medium fertility
Eucalyptus piperita	Sydney peppermint	Locally frequent, in dry sclerophyll forest or woodland on moderately fertile often alluvial sandy soil
Eucalyptus saligna	Sydney bluegum	Widespread and abundant, in wet forest on soils of moderate fertility
Melaleuca armillaris	Bracelet honey-myrtle	Widespread in heath communities, often on headlands or coastal ranges

Botanical name	Scientific name	Habitat or distribution
Pittosporum undulatum	Sweet pittosporum	Rainforest and wet sclerophyll forest and sheltered situations in dry sclerophyll forest or woodland
Syncarpia glomulifera	Turpentine	Often grows as an emergent near the margins of rainforest or in wet sclerophyll forest, often on heavier soils
Local native - habitat absent		
Acacia elata		Rainforest and wet sclerophyll forest
Angophora floribunda	Rough-barked apple	Widely scattered and locally abundant, usually on deep alluvial sandy soils
Casuarina cunninghamiana	River oak	Occurs along permanent freshwater streams
Eucalyptus robusta	Swamp mahogany	Locally abundant in heath on low swampy sites on sandy soils
Melaleuca linariifolia	Flax-leaved paperbark	Heath and dry sclerophyll forest in moist or swampy ground
Melaleuca quinquenervia	Broad leaved paperbark	Widespread in coastal swamps and around lake margins
Melaleuca styphelioides	Prickly leaved paperbark	Grows in moist situations, often along stream banks
Melia azedarach	White cedar	Grows in subtropical and dry rainforest, mostly on margins
Syzygium paniculatum	Magenta lilly pilly	Subtropical and littoral rainforest on sandy soils or stabilized dunes, often near the sea
Tristaniopsis laurina	Water gum	Rainforest and sclerophyll forest usually along banks of streams
Non-local native or local cultivar		
Acacia baileyana	Cootamundra wattle	Endemic to the Temora-Cootamundra district; widely cultivated
Araucaria heterophylla	Norfolk Island pine	Endemic on Norfolk Island, widely cultivated
Archontophoenix alexandrae	Alexandra palm	Native range of this species is north-east and central-east Queensland, widely cultivated
Callistemon viminalis	Weeping bottlebrush	Occurs north of the Gloucester area. Widely cultivated species
Corymbia citriodora	Lemon-scented gum	A tall tree from temperate and tropical eastern Australia
Cyathea cooperi	Straw/scaly/lacy treefern	Occurs in gullies in warm coastal rainforest; north from Durras Mtn
Eucalyptus cladocalyx (?)	Sugar gum	Endemic to South Australian native species
Eucalyptus microcorys	Tallowood	North from about the Gosford area, to Hervey Bay in Qld and including Fraser Island.
Eucalyptus scoparia	Wallangarra white gum	Known from only three locations near Tenterfield, including Bald Rock National Park.
Ficus benjamina	Weeping fig	One of the most cultivated in the world, found in Northern Qld and NT
Grevillea robusta	Silky oak	Grows on the coast and inland ranges north of Coffs Harbour

Botanical name	Scientific name	Habitat or distribution
		district. Widely cultivated species
Grevillea spinosa	Tjiilka-tjiilka	Endemic to inland Western Australia
Leptospermum petersonii	Lemon-scented teatree	North of Port Macquarie. Naturalised in NSW, cultivated for landscaping
Lophostemon confertus	Brushbox	North from the Hunter Valley; sparingly naturalised around Sydney, commonly planted as a street tree
Macadamia sp.		Macadamia genus is indigenous to Australia, native to northeastern NSW and central and southeastern Qld

2.2.3 Mapping native vegetation extent

The native vegetation extent on the subject land was assessed via desktop aerial interpretation using Nearmap imagery from March 2023 (EPSG7856_Date20230316 Lat-33.767336 Lon151.1766 Mpp1.194.jpg) and vegetation mapping as described in Section 2.1.2.

Ground truthing was undertaken on several occasions (see Table 3) to verify available vegetation mapping (refer Section 2.1.2), arboricultural assessment findings (Naturally Trees 2022, 2023) and distinguish between planted and naturally occurring native vegetation.

Table 3. Vegetation surveys

Date	Surveyor	Areas surveyed
27 October 2022	Actinotus	All of subject land
23 March 2023	Actinotus	Northern site portion
10 April 2023	écologique	All of subject land
14 June 2023	Eco Logical Australia	Southwestern and northern site portions (refer Appendix D)
22 June 2023	Actinotus and écologique	Northern site portion and land northeast on opposite side of Stanhope Road

All areas of vegetation were able to be comprehensively assessed as located in managed curtilage and covering a relatively small extents. Vegetation community boundaries were measured using hand-held GPS, notated on printed aerial photographs, then transferred to ArcMap for interrogation and map production.

Additional site visits to nearby vegetated locations were also undertaken on 22 June 2023 for comparison of similarly mapped vegetation areas. This was done given the difficulties in allocating 'best fit' plant community types (PCTs) to planted native vegetation in the subject land. Additional sites visited are shown on Figure 12and included:

- Wombin Reserve, Nelson Road, Killara
- Killara Park, Springdale Road, Killara
- Soldiers Memorial Park, Tryon Road Lindfield

Vegetation within the subject land was categorised into the broad vegetation types listed in Table 4. These broad vegetation types were assessed further against historical imagery (refer Section 2.2.4) and, where applicable, allocated to PCTs based on data collected from BAM floristic plots (refer Section 2.2.5).

Further discussion regarding the allocation of PCTs is provided in Section 2.2.8 (Vegetation classification database) and Section 4.3 (Plant community types).

Table 4. Vegetation types assessed in the subject land

Vegetation type	Status
Remnant	Remnant (assumed) native vegetation
Planted native	Planted native vegetation able to be allocated to a PCT
Landscaping	Planted local native
	Planted local native/habitat absent
	Planted native/non-local native mixture
	Planted non-local native
	Planted non-local native/exotic mixture
	Exotic

2.2.4 Historical imagery

Historical imagery from the early 1900s to current day provides insight into land-use changes over time. This method of assessment is particularly useful when an area of interest (such as the subject land) contains numerous non-local native and exotic planted species.

Historical imagery indicates the potential for small pockets of existing vegetation to be of remnant origin, although the assessment of historical imagery is limited as the subject land was cleared prior to the earliest available imagery in 1929.

Imagery of the subject land during construction of the existing development, in combination with ground truthing, has guided the allocation of the 'landscaping' vegetation type identified in Table 4.Photographic plates have been marked up to indicate where vegetation cover within the subject land has remained constant over time and thereby indicating where vegetation has the most potential to be of remnant origins (see Appendix C).

Further historical information is provided in the Project's heritage assessment (GML Heritage 2017), which discusses land ownership and land use that pre-dates the available historical aerial imagery.

Site photographs show views into surrounding bushland and the habit of retained remnant trees. Albeit limited to the cleared and developed area of the subject land (associated the Headfort School), photography indicates a dry sclerophyll environment (see Appendix C).

Parish mapping from 1897 shows Stanhope Road located to the south of the existing northern most area of native vegetation. By 1934, the Congregational Union of NSW 1934 land holdings plan shows Stanhope Road in its current alignment.

Figure 4 illustrates the irregularly shaped land located between the boundary of Lots 217-219 in 1897 and that acquisitioned by 1934 into the land holdings of the Congregational Union of NSW. This irregularly shaped land encompasses the northern most area of vegetation in the contemporary subject land .

Figure 4 also shows:

- Current site imagery overlain by the indicative location of Stanhope Road before its relocation; and
- An indicative patch of previously uninterrupted vegetation that has been floristically investigated further (refer Section 2.2.5 below, Section 2.2.8 - Vegetation classification database and Section 4.3 - Plant community types).

2.2.5 Plot-based vegetation survey

Plot-based floristic vegetation surveys were undertaken in accordance with BAM Subsection 4.2.1.

Initially, data from four floristic plots was collected to verify the vegetation mapping and extent components of the BAM (see Table 5 below).

Table 5. Vegetation survey plots

Plot no	Location	Vegetation mapping	
		OEH (2016)	DPE (2022)
1	Northwestern corner of subject land	PCT 3262 (STIF) Urban Exotic/Native	Not native
2	Southwestern corner of subject land	PCT 3592 (SCESF) PCT 3136 (BGHF)	PCT 3592 (SCESF) PCT 3136 (BGHF)
3	Mid-site portion of subject land	Urban Exotic/Native	Not native
4	Mid-northern site portion of subject land	Urban Exotic/Native	Not native

The location of plots sought to validate the following:

- Planted native vegetation – for assessment under the BAM streamlined module for planted native vegetation;
- Planted native vegetation – that can be feasibly allocated to a PCT and assessed under the standard BAM; and
- Potential remnant vegetation – for allocation to a PCT and assessed under the standard BAM.

It should be noted that opportunities for locating plots to avoid areas of disturbance was limited due to the managed nature of the subject land and limited areas of vegetation.

This limitation was partially addressed through additional vegetation plots collected by Eco Logical Australia (ELA) on 14 June 2023 and later by Actinotus and écologique on 22 June 2023 (see Table 6).

Table 6. Additional vegetation survey plots

Plot no	Location	Vegetation mapping	
		OEH (2016)	DPE (2022)
5[#]	Bushland south of subject land in Seven Little Australians Park	PCT 3592 (SCESF)	PCT 3136 (BGHF)
6[#]	Planted and potential remnant native vegetation in the northern site portion adjacent Stanhope Road	Urban Exotic/Native	Not native vegetation
7[##]	Bushland northeast of subject land on northern side of Stanhope Road	Urban Exotic/Native	PCT 3595 (CSGF)

[#] surveys conducted by ELA (refer Appendix D)

[##] survey conducted by Actinotus and écologique on undeveloped land that was continuous with the subject land pre 1934 when Stanhope Road was realigned.

2.2.6 Vegetation Integrity Assessment

Vegetation integrity assessments were undertaken in the subject land in accordance with the BAM Section 4.2.4, which requires the quantitative measure of composition, structure and function attributes from each vegetation zone.

Survey plots were established around a central 50 m midline as follows:

- One 400 m^2 plot (20 m × 20 m), to assess:
  - Composition (number of native species in each growth form)
  - Structure (percent cover of native species in each growth form)
- One 1,000 m^2 (standard 20 m × 50 m) plot, to assess the function attributes (number of large trees, number of hollow bearing trees, stem size classes, tree regeneration, length of logs)
- Five 1 m^2 subplots, to assess average litter cover

Vegetation integrity plots coincided with the Plots 1-4 in Table 5.

To collect BAM data compliantly, plots and transects were variously shaped to avoid areas of hardstand as far as practical.

The location and approximate shape of plots is shown in Figure 12 and BAM data is provided in Appendix B.

Table 7 identifies the broad zones in which vegetation integrity plots were conducted and compliance with the minimum number of plots required (i.e., 1 plot per zone <2ha).

Table 7. Vegetation zones

Location	Area (ha)	Plots required	Plots completed
Remnant and planted native vegetation	0.14	1	2
Landscaped native vegetation (can be allocated to a PCT)	0.10	1	1
Urban Exotic/Native (Landscaping – not allocated to a PCT)	0.46	1	1
	0.70		

2.2.7 BAM Streamlined module – Planted Native Vegetation

BAM Appendix D: Streamlined assessment module – Planted native vegetation provides the framework for the assessment of planted native vegetation using the BAM.

Vegetation identified as Landscaping in Table 4 has been assessed using the streamlined module for planted native vegetation and the standard BAM used to assess vegetation identified as Remnant in Table 4.

2.2.8 Vegetation classification database

The PCT filter tool in the Bionet Vegetation Classification database was used to allocate the best fit plant community types (PCTs) to native vegetation that was not assessed in the streamlined module for planted native vegetation. Table 8 lists the database filters used.

Table 8. PCT filters used

IBRA region	Sydney Basin
IBRA subregion	Cumberland Plain
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation) Dry Sclerophyll Forests (Grassy sub-formation) Wet Sclerophyll Forests (Shrubby sub-formation) Wet Sclerophyll Forests (Grassy sub-formation)
Keith vegetation form	Sydney Coastal Dry Sclerophyll Forests Sydney Hinterland Dry Sclerophyll Forests

	Northern Hinterland Wet Sclerophyll Forests North Coast Wet Sclerophyll Forests
Species (all strata and growth form groups)	Species observed in each plot / vegetation type mapped in the subject land

Further filtering of the results were undertaken to remove:

- PCTs that do not occur in the IBRA region and subregion[1];
- Vegetation types that do not occur in the subject land, such as rainforest, forested wetlands, wetlands, riparian communities and heath;
- PCTs that are specific to geographic regions, such as the Woronora Plateau and Blue Mountains;
- Species that are not local to the subject land, such as tallowwood; and
- Species that the subject land does not provide habitat for, such as swamp mahogany.

The resultant PCT list was then further investigated by comparing the characteristics found in the scientific description of each PCT in the vegetation classification database:

- Descriptive attributes; and
- Frequency in which species occur within plots that have informed the diagnostic species list for each PCT

To a lesser degree landscape characteristics were considered, such as rainfall, elevation, dominant soils or geology (refer limitations below).

Limitations:

- Insufficient floristic data to obtain confident assignment from the PCT filter tool due to the highly modified nature of native vegetation and lack of species richness within the subject land;
- The absence of shrub and ground layer species diversity (most likely coinciding with the data required to distinguish between most PCTs).
- Similarities in the PCTs returned include overlapping annual rainfall, temperatures and elevations where they are predicted to occur.
- The median native species richness per plot for returned PCTs ranged between 44 and 40 (i.e., the plot data that the list of PCT diagnostic species is based on in the vegetation classification database). Whereas species richness gained from subject land plots were a minimum of 9 and maximum of 17. Thus, analysis using diagnostic species is not robust.
- Analysis of dominant soils and / or geology were also limited due to Geotechnical findings (JK Geotechnics 2022) conflicting with landscape mapping. This is likely to be due to historical site disturbance over the past century. In particular, investigative sampling from two sites within the northern vegetated area of the subject land found 300mm of fill overlying sandstone.
- Based on species descriptions in the RBG PlantNet – Flora of NSW), several diagnostic species in PCTs that are restricted to the Sydney Basin region are identified as:
    - Not of local origin, and/or
    - The subject land does not contain habitat in which the species is known to occur

A key distinction between the mapped PCTs within and adjacent to the subject land is whether the vegetation formation is wet or dry sclerophyll forest.

[1] The Vegetation Classification Database PCT filter tool returns database PCTs in descending order based on the total number of matches and in some cases will return PCTs with high numbers of all species present, but the PCT does not occur in the bioregion or subregion or is not of the correct vegetation formation and class.

The existing condition of the subject land indicates a dry sclerophylly forest formation, although it is not known what occurred prior to historical clearing and what impact this had on microclimate.

Geotechnical investigations found sandstone rock outcrops and exposed sandstone cut faces between 1.2m and 1.6m high and sandstone at shallow depths throughout the site.

Pre-development of the retirement Village the history of the subject land does not suggest any surface disturbances other than clearing and construction of buildings within the western site portion and relocation of Stanhope Road (circa early 1930s). Thus, the site portions that have remained consistently vegetated prior to the Village development are expected to be of natural origin.

An example of PCT filter tool results is provided in Table 9, that used native species found from within the vegetated area s (i.e., existing vegetation immediately north and south of Stanhope Road and total of 30 species entered into the filter tool). The results demonstrate the closeness in PCTs generated from these searches.

Table 9. PCT filter tool results

PCT	Common_Name	Matches	IBRA	IBRA Sub	Angophora costata	Corymbia gummifera	Eucalyptus pilularis	Eucalyptus saligna	Eucalyptus paniculata	Allocasuarina torulosa	Allocasuarina littoralis	Pittosporum undulatum	Elaeocarpus reticulatus	Ozothamnus diosmifolius	Acacia implexa	Leucopogon juniperinus	Microlaena stipoides	Entolasia stricta	Lomandra longifolia	Imperata cylindrica	Themeda triandra	Aristida vagans	Oplismenus aemulus	Digitaria parviflora	Cyathochaeta diandra	Gahnia clarkei	Lobelia purpurascens	Dianella caerulea	Dichondra repens	Centella asiatica	Oxalis perennans	Commelina cyanea	Eucalyptus botryoides	Angophora hispida	Cynodon dactylon
Dry Sclerophyll Forests (Shrubby sub-formation)																																			
Sydney Coastal Dry Sclerophyll Forests																																			
3592	Sydney Coastal Enriched Sandstone Forest	33	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3594	Sydney Coastal Sandstone Foreshores Forest	30	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
3595	Sydney Coastal Sandstone Gully Forest	29	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	1
Wet Sclerophyll Forests (Grassy sub-formation)																																			
Northern Hinterland Wet Sclerophyll Forests																																			
3262	Sydney Turpentine Ironbark Forest	32	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
3259	Sydney Coastal Shale-Sandstone Forest	31	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Wet Sclerophyll Forests (Shrubby sub-formation)																																			
North Coast Wet Sclerophyll Forests																																			
3176	Sydney Enriched Sandstone Moist Forest	27	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1	0	0	0
3136	Blue Gum High Forest	27	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	0	1

2.3 Threatened flora species methods

2.3.1 Review of existing information

The assessment of habitat suitability has been informed by the TBDC, threatened species profiles and the NSW Scientific Committee's conservation advice and final determinations.

Threatened species are categorised in the BAM-C as ecosystem species or species credit species.

Ecosystem credit species

Ecosystem credit species are those threatened species where the likelihood of occurrence of a species or elements of the species' habitat can be predicted by vegetation surrogates and landscape features, or for which targeted survey has a low probability of detection.

A targeted survey is not required to identify or confirm the presence of ecosystem credit species.

Species credit species

Species credit species are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence or components of their habitat. A targeted survey or an expert report is required to confirm the presence of these species on the subject land.

Dual credit species have different habitat constraints for each credit class (e.g., habitat constraints for breeding habitat which is a species credit component). Most dual credit species will be listed as an ecosystem credit species – for foraging habitat.

Under Section 5.2.2 of the BAM 2020, species credit species can be excluded from further assessment, and thereby targeted surveys, if it is determined that none of the species-specific habitat constraints are present within the subject land.

Under Section 5.2.3 of the BAM, a candidate species credit species can be considered unlikely to occur on the subject land (or specific vegetation zones) if after carrying out a field assessment, the assessor determines that the habitat is substantially degraded such that the species is unlikely to utilise the subject land (or specific vegetation zones).

2.3.2 Habitat constraints

Desktop assessments and field surveys within the subject land included assessment of habitat constraints and microhabitats for predicted species credit flora species.

2.3.3 Targeted threatened flora species survey

Most of the subject land is managed curtilage and does not provide suitable habitat for many of the candidate threatened flora species. Table 10 lists threatened flora species for which the subject land's remnant peripheral native vegetation may contain marginal microhabitat for.

All areas of potential habitat were able to be searched comprehensively due to the relatively small and discontinuous patches of vegetation and lack of dense mid and understorey (i.e., without the need to allocate grid or parallel transect survey methods).

Table 10. Threatened flora species maintained in the BAM

Scientific name	Common name	Recommended survey times	Times surveyed	Survey Personnel/ Hours
Acacia pubescens	Downy wattle	All year round	27 October 2022	6 hrs x 1 person
Callistemon linearifolius	Netted bottlebrush	October to January	27 October 2022	6 hrs x 1 person
Darwinia biflora		All year round	27 October 2022	6 hrs x 1 person
Darwinia peduncularis		All year round	27 October 2022	6 hrs x 1 person
Dillwynia tenuifolia		August to October	27 October 2022	6 hrs x 1 person
Epacris purpurascens var. purpurascens		September to October	27 October 2022	6 hrs x 1 person
Eucalyptus camfieldii	Camfield's stringybark	All year round	27 October 2022	6 hrs x 1 person
Grevillea parviflora subsp. parviflora		August to November	27 October 2022	6 hrs x 1 person
Hibbertia puberula		October to December	27 October 2022	6 hrs x 1 person
Hibbertia spanatha		October to November	27 October 2022	6 hrs x 1 person
Hibbertia superans		July to December	27 October 2022	6 hrs x 1 person
Lasiopetalum joyceae		September to November	27 October 2022	6 hrs x 1 person
Marsdenia viridiflora	Marsdenia viridiflora – endangered population	November to February	27 October 2022	6 hrs x 1 person
Melaleuca deanei	Deane's paperbark	All year round	27 October 2022	6 hrs x 1 person
Persoonia hirsuta		All year round	27 October 2022	6 hrs x 1 person

Scientific name	Common name	Recommended survey times	Times surveyed	Survey Personnel/ Hours
Persoonia mollis subsp. maxima		All year round	27 October 2022	6 hrs x 1 person
Pimelea curviflora var. curviflora		October to March	27 October 2022	6 hrs x 1 person
Tetratheca glandulosa		August to November	27 October 2022	6 hrs x 1 person

No threatened flora species were found during surveys conducted on 27/10/2022. Additional site surveys conducted on 23/03/2023, 10/04/2023 and 22/06/2023 also did not detect any native species of conservation significance (see Table 3).

2.4 Threatened fauna species survey

2.4.1 Habitat Constraints

Desktop assessments and field surveys within the subject land included assessment of habitat constraints and microhabitats for predicted species credit fauna species.

The subject land does not contain any drainage lines and was not found to contain any hollow-bearing trees or evidence of nesting or breeding habitat for threatened species.

Other identified habitat constraints include the network of access roads and associated car and pedestrian traffic, noise and light pollution.

The subject land is not expected to be used preferentially over the surrounding and more intact native bushland that is contiguous with Garigal National Park. This includes mapped important habitat area for the Swift Parrot (refer to Section 5).

2.4.2 Field surveys

No candidate threatened fauna species were maintained in the BAM-C for further investigation due to the absence of microhabitat for species credit species and breeding habitat for dual credit species.

Despite the lack of microhabitat and breeding habitat identified, diurnal bird census (as per DEC 2004 guidelines) were undertaken during vegetation surveys and a microchiropteran survey also undertaken (see Table 11).

Table 11. Fauna surveys conducted

Fauna group	Date	Survey technique(s)	Survey effort	Personnel
Diurnal birds	27/10/2022 23/03/2023 10/04/2023 22/06/2023	Bird census counts were conducted at each of the following survey locations: 1. Western corner (adjacent Stanhope Road): 2 x 1 person x 20min (40 mins) 2. Southwestern site portion (adjacent bushland): 2 x 1 person x 20min (40 mins) 3. Southeastern site portion (adjacent bushland): 2 x 1 person x 20min (40 mins) 4. Central development area: 2 x 1 person x 20min (40 mins) 5. Mid-eastern site portion (vacant buildings adjacent bushland): 1 x 2 people x 20min (40 mins) 6. Northern site portion: 3 x 1 person x 20min and 1 x 2 people x 20min (100 mins) Additional opportunistic observations were also recorded	300 min	Peter Stricker (150 mins) Kat Duchatel (150 mins)
Microbats	21/11/2022 – 24/11/2022	A dedicated mirochiropteran survey (4 evening sampling surveys) was undertaken from 21/11/2022 – 24/11/2022 to record the potential for presence of microbats across the subject area. **Methodology:** Two SongMeter Minibat ultrasonic recorders were set at 95 Stanhope Rd, Killara for four consecutive nights during fair, warm temperature conditions. Afternoon temperatures varied from 25.9^0 – 26.3^0, with wind speeds varying from 17kmh (South on Wednesday 23rd) to 33kmh (West on Monday 21st). The detectors were placed at the northeast (NE) and southwest (SW) corners of the subject land within areas of open vegetation as indicated in see Figure 5.	8 nights	Amy Rowles

Fauna species detected in the subject land are listed in Table 12 and microchiropteran findings are summarised in Table 13. Figure 5 illustrates the locations of surveys undertaken.

Table 12. Fauna species observed in subject land

Class/Family	Common name	Scientific name	Record type
Aves			
Cacatuidae	Sulphur-crested Cockatoo	*Cacatua galerita*	OW
Campephagidae	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	O
Charadriidae	Laughing Kookaburra	*Dacelo novaeguineae*	OW
Columbidae	Crested Pigeon	*Ocyphaps lophotes*	O
	Spotted Turtle Dove*	*Spilopelia chinensis*	O
Corvidae	Australian Raven	*Corvus coronoides*	OW
Cracticidae	Grey Butcherbird	*Cracticus torquatus*	OW
	Magpie	*Gymnorhina tibicen*	O
	Pied Currawong	*Streptera graculina*	O
Cuculidae	Channel-bill Cuckoo	*Scythrops novahollandiae*	W
	Eastern Koel	*Eudynamys orientalis*	W
Maluridae	Superb Fairy-wren	*Malurus cyaneus*	O
Megapodiidae	Australian Brushturkey	*Alectura lathami*	O
Meliphagidae	Eastern Spinebill	*Acanthorhynchus tenuirostris*	O
	Little Wattlebird	*Acanthochaera chrysoptera*	O
	Noisy Miner	*Manorina melanocephala*	O
	Red Wattlebird	*Acanthochaera caranculata*	O
Psittacidae	Crimson Rosella	*Platycercus elegans*	O
	Rainbow Lorikeet	*Trichoglossus moluccanus*	H
Rhipiduridae	Grey Fantail	*Rhipidura albiscapa*	O
Sternidae	Common Mynah	*Acridotheres tristis*	O
Mammalia			
Macropodidae	Swamp wallaby	*Wallabia bicolor*	P
Phalangeridae	Common Brushtail Possum	*Trichosurus vulpecula*	F
	Ringtail Possum	*Pseudocheirus peregrinus*	F
Reptilia			
Scincidae	Dark-flecked Garden Sunskink	*Lampropholis delicata*	O
	Eastern Water Skink	*Eulamprus quoyii*	O

Table 13. Results of bat surveys (A. Rowles 2022)

Species	Common name	Identification Confidence (no. of passes of individuals)	
		Detector 1 (SW)	Detector 2 (NE)
Austronomus australis	White-striped freetailed bat	D (7)	D (6)
Chalinolobus gouldii	Gould's wattle bat	Pr (2)	D (9); Pr (9)
Miniopterus orianae oceanensis	Large bent-winged bat	D (1)	D (1); Pr (1)
Miniopterus australis	Little bent-winged bat		D (2)

Legend: D – definite identification | Pr – Probable identification (high likelihood) SW – southwest | NE – northeast

Results summarised in Table 13 indicate that over the survey period, microbat activity was very low, recording only four species of microchiropterans despite suitable weather conditions.

Two common species, the white-striped freetailed bat and Gould's wattle bat appear to be foraging at both sites with several passes at each location. Some species, including the Gould's wattle bat, will travel several kilometres from roost sites to reach preferred foraging habitat (Lumsden, 2004).

Two threatened species were recorded, these being the large bent-winged bat and little bent-winged bat. However only a few passes of each were recorded and are considered to most likely be individuals passing through the subject land and not foraging (Rowles 2022).

Both these species have been maintained in the BAM-C as ecosystem credit species but discounted as species credit species due to the absence of breeding habitat (i.e., the absence of maternity caves and known nursery sites).

Limitations:

Under the guidelines for 'Species credit' threatened bats and their habitats (OEH, 2018) surveys should be undertaken over 16 nights (i.e., 4 units x 4 nights, or 2 units x 8 nights). The survey undertaken for this assessment was not compliant, consisting of 2 units x 4 nights).

2.5 Weather conditions

Table 14. Weather conditions

Surveys conducted	Date	Weather conditions[a]	Preceding rainfall[b]
Floristics Threatened Flora Diurnal bird census	27/10/2022	Fine conditions, no rainfall, slight wind. 9am: Temp. 22.9^0; Wind NW 13km/hr 3pm: Temp. 22.9^0; Wind NNW 13km/hr	Preceding week: 37.6mm Preceding 2 weeks: 49.6mm Preceding 3 weeks: 144.4mm Preceding 4 weeks: 162.6mm
Microbat ultrasonic recording	21/11/2022	9am Temp. 22.8^0; Wind W 22km/hr 3pm Temp. 22.8^0; Wind W 33km/hr No Rainfall	Preceding week: 41.4mm Preceding 2 weeks: 42.8mm Preceding 3 weeks: 44.2mm Preceding 4 weeks: 78.2mm
Microbat ultrasonic recording	22/11/2022	9am Temp. 15.7^0; Wind W 17km/hr 3pm Temp. 26.3^0; Wind S 17km/hr	Preceding week: 2.8mm Preceding 2 weeks: 42.8mm

Surveys conducted	Date	Weather conditions[a]	Preceding rainfall[b]
		No Rainfall	Preceding 3 weeks: 44.2mm Preceding 4 weeks: 69.2mm
Microbat ultrasonic recording	23/11/2022	9am Temp. 19.5^0; Wind WSW 24km/hr 3pm Temp. 23.1^0; Wind WSW 17km/hr No Rainfall	Preceding week: 2.8mm Preceding 2 weeks: 42.4mm Preceding 3 weeks: 43.6mm Preceding 4 weeks: 45mm
Microbat ultrasonic recording	24/11/2022	9am Temp. 21.3^0; Wind SW 7km/hr 3pm Temp. 23.6^0; Wind ENE 20km/hr No Rainfall	Preceding week: 2.8mm Preceding 2 weeks: 42.4mm Preceding 3 weeks: 43.6mm Preceding 4 weeks: 44.6mm
Floristics Diurnal bird census	23/03/2023	Fine conditions, no rainfall, still. 9am: Temp 19.9^0; Wind WNW 6km/hr 3pm: Temp. 25.5^0; Wind SSW 13km/hr	Preceding week: 1.7mm Preceding 2 weeks: 38.5mm Preceding 3 weeks: 43.9mm Preceding 4 weeks: 47.5mm
Floristics Diurnal bird census	10/04/2023	Fine conditions, no rainfall, slight wind. 9am: Temp. 15.9^0; Wind WSW 13km/hr 3pm: Temp. 21.0^0; Wind WSW 15km/hr	Preceding week: 12.8mm Preceding 2 weeks: 78mm Preceding 3 weeks: 90.4mm Preceding 4 weeks: 127.3mm
Floristics Diurnal bird census	26/06/2023	Fine conditions, no rainfall, slight breeze. 9am: Temp. 9.2^0; Wind WNW 7km/hr 3pm: Temp. 13.8^0; Wind NW 2km/hr	Preceding week: 7mm Preceding 2 weeks: 7.2mm Preceding 3 weeks: 9.2mm Preceding 4 weeks: 11.4mm

[a] Daily Weather Observations for Sydney Olympic Park Station no: 066212 (10.1km from Killara)

[b] Daily Rainfall Data for Macquarie Park (Willandra Village) Station no: 66156 (3.6km from Killara)

3. Site context

3.1 Assessment area

Landscape features relevant to the proposal have been assessed from within a 1500m buffer zone (the BDAR assessment area) around the proposed development site (subject land). The BDAR assessment area covers 851.6 ha.

3.2 Landscape features

In accordance with Sections 3.1 and 3.2 of the BAM (2020) assessment and mapping of the following landscape features are required:

- IBRA bioregions and subregions;
- NSW (Mitchell) landscapes;
- Rivers and streams classified according to stream order;
- Wetlands within, adjacent to and downstream of the site;
- Connectivity of different areas of habitat;
- Geological features such as karst, caves, crevices, cliffs, rocks and other geological features of significance and for vegetation clearing proposals, soil hazard features;
- Areas of outstanding biodiversity value occurring on the subject land and assessment area; and
- Percent native vegetation cover in the assessment area.

3.2.1 Topography and soil landscapes

The topography of the subject land slopes from a hillcrest gently to the south-east over gradients of from 2 – 5^0.

The local underlying geology of the subject area occurs across the boundaries of the Ashfield Shale Series of the Wianamatta Group of Shales (Herbert 1983) and Hawkesbury Sandstone (Herbert 1983).

The Soil Landscape type in the north-western section of the site is the 'residual 'Lucas Heights' Soil landscape Series that is characterised by gently undulating crests and ridges on plateau surfaces of the Mittagong Formation where rock outcropping is usually absent (Chapman & Murphy 1989).

The lower and eastern sections of the subject land appear to be more associated with Hawkesbury Sandstone sediments where the colluvial 'Hawkesbury' Soil Landscape Series is characterised by rolling hills on Hawkesbury Sandstone including rock outcropping with rocky benches, broken scarps and boulders (Chapman & Murphy 1989).

JK Geotechnics (2022) indicated that a large part of the subject land to contain various thicknesses of fill overlying sandstone. In particular, investigative sampling from two sites within the northern vegetated area of the subject land found 300mm of fill overlying sandstone.

See Figure 6 shows soil landscape mapping and contours relevant to the subject land.

3.2.2 IBRA bioregions and IBRA subregions

The subject land occurs wholly within the Sydney Basin IBRA region and the Cumberland IBRA Subregion. The Pittwater IBRA Subregion occurs within the BDAR assessment area, which is distanced approximately 370m to the northeast of the subject land (see Figure 7).

3.2.3 Rivers, streams, estuaries and wetlands

The subject land does not contain any drainage lines. As shown in Figure 7 there are several watercourses within the BDAR assessment area, which include Little Bluegum Creek, Stoney Creek, Rocky Creek and Gordons Creek.

The subject land is located upslope approximately 100m from a first order tributary of Gordons Creek, which rises in Swain Gardens. The confluence of this stream and another first order stream that flows from the south is located approximately 150m southeast of the subject land.

No wetlands of local, regional, national or international significance are located within the subject land or BDAR assessment area.

Gordon Creek is a tributary of Middle Harbour, which is located outside of the BDAR assessment area (see Figure 7).

3.2.4 Habitat connectivity

As shown in Figure 9, the subject land is juxtaposed at the edge of extensive existing developed land and remnant bushland. The latter contained within the Garigal National Park, which extends to Middle Harbour and provides substantial connectivity.

The proposal does not impact on the remnant bushland adjacent to the subject land and will not result in the isolation or fragmentation of native vegetation and/or connectivity.

3.2.5 Karst, caves, crevices, cliffs, rocks or other geological features of significance

No karsts, caves, crevices, cliffs or areas of geological significance have been identified within the BDAR assessment area.

3.2.6 Areas of outstanding biodiversity value

Areas of Outstanding Biodiversity Values (AOBV) are special areas that contain irreplaceable biodiversity values that are considered important to NSW, Australia or globally. No listed AOBVs occur within the subject land or BDAR assessment area.

3.2.7 NSW (Mitchell) landscape

Mitchell landscape mapping indicates that most of the subject land is in the Pennant Hills Ridges landscape with a smaller eastern site portion located in the Belrose Coastal Slopes landscape ((see Figure 7).

3.3 Native vegetation cover

Table 15 summarises the extent of native vegetation cover within the assessment area. Figure 8 shows native vegetation cover within the assessment area.

Table 15. Native vegetation cover in the assessment area

Assessment area (ha)	851.6
Total area of native vegetation cover (ha)	196.5
Percentage of native vegetation cover (%) **SVTM**	5.9
Percentage of native vegetation cover (%) **SMA**	23.1
Class (0-10, >10-30, >30-70 or >70%)	>10-30 adopted

4. Native vegetation, threatened ecological communities and vegetation integrity

4.1 Native vegetation extent

4.1.1 Changes to the mapped native vegetation extent

Available mapping by OEH (2016) and DPE (2022) indicate most of the subject site to either contain urban native/exotic or not-native vegetation see Figure 10 and Figure 11 (respectively).

Mapped vegetation by DPE (2022) identifies the following PCTs as occurring either immediately adjacent the subject land and/or within the periphery of the subject land:

- Blue Gum High Forest (PCT 3136);
- Sydney Coastal Sandstone Gully Forest (PCT 3595); and
- Sydney Coastal Enriched Sandstone Forest (PCT 3592).

OEH's SydneyMetroArea_v3_2016_E_4489 mapping similarly indicates the subject land to be dominated by "Urban Exotic/Native" vegetation, however it also has mapped small patches of the following PCTs:

- Sydney Coastal Shale-Sandstone Forest (PCT 3259); and
- Sydney Turpentine Ironbark Forest (PCT 3262).

4.1.1.1 Blue Gum High Forest (PCT 3136)

Mapping by OEH (2016) and DPE (2022) indicate Blue Gum High Forest (PCT 3136) as encroaching into the southwestern corner of the subject land as shown in Figure 10 and Figure 11.

Eco Logical Australia (ELA) collected data from a BAM floristic plot from within the area mapped as containing PCT 3136 (see Figure 12 for location of plot). Analysis of the floristic data by ELA found the vegetation at this location to be representative of Sydney Coastal Enriched Sandstone Forest (refer to Section 4.3 for discussion on PCT allocation and Appendix D for ELA's full report).

These findings are supported by Actinotus (ACS) and écologique, who both found the area mapped as PCT 3136 to align with Sydney Coastal Enriched Sandstone Forest (PCT 3592). Photographic plates 4.19 to 4.22 provided in Section 4.3.3 illustrate the nature of the southwestern corner of the subject land and bushland immediately adjacent.

Consequently, PCT 3136 is not required to be assessed further in this BDAR.

Irrespective of the vegetation present, the proposed development will not directly impact on any remnant native vegetation from this area, due to:

- This vegetation primarily originates outside of the subject land's boundary with most of the mapped vegetation shown in the subject land comprising canopy cover;
- An existing hardstand fire access road and retaining wall (surrounding a rain garden) separates remnant vegetation from the existing dwellings and where works are proposed; and
- Best practice mitigation measures will be implemented to reduce the risk of indirect impacts occurring. The potential for indirect impacts on remnant vegetation is detailed in Section 8.

4.1.1.2 Sydney Coastal Shale-Sandstone Forest (PCT 3259)

The area mapped in the subject land by OEH (2016) as Sydney Coastal Shale-Sandstone Forest (PCT 3259) was cleared by 1985 and replaced by exotic vegetation and an ornamental garden (including hedging) at the village boundary. Historical imagery showing this area is provided in Appendix C.

4.1.1.3 Sydney Coastal Sandstone Gully Forest (PCT 3595)

OEH (2016) and DPE (2022) have mapped Sydney Coastal Sandstone Gully Forest (PCT 3595) as occurring as a large continuous patch along the southeastern and eastern boundary of the subject land.

This vegetation was not surveyed for this assessment as it will not be directly impacted on by the proposed development. It is located on the outer periphery of the existing access road and predominantly originates downslope of the road embankment (and out of the subject land boundary). The potential for indirect impacts on remnant vegetation is detailed in Section 8.

4.1.1.4 Sydney Coastal Enriched Sandstone Forest (PCT 3592)

OEH (2016) and DPE (2022) have mapped Sydney Coastal Enriched Sandstone Forest (PCT 3592) within southern edge of the subject land, also occurring as a large continuous patch within the surround bushland. There is some variation between the two mapping projects as to the extent this patch extends into the subject land from the adjacent bushland, but this is inconsequential as he mapped PCT 3592 on the subject land comprises either:

- Aerial canopy extent of vegetation, which originates to the south of hardstand access road and in part beyond the subject land boundary (and will not be directly impacted by the proposal), or
- Planted native vegetation within constructed raingardens.

Notwithstanding, PCT 3592 was determined to best represent the mixture of native local and non-local planted species in rain gardens and along the roadside.

4.1.1.5 Sydney Turpentine Ironbark Forest (PCT 3262)

Mapping by OEH (2016) indicates Sydney Turpentine Ironbark Forest (PCT 3262) occurring in two locations along the western side of the subject land. DPE (2022) mapping does not indicate this community as occurring on the subject land (see Figure 10 and Figure 11 respectively).

The two mapped locations were previously discounted as containing PCT 3262 due to the highly modified environment, with only a small number of *Syncarpia glomulifera* (turpentine) occurring in each patch overlying a mown lawn and garden bed in carpark.

Following consultation with DPE's Environment and Heritage Group (EHG) and feedback on an earlier version of the proposal's BDAR (dated 4 May 2023), further consideration was paid to the significance of this vegetation, which included:

- Additional analysis of historical imagery that found the areas of mapped PCT 3262 coincide with areas consistently vegetated (albeit trees only and not bushland) in historical imagery as far back as 1929 (historical imagery is provided in Appendix C);
- Review of OEH (2016) showed that the confidence level of the mapping of these patches to be 'very high' with the site 'visited by others'; and
- Ultimately, the proposed development footprint was amended to avoid clearing of this vegetation (refer to Section 7).

4.1.1.6 PCTs allocated to planted native vegetation

In addition to the above mapped patches of PCT 3262, the area of native vegetation located along the northern boundary of the subject land has been investigated thoroughly to determine whether it may also contain PCT 3262 or other PCT.

Confidently allocating a PCT to this patch of vegetation has been difficult due to:

- The very high proportion of non-local native species (i.e., within the patch collectively approximately 30% of the tree specimens present are of local native origin);
- The lack of shrub and groundlayer species diversity which would assist in distinguishing between PCTs;

- Geotechnical investigations found this area to contain fill overlying sandstone; suggesting that historical and more contemporary disturbance has modified the soil profiles (noting that this patch of vegetation is located within the irregular patch of land that was historically located north of Stanhope Road as discussed in Section 2.2.4 and shown in Figure 4);
- The closest 'best fit' PCTs differ significantly in vegetation formation and class, i.e., being either dry or wet sclerophyll formations.

The native vegetation extent adopted for this assessment is shown in Table 16 and Figure 12 and is based on the following:

- Assessment of historical aerial imagery (provided in Appendix C);
- Ground truthing of the subject land and floristic data collection;
- Review and consideration of geotechnical and detailed site analysis of the subject area;
- Additional field investigations completed by ELA (provided in Appendix D).
- Consultation between ACS, écologique and ELA, which included workshopping the allocation of PCTs to the native vegetation on the subject land; and
- Subsequent additional investigations (following workshops) that included:
  - Review of historical studies and associated imagery and mapping;
  - Collection of floristic data from bushland immediately northeast of Stanhope Road (adjacent to the subject land); and
  - Inspection of other sites in the locality mapped as containing Sydney Turpentine Ironbark Forest (PCT 3262) for comparison.

Table 16. Subject land vegetation

PCT	Area		Description
	(m2)	(ha)	
PCT 3262 (ELA)	496		Allocated potentially remnant and planted vegetation
PCT 3262 (ELA)	961		Allocated potentially remnant and planted vegetation
PCT 3262 (OEH, 2016)	167		Mapped – accepted (OEH 2016)
PCT 3262 (OEH, 2016)	100		Mapped – accepted (OEH 2016)
	1,724	**0.17**	
PCT 3592	871		Native regrowth & planted
PCT 3592	780		Allocated planted vegetation (non-local dominant)
PCT 3592	184		Allocated planted vegetation (non-local dominant)
PCT 3592	140		Allocated planted vegetation (non-local dominant)
PCT 3592	2,672		Allocated planted vegetation (non-local dominant)
PCT 3592	419		Allocated planted vegetation (non-local dominant)
PCT 3592	2,328		Remnant (continuous with native bushland)
PCT 3592	1,158		Remnant (continuous with native bushland)
	8,552	**0.85**	

4.1.2 Areas that are not native vegetation

Approximately 1.15 ha of planted vegetation in the subject land is exotic (see Figure 12). Approximately 1.02 ha of exotic vegetation will be cleared and 0.13 ha retained.

4.2 Planted native vegetation

D.1 Decision-making key

The Planted Native Vegetation Module includes a decision-making key to identify whether a streamlined assessment can be applied to part or all of the subject land.

The first 3 questions of the decision-making key are used to evaluate if the proposed impacts to the vegetation require assessment under the standard BAM. A 'yes' to any of these questions requires the vegetation to be assigned to a plant community type (PCT) and assessed using the standard BAM.

If all responses are 'no', the remainder of the questions apply, with Questions 4–6 used to evaluate the reasons for application of D.2. Under D.2, the planted native vegetation is assessed for threatened species habitat only and biodiversity credits are not calculated.

Table 17 outlines how the decision-making key has been applied and photographic plates 4.1 to 4.12 show various areas of planted native vegetation. Figure 12 shows planted native vegetation collectively as 'landscaping'.

Table 17. DI Decision making key

Key	Decision
1. Does the planted native vegetation occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal?	Most of the subject land's planted native vegetation does not occur within a mosaic of planted and remnant native vegetation and cannot be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal.
i. Yes .... The planted native vegetation must be allocated to the best fit PCT and the BAM must be applied.	0.10 ha of planted native vegetation has been allocated to PCT 3592 – Sydney Coastal Enriched Sandstone Forest (refer to (Section 4.3).
ii. No..... Go to 2.	0.48 ha of planted native trees and landscaping is further assessed herein.
2. Is the planted native vegetation:	
a. planted for the purpose of environmental rehabilitation or restoration under an existing conservation obligation listed in BAM Section 11.9(2.), and	No
b. the primary objective was to replace or regenerate a plant community type or a threatened plant species population or its habitat?	No
i. Yes .... The planted native vegetation must be assessed in accordance with Chapters 4 and 5 of the BAM.	Not applicable
ii. No..... Go to 3.	
3. Is the planted/translocated native vegetation individuals of a threatened species or other native species planted/translocated for the purpose of providing threatened species habitat under one of the following:	
a. a species recovery project	No
b. *Saving our Species* project	No
c. other types of government funded restoration project	No
d. condition of consent for a development approval that required those species to be planted or translocated for the purpose of providing threatened species habitat	No
e. legal obligation as part of a condition or ruling of court. This includes regulatory directed or ordered remedial plantings	No

Key	Decision
(e.g., Remediation Order for clearing without consent issued under the BC Act or the Native Vegetation Act)	
f. ecological rehabilitation to re-establish a PCT or TEC that was, or is carried out under a mine operations plan, or	No
g. approved vegetation management plan (e.g., as required as part of a Controlled Activity Approval for works on waterfront land under the NSW *Water Management Act 2000*)?	No
i. Yes .... The planted native vegetation must be assessed in accordance with Chapters 4 and 5 of the BAM.	Not applicable
ii. No..... Go to 4.	
4. Was the planted native vegetation (including individuals of a threatened flora species) undertaken voluntarily for revegetation, environmental rehabilitation or restoration without a legal obligation to secure or provide for management of the native vegetation?	No
i. Yes..... Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied).	Not applicable
ii. No..... Go to 5.	
5. Is the native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, horticultural or plantation forestry purposes? This includes examples such as: windbreaks in agricultural landscapes, roadside plantings (including street trees, median strips, roadside batters), landscaping in parks, gardens and sport fields/complexes, macadamia plantations or tea-tree farms?	Yes
i. Yes .... Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied).	

D.2 Assessment of planted native vegetation for threatened species habitat

An assessment of the potential for the planted native vegetation to provide habitat for threatened species is required. If there is evidence that threatened species are using the planted native vegetation as habitat, the assessor must apply Section 8.4 of the BAM to mitigate and manage impacts on these species. Species credits are not required to offset the proposed impacts.

Threatened flora and fauna species assessed under the BAM has considered the entire subject land, including planted native and exotic vegetation and humanmade structures, refer Section 5 (Threatened Species) and Section 6 (Prescribed impacts) and concluded that the planted native vegetation assessed in this section does not:

- Provide habitat for threatened species, and
- Application of BAM Section 8.4 is not required.

Photo plate 4.1: *Pittosporum undulatum, Allocasuarina torulosa* and exotics planted in garden bed (within western site portion)

Photo plate 4.2: *Leptospermum petersonsii* (non-local native) specimens planted with exotic understorey in roadside garden bed

Photo plate 4.3: *Araucaria heterophylla* and Grevillea robusta (non-local natives) and *Angophora costata* (local native) with exotic understorey in roadside garden bed (along south western boundary)

Photo plate 4.4: *Lophostemon confertus* and *Eucalyptus scoparia* (non-local natives) and *Corymbia gummifera* (local native) with exotic understorey in garden bed (eastern site boundary)

Photo plate 4.5: *Melaleuca quinquenervia* and *Casuarina cunninghamiana* (local natives – natural habitat absent) planted in rain garden

Photo plate 4.6: drainage pit and mixture of native and introduced groundlayer species in rain garden

Photo plate 4.7: *Banksia serrata* (local native) plantings in residential garden beds (on left) and road side garden bed (on right)

Photo plate 4.8: Example of residential area with planted local natives (Angophora floribunda in background) and non-local natives (Callistemon viminalis) in foreground

Photo plate 4.9: planted *Melaleuca quinquenervia, Araucaria heterophylla* and *Phoenix canariensis* either side of entrance road

Photo plate 4.10: stand of the non-local native *Eucalyptus microcorys* planted along northern boundary of subject land

Photo plate 4.11: *Acacia baileyana* (non-local native), native groundcovers planted along Stanhope Road. Semi-mature Casuarina cunninghamiana specimens in background on left (local native – habitat absent)

Photo plate 4.12: non-local native *Eucalyptus microcorys* planted along Stanhope Road – managed canopy and lower electricity easement. Note: upward canopy growth stunted and instead extending north over road.

4.3 Plant community types

4.3.1 Overview

Vegetation within the subject land has been assessed as aligning with the Vegetation Classification database PCTs identified in Table 18 and their extent is shown in Figure 12. PCTs that will be impacted by the proposed development are summarised in Table 19.

Table 18. PCTs identified within the subject land

PCT	Area		Description
	(m2)	(ha)	
PCT 3262 (ELA)	496	0.14	Allocated potentially remnant and planted vegetation
PCT 3262 (ELA)	961		Allocated potentially remnant and planted vegetation
PCT 3262 (OEH, 2016)	167	0.03	Mapped – accepted (OEH 2016)
PCT 3262 (OEH, 2016)	100		Mapped – accepted (OEH 2016)
Total PCT 3262	**1,724**	**0.17**	
PCT 3592	871	0.09	Native regrowth & planted
PCT 3592	780	0.42	Allocated planted vegetation (non-local dominant)
PCT 3592	184		Allocated planted vegetation (non-local dominant)
PCT 3592	140		Allocated planted vegetation (non-local dominant)
PCT 3592	2,672		Allocated planted vegetation (non-local dominant)
PCT 3592	419		Allocated planted vegetation (non-local dominant)
PCT 3592	2,328	0.34	Remnant (continuous with native bushland)
PCT 3592	1,158		Remnant (continuous with native bushland)
Total PCT 3592	**8,552**	**0.85**	

Table 19. Impacted PCT areas

PCT	Area		Description
	(m2)	(ha)	
PCT 3262 (ELA)	496		Allocated potentially remnant and planted vegetation
	496	**0.05**	
PCT 3592	871	0.09	Native regrowth & planted
	780	0.11	Allocated planted vegetation (non-local dominant)
	184		
	140		
	1,975	**0.20**	

4.3.2 PCT 3262 Sydney Turpentine Ironbark Forest

4.3.2.1 PCT overview

PCT 3262 is described in the Bionet Vegetation Classification database as a tall to very tall sclerophyll open forest with mid-stratum of mixed sclerophyll and mesophyll shrubs and a ground layer of grasses and forbs, found on shale or sheltered shale-sandstone soils mainly in the northern suburbs of Sydney and lower Blue Mountains.

This PCT occurs as small remnants in mosaics of urban land use in the shale-dominated landscapes in higher rainfall zones of the Sydney Metropolitan area, with the northern suburbs between Baulkham Hills and Ku-ring-gai including the highest number of remnants.

This community grades into tall moist shrub forests PCT 3136 (Blue Gum High Forest) in higher rainfall shale-rich soils on the north shore, or into PCT 3620 (Sydney Hinterland Turpentine Sheltered Forest) in sandstone environments.

The tree canopy very frequently includes *Syncarpia glomulifera* either as a canopy dominant or as a smaller tree or both. Other species which are localised and occasionally dominant or co-dominant occasionally include *Eucalyptus pilularis, Angophora costata* and *Eucalyptus punctata*, rarely with one of several species from the ironbark, stringybark or mahogany eucalypt groups of which *Eucalyptus paniculata, Eucalyptus globoidea* and *Eucalyptus resinifera* are the most frequent of each group.

The mid-stratum is layered, with a sparse cover of small trees that includes eucalypts, occasionally *Acacia parramattensis* and *Allocasuarina torulosa*, rarely with *Allocasuarina littoralis*. The lower shrub layer very frequently includes *Pittosporum undulatum* and *Leucopogon juniperinus*, commonly with *Breynia oblongifolia, Polyscias sambucifolia, Ozothamnus diosmifolius* and *Notelaea longifolia*. The ground layer includes a diverse cover of grasses that very frequently includes *Microlaena stipoides* and *Entolasia stricta*, commonly with *Imperata cylindrica, Entolasia marginata* and *Themeda triandra*. Small forbs including *Lobelia purpurascens* are also very frequent, together with *Lomandra longifolia*.

PCT 3262 occurs in three locations in the subject land, as follows:

1. Approximately 137 m^2 located in a carpark garden bed with street frontage to Stanhope Road, which consists of a cluster of *Syncarpia glomulifera* amongst exotic vegetation and hardstand (see photo plate 4.13 and 4.14).

   This location has been avoided.

2. Approximately 100 m^2 located in mown lawn adjacent the fenceline to neighbouring residential dwelling, which comprises three individual of *S.glomulifera* amongst exotic and non-local native landscaping(see photo plate 4.15 and 4.16).

   This location has also been avoided.

3. Approximately 1,147 m^2 located beneath an electricity easement adjacent the retirement village, where it is maintained without a shrub and ground layer (see photo plate 4.17 and 4.18).

   Approximately 961 m^2 at this location has been avoided, with 496 m^2 to be cleared. The area to be cleared comprises both local and non-local tree species (e.g., Tallowwood) overlying an under-scrubbed understorey, which has been maintained this way (assumedly due to the overhead powerlines and possibly an asset protection zone, the latter not documented).

Table 20. PCT 3262 Sydney Turpentine Ironbark Forest

PCT ID	PCT 3262
PCT name	Sydney Turpentine Ironbark Forest
Vegetation formation	Wet Sclerophyll Forests (Grassy sub-formation)
Vegetation class	Northern Hinterland Wet Sclerophyll Forest
Per cent cleared value (%)	95.91
Extent within subject land (ha)	0.17 ha

4.3.2.2 Condition states

All areas of vegetation allocated to PCT 3262 within the subject land are in areas that are managed such that the capacity for natural regeneration or recruitment is extremely limited.

The area of PCT 3262 (location 3) that will be impacted has been assessed as one vegetation zone identified as a 'managed' condition state.

4.3.2.3 Justification of PCT selection

PCT 3262 at locations 1 and 2 has been adopted based on:

- Previous mapping by OEH (2016), which indicated a very high confidence level in the assignment of this PCT due to the site being visited during the mapping project;
- Historical imagery which suggests that vegetation at these locations may have prevailed since the early 1900s; and
- The presence of Turpentine ironbark specimens, which is common to all sites mapped by OEH (2016) and DPE (2022) as containing this PCT within the locality.

PCT 3262 at location 3 was determined by ELA as the most likely best fit PCT (see Appendix D).

The extent of PCT 3262 adopted is limited only to the proportion of the northern subject land vegetation that is not dominated by non-local native vegetation (see Figure 13). The remaining northern subject land vegetation has been allocated to PCT 3592 (refer Section 4.3.3 and Figure 13).

The allocation of PCTs to the northern subject land vegetation is based on:

- The justification for PCT 3262 allocation by ELA (Appendix D);
- Review of historical studies and associated imagery and mapping, providing evidence that the northern vegetated area maintained as PCT 3626 has been consistently vegetation over time;
- Frequency of diagnostic species present in this vegetation when compared between PCTs 3262 and PCT 3259, in particular the presence of older growth *Eucalyptus paniculata* (see Table 21);
- Approximately 70% of the entire northern area containing non-local planted native species;
- Frequency of diagnostic species present in vegetation dominated by planted non-local species when compared between PCTs 3262 and PCT 3259 (see Table 25); and
- Comparison between PCT 3262 mapped sites at other locations and the lack of *S.glomulifera*, which is constant at all other sites and has an 87% frequency of occurring in STIF (see Table 21 and photo plates 4.19 to 4.24).

Table 21. Species found in northern PCT 3262 patch

PCT 3262 STIF			PCT 3952 SCESF		
Species	**Frequency**	**Presence**	**Species**	**Frequency**	**Presence**
TREE(TG)					
Syncarpia glomulifera	87		Angophora costata	79	**X**
Eucalyptus pilularis	44	**X**	Corymbia gummifera	64	**X**
Angophora costata	43	**X**	Eucalyptus pilularis	45	**X**
Allocasuarina torulosa	45	**X**	Syncarpia glomulifera	39	
Eucalyptus paniculata	28	**X**	Allocasuarina torulosa	23	**X**
Corymbia gummifera	17	**X**	Eucalyptus paniculata	3	
Allocasuarina littoralis	13	**X**	Eucalyptus saligna	3	**X**
Eucalyptus saligna	6	**X**	Melia azedarach	2	**X**
Melia azedarach	5	**X**	Acacia elata	1	**X**
Corymbia maculata	3	**X**			
Acacia elata	1	**X**			
SHRUB (SG)					
Pittosporum undulatum	79	**X**	Pittosporum undulatum	77	**X**
Ozothamnus diosmifolius	51	**X**	Elaeocarpus reticulatus	64	**X**
Elaeocarpus reticulatus	15	**X**	Ozothamnus diosmifolius	37	**X**
Melaleuca nodosa	4	**X**	Melaleuca nodosa	3	**X**

PCT 3262 STIF			PCT 3952 SCESF		
Species	Frequency	Presence	Species	Frequency	Presence
GRASS & GRASSLIKE (GG)					
Microlaena stipoides	87	X	Lomandra longifolia	96	X
Entolasia stricta	82	X	Entolasia stricta	95	X
Lomandra longifolia	74	X	Microlaena stipoides	61	X
Imperata cylindrica	52	X	Themeda triandra	40	X
Themeda triandra	51	X	Imperata cylindrica	39	X
Aristida vagans	45	X	Aristida vagans	15	X
Oplismenus aemulus	31	X	Oplismenus aemulus	14	X
Digitaria parviflora	18	X	Digitaria parviflora	12	X
Cynodon dactylon	9	X	Cynodon dactylon	3	X
FORB (FG)					
Lobelia purpurascens	83	X	Dianella caerulea	96	X
Dianella caerulea	80	X	Lobelia purpurascens	40	X
Dichondra repens	50	X	Dichondra repens	7	X
Centella asiatica	25	X	Centella asiatica	6	X
Oxalis perennans	18	X	Commelina cyanea	6	X
Commelina cyanea	8	X	Oxalis perennans	3	X

Table 22. Comparison of species found in areas dominated by non-local planted species

PCT 3262 STIF			PCT 3952 SCESF		
Species	Frequency	Presence	Species	Frequency	Presence
TREE(TG)					
Eucalyptus pilularis	44	X	Angophora costata	79	X
Angophora costata	43	X	Allocasuarina littoralis	69	X
Allocasuarina torulosa	45	X	Corymbia gummifera	64	X
Eucalyptus paniculata	28		Eucalyptus pilularis	45	X
Corymbia gummifera	17	X	Allocasuarina torulosa	23	X
Allocasuarina littoralis	13	X	Eucalyptus haemastoma	6	X
Eucalyptus saligna	6	X	Eucalyptus botryoides	3	X
Corymbia maculata	3	X	Eucalyptus paniculata	3	
Acacia elata	1	X	Eucalyptus robusta	3	X
			Eucalyptus saligna	3	X
			Angophora hispida	2	X
			Acacia elata	1	X
SHRUB (SG)					
Pittosporum undulatum	79	X	Pittosporum undulatum	77	X
Leucopogon juniperinus	75	X	Elaeocarpus reticulatus	64	X
Ozothamnus diosmifolius	51	X	Ozothamnus diosmifolius	37	X
Acacia implexa	15	X	Leucopogon juniperinus	30	X
Elaeocarpus reticulatus	15	X	Acacia implexa	3	X
GRASS & GRASSLIKE (GG)					
Microlaena stipoides	87	X	Lomandra longifolia	96	X

PCT 3262 STIF			PCT 3952 SCESF		
Species	**Frequency**	**Presence**	**Species**	**Frequency**	**Presence**
Entolasia stricta	82	**X**	Entolasia stricta	95	**X**
Lomandra longifolia	74	**X**	Lepidosperma laterale	72	**X**
Lepidosperma laterale	64	**X**	Microlaena stipoides	61	**X**
Entolasia marginata	58	**X**	Entolasia marginata	43	**X**
Imperata cylindrica	52	**X**	Themeda triandra	40	**X**
Themeda triandra	51	**X**	Imperata cylindrica	39	**X**
Aristida vagans	45	**X**	Cyathochaeta diandra	23	**X**
Oplismenus aemulus	31	**X**	Aristida vagans	15	**X**
Cyathochaeta diandra	4	**X**	Oplismenus aemulus	14	**X**
Gahnia clarkei	1	**X**	Gahnia clarkei	4	**X**
			Cynodon dactylon	3	**X**
FORB (FG)					
Lobelia purpurascens	83		Dianella caerulea	96	**X**
Dianella caerulea	80	**X**	Lobelia purpurascens	40	
Dichondra repens	50	**X**	Dichondra repens	7	**X**
Centella asiatica	25	**X**	Centella asiatica	6	**X**
Oxalis perennans	18		Commelina cyanea	6	**X**
Commelina cyanea	8	**X**	Oxalis perennans	3	
OTHER (OG)					
Billardiera scandens	66	**X**	Billardiera scandens	74	**X**

As can be seen in Table 21 and Table 25, the constituent species in both PCTs are very similar and in the absence of diverse and an abundance of shrub and ground layer species, the use of analytical tools such as the Vegetation classification database PCT filter tool (refer Section 2.2.5) and Hagan and Steenbeeke tool used by ELA, are limited. This is demonstrated in the Hagan and Steenbeeke tool used by ELA, which identifies that the required minimum number to total native species and required minimum positive diagnostic species have not been achieved (refer Appendix D).

Additional consideration has been paid to the NSW Scientific Committee Final Determination for Sydney Turpentine Ironbark Forest, which is not informative:

Part 1. Assemblage of species

As previously discussed, there is a considerable overlap in constituent species between PCT 3262 and 3592 (see Table 23).

Table 23. Species in subject land from final determination

Species name	PCT 3262	PCT 3592
Acacia implexa	X	X
Allocasuarina torulosa	X	X
Angophora costata	X	X
Aristida vagans	X	X
Billardiera scandens	X	X
Centella asiatica	X	X
Commelina cyanea	X	X
Dianella caerulea	X	X
Dichondra spp.	X	X
Digitaria parviflora	X	X

Species name	PCT 3262	PCT 3592
Elaeocarpus reticulatus	X	X
Entolasia stricta	X	X
Eucalyptus paniculata subsp. paniculata	X	
Eucalyptus pilularis	X	X
Imperata cylindrica	X	X
Lepidosperma laterale		X
Leucopogon juniperinus	X	X
Lomandra longifolia	X	X
Microlaena stipoides	X	X
Oplismenus aemulus	X	X
Pittosporum undulatum	X	X
Pratia purpurascens	X	X
Themeda triandra	X	X

Part 2. Particular area occupied by the ecological community

The assemblage of species which characterises the Sydney Turpentine-Ironbark Forest occurs within the Sydney Basin Bioregion. PCT 3592 also occurs in the Sydney Basin Bioregion.

4.3.2.4 Alignment with TECs

PCT 3262 is aligned with the TEC Sydney Turpentine Ironbark Forest in the Sydney Basin Region, which is listed as a CEEC under the BC Act.

4.3.2.5 Alignment with EPBC Act listed ECs

PCT 3262 is aligned with the Commonwealth Turpentine-Ironbark Forest of the Sydney Basin Region, which is listed as a CEEC under the EPBC Act. The mapped patches of PCT 3262 and vegetation allocated to PCT 3262 in the subject land are not considered to be part of the nationally listed ecological community (refer to Section 4.4 for further detail).

Photo plate 4.13: Location 1

Photo plate 4.14: Location 1

Photo plate 4.15: Location 2

Photo plate 4.16: Location 2

Photo plate 4.17: Location 3

Photo plate 4.18: Location 3

Photo plate 4.19: Wombin Reserve (photo approx. 600m west of subject land STIF patch)	**Photo plate 4.20:** Wombin Reserve (photo approx. 450m west of subject land STIF patch)
Photo plate 4.21: Wombin Reserve approx. 600m west of subject land STIF patch	**Photo plate 4.22:** STIF patch Stanhope Rd approx. 600m west of subject land STIF patch

4.3.3 PCT 3592 Sydney Coastal Enriched Sandstone Forest

4.3.3.1 PCT overview

PCT 3592 is described in the Bionet Vegetation Classification database as a tall to very tall shrubby sclerophyll open forest found on slightly enriched Hawkesbury sandstone soils on sheltered slopes and occasionally crests on the Sydney coastal sandstone plateaus. The tree canopy very frequently includes a high cover of *Angophora costata* commonly in combination with *Corymbia gummifera* and *Eucalyptus piperita*, with *Eucalyptus pilularis* occasionally locally abundant.

A taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis* or *Allocasuarina torulosa*. A mid-dense lower shrub layer is comprised of dry sclerophyll species that commonly include *Leptospermum trinervium, Persoonia levis, Lomatia silaifolia, Acacia ulicifolia* and *Dodonaea triquetra*, with *Banksia serrata* and *Banksia spinulosa* recorded occasionally.

The ground layer is typically a sparse cover of graminoids that almost always includes *Dianella caerulea* and *Lomandra longifolia* with the grass *Entolasia stricta* and fern *Pteridium esculentum*, with frequent occurrences of climbers such as *Smilax australis*. This PCT is primarily distributed at elevations of less than 200 metres asl downslope of shale soils on the north shore of Sydney and Sutherland and on the Narrabeen sandstone escarpment along the Pittwater Peninsular. It grades into a heathy forest PCT 3595 on rocky Hawkesbury sandstone gullies or moist shrub and fern forest PCT 3176 with increased shelter in deeper gullies.

PCT 3592 occurs as remnant native vegetation along the southern and southeastern peripheries of the subject land (see photo plates 4.19, 4.20 and 4.26) .

Within the subject land PCT 3592 predominantly occurs as planted native vegetation although one small area of regrowth occurs on sandstone outcropping in the central area of the existing development (see photo plate 4.30).

PCT 3592 has been allocated to native vegetation planted along road verges and in rain gardens that are in close proximity to naturally occurring PCT 3592 (see photo plates 4.21-4.26) and vegetation dominated by planted tallowwoods in the northern area of the subject land (see photo plates 4.27-4.29).

4.3.3.2 Condition states

PCT 3592 has been assessed as one 'managed' condition state. The areas of PCT 3592 that will be impacted by the development are managed such that any capacity to regenerate naturally has not occurred.

Remnant vegetation continuous with native bushland in the subject land will not be impacted by the proposed development.

4.3.3.3 Justification of PCT selection

Selection of PCT 3592 has been discussed already in detail in Section 4.3.2.3 (justification for selection of PCT 3262). In summary PCT 3592 was selected based on the following information:

- Frequency of diagnostic species returned in the PCT filter tool (see Table 21);
- Site geologies and soil assessments (which indicate shallow fill over sandstone in northern vegetated areas and sandstone outcropping throughout);
- Elevation requirements (minimum 6 m and maximum 203.6 m), which align with the subject land's elevation (maximum of 106 m);
- Photo plate 4.29 shows planted tallowwoods on the northern side of Stanhope Road, which was once uninterrupted bushland with that on the subject land. This area of vegetation has not been managed with consideration to power lines and while still degraded from edge effects (particularly weed invasions) provided some insight into native shrub and ground cover species which are naturally regenerating (see Table 21).
- The location of this PCT mapped within and adjacent to the subject land.

Table 24. Frequency of occurrence of PCT 3592 species on the subject land

Species name	Frequency	Location found
Trees		
Angophora costata	79	All areas
Allocasuarina littoralis	69	South and northern patches
Corymbia gummifera	64	All areas
Eucalyptus pilularis	45	All areas
Allocasuarina torulosa	23	Northern patch
Shrubs		
Pittosporum undulatum	77	All areas
Elaeocarpus reticulatus	64	South and northern patches
Ozothamnus diosmifolius	37	South and northern patches
Leucopogon juniperinus	30	Northern patch
Grasses		
Lomandra longifolia	96	All areas
Entolasia stricta	95	All areas
Microlaena stipoides	61	All areas
Themeda triandra	40	Northern patch
Imperata cylindrica	39	Northern patch
Cyathochaeta diandra	23	Northern patch
Forbs		
Dianella caerulea	96	Northern patch
Lobelia purpurascens	40	Northern patch

4.3.3.4 Alignment with TECs

PCT 3592 is not aligned with any TECs under the BC Act or EPBC Act.

Table 25. PCT 3592 Sydney Coastal Enriched Sandstone Forest

PCT ID	PCT 3592
PCT name	Sydney Coastal Enriched Sandstone Forest
Vegetation formation	Dry Sclerophyll Forests (Shrubby sub-formation)
Vegetation class	Sydney Coastal Dry Sclerophyll Forests
Per cent cleared value (%)	60.82
Extent within subject land (ha)	0.85 ha

Photographic plates 4.19 to 4.30 illustrate PCT 3592 within and adjacent to the subject land.

Photo plate 4.19: Remnant PCT 3592 on southern boundary of subject land (will not be disturbed)

Photo plate 4.20: Remnant PCT 3592 on southern boundary of subject land (will not be disturbed)

Photo plate 4.21: Plot 2 – individuals of *Eucalyptus piluaris* in planted assemblage within managed curtilage

Photo plate 4.22: rain garden included in Plot 2, containing *E.pilularis, Corymbia maculata, M.quinqenervia, Lomandra longifolia*

Photo plate 4.25: rain garden included in Plot 2, containing *E.pilularis, Corymbia maculata, M.quinqenervia, Lomandra longifolia*

Photo plate 4.26: adjacent PCT 3592 – southeast corner of site

Photo plate 4.27: Planted local and non-local natives allocated to PCT 3592 in between village and Stanhope Road.

Photo plate 4.28: Planted local and non-local natives allocated to PCT 3592 adjacent Stanhope Road.

Photo plate 4.29: Planted non-local natives on northern side of Stanhope Road.

Photo plate 4.30: Regenerated PCT 3592 and landscaping on sandstone outcrop in subject land

4.4 Threatened ecological communities

TECs are listed in Table 26 and their extent is shown on Figure 14.

Table 26. TECs within the subject land

TEC name	Profile ID (from TBDC)	BC Act status	EPBC Act status	Associated vegetation zones within the subject land	Area within subject land (ha)
Sydney Turpentine Ironbark Forest	10789	CEEC	CEEC	PCT 3262	0.17

Consideration has been paid to the NSW Scientific Committee Final Determination for Sydney Turpentine Ironbark Forest (refer Section 4.3.2.3).

4.4.1 Sydney Turpentine Ironbark Forest

The mapped PCT 3262 in the subject land would not be considered to be part of the nationally listed ecological community due to the size of each patch being less than one hectare (ha).

Occurrences of the Turpentine–Ironbark Forest in the Sydney Basin Bioregion ecological community are considered to be part of the nationally listed ecological community if patches are in good condition (EPBC Act Approved Conservation Listing, 2014). Good condition is generally determined as:

- The vegetation has some characteristic components from all structural layers (tree canopy, small tree/shrub midstorey, and understorey);
- The tree canopy cover is greater than 10%; and
- The patch size is greater than one hectare.

Floristic data was collected from bushland along the northern boundary of the subject area and analysed by Eco Logical Australia (refer Appendix D) and found to be potentially representative of Sydney Turpentine Ironbark Forest (PCT 3262).

The location of this patch of vegetation is approximately 0.146 ha and is continuous with planted native vegetation (dominated by tallowwoods and swamp mahogany subdominant) that extends over approximately 0.405 ha.

A further patch of planted tallowwoods occurs on the edge of bushland along the northern side of Stanhope Road.

If planted native vegetation are not included in the patch size, it is possible that the allocated PCT 3262 in the subject land does not meet the criteria patch size of >1 ha.

4.5 Vegetation integrity (vegetation condition)

4.5.1 Vegetation integrity survey plots

Vegetation integrity plots coincided with the Plots 1-4 in Table 5 (refer Section 2.2.6) and the location of plot/transects is shown in Figure 12.

Table 27 (below) identifies each zone and the minimum number of plots required and completed.

Table 27. Vegetation zones

Location	Area (ha)	Plots required	Plots completed
PCT 3262 – Managed zone	0.14	1	1
PCT 3592 – Managed zone	0.20	1	2

4.5.2 Scores

Table 28 summarises each zones composition, structure and function score and vegetation integrity score.

Table 28. Vegetation integrity scores

Vegetation zone ID	Composition condition score	Structure condition score	Function condition score	Vegetation integrity score	Hollow bearing trees present?
PCT 3262 – Managed	16.8	30.7	16.2	20.3	No
PCT 3592– Managed	10.9	44.5	63.7	31.3	No

4.6 Patch size

All PCTs within the subject land have been assigned a patch size of <100 ha due to the continuous bushland, contiguous Garigal National Park which extends onto Middle Harbour. Figure 15 shows the continuity of the subject land with the adjacent bushland to the south and east.

5. Habitat suitability for threatened species

5.1 Identification of threatened species for assessment

5.1.1 Ecosystem credit species

Table 29 identifies the ecosystem credit species likely to occur on or use the subject land returned by the BAM and whether they have been retained in the BAM-C.

Table 29. Predicted ecosystem credit species

Common name	Scientific name	Listing status		Dual credit species	Sources	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act					
Anthochaera phrygia	Regent honeyeater	V	V	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Artamus cyanopterus cyanopterus	Dusky woodswallow	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Callocephalon fimbriatum	Gang-gang cockatoo	V	E	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Calyptorhnchus lathami	Glossy black cockatoo	V	V	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Chthonicola sagittata	Speckled warbler	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Climacteris picumnus victoriae	Brown treecreeper	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Daphoenositta chrysoptera	Varied Sittella	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Dasyurus maculatus	Spotted-tailed Quoll	V	E	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Glossopsitta pusilla	Little lorikeet	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High

Common name	Scientific name	Listing status		Dual credit species	Sources	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act					
Hieraaetus morphnoides	Little eagle	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Hirundapus caudacutus	White-throated needletail	-	V	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Ixobrychus flavicollis	Black Bittern	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3262	Moderate
Lathamus discolor	Swift parrot	E	CE	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Lophoictinia isura	Square-tailed kite	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Melanodryas cucullata cucullata	Hooded robin	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Melithreptus gularis gularis	Black-chinned honeyeater	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3262	High
Neophema pulchella	Turquoise parrot	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592	High
Ninox connivens	Barking owl	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Ninox strenua	Powerful owl	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Petroica boodang	Scarlet robin	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592	Moderate

Common name	Scientific name	Listing status		Dual credit species	Sources	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act					
Petroica phoenicea	Flame robin	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Pandion cristatus	Eastern osprey	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	Moderate
Tyto novaehollandiae	Masked owl	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Miniopterus australis	Little bent-winged bat	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Miniopterus orianae oceanensis	Large bent-winged bat	V	-	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Saccolaimus flaviventris	Yellow-bellied sheathtail bat	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Scoteanax rueppellii	Greater Broad-nosed bat	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592	High
Stagonopleura guttata	Diamond Firetail	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3262	Moderate
Pteropus poliocephalus	Grey-headed flying-fox	V	V	Yes	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Varanus rosenbergi	Rosenberg's goanna	V	-	No	☒ BAM-C	Retained in BAM-C	PCT 3592 PCT 3262	High
Botaurus poiciloptilus	Australasian bittern*	V	-	No	☒ BAM-C	**Habitat absent:** Requires freshwater wetland habitat with tall, dense vegetation, particularly bullrushes (Typha spp.) and spikerushes (Eleocharis spp.).	PCT 3592	High
Ephippiorhynchus asiaticus	Black-necked stork	E	-	No	☒ BAM-C	**Habitat absent:** Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor	PCT 3592 PCT 3262	Moderate

Common name	Scientific name	Listing status		Dual credit species	Sources	Reason for exclusion from further assessment	Vegetation zone ID species retained within, including PCT ID	Sensitivity to gain class
		BC Act	EPBC Act					
						floodplains, coastal sandplain wetlands and estuaries.		
Grantiella picta	Painted honeyeater	V	V	No	☒ BAM-C	**Habitat absent:** Inhabits Boree/ Weeping Myall (Acacia pendula), Brigalow (A. harpophylla) and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias.	PCT 3592 PCT 3262	Moderate
Haliaeetus leucogaster	White-bellied sea eagle	V	-	Yes	☒ BAM-C	**Habitat absent:** Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries and mangroves; and at, or in the vicinity of freshwater swamps, lakes, reservoirs, billabongs and saltmarsh. Terrestrial habitats include coastal dunes, tidal flats, grassland, heathland, woodland, and forest (including rainforest). Feed mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion.	PCT 3592 PCT 3262	High

5.1.2 Species credit species

Table 30 and Table 31 lists all predicted species credit species returned in the BAM C and justification as to whether the species has been retained for further assessments or not.

Table 30. Predicted flora species credit species

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
Acacia pubescens	Downy wattle	V	V	☒ BAM-C	Yes	
Callistemon linearifolius	Netted bottlebrush	V	-	☒ BAM-C	Yes	
Darwinia biflora	Darwinia biflora	V	V	☒ BAM-C	Yes	
Darwinia peduncularis	Darwinia peduncularis	V	-	☒ BAM-C	Yes	
Deyeuxia appressa	Deyeuxia appressa	E	E	☒ BAM-C	No	**Habitat degraded:** Given that *D. appressa* hasn't been seen in over 60 years, almost nothing is known of the species' habitat and ecology except that the species flowers in spring to summer and is mesophytic (grows in moist conditions). The species is an erect perennial grass to 0.9 m high. Natural moist habitat is lacking from the subject land and rain gardens are only temporarily wet and lack tall native grasses.
Dillwynia tenuifolia	Dillwynia tenuifolia	V	V	☒ BAM-C	Yes	
Epacris purpurascens var. purpurascens	Epacris purpurascens var. purpurascens	V	-	☒ BAM-C	Yes	
Eucalyptus camfieldii	Camfield's stringybark	V	V	☒ BAM-C	Yes	
Genoplesium baueri	Bauer's midge orchid	E	E	☒ BAM-C	No	**Habitat degraded:** i.e., the species grows in dry sclerophyll forest and moss gardens over sandstone. The subject land's original landform has been substantially modified such that the species is unlikely to have subsisted in managed garden beds, rain gardens and turfed areas.
Grevillea parviflora subsp. parviflora	Grevillea parviflora subsp. parviflora	V	V	☒ BAM-C	Yes	
Haloragodendron lucasii	Haloragodendron lucasii	E	E	☒ BAM-C	No	**Habitat absent:** i.e., the species is reported to grow in moist sandy loam soils in sheltered aspects, and on gentle slopes below cliff-lines near creeks in low open woodland. Such habitat is absent from the subject land.

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
Hibbertia puberula	Hibbertia puberula	E	-	☒ BAM-C	Yes	
Hibbertia spanatha	Hibbertia spanatha	CE	CE	☒ BAM-C	Yes	
Hibbertia superans	Hibbertia superans	E	-	☒ BAM-C	Yes	
Lasiopetalum joyceae	Lasiopetalum joyceae	V	V	☒ BAM-C	Yes	
Leucopogon fletcheri subsp. fletcheri	Leucopogon fletcheri subsp. fletcheri	E	-	☒ BAM-C	No	**Geographic limitation:** i.e., restricted to north-western Sydney between St Albans in the north and Annangrove in the south, within the local government areas of Hawkesbury, Baulkham Hills and Blue Mountains.
Marsdenia viridiflora	Marsdenia viridiflora - endangered population	E (pop)	-	☒ BAM-C	Yes	
Melaleuca deanei	Deane's paperbark	V	V	☒ BAM-C	Yes	
Persoonia hirsuta	Persoonia hirsuta	E	E	☒ BAM-C	Yes	
Persoonia mollis subsp. maxima	Persoonia mollis subsp. maxima	E	E	☒ BAM-C	Yes	
Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	V	V	☒ BAM-C	Yes	
Pomaderris brunnea	Brown pomaderris	E	V	☒ BAM-C	No	**Geographic limitation:** i.e., found in a very limited area around the Colo, Nepean and Hawkesbury Rivers, including the Bargo area and near Camden. It also occurs near Walcha on the New England tablelands and in far eastern Gippsland in Victoria. Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines
Pomaderris prunifolia – endangered population	Pomaderris prunifolia – endangered population	E (pop)	-	☒ BAM-C	No	**Geographic limitation:** i.e., subject land is not located in the Parramatta, Auburn, Strathfield and Bankstown LGAs.
Rhizanthella slateri	Eastern Australian underground orchid	V	E	☒ BAM-C	No	**Habitat degraded:** the species' habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest. Highly cryptic given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore, usually located only when the soil is disturbed.

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
						The subject land's original landform has been substantially modified such that the species is unlikely to have subsisted in managed garden beds, rain gardens and turfed areas.
Rhodamnia rubescens	Scrub Turpentine	CE	CE	☒ BAM-C	Yes	
Tetratheca glandulosa	Tetratheca glandulosa	V	-	☒ BAM-C	Yes	
Wahlenbergia multicaulis – endangered population	Wahlenbergia multicaulis – endangered population	E (pop)	-	☒ BAM-C	No	**Geographic limitation:** i.e., subject land is not located in the Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield LGAs.

Table 31. Predicted fauna species credit species

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
Anthochaera phrygia	Regent honeyeater	V	V	☒ BAM-C	No	**Breeding habitat constraint:** i.e., subject land not within a mapped breeding area for the species (which is only known to breed at three locations). Maintained as ecosystem credit species in BAM C.
Burhinus grallarius	Bush stone curlew	E	-	☒ BAM-C	No	**Habitat absent:** i.e., inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber and nests on the ground in a scrape or small bare patch. Subject land lacks fallen timber and nesting habitat.
Callocephalon fimbriatum	Gang-gang cockatoo	V	E	☒ BAM-C	No	**Breeding habitat constraint:** i.e., hollows that are 10 cm in diameter or larger and at least 9m above the ground in eucalypts. Maintained as ecosystem credit species in BAM C.
Calyptorhynchus lathami	Glossy black cockatoo	V	V	☒ BAM-C	No	**Breeding habitat constraint:** i.e., dependent on large hollow-bearing eucalypts for nest sites Maintained as ecosystem credit species in BAM C.
Cercartetus nanus	Eastern pygmy possum	V	-	☒ BAM-C	No	**Habitat degraded:** i.e., found in a broad range of habitats, but in most areas woodlands and heath appear to be preferred, except in north-

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
						eastern NSW where they are most frequently encountered in rainforest. They may occupy small patches of vegetation in fragmented landscapes and although the species prefers habitat with a rich shrub understory, they are known to occur in grassy woodlands and the presence of Eucalypts alone is sufficient to support populations in low densities. Feed largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelter in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (Pseudocheirus peregrinus) dreys or thickets of vegetation, (e.g., grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks. Such habitat is either absent or highly degraded due to the managed curtilage within the subject land.
Chalinolobus dwyeri	Large-eared pied bat	V	V	☒ BAM-C	Yes	
Haliaeetus leucogaster	White-bellied sea eagle	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., nest trees are typically large emergent eucalypts and often have emergent dead branches or large dead trees nearby which are used as 'guard roosts'. Nests are large structures built from sticks and lined with leaves or grass. No tall emergent trees or stick nests evident within the subject land.
Heleioporus australiacus	Giant burrowing frog	V	V	☒ BAM-C	No	Habitat degraded: i.e., within its broad distribution, this species will occupy various habitat types ranging from heaths, woodlands, dry sclerophyll and even moist forest types but not rainforest. Usually live along clear, small slowly flowing water courses which traverse plateaus and broad upland gullies. They also live adjacent to stream headwaters

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
						where they prefer permanently moist soaks and pondages. Many breeding sites have been found to be associated with shallow temporary ponds receiving seepage and the ponded sections of slow flowing creeks that drain ridges and plateaus. Have not been recorded breeding in waters that are even mildly polluted and are adversely affected by small pH changes. Burrows are excavated into the earth around, or associated with rocks fissures or boulders, probably to take advantage of water run-off from outcroppings. It has also been reported that yabbie holes are utilised along the beds and banks of drying creeks. Opportunistic use of the excavations of small mammals may also be made. Such habitat is absent from the subject land.
Hieraaetus morphnoides	Little eagle	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. No tall emergent trees or stick nests evident within the subject land. Maintained as ecosystem credit species in BAM C.
Lathamus discolor	Swift parrot	E	CE	☒ BAM-C	Yes	
Litoria aurea	Green and golden bell frog	E	V	☒ BAM-C	No	**Habitat absent:** i.e., inhabits marshes, dams and stream-sides, particularly those containing bullrushes (Typha spp.) or spikerushes (Eleocharis spp.). Optimum habitat includes waterbodies that are unshaded, free of predatory fish such as Plague Minnow (Gambusia holbrooki), have a grassy area nearby and diurnal sheltering sites available. Such habitat is absent from the subject land.
Lophoictinia isura	Square tailed kite	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., nest sites generally located along or near watercourses, in a fork or on large horizontal limbs. Maintained as ecosystem credit species in BAM C.
Meridolum corneovirens	Cumberland Plain Land Snail	E	-	☒ BAM-C	No	Species not found
Miniopterus australis	Little bent-winged bat	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., only five nursery sites /maternity colonies are known in Australia Maintained as ecosystem credit species in BAM C.

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
Miniopterus orianae oceanensis	Large bent-winged bat	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., maternity caves with specific temperature and humidity regimes. Maintained as ecosystem credit species in BAM C.
Myotis macropus	Southern myotis	V	-	☒ BAM-C	No	Not detected
Ninnox connivens	Barking owl	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Maintained as ecosystem credit species in BAM C.
Ninnox strenua	Powerful owl	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. Maintained as ecosystem credit species in BAM C.
Pandion cristatus	Eastern osprey	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. Maintained as ecosystem credit species in BAM C.
Perameles nasuta	Long-nosed Bandicoot population on Western Sydney	E (pop)	-	☒ BAM-C	No	Species not found
Petaurus norfolcensis	Squirrel glider	V	-	☒ BAM-C	No	**Habitat degraded:** i.e., inhabits mature or old growth Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites, which are absent from the subject land.
Phascolarctos cinereus	Koala	E	E	☒ BAM-C	No	Species not found – subject land not in LGAs where known populations occur
Pommerhelix duralensis	Dural land snail	E	E	☒ BAM-C	No	**Habitat degraded:** i.e., the species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. The subject land is located within this interface region but has been substantially modified and good native cover and woody debris absent.

Common name	Scientific name	Listing status		Sources	Species retained for further assessment ?	Reason for exclusion from further assessment
		BC Act	EPBC Act			
Pseudophryne australis	Red-crowned toadlet	V	-	☒ BAM-C	No	**Habitat degraded:** i.e., occur in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. Red-crowned Toadlets have not been recorded breeding in waters that are even mildly polluted or with a pH outside the range 5.5 to 6.5. Such habitat is absent from the subject land.
Pteropus poliocephalus	Grey-headed flying fox	V	V	☒ BAM-C	No	**Breeding habitat constraint:** i.e., subject land located about 2 km to the north-west of the Ku-ring-gai Flying-fox Reserve, which is a nationally significant roosting and maternity habitat for the species. However, the subject land does not provide any potential for roosting or maternity habitat. Maintained as ecosystem credit species in BAM C.
Tyto novaehollandiae	Masked owl	V	-	☒ BAM-C	No	**Breeding habitat constraint:** i.e., Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting. Maintained as ecosystem credit species in BAM C.

5.2 Presence of candidate species credit species

Table 32. Determining the presence of candidate flora species credit species on the subject land

Common name	Scientific name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
Acacia pubescens	Downy wattle	V	V	Targeted threatened species survey	No	No
Callistemon linearifolius	Netted bottlebrush	V	-	Targeted threatened species survey	No	No
Darwinia biflora	Darwinia biflora	V	V	Targeted threatened species survey	No	No
Darwinia peduncularis	Darwinia peduncularis	V	-	Targeted threatened species survey	No	No
Dillwynia tenuifolia	Dillwynia tenuifolia	V	V	Targeted threatened species survey	No	No
Epacris purpurascens var. purpurascens	Epacris purpurascens var. purpurascens	V	-	Targeted threatened species survey	No	No
Eucalyptus camfieldii	Camfield's stringybark	V	V	Targeted threatened species survey	No	No
Grevillea parviflora subsp. parviflora	Grevillea parviflora subsp. parviflora	V	V	Targeted threatened species survey	No	No
Hibbertia puberula	Hibbertia puberula	E	-	Targeted threatened species survey	No	No
Hibbertia spanatha	Hibbertia spanatha	CE	CE	Targeted threatened species survey	No	No
Hibbertia superans	Hibbertia superans	E	-	Targeted threatened species survey	No	No
Lasiopetalum joyceae	Lasiopetalum joyceae	V	V	Targeted threatened species survey	No	No
Marsdenia viridiflora	Marsdenia viridiflora - endangered population	E (pop)	-	Targeted threatened species survey	No	No
Melaleuca deanei	Deane's paperbark	V	V	Targeted threatened species survey	No	No

Common name	Scientific name	Listing status		Method used to determine presence	Present?	Further assessment required?
		BC Act	EPBC Act			
Persoonia hirsuta	Persoonia hirsuta	E	E	Targeted threatened species survey	No	No
Persoonia mollis subsp. maxima	Persoonia mollis subsp. maxima	E	E	Targeted threatened species survey	No	No
Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	V	V	Targeted threatened species survey	No	No
Rhodamnia rubescens	Scrub Turpentine	CE	CE	Targeted threatened species survey	No	No
Tetratheca glandulosa	Tetratheca glandulosa	V	-	Targeted threatened species survey	No	No

Table 33. Determining the presence of candidate fauna species credit species on the subject land

Common name	Scientific name	Listing status		Method used to determine presence	Present?	Further assessment required? (BAM Subsections 5.2.5 and 5.2.6)
		BC Act	EPBC Act			
Swift Parrot	*Lathamus dicolor*	E	CE	Within important habitat mapped area	Assumed present	Yes

5.3 Threatened species surveys

As discussed in Section 2.3.3 (Threatened flora species survey methods), due to the managed curtilage and lack of dense mid and groundlayer species in areas of more dense vegetation, all areas of potential habitat were able to be searched comprehensively (i.e., without the need to allocate grid and parallel transect survey methods).

Table 34 lists the flora species surveyed and outlines survey details. Weather conditions at the time of surveys are provided in in Section 2.5.

Table 34. Threatened species surveys for candidate flora species credit species on the subject land

Scientific name	Common name	Threatened flora species surveys			Present	Further assessment req'd
		Timing of survey – within recommended period?		Effort (hours & no. people)		
Acacia pubescens	Downy wattle	☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Callistemon linearifolius	Netted bottlebrush	☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Darwinia biflora		☒ Yes October to January	27.10.22	6 hrs x 1 person	No	No
Darwinia peduncularis		☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Dillwynia tenuifolia		☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Epacris purpurascens var. purpurascens		☒ Yes August to October	27.10.22	6 hrs x 1 person	No	No
Eucalyptus camfieldii	Camfield's stringybark	☒ Yes September to October	27.10.22	6 hrs x 1 person	No	No
Grevillea parviflora subsp. parviflora		☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Hibbertia puberula		☒ Yes August to November	27.10.22	6 hrs x 1 person	No	No
Hibbertia spanatha		☒ Yes October to December	27.10.22	6 hrs x 1 person	No	No
Hibbertia superans		☒ Yes October to November	27.10.22	6 hrs x 1 person	No	No
Lasiopetalum joyceae		☒ Yes July to December	27.10.22	6 hrs x 1 person	No	No

Scientific name	Common name	Threatened flora species surveys			Present	Further assessment req'd
		Timing of survey – within recommended period?		Effort (hours & no. people)		
Marsdenia viridiflora	Marsdenia viridiflora - endangered population	☒ Yes September to November	27.10.22	6 hrs x 1 person	No	No
Melaleuca deanei	Deane's paperbark	☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Persoonia hirsuta		☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Persoonia mollis subsp. maxima		☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Pimelea curviflora var. curviflora		☒ Yes All year round	27.10.22	6 hrs x 1 person	No	No
Rhodamnia rubescens	Scrub Turpentine	☒ Yes October to March	27.10.22	6 hrs x 1 person	No	No
Tetratheca glandulosa		☒ Yes August to November	27.10.22	6 hrs x 1 person	No	No

Table 35. Threatened species surveys for candidate flora species credit species on the subject land

Species	Threatened fauna species surveys	Present	Further assessment required (BAM Subsections 5.2.5 and 5.2.6)
Lathamus discolor Swift Parrot	N/A	Assumed present	Yes

5.4 Expert reports

Expert reporting has not been used in this assessment.

5.5 More appropriate local data (where relevant)

Local data has not been used to assess habitat suitability in this assessment.

5.6 Location of suitable habitat for a species credit species

5.6.1 Swift Parrot important habitat

The subject land contains approximately 2,377 m^2 (or 0.24 ha) of mapped important habitat map for *Lathamus discolor* (swift parrot).

Table 36. Areas of Swift Parrot important habitat impacted

Vegetation type	Area	
	m2	ha
PCT 3592 planted native/non-local native mixture	140	
Total PCT 3592	**140**	0.014
Exotic landscaping	95	
Exotic landscaping	118	
Exotic landscaping	26	
Total exotic	**239**	0.024
Total area	379	0.038

The area of PCT 3592 that will be cleared from the mapped important habitat area comprises three (3) *Melaleuca quinquenervia* that have been planted in a rain garden. Each species of *M. quinquenervia* being removed is semi-mature with dbh's of 250mm each. Other species in this patch of planted native vegetation (allocated to PCT 3592) will be retained and includes:

- 2 x Corymbia maculata (each with dbh 450mm)
- 3 x Eucalyptus pilularis (each with dbh 450mm)
- 2 x Melaleuca quinquenervia (each with dbh 300mm)
- 1 x Casuarina cunninghamiana (dbh 600mm)

Figure 18 shows the extent of important habitat within the subject land and the areas that will be impacted by the proposal and the species polygon area that has been used to calculate an offset for this species in the BAM C.

5.6.2 Chalinolobus dwyeri (large-eared pied bat)

Breeding habitat for this species is '*Potential breeding habitat is PCTs associated with the species within 100m of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings'*. Such habitat is absent from within 100m of the subject land.

Landscape analysis identified two escarpment locations within two kms (1.8km and 1.9km) to the north of the subject land (see Figure 20). Such habitat is absent from within 100m of the subject land. Therefore, the subject land may provide foraging habitat by definition under the BAM.

As the correct number of nights for this species were not surveyed (i.e., only four nights, where eight required) the potential for the subject land cannot be discounted, although it is still considered unlikely, given the description from the TBDC states the species:

- Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Petrochelidon ariel*);
- Frequents low to mid-elevation dry open forest and woodland close to these features;
- Is found in well-timbered areas containing gullies; and
- The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

Additional surveys are required to confirm this assumption in the summer months of 2023/2024.

6. Identifying prescribed impacts

Prescribed additional biodiversity impacts (prescribed impacts) must be assessed as per clause 6.1 of the BC Reg. Prescribed impacts include those impacts on the habitat of threatened species or ecological communities from development that is not directly caused as a result of vegetation clearing.

Table 37 lists the prescribed impacts, which are identified in Clause 6.1 of the BC Reg and the relevance of each prescribed impact in relation to the proposal.

Table 37. Prescribed and Uncertain Impacts

Feature	Present	Description of feature characteristics and location
Karst, caves, crevices, cliffs, rocks or other geological features of significance	☐Yes / ☒No	Not relevant. Features are not present within the subject land.
Human-made structures	☒Yes / ☐No	Relevant. The project includes the staged demolition of a number of existing buildings within the subject land. Despite being aged in providing aged services, the buildings are in good condition and are actively managed and well maintained. There are no areas of roofing, eaves, piping or other building components that are in disrepair, and no obvious access points for microchiropteran bats. Human made structures will be demolished during the construction phase of the project.
Non-native vegetation	☒Yes / ☐No	Relevant. Non-native vegetation occurring within the subject land comprises areas of managed lawns, landscaped gardens and exotic road side plantings. This vegetation may provide some low-value habitat for native fauna species, including threatened birds and bats, on occasion. Impacts to non-native vegetation would occur during the construction phase of the project.
Habitat connectivity	☒Yes / ☐No	Relevant. The subject land's peripheral vegetation along its southern and eastern boundaries is adjacent to the bushland that is contiguous with Garigal National Park (separated only be the Eastern Arterial Road to the east). Garigal National Park extends to Middle Harbour, thereby providing substantial connectivity. The vegetation within the subject land may provide some habitat connectivity to the adjacent bushland and to the extensive connected corridor beyond Gadigal National Park and Middle Harbour. The proposed development is to be situated within an area that has been historically cleared, and where there is limited connectivity to the north west and west of the subject land.
Waterbodies, water quality and hydrological processes	☒Yes / ☐No	Relevant. The subject land does not contain any watercourses or other surface drainage lines. However, stormwater runoff from the subject land discharges to creek systems in the adjacent bushland and downstream National Park.

Feature	Present	Description of feature characteristics and location
		Impacts to downstream aquatic biota may occur during construction and operational phases of the project. Measures will be implemented as part of the project CEMP to minimise potential sediment and erosion risks during construction. Stormwater management measures will comply with the SEARs and Council DCP requirements to minimise the risk of increased water quantity and decreased water quality during the development's operation.
Wind turbine strikes (wind farm development only)	☐Yes / ☒No	Not relevant. The proposal does not involve wind farming.
Vehicle strikes	☒Yes / ☐No	Relevant. The potential for vehicle strike may increase above that which currently exists. The proposed development will result in the creation of additional access roads / private driveways and increased traffic (by way of increased dwellings), increasing the risk of potential vehicle strike.

Stage 2: Impact Assessment

7. Avoid and minimise impacts

7.1 Avoid and minimise direct and indirect impacts

7.1.1 Project necessity

The redevelopment of the village is necessary as the existing aging buildings, which were original constructed in 1983, need renewal to provide modern seniors housing. The existing housing has limited accessibility with many of the dwellings without lift access and the gradient of streets and pathways providing poor pedestrian connectivity.

The dwellings are accessed via a network of narrow internal paths and stairways making pedestrian movement across the site difficult, with some streets too steep to walk. The building stock is aging and does not provide services and facilities that are competitive with market demand nor compliant with current Building Codes or Bushfire standards. Accordingly, major renewal of the housing and infrastructure is required which has resulted in the development of the Planning Proposal and master plan.

Building footprints have been located with the view to minimise impacts on biodiversity wherever possible. However, locations and building footprints have also been driven by the need to meet the requirements of the Apartment Design Guide for building separation and solar access and to provide generous communal space at the ground level as well as to achieve suitable building floorplates to accommodate modern seniors housing, necessitating some impacts on biodiversity.

The proposed changes to the internal road network seek to establish a separate access network for the private town house development to the south of the site and the seniors housing (independent living units and residential aged care) at the north of the site. This necessitates a new site access point to Stanhope Road at the west of the site and a new access road along the western boundary as well as a new site access connecting to the existing roundabout at Stanhope Road which will impact on small areas of native vegetation.

This ensure safe and efficient access to the proposed land uses and locates access to the basement and loading areas for the seniors housing as close as possible to Stanhope Road limiting the intrusion of vehicles into the site as much as feasible and also by extension serving to limit the effect of vehicle movements from a noise and pollution perspective within the local context. It also allows for a low traffic environment for the internal road serving the townhouses providing for a high level of pedestrian safety and amenity and minimal noise impacts in these areas.

7.1.2 Project location

Given the significant landholding and obligations to house existing residents during the development, alternate sites were not considered appropriate nor feasible for the proposal objectives.

The proposal is predominantly located within the existing developed footprint of the subject land and in accordance with Section 7.1.2 of the BAM, as far as practical, has sought to avoid the following:

- In areas that have negligible or no biodiversity values; and
- In vegetated areas that:
  - are in the poorest condition, and/or
  - do not contain habitat for threatened species.

This is demonstrated in Table 38, which identifies the areas of exotic vegetation to be the most impacted (at 1.01 ha); 1.07 ha out of 1.77 ha of native vegetation avoided, with most native vegetation being cleared comprising landscaping.

Table 38. Avoided and impacted native vegetation

Vegetation type	Total area (ha)	Avoided (ha)	% avoided	Impacted (ha)	% impacted
PCT 3262	0.17	0.12	70.6	0.05	29.1
PCT 3295	0.86	0.66	76.7	0.20	23.3
Landscaping (native)	0.74	0.29	39.2	0.45	60.8
Total native vegetation	**1.77**	**1.07**		**0.70**	
Landscaping (exotic)	1.14	0.13	11.4	1.01	85.6
Total all vegetation	**2.91**	**1.20**		**1.71**	

7.1.3 Project design

During the design development, various possibilities were explored regarding the development layout of the site. This comprehensive evaluation considered the potential opportunities and constraints presented by the location, aiming to develop a place-based master planned renewal of the village suitable for seniors living.

Figure 16 shows the final development footprint and alternative footprint which had a greater impact on biodiversity values including impacts to the critically endangered Sydney Turpentine Ironbark Forest and mapped important habitat of the Swift Parrot. Figure 17 illustrates the areas of native vegetation avoided.

This was achieved through the following design amendments:

- Relocation and realignment of the western entrance, enabling the retention of the subject land's remaining *Syncarpia glomulifera* (turpentine) trees and areas mapped as comprising the critically endangered Sydney Turpentine Ironbark Forest (PCT 3262)
- Redesign of southern townhouses to retain more mature native vegetation along the southern boundary and thereby minimise impacts to Swift Parrot feed trees (adjacent mapped important habitat area for the species) and reduce clearing of PCT 3952;
- Modification of the Northeastern Independent Living Apartment Building to avoid and minimise impact on the adjacent vegetation to the north. This was completed by the reduction in the basement footprint and amendments to the apartment floor plate and facades.

The outcome of design amendments is an overall reduction in clearing of PCT vegetation from 0.58 ha to 0.25 ha (i.e., a further avoidance of 0.33ha of PCTs).

Table 39 provides a summary of avoidance and minimisation components that have been considered through design iterations.

Table 39. Avoidance and minimisation measures for direct, indirect and prescribed impacts

Avoidance and minimisation components	Action	Outcome	Timing	Responsibility
Efforts to avoid and minimise impacts through design must be documented and justified	Through the various iterations, the proponent has determined that the proposed impacts to 0.7 ha cannot be avoided because the footprint has been amended to accommodate: ▪ Necessity of multiple access roadways to facilitate emergency evacuation	The outcome of design amendments is an overall reduction in clearing of PCT vegetation from 0.58 ha to 0.25 ha (i.e., the additional avoidance of 0.33ha of PCTs has been achieved). Most clearing is of exotic vegetation (1.0 ha of 1.14 ha). All areas of native vegetation being removed	Planning phase	Proponent

Avoidance and minimisation components	Action	Outcome	Timing	Responsibility
	▪ Location of the building footprints in accordance with Bushfire Constraints ▪ Grading of portions of the site to meet requirements for Housing SEPP - Seniors Living design & civil engineering constraints	(including PCTs) contain a mixture of native and planted non-local species, which are located in managed curtilage and lack a fully structured community (i.e., absence of native shrub and ground layers)		
Alternative development site locations				
Avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	Given the significant landholding and obligations to house existing residents during the development, alternate sites were not considered appropriate or feasible for the proposal objectives.	The project is sited within existing areas of development that are proximal to existing infrastructure and urban amenities, and impacts only on vegetation that is in a disturbed condition.	Planning phase	Proponent
Avoidance of impacts on biodiversity values through location of design				
Locating the project in areas where the native vegetation: ▪ is in the poorest condition; ▪ does not provide habitat for threatened species; and Avoids vegetation in high threat categories (e.g., an EEC or CEEC).	The project footprint has been located within an already developed area and where vegetation is dominated by planted exotic and native landscaping. Most clearing is of exotic vegetation (1.0ha of 1.14ha existing exotic vegetation, including large areas of mown lawns). Unavoidable impacts on older growth native vegetation is limited to relatively small areas around the periphery of the subject land and several individual planted specimens within built up areas. All areas of native vegetation being removed (including PCTs) contain a mixture of native and planted non-local species, which are located in managed curtilage and lack a fully structured community (i.e., absence of native shrub and ground layers)	Impacts across the development footprint are mostly limited to areas containing planted exotic and native vegetation. The proposed application will affect 0.70ha of a total 1.70ha of native vegetation. Approximately 0.05 ha of remnant and planted native vegetation allocated to PCT 3262 (a CEEC) will be impacted. Approximately 0.17ha of this PCT will be avoided. Approximately 0.2ha of remnant and planted native vegetation allocated to PCT 3592 (not threat listed) will be impacted. Approximately 0.7ha of this PCT will be avoided. A further 0.45ha of planted native vegetation not allocated to a PCT will be cleared and approximately 0.3ha avoided. Potential impacts to threatened species habitat is limited to marginal	Planning phase	Proponent

Avoidance and minimisation components	Action	Outcome	Timing	Responsibility
		foraging habitat only, which is unlikely to be preferred over the intact bushland adjacent to the subject land's east and southern boundaries. Noting that there is limited connectivity to the northwest and west of the subject land.		
Avoidance of impacts on biodiversity values through proposal design				
Design amendment - north eastern Independent Living Apartment Building Amendments	In response to EHG RtS (6/06/23) the Northeastern Independent Living Building has been modified to further avoid and minimise the adjacent vegetation to the north. This included the reduction in the basement footprint and amended to the apartment facade and layout.	The proposed clearing of a small area of 0.05 ha (or 500m2) from a total of 0.61 ha of native vegetation allocated to PCT 3262 (a CEEC). The vegetation within the 500 m^2 to be removed is located on a modified earthen bund which lacks a shrub and groundlayer, consisting only of eight trees, three of which are non-local native species (3 x tallowwoods).	Planning phase	Proponent
Design amendment - western access road	Avoidance of areas of intact vegetation through the relocation and realignment of the western entrance road to enabling the retention of the subject land's remnant *Syncarpia glomulifera* (Sydney turpentine) trees and areas mapped as comprising the critically endangered Sydney Turpentine Ironbark Forest (PCT 3262)	Retention of mature trees where possible which provide higher quality potential resources for highly mobile common fauna in the wider locality. Retention of remnant native vegetation relating to a critically endangered community under the BC Act.	Planning phase	Proponent
Design amendment - eastern access road	Additional avoidance of areas through amended siting of the eastern access roadway.	Areas with larger concentration of existing native/ planted native vegetation were avoided and access ways were located through areas of poorer condition vegetation.	Planning phase	Proponent
Design amendment - south western townhouse design	Amendment of townhouse design footprint to avoid clearing of planted native	Retention of mature and higher quality Swift Parrot feed trees immediately	Planning phase	Proponent

Avoidance and minimisation components	Action	Outcome	Timing	Responsibility
change and road re-alignment	vegetation including Swift Parrot feed trees	adjacent to mapped Swift Parrot important habitat area. Removal of 3 x semi-mature *Melaleuca quinquenervia* x with dbh's of 250mm. Avoidance of: 2 x Corymbia maculata (each with dbh 450mm) 3 x Eucalyptus pilularis (each with dbh 450mm) 2 x Melaleuca quinquenervia (each with dbh 300mm) 1 x Casuarina cunninghamiana (dbh 600mm)		
Minimisation of earthworks	Minimisation of cut and fill at the boundary of the sites to enable retention of the existing perimeter road.	Retention of mature and higher quality patches of remnant and planted native vegetation.	Planning phase	Proponent
Habitat connectivity	As shown in Figure 9 the subject land is juxtaposed at the edge of extensive existing developed land and remnant bushland to its south and east. The latter continuous with Garigal National Park, which extends to Middle Harbour and provides substantial connectivity. The site's periphery vegetation along the southern and eastern boundaries supplements but does not provide a significant contribution to this connectivity.	Peripheral native vegetation clearing is limited to small non-local native trees that have been planted in a raingardens. Larger and higher quality native trees have been avoided through design iteration to minimise clearing of peripheral vegetation in the south to 140m^2 (where previously 664m^2 was proposed to be cleared). This includes 5 x trees with dbh of 450mm and 1 tree with dbh of 600mm.	Planning phase	Proponent
Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal				
Bushfire Constraint	Siting of the building footprints and road access points are heavily constrained by Bushfire Engineering constraints associated with the site.	The masterplan is guided by the Bushfire Engineering Design Compliance Strategy, which is endorsed by RFS for the Planning Proposal	Planning phase	Proponent

8. Impact assessment

8.1 Direct impacts

8.1.1 Residual direct impacts

Table 40 documents impacts likely to occur on the subject land after steps taken to avoid and minimise impacts.

Table 40. Summary of residual direct impacts

Direct impact (Describe the impact on PCT/TEC/EC or threatened species and their habitat)	**BC Act status**	**EPBC Act status**	**SAII entity**	**Project phase/timing of impact** (e.g., construction, operation, rehabilitation)	**Extent** (ha, number of individuals)
Clearing of native vegetation allocated to PCT 3592	n/a	n/a	No	Construction	0.20 ha
Clearing of native vegetation allocated to PCT 3262	Critically Endangered	Critically Endangered	Yes	Construction	0.05 ha
Clearing of native vegetation located in an area of mapped Swift Parrot important habitat area clearing	Endangered	Critically Endangered	Yes	Construction	0.01 ha

8.1.2 Change in vegetation integrity score

Table 41 documents the change in vegetation integrity for residual direct impacts on native vegetation, TECs, threatened species and their habitat that were identified on the subject land.

Table 41. Impacts to vegetation integrity

Vegetation zone	**PCT ID**	**Management zone**	**Area** (ha)	**Before development**			**After development**			**Change**		
				Composition	**Structure**	**Function**	**VI score**	**Composition**	**Structure**	**Function**	**VI score**	**Change in VI score**
Zone 1. Managed	3592	n/a	0.2	10.9	44.5	63.7	31.3	0	0	0	0	-31.3
Zone 1. Managed	3262	n/a	0.05	16.8	30.7	16.2	20.3	0	0	0	0	-20.3

8.2 Indirect impacts

Table 42 provides a summary of potential indirect impacts to biodiversity values within and/or proximal to the subject land.

Table 42. Summary of indirect impacts

Indirect impact	Duration	Biodiversity values impacted	Consequence
Inadvertent impacts on adjacent habitat or vegetation	Short term during construction	Damage to adjacent habitat and vegetation	Retained vegetation will be protected in accordance with the project arborist's recommendations and mitigation measures recommended in Section 8. Allowance for construction impacts outside of the design footprint have been included in the total area of clearing being offset under the Scheme.
Increased sedimentation	Short term during construction	General environment	Vegetation clearing and earthworks can expose soils and subsoils, which following rainfall may erode and mobilise soils in runoff, potentially smothering ground layer vegetation (in turn affecting health through a decrease in photosynthesis) or impact on water quality in downstream aquatic ecosystems (in turn affecting aquatic organisms that may provide a food resource for native fauna). Providing that best practices in erosion and sedimentation management are implemented in accordance with the project's Erosion and Sediment Control Plan (ESCP) the consequence of this impact is considered to be a low risk. Providing that best practices in erosion and sedimentation management are implemented in accordance with the project's Erosion and Sediment Control Plan (ESCP) the consequence of this impact is considered to be a low risk.
Introduction of weeds and pathogens	Short term during construction	General environment	Construction activities have the potential to both spread existing weed infestations, introduce new weed species, and introduce or spread soil borne pathogens on machinery and equipment. As a consequence, the condition (e.g., site integrity values) of retained and neighbouring vegetation could be decreased. Providing that the mitigation measures recommended in Section 8 are implemented the consequence of this impact is considered to be a low risk.
Trampling or other damage to remnant vegetation, including threatened species	Short term during construction	Retained vegetation	Retained vegetation will be protected in accordance with the project arborist's recommendations and mitigation measures recommended in Section 8. Allowance for construction impacts outside of the design footprint have been included in the total area of clearing being offset under the Scheme.

Indirect impact	Duration	Biodiversity values impacted	Consequence
Fertiliser drift	N/A	N/A	Fertiliser will not be used
Rubbish dumping, wood collection, removal and disturbance of rocks, including bush rock	N/A	N/A	The subject lands will not be accessible by the public (through security fencing) and the consequence of this impact is considered to be a low risk.
Reduced viability of adjacent habitat due to:			
Dust	Short term during construction	Retained native vegetation	Dust generation during construction activities will be managed through the following measures: ▪ Construction staging, ▪ Minimising material stockpiles, ▪ Cleaning (water suppression) of construction haul roads, ▪ Speed restrictions, and ▪ Implementation of the project's ESCP, and ▪ Implementation of mitigations measures prescribed within the Construction Environmental Management Plan (CEMP). The proposal is considered unlikely to reduce viability of retained native vegetation due to dust generation.
Light spill	Long term	Retained native vegetation	The proposal will result in an increase in light levels above that which already exists. Light spill will be mitigated during the design phase in accordance with available standards and guidelines for mitigating impacts on fauna habitat, which include but may not be limited to the following: ▪ Commonwealth of Australia (2020) National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds; and ▪ AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting recognises the impact of artificial light on biota. The above guidelines provide a range of measures to minimise light spill impacts on fauna and fauna habitat. Examples include:

Indirect impact	Duration	Biodiversity values impacted	Consequence
			▪ The use of recent advances in smart control technology options for better controlled and targeted artificial light management; ▪ Ensuring that lighting is shielded and directed only to the intended object or area; ▪ Ensuring that light intensity is appropriate for the target area using only the minimum number and intensity of lights needed to provide safe and secure illumination for the area at the time required to meet the lighting objectives; and ▪ Consideration of the following lighting aspects: ○ high quality, low glare lighting, which enhances visibility for the user at night, reduces eye fatigue, improves night vision and delivers light where it is needed, ○ non-reflective, dark coloured surfaces, ○ reduced or filtered out blue, violet and ultraviolet wavelengths, which wildlife are sensitive to. Providing the design of the village's lighting installations incorporates the above and current best practice measures, the likelihood of light spill impacts on fauna and fauna habitat will be minimised as far as practical.
Noise	Short term during construction	Retained native vegetation	All construction works are proposed to be undertaken during standard construction hours: ▪ Monday to Friday, 7am to 6pm; ▪ Saturday 8am to 1pm; and ▪ No work on Sundays or public holidays. The proposed construction will be temporary in nature and the risk of consequence is considered low. Long term operation: ▪ The proposal will not result in a significant increase in noise levels above that which already exists; ▪ Resident fauna within the vicinity of the proposed development would already be accustomed to ambient noise levels from existing development. The consequence of increased noise impacts is considered a low risk.

Indirect impact	Duration	Biodiversity values impacted	Consequence
Increased risk of starvation, exposure, loss of shade or shelter	N/A	N/A	The proposal would not result in any significant changes to existing food resources, shade or shelter. Existing vegetation within the subject land does not provide any important habitat (in terms of foraging, shade and shelter). Therefore, the proposed development is considered a low risk in this respect.
Loss of breeding habitat	N/A	N/A	Breeding habitat for threatened species is absent from subject land.
Reduced viability of adjacent habitat due to edge effects	Short and long term	Adjacent bushland	The proposal will not be disturbing the existing edges of the subject land where it adjoins adjacent bushland.
Habitat connectivity			
Habitat connectivity	N/A	N/A	The proposal does not impact on the remnant bushland adjacent to the subject land and will not result in the isolation or fragmentation of native vegetation and/or connectivity.
Water bodies, water quality and hydrological processes			
Water bodies, water quality and hydrological processes	Short and long term	Gordon Creek	The proposal's civil engineering strategy will provide a best practice solution within the constraints of the existing landform and proposed development layout. Within this strategy a stormwater quantity and quality management strategy will be developed to consider peak flows and reduce pollutant loads in stormwater leaving this site. A hydrological assessment will be required to show that local post development flows from the site will be consistent with pre-development flows and demonstrate that the site discharge will not adversely affect any land, drainage systems or watercourse as a result of the development. During the construction phase, a Sediment and Erosion Control Plan will be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.

8.3 Prescribed impacts

8.3.1 Human-made structures

8.3.1.1 Nature

As described in Table 37, all buildings that will be demolished during the construction phase of the project are in good condition, are actively managed and well maintained.

There are no areas of roofing, eaves, piping or other building components that are in disrepair, and no obvious access points for microchiropteran bats.

A dedicated microchiropteran bat survey conducted to the east and southwest of existing vacant buildings found microbat activity to be very low, recording only four species of microchiropterans despite suitable weather conditions (refer Section 2.4).

8.3.1.2 Extent

Due to the extent of redevelopment works required to make the village compatible with current standards, impacts to human-made structures are not able to be avoided as part of the project.

8.3.1.3 Duration

Should there be any roosting habitat in buildings being demolished, the redevelopment would thereby represent a permanent residual impact.

8.3.1.4 Threatened Entities Affected

The habitat provided by human-made structures may provide roosting habitat for ecosystem species, such as microchiropteran bats, but this is considered unlikely, due to the existing ongoing use of the human-made structures and extensive alternative habitat proximal to the subject land.

8.3.1.5 Consequences

Potential impacts from the demolition of the buildings will be minimised through the implementation of pre-demolition inspections that will coincide with ecologist pre-clearance surveys (see Section 8.4).

8.3.2 Non-native vegetation

8.3.2.1 Nature

The subject land contains 1.13 ha exotic vegetation, which is largely made up of mown lawn, garden beds and other landscaping areas. Exotic trees are dominated ornamental species (such as Chinese tallow, Angel's trumpets, Japanese maple, Wych elm and Evergreen elder, Camellia, Ornamental prune, Tibouchina and Jacaranda) with less widespread palm species and larger tree species (such as Camphor laurel, Liquidambar and Magnolia).

8.3.2.2 Extent

The redevelopment will result in the removal of up to 1.0 ha of 1.13 ha exotic vegetation, which is made up of 74 individual tree specimens, including 64 ornamental species (most with a dbh <100mm dbh), and 10 palm species.

8.3.2.3 Duration

Impacts to non-native vegetation would occur during the construction phase of the project. The removal of the non-native vegetation is a long-term impact.

8.3.2.4 Threatened Entities Affected

The habitat provided by non-native vegetation may provide some foraging habitat for ecosystem species, such as microchiropteran bats, birds and the Grey-headed flying-fox, which may forage on

palms when fruiting. The non-native vegetation is not considered suitable breeding habitat due to lack of hollows.

8.3.2.5 Consequences

The project will result in a reduction in non-native vegetation by 1.0 ha, which is not considered to significantly impact upon any potentially affected threatened entities. The non-native vegetation comprises marginal to sub-optimal habitat and other areas of suitable habitat, in the form of both native and non-native vegetation (within the subject land) and extensive intact bushland (adjacent to the subject land), will remain available.

8.3.3 Waterbodies, water quality and hydrological processes

8.3.3.1 Nature

Stormwater from the existing and proposed redeveloped village discharges into the existing stormwater system, part of which discharges to a first order tributary of Gordon Creek to the south of the subject land.

8.3.3.2 Extent

Sediment and erosion during earthworks and construction activities if unmitigated can impact on downstream aquatic biota.

Discharge of excess nutrients and pollutants in stormwater may also impact on downstream aquatic biota.

8.3.3.3 Duration

Discharge of sediment and pollutants in stormwater may occur sporadically (accidentally or in pulses), or over a longer term depending on the contaminants (i.e., hydrocarbon or chemical spills) and also frequency of polluted discharge (i.e., regular in puts of excessive nutrients, high or low pH, etc).

8.3.3.4 Threatened Entities Affected

No known threatened species are associated with the downstream Gordon Creek tributary. Aquatic species are more likely to be associated with Gordon Creek and the downstream Middle Harbour system.

8.3.3.5 Consequences

Stormwater management will be required to match pre-development flows and specific water quality objectives that protect the downstream aquatic ecosystems.

Erosion and sediment control measures will be implemented throughout the construction periods in order to minimise potential impacts to the existing hydrological processes of the subject land.

Consequently, the risks of impacts on biodiversity associated with stormwater discharge is considered to be low.

8.3.4 Habitat connectivity

8.3.4.1 Nature

The subject land's peripheral native vegetation in the south and eastern site portions is adjacent to continuous native bushland, which provides substantial connectivity to Garigal National Park and thereafter Middle Harbour.

The proposal will remove a very small amount of planted non-local native trees in the southwest of the subject land. This patch is partially fragmented from adjacent bushland at the ground level by a

sealed road. The trees to be removed are semi-mature and do not significantly contribute to the existing canopy cover provided by the mature and higher quality trees being retained in this patch.

The native and non-native trees proposed for removal in the north of the subject land are at the edge of a vegetated corridor located between the development and Stanhope Road and will have limited impact on connectivity to the northeast.

Connectivity to the north, northwest and west is limited due to existing development.

As noted, there is an expansive tract of native vegetation to the northeast, east and south of the subject land which connect to Garigal National Park. It is unlikely that the trees to be removed within the subject land would be preferred habitat over the native vegetation in the locality. It is unlikely that any threatened species which could potentially foraging over the subject land on occasion would be significantly affected by its removal, as high-quality habitat is available in the locality.

8.3.4.2 Extent

Vegetation mapped by OEH (2016) and DPE (2022) coincides with a mapped important habitat area for the endangered Swift Parrot. This area encroaches into the subject land from the adjacent bushland and the boundary is relatively coarse. As can be seen in Figure 18 the mapping includes part of the sealed boundary road and also includes areas of exotic garden plantings.

The mapped important habitat area extends over 0.24 ha (2,377 m^2), which includes part of the sealed boundary road, areas of exotic and non-native planted gardens and landscaping and canopy cover from the adjacent bushland.

Areas of mapped important habitat area that will be cleared includes the following:

- Planted native/non-local native mixture (140 m^2) – comprising 3 x small native paperbarks plated in a rain garden (each with a dbh of 300mm); and
- Planted exotic vegetation (239 m^2)

8.3.4.3 Duration

The loss of 140 m^2 of native vegetation will be a permanent impact. However, proposed landscaping with local native species will enhance habitat connectivity across the subject land.

8.3.4.4 Threatened Entities Affected

Threatened entities that would potentially be affected include highly mobile microbat and bird species, including the Swift Parrot.

8.3.4.5 Consequences

It is considered unlikely that any native fauna would be solely reliant on the habitat within the subject land for movement between different areas of habitat and the consequences are considered to be a very low risk.

8.3.5 Vehicle strike

8.3.5.1 Nature

The project will result in the creation of additional access roads and private driveways within the subject land along with an increased population of residents through the inclusion of multi-level buildings. As such, there is likely to be an increase in vehicle traffic within the subject land and thereby increasing the potential of vehicle strikes. The implementation of traffic control measures, primarily speed limits along access roads and driveways will reduce the potential for vehicle strikes on native fauna species.

8.3.5.2 Extent

The redevelopment will result in a permanent risk of vehicle strike, however there are no anecdotal occurrences of road kill from the retirement village.

8.3.5.3 Duration

The redevelopment will result in a permanent risk of vehicle strike

8.3.5.4 Threatened Entities Affected

The subject land does not provide suitable microhabitat for any threatened ground dwelling fauna species and none have been incidentally recorded on the subject land.

8.3.5.5 Consequences

The potential for vehicle strike is consider low given the subject land contains shared road and pedestrian pathways and speed limits are restricted to 10km/hr.

8.4 Mitigating residual impacts – management measures and implementation

Table 43 summarises the typical mitigation measures that would be implemented to avoid or minimise accidental direct impacts and indirect impacts.

NOTE: prior to commencement of the proposal a development application will be submitted as a State Significant Development (SSD). An updated BDAR will be prepared for submission with the SSD application. At this time, further detail will be possible as it relates to mitigation and management of impacts in accordance with BAM Sections 8.4 and 8.5 and the minimum information requirements in Appendix K of the BAM (i.e., as the detailed design is completed).

Table 43. Summary of mitigation measures for impacts to biodiversity values

Mitigation measure	Proposed technique	Timing	Frequency	Responsibility	Risk of Failure	Risk and consequences of residual impacts
Delineation of clearing limits	Clearing limits are delineated with high visibility tape, temporary fencing, or other appropriate boundary markers. Materials and methods of marking trees to be removed or retained and protected will be agreed to prior to their employment.	Pre-construction	Once	Contractor	High	Unauthorised clearing and/or damage to vegetation to be retained
Erosion and sediment controls	Implementation of Erosion and Sediment Control Plan (ESCP) measures	Pre-construction	Ongoing	Contractor	High	Sedimentation of native vegetation and downstream aquatic environment.
Microchiroptera survey	While it is considered unlikely that any of the village buildings provide roosting habitat for microbats, the following best practice daytime roost searches are to be undertaken as a precaution. Prior to demolition of buildings, daytime roost searches should be carried out. A search is to be undertaken by looking for bats or signs of bats in suitable roost habitat during the daytime. All roost searches should use a torch to shine in holes, cracks and crevices, and carry a handheld bat detector to locate bats that may call. If bats are detected, demolition of the building must be delayed until bats are able to be relocated.	Pre-construction during preclearance surveys	Once	Contractor / Project Ecologist	Moderate	Harm / death of microbats – low risk providing pre-construction surveys completed

Mitigation measure	Proposed technique	Timing	Frequency	Responsibility	Risk of Failure	Risk and consequences of residual impacts
Pre-clearance surveys	Pre-clearing surveys will be undertaken by a suitably qualified ecologist ahead of clearing, to limit fauna injury and mortality and to identify habitat features to be relocated. Pre-clearance surveys will be conducted by suitably qualified ecologists and all fauna found during these surveys will be encouraged to move on or relocated by the ecologists in areas of similar habitat nearby that will not be impacted. Pre-clearing surveys will include: ▪ Demarcation of key habitat features as hollow-bearing trees, fallen logs and bush rock; ▪ Checking trees for the presence of bird nests and arboreal mammals, such as possums, and bats; ▪ Animals found to be occupying trees and habitat will be safely removed and relocated into nearby wooded habitat. ▪ Identification and nomination of habitat trees to be salvaged and relocated to adjacent retained vegetation for reuse as fauna habitat (if applicable); and ▪ Provision of a report following the completion of a pre-clearing survey, detailing the location and type of each habitat feature, and a record of all fauna species encountered.	Pre-construction (maximum of 7 days pre-clearance)	Once	Contractor / Project Ecologist	Moderate	Habitat features not identified Harm / death of fauna Woody weeds inadvertently chipped and reused on site as mulch – low risk providing pre-clearance surveys completed and contractors implement Project Ecologist recommendations.
Clearance staging	The clearing will be conducted using a two-stage clearing process as follows: Stage 1: Clearing will commence following the identification of potential habitat features by a qualified ecologist. Habitat trees marked during pre-clearing will not be cleared during the first stage; however, all vegetation around these trees will be cleared to enable isolation of the feature.	During clearance	Once	Contractor / Project Ecologist	Moderate	Harm / death of fauna – low risk as above

Mitigation measure	Proposed technique	Timing	Frequency	Responsibility	Risk of Failure	Risk and consequences of residual impacts
	Identified habitat trees will be left at a minimum overnight after Stage 1 clearing to allow resident fauna to voluntarily move from the area. Stage 2: After habitat trees have been left overnight, the trees will be cleared using the following protocols: ▪ Trees marked as containing habitat will be shaken by machinery prior to clearing to encourage any animals remaining to leave the hollows and move on; ▪ Use a bulldozer or excavator to start pushing the tree over. Move the bulldozer over the roots and continue gently pushing the tree over; and ▪ All habitat trees will be investigated by an ecologist for the presence of fauna following felling of the tree. The felled habitat tree will be left overnight to allow any remaining fauna time to leave the hollows and move on. The two-stage clearing process enables fauna a chance to self-relocate upon nightfall, when foraging typically occurs.					
Habitat Salvage	Any timber that would be suitable to create habitat within peripheral bushland areas should be salvaged during clearing. These should be identified by the ecologist during clearance supervision and should be separated from remaining material that could be mulched on site. Timber suitable for salvage should include larger logs and branches that are unlikely to decompose between clearing and revegetation. Salvaged features should be stockpiled away from areas impacted by earthworks to ensure the features do not become mixed with soil.	During clearance	Once	Contractor / Project Ecologist	N/A	N/A

Mitigation measure	Proposed technique	Timing	Frequency	Responsibility	Risk of Failure	Risk and consequences of residual impacts
Biosecurity management	Implementation of hygiene measures, such as washdown facilities, spray down of equipment entering/exiting site, to prevent the introduction and / or spread of introduced flora and fauna species, pathogens and / or disease.	Throughout	Ongoing	Contractor / Principal	Moderate	Introduction and/or spread of pest species, pathogens, disease, and in turn harm death of adjacent flora and fauna – low risk providing hygiene measures, weed control and other CEMP requirements are met
Noise	Timing of construction operations will be optimised as per an approved CEMP, which will noise mitigation and hours in which construction is permissible	Construction	Ongoing	Contractor / Principal	Moderate	Disturbance to fauna which may lead to displacement – low risk due to extensive adjacent habitat available, implementation of mitigation measures and consent conditions
Dust	Dust levels during operations managed according to an approved CEMP: ▪ Daily monitoring of dust generated by construction activities; and ▪ Dust suppression measures (setting maximum speed limits and application of dust suppressants) will be	During construction	Daily	Contractor / Principal	Moderate	Reduced viability of retained native vegetation – low risk

Mitigation measure	Proposed technique	Timing	Frequency	Responsibility	Risk of Failure	Risk and consequences of residual impacts
	implemented during construction works to limit dust on site.					

8.5 Mitigation Measures for Prescribed Impacts

The following mitigation measures, described in Section 8.3, are relevant to the prescribed impacts of the project:

- Sedimentation control measures;
- Pre-demolition building surveys;
- Pre-clearance vegetation / habitat surveys;
- Clearing supervision and protocols;
- Weed control and hygiene protocols; and
- Stormwater management measures in accordance with SEARs and Council DCP requirements.

No additional measures are proposed to mitigate against prescribed impacts.

8.6 Use of Biodiversity Credits to Mitigate or Offset Indirect or Prescribed Impacts

The project does not propose to use additional biodiversity credits to mitigate or offset indirect or prescribed impacts as the impacts are not considered to be significant when the proposed management strategies for these impacts are taken into consideration.

8.7 Adaptive management strategy for uncertain impacts (where relevant)

The project is considered unlikely to result in any uncertain impacts that require adaptive management.

9. Serious and irreversible impacts

9.1 Assessment for serious and irreversible impacts on biodiversity values

Two entities identified to be at risk of serious and irreversible impacts (SAII entities) are assessed in this section (see Table 44).

The information in the following sections is provided to assist the consent authority to evaluate the nature of an impact on a potential entity at risk of a serious and irreversible impact.

Table 44. Entities at risk of an SAII

Common name	Scientific name	Reason for inclusion in assessment
Sydney Turpentine Ironbark Forest	Sydney Turpentine Ironbark Forest	Included in current list of entities at risk of an SAII and is likely to be impacted by the proposal
Swift Parrot	Lathamus discolor	Included in current list of entities at risk of an SAII and is likely to be impacted by the proposal

9.1.1 Additional impact assessment provisions for TECs at risk of an SAII

9.1.1.1 Sydney Turpentine Ironbark Forest (STIF)

1. Actions to avoid and minimise direct and indirect impacts

Planning revisions have located the eastern access roadways and entrances to the development site in response to areas of existing flora and the overall bushfire strategy. This has resulted in the proposed clearing of a small area of 0.05 ha (or 500m^2) from a total of 0.61 ha of native vegetation allocated to PCT 3262 (nominated in adherence to the Precautionary Principle).

As such, areas with a larger concentration of existing native/ planted native vegetation were avoided and access ways were located through areas with poorer vegetation condition.

The vegetation within the 500 m^2 to be removed is located on a modified earthen bund which lacks a shrub and groundlayer, consisting only of eight trees, three of which are non-local native species (3 x tallowwoods). See photo plates 9.1 and 9.2.

Photo plate 9.1. Indicative location of PCT 3262 in area to be cleared

Photo plate 9.2. Indicative location of PCT 3262 in area to be cleared

The proposed landscaping will reinstate local native species that are representative of the PCT 3262 and aim to increase the abundance and distribution of PCT 3262 throughout the redeveloped Village, in turn increasing dispersal opportunities for PCT 3262 species in the locality.

2. Current status (excluding impacts of the proposal)

Table 45. Current status – Sydney Turpentine Ironbark Forest (STIF)

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
Current total geographic extent (ha) of the TEC in NSW	1,038	BIONET vegetation classification database	Calculated from State Vegetation Type Map (SVTM) extant PCT map C1.1.M1 and Inland Multinomial Modelling. Values rounded to nearest hectare.
	2,940	NSW Scientific Committee's final determination (2019) – Section 3.1.4	Tozer *et al*. (2010) estimated some 2,300 ha remains. Additional remnants have been mapped by BMCC (2003) (a total of 190 ha) and Smith and Smith (2008) (148 ha). Combining these maps with the maps of Tozer et al. (2010) and NSW OEH (2013ab) gives an estimated **2,940 ha** of STIF remaining.
Estimated reduction in geographic extent of the TEC since 1970	Not available	Not available	The estimated reduction in the geographic extent of STIF since 1970 is not available in the TBDC, BioNet, the final determination and was not identified from a search of available literature. Nonetheless, the pre-European extent of STIF is listed as approximately 25,348 ha in the TBDC.
Extent of reduction in ecological function, describing the degree of environmental degradation or disruption to biotic processes (Principle 2) indicated by factors listed in BAM Subsection 9.1.1(2.b.) Factors listed in BAM Subsection 9.1.1(2.b.) are:			

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
i. change in community structure ii. change in species composition iii. disruption of ecological processes iv. invasion and establishment of exotic species v. degradation of habitat, and vi. fragmentation of habitat The NSW Scientific Committee's final determination (2019) describes STIF as historically subjected to a range of anthropogenic disturbances including logging, grazing by domesticated livestock and burning at varying intensities (Benson and Howell 1994). These disturbances have affected the structure and potentially the composition of remnants. The removal of large older trees has been suggested to lead to higher densities of smaller trees such that remnants typically have the structure of regrowth forest. Increased fire frequencies associated with hazard reduction burning have led to declines in populations of slow-maturing, fire sensitive species and effected a structural simplification in some remnants of STIF. Conversely, remnants with a long-term history of fire-exclusion, particularly when coupled with increases in nutrient and moisture availability, are characterised by higher densities and cover of mesic species (such as *Pittosporum undulatum, Glochidion ferdinandi* and *Homalanthus populifolius*), larger and more diverse populations of exotic species and lower diversity of understorey species (Rose and Fairweather 1997, McDonald et al. 2002, Howell 2003). Fragmentation and continued clearing for development are also attributed to the reduction in extent and ecological function of the community, with remnants typically small and fragmented and susceptible to continuing attrition through clearing for routine land management practices due to the majority of remnants being located in close proximity to rural land or urban interfaces (Benson and Howell 1994; Tozer 2003). Remnants of Sydney Turpentine-Ironbark Forest are also subject to ongoing invasion by an extensive range of naturalised plant species. Weed invasion is exacerbated by the proximity of remnants to areas of rural and urban development and the associated influx of both weed propagules from gardens and nutrients contained in stormwater runoff, dumped garden refuse and animal droppings.			
Evidence of restricted geographic distribution (Principle 3) based on the TEC's geographic range in NSW			
Extent of occurrence (ha)	The distribution of Sydney Turpentine-Ironbark Forest is highly restricted. The extent of occurrence (EOO) of STIF is 4,479 km^2	NSW Scientific Committee's final determination (2019) – Section 3.1.4	Based on a minimum convex polygon enclosing known occurrences of the community as interpreted in Sections 4.2 – 4.10 and using the method of assessment recommended by IUCN (Bland et al. 2017). The estimated area of occupancy (AOO) is 12 10 km x 10 km grid cells, the scale recommended for assessing AOO by IUCN and applying a minimum occupancy

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
			threshold of 1% (Bland et al. 2017).
Area of occupancy (ha)	An estimated 280 ha of STIF (less than 1% of the pre-European extent) is distributed among 15 reserves (with a minimum area of 0.5 ha) under the management of the NSW NPWS. A further 254 ha occurs in Crown Reserves and 36 ha is preserved in perpetuity under Biobanking or Conservation Agreements. The total area under reservation is estimated to be 570 ha, equivalent to less than 2% of the estimated pre-1750 distribution or 20% of the remaining extent.	NSW Scientific Committee's final determination (2019) – Section 3.1.5	
Number of threat-defined locations	Not available		No threat defined locations are listed in the TBDC.

3. Impact assessment

Table 46. Impact assessment – Sydney Turpentine Ironbark Forest

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
Impact on the geographic extent of the TEC (Principles 1 and 3)			
Area of TEC to be impacted by the proposal (ha)	0.05	N/A	N/A
Area of TEC to be impacted by the proposal as a % of the current geographic extent in NSW (%)	0.0017	N/A	N/A
Direct/indirect impacts likely as a result of the proposal to contribute to loss of flora/fauna	No further direct or indirect impacts to this community is anticipated. This includes partial losses from changes to fire regime, species interactions,	N/A	N/A

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
species characteristic of the TEC (BAM Subsection 9.1.1(4.a.ii.))	fragmentation, increased edge effects, which are likely to contribute to the loss of flora and/or fauna species characteristic of the TEC. The existing vegetation is predominantly planted native tree species located in a managed curtilage (i.e., absence of shrub and ground layers and canopy limited due to overhead powerlines).		
Impacts likely to contribute to further environmental degradation or disruption of biotic processes (Principle 2)			
Remaining extent of isolated areas of TEC (ha)	Remaining areas of STIF from within a 500m of the development footprint is 4.53 ha of which approximately 50% is reserved and the remainder made of isolated small patches on private land. The proposed clearing of 0.05 represents 1.1% of this area.	SydneyMetroArea-v3E-4489 (OEH 2016)	Extent of mapped STIF in 500m buffer from development site calculated in ArcMap V10.8.2.
Average distance between remaining remnants – remnant is retained (m) Average distance between remaining remnants – remnant is removed (m)	With or without STIF removal distances remain constant **Within subject land :** 115 **Within locality** : 432 Lengths measured x 8 minimum 101 maximum 722 median 463	SydneyMetroArea-v3E-4489 (OEH 2016)	Lineal distances measured in in ArcMap V10.8.2. Smaller patches of STIF in residential properties ignored in wider locality. (see Figure 19)
Estimated maximum dispersal distance of species associated with the TEC (km)	Both plants and animals as well as other organisms e.g., fungi are associated with this TEC and it is anticipated that the dispersal range would vary very significantly. For example: the Grey-headed Flying-fox transport pollen from some eucalypt species over hundreds of kilometres. Similarly spores from ferns and fungi (puffballs) can be transported hundreds of kilometres by wind. In contrast, the dispersal distance of pollen for some insect pollinated species is likely to in the order of tens of metres. Similarly, the dispersal distances of some seeds in more likely to be in the order of tens of metres.	Not available	Not available

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
Area to perimeter ratio of remaining remnants (ratio)	Perimeter (m): 228, 47, 90 Area (m^2): 1565, 154, 400 Ratio: 0.15, 0.31, 0.23	SydneyMetroArea-v3E-4489 (OEH 2016)	Extent of mapped STIF in (m^2) and perimeter (m) calculated in ArcMap V10.8.2.
Vegetation integrity analysis			
Vegetation Zone 1 (Composition score)	16.8	N/A	N/A
Vegetation Zone 1 (Structure score)	30.7	N/A	N/A
Vegetation Zone 1 (Function score)	16.2	N/A	N/A

Vegetation integrity benchmark data compared to subject land data

Attribute	Benchmark Data			ACS data (Nov 2022	ELA data (Jun 2023)
Tree Richness	7	8	7	4	3
Shrub Richness	13	14	13	3	1
Grass And Grass Like Richness	10	9	10	1	6
Forb Richness	12	12	12	4	6
Fern Richness	3	3	3	0	0
Other Richness	9	11	8	0	0
Tree Cover	62	56	69	35	85
Shrub Cover	29	29	29	3	4
Grass And Grass Like Cover	38	39	40	1	2
Forb Cover	8	8	8	2	8
Fern Cover	2	3	2	0	0
Other Cover	10	13	8	0	0
Total length of fallen logs	80	80	80	0	n/a
Litter Cover	61	61	61	22	n/a
Number of Large Trees	1	1	1	1	n/a
Large Tree Threshold Size	80	80	80	50	n/a

9.1.2 Additional impact assessment provisions for threatened species at risk of an SAII

9.1.2.1 Lathamus discolor / Swift Parrot

1. Actions to avoid and minimise direct and indirect impacts

The subject land contains approximately 2,377 m^2 (or 0.24 ha) of mapped important habitat for *Lathamus discolor* (swift parrot). Approximately 140m^2 of native vegetation from within this area will be cleared (see Figure 18).

An earlier development footprint would have resulted in approximately 816m^2 for construction of a western access road and the proposed southern apartment building footprints.

The western access has been realigned and the southern apartment building footprints substantially reduced to avoid impacts on this area.

2. Current status

Table 47. Current status – Lathamus discolor / Swift Parrot

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Evidence of rapid decline (Principle 1)			
Change in population size in NSW in the past 10 years or 3 generations (indicate whether as a direct estimate of the population or if indicated by an index or surrogate)	The swift parrot population was estimated to be 2000 individuals in 2010 (Garnett et al. 2011). More recent estimates, predict the population of this species to be 750 with a maximum of 1000 (M Webb, D Stijanovic, R Heinsohn unpublished). Studies have predicted that population viability is likely to decrease by 79-95% over 12-18 years (Heinsohn et al., 2015). Other studies have predicted a further 6% (Heinshon et al., 2019). These projected declines are consistent with findings of annual assessments of over 1000 breeding sites across the breeding range. These assessments track variation and abundance across the range. Habitat loss and habitat degradation are significant threats impacting breeding (nesting and foraging) habitat.	TBDC	N/A
Evidence of small population size (Principle 2)			
Current population size in NSW	The Swift Parrot breeds in Tasmania, where the breeding population has declined from in excess of 10,000 pairs to less than 1,000 pairs (Forshaw 1993,	NSW Scientific Committee - final determination (Page last updated 9 June 2021	

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
	Garnett 1993, Brereton 1998). Numbers in New South Wales are considerably less than this.		
Decline in species' population size in 3 years or one generation	Population reduction >80% in 10 years of 3 generations	TBDC	N/A
Number or percentage of mature individuals in each subpopulation or whether the species is likely to undergo extreme fluctuations	2,000	Threatened Species Strategy – Year 3 Priority Species Scorecard (2018)	Information derived from the Conservation Advice (Threatened Species Scientific Committee 2016), with some amendments made by contributing experts based on new information
Evidence of limited geographic range (Principle 3)			
Extent of occurrence (ha)	Area of occupancy appears to have declined significantly since European settlement, as can be inferred from the extent of habitat loss. For example, 70% percent of box-ironbark habitat (the principal wintering habitat of the swift parrot on the mainland) has been cleared in NSW. White box-yellow gum-Blakely's red gum woodland, another important habitat in NSW, has been reduced to less than 4 percent of its pre-European extent on the south-western slopes and southern tablelands of NSW.	Threatened Species Scientific Committee (2016). Conservation Advice Lathamus discolor swift parrot.	
Area of occupancy (ha)	The full extent of occurrence (EOO) for this species was estimated at 57,000km^2 in the Action Plan for Australian Birds 2010 (Garnett et al., 2011), which is not considered limited.	Threatened Species Scientific Committee (2016). Conservation Advice Lathamus discolor swift parrot.	
	Area of Occupancy : 1,400km^2	Threatened Species Strategy – Year 3 Priority Species Scorecard (2018)	

Criteria	Data/ information	Data sources	Details of data deficiency, assumptions, reasons for low confidence in information
Number of threat-defined locations	The majority of Swift Parrot foraging sites in NSW, Queensland and South Australia occur outside conservation reserves and therefore continue to be vulnerable to loss, fragmentation or disturbance.		No threat defined locations are listed in the TBDC.
Whether the species' population is likely to undergo extreme fluctuations	Projected that Swift Parrots will undergo substantial declines within three generations	Threatened Species Strategy – Year 3 Priority Species Scorecard (2018)	Population Viability Analysis (Heinsohn et al. 2015) (based on modelled scenarios that considered impacts of sugar glider predation).

3. Impacts assessment

Table 48. Impacts assessment – Lathamus discolor / Swift Parrot

Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
Number of individuals (mature and immature) present in the subpopulation on the subject land	The NSW Bionet Atlas was used to investigate records of the swift parrot since 1 Jan 1990 within or near the site. The site is centred within the 10 km x 10 km square (investigation area). There are 16 records of the swift parrot. All records were in the period 2002 - 2014. None of the records were within the site. The closest record is approximately 1100 m from the site.	NSW Bionet Atlas	

Impact	Data / information	Data sources	Details of data deficiency, assumptions or reasons for low confidence in information (e.g., TBDC indicates data is unknown or deficient)
Number of individuals (mature and immature) present as a percentage of total NSW population (%)	Not applicable Only one population nationally		
Area of habitat to be impacted (ha) (for species measured by area only)	Approximately 0.014 ha	BAM Swift Parrot Important Habitat Map	Extent of mapped habitat impacted calculated in ArcMap V10.8.2.
Area of the species' geographic range to be impacted by the proposal (ha)			
Area of the species' geographic range to be impacted as a percentage of the total area or extent of occupancy (%)	0.00001% of occupancy		Extent of mapped habitat impacted calculated in ArcMap V10.8.2.
Individuals impacted	No individuals will be directly impacted, some habitat will be impacted		
Viability of a fragmented population	The species habitat polygon will not become fragmented. Three small semi-mature paperbarks are being removed from the outer peripheral extent of the mapped habitat		The swift parrot is extremely mobile being migratory. The proposal will almost certainly not cause fragmentation for the species.

10. Impact summary

10.1 Determine an offset requirement for impacts

10.1.1 Impacts on native vegetation and TECs or ECs (ecosystem credits)

Table 49 identifies impacts that require an offset (as per BAM Subsection 9.2.1(1.)).

Table 49. Impacts that require an offset – ecosystem credit

Vegetation zone	PCT name	TEC	Impact area (ha)	Current VI score	Future VI score	Change in VI score	Biodiversity risk weighting	Number of ecosystem credits required
PCT 3592 - MANAGED	Sydney Coastal Enriched Sandstone Forest	NO	0.20	25.8	0	-25.8	1.75	2
PCT 3262 - MANAGED	Sydney Turpentine Ironbark Forest	YES	0.05	21	0	-21	2.5	1
							Total credits	**3**

10.1.2 Impacts on threatened species and their habitat (species credits)

Figure 21 and Table 50 identifies impacts to the Swift Parrot that require an offset (as per BAM Subsection 9.2.2(2.).

Table 50. Impacts that require an offset – species credits

Common name	Scientific name	BC Act status	EPBC Act status	Loss of habitat (ha) or individuals	Biodiversity risk weighting	Number of species credits required
Swift Parrot	*Lathamus discolor*	E	CE	0.01	3.0	1
					Total credits	1

10.2 Impacts that do not need further assessment

Figure 22 and Table 51 identifies the impacts that do not need further assessment for ecosystem credits (as per BAM Section 9.3(1–2.).

Table 51. Impacts that do not need further assessment for ecosystem credits

Impact	Location within subject land	Justification why no further assessment is required
Clearing of planted native vegetation	Interspersed throughout	Refer to Section 4.2. Streamlined assessment module for planted native vegetation. Under D2 the planted native vegetation has been assessed for threatened species habitat only and biodiversity credits are not calculated.
Clearing of exotic vegetation	Interspersed throughout	Exotic vegetation has been assessed as not providing habitat for threatened species

11. Biodiversity credit report

11.1 Ecosystem credits

Ecosystem credits and matching credit profiles are provided in Table 52 and Appendix A.

Table 52. Ecosystem credit class and matching credit profile

Ecosystem credit	Attributes shared with matching credits						
	PCT name	**PCT vegetation class**	**PCT vegetation formation**	**Associated TEC or EC**	**Offset trading group** (BAM Section 10.2, Tables 4 & 5)	**Hollow bearing trees present?**	**IBRA subregion** (in which proposal is located)
1	3262- Sydney Turpentine-Ironbark Forest	Wet Sclerophyll Forests (Grassy sub-formation)	Northern Hinterland Wet Sclerophyll Forests	Sydney Turpentine Ironbark Forest in the Sydney Basin Bioregion	-	No	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo; or Any IBRA subregion that is within 100 kilometres of the outer edge of the impacted site.
2	3592-Sydney Coastal Enriched Sandstone Forest	Dry Sclerophyll Forests (Shrubby sub-formation)	Sydney Coastal Dry Sclerophyll Forests	-	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	No	

11.2 Species credits

Species credits and matching credit profiles are provided in Table 53 and Appendix A.

Table 53. Species credit class and matching credit profile

Species credit	Attributes shared with matching credits				
	Name of threatened species	**Kingdom**	**BC Act status**	**EPBC Act status**	**IBRA region**
1	**Lathamus discolor** / Swift Parrot	Fauna	Endangered	Critically Endangered	Any in NSW

12. References

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13. Figures

Figure 3. Location of trees in subject land

Figure 4. Historical boundary change

Figure 5. Targeted surveys

Figure 6. Subject land soil landscapes

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Figure 8. Native vegetation cover

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Figure 21. Impacts that require an offset

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Lourdes Retirement Village

Figure 3.
Subject land trees

Legend

- Subject land
- Local native
- Local native - habitat absent
- Non-local native
- Exotic

N

0 20 40 80
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data drawn: 28 June 2023

Above: Extract from 1897 parish map of Gordon showing the present-day location of Village in blue
Source: GML Heritage 2017

Above: 1934 plan of Congregational Union of NSW landholdings showing contemporary location of Stanhope Road
Source: GML Heritage 2017

Coordinate System: MGA Zone 56 (GDA 2020) | Image source: Nearmap 16 March 2023

Historical_Stanhope_Road_alignment

Area previously uninterrupted

Lourdes Retirement Village

Figure 4. Historical boundary change

Subject land

Anabat_detectors

Survey locations

27/10/2022 & 23/03/2023

10/04/2023

N

0 40 80 160

m

Lourdes Retirement Village

Figure 5. Targeted surveys

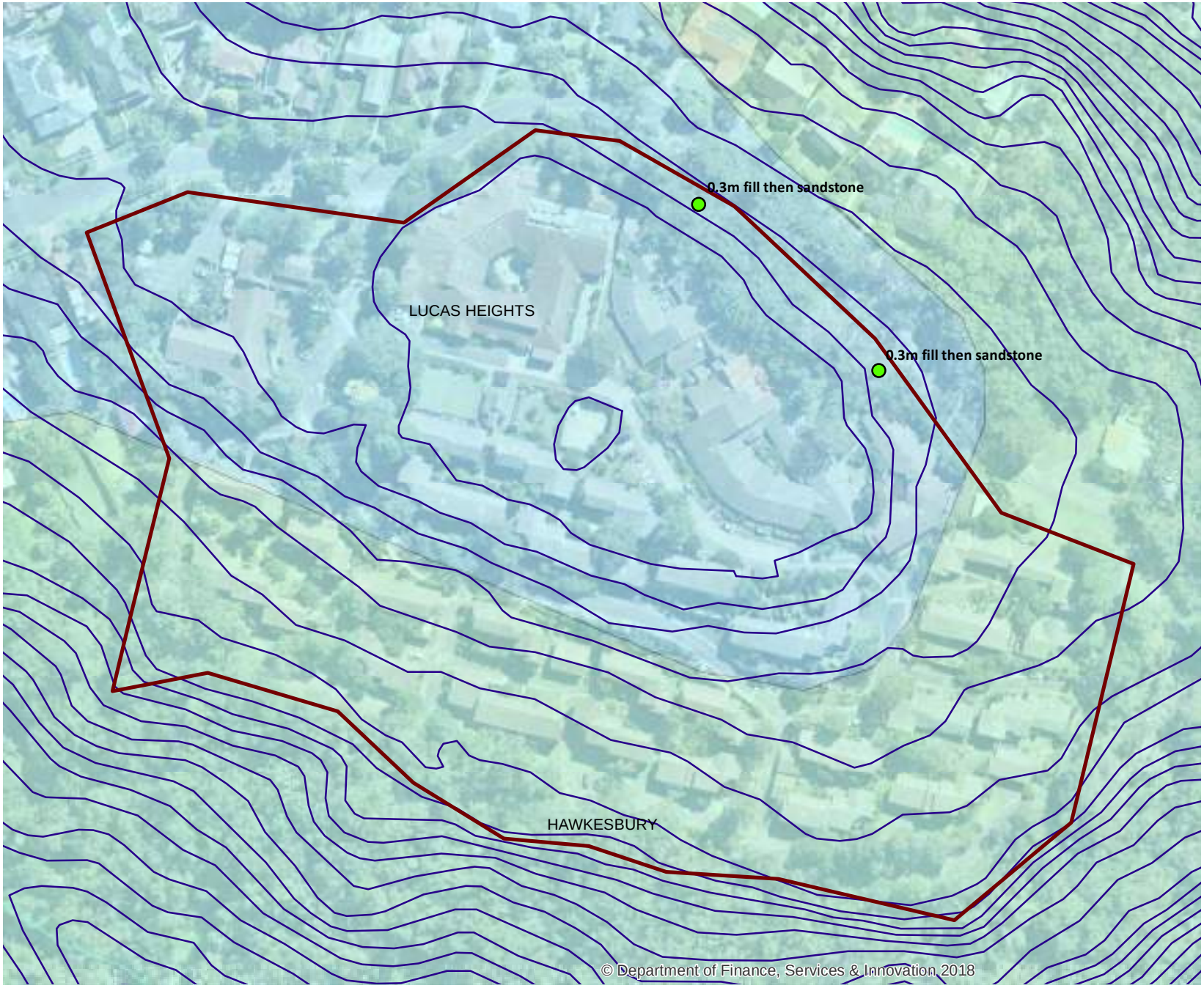
Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data drawn: 1 May 2023

Lourdes Retirement Village

Figure 2-1. Subject land soil landscapes



Legend

Name

- Subject land
- Contours 2m

Soil landscape

- GYMEA
- HAWKESBURY
- LUCAS HEIGHTS

N

0 15 30 60

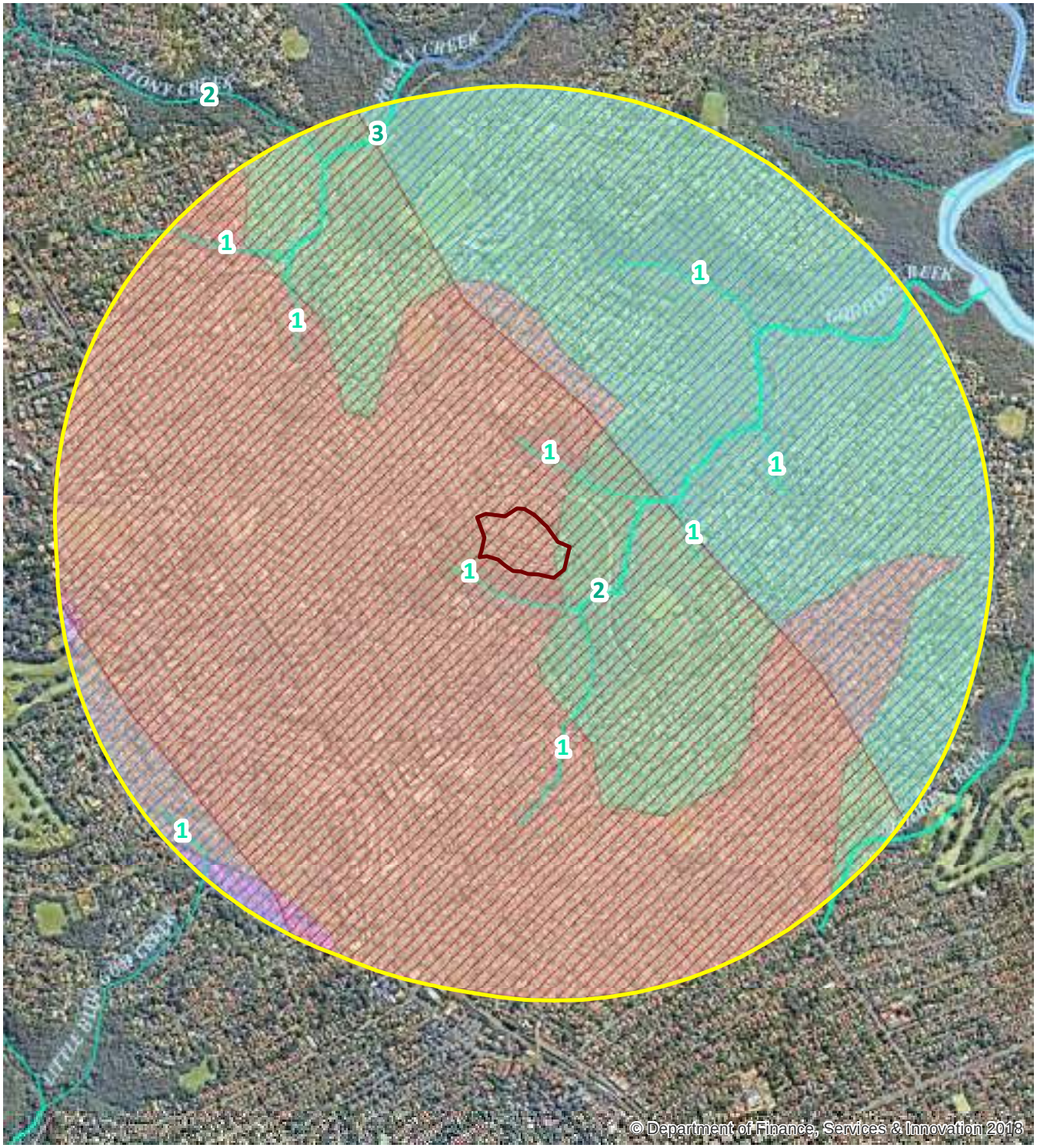
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: Sydney Soil Landscapes\ Sydney_GIS_data\Sydney_SL100K_v4_GDA94.shp

Data drawn: 20 April 2023



Legend

BDAR_assessment_area

Subject_site

IBRA subregion

Cumberland

Pittwater

Mitchell landscape

Belrose Coastal Slopes

Pennant Hills Ridges

Port Jackson Basin

N

0 345 690 1,380

m

Lourdes Retirement Village

Figure 7. Landscape assessment

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: IBRA7 Subregions; Land_Mitchell_Landscapes_v3

Data drawn: 20 April 2023

Legend

- BDAR_assessment_area
- Subject_site
- <all other values>
- NV cover (DPE, 2022)
- NV cover (OEH, 2016)

N

0 345 690 1,380

m

Lourdes Retirement Village

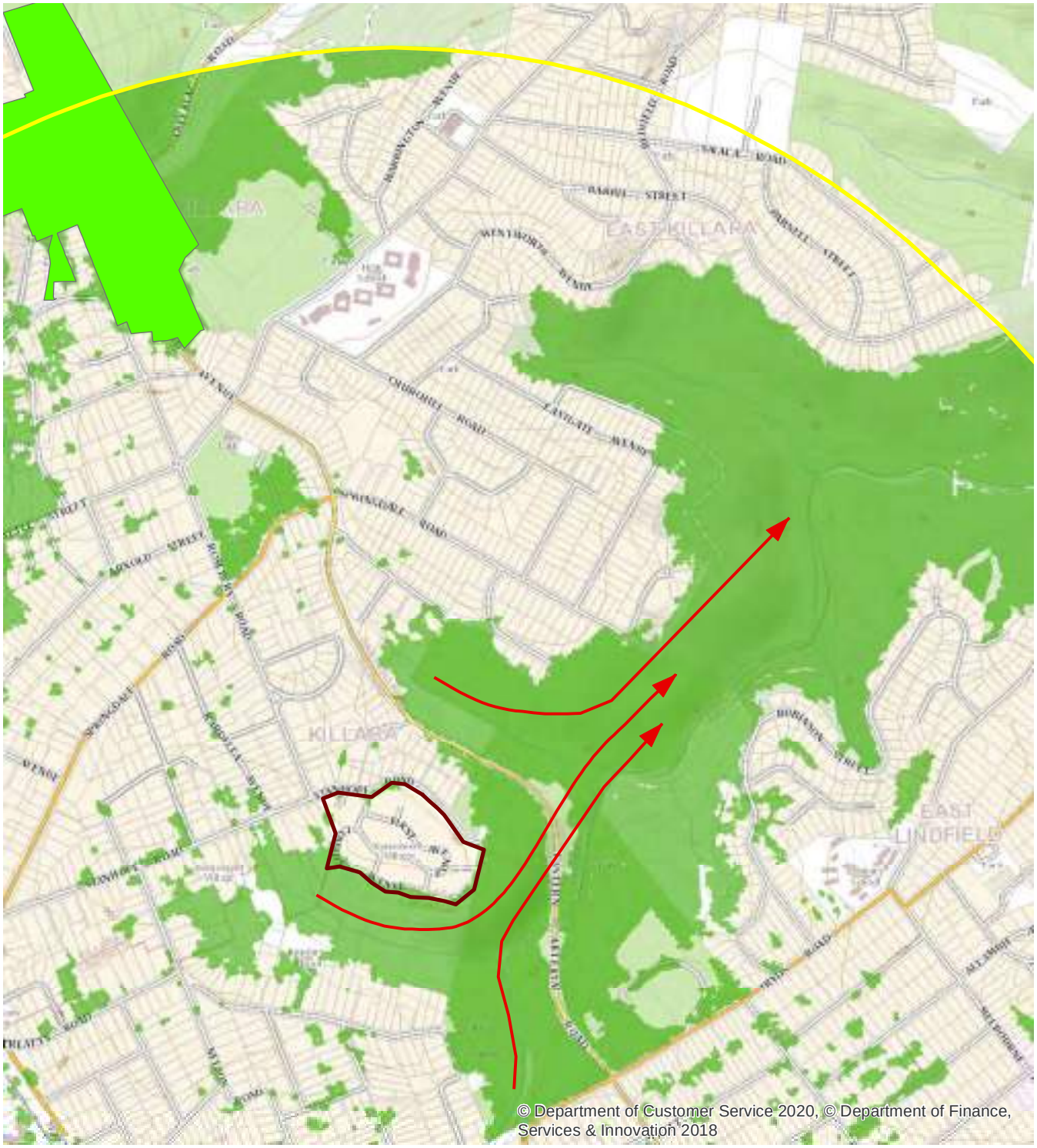
Figure 8. Native vegetation cover

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: SVTM (DPE 2022)
SydneyMetroArea_v3_2016_E_4489

Data drawn: 20 April 2023



Legend

- BDAR_assessment_area
- Subject_site
- Regional Corridor
- Connectivity

N

0 200 400 800

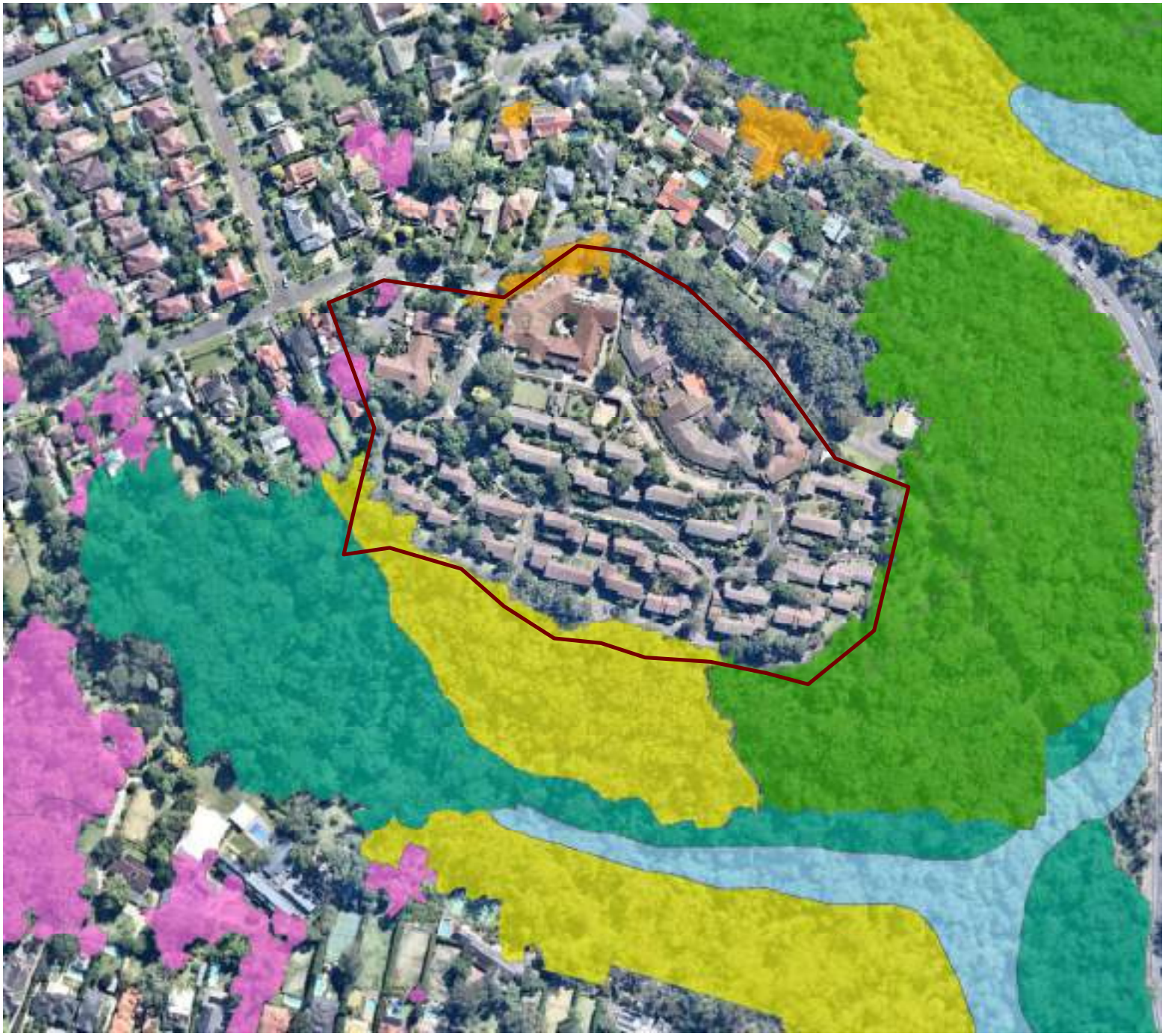
m

Lourdes Retirement Village

Figure 9. Connectivity

Coordinate System: MGA Zone 56 (GDA 2020)

Data drawn: 20 April 2023



Lourdes Retirement Village
95 Stanhope Road, Killara

Figure 10. SMA (OEH 2016) vegetation mapping

Legend

- SCCGR | PCT 3038 ex_1828
- SCESF | PCT 3592 ex_1776
- SCSGF | PCT 3595 ex_1250
- BGHF | PCT 3136 ex_1237
- STIF | PCT 3262 ex_1281
- SCSSF | PCT 3259 ex_1845

N

0 40 80 160

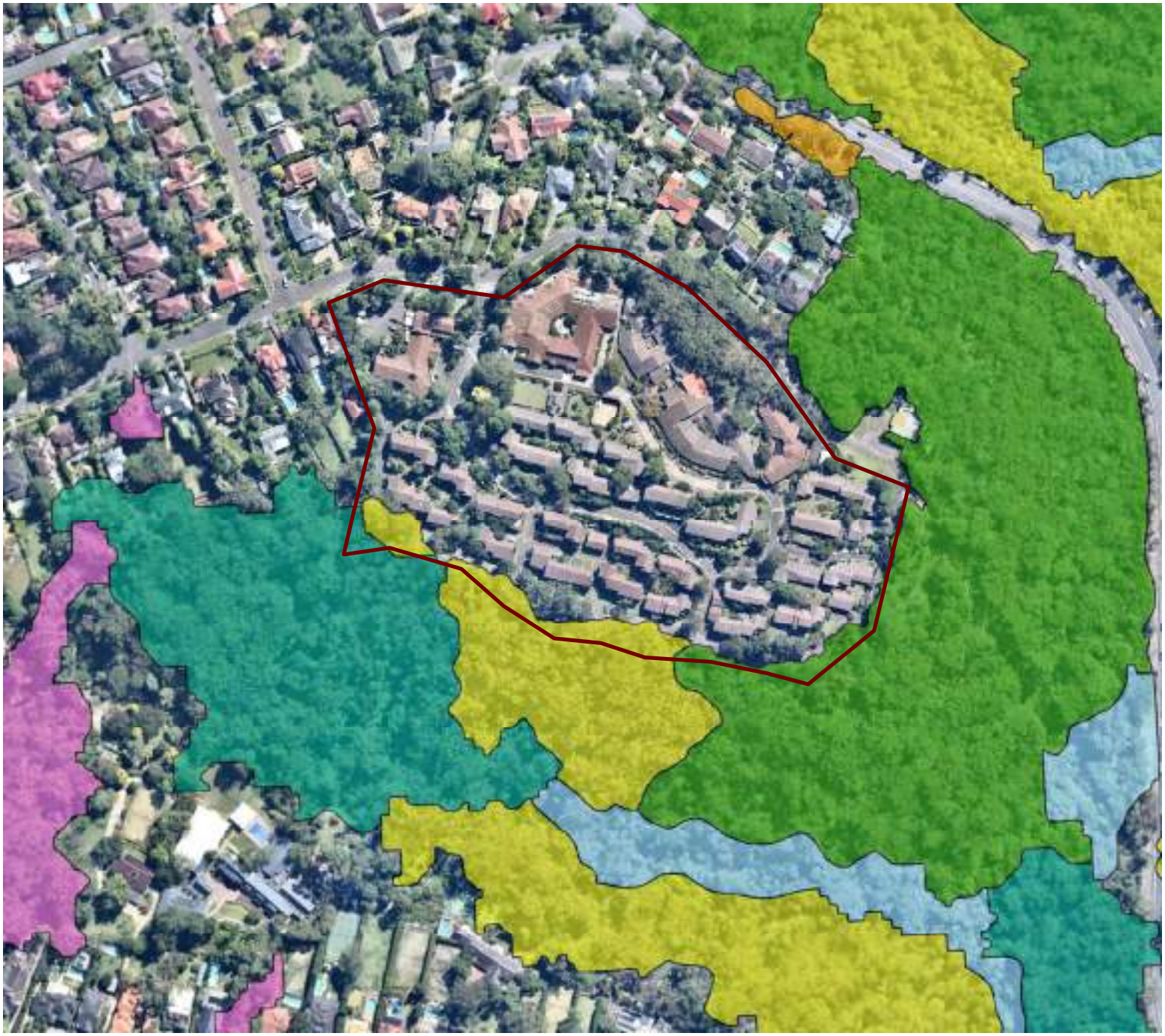
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: SydneyMetroArea_v3_2016_E_4489

Data drawn: 3 July 2023



Lourdes Retirement Village
95 Stanhope Road, Killara

Figure 11. SVTM (DPE 2022) vegetation mapping

Legend

- SCCGR | PCT 3038 ex_1828
- SCESF | PCT 3592 ex_1776
- SCSGF | PCT 3595 ex_1250
- BGHF | PCT 3136 ex_1237
- STIF | PCT 3262 ex_1281
- SCSSF | PCT 3259 ex_1845

N

0 40 80 160

m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: SVTM_NSW_Extant_PCT_Quickview.gdb

Data drawn: 3 July 2023

Coordinate System: MGA Zone 56 (GDA 2020) | Image source: Nearmap 16 March 2023

Legend

- Subject land
- BAM_plots
- Plot_locations
- ELA_plot_locations
- PCT 3262
- PCT 3592
- Landscaping
- Killlara Park
- Soldiers Memorial Park
- Wombin Resere

N

0 25 50 100
m

Lourdes Retirement Village

Figure 12. Subject land PCT mapping

Lourdes Retirement Village

Figure 13.
Subject land PCT clearing

Legend

- Subject land
- PCT 3262
- PCT 3592
- Landscaping

N

0 20 40 80
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Date drawn: 9 July 2023

Lourdes Retirement Village

Figure 14.
Subject land TECs

Legend

Subject land

Sydney Turpentine Ironbark Forest

N

0 20 40 80
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Date drawn: 9 July 2023

Lourdes Retirement Village

Figure 15. Patch size

Legend

Subject_site

Patch_size

N

0 140 280 560

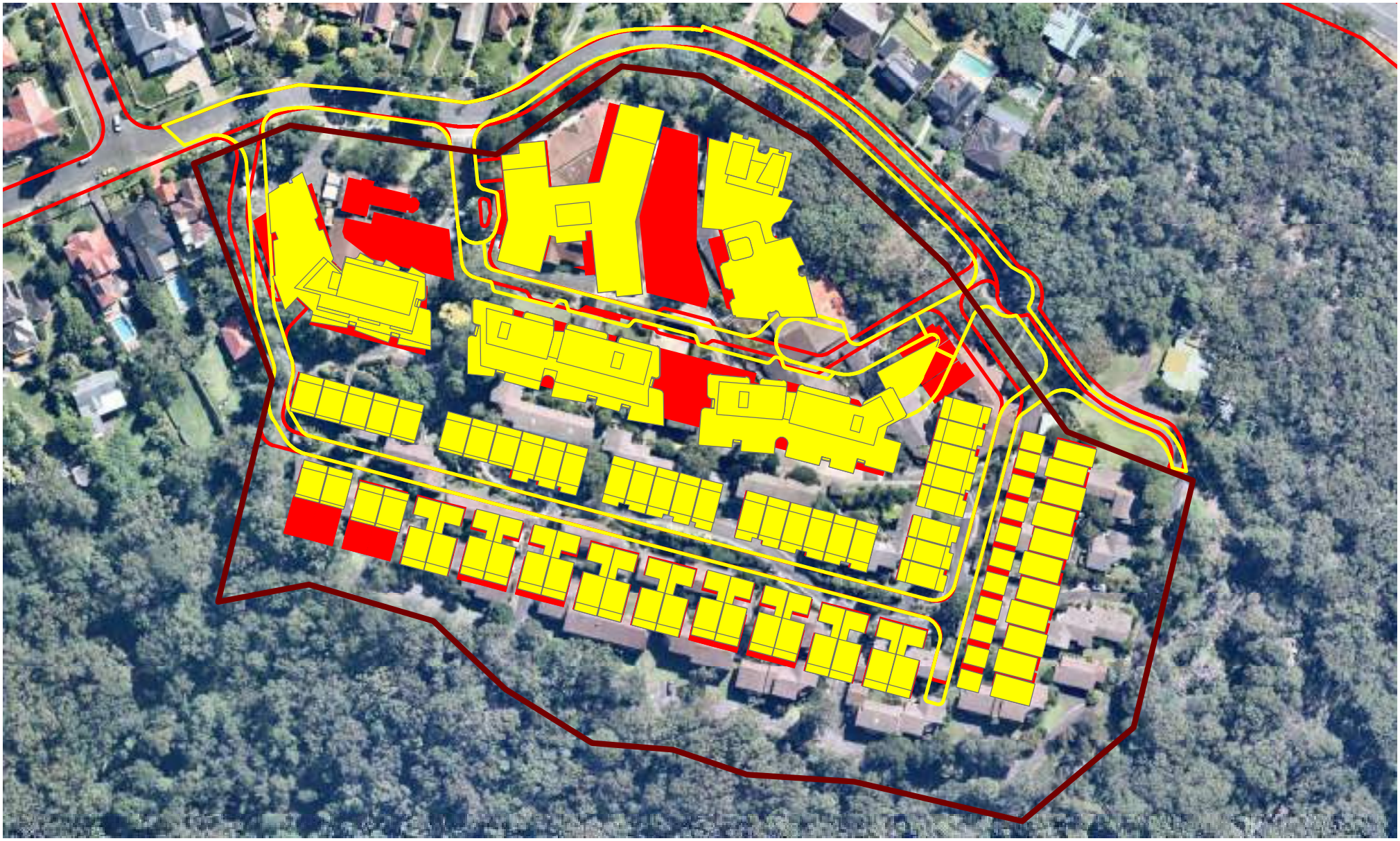
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: SydneyMetroArea_v3_2016_E_4489

Data drawn: 28 April 2023



Lourdes Retirement Village

Figure 16. Avoidance

Legend

- Subject land
- Exhibited Master Plan
- Updated Master Plan

N

0 25 50 100

m

Coordinate System: MGA Zone 56 (GDA 2020)
Image source: Nearmap 16 March 2023
Data drawn: 12 July 2023

Lourdes Retirement Village

Figure 17.
Vegetation avoided

Legend

- Subject land
- PCT 3262
- PCT 3592
- Landscaping

N

0 20 40 80
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Date drawn: 9 July 2023

Lourdes Retirement Village
95 Stanhope Road, Killara

Figure 18. Swift parrot important habitat mapping

Legend

Subject land

Tree clearing

ID 109. M.quinquervia (dbh: 25cm)

ID 112. M.quinquervia (dbh: 25cm)

ID 113. M.quinquervia (dbh: 25cm)

Swift_Parrot_Important_Areas

Species polygon

N

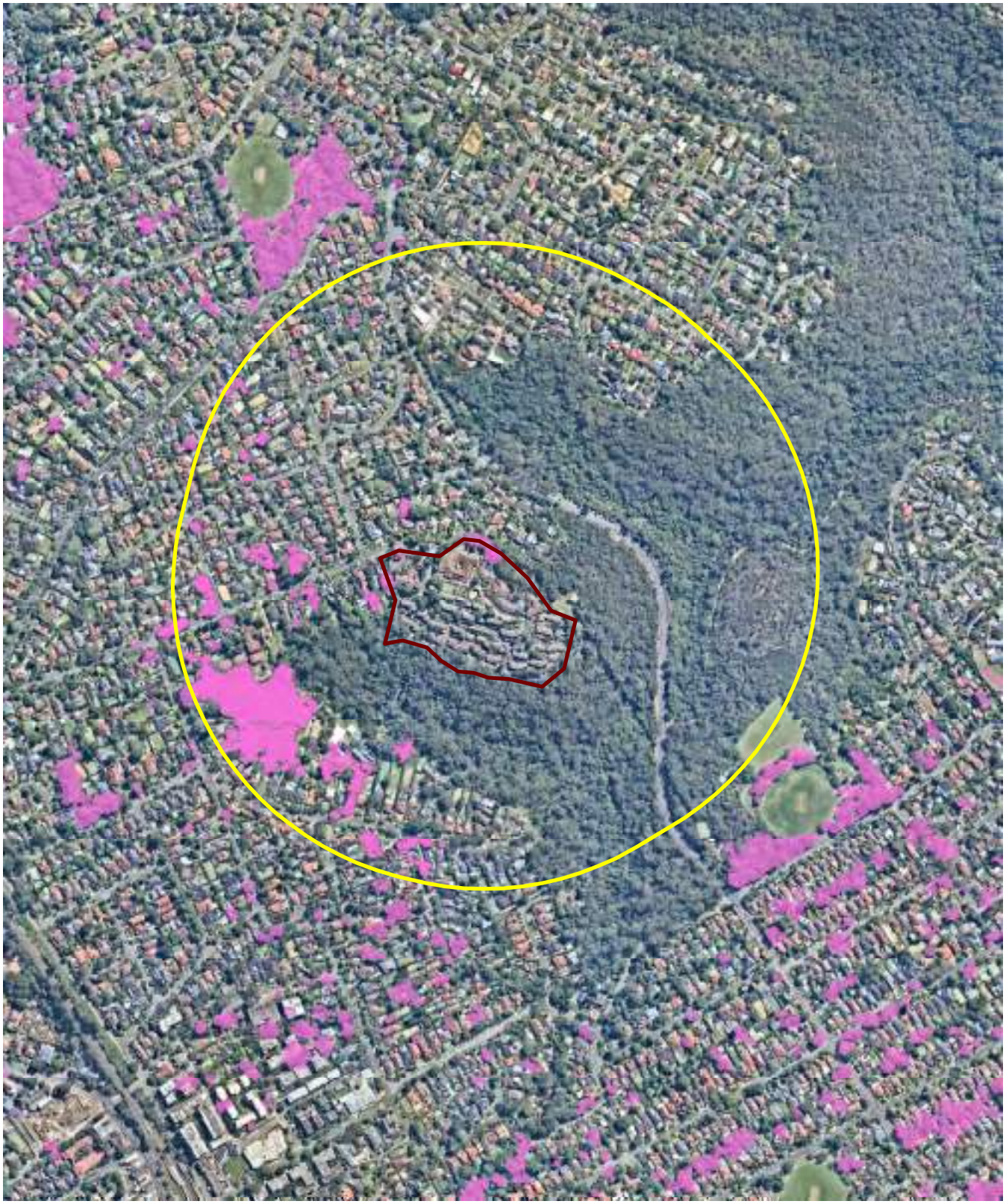
0 25 50 100

M

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data drawn: 3 July 2023



Lourdes Retirement Village

Figure 19. SAII TEC entity

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data source: SydneyMetroArea_v3_2016_E_4489

Data drawn: 12 July 2023

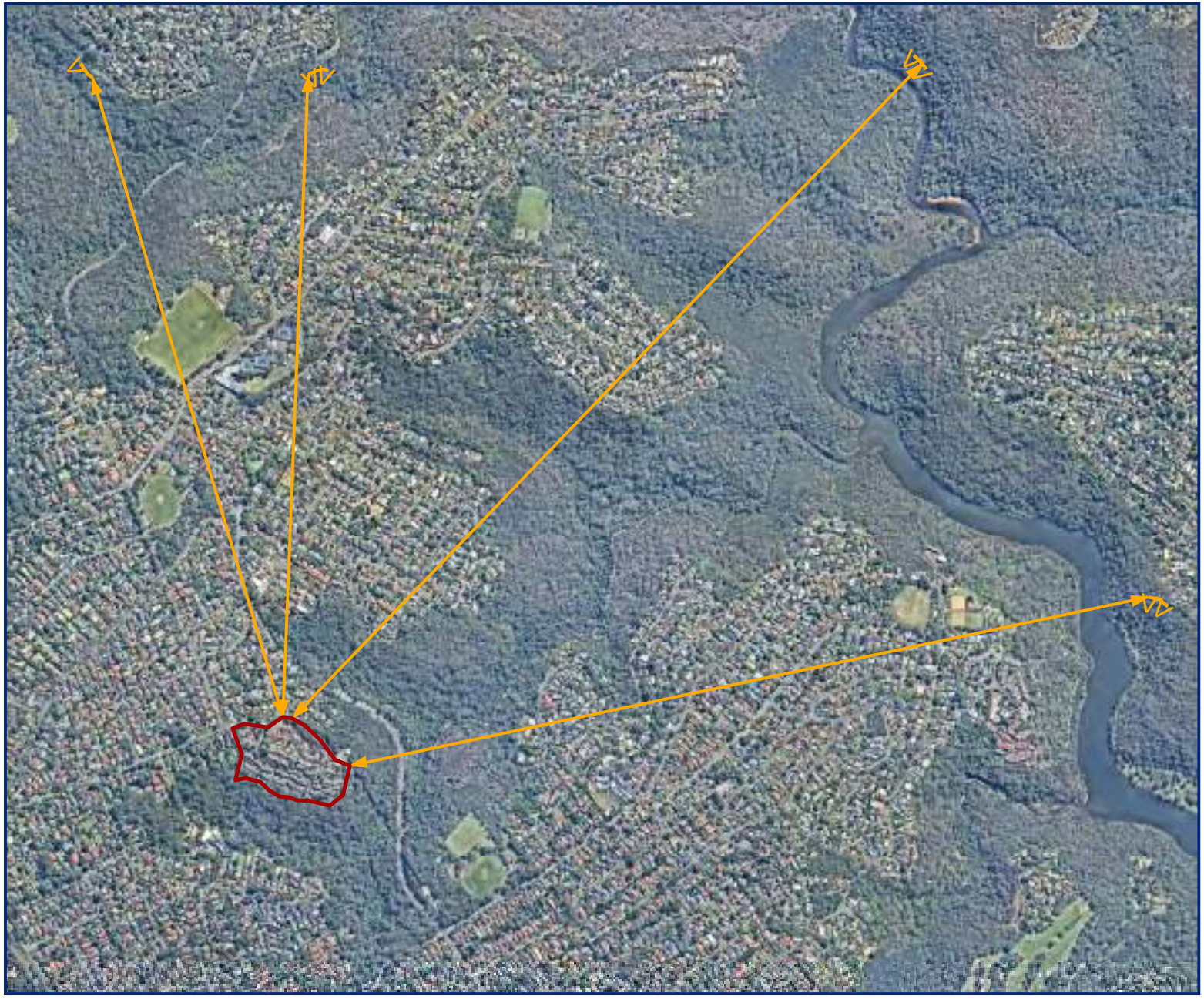
Legend

- Subject land
- SAII_500m_buffer
- Sydney Turpentine Ironbark Forest

N

0 160 320 640

m



Lourdes Retirement Village
95 Stanhope Road, Killara

Figure 20. Escarpment habitat

Legend

Subject land

Escarpment

Escarpment_distances

N

0 230 460 920

M

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Data drawn: 12 July 2023

Lourdes Retirement Village

Figure 21.
Impacts that require an offset

Legend

Subject land

Swift parrot mapped habitat

Vegetation clearing

PCT 3262

PCT 3592

N

0 20 40 80

m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Date drawn: 9 July 2023

Lourdes Retirement Village

Figure 22.
Impacts that do not require an offset

Legend

- Subject land
- Exotic
- Landscaping

N

0 20 40 80
m

Coordinate System: MGA Zone 56 (GDA 2020)

Image source: Nearmap 16 March 2023

Date drawn: 9 July 2023

Appendix A: Credit reports

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00036553/BAAS18125/23/00041620

Proposal Name
LOURDES RETIREMENT VILLAGE PROPOSED REDEVELOPMENT

BAM data last updated *
22/06/2023

Assessor Name
PETER STRICKER

Assessor Number
BAAS18125

BAM Data version *
61

Proponent Name(s)
Nathan Donn

Report Created
12/07/2023

BAM Case Status
Finalised

Assessment Revision
1

Assessment Type
Major Projects

Date Finalised
12/07/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered Ecological Community	3262-Sydney Turpentine Ironbark Forest

Species
Lathamus discolor / Swift Parrot

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3592-Sydney Coastal Enriched Sandstone Forest	Not a TEC	0.2	0	2	2.00
3262-Sydney Turpentine Ironbark Forest	Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion	0.1	0	1	1.00

3262-Sydney Turpentine Ironbark Forest

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion This includes PCT's: 3262	-	3262_Class name1	No	1	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

3592-Sydney Coastal Enriched Sandstone Forest

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 3583, 3592, 3594	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	3592_DEGRADED	No	2	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Dry Sclerophyll Forests (Shrubby sub-formation)	Tier 3 or higher threat status	3592_DEGRADED	No	2	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Lathamus discolor / Swift Parrot	**3592_DEGRADED**	0.0	1.00

Credit Retirement Options

Like-for-like options

Lathamus discolor/ Swift Parrot	Spp		IBRA region
	Lathamus discolor/Swift Parrot		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Endangered	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00036553/BAAS18125/23/00041620	Proposal Name LOURDES RETIREMENT VILLAGE PROPOSED REDEVELOPMENT	BAM data last updated * 22/06/2023
Assessor Name PETER STRICKER	Assessor Number BAAS18125	BAM Data version * 61
Proponent Names Nathan Donn	Report Created 12/07/2023	BAM Case Status Finalised
Assessment Revision 1	Assessment Type Major Projects	Date Finalised 12/07/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered Ecological Community	3262-Sydney Turpentine Ironbark Forest

Species
Lathamus discolor / Swift Parrot

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
3592-Sydney Coastal Enriched Sandstone Forest	Not a TEC	0.2	0	2	2
3262-Sydney Turpentine Ironbark Forest	Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion	0.1	0	1	1

3262-Sydney Turpentine Ironbark Forest	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion This includes PCT's: 3262	-	3262_Classname1	No	1	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
3592-Sydney Coastal Enriched Sandstone Forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 3583, 3592, 3594	Sydney Coastal Dry Sclerophyll Forests >=50% and <70%	3592_DEGRADED	No	2	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Lathamus discolor / Swift Parrot	**3592_DEGRADED**	0.0	1.00

Credit Retirement Options

Like-for-like credit retirement options

	Spp	IBRA subregion
Lathamus discolor / Swift Parrot	**Lathamus discolor /** Swift Parrot	Any in NSW

BAM Candidate Species Report

Proposal Details

Assessment Id 00036553/BAAS18125/23/00041620	Proposal Name LOURDES RETIREMENT VILLAGE PROPOSED REDEVELOPMENT	BAM data last updated * 22/06/2023
Assessor Name PETER STRICKER	Report Created 12/07/2023	BAM Data version * 61
Assessor Number BAAS18125	Assessment Type Major Projects	BAM Case Status Finalised
Assessment Revision 1	Date Finalised 12/07/2023	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

List of Species Requiring Survey

Name	Presence	Survey Months
Chalinolobus dwyeri Large-eared Pied Bat	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☑ Nov ☐ Dec ☐ Survey month outside the specified months?
Lathamus discolor Swift Parrot	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Barking Owl	Ninox connivens	Habitat degraded
Bauer's Midge Orchid	Genoplesium baueri	Habitat degraded
Brown Pomaderris	Pomaderris brunnea	Habitat degraded
Bush Stone-curlew	Burhinus grallarius	Habitat degraded
Camfield's Stringybark	Eucalyptus camfieldii	Habitat degraded
Cumberland Plain Land Snail	Meridolum corneovirens	Habitat degraded
Darwinia biflora	Darwinia biflora	Habitat degraded
Darwinia peduncularis	Darwinia peduncularis	Habitat degraded
Deane's Paperbark	Melaleuca deanei	Habitat degraded
Deyeuxia appressa	Deyeuxia appressa	Habitat degraded
Dillwynia tenuifolia	Dillwynia tenuifolia	Habitat degraded
Downy Wattle	Acacia pubescens	Habitat degraded
Dural Land Snail	Pommerhelix duralensis	Habitat degraded
Eastern Australian Underground Orchid	Rhizanthella slateri	Habitat degraded
Eastern Osprey	Pandion cristatus	Habitat degraded
Eastern Pygmy-possum	Cercartetus nanus	Habitat degraded
Epacris purpurascens var. purpurascens	Epacris purpurascens var. purpurascens	Habitat degraded
Gang-gang Cockatoo	Callocephalon fimbriatum	Habitat degraded
Glossy Black-Cockatoo	Calyptorhynchus lathami	Habitat degraded
Gosford Wattle, Hurstville and Kogarah Local Government Areas	Acacia prominens - endangered population	Habitat degraded Geographic limitations
Green and Golden Bell Frog	Litoria aurea	Habitat degraded
Grevillea parviflora subsp. supplicans	Grevillea parviflora subsp. supplicans	Habitat degraded Geographic limitations
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat degraded
Hairy Geebung	Persoonia hirsuta	Habitat degraded
Haloragodendron lucasii	Haloragodendron lucasii	Habitat degraded Geographic limitations

Hibbertia puberula	Hibbertia puberula	Habitat degraded
Hibbertia superans	Hibbertia superans	Habitat degraded
Julian's Hibbertia	Hibbertia spanantha	Habitat degraded
Koala	Phascolarctos cinereus	Habitat degraded
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat degraded
Lasiopetalum joyceae	Lasiopetalum joyceae	Habitat degraded
Leucopogon fletcheri subsp. fletcheri	Leucopogon fletcheri subsp. fletcheri	Habitat degraded
Little Bent-winged Bat	Miniopterus australis	Habitat degraded
Little Eagle	Hieraaetus morphnoides	Habitat degraded
Long-nosed Bandicoot population in inner western Sydney	Perameles nasuta - endangered population	Habitat degraded Geographic limitations
Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	Marsdenia viridiflora subsp. viridiflora - endangered population	Habitat degraded Geographic limitations
Masked Owl	Tyto novaehollandiae	Habitat degraded
Netted Bottle Brush	Callistemon linearifolius	Habitat degraded
P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	Pomaderris prunifolia - endangered population	Habitat degraded Geographic limitations
Persoonia mollis subsp. maxima	Persoonia mollis subsp. maxima	Habitat degraded
Pimelea curviflora var. curviflora	Pimelea curviflora var. curviflora	Habitat degraded
Powerful Owl	Ninox strenua	Habitat degraded
Red-crowned Toadlet	Pseudophryne australis	Habitat degraded
Regent Honeyeater	Anthochaera phrygia	Habitat degraded
Scrub Turpentine	Rhodamnia rubescens	Habitat degraded
Southern Myotis	Myotis macropus	Habitat degraded
Square-tailed Kite	Lophoictinia isura	Habitat degraded

Squirrel Glider	Petaurus norfolcensis	Habitat degraded
Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	Wahlenbergia multicaulis - endangered population	Habitat degraded Geographic limitations
Tetratheca glandulosa	Tetratheca glandulosa	Habitat degraded
White-bellied Sea-Eagle	Haliaeetus leucogaster	Habitat degraded
Zieria involucrata	Zieria involucrata	Habitat degraded

BAM Credit Summary Report

Proposal Details

Assessment Id 00036553/BAAS18125/23/00041620	Proposal Name LOURDES RETIREMENT VILLAGE PROPOSED REDEVELOPMENT	BAM data last updated * 22/06/2023
Assessor Name PETER STRICKER	Report Created 12/07/2023	BAM Data version * 61
Assessor Number BAAS18125	BAM Case Status Finalised	Date Finalised 12/07/2023
Assessment Revision 1	Assessment Type Major Projects	

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Sydney Coastal Enriched Sandstone Forest												
1	3592_DEGRADED	Not a TEC	25.8	25.8	0.2	PCT Cleared - 61%	High Sensitivity to Gain			1.75		2
											Subtotal	**2**
Sydney Turpentine Ironbark Forest												
2	3262_Classname1	Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion	21	21.0	0.05	Population size	High Sensitivity to Gain	Critically Endangered Ecological Community	Not Listed	2.50	True	1
											Subtotal	**1**
											Total	**3**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

Lathamus discolor / Swift Parrot (Fauna)									
3592_DEGRADED	25.8	25.8	0.01	Environment Protection and Conservation Act listing status	Effectiveness of management in controlling threats	Endangered	Critically Endangered	True	1
								Subtotal	**1**

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00036553/BAAS18125/23/00041620	LOURDES RETIREMENT VILLAGE PROPOSED REDEVELOPMENT	22/06/2023
Assessor Name	**Report Created**	**BAM Data version ***
PETER STRICKER	12/07/2023	61
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS18125	Major Projects	Finalised
Assessment Revision		**Date Finalised**
1		12/07/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barking Owl	Ninox connivens	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Black Bittern	Ixobrychus flavicollis	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Black-chinned Honeyeater (eastern subspecies)	Melithreptus gularis gularis	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Black-necked Stork	Ephippiorhynchus asiaticus	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Brown Treecreeper (eastern subspecies)	Climacteris picumnus victoriae	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Diamond Firetail	Stagonopleura guttata	3262-Sydney Turpentine Ironbark Forest
Dusky Woodswallow	Artamus cyanopterus cyanopterus	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Eastern Osprey	Pandion cristatus	3592-Sydney Coastal Enriched Sandstone Forest

Eastern Osprey	Pandion cristatus	3262-Sydney Turpentine Ironbark Forest
Flame Robin	Petroica phoenicea	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Gang-gang Cockatoo	Callocephalon fimbriatum	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Glossy Black-Cockatoo	Calyptorhynchus lathami	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Grey-headed Flying-fox	Pteropus poliocephalus	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Hooded Robin (south-eastern form)	Melanodryas cucullata cucullata	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Large Bent-winged Bat	Miniopterus orianae oceanensis	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Little Bent-winged Bat	Miniopterus australis	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Little Eagle	Hieraaetus morphnoides	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Little Lorikeet	Glossopsitta pusilla	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Masked Owl	Tyto novaehollandiae	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Painted Honeyeater	Grantiella picta	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Powerful Owl	Ninox strenua	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Regent Honeyeater	Anthochaera phrygia	3262-Sydney Turpentine Ironbark Forest
Rosenberg's Goanna	Varanus rosenbergi	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Scarlet Robin	Petroica boodang	3592-Sydney Coastal Enriched Sandstone Forest
Speckled Warbler	Chthonicola sagittata	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Spotted-tailed Quoll	Dasyurus maculatus	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Square-tailed Kite	Lophoictinia isura	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest

Swift Parrot	Lathamus discolor	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Turquoise Parrot	Neophema pulchella	3592-Sydney Coastal Enriched Sandstone Forest
Varied Sittella	Daphoenositta chrysoptera	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
White-bellied Sea-Eagle	Haliaeetus leucogaster	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
White-throated Needletail	Hirundapus caudacutus	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	3592-Sydney Coastal Enriched Sandstone Forest
		3262-Sydney Turpentine Ironbark Forest

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C

BAM Vegetation Zones Report

Proposal Details

Assessment Id
00036553/BAAS18125/23/00041620

Assessment name
LOURDES RETIREMENT VILLAGE PROPOSED REDEVELOPMENT

BAM data last updated *
22/06/2023

Assessor Name
PETER STRICKER

Report Created
12/07/2023

BAM Data version *
61

Assessor Number
BAAS18125

Assessment Type
Major Projects

BAM Case Status
Finalised

Assessment Revision
1

Date Finalised
12/07/2023

* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.

Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones
1	3592_DEGRADED	3592-Sydney Coastal Enriched Sandstone Forest	DEGRADED	0.2	1	

2	3262_Classname1	3262-Sydney Turpentine Ironbark Forest	Classname1	0.05	1	

Appendix B: Vegetation survey data

Plot	Zone	Coordinates		Bearing
1	56H	330800	6262304	170
2	56H	330830	6262178	55
3	56H	330978	6262214	60
4	56H	330974	6262217	65
7	56H	331087	6262280	225

Composition

Plot	Tree	Shrub	Grass	Forb	Fern	Other
1	3	2	0	4	0	0
2	3	0	1	3	0	0
3	3	3	0	1	1	0
4	4	2	1	4	0	0
7	4	2	7	4	1	1

Structure

Plot	Tree	Shrub	Grass	Forb	Fern	Other
1	50	10	0	6	0	0
2	58	0	15	7	0	0
3	15	15	0	2	2	0
4	22	3	1	2.3	0	0
7	45	6	6	1	0	0.1

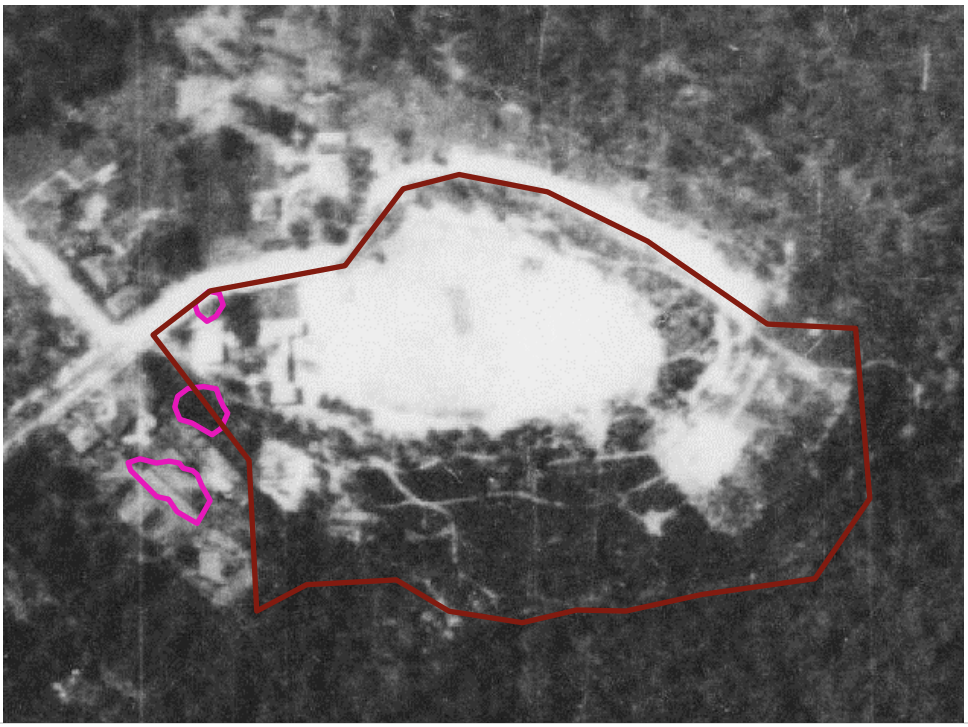
Function

Plot	Stem classes (cm)					
	<5	5-9	10-19	20-29	30-49	>50
1	0	0	2	4	0	0
2	0	2	0	1	3	3
3	0	1	0	4	4	0

Plot	HBTs	Litter cover	LWD (m)	HTW
1	0	15	0	0
2	0	58	0	2
3	0	5	0	0

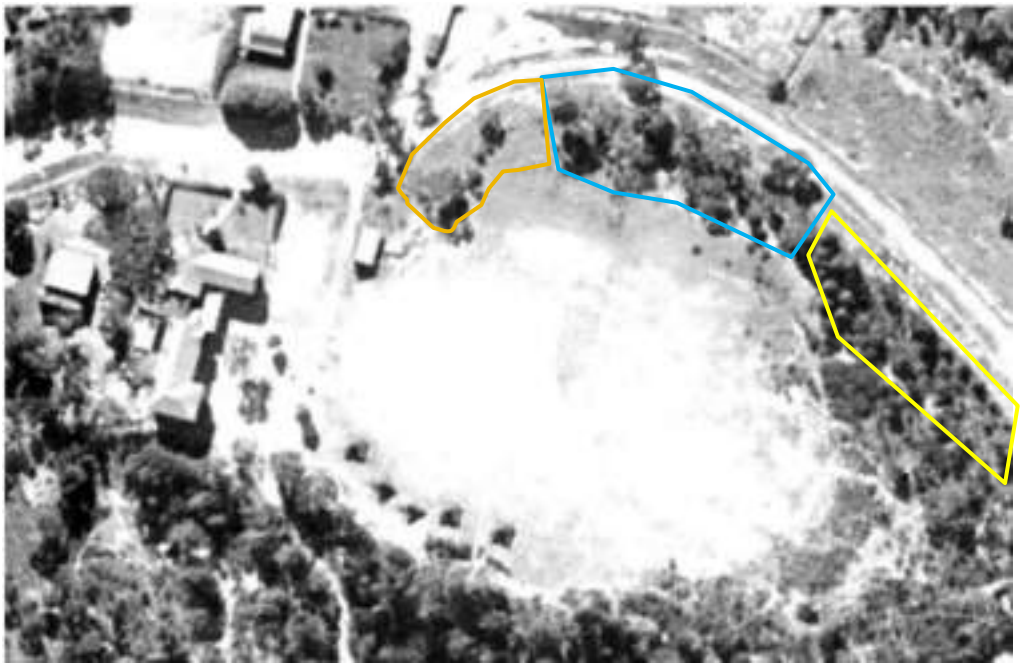
GF	Species name	Common name	Plot 1 Cover	Plot 2 Cover	Plot 3 Cover	Plot 4 Cover	Plot 7 Cover
TG	Allocasuarina littoralis	Black sheoak	15				15
TG	Allocasuarina torulosa	Forest oak					
TG	Angophora costata	Smooth-barked apple			5	15	
TG	Angophora floribunda	Rough-barked apple			0.1		
TG	Banksia integrifolia	Coastal banksia					
TG	Banksia serrata	Old-man banksia			10		
TG	Corymbia gummifera	Red bloodwood				5	5
TG	Corymbia maculata	Spotted gum		15			
TG	Eucalyptus microcorys	Tallowwood					10
TG	Eucalyptus paniculata	Grey ironbark				5	
TG	Eucalyptus pilularis	Blackbutt		40			
TG	Eucalyptus robusta	Swamp mahogany	10				10
TG	Eucalyptus saligna	Sydney bluegum				10	
TG	Syncarpia glomulifera	Turpentine	25	3			
SG	Acacia implexa	Hickory wattle					2
SG	Acacia longifolia		2				
TG	Allocasuarina torulosa	Forest oak					
SG	Banksia spinulosa	Hairpin banksia			5		
SG	Callistemon citrinus	Crimson bottlebrush			5		
SG	Leucopogon juniperinus	Prickly Beard-heath					3
SG	Polyscias sambucifolia	Elderberry panash					0.1
SG	Elaeocarpus reticulatus	Blueberry ash			5	2	
SG	Ozothamnus diosmifolius	Rice flower				1	0.1
SG	Pittosporum undulatum	Sweet pittosporum	8				
GG	Aristida vagans	Three-awned spear grass					1
GG	Cyathochaeta diandra						0.5
GG	Entolasia marginata	Bordered panic					0.1
GG	Entolasia stricta	Wiry bordered panic					1
GG	Gahnia clarkei	Saw sedge					1
GG	Lachnagrostis filiformis	Blown grass			0.1		
GG	Lomandra longifolia	Spiny mat rush		15			1
GG	Microlaena stipoides	Weeping meadow grass			0.1	1	1
GG	Oplismenus aemulus	Basket grass			0.1		
FG	Centella asiatica	Indian pennywort	1	3		0.1	
FG	Commelina cyanea	Scurvy weed	2			0.1	
FG	Dianella caerulea	Native flax lily			5	0.1	1
FG	Dichondra repens	Kidney weed	2	2		2	
FG	Geranium homeanum	Native geranium	1	2			
EG	Calochalena dubia	False bracken			2		
OG	Billardiera scandens	Hairy apple berry					0.1

Appendix C: Historical Imagery Assessment



1929: extent of early 1900s clearing – area denoted in pink coincides with SMA mapping of PCT 3262 (STIF)

1943: Showing central-north site portion and land to north of subject land cleared



1943: zoomed in to show potential remnant native vegetation (in orange and blue outline) in the central-north site portion whereas the mid-right side of photograph indicates plantings (even aged trees and linear arrangement in yellow outline), which coincides with existing tallowwood trees.

1951: Regrowth from surrounding bushland and some development along Stanhope Road evident – zones outlined in 1943 provided for comparison over time. Areas outlined in pink show indicative location of STIF mapped by OEH (2016)

1960: pre-existing development with regrowth from surrounding bushland and residential development along Stanhope Road evident – zones outlined in 1943 provided for comparison over time

1977: pre-existing development regrowth evident as denser bushland – zones outlined in 1943 provided for comparison over time

1982: development of existing retirement village underway, existing fire track evident – zones outlined in 1943 provided for comparison over time

1985: current day development evident with southern site portion vegetation clearance completed. The area of Sydney Coastal Shale Sandstone PCT 3259 mapped by OEH (2016) is predominantly cleared.

Further historical information is provided in the Project's heritage assessment (GML Heritage 2017), which discusses land ownership and land use that pre-dates the available historical aerial imagery.

Site photographs (albeit limited to the cleared and developed area of the subject land associated the Headfort School) shows views into surrounding bushland and the habit of retained remnant trees (see photo plates below).

Photo plates

Headfort School, taken in c.1921 (source. The Headfort Chronicle: The Magazine of Headfort School, Killara in GML Heritage, 2017)

Swimming pool at Headfort School taken in c.1921 (source. The Headfort Chronicle: The Magazine of Headfort School, Killara in GML Heritage, 2017)

The irregularly shaped land located between the boundary of Lots 217-219 in 1897 and that acquisitioned by 1934 into the land holdings of the Congregational Union of NSW (shown in red outline), encompasses the northern most area of vegetation in the contemporary subject land.

Figure 0-1. Extract from 1897 parish map of Gordon showing the present-day location of Lourdes Retirement Village - outlined in blue (reference: GML Heritage 2017)

Figure 0-2. 1934 plan of Congregational Union of NSW landholdings (reference: GML Heritage 2017) – showing contemporary location of Stanhope Road

Appendix D: Eco Logical Australia PCT assessment

Level 3
101 Sussex Street
Sydney NSW 2000
t: (02) 9259 3800

12 July 2023
Our ref: 23SYD5827

Levande Pty. Ltd.
Level 18,
9 Castlereagh Street,
Sydney, NSW 2000

Attention: Nathan Donn

Dear Nathan,

RE: PCT validation to assist Planning Proposal at 95 Stanhope Road – Killara

Eco Logical Australia Pty. Ltd. (ELA) was engaged by Levande Pty. Ltd. to review a Biodiversity Development Assessment Report (BDAR) prepared by ASC Environmental (4 May 2023) for the Planning Proposal at 95 Stanhope Road, Killara; and to review Environment and Heritage Group's (EHG's) response to the BDAR.

Upon review of the BDAR and EHG's response, ELA were commissioned to undertake a site inspection, focusing on the areas mapped as remnant vegetation on page 17 of the BDAR. The site inspection was required to validate native Plant Community Types present within the subject land and collect BAM floristic plot data to assist in the determination of Plant Community Types. The subject land is defined at 95 Stanhope Road, Killara, which is legally identified as Lot 21 and Lot 22 in Deposited Plan 634645, in the Ku-ring-gai Local Government Area (LGA).

This letter describes the field survey undertaken over one day within the subject land and provides ELA's Plant Community Type validation, and PCT selection process. It also describes the occurrence of Threatened Ecological Communities likely to be present within the subject land.

If you have any queries, please feel free to contact me via email at staceyw@ecoaus.com.au

Regards,

Stacey Wilson
Senior Ecologist BAAS22030

Regards,

Dr Daniel McDonald

Principal Ecologist and Senior Arborist BAAS170

1.1. Field survey

A field survey was conducted over one day on 14 June 2023 by Principal Ecologist Daniel McDonald and Senior Ecologist Stacey Wilson. The purpose of the field survey was to:

- review previous vegetation mapping on site as assessed by ACS environmental
- validate the PCTs present
- identify the potential for any threatened ecological communities listed under the BC Act and/or EPBC Act to occur within the subject land.

A total of two 20 m x 20 m full floristic plots were surveyed to identify Plant Community types (PCTs) and assist in informing threatened ecological communities (TECs) on the subject land. Figure 3 shows the location of the plots undertaken.

Plot 1 was undertaken in the north-eastern portion of the subject land which has been previously assigned to PCT 3592 *Sydney Coastal Enriched Sandstone Forest* in the Biodiversity Development Assessment Report 4 May 2023 prepared by ACS Environmental Pty. Ltd.

As mentioned above, much of the subject land has been historically cleared, and areas on the east and south of the development site contain very little native species cover to assist in informing PCT selection. Therefore, the decision was made to undertake the second floristic plot, Plot 2 within an area of native vegetation to the south of the subject land.

The use of this floristic information in the adjacent vegetation would provide a greater understanding of the PCTs present in the locality and would assist in the selection of the best-fit PCT for the vegetation within the southern portion of the subject land. This area has been previously mapped by DPE in their regional mapping project (State Type Vegetation Map 2022)as PCT 3136 as *Blue Gum High Forest*.

1.1.1. Survey Limitations

This assessment was completed over one day and not intended to provide an inventory of all species present across the subject land but instead an overall assessment of the ecological values of the subject land with particular emphasis on mapping Plant Community Types and threatened ecological communities.

The field survey was undertaken using a hand-held GPS unit. It should be noted that these units can have errors in accuracy of up to 20 m (subject to availability of satellites on the day).

Additional survey work undertaken in the wider area may assist in identification of plant community types present in the site. However, due to time constraints additional survey work was not undertaken.

1.2. Results – Plant Community Type validation

Two PCTs were identified within the subject land following the field survey; they are PCT 3262 *Sydney Turpentine Ironbark Forest* and PCT 3592 *Sydney Coastal Enriched Sandstone Forest.* A summary of the vegetation validated as part of ELA's assessment is presented in Table 1 and shown in Figure 3. A description of the Plant Community Types identified is detailed below.

Table 1: Vegetation communities validated within the subject land

PCT ID	PCT Name	Area of vegetation validated	No. of plots collected
3262	Sydney Turpentine Ironbark Forest	Regrowth of remnant vegetation in the north east of the subject land	1
3592	Sydney Coastal Enriched Sandstone Forest	Vegetation within Seven Little Australians Park directly adjacent to the south of the subject land.	1

1.2.1. PCT 3262 Sydney Turpentine Ironbark Forest

Vegetation which was validated as PCT 3262 contains canopy species *Eucalyptus pilularis* (Blackbutt) and *Eucalyptus microcorys* (Tallowwood) within the floristic plot. *E. microcorys* is not a native species to Sydney and is naturally found on the north coast of New South Wales and Queensland and is likely to have been planted. The midstorey is sparse and contains *Elaeocarpus reticulatus* (Blueberry Ash) and *Ozothamnus diosmifolius* (White Dogwood). The groundcover contains a very sparse cover of grasses, including *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass), *Aristida vagans* (Threeawn speargrass), *Oplismenus aemulus* (Australian Basket Grass) and *Digitaria* sp. Forbs present in the groundcover include *Dianella caerulea* var. *producta, Centella asiatica* (Indian Pennywort), *Dichondra repens* (Kidney Weed) and *Commelina cyanea.* Exotic species include *Osteospermum* sp. (African Daisy), *Ehrharta erecta* (Panic Veldtgrass), *Chlorophytum* sp., *Phoenix canariensis* (Canary Island Date Palm) and *Cinnamomum camphora* (Camphor Laurel).

A list of species immediately surrounding the 20 m x 20 m plot includes native canopy species, *Eucalyptus robusta* (Swamp Mahogany), *Angophora hispida* (Dwarf Apple), midstorey species, *Callistemon citrinus* (Crimson Bottlebrush), *Acacia longifolia* (Sydney Golden Wattle) *Breynia oblongifolia* (Coffee Bush), *Imperata cylindrica* (Blady Grass), *Acacia ulicifolia* (Prickly Moses), *Melaleuca nodosa* (Prickly-leaved Paperbark). Groundcovers outside of plot 1, though present in the surrounding area include *Eragrostis brownii* (Brown's Love Grass), *Glycine microphylla* (Small-leaf glycine), *Cyperus gracilis* (Slender Flat-sedge), *Calystegia* sp., *Lomandra longifolia* (Spiny-headed Mat-Rush) and *Lomandra gracilis.* Weeds included *Sida rhombifolia* (Paddy's Lucerne), *Nandina domestica* (Nanten), *Sporobolus africanuus* (Parramatta Grass), *Senecio madagascariensis* (Fireweed). Also present were *Acacia podalyriifolia* and *Acacia saligna* (Golden Wreath Wattle) which have naturalised in the Sydney region. The vegetated area in the north east portion of the subject land appears to have undergone historical disturbance. As can be seen on the right side in Photo 1, a built-up area of soil, forming a mound is present. It is likely that the soil has been moved around this area during past construction activities. However, the soil on the flattest part of the area, has a more natural appearance and are potentially remnant soils.

Photo 1 below shows the start of the 20 m x 20 m floristic plot looking towards the end of the 50 m plot. Photo 2 shows the end of the plot looking back towards the start.

1.2.2. PCT 3592 Sydney Coastal Enriched Sandstone Forest

As discussed above, due to the lack of native species that could be collected in a 20 m x 20 m plot within the subject land, analysis of plot data would likely not produce a meaningful result to assist in PCT determination. Therefore, the decision was made to collect a second floristic plot within vegetation to the south of the development site, to help inform the best fit PCT in the southern portion of the subject land.

The vegetation validated as PCT 3592 includes canopy species *Corymbia gummifera* (Red Bloodwood), *Angophora costata* (Sydney Red Gum), *Eucalyptus pilularis* (Blackbutt), *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine) and a sub-canopy of *Ceratopetalum gummiferum* (Christmas Bush), *Allocasuarina littoralis* (Black She-oak) and *Pittosporum undulatum* (Sweet Pittosporum). The midstorey was diverse, with an open structure and includes *Acacia longissima* (Long Leaf Wattle), *Elaeocarpus reticulatus* (Blueberry Ash), *Leucopogon juniperinus* (Prickly Beard-heath), *Coronidium elatum* subsp. *elatum, Dodonaea triquetra* (Large-leaf Hop-bush), *Polyscias sambucifolia* (Elderberry Panax), and *Ozothamnus diosmifolius* (White Dogwood). The groundcover is diverse and includes grasses; *Microlaena stipoides* (Weeping Grass), *Entolasia stricta* (Wiry Panic), *Lomandra longifolia* (Spiny-headed Mat Rush), *Oplismenus imbecillis* (Creeping Beard Grass). Forbs included *Dianella caerulea* var. *producta,* ferns included *Pteridium esculentum* (Common Bracken) and *Calochlaena dubia* (Rainbow Fern), while other growth form group species included *Billardiera scandens* (Hairy Apple Berry). Non-native species *Cordyline australis* (Cabbage Tree) were also present. Invasive exotic species present include *Cinnamomum camphora* (Camphor Laurel), *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaved Privet), *Ochna serrulata* (Mickey Mouse Plant), *Solanum mauritianum* (Wild Tobacco Bush), *Hedychium gardnerianum* (Ginger Lily), *Asparagus* spp., *Agapanthus* sp., *Ageratina adenophora* (Crofton Weed) and *Cestrum parqui* (Green Cestrum). Photo 3 shows vegetation validated as PCT 3592 adjacent to the southern boundary of the subject land.

Photo 1: Start of 20 m x 20 m floristic plot taken within vegetation at the north east of the subject land

Photo 2: end of the 20 m x 20 m floristic plot within vegetation at the north east of the subject land

Photo 3: Vegetation validated as PCT 3592 Sydney Coastal Enriched Sandstone Forest

1.3. Soil profile

Two soil profiles were undertaken within the subject land to assist in PCT selection justification. One soil profile was taken within proximity to the start of the floristic plot 1 and is referred to as soil profile site 1. The second soil profile was undertaken at the north west boundary of the Subject land. The locations of the soil profiles taken is presented in Figure 3.

Texture assessments at soil profile site 1 (Photo 1) are consistent with the soil being approximately a sandy clay loam to clay loam. The results of the soil profile assessment are that the soil characteristics are consistent with a yellow podzolic soil (Great Soil Group). This soil appeared relatively undisturbed. However, an unusual artifact was present in the earthen wall of the profile trench. The white coloured fragment can be seen in Photo 1. It lies horizontally within the profile and is right of the tape measure near the '10' on the measuring tape. Perhaps some minor disturbance has occurred at this location.

The soil assessment at soil profile site 2 recorded fill in the soil sample. Additionally, the A horizon was relatively thin and it overlayed a very hard B/C horizon. The soil at site 2 shows evidence of significant disturbance, with blue metal gravel and concrete fragments (See Photo 2).

Photo 1: Soil profile site 1

Photo 2: Soil profile site 2

Figure 3: ELA validated Plant Community Types within the subject land.

1.4. Quantitative analysis

Quantitative analysis was completed, using the Hager/Steenebeeke 2010 analysis excel spreadsheet for each vegetation integrity plot to determine the best fit PCT using standardised ratio comparison positive native to total native score. This analysis uses the diagnostic species as described by Tozer (2003) and Tozer (2010). Vegetation integrity plot 1 has undergone historical disturbance and contained only a small number of native species. Plot 2 had a greater number of native species recorded during floristic survey. The analysis is provided in Appendix B.

1.5. PCT selection justification

Plant Community Type (PCT) justifications are provided for PCT 3262 validated by ELA.

The following inputs were used to build queries in the BioNet Vegetation Classification Dataset (DPE 2023) for the vegetation within the north-east portion of the subject land:

- IBRA region text contains 'Sydney Basin'
- IBRA subregion text contains 'Cumberland'
- Vegetation Formation text contains 'Dry Sclerophyll Forests (Shrubby sub-formation) AND 'Dry Sclerophyll Forests (Shrub/grass sub-formation) AND 'Wet Sclerophyll Forests (Shrubby sub-formation AND 'Wet Sclerophyll Forests (Grassy sub-formation).
- Species text contains '*Eucalyptus pilularis, Elaeocarpus reticulatus*, *Dianella caerulea* var. *producta, Lobelia purpurascens, Melia azedarach, Microlaeana stipodies, Oplismenus aemulus, Ozothamnus diosmifolius, Oxalis* sp., *Digitaria* sp., *Dichondra repens, Cynodon dactylon, Commelina cyanea, Centella asicatica, Aristida vagans* and *Entolasia stricta'.*

The outputs of this query provided a preliminary list of potential PCTs. The PCTs were then further investigated by comparing the matches of upper stratum species listed in the BioNet Vegetation Classification for those PCTs against the species recorded within plots for each vegetation zone. The descriptive attribute of the PCTs, landscape position and information on dominant soils or geology, average annual rainfall and elevation above sea level was also considered.

Other documentation consulted to assist in PCT selection included

- Final determination - Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion - critically endangered ecological community listing (NSW Threatened Species Scientific Committee 2019).
- Sydney turpentine ironbark forest - endangered ecological community profile (NSW Department of Environment and Conservation)
- Best practice guidelines for Sydney Turpentine Ironbark Forest (Department of Environment and Climate Change NSW 2008).
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (2005).
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A number of other PCTs were considered in the selection process for PCT 3262. An analysis of these PCTs is included in Table 2.

Table 2: Other PCTs considered during the selection process for PCT 3262

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
3259	Sydney Coastal Shale-Sandstone Forest	The tree canopy almost always includes *Corymbia gummifera*, very frequently with *Angophora costata*. Species from the stringybarks eucalypt group (*Eucalyptus globoidea, Eucalyptus capitellata* rarely *Eucalyptus sparsifolia*) are also common however rarely with high cover. In contrast *Eucalyptus pilularis* or species from the mahogany eucalypt group (*Eucalyptus resinifera or Eucalyptus umbra*) are occasional however with high cover.	PCT 3259 was considered for selection as the vegetation community occurs within the Sydney Basin bioregion, and Cumberland sub-region and had the same match of species which were entered into the PCT filer query (13 matches). However, it was considered that PCT 3262 is a better fit based on overall species composition and known local occurrence within the Ku-ring-gai LGA. PCT 3259 does list *E. pilularis* as a species which can occasionally occur in this community, with high cover and the PCT does contain similar groundcover species which were collected in the floristic plot. However, the dominant midstory species listed for this community frequently includes *Persoonia levis, Banksia spinulosa, Lomatia silaifolia* with *Acacia myrtifolia* and *Hakea sericea* also common. None of these species were recorded in the floristic plot, which makes PCT 32562 a better fit PCT selection based on the assemblage of species present. Further, another characteristic of this PCT is that it has a grassier ground layer than other coastal sandstone ridgetop forests. *Entolasia stricta* is very frequent, often with a moderate cover, with *Austrostipa pubescens*, *Imperata cylindrica* and *Themeda triandra* with high cover. The vegetation mapped within plot 2 did contain *Entolasia stricta* but only recorded a low cover (0.5) within the 20 m x 20

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			m floristic plot and did not record the presence of *A. pubescens*, *I. cylindrica* nor *T. triandra.* This PCT is not mapped within proximity to the subject land, whilst PCT other PCTs such as 3592, 3595 and 3262 and 3136 are mapped within proximity, making these PCTs potentially better fits for this PCT (DPE 2022).
3594	Sydney Coastal Sandstone Foreshores Forest	The tree canopy is very frequently dominated by *Angophora costata* with occasional local stands of *Eucalyptus botryoides* or rarely other eucalypt species. A sparse taller layer in the mid-stratum commonly includes *Banksia integrifolia* or *Allocasuarina littoralis* and occasionally *Ficus rubiginosa.*	This PCT is described as a tall, occasionally very tall, sclerophyll open forest with a mixed understorey of dry shrubs and mesic small trees found along the foreshores of Sydney's major waterways and coastal escarpments. It is not known within the Ku-ring-gai LGA. Its maximum elevation is 90 m above sea level. Although this PCT had 13 matches against the VIS filtering tool selection criteria, the vegetation within the subject land is not located along major waterways and coastal escarpments. The assemblage of species listed for this community in the VIS contains a high proportion of *Glochidion ferdinandi* (Cheese Tree) and *A. costata. PCT 3594* was not considered to be the best fit PCT for this community.
3592	Sydney Coastal Enriched Sandstone Forest	*Angophora costata* commonly in combination with *Corymbia gummifera* and *Eucalyptus piperita*, with *Eucalyptus pilularis* occasionally locally abundant. A taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis* or *Allocasuarina torulosa.*	This PCT was considered as a potentially strong selection for the vegetation community. PCT 3592 is known to occur within the Sydney Basin Bioregion, Cumberland subregion, and is known to occur within the Ku-ring-gai LGA. The vegetation within the subject land falls within the average annual rainfall for this PCT and elevation ranges above sea level. However the frequently recorded canopy species in this PCT did not occur within the vegetation in the north east portion of the subject land, with only *E. pilularis* and *Allocasuarina littoralis* in common. Further, this PCT is more commonly known to occur on slightly enriched Hawkesbury sandstone soils on sheltered slopes and occasional crests. The soil landscape where this vegetation is found is more likely to lie on the Lucas Heights soil landscape, and its position was on the top of the ridge rather than a sheltered slope. Therefore, PCT 3262 was considered a better fit for this community.
3136	Blue Gum High Forest	The tree canopy very frequently includes a high cover of *Eucalyptus saligna*, commonly with *Eucalyptus pilularis* and occasionally *Syncarpia glomulifera*. The mid-stratum is layered, with a sparse cover of small trees that very frequently includes *Pittosporum undulatum* and occasionally *Elaeocarpus reticulatus.*	Blue Gum High Forest was considered for the selection of PCTs. PCT3136 is known to occur in the Sydney Basin Bioregion, Cumberland Subregion and is known in the Kur-ring-gai LGA and has been previously mapped by DPE 2022 as occurring to the south and west of the subject land. This community is described as a very tall to extremely tall sclerophyll open forest, dominated by either *Eucalyptus pilularis* (Blackbutt) or *E. saligna* (Sydney Blue Gum), with a mean tree height of 39.3 m (±16.2 m) and a mean

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			foliage cover of 30.7% (±13.7%). In areas located close to the shale/sandstone boundary *Angophora costata* (Smooth-barked Apple) is present frequently in the tallest tree layer. The vegetation within the north east of the subject land is tall, and approximately to 20 to 30 m (Naturally Trees 2023), however, would not be considered an extremely tall forest. The vegetation did contain *E. pilularis* as a dominant canopy species within the plot however, lacked *E. saligna* or *A. costata* within this area. Blue Gum High Forest is generally found at altitudes higher than 100 m above sea level on the Hornsby Plateau in the North Shore and northern suburbs of Sydney. The subject land's highest point is approximately 110 m above sea level. Blue Gum High Forest is predominantly restricted to deep soils derived from Wianamatta Shale in high-rainfall areas that receive more than 1100 mm per year. The mean annual rainfall is 1241 mm for the area and is likely situated on Wianamatta Shale, also making this PCT a possible fit for this community. However, this PCT was not selected as the best-fit community due to the understorey species more closely aligning with a drier, understorey of sub-canopy and shrub species which is more representative of 3262 than a more mesic, moist rainforest midstorey and ferny or herbaceous understorey. The soil landscape on the top of the ridge is also mapped as Lucas Heights (shale with fine-grained sandstones) which is more likely to fit PCT 3262 than soils with a deep shale influence. The Arboricultural Impact Appraisal and Method Statement has also included *E. paniculata* as one of the Eucalypt species present within the north-eastern portion of the subject land. *E. paniculata* is listed as one of the characteristic canopy species for Sydney Turpentine ironbark Forest but can also be found on upper slopes of Blue Gum High Forest. Sydney Turpentine Forest and Blue Gum High Forest share many similar characteristics and can be difficult to discern between the two communities, particularly in a modified landscape with a long disturbance history. Quantitative analysis using Hager/Steenebeeke 2010 analysis excel spreadsheet was conducted for each vegetation integrity plot to determine the best fit PCT using standardised ratio comparison positive native to total native score. The score achieved for Sydney Turpentine Forest was (67%) in favour of this community compared to (33%) for Blue Gum High Forest.

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			In summary, PCT 3136 was a possible PCT selection of the vegetation in the north-east of the subject land, however, based on rapid soil texture assessment, review of soil landscape mapping, position on top of the ridgeline, the tall to very tall rather than tall to extremely tall forest (Walker and Hopkins 1990), lack of mesic species in the understorey and comparison of diagnostic species with the Hager/Steenebeeke 2010 analysis excel spreadsheet which incorporates diagnostic species from Tozer 2003 favouring towards Sydney Turpentine Ironbark Forest, PCT 3262 was selected as the best fit PCT for the vegetation in the north-east portion of the subject land.
3258	Sydney Basin Creekflat Blue Gum-Apple Forest	The tree canopy is variable however very frequently includes *Angophora floribunda* in the canopy or as a small tree. Common eucalypts with a high foliage cover are species from the blue gum eucalypt group, *Eucalyptus deanei* or *Eucalyptus saligna*, occasionally in association with stringybark eucalypts including *Eucalyptus eugenioides.*	PCT 3528 is known to occur in the Sydney Basin Bioregion and Cumberland subregion. This vegetation community also had the same number of matches in the PCT filtering tool with 3262. However, the matches more closely aligned with the groundcover species present, the dominant canopy species listed for this community comprise of a number of species which were not recorded within the north-east portion of vegetation within the subject land. PCT 3258 is also described as primarily distributed at elevations of less than 200 m above sea level downslope of shale soils on the north shore of Sydney. The location of the plot was taken on the top of the ridge and was therefore not downslope of shale soils. The location of the plot on top of the flatter ridge aligns more closely with PCT 3262, as described in the final determination where Sydney Turpentine-Ironbark Forest occurs on low rolling hills characteristic of the Cumberland Lowlands and the broad, shale-capped ridges of the surrounding plateaux. Therefore PCT 3258 was considered as a potential fit, however, PCT 3262 is a better fir for the vegetation present within the north east of the subject land.
3262	Sydney Turpentine Ironbark Forest	The tree canopy very frequently includes *Syncarpia glomulifera* either as a canopy dominant or as a smaller tree or both. Other species which are localised and occasionally dominant or co-dominant occasionally include *Eucalyptus pilularis, Angophora costata* and *Eucalyptus punctata*, rarely with *Eucalyptus paniculata, Eucalyptus globoidea* or *Eucalyptus resignifera.*	This community occurs as a tall to very tall sclerophyll open forest found on shale or sheltered shale-sandstone soils mainly in the northern suburbs of Sydney and lower Blue Mountains. This was considered to be the best fit PCT for the vegetation community assessed in Plot 1~~on site~~. This PCT occurs in the Sydney Basin Bioregion and Cumberland subregion, it is known to the Ku-ring-gai LGA and has been previously mapped within proximity to the subject land (DPE 2022). Whilst the vegetation collected in the plot analysis only recorded *Eucalyptus pilularis* as the potentially remnant dominant canopy species, the arborist report also identified that *Eucalyptus paniculata* may occur within this location.

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			The position of the vegetation is located on the top of a ridge, and the rapid texture assessment undertaken at soil profile site 1 in the vicinity of the plot, was consistent with the soil being approximately a sandy clay loam to clay loam. The results of the soil profile assessment are that the soil characteristics are consistent with a yellow podzolic soil (Great Soil Group). Yellow podzolic soil is a characteristic of the Lucas Heights soil landscape. The vegetation within the north east portion of the subject land is mapped at the boundary of the Lucas Heights and the Hawkesbury soil landscape. The shrub species listed in the VIS for this community were lacking within the vegetation zone, likely due to historical disturbance of the area. However, the groundcover species recorded shared species listed in the VIS for PCT including *Microlaena stipoides* and *Entolasia stricta* and *Lobelia purpurascens* and species located just outside the 20 m x 20 x plot *Lomandra longifolia, Imperata cylindrica, Ozothamnus diosmifolius, Breynia oblongifolia*. Finally, as discussed for Blue Gum High Forest above, the *Hager/Steenebeeke 2010* analysis excel spreadsheet which incorporates diagnostic species from Tozer 2003 favouring towards Sydney Turpentine Ironbark Forest, PCT 3262 was selected as the best fit PCT for the vegetation in the north-east portion of the subject land. Therefore, given the position in the landscape, the assemblage of species present, and the soil characteristics present. PCT 3262 was the best-fit Plant Community Type for this location.

The assemblage of key species, formation characteristics in combination with its known occurrence in the Local Government Area (LGA) of Ku-ring-gai, and occurrence within the Cumberland IBRA-subregion of the Sydney Basin Bioregion aligns with the Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion.

The TEC is known to occur between elevations of 5 m to 460 m above sea level. The elevation of the subject land is approximately 110 m above sea level and therefore falls within the elevation range for this TEC.

The TEC is known to occur in areas with annual rainfall between 806 mm to 1256 mm. The average annual rainfall taken from BOM Station data at the Gordon Golf Club (66120) with the mean annual rainfall 1241 for the area. The subject land falls within the range of average annual rainfall for this TEC.

The vegetation is located on top of a ridge on the boundary between the Lucas Heights soil landscape and is in close proximity to the Hawkesbury soil landscape. The Lucas Heights soil landscape is characterised by gently undulating crests and ridges on plateau surfaces of the Mittagong formation (alternating bands of shale and fine-grained sandstones). The soils associated with this soil landscape are moderately deep (50–150 cm), hardsetting Yellow Podzolic Soils and Yellow Soloths (Figure 4). A rapid soil analysis (Soil profile site 1) taken in close proximity to the floristic plot 1 found that the texture assessments were consistent with the soil being approximately a sandy clay loam to clay loam. The results of the soil profile assessment are that the soil characteristics are consistent with a yellow podzolic soil (Great Soil Group).

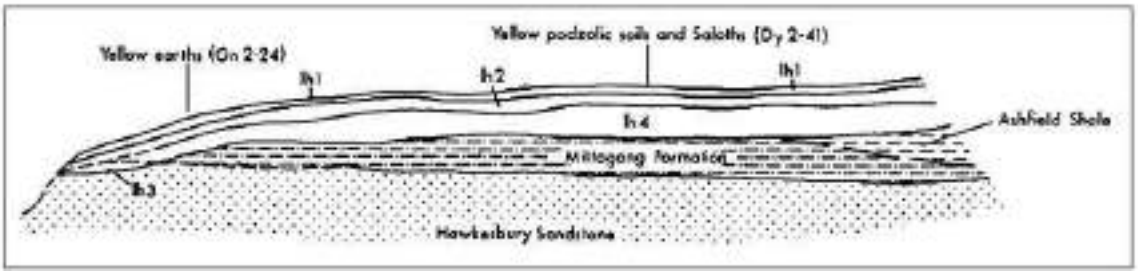

Figure 4: Schematic cross-section of Lucas Heights soil landscape illustrating the occurrence and relationship of the dominant soil materials.

The rapid soil assessment undertaken at soil profile site 1 suggests a clay influence in the soils, which is consistent with the occurrence of Sydney Turpentine Ironbark Forest which is known to occur on soils derived from shale interbedded with Hawkesbury Sandstone.

An additional desktop assessment of online mapping was undertaken to assist the assessment. Figure 5_below shows the Sydney Metro Vegetation Map (SMVM; OEH 2016) for the locality. Many of the vegetation polygons (small patches) were allocated to a PCT (vegetation community) based on a site inspection by the authors of the SMVM. However, it is likely that other parameters may have been used to allocate vegetation to a likely PCT. A trend that can be observed on Figure 5 is that Sydney Turpentine (PCT1281) is mapped on the western side of the site (approximately to the left of the blue line) and Smooth-barked Apple – Red Bloodwood – Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney (PCT1845) is mapped to the east (right-side) of the line.

Figure 5: Sydney Metro Vegetation Mapping 2016 for the locality.

A possibility is that modelled soil types may have been used to assist in allocating each polygon (small patch) to a PCT. Figure 6 shows Great Soil Group (GSG) mapping for the locality at 1:75,000 scale. This scale was chosen as it is consistent with the scale of GSG mapping provided on the NSW eSpade website.

The site lies near the boundary of Yellow Podzolic Soils (less fertile) and Siliceous Sands (Figure 6). One difference between these two soil types is that podzolic soils will generally have a higher clay content compared to siliceous sand soils. The real boundary / transition zone between these two soil types in the locality is unknown. If the boundary / transition zone between the two soil types is present it is likely that there would be a corresponding change in the PCT.

If a plot is used for the determination of a PCT then strictly only the plot can be allocated to a PCT. However, nearby similar vegetation is highly likely to represent the same PCT.

At the location of plot 1 both the vegetation within the plot and adjacent to the plot has experienced disturbance. A gradual change in the vegetation community might not be obvious.

The area to the south-east of the plot but within the polygon (small patch) has also been allocated to Sydney Turpentine Ironbark Forest PCT 3262 (see Figure 3) by ELA. The most useful species for selecting a PCT in forest and woodland are often remnant trees. The majority of the trees within this area are the planted species *Eucalyptus microcorys* (Tallowwood). The lack of remnant trees within parts of the patch make a confident allocation of PCT difficult for the whole patch. No obvious change is PCT was observed at within the patch however, the lack of indigenous tree species makes any transition more difficult to observe. If a change or transition in soil type occurs within the patch, parts of the patch may represent different PCTs.ELA did not determine the boundary between PCTs within the site and nearby. This can be a difficult task. Preston and Adam (2004) quoted Hodgson JA to emphasise the difficulties defining ecological community boundaries:

> '*There will often be cases where there are areas of transition between one ecological community, broadly considered, and another ecological community, where species which are part of each ecological community occur. Precise determination of whether those species in the transitional area are to be regarded as part of one ecological community or of the other, or of neither, will be incapable of precise and definite determination.'*

Figure 6: Great Soil Group (GSG) mapping for the locality.

The following inputs were used to build queries in the Vegetation Classification for the vegetation directly adjacent to the south of the subject land, with the intention of providing a best-fit PCT for the vegetation within the southern boundary of the subject land.

- IBRA region text contains 'Sydney Basin'
- IBRA subregion text contains 'Cumberland'
- Vegetation Formation text contains 'Dry Sclerophyll Forests (Shrubby sub-formation) AND 'Dry Sclerophyll Forests (Shrub/grass sub-formation) AND 'Wet Sclerophyll Forests (Shrubby sub-formation AND 'Wet Sclerophyll Forests (Grassy sub-formation).
- Species text contains '*Acacia ulicifolia, Allocasuarina littoralis, Angophora costata, Billardiera scandens, Calochlaena dubia, Ceratopetalum gummiferum, Corymbia gummifera, Dianella caerulea* var. *producta, Dodonaea triquetra, Elaeocarpus reticulatus, Entolasia marginata, Entolasia stricta, Eucalyptus pilularis, Ficus spp., Glochidion ferdinandi var. ferdinandi, Hypolepis muelleri, Juncus usitatus, Leucopogon juniperinus, Lindsaea microphylla, Lobelia purpurascens, Lomandra filiformis* subsp. *filiformis, Lomandra longifolia, Microlaena stipoides, Oplismenus imbecillis, Ozothamnus diosmifolius, Parsonsia straminea, Pittosporum undulatum, Plectranthus parviflorus, Pteridium esculentum, Pultenaea flexilis, Smilax glyciphylla, Veronica plebeia, Zieria smithii, Polyscias sambucifolia, Syncarpia glomulifera* subsp. *glomulifera, Xanthorrhoea media, Helichrysum elatum* and *Sigesbeckia orientalis* subsp. *orientalis'*

1.5.1. Justification for the selection of PCT 3592 Sydney Coastal Enriched Sandstone Forest

A number of other PCTs were considered in the selection process for PCT 3592 Sydney Coastal Enriched Sandstone Forest. An analysis of these PCTs is included in Table 3.

Table 3: Other PCTs considered during the selection process for PCT 3592

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
3136	Blue Gum High Forest	The tree canopy very frequently includes a high cover of *Eucalyptus saligna*, commonly with *Eucalyptus pilularis* and occasionally *Syncarpia glomulifera*. The mid-stratum is layered, with a sparse cover of small trees that very frequently includes *Pittosporum undulatum* and occasionally *Elaeocarpus reticulatus.*	Blue Gum High Forest was considered for the section of PCTs. 3136 is known to occur in the Sydney Basin Bioregion, Cumberland Subregion is known to the Kur-ring-gai LGA and has been previously mapped by DPE 2022 as occurring to the south and west of the subject land. This community is described as a very tall to extremely tall sclerophyll open forest, dominated by either *Eucalyptus pilularis* (Blackbutt) or *E. saligna* (Sydney Blue Gum), with a mean tree height of 39.3 m (±16.2 m) and a mean foliage cover of 30.7% (±13.7%). In areas located close to the shale/sandstone boundary *Angophora costata* (Smooth-barked Apple) is present frequently in the tallest tree layer. The vegetation within the north east of the subject land is tall, and approximately to 20 to 30 m (Naturally Trees 2023), however, would not be considered an extremely tall forest. The vegetation did contain *E. pilularis* as a dominant canopy species within the plot however, lacked *E. saligna*. Blue Gum High Forest is generally found at altitudes higher than 100 m above sea level on the Hornsby Plateau in the North Shore and northern

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			suburbs of Sydney. The location of the vegetation community on the downhill slope is situated at approximately 92 m above sea level. This community is slightly below the altitudes in which Blue Gum High Forest is found. Quantitative analysis using Hager/Steenebeeke 2010 analysis excel spreadsheet was conducted for each vegetation integrity plot to determine the best fit PCT using standardised ratio comparison positive native to total native score. The total number of diagnostic species for Blue Gum High Forest was 14 while it was 20 for other communities such as STIF and Hinterland sandstone Gully Forest. In summary, PCT 3136 was a possible PCT selection of the vegetation in the north-east of the subject land, however, elevation of the vegetation within the landscape, the tall rather than extremely tall forest, and comparison of diagnostic species with the Hager/Steenebeeke 2010 analysis excel spreadsheet which incorporates diagnostic species from Tozer 2003 and Tozer 2010 favouring towards either Sydney Turpentine Ironbark Forest, or Sydney Hinterland Gully Forest were considered as other options for the vegetation in the north-east portion of the subject land.
3595	Sydney Coastal Sandstone Gully Forest	A tall to very tall heathy sclerophyll open forest associated with Hawkesbury sandstone gullies found along the eastern extent of the Sydney sandstone plateaus. The tree canopy very frequently includes a high cover of *Eucalyptus piperita* and *Angophora costata* with *Corymbia gummifera* occurring less frequently and with a lower cover. The mid-stratum includes a sparse small tree layer that very frequently includes *Ceratopetalum gummiferum* and *Banksia serrata*	PCT 3595 is known to occur in the Sydney Bioregion and Cumberland subregion, this PCT had the highest number of diagnostic species present in the Quantitative (Tozer) analysis along with STIF. This PCT had the third highest number of matches against the VIS PCT filtering tool, following 3592 and 3262. Therefore this PCT was considered during the selection process, however was not selected as the best fit PCT for this community as; the position of the vegetation in the landscape was mid-slope and not within the gully, the dominant canopy did not record any *E piperita* and had contained *E. pilularis,* which is not a frequently recorded species for this community in the VIS Species by Growth Form. PCT 3595 is also described as a heathy sclerophyll open forest, whereas this community was considered to be less of a heath community and lacked some of the dominant species for this community such as *Leptospermum trinervium*, *Dillwynia retorta*, *Lomatia salicifolia* and *Persoonia spp.*. Another feature of PCT 3595 is the high occurrence of *B. serrata,* the plot data did not record any *B. serrata*
3262	Sydney Turpentine Ironbark Forest	The tree canopy very frequently includes *Syncarpia glomulifera* either as a canopy dominant or as a smaller tree or both. Other species	This PCT occurs in the Sydney Basin Bioregion and Cumberland subregion, it is known to the Ku-ring-gai LGA and was validated as the best fit PCT for the vegetation community at the top of the subject land.

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
		which are localised and occasionally dominant or co-dominant occasionally include *Eucalyptus pilularis, Angophora costata* and *Eucalyptus punctata*, rarely with *Eucalyptus paniculata, Eucalyptus globoidea* or *Eucalyptus resignifera.*	This PCT had the second highest number of matches in the PCT VIS filtering tool and received the same number of diagnostic species in the Quantitative (Tozer) analysis of plot 2 data, therefore this PCT was considered in the selection process for the vegetation in the south of the subject land. Whilst the canopy species recorded similar dominant canopy species, being *Syncarpia glomulifera Eucalyptus pilularis* and *Angophora costata,* the diversity of canopy species present in this community was higher and also included, Corymbia gummifera and a smaller canopy of *Pittosporum undulatum* and *Allocasuarina littoralis. The mdstory and groundcover layer was also much more mesic* compared to the vegetation at the top of the ridge and had a high diversity and cover of ferns and forbs. Sydney Turpentine Ironbark Forest is also known to occur on the ridgetops or crests in the landscape whereas this vegetation community was located downslope of the ridgetop and is also more likely to occur on Hawkesbury sandstone soils, both features favour the selection of a sandstone community rather than a vegetation community with a shale influence. Due to the assemblage of species present, position in the landscape and likely soils present, PCT 3592 was selected as a better fit for this community than Sydney Turpentine Ironbark Forest
3592	Sydney Coastal Enriched Sandstone Forest	*Angophora costata* commonly in combination with *Corymbia gummifera* and *Eucalyptus piperita*, with *Eucalyptus pilularis* occasionally locally abundant. A taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis* or *Allocasuarina torulosa.*	This PCT was selected as the best fit PCT for the vegetation community within the vegetation directly adjacent the southern boundary of the subject land. This PCT had the highest number of matches (34) in the VIS PCT filtering tool. Followed by the other PCTs compared; 3262 with 33 matches and PCT 3595 with 32 matches. The description of the dominant upper stratum species listed in the VIS for this PCT shared many of the same species including *A.costata* commonly in combination with *Corymbia gummifera, E.pilularis, A. littoralis* and *P.undulatum.* PCT 3592 is known to occur within the Sydney Basin Bioregion, Cumberland subregion, and is known to occur within the Ku-ring-gai LGA. The vegetation within the subject land falls within the average annual rainfall for this PCT and elevation ranges above sea level. However the frequently recorded canopy species in this PCT did not occur within the vegetation in the north east portion of the subject land, with only *E. pilularis* and *Allocasuarina littoralis* in common. Further, this PCT is more commonly known to occur on slightly enriched Hawkesbury sandstone soils on sheltered slopes and occasional crests. The soil landscape is

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			also likely to be Hawkesbury soil landscape, as mapped by ESspade which is more aligned with the description of this PCT occurring on Hawkesbury sandstone, rather than the likely more clay influenced Lucas heights soil landscape at the top of the ridge. The position of this vegetation within the landscape is also downslope of the ridge but it positioned higher than the gully, also matching the PCT description in the VIS for this community. Considering the assemblages of species present, the soil landscape and position in the landscape, along with the Quantitative plot analysis (Tozer) favouring a sandstone influenced community, PCT3592 was considered to be the best fit PCT to assign to this vegetation community.

1.6. Threatened ecological communities

There is one threatened ecological community (TEC) within the subject land. The listing status of the TEC and consistency of PCTs with the TECs is provided in Table 4.

PCT 3262 is consistent with the critically threatened ecological community (TEC) *Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion*. This community is critically endangered under the *Biodiversity Conservation Act 2016* (BC Act). It is also noted that this community is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), where it meets specific condition thresholds.

Occurrences of the Turpentine–Ironbark Forest in the Sydney Basin Bioregion ecological community are considered to be part of the nationally listed ecological community if patches are in good condition (Conservation Advice 2014).

'Good condition is generally determined as:

- *the vegetation has some characteristic components from all structural layers (tree canopy, small tree/shrub midstorey, and understorey); and*
- *the tree canopy cover is greater than 10%; and*
- *the patch size is greater than one hectare.*

However, patches with a tree canopy cover of less than 10% are also included in the ecological community, if:

- *the patch of the ecological community is greater than one hectare in size; and*
- *it is part of a remnant of native vegetation that is 5 hectares or more in area.'*

The plot data collected had structural characteristic components from all structural layers. The plot data collected also had a tree canopy cover of approximately 85%.

Eco Logical Australia have only validated the patch of Sydney Turpentine Ironbark Forest within the north east of the subject land and cannot comment if Sydney Turpentine Ironbark Forest is present in patches directly adjacent to the north east of the subject land and are therefore unable to comment if the Sydney Turpentine Ironbark Forest within the subject land meets the condition threshold to be listed as the Commonwealth listed community. That is, if the patch identified is greater than 1 ha in size or is part of remnant vegetation that is 5 ha or more in area. Further plot data and validation of vegetation in surrounding areas adjacent to the subject land would be required to determine whether the Sydney Turpentine Ironbark Forest on site meets the EPBC Act definition of this community.

PCT 3592 Sydney Coastal Enriched Sandstone Forest identified is not associated with any threatened ecological communities under the BC and or EPBC Acts.

Table 4: Threatened ecological communities present within the subject land

PCT ID	PCT Name	BC Act listing status and name	BC Act Associated TEC justification	EPBC Act listing status and name	EPBC Act Associated TEC justification
3262	Sydney Turpentine Ironbark Forest	Critically endangered - *Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion*	Yes – the PCT meets characteristic of the BC Act listed TEC. The assemblage of key species, formation characteristics in combination with its known occurrence in the Local Government Area (LGA) of Ku-ring-gai, and occurrence within the Cumberland IBRA-subregion of the Sydney Basin Bioregion aligns with the Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion.	Critically *endangered – Turpentine-Ironbark Forest of the Sydney Basin Bioregion*	Potential - see Section 1.6. Insufficient time for ELA to collect data to inform EPBC Act condition criteria listing.
3592	Sydney Coastal Enriched Sandstone Forest	Not listed	N/A	Not listed	N/A

The final determination for Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion listed as critically endangered under the NSW BC Act. Defines this community:

> *Section 1.6 of the Act defines an ecological community as "an assemblage of species occupying a particular area". These features of Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion are described in Parts 1 and 2 of this Determination, respectively.*

Presented in Table 5 below are the Parts 1, 2 and 4 listed in the final determination for this ecological community and a review against characteristics of the subject land to determine if the vegetation on site is likely to conform to the TEC.

Table 5: Parts presented in the Final Determination for Sydney Turpentine Ironbark Forest and review against characteristics of the subject land

Part 1. Assemblage of species	
Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion (hereafter referred to as Sydney Turpentine-Ironbark Forest) is characterised by the assemblage of species listed below. The species collected in Plot 1 along with those species recorded around the edge of the floristic plot within the north-east of the subject land are highlighted in **bold** text.	
Acacia falcata	*Acacia floribunda*
Acacia implexa	***Acacia longifolia***
Acacia parramattensis	*Adiantum aethiopicum*
Allocasuarina torulosa	*Angophora costata*
Anisopogon avenaceus	***Aristida vagans***
Arthropodium milleflorum	*Austrostipa pubescens*
Austrostipa rudis	*Billardiera scandens*
Breynia oblongifolia	*Brunoniella australis*
Brunoniella pumilio	*Bursaria spinosa*
Cayratia clematidea	***Centella asiatica***
Cheilanthes sieberi	*Clematis aristata*
Clematis glycinoides var. *glycinoides*	*Clerodendrum tomentosum*
Commelina cyanea	*Daviesia ulicifolia*
Denhamia silvestris	*Desmodium rhytidophyllum*
Desmodium varians	***Dianella caerulea***
Dianella longifolia	*Dichelachne inaequiglumis*
Dichelachne rara	***Dichondra* spp.**
Digitaria parviflora	*Dodonaea triquetra*
Doodia aspera	*Echinopogon caespitosus* var. *caespitosus*
Echinopogon ovatus	*Einadia hastata*
Elaeocarpus reticulatus	*Entolasia marginata*
Entolasia stricta	*Eucalyptus acmenoides*
Eucalyptus fibrosa	*Eucalyptus globoidea*
Eucalyptus notabilis	***Eucalyptus paniculata* subsp. *paniculata* (likely present)**
Eucalyptus pilularis	*Eucalyptus punctata*
Eucalyptus resinifera subsp. *resinifera*	*Eucalyptus saligna* X *E. botryoides*
Eustrephus latifolius	*Exocarpos cupressiformis*
Gahnia aspera	*Geranium solanderi* var. *solanderi*
Glochidion ferdinandi var. *ferdinandi*	*Glycine clandestina*
Glycine microphylla	*Glycine tabacina*
Gonocarpus tetragynus	*Goodenia hederacea* subsp. *hederacea*
Goodenia heterophylla	*Hibbertia aspera* subsp. *aspera*
Hibbertia diffusa	*Hydrocotyle sibthorpioides*
Imperata cylindrica	*Indigofera australis*
Kennedia rubicunda	*Kunzea ambigua*
Lepidosperma laterale	*Leucopogon juniperinus*
Lindsaea microphylla	*Lomandra filiformis* subsp. *filiformis*
Lomandra longifolia	***Microlaena stipoides***
Myrsine variabilis	*Notelaea longifolia* forma *longifolia*
Opercularia hispida	*Opercularia varia*

Oplismenus aemulus	*Oplismenus imbecillis*
Oxalis exilis	***Ozothamnus diosmifolius***
Pandorea pandorana	*Panicum simile*
Paspalidium distans	*Passiflora herbertiana* subsp. *herbertiana*
Persoonia linearis	*Pittosporum revolutum*
Pittosporum undulatum	*Poa affinis*
Poa sieberiana var. *sieberiana*	*Polyscias sambucifolia*
Pomaderris intermedia	*Poranthera microphylla*
***Pratia purpurascens* *(now *Lobelia purpurascens*)**	*Pseuderanthemum variabile*
Pultenaea villosa	*Rubus parvifolius*
Rumex brownii	*Sarcopetalum harveyanum*
Sigesbeckia orientalis subsp. *orientalis*	*Smilax australis*
Smilax glyciphylla	*Solanum prinophyllum*
Syncarpia glomulifera subsp. *glomulifera*	*Themeda triandra*
Trema tomentosa var. *viridis*	*Tylophora barbata*
Veronica plebeia	*Zieria smithii*

Of the 112 species listed in the final determination for this ecological community. There are 18, (potentially 19) species present in the north east perimeter of the subject land. This is a promising indication for this community to meet the TEC listing given the general lack of understorey species present due to historical land disturbance.

Part 2. Particular area occupied by the ecological community occupied by Sydney Turpentine Ironbark Forest as listed in the final determination against the characteristics of the subject land

2.1.1 The assemblage of species listed in Part 1.1 above which characterises the Sydney Turpentine-Ironbark Forest occurs within the Sydney Basin Bioregion	The subject land occurs within the Sydney Basin IBRA region and is consistent with the final determination.
2.2 It is the intent of the NSW Threatened Species Scientific Committee that all occurrences of the ecological community (both recorded and as yet unrecorded, and independent of their condition) that occur within this bioregion be covered by this Determination.	Given the information collected over one rapid field day, and review of existing mapping and information collected on soil landscapes that the vegetation within the subject land may be included as the TEC due to the assemblage of species present and the location of this vegetation within the Sydney Basin Bioregion, despite the disturbance history at this location.

Part 4 Additional information about the ecological community. The following information is additional to that required to meet the definition of an ecological community under the Act but is provided to assist in the recognition of the Sydney Turpentine- Ironbark Forest in the Sydney Basin Bioregion

4.1 Sydney Turpentine-Ironbark Forest typically has the structural form of Open Forest (*sensu* Specht 1970) with a tree canopy ranging in height from the mid to upper range for this form (10-30 m) and with projected foliage cover at the mid to lower end of the range (30-50%)	The structure of the vegetation within the north east portion of the subject land had an open forest structure and ranged between 20 to 30 m in height, which fits the description of the TEC. However, the projected foliage cover recorded in plot 1 was 85.1%. Which is considerably higher than that listed in the final determination for the community, which the upper limit is around 50%.
4.2 Sydney Turpentine-Ironbark Forest has been reported as occurring in areas receiving moderate rainfall (900-1100 mm) on soils derived either from Wianamatta Shale or from Wianamatta Shale interbedded with Hawkesbury Sandstone (Benson and Howell 1994, Tozer 2003). In most of these locations STIF occurs up to approximately 100 m above sea level although it is found as high as 200 m above sea level on the western edge of the Hornsby Plateau where average annual rainfall falls below 1050 mm (Tozer 2003).	The subject land's highest point is approximately 110 m above sea level where the Plot 1 floristic data was collected. The subject land is mapped as occurring on the Lucas Heights soil landscape which contains Yellow Podzolic Soils which are likely overlain on Ashfield Shale from the Mittagong formation which contains alternating bands of shale and fine-grained sandstones which is over Hawkesbury Sandstone. The average annual rainfall taken from BOM Station data at the Gordon Golf Club (66120) with the mean annual rainfall 1241 for the area. The subject land falls within the range of average annual rainfall for this TEC.
4.3 Sydney Turpentine-Ironbark Forest occurs on low rolling hills characteristic of the Cumberland Lowlands and the broad, shale-capped ridges of the surrounding plateaux.	The landscape position of the vegetation was located on the top of the ridge, which is consistent with the shale-capped ridges as described in the Final Determination.

4.5 Based on plot samples analysed by Tozer et al. (2010), species which have been recorded more frequently in Blue Gum High Forest (WSFp153) compared with STIF (WSFp87) include, in decreasing order of diagnostic power*, *Platylobium formosum, Calochlaena dubia, Alphitonia excelsa, Smilax glyciphylla, Morinda jasminoides, Blechnum cartilagineum and Marsdenia rostrata.* **Species which have been recorded more frequently in STIF include,** in decreasing order of diagnostic power*, *Clematis glycinoides* var. *glycinoides, Solanum prinophyllum,* ***Glycine microphylla,*** *Bursaria spinosa, Echinopogon caespitosus* var. *caespitosus, Eucalyptus punctata, Acacia parramattensis, Panicum simile,* ***Centella asiatica, Acacia floribunda,*** *Hydrocotyle sibthorpioides, Veronica plebeia,* ***Aristida vagans****, Lomandra filiformis* subsp. *filiformis* and *Billardiera scandens.*	The vegetation within the north east boundary contains the highlighted in bold diagnostic species recorded more frequently in Sydney Turpentine Ironbark Forest than Blue Gum High Forest
4.7 Sydney Turpentine-Ironbark Forest is characterised by a number of frequently recorded species which are highly diagnostic of STIF but are much less frequently recorded in samples of the adjacent Sandstone Ridgetop Woodland and Sandstone Gully Forest (map units DSFp131 and DSFp142 of Tozer et al. (2010). These include, in decreasing order of diagnostic power*, ***Pratia purpurascens, Dichondra* spp**., *Eustrephus latifolius, Oplismenus imbecillis, Entolasia marginata,* ***Breynia oblongifolia****, Pittosporum undulatum, Bursaria spinosa, Hibbertia aspera* subsp. *aspera,* ***Imperata cylindrica,*** *Clematis glycinoides var. glycinoides, Pseuderanthemum variabile,* ***Ozothamnus diosmifolius****, Adiantum aethiopicum, Notelaea longifolia* forma *longifolia, Pittosporum revolutum, Solanum prinophyllum, Echinopogon caespitosus* var. *caespitosus,* ***Leucopogon juniperinus, Glycine microphylla,*** *Acacia parramattensis,* ***Oplismenus aemulus****, Panicum simile, Myrsine variabilis,* ***Acacia floribunda****, Echinopogon ovatus, Themeda triandra, Clerodendrum tomentosum, Tylophora barbata, Veronica plebeia* and ***Aristida vagans*** (Tozer et al. 2010).	A number of the highly diagnostic species of STIF listed, were recorded within the north portion of vegetation within the subject land, as highlighted in bold text.
Considering all the information above, it was determined that PCT 3262 was likely to fit the descriptions of Part 1, 2 and additional information in Part 4 of the Final Determination to list assign PCT 3262 as *Sydney Turpentine Ironbark Forest of the Sydney Basin Bioregion*.	

Appendix A Vegetation floristic plot data

Two full floristic plots were undertaken as part of the assessment of PCTs. One plot (Plot 1) was undertaken within vegetating to the north-eastern portion of the subject land. Plot 2 was undertaken in vegetation directly adjacent to the south of the subject land. Table 6 presents the locations of the plots and Table 7 contains the floristic plot data collected.

Table 6: Plot locations

Plot ID	PCT ID	PCT Name	Zone	Eastings	Northings	Bearing
Plot 1	3262	Sydney Turpentine Ironbark Forest	56	330986	6262320	117
Plot 2	3592	Sydney Coastal Enriched Sandstone Forest	56	330808	6262153	90

Table 7: 20 m x 20 m full floristic plot data taken for Plot 1 and Plot 2.

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Acacia implexa	Hickory Wattle			Shrub (SG)				M	3	2
Acacia ulicifolia	Prickly Moses			Shrub (SG)				G	0.1	1
Acer spp.		*			G	0.1	1			
Agapanthus spp.		*						G	4	20
Ageratina adenophora	Crofton Weed	*	1					G	0.1	2
Allocasuarina littoralis	Black She-Oak			Tree (TG)				U	5	2
Angophora costata	Sydney Red Gum			Tree (TG)				U	25	8
Araujia sericifera	Moth Vine	*	1		G	0.1	1			
Aristida vagans	Threeawn Speargrass			Grass & grasslike (GG)	G	0.1	10			
Asparagus aethiopicus	Asparagus Fern	*	1		G	8	50	G	0.1	1
Asparagus spp.		*						G	0.1	10
Bidens pilosa var. *pilosa*		*			G	0.1	1	G	0.1	1
Billardiera scandens	Hairy Apple Berry			Other (OG)				G	0.2	5
Bromus catharticus	Praire Grass	*			G	0.1	1			
Calochlaena dubia	Rainbow Fern			Other (OG)				G	35	100
Centella asiatica	Indian Pennywort			Forb (FG)	G	0.1	10			
Ceratopetalum gummiferum	Christmas Bush			Tree (TG)				M	2	5
Cestrum parqui	Green Cestrum	*	1					G	0.1	1

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Chlorophytum spp.		*			G	0.2	1			
Cinnamomum camphora	Camphor Laurel	*	1		G	0.1	1	G	3	2
Corymbia gummifera	Red Bloodwood			Tree (TG)				U	2	1
Cirsium vulgare	Spear Thistle	*			G	0.1	1			
Commelina cyanea	Native Wandering Jew			Forb (FG)	G	0.1	10			
Conyza spp.	A Fleabane	*			G	0.1	1	G	0.1	1
Cordyline australis				Other (OG)				G	0.5	1
Coronidium elatum subsp. *elatum*				Shrub (SG)				G	0.2	1
Corymbia gummifera	Red Bloodwood			Tree (TG)				U		
Cotoneaster spp.		*	1					G	0.1	5
Cynodon dactylon	Common Couch			Grass & grasslike (GG)	G	0.1	1			
Dianella caerulea var. *producta*				Forb (FG)	G	8	50	G	0.2	10
Dichondra repens	Kidney Weed			Forb (FG)	G	0.1	10			
Dietes spp.				Forb (FG)	G	0.1	1			
Digitaria spp.	A Finger Grass			Grass & grasslike (GG)	G	0.1	100			
Dodonaea triquetra	Large-leaf Hop-bush			Shrub (SG)				G	0.2	1
Ehrharta erecta	Panic Veldtgrass	*	1		G	1	100			
Elaeocarpus reticulatus	Blueberry Ash			Shrub (SG)	M	4	1	M	2	5
Entolasia marginata	Bordered Panic			Grass & grasslike (GG)				G	0.1	1

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Entolasia stricta	Wiry Panic			Grass & grasslike (GG)	G	1	100	G	0.5	1000
Eucalyptus microcorys	Tallowwood			Tree (TG)	U	15	4			
Eucalyptus sp.				Tree (TG)	U	50	8			
Eucalyptus pilularis	Blackbutt			Tree (TG)	U	20	1	U	35	2
Ficus rubiginosa	Port Jackson Fig			Tree (TG)				G	0.1	1
Geranium spp.				Forb (FG)				G	0.1	5
Glochidion ferdinandi var. *ferdinandi*	Cheese Tree			Tree (TG)				G	0.1	1
Hedychium gardnerianum	Ginger Lily	*						G	0.2	5
Hydrocotyle tripartita	Pennywort			Forb (FG)				G	0.1	1
Hypolepis muelleri	Harsh Ground Fern			Fern (EG)				G	0.1	1
Jacaranda spp.		*			G	0.1	2			
Juncus usitatus				Grass & grasslike (GG)				G	0.2	2
Lantana camara	Lantana	*	1					G	0.1	1
Leucopogon juniperinus	Prickly Beard-heath			Shrub (SG)				M	2	5
Ligustrum sinense	Small-leaved Privet	*	1					G	0.1	2
Lindsaea microphylla	Lacy Wedge Fern			Fern (EG)				G	0.1	1
Lobelia purpurascens	whiteroot			Forb (FG)	G	0.2	100	G	0.1	20
Lomandra filiformis subsp. *filiformis*				Grass & grasslike (GG)				G	0.1	2
Lomandra longifolia	Spiny-headed Mat-rush			Grass & grasslike (GG)				G	10	50

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Melia azedarach	White Cedar			Tree (TG)	G	0.1	1			
Microlaena stipoides var. *stipoides*	Weeping Grass			Grass & grasslike (GG)	G	0.5	100	G	1	50
Nephrolepis cordifolia	Fishbone Fern			Fern (EG)				G	0.1	10
Ochna serrulata	Mickey Mouse Plant	*	1		G	0.5	1	G	0.1	5
Oplismenus aemulus				Grass & grasslike (GG)	G	0.1	10			
Oplismenus imbecillis				Grass & grasslike (GG)				G	0.2	100
Acianthus spp.	Mosquito Orchid			Forb (FG)				G	0.2	4
Osteospermum spp.	South African daisy	*			G	0.5	10			
Oxalis spp.				Forb (FG)	G	0.1	1	G	0.1	1
Ozothamnus diosmifolius	White Dogwood			Shrub (SG)	M	0.2	1	G	0.2	10
Parsonsia straminea	Common Silkpod			Other (OG)				G	0.1	2
Passiflora edulis	Common Passionfruit	*						G	0.1	1
Phoenix canariensis	Canary Island Date Palm	*	1		G	0.5	1			
Physalis peruviana	Cape Gooseberry	*						G	0.1	1
Pittosporum undulatum	Sweet Pittosporum			Shrub (SG)				M	0.5	1
Plectranthus parviflorus				Forb (FG)				G	0.1	1
Polyscias sambucifolia				Shrub (SG)				G	0.2	5
Pteridium esculentum	Bracken			Fern (EG)				G	0.5	1
Pultenaea flexilis				Shrub (SG)				G	0.1	3

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Richardia brasiliensis	Mexican Clover	*			G	0.1	1			
Sigesbeckia orientalis subsp. *orientalis*	Indian Weed			Forb (FG)				G	0.1	5
Smilax glyciphylla	Sweet Sarsparilla			Other (OG)				G	0.1	10
Solanum americanum	Glossy Nightshade			Forb (FG)				G	0.1	2
Solanum mauritianum	Wild Tobacco Bush	*						G	0.2	2
Solanum nigrum	Black-berry Nightshade	*			G	0.1	10			
Sonchus oleraceus	Common Sowthistle	*			G	0.1	1			
Syagrus spp.		*						G	0.2	1
Syncarpia glomulifera subsp. *glomulifera*				Tree (TG)	U			U	15	4
Triadica sebifera	Chinese Tallowood	*	1		G	0.1	1	G	0.1	4
Veronica plebeia	Trailing Speedwell			Forb (FG)				G	0.1	1
Xanthorrhoea media				Other (OG)				G	0.1	1
Zieria smithii	Sandfly Zieria			Shrub (SG)				G	0.1	1

Appendix B Floristic analysis results

Plot	Vegetation analysis tool (Tozers Metro)	Selected PCT rational
Plot 1	Blue Gum High Forest Sydney Turpentine-Ironbark Forest	The plot located within the north east of the subject land has undergone historical disturbances, and therefore generally lacks a diverse number of species. The required minimum + positive diagnostic species was not achieved for either Sydney Turpentine Ironbark Forest nor Blue Gum High Forest, there the analysis relied on the presence of total diagnostic species between Sydney Turpentine Ironbark Forest and Blue Gum High Forest. The plot data contained 12 diagnostic species belonging to Sydney Turpentine Ironbark Forest and 6 against Blue Gum High Forest. It was determined that Sydney Turpentine Ironbark Forest (PCT 3262) was the most appropriate PCT for the vegetation based on numerous factors outlined in Table 2, in conjunction with the results of the Tozer analysis.
Plot 2	Blue Gum High Forest Sydney Turpentine-Ironbark Forest Hinterland Sandstone Gully Forest	Sydney Turpentine-Ironbark Forest had 20 diagnostic species as did Sydney Hinterland Sandstone Gully Forest, and Blue Gum High Forest with 14 diagnostic species. However, the Hinterland Sandstone Gully Forest was the only vegetation community between the three which had the highest count of diagnostic species and also achieved the ratio of positive diagnostic species to total native species ratio. Given this outcome, Sandstone PCTs were investigated in the PCT selection process. Whilst Hinterland Sandstone Gully Forest was not selected as the final vegetation community. A similar community 3592, Sydney Coastal Enriched Sandstone Forest was selected, based on the number of characteristic canopy species present, including *Angophora costata Corymbia gummifera, Eucalyptus pilularis, Ceratopetalum gummiferum* and *Syncarpia glomulifera* subsp. *glomulifera* and a taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis.* This PCT is primarily distributed at elevations of less than 200 metres asl downslope of shale soils on the north shore of Sydney. The landscape position fit this PCT the best as it is downslope of shale soils on north shore of Sydney, but is not located higher upslope before it grads into a gully below. This PCT was the best fit PCT for the vegetation directly adjacent to the subject land and was therefore selected as the most appropriate PCT to assign to the vegetation along the southern portion of the subject land, including the vegetation within the detention basin.

B1 Analysis of vegetation plot 1 – identified as PCT 3262 Sydney Turpentine Ironbark Forest

The images below show the outputs from the Hager / Steenbeecke tool.

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	Community Type	CSF p1	SW p2	CSF p6	CSF p7	CSF p4	SW p28	SW p29	CSF p662	WSF p97	FEW p33	WSF p44	WSF p39	WSF p39	SW p514	FEW p33	CSF p64	WSF p172	WSF p161	FEW p111	CSF p140	CSF p142	CSF p143	CSF p144	CSF p151	CSF p209	FC p50
2	Correct ID	CSF	SSTF	RNHW	CSGW	CSW	SHW	SPW	SGTF	STF	ORFF	NSCF	SWDF	WIDR	MSW	SSF	CSF	LBWWF	SGHF	SRS	CSGF	HSGF	SWDF	SHTW	CBRW	ABW	SCS
3	Total diagnostic species	8	8	2	3	2	4	8	8	12	8	1	8	4	3	3	3	6	8	1	3	8	3	7	1	0	0
4	Required minimum +ve diagnostic species	21	26	17	30	19	20	26	35	33	16	6	18	32	19	6	18	23	15	6	23	26	26	31	31	28	16
5	Achieved?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
6	No. by which required minimum +ve diagnostic spp. is exceeded?																										
7	Ratio of actual: required +ve diagnostic species	24%	22%	10%	10%	10%	20%	30%	24%	32%	50%	17%	28%	13%	16%	33%	30%	26%	40%	17%	13%	19%	8%	23%	3%	0%	0%
8	Total native species	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
9	Required minimum total native species	35	39	37	45	37	31	31	37	40	28	27	31	32	30	17	21	33	39	23	33	39	43	45	41	38	24
10	Achieved?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No
11	Ratio of +ve diagnostic species : total native species	26%	22%	10%	10%	10%	21%	47%	32%	63%	42%	5%	26%	21%	16%	16%	16%	21%	32%	5%	16%	26%	11%	37%	5%	0%	0%
12	Native Species																										
13	Aristida vagans	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
14	Cymbopogon refractus	0	0	0	0	1	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
15	Commelina cyanea	0	0	0	0	0	1	1	0	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
16	Cynodon dactylon	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Dianella caerulea var. producta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0
18	Dichondra repens	0	1	0	0	0	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
19	Digitaria sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Eleocarpus reticulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0
21	Entolasia stricta	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0
22	Eucalyptus microcorys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	Eucalyptus pilularis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	1	1	1	0	0
24	Gratia purpurascens	1	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	1	1	0	0	0	0	1	0	0	0
25	Melia azedarach	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Microlaena stipoides	1	1	0	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Oplismenus aemulus	0	0	0	0	0	1	1	0	1	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0
28	Oxalis sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Ozothamnus diosmifolius	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0

B2 : Analysis of Plot 2 - identified as Sydney Coastal Enriched Sandstone Forest

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X
1	Community Type	DSF p1	DSF p2	DSF p6	DSF p7	DSF p4	GSF p20	GSF p19	DSF p502	WSF p87	Folk p33	WSF p88	RF p38	RF p39	GSF p14	Folk p44	DSF p84	WSF p102	wet p153	Folk p48	DSF p140	DSF p142	DSF p148
2	Cornor ID	CIF	SSTF	BNHV	CSCV	CSV	SHV	SPV	SCTF	STIF	CIFF	NSCF	CMDF	VSDF	MSV	SSF	CSF	LBMVF	BCHF	SDS	CSCF	HSGF	SSICF
3	Total diagnostic species	7	10	2	2	3	3	6	8	20	8	2	6	4	1	5	7	15	14	5	12	20	12
4	Required minimum +ve diagnostic species	21	28	17	30	19	20	28	25	23	16	6	18	22	19	9	10	20	15	8	23	26	26
5	Achieved?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
6	No. by which required minimum +ve diagnostic spp. is exceeded?																						
7	Ratio of actual : required +ve diagnostic species	33%	36%	12%	7%	16%	15%	21%	32%	87%	50%	33%	33%	18%	5%	56%	70%	75%	93%	63%	52%	77%	46%
8	Total native species	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
9	Required minimum total native species	35	39	37	43	37	31	31	37	40	26	27	31	32	30	17	21	35	39	25	38	38	43
10	Achieved?	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
11	Ratio of +ve diagnostic species : total native species	18%	26%	5%	5%	8%	8%	21%	21%	53%	21%	5%	16%	10%	3%	13%	18%	39%	37%	13%	32%	53%	32%
12	Native Species																						
13	Acacia ulicifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
14	Allocasuarina littoralis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
15	Angophora costata	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1
16	Billardiera scandens	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1
17	Calochlaena dubia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0
18	Ceratopetalum gummiferum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1
19	Corymbia gummifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
20	Dianella caerulea var. producta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
21	Dodonaea triquetra	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	1
22	Elaeocarpus reticulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0
23	Entolasia marginata	0	1	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	1	0	0	0	0
24	Entolasia stricta	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1
25	Eucalyptus pilularis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	1
26	Ficus rubiginosa	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
27	Glochidion ferdinandi var. ferdinandi	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0
28	Hypolepis muelleri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Juncus usitatus	0	0	0	0	1	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
30	Leucopogon juniperinus	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
31	Lindsaea microphylla	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1
32	Pratia purpurascens	1	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	1	1	0	0	0	0
33	Lomandra filiformis subsp. filiformis	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0
34	Lomandra longifolia	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	0
35	Microlaena stipoides	1	1	0	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0
36	Oplismenus imbecillis	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
37	Ozothamnus diosmifolius	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
38	Parsonsia straminea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
39	Pittosporum undulatum	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
40	Platrantus parviflorus	0	0	0	0	0	1	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0
41	Pteridium esculentum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1

Appendix E: BDAR requirements compliance

Appendix E: BDAR requirements compliance

Table 1. Assessment of compliance with BDAR minimum information requirements

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
Introduction	Chapters 2 and 3	**Information**	
		Introduction to the biodiversity assessment including: ▪ brief description of the proposal ▪ identification of subject land boundary ▪ general description of the subject land ▪ sources of information used in the assessment, including reports and spatial data ▪ identification and justification for entering the BOS	Section 1.1 ▪ Section 1.1.3 ▪ Section 1.1.2 ▪ Section 1.1.4 ▪ Section 1.1.5 ▪ Section 1.2
		Maps and tables	
		Map of the subject land boundary showing the final proposal footprint, including the construction footprint for any clearing associated (Note: temporary/ancillary construction facilities and infrastructure yet to be determined and submitted with SSD	Figure 1. Subject land Figure 2. Proposal layout Figure 13. Subject land PCT clearing
Landscape	Sections 3.1 and 3.2, Appendix E	**Information**	
		Identification of site context components and landscape features, including: ▪ general description of subject land topographic and hydrological setting, geology and soils ▪ per cent native vegetation cover in the assessment area (as described in BAM Section 3.2) ▪ IBRA bioregions and subregions (as described in BAM Subsection 3.1.3(2.)) ▪ rivers and streams classified according to stream order (as described in BAM Subsection 3.1.3(3.) ▪ wetlands within, adjacent to and downstream of the site (as described in BAM Subsection 3.1.3(3.)) ▪ connectivity of different areas of habitat (as described in BAM Subsection 3.1.3(5–6.)) ▪ karst, caves, crevices, cliffs, rocks and other geological features of significance and for vegetation clearing proposals, soil hazard features (as described in BAM Subsections 3.1.3(7.) and 3.1.3(12.))	▪ Sections 1.1.4 & 3.1 ▪ Sections 2.2.3 & 3.3 ▪ Sections 2.2.1 & 3.2.2 ▪ Section 3.2.3 ▪ Section 3.2.3 ▪ Section 3.2.4 ▪ Section 3.2.5

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ areas of outstanding biodiversity value occurring on the subject land and assessment area (as described in BAM Subsection 3.1.3(8–9.)) ▪ any additional landscape features identified in any SEARs for the proposal ▪ NSW (Mitchell) landscape on which the subject land occurs ▪ details of field reconnaissance undertaken to confirm the extent and condition of landscape features and native vegetation cover (as described in Operational Manual Stage 1 Section 2.4)	▪ Section 3.2.6 ▪ N/A ▪ Section 3.2.7 ▪ Section 2
		Maps and tables	
		Site Map ▪ Property boundary ▪ Cadastre of subject land (including labelling of Lot and DP or section plan if relevant) ▪ Boundary of subject land ▪ Landscape features identified in BAM Subsection 3.1.3	Figure 1 Figure 7 Figure 1 Figure 7
		Location Map ▪ Digital aerial photography at 1:1,000 scale or finer ▪ Boundary of subject land ▪ Assessment area (i.e., the subject land and either 1500 m buffer area or 500 m buffer for linear development) ▪ IBRA bioregions and subregions regions ▪ rivers, streams and estuaries ▪ wetlands and important wetlands ▪ connectivity of different areas of habitat ▪ karst, caves, crevices, cliffs, rocks and other geological features of significance and if required, soil hazard features ▪ areas of outstanding biodiversity value occurring on the subject land and assessment area ▪ NSW (Mitchell) landscape on which the subject land occurs	Figure 7 Figure 7 Figure 7 Figure 7 Figure 7 Figure 9 Figure 20 Figure 7

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		Data	
		All report maps as separate jpeg files	
		Individual digital shape files of: ▪ subject land & assessment area (i.e., subject land and 1500 m buffer area) boundary ▪ cadastral boundary of subject land ▪ areas of native vegetation cover ▪ landscape features	
Native vegetation	**Chapter 4, Appendix A & Appendix H**	**Information**	
		Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1)	
		Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	
		Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1)	
		Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	
		Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A)	
		For each PCT within the subject land, describe: ▪ PCT name and ID ▪ vegetation class ▪ extent (ha) within subject land ▪ evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.)) ▪ plant species relied upon for identification of the PCT and relative abundance of each species	▪ Section 4.3 ▪ Section 4.3 ▪ Section 4.3 ▪ Sections 4.3 & 2.2 ▪ Sections 4.3 & Appendix B

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.)) ▪ estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	▪ Section 4.4 ▪ Section 4.3
		Describe the vegetation integrity assessment of the subject land, including: ▪ identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1) ▪ description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2) ▪ area (ha) of each vegetation zone ▪ assessment of patch size (as described in BAM Subsection 4.3.2) ▪ survey effort (i.e., number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.) ▪ use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	▪ Sections 4.1 & 4.3 ▪ Section 4.3 ▪ Section 4.6 ▪ Sections 2.4.2 ▪ N/A
		Maps and tables	
		Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of all areas of native vegetation including areas that are ground cover only, cleared areas (as described in BAM Section 4.1(1–3.)) and all parts of the subject land that do not contain native vegetation (BAM Subsection 4.1.2) Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	Figure 12
		▪ Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1) ▪ Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries ▪ Map of TEC distribution on the subject land and table of TEC listing, status and area (ha) ▪ Map of patch size locations for each native vegetation zone and table of patch size areas (as described in BAM Subsection 4.3.2)	Figures 12 & 13 Figure 12 Figure 14 Figure 15
		Table of current vegetation integrity scores for each vegetation zone within the site and including: ▪ composition condition score ▪ structure condition score ▪ function condition score ▪ presence of hollow bearing trees	Table 28

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		Data	
		All report maps as separate jpeg files Plot field data (MS Excel format) Plot field datasheets	Provided to Client
		Digital shape files of: ▪ PCT boundaries within subject land ▪ TEC boundaries within subject land ▪ vegetation zone boundaries within subject land ▪ floristic vegetation survey and vegetation integrity plot locations	

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
Native vegetation	Chapter 4, Appendices A and H	**Information**	
		Identify native vegetation extent within the subject land, including cleared areas and evidence to support differences between mapped vegetation extent and aerial imagery (as described in BAM Section 4.1(1–3.) and Subsection 4.1.1)	Sections 2.1.2 & 4.1
		Provide justification for all parts of the subject land that do not contain native vegetation (as described in BAM Subsection 4.1.2)	Section 4.1.2
		Review of existing information on native vegetation including references to previous vegetation maps of the subject land and assessment area (described in BAM Section 4.1(3.) and Subsection 4.1.1)	Sections 2.1.2 & 4.1
		Describe the systematic field-based floristic vegetation survey undertaken in accordance with BAM Section 4.2	Sections 2.2.5 & 2.2.6
		Where relevant, describe the use of more appropriate local data, provide reasons that support the use of more appropriate local data and include the written confirmation from the decision-maker that they support the use of more appropriate local data (as described in BAM Subsection 1.4.2 and Appendix A)	N/A
		For each PCT within the subject land, describe:	
		▪ PCT name and ID	Section 4.3
		▪ vegetation class	Section 4.3
		▪ extent (ha) within subject land	Section 4.3
		▪ evidence used to identify a PCT including any analyses undertaken, references/sources, existing vegetation maps (BAM Section 4.2(1–3.))	Sections 4.2 & 4.3
		▪ plant species relied upon for identification of the PCT and relative abundance of each species	Section 4.3
		▪ if relevant, TEC status including evidence used to determine vegetation is the TEC (BAM Subsection 4.2.2(1–2.))	Section 4.4
		▪ estimate of per cent cleared value of PCT (BAM Subsection 4.2.1(5.))	Section 4.3
		Describe the vegetation integrity assessment of the subject land, including:	
		▪ identification and mapping of vegetation zones (as described in BAM Subsection 4.3.1)	Section 4.1
		▪ description of vegetation zones within the subject land (as described in Operational Manual Stage 1 Table 2 and Subsection 3.3.2)	Section 4.3
		▪ area (ha) of each vegetation zone	Section 4.3
		▪ assessment of patch size (as described in BAM Subsection 4.3.2)	Section 4.6

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ survey effort (i.e., number of vegetation integrity survey plots) as described in BAM Subsection 4.3.4(1–2.)	Section 2.2.6
		▪ use of relevant benchmark data from BioNet Vegetation Classification (as described in BAM Subsection 4.3.3(5.))	N/A
		Maps and tables	
		Map of native vegetation extent within the subject land at scale not greater than 1:10,000 including identification of all areas of native vegetation including areas that are ground cover only, cleared areas (as described in BAM Section 4.1(1–3.)) and all parts of the subject land that do not contain native vegetation (BAM Subsection 4.1.2)	Figures 12-13
		Map of PCTs within the subject land (as described in BAM Section 4.2(1.))	Figures 12-13
		Map of vegetation zones within the subject land (as described in BAM Subsection 4.3.1)	Figure 13
		Map the location of floristic vegetation survey plots and vegetation integrity survey plots relative to PCT boundaries	Figure 12
		Map of TEC distribution on the subject land and table of TEC listing, status and area (ha)	Figure 14
		Map of patch size locations for each native vegetation zone and table of patch size areas (as described in BAM Subsection 4.3.2)	Figure 15
		Table of current vegetation integrity scores for each vegetation zone within the site and including:	
		▪ composition condition score	Table 28
		▪ structure condition score	
		▪ function condition score	
		▪ presence of hollow bearing trees	
		Data	
		All report maps as separate jpeg files	Provided to Client
		Plot field data (MS Excel format)	
		Plot field datasheets	
		Digital shape files of:	
		▪ PCT boundaries within subject land ▪ TEC boundaries within subject land ▪ vegetation zone boundaries within subject land ▪ floristic vegetation survey and vegetation integrity plot locations	
Threatened species	Chapter 5	**Information**	

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		Identify ecosystem credit species likely to occur on the subject land, including:	
		▪ list of ecosystem credit species derived from the BAM-C (as described in BAM Subsection 5.1.1 and Section 5.2(1.))	Table 29
		▪ justification and supporting evidence for exclusion of any ecosystem credit species based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	
		▪ justification for addition of any ecosystem credit species to the list	
		Identify species credit species likely to occur on the subject land, including:	
		▪ list of species credit species derived from the BAM-C (as described in BAM Subsection 5.1.1)	Tables 30 & 31
		▪ justification and supporting evidence for exclusions based on geographic limitations, habitat constraints or vagrancy (as described in BAM Subsections 5.2.1 and 5.2.2)	
		▪ justification and supporting evidence for exclusions based on degraded habitat constraints and/or microhabitats on which the species depends (as described in BAM Subsection 5.2.2)	
		▪ justification for addition of any species credit species to the list	
		From the list of candidate species credit species, identify:	
		▪ species assumed present within the subject land (if relevant) (as described in BAM Subsection 5.2.4(2.a.))	Tables 32 & 33
		▪ species present within the subject land based on being identified on an important habitat map for a species (as described in BAM Subsection 5.2.4(2.d.))	
		▪ species for which targeted surveys are to be completed to determine species presence (BAM Subsection 5.2.4(2.b.))	
		▪ species for which an expert report is to be used to determine species presence (BAM Subsection 5.2.4(2.c.))	
		Present the outcomes of species credit species assessments from:	
		▪ threatened species survey (as described in BAM Section 5.2.4)	Section 5
		▪ expert reports (if relevant) including justification for presence of the species and information used to make this determination (as described in BAM Subsection 5.2.4, Section 5.3, Box 3)	N/A
		Where survey has been undertaken include detailed information on:	
		▪ survey method and effort (as described in BAM Section 5.3)	Sections 2.3 & 2.4
		▪ justification of survey method and effort (e.g., citation of peer-reviewed literature) if approach differs from the department's taxa-specific survey guides or where no relevant guideline has been published	N/A

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ timing of survey in relation to requirements in the TBDC or the department's taxa-specific survey guides. Where survey was undertaken outside these guides include justification for the timing of surveys	Sections 2.3 & 2.4
		▪ survey personnel and relevant experience	
		▪ describe any limitations to surveys and how these were addressed/overcome	
		Where an expert report has been used in place of survey (as described in BAM Section 5.3, Box 3), include:	
		▪ justification of the use of an expert report	N/A
		▪ identify the expert, provide evidence of their expert credentials and departmental approval of expert status	
		▪ all requirements of Box 3 have been addressed in the expert report	
		Where use of local data is proposed (BAM Subsection 1.4.2):	
		▪ identify relevant species	N/A
		▪ identify data to be amended	
		▪ identify source of information for local data, e.g., published literature, additional survey data, etc.	
		▪ justify use of local data in preference to VIS Classification or TBDC data	
		provide written confirmation from the decision-maker that they support the use of local data	
		Species polygon completed for species credit species present within the subject land (assumed present or determined based on survey, expert report or important habitat map) ensuring that:	
		▪ the unit of measure for each species is documented	Section 5.6 and Figures 18 & 20
		▪ for species assessed by area:	
		the polygon includes the extent of suitable habitat for the target species within the subject land (as described in BAM Subsection 5.2.5)	
		a description of, and evidence-based justification for, the habitat constraints, features or microhabitats used to map the species polygon including reference to information in the TBDC for that species and any buffers applied	
		▪ for species assessed by counts of individuals:	N/A
		▪ the number of individual plants present on the subject land (as described in BAM Subsection 5.2.5(3.))	
		▪ the method used to derive this number (i.e., threatened species survey or expert report) and evidence-based justification for the approach taken	
		▪ the polygon includes all individuals located on the subject land with a buffer of 30 m around the individuals or groups of individuals on the subject land	

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ Identify the biodiversity risk weighting for each species credit species identified as present within the subject land (as described in BAM Section 5.4)	Tables 34 & 35
		Maps and tables	
		Table showing ecosystem credit species in accordance with BAM Subsection 5.1.1, and identifying:	
		▪ the ecosystem credit species removed from the list	Table 29
		▪ the sensitivity to gain class of each species	
		Table detailing species credit species in accordance with BAM Section 5.2 and identifying:	
		▪ the species credit species removed from the list of species because the species is considered vagrant, out of geographic range or the habitat or microhabitat features are not present	Tables 30 - 36
		▪ the candidate species credit species not recorded on the subject land as determined by targeted survey, expert report or important habitat map	
		▪ Table detailing species credit species recorded or assumed as present within the subject land, habitat constraints or microhabitats associated with the species, counts of individuals (flora)/extent of suitable habitat (flora and fauna) (as described in BAM Subsection 5.2.6) and biodiversity risk weighting (BAM Section 5.4)	
		▪ Map indicating the GPS coordinates of all individuals of each species recorded within the subject land and the species polygon for each species (as described in BAM Subsection 5.2.5)	Figures 18 & 20
		Data	
		Digital shape files of suitable habitat identified for survey for each candidate species credit species	Provided to client
		Survey locations including GPS coordinates of any plots, transects, grids	
		Digital shape files of each species polygon including GPS coordinates of located individuals	
		Species polygon map in jpeg format	
		Field datasheets detailing survey information including prevailing conditions, date, time, equipment used, etc.	TBD

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
Prescribed impacts	Chapter 6	**Information**	
		Identify potential prescribed biodiversity impacts on threatened entities, including:	
		▪ karst, caves, crevices, cliffs, rocks and other geological features of significance (as described in BAM Subsection 6.1.1) ▪ occurrences of human-made structures and non-native vegetation (as described in BAM Subsection 6.1.2) ▪ corridors or other areas of connectivity linking habitat for threatened entities (as described in BAM Subsection 6.1.3) ▪ waterbodies or any hydrological processes that sustain threatened entities (as described in BAM Subsection 6.1.4)	Sections 6 & 8.3
		▪ protected animals that may use the proposed wind farm development site as a flyway or migration route (as described in BAM Subsection 6.1.5)	N/A
		▪ where the proposed development may result in vehicle strike on threatened fauna or on animals that are part of a threatened ecological community (as described in BAM Subsection 6.1.6)	Sections 6 & 8.3
		Identify a list of threatened entities that may be dependent upon or may use habitat features associated with any of the prescribed impacts	Sections 6 & 8.3
		Describe the importance of habitat features to the species including, where relevant, impacts on life cycle or movement patterns (e.g., Subsection 6.1.3)	Sections 6 & 8.3
		Where the proposed development is for a wind farm:	
		▪ identify a candidate list of protected animals that may use the development site as a flyway or migration route, including: resident threatened aerial species, resident raptor species and nomadic and migratory species that are likely to fly over the proposal area (as described in BAM Subsection 6.1.5)	N/A
		▪ provide details of targeted survey for candidate species of wind farm developments undertaken in accordance with BAM Subsection 6.1.5(2–3.)	
		▪ predict the habitual flight paths for nomadic and migratory species likely to fly over the subject land and map the likely habitat for resident threatened aerial and raptor species (BAM Subsection 6.1.5(4.))	

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		Where the proposal may result in vehicle strike:	
		▪ identify a list of threatened fauna or protected fauna species that are part of a TEC and at risk of vehicle strike due to the proposal	Sections 6 & 8.3
		Maps and tables	
		Map showing location of any prescribed impact features (i.e., karst, caves, crevices, cliffs, rocks, human-made structures, etc.)	Figures 18 & 20
		Map showing location of potential vehicle strike locations	-
		Maps of habitual flight paths for nomadic and migratory species likely to fly over the site and maps of likely habitat for threatened aerial species resident on the site (for wind farm developments only)	N/A
		Data	
		Digital shape files of prescribed impact feature locations	Provided to client
		Prescribed impact features map in jpeg format	
Avoid and minimise impacts	Chapter 7	**Information**	
		Demonstration of efforts to avoid and minimise impacts on biodiversity values (including prescribed impacts) associated with the proposal location in accordance with Chapter 7, including an analysis of alternative:	
		▪ modes or technologies that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed mode or technology	Section 7
		▪ routes that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed route	
		▪ alternative locations that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed location	
		▪ alternative sites within a property on which the proposal is located that would avoid or minimise impacts on biodiversity values and justification for selecting the proposed site	
		Describe efforts to avoid and minimise impacts (including prescribed impacts) to biodiversity values through proposal design (as described in BAM Sections 7.1 and 7.2)	Sections 7.1.2 & 7.1.3
		Identification of any other site constraints that the proponent has considered in determining the location and design of the proposal (as described in BAM Subsection 7.2.1(3.))	Section 7
		Detail measures or options considered but not implemented because they are not feasible and/or practical (e.g., due to site constraints)	N/A

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		Maps and tables	
		Table of measures to be implemented to avoid and minimise the impacts of the proposal, including action, outcome, timing and responsibility	Tables 39 & 43
		Map of alternative footprints considered to avoid or minimise impacts on biodiversity values; and of the final proposal footprint, including construction and operation	Figure 16
		Maps demonstrating indirect impact zones where applicable	-
		Data	
		Digital shape files of:	
		▪ alternative and final proposal footprint	Provided to client
		▪ direct and indirect impact zones	
		Maps in jpeg format	
Assessment of impacts	Chapter 8, Sections 8.1 and 8.2	**Information**	
		Determine the impacts on native vegetation and threatened species habitat, including a description of direct impacts of clearing of native vegetation, threatened ecological communities and threatened species habitat (as described in BAM Section 8.1)	Section 8
		Assessment of indirect impacts on vegetation and threatened species and their habitat including (as described in BAM Section 8.2):	Section 8.1 & Tables 39-43
		▪ description of the nature, extent, frequency, duration and timing of indirect impacts of the proposal	
		▪ documenting the consequences to vegetation and threatened species and their habitat including evidence-based justifications	
		▪ reporting any limitations or assumptions, etc. made during the assessment	
		▪ identification of the threatened entities and their habitat likely to be affected	
		Assessment of prescribed biodiversity impacts (as described in BAM Section 8.3) including:	
		Assessment of the nature, extent frequency, duration and timing of impacts on the habitat of threatened species or ecological communities associated with:	
		▪ karst, caves, crevices, cliffs, rocks and other features of geological significance	Section 8.3
		▪ human-made structures	Section 8.3.1

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ non-native vegetation	Section 8.3.2
		▪ connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Section 8.3.4
		▪ movement of threatened species that maintains their life cycle	-
		▪ water quality, waterbodies and hydrological processes that sustain threatened species and threatened ecological communities	Section 8.3.3
		▪ assessment of the impacts of wind turbine strikes on protected animals	N/A
		▪ assessment of the impacts of vehicle strikes on threatened species of animals or on animals that are part of a TEC	Section 8.3.5
		▪ evaluate the consequences of prescribed impacts	Section 8.3
		▪ describe impacts that are uncertain	-
		▪ document limitations to data, assumptions and predictions	-
		Maps and tables	
		Table showing change in vegetation integrity score for each vegetation zone because of identified impacts	Table 28
		Data	
		N/A	
Mitigation and management of impacts	Chapter 8, Sections 8.4 and 8.5	**Information**	
		Identification of measures to mitigate or manage impacts in accordance with the recommendations in BAM Sections 8.4 and 8.5 including:	
		▪ techniques, timing, frequency and responsibility	Section 8.4 & Tables 39 & 43
		▪ identify measures for which there is risk of failure	
		▪ evaluate the risk and consequence of any residual impacts	
		▪ document any adaptive management strategy proposed	
		Identification of measures for mitigating impacts related to:	
		▪ displacement of resident fauna (as described in BAM Subsection 8.4.1(2.))	Tables 39 & 43
		▪ indirect impacts on native vegetation and habitat (as described in BAM Subsection 8.4.1(3.))	

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ mitigating prescribed biodiversity impacts (as described in BAM Subsection 8.4.2)	Table 39
		Details of the adaptive management strategy proposed to monitor and respond to impacts on biodiversity values that are uncertain (BAM Section 8.5)	-
		Maps and tables	
		Table of measures to be implemented before, during and after construction to mitigate and manage impacts of the proposal, including action, outcome, timing and responsibility	Table 43
		Data	
		N/A	
Impact summary	Chapter 9	**Information**	
		Identification and assessment of impacts on TECs and threatened species that are at risk of a serious and irreversible impacts (SAII, in accordance with BAM Section 9.1) including:	
		▪ addressing all criteria in Subsection 9.1.1 for each TEC listed as at risk of an SAII present on the subject land	Section 9.1.1
		▪ for each TEC, report the extent of the TEC in NSW	
		▪ addressing all criteria in Subsection 9.1.2 for each threatened species at risk of an SAII present on the subject land	Section 9.1.2
		▪ for each threatened species, report the population size in NSW	
		▪ documenting assumptions made and/or limitations to information	
		▪ documenting all sources of data, information, references used or consulted	
		▪ clearly justifying why any criteria could not be addressed	
		Identification of impacts requiring offset in accordance with BAM Section 9.2	Section 10.1
		Identification of impacts not requiring offset in accordance with BAM Subsection 9.2.1(3.)	Section 10.2
		Identification of areas not requiring assessment in accordance with BAM Section 9.3	-
		Maps and tables	
		Map showing the extent of TECs at risk of an SAII within the subject land	Figure 19
		Map showing location of threatened species at risk of an SAII within the subject land	Figures 18 & 20
		Map showing location of:	
		▪ impacts requiring offset	Figure 21
		▪ impacts not requiring offset	Figure 22

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		▪ areas not requiring assessment	
		Data	
		Digital shape files of:	
		▪ extent of TECs at risk of an SAII within the subject land	Provided to client
		▪ location of threatened species at risk of an SAII within the subject land	
		▪ boundary of impacts requiring offset	
		▪ boundary of impacts not requiring offset	
		▪ boundary of areas not requiring assessment	
		Maps in jpeg format	
Impact summary	Chapter 10	**Information**	
		Ecosystem credits and species credits that measure the impact of the development on biodiversity values, including:	
		▪ future vegetation integrity score for each vegetation zone within the subject land (Equation 25 and Equation 26 in BAM Appendix H)	Table 41
		▪ change in vegetation integrity score (BAM Subsection 8.1.1)	
		▪ number of required ecosystem credits for the direct impacts of the proposal on each vegetation zone within the subject land (BAM Subsection 10.1.2)	
		▪ biodiversity risk weighting for each	
		▪ number of required species credits for each candidate threatened species that is directly impacted on by the proposal (BAM Subsection 10.1.3)	
		Maps and tables	
		Table of PCTs requiring offset and the number of ecosystem credits required	Table 49
		Table of threatened species requiring offset and the number of species credits required	Table 50
		Data	
		Submitted proposal in the BAM Calculator	Appendix A
Biodiversity credit report	Chapter 10	**Information**	
		Description of credit classes for ecosystem credits and species credits at the development or clearing site or land to be biodiversity certified (BAM Section 10.2)	Section 11

BDAR section	BAM ref.	BAM requirement	Page reference(s) in the BDAR
		BAM credit report in pdf format	Appendix A
		Maps and tables	
		Table of credit class and matching credit profile	Tables 52 & 53
		Data	
		BAM credit report in pdf format	Appendix A

BLACKASH
BUSHFIRE CONSULTING

4 July 2023

Nathan Donn
Senior Development Manager
Levande
By email: nathan.donn@levande.com.au

Dear Mr. Donn,

Re: Lourdes Retirement Village - Bushfire Landscaping

Blackash Bushfire Consulting has been engaged to review the design, landscaping and bushfire requirements for the proposed master plan presented in the Planning Proposal of the Lourdes Retirement Village and the relevant matters raised by the Environment and Heritage Group (EHG) dated 29/05/2023.

I have reviewed the 'Key Deficiencies' identified by EHG, specifically '*Key Deficiency 5: Avoidance of Biodiversity Impacts*'.

From a bushfire perspective, the renewal of the site as envisaged by the Planning Proposal will deliver a significantly enhanced bushfire safety outcome for the existing and future residents through improved access/egress from the site, improved bushfire construction of new buildings, and the location of vulnerable seniors housing residents further from the bushfire risk. In particular, the additional access points to the site are required to support evacuation during a bushfire event (if necessary) and have been located to avoid Biodiversity values to the greatest extent possible.

The NSW Rural Fire Services approved the *Bushfire Engineering Design Compliance Strategy* in November 2020 and raised no objection to the rezoning proceeding on that basis. The compliance with strategy will satisfy section 100B of the *Rural Fires Act 1997* through a performance-based approach using the Bush Fire Engineering Brief (BFEB) process for the APZ design and building construction. The *Bushfire Engineering Design Compliance Strategy* will be used to inform more detailed design and engineering at the DA stage, so that bushfire risk and occupant safety is appropriately addressed through the final design.

Further development of the emergency management strategy for the site and appropriate RFS access to the site during a bushfire event is a key aspect of the *Bushfire Engineering Design Compliance Strategy* which will be further addressed at DA stage.

As part of the response to submissions for the Planning Proposal, RFS requested additional analysis to be undertaken to determine the maximum number of occupants that could be on-site because of the proposed renewal and the adequacy/appropriateness of roadways for emergency egress and fire brigade access given reasonable worst case bush fire scenarios. This testing was carried based on the

access points to the site identified in the master plan along with the capacity of the wider road network and demonstrated that the site could be readily evacuated in the bushfire event should this be required.

The bushfire advice which supported the response to submissions noted that the planning proposal whilst increasing the number of people on site has them within buildings significantly exceeding contemporary bushfire construction standards (under AS3959), provides more efficient and effective access and has the more vulnerable residents of the Village located in a safer position (e.g. further from the hazard). This is a considerable better bushfire outcome than currently exists on site and complies with current bushfire planning legislation.

The proposed tree retention and landscaping as identified in the following documents has also been reviewed:

- *Urban Design Report – Response to Council Submission*", prepared for Plus Architecture and Arcadia (December 2022)
- Addendum Urban Design Report prepared by Plus Architecture an Arcadia (dated 4/07/23)
- The arborist report prepared by Naturally Trees (dated 16/06/23).

The proposed tree retention and landscaping can accommodate an APZ which will provide a fuel-reduced area surrounding the buildings and between the buildings and the bush fire hazard. The fuels within the APZ will be such that the vegetation does not provide a path for the spread of fire to the buildings, therefore satisfying the requirements of an APZ without the need for any additional tree removal.

The proposed design has been carefully developed to ensure the bushfire protection measures are appropriately addressed. Ongoing collaboration between Blackash and Arcadia as part of the detailed design will ensure APZ design and landscaping across the entire site is appropriate and consistent with the intent of *Planning for Bush Fire Protection 2019*.

If you have any questions, please contact me on 0418 412 118.

Yours sincerely,

Corey Shackleton

Principal Bushfire & Resilience
B.Sc., Grad. Dip. (Design for Bush fires)
Fire Protection Association of Australia BPAD Level 3 –34603

Level 3
101 Sussex Street
Sydney NSW 2000
t: (02) 9259 3800

12 July 2023
Our ref: 23SYD5827

Levande Pty. Ltd.
Level 18,
9 Castlereagh Street,
Sydney, NSW 2000

Attention: Nathan Donn

Dear Nathan,

RE: PCT validation to assist Planning Proposal at 95 Stanhope Road – Killara

Eco Logical Australia Pty. Ltd. (ELA) was engaged by Levande Pty. Ltd. to review a Biodiversity Development Assessment Report (BDAR) prepared by ASC Environmental (4 May 2023) for the Planning Proposal at 95 Stanhope Road, Killara; and to review Environment and Heritage Group's (EHG's) response to the BDAR.

Upon review of the BDAR and EHG's response, ELA were commissioned to undertake a site inspection, focusing on the areas mapped as remnant vegetation on page 17 of the BDAR. The site inspection was required to validate native Plant Community Types present within the subject land and collect BAM floristic plot data to assist in the determination of Plant Community Types. The subject land is defined at 95 Stanhope Road, Killara, which is legally identified as Lot 21 and Lot 22 in Deposited Plan 634645, in the Ku-ring-gai Local Government Area (LGA).

This letter describes the field survey undertaken over one day within the subject land and provides ELA's Plant Community Type validation, and PCT selection process. It also describes the occurrence of Threatened Ecological Communities likely to be present within the subject land.

If you have any queries, please feel free to contact me via email at staceyw@ecoaus.com.au

Regards,

Stacey Wilson
Senior Ecologist BAAS22030

Regards,

Dr Daniel McDonald

Principal Ecologist and Senior Arborist BAAS170

1.1. Field survey

A field survey was conducted over one day on 14 June 2023 by Principal Ecologist Daniel McDonald and Senior Ecologist Stacey Wilson. The purpose of the field survey was to:

- review previous vegetation mapping on site as assessed by ACS environmental
- validate the PCTs present
- identify the potential for any threatened ecological communities listed under the BC Act and/or EPBC Act to occur within the subject land.

A total of two 20 m x 20 m full floristic plots were surveyed to identify Plant Community types (PCTs) and assist in informing threatened ecological communities (TECs) on the subject land. Figure 3 shows the location of the plots undertaken.

Plot 1 was undertaken in the north-eastern portion of the subject land which has been previously assigned to PCT 3592 *Sydney Coastal Enriched Sandstone Forest* in the Biodiversity Development Assessment Report 4 May 2023 prepared by ACS Environmental Pty. Ltd.

As mentioned above, much of the subject land has been historically cleared, and areas on the east and south of the development site contain very little native species cover to assist in informing PCT selection. Therefore, the decision was made to undertake the second floristic plot, Plot 2 within an area of native vegetation to the south of the subject land.

The use of this floristic information in the adjacent vegetation would provide a greater understanding of the PCTs present in the locality and would assist in the selection of the best-fit PCT for the vegetation within the southern portion of the subject land. This area has been previously mapped by DPE in their regional mapping project (State Type Vegetation Map 2022)as PCT 3136 as *Blue Gum High Forest*.

1.1.1. Survey Limitations

This assessment was completed over one day and not intended to provide an inventory of all species present across the subject land but instead an overall assessment of the ecological values of the subject land with particular emphasis on mapping Plant Community Types and threatened ecological communities.

The field survey was undertaken using a hand-held GPS unit. It should be noted that these units can have errors in accuracy of up to 20 m (subject to availability of satellites on the day).

Additional survey work undertaken in the wider area may assist in identification of plant community types present in the site. However, due to time constraints additional survey work was not undertaken.

1.2. Results – Plant Community Type validation

Two PCTs were identified within the subject land following the field survey; they are PCT 3262 *Sydney Turpentine Ironbark Forest* and PCT 3592 *Sydney Coastal Enriched Sandstone Forest.* A summary of the vegetation validated as part of ELA's assessment is presented in Table 1 and shown in Figure 3. A description of the Plant Community Types identified is detailed below.

Table 1: Vegetation communities validated within the subject land

PCT ID	PCT Name	Area of vegetation validated	No. of plots collected
3262	Sydney Turpentine Ironbark Forest	Regrowth of remnant vegetation in the north east of the subject land	1
3592	Sydney Coastal Enriched Sandstone Forest	Vegetation within Seven Little Australians Park directly adjacent to the south of the subject land.	1

1.2.1. PCT 3262 Sydney Turpentine Ironbark Forest

Vegetation which was validated as PCT 3262 contains canopy species *Eucalyptus pilularis* (Blackbutt) and *Eucalyptus microcorys* (Tallowwood) within the floristic plot. *E. microcorys* is not a native species to Sydney and is naturally found on the north coast of New South Wales and Queensland and is likely to have been planted. The midstorey is sparse and contains *Elaeocarpus reticulatus* (Blueberry Ash) and *Ozothamnus diosmifolius* (White Dogwood). The groundcover contains a very sparse cover of grasses, including *Entolasia stricta* (Wiry Panic), *Microlaena stipoides* (Weeping Grass), *Aristida vagans* (Threeawn speargrass), *Oplismenus aemulus* (Australian Basket Grass) and *Digitaria* sp. Forbs present in the groundcover include *Dianella caerulea* var. *producta, Centella asiatica* (Indian Pennywort), *Dichondra repens* (Kidney Weed) and *Commelina cyanea.* Exotic species include *Osteospermum* sp. (African Daisy), *Ehrharta erecta* (Panic Veldtgrass), *Chlorophytum* sp., *Phoenix canariensis* (Canary Island Date Palm) and *Cinnamomum camphora* (Camphor Laurel).

A list of species immediately surrounding the 20 m x 20 m plot includes native canopy species, *Eucalyptus robusta* (Swamp Mahogany), *Angophora hispida* (Dwarf Apple), midstorey species, *Callistemon citrinus* (Crimson Bottlebrush), *Acacia longifolia* (Sydney Golden Wattle) *Breynia oblongifolia* (Coffee Bush), *Imperata cylindrica* (Blady Grass), *Acacia ulicifolia* (Prickly Moses), *Melaleuca nodosa* (Prickly-leaved Paperbark). Groundcovers outside of plot 1, though present in the surrounding area include *Eragrostis brownii* (Brown's Love Grass), *Glycine microphylla* (Small-leaf glycine), *Cyperus gracilis* (Slender Flat-sedge), *Calystegia* sp., *Lomandra longifolia* (Spiny-headed Mat-Rush) and *Lomandra gracilis.* Weeds included *Sida rhombifolia* (Paddy's Lucerne), *Nandina domestica* (Nanten), *Sporobolus africanuus* (Parramatta Grass), *Senecio madagascariensis* (Fireweed). Also present were *Acacia podalyriifolia* and *Acacia saligna* (Golden Wreath Wattle) which have naturalised in the Sydney region. The vegetated area in the north east portion of the subject land appears to have undergone historical disturbance. As can be seen on the right side in Photo 1, a built-up area of soil, forming a mound is present. It is likely that the soil has been moved around this area during past construction activities. However, the soil on the flattest part of the area, has a more natural appearance and are potentially remnant soils.

Photo 1 below shows the start of the 20 m x 20 m floristic plot looking towards the end of the 50 m plot. Photo 2 shows the end of the plot looking back towards the start.

1.2.2. PCT 3592 Sydney Coastal Enriched Sandstone Forest

As discussed above, due to the lack of native species that could be collected in a 20 m x 20 m plot within the subject land, analysis of plot data would likely not produce a meaningful result to assist in PCT determination. Therefore, the decision was made to collect a second floristic plot within vegetation to the south of the development site, to help inform the best fit PCT in the southern portion of the subject land.

The vegetation validated as PCT 3592 includes canopy species *Corymbia gummifera* (Red Bloodwood), *Angophora costata* (Sydney Red Gum), *Eucalyptus pilularis* (Blackbutt), *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine) and a sub-canopy of *Ceratopetalum gummiferum* (Christmas Bush), *Allocasuarina littoralis* (Black She-oak) and *Pittosporum undulatum* (Sweet Pittosporum). The midstorey was diverse, with an open structure and includes *Acacia longissima* (Long Leaf Wattle), *Elaeocarpus reticulatus* (Blueberry Ash), *Leucopogon juniperinus* (Prickly Beard-heath), *Coronidium elatum* subsp. *elatum, Dodonaea triquetra* (Large-leaf Hop-bush), *Polyscias sambucifolia* (Elderberry Panax), and *Ozothamnus diosmifolius* (White Dogwood). The groundcover is diverse and includes grasses; *Microlaena stipoides* (Weeping Grass), *Entolasia stricta* (Wiry Panic), *Lomandra longifolia* (Spiny-headed Mat Rush), *Oplismenus imbecillis* (Creeping Beard Grass). Forbs included *Dianella caerulea* var. *producta,* ferns included *Pteridium esculentum* (Common Bracken) and *Calochlaena dubia* (Rainbow Fern), while other growth form group species included *Billardiera scandens* (Hairy Apple Berry). Non-native species *Cordyline australis* (Cabbage Tree) were also present. Invasive exotic species present include *Cinnamomum camphora* (Camphor Laurel), *Lantana camara* (Lantana), *Ligustrum sinense* (Small-leaved Privet), *Ochna serrulata* (Mickey Mouse Plant), *Solanum mauritianum* (Wild Tobacco Bush), *Hedychium gardnerianum* (Ginger Lily), *Asparagus* spp., *Agapanthus* sp., *Ageratina adenophora* (Crofton Weed) and *Cestrum parqui* (Green Cestrum). Photo 3 shows vegetation validated as PCT 3592 adjacent to the southern boundary of the subject land.

Photo 1: Start of 20 m x 20 m floristic plot taken within vegetation at the north east of the subject land

Photo 2: end of the 20 m x 20 m floristic plot within vegetation at the north east of the subject land

Photo 3: Vegetation validated as PCT 3592 Sydney Coastal Enriched Sandstone Forest

1.3. Soil profile

Two soil profiles were undertaken within the subject land to assist in PCT selection justification. One soil profile was taken within proximity to the start of the floristic plot 1 and is referred to as soil profile site 1. The second soil profile was undertaken at the north west boundary of the Subject land. The locations of the soil profiles taken is presented in Figure 3.

Texture assessments at soil profile site 1 (Photo 1) are consistent with the soil being approximately a sandy clay loam to clay loam. The results of the soil profile assessment are that the soil characteristics are consistent with a yellow podzolic soil (Great Soil Group). This soil appeared relatively undisturbed. However, an unusual artifact was present in the earthen wall of the profile trench. The white coloured fragment can be seen in Photo 1. It lies horizontally within the profile and is right of the tape measure near the '10' on the measuring tape. Perhaps some minor disturbance has occurred at this location.

The soil assessment at soil profile site 2 recorded fill in the soil sample. Additionally, the A horizon was relatively thin and it overlayed a very hard B/C horizon. The soil at site 2 shows evidence of significant disturbance, with blue metal gravel and concrete fragments (See Photo 2).

Photo 1: Soil profile site 1

Photo 2: Soil profile site 2

Figure 3: ELA validated Plant Community Types within the subject land.

1.4. Quantitative analysis

Quantitative analysis was completed, using the Hager/Steenebeeke 2010 analysis excel spreadsheet for each vegetation integrity plot to determine the best fit PCT using standardised ratio comparison positive native to total native score. This analysis uses the diagnostic species as described by Tozer (2003) and Tozer (2010). Vegetation integrity plot 1 has undergone historical disturbance and contained only a small number of native species. Plot 2 had a greater number of native species recorded during floristic survey. The analysis is provided in Appendix B.

1.5. PCT selection justification

Plant Community Type (PCT) justifications are provided for PCT 3262 validated by ELA.

The following inputs were used to build queries in the BioNet Vegetation Classification Dataset (DPE 2023) for the vegetation within the north-east portion of the subject land:

- IBRA region text contains 'Sydney Basin'
- IBRA subregion text contains 'Cumberland'
- Vegetation Formation text contains 'Dry Sclerophyll Forests (Shrubby sub-formation) AND 'Dry Sclerophyll Forests (Shrub/grass sub-formation) AND 'Wet Sclerophyll Forests (Shrubby sub-formation AND 'Wet Sclerophyll Forests (Grassy sub-formation).
- Species text contains '*Eucalyptus pilularis, Elaeocarpus reticulatus*, *Dianella caerulea* var. *producta, Lobelia purpurascens, Melia azedarach, Microlaeana stipodies, Oplismenus aemulus, Ozothamnus diosmifolius, Oxalis* sp., *Digitaria* sp., *Dichondra repens, Cynodon dactylon, Commelina cyanea, Centella asicatica, Aristida vagans* and *Entolasia stricta'.*

The outputs of this query provided a preliminary list of potential PCTs. The PCTs were then further investigated by comparing the matches of upper stratum species listed in the BioNet Vegetation Classification for those PCTs against the species recorded within plots for each vegetation zone. The descriptive attribute of the PCTs, landscape position and information on dominant soils or geology, average annual rainfall and elevation above sea level was also considered.

Other documentation consulted to assist in PCT selection included

- Final determination - Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion - critically endangered ecological community listing (NSW Threatened Species Scientific Committee 2019).
- Sydney turpentine ironbark forest - endangered ecological community profile (NSW Department of Environment and Conservation)
- Best practice guidelines for Sydney Turpentine Ironbark Forest (Department of Environment and Climate Change NSW 2008).
- Turpentine-Ironbark Forest of the Sydney Basin Bioregion Advice to the Minister for the Environment and Heritage from the Threatened Species Scientific Committee (TSSC) on amendments to the List of Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (2005).
- Approved Conservation Advice for Turpentine–Ironbark Forest in the Sydney Basin Bioregion (2014)

- Tozer, M (2003). The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities. *Cunninghamia* 8, 1–75.
- Tozer, et al. (2010). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands. *Cunninghamia* 11(3).
- The NSW State Vegetation Type Map (DPE 2022)
- Department of Planning and Environment (DPE) 2023a, eSPADE online tool. Available: https://www.environment.nsw.gov.au/eSpade2Webapp (Accessed June 2023).
- Department of Planning and Environment (DPE) 2019. Blue Gum High Forest in the Sydney Basin Bioregion – critically endangered ecological community listing. Available: Blue Gum High Forest in the Sydney Basin Bioregion - critically endangered ecological community listing | NSW Environment and Heritage.
- Preston, B. (SC) and Adam, P. (1995) Describing and listing threatened ecological communities under the *Threatened Species Conservation Act 1995* (NSW): Part 1 – the assemblage of species and the particular area. *Environmental Planning and Law Journal* 21:250 – 263.Justification for the selection of PCT 3262 Sydney Turpentine Ironbark Forest

A number of other PCTs were considered in the selection process for PCT 3262. An analysis of these PCTs is included in Table 2.

Table 2: Other PCTs considered during the selection process for PCT 3262

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
3259	Sydney Coastal Shale-Sandstone Forest	The tree canopy almost always includes *Corymbia gummifera*, very frequently with *Angophora costata*. Species from the stringybarks eucalypt group (*Eucalyptus globoidea, Eucalyptus capitellata* rarely *Eucalyptus sparsifolia*) are also common however rarely with high cover. In contrast *Eucalyptus pilularis* or species from the mahogany eucalypt group (*Eucalyptus resinifera or Eucalyptus umbra*) are occasional however with high cover.	PCT 3259 was considered for selection as the vegetation community occurs within the Sydney Basin bioregion, and Cumberland sub-region and had the same match of species which were entered into the PCT filer query (13 matches). However, it was considered that PCT 3262 is a better fit based on overall species composition and known local occurrence within the Ku-ring-gai LGA. PCT 3259 does list *E. pilularis* as a species which can occasionally occur in this community, with high cover and the PCT does contain similar groundcover species which were collected in the floristic plot. However, the dominant midstory species listed for this community frequently includes *Persoonia levis, Banksia spinulosa, Lomatia silaifolia* with *Acacia myrtifolia* and *Hakea sericea* also common. None of these species were recorded in the floristic plot, which makes PCT 32562 a better fit PCT selection based on the assemblage of species present. Further, another characteristic of this PCT is that it has a grassier ground layer than other coastal sandstone ridgetop forests. *Entolasia stricta* is very frequent, often with a moderate cover, with *Austrostipa pubescens*, *Imperata cylindrica* and *Themeda triandra* with high cover. The vegetation mapped within plot 2 did contain *Entolasia stricta* but only recorded a low cover (0.5) within the 20 m x 20

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			m floristic plot and did not record the presence of *A. pubescens*, *I. cylindrica* nor *T. triandra.* This PCT is not mapped within proximity to the subject land, whilst PCT other PCTs such as 3592, 3595 and 3262 and 3136 are mapped within proximity, making these PCTs potentially better fits for this PCT (DPE 2022).
3594	Sydney Coastal Sandstone Foreshores Forest	The tree canopy is very frequently dominated by *Angophora costata* with occasional local stands of *Eucalyptus botryoides* or rarely other eucalypt species. A sparse taller layer in the mid-stratum commonly includes *Banksia integrifolia* or *Allocasuarina littoralis* and occasionally *Ficus rubiginosa.*	This PCT is described as a tall, occasionally very tall, sclerophyll open forest with a mixed understorey of dry shrubs and mesic small trees found along the foreshores of Sydney's major waterways and coastal escarpments. It is not known within the Ku-ring-gai LGA. Its maximum elevation is 90 m above sea level. Although this PCT had 13 matches against the VIS filtering tool selection criteria, the vegetation within the subject land is not located along major waterways and coastal escarpments. The assemblage of species listed for this community in the VIS contains a high proportion of *Glochidion ferdinandi* (Cheese Tree) and *A. costata. PCT 3594* was not considered to be the best fit PCT for this community.
3592	Sydney Coastal Enriched Sandstone Forest	*Angophora costata* commonly in combination with *Corymbia gummifera* and *Eucalyptus piperita*, with *Eucalyptus pilularis* occasionally locally abundant. A taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis* or *Allocasuarina torulosa.*	This PCT was considered as a potentially strong selection for the vegetation community. PCT 3592 is known to occur within the Sydney Basin Bioregion, Cumberland subregion, and is known to occur within the Ku-ring-gai LGA. The vegetation within the subject land falls within the average annual rainfall for this PCT and elevation ranges above sea level. However the frequently recorded canopy species in this PCT did not occur within the vegetation in the north east portion of the subject land, with only *E. pilularis* and *Allocasuarina littoralis* in common. Further, this PCT is more commonly known to occur on slightly enriched Hawkesbury sandstone soils on sheltered slopes and occasional crests. The soil landscape where this vegetation is found is more likely to lie on the Lucas Heights soil landscape, and its position was on the top of the ridge rather than a sheltered slope. Therefore, PCT 3262 was considered a better fit for this community.
3136	Blue Gum High Forest	The tree canopy very frequently includes a high cover of *Eucalyptus saligna*, commonly with *Eucalyptus pilularis* and occasionally *Syncarpia glomulifera*. The mid-stratum is layered, with a sparse cover of small trees that very frequently includes *Pittosporum undulatum* and occasionally *Elaeocarpus reticulatus.*	Blue Gum High Forest was considered for the selection of PCTs. PCT3136 is known to occur in the Sydney Basin Bioregion, Cumberland Subregion and is known in the Kur-ring-gai LGA and has been previously mapped by DPE 2022 as occurring to the south and west of the subject land. This community is described as a very tall to extremely tall sclerophyll open forest, dominated by either *Eucalyptus pilularis* (Blackbutt) or *E. saligna* (Sydney Blue Gum), with a mean tree height of 39.3 m (±16.2 m) and a mean

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			foliage cover of 30.7% (±13.7%). In areas located close to the shale/sandstone boundary *Angophora costata* (Smooth-barked Apple) is present frequently in the tallest tree layer. The vegetation within the north east of the subject land is tall, and approximately to 20 to 30 m (Naturally Trees 2023), however, would not be considered an extremely tall forest. The vegetation did contain *E. pilularis* as a dominant canopy species within the plot however, lacked *E. saligna* or *A. costata* within this area. Blue Gum High Forest is generally found at altitudes higher than 100 m above sea level on the Hornsby Plateau in the North Shore and northern suburbs of Sydney. The subject land's highest point is approximately 110 m above sea level. Blue Gum High Forest is predominantly restricted to deep soils derived from Wianamatta Shale in high-rainfall areas that receive more than 1100 mm per year. The mean annual rainfall is 1241 mm for the area and is likely situated on Wianamatta Shale, also making this PCT a possible fit for this community. However, this PCT was not selected as the best-fit community due to the understorey species more closely aligning with a drier, understorey of sub-canopy and shrub species which is more representative of 3262 than a more mesic, moist rainforest midstorey and ferny or herbaceous understorey. The soil landscape on the top of the ridge is also mapped as Lucas Heights (shale with fine-grained sandstones) which is more likely to fit PCT 3262 than soils with a deep shale influence. The Arboricultural Impact Appraisal and Method Statement has also included *E. paniculata* as one of the Eucalypt species present within the north-eastern portion of the subject land. *E. paniculata* is listed as one of the characteristic canopy species for Sydney Turpentine ironbark Forest but can also be found on upper slopes of Blue Gum High Forest. Sydney Turpentine Forest and Blue Gum High Forest share many similar characteristics and can be difficult to discern between the two communities, particularly in a modified landscape with a long disturbance history. Quantitative analysis using Hager/Steenebeeke 2010 analysis excel spreadsheet was conducted for each vegetation integrity plot to determine the best fit PCT using standardised ratio comparison positive native to total native score. The score achieved for Sydney Turpentine Forest was (67%) in favour of this community compared to (33%) for Blue Gum High Forest.

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			In summary, PCT 3136 was a possible PCT selection of the vegetation in the north-east of the subject land, however, based on rapid soil texture assessment, review of soil landscape mapping, position on top of the ridgeline, the tall to very tall rather than tall to extremely tall forest (Walker and Hopkins 1990), lack of mesic species in the understorey and comparison of diagnostic species with the Hager/Steenebeeke 2010 analysis excel spreadsheet which incorporates diagnostic species from Tozer 2003 favouring towards Sydney Turpentine Ironbark Forest, PCT 3262 was selected as the best fit PCT for the vegetation in the north-east portion of the subject land.
3258	Sydney Basin Creekflat Blue Gum-Apple Forest	The tree canopy is variable however very frequently includes *Angophora floribunda* in the canopy or as a small tree. Common eucalypts with a high foliage cover are species from the blue gum eucalypt group, *Eucalyptus deanei* or *Eucalyptus saligna*, occasionally in association with stringybark eucalypts including *Eucalyptus eugenioides.*	PCT 3528 is known to occur in the Sydney Basin Bioregion and Cumberland subregion. This vegetation community also had the same number of matches in the PCT filtering tool with 3262. However, the matches more closely aligned with the groundcover species present, the dominant canopy species listed for this community comprise of a number of species which were not recorded within the north-east portion of vegetation within the subject land. PCT 3258 is also described as primarily distributed at elevations of less than 200 m above sea level downslope of shale soils on the north shore of Sydney. The location of the plot was taken on the top of the ridge and was therefore not downslope of shale soils. The location of the plot on top of the flatter ridge aligns more closely with PCT 3262, as described in the final determination where Sydney Turpentine-Ironbark Forest occurs on low rolling hills characteristic of the Cumberland Lowlands and the broad, shale-capped ridges of the surrounding plateaux. Therefore PCT 3258 was considered as a potential fit, however, PCT 3262 is a better fir for the vegetation present within the north east of the subject land.
3262	Sydney Turpentine Ironbark Forest	The tree canopy very frequently includes *Syncarpia glomulifera* either as a canopy dominant or as a smaller tree or both. Other species which are localised and occasionally dominant or co-dominant occasionally include *Eucalyptus pilularis, Angophora costata* and *Eucalyptus punctata*, rarely with *Eucalyptus paniculata, Eucalyptus globoidea* or *Eucalyptus resignifera.*	This community occurs as a tall to very tall sclerophyll open forest found on shale or sheltered shale-sandstone soils mainly in the northern suburbs of Sydney and lower Blue Mountains. This was considered to be the best fit PCT for the vegetation community assessed in Plot 1~~on site~~. This PCT occurs in the Sydney Basin Bioregion and Cumberland subregion, it is known to the Ku-ring-gai LGA and has been previously mapped within proximity to the subject land (DPE 2022). Whilst the vegetation collected in the plot analysis only recorded *Eucalyptus pilularis* as the potentially remnant dominant canopy species, the arborist report also identified that *Eucalyptus paniculata* may occur within this location.

PCT	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			The position of the vegetation is located on the top of a ridge, and the rapid texture assessment undertaken at soil profile site 1 in the vicinity of the plot, was consistent with the soil being approximately a sandy clay loam to clay loam. The results of the soil profile assessment are that the soil characteristics are consistent with a yellow podzolic soil (Great Soil Group). Yellow podzolic soil is a characteristic of the Lucas Heights soil landscape. The vegetation within the north east portion of the subject land is mapped at the boundary of the Lucas Heights and the Hawkesbury soil landscape. The shrub species listed in the VIS for this community were lacking within the vegetation zone, likely due to historical disturbance of the area. However, the groundcover species recorded shared species listed in the VIS for PCT including *Microlaena stipoides* and *Entolasia stricta* and *Lobelia purpurascens* and species located just outside the 20 m x 20 x plot *Lomandra longifolia, Imperata cylindrica, Ozothamnus diosmifolius, Breynia oblongifolia*. Finally, as discussed for Blue Gum High Forest above, the *Hager/Steenebeeke 2010* analysis excel spreadsheet which incorporates diagnostic species from Tozer 2003 favouring towards Sydney Turpentine Ironbark Forest, PCT 3262 was selected as the best fit PCT for the vegetation in the north-east portion of the subject land. Therefore, given the position in the landscape, the assemblage of species present, and the soil characteristics present. PCT 3262 was the best-fit Plant Community Type for this location.

The assemblage of key species, formation characteristics in combination with its known occurrence in the Local Government Area (LGA) of Ku-ring-gai, and occurrence within the Cumberland IBRA-subregion of the Sydney Basin Bioregion aligns with the Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion.

The TEC is known to occur between elevations of 5 m to 460 m above sea level. The elevation of the subject land is approximately 110 m above sea level and therefore falls within the elevation range for this TEC.

The TEC is known to occur in areas with annual rainfall between 806 mm to 1256 mm. The average annual rainfall taken from BOM Station data at the Gordon Golf Club (66120) with the mean annual rainfall 1241 for the area. The subject land falls within the range of average annual rainfall for this TEC.

The vegetation is located on top of a ridge on the boundary between the Lucas Heights soil landscape and is in close proximity to the Hawkesbury soil landscape. The Lucas Heights soil landscape is characterised by gently undulating crests and ridges on plateau surfaces of the Mittagong formation (alternating bands of shale and fine-grained sandstones). The soils associated with this soil landscape are moderately deep (50–150 cm), hardsetting Yellow Podzolic Soils and Yellow Soloths (Figure 4). A rapid soil analysis (Soil profile site 1) taken in close proximity to the floristic plot 1 found that the texture assessments were consistent with the soil being approximately a sandy clay loam to clay loam. The results of the soil profile assessment are that the soil characteristics are consistent with a yellow podzolic soil (Great Soil Group).

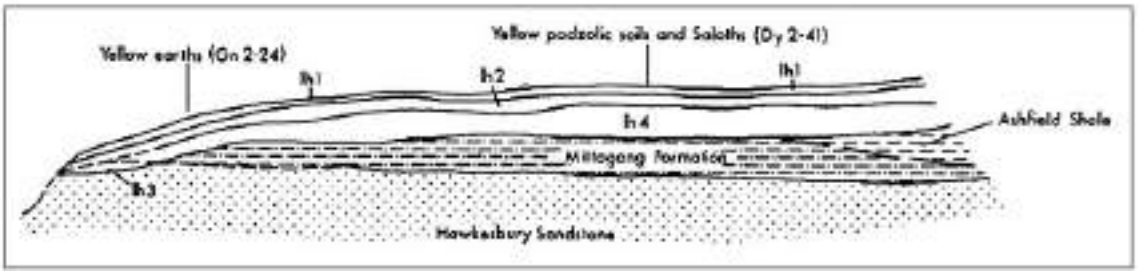

Figure 4: Schematic cross-section of Lucas Heights soil landscape illustrating the occurrence and relationship of the dominant soil materials.

The rapid soil assessment undertaken at soil profile site 1 suggests a clay influence in the soils, which is consistent with the occurrence of Sydney Turpentine Ironbark Forest which is known to occur on soils derived from shale interbedded with Hawkesbury Sandstone.

An additional desktop assessment of online mapping was undertaken to assist the assessment. Figure 5_below shows the Sydney Metro Vegetation Map (SMVM; OEH 2016) for the locality. Many of the vegetation polygons (small patches) were allocated to a PCT (vegetation community) based on a site inspection by the authors of the SMVM. However, it is likely that other parameters may have been used to allocate vegetation to a likely PCT. A trend that can be observed on Figure 5 is that Sydney Turpentine (PCT1281) is mapped on the western side of the site (approximately to the left of the blue line) and Smooth-barked Apple – Red Bloodwood – Blackbutt tall open forest on shale sandstone transition soils in eastern Sydney (PCT1845) is mapped to the east (right-side) of the line.

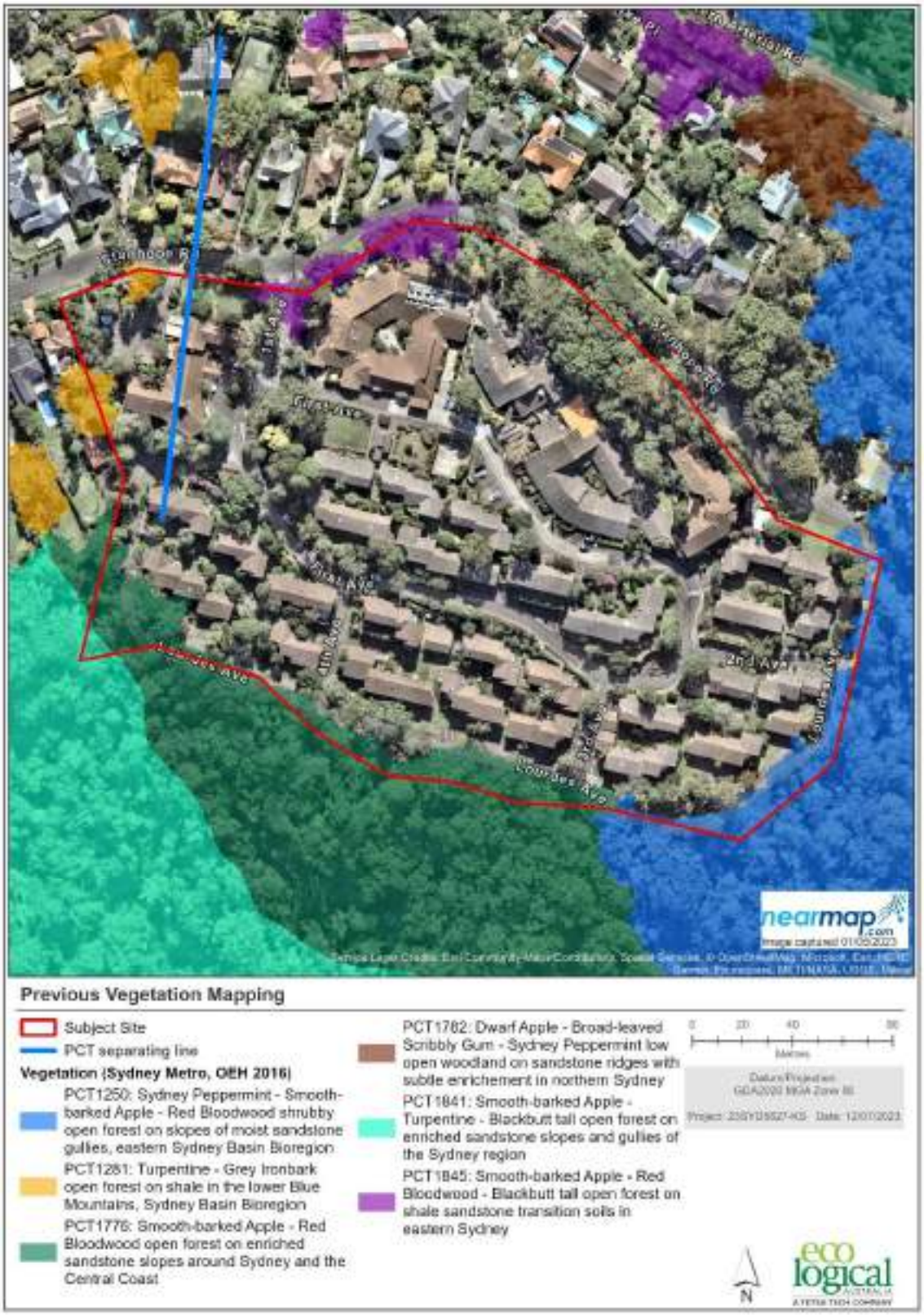

Figure 5: Sydney Metro Vegetation Mapping 2016 for the locality.

A possibility is that modelled soil types may have been used to assist in allocating each polygon (small patch) to a PCT. Figure 6 shows Great Soil Group (GSG) mapping for the locality at 1:75,000 scale. This scale was chosen as it is consistent with the scale of GSG mapping provided on the NSW eSpade website.

The site lies near the boundary of Yellow Podzolic Soils (less fertile) and Siliceous Sands (Figure 6). One difference between these two soil types is that podzolic soils will generally have a higher clay content compared to siliceous sand soils. The real boundary / transition zone between these two soil types in the locality is unknown. If the boundary / transition zone between the two soil types is present it is likely that there would be a corresponding change in the PCT.

If a plot is used for the determination of a PCT then strictly only the plot can be allocated to a PCT. However, nearby similar vegetation is highly likely to represent the same PCT.

At the location of plot 1 both the vegetation within the plot and adjacent to the plot has experienced disturbance. A gradual change in the vegetation community might not be obvious.

The area to the south-east of the plot but within the polygon (small patch) has also been allocated to Sydney Turpentine Ironbark Forest PCT 3262 (see Figure 3) by ELA. The most useful species for selecting a PCT in forest and woodland are often remnant trees. The majority of the trees within this area are the planted species *Eucalyptus microcorys* (Tallowwood). The lack of remnant trees within parts of the patch make a confident allocation of PCT difficult for the whole patch. No obvious change is PCT was observed at within the patch however, the lack of indigenous tree species makes any transition more difficult to observe. If a change or transition in soil type occurs within the patch, parts of the patch may represent different PCTs.ELA did not determine the boundary between PCTs within the site and nearby. This can be a difficult task. Preston and Adam (2004) quoted Hodgson JA to emphasise the difficulties defining ecological community boundaries:

> '*There will often be cases where there are areas of transition between one ecological community, broadly considered, and another ecological community, where species which are part of each ecological community occur. Precise determination of whether those species in the transitional area are to be regarded as part of one ecological community or of the other, or of neither, will be incapable of precise and definite determination.'*

Figure 6: Great Soil Group (GSG) mapping for the locality.

The following inputs were used to build queries in the Vegetation Classification for the vegetation directly adjacent to the south of the subject land, with the intention of providing a best-fit PCT for the vegetation within the southern boundary of the subject land.

- IBRA region text contains 'Sydney Basin'
- IBRA subregion text contains 'Cumberland'
- Vegetation Formation text contains 'Dry Sclerophyll Forests (Shrubby sub-formation) AND 'Dry Sclerophyll Forests (Shrub/grass sub-formation) AND 'Wet Sclerophyll Forests (Shrubby sub-formation AND 'Wet Sclerophyll Forests (Grassy sub-formation).
- Species text contains '*Acacia ulicifolia, Allocasuarina littoralis, Angophora costata, Billardiera scandens, Calochlaena dubia, Ceratopetalum gummiferum, Corymbia gummifera, Dianella caerulea* var. *producta, Dodonaea triquetra, Elaeocarpus reticulatus, Entolasia marginata, Entolasia stricta, Eucalyptus pilularis, Ficus spp., Glochidion ferdinandi var. ferdinandi, Hypolepis muelleri, Juncus usitatus, Leucopogon juniperinus, Lindsaea microphylla, Lobelia purpurascens, Lomandra filiformis* subsp. *filiformis, Lomandra longifolia, Microlaena stipoides, Oplismenus imbecillis, Ozothamnus diosmifolius, Parsonsia straminea, Pittosporum undulatum, Plectranthus parviflorus, Pteridium esculentum, Pultenaea flexilis, Smilax glyciphylla, Veronica plebeia, Zieria smithii, Polyscias sambucifolia, Syncarpia glomulifera* subsp. *glomulifera, Xanthorrhoea media, Helichrysum elatum* and *Sigesbeckia orientalis* subsp. *orientalis'*

1.5.1. Justification for the selection of PCT 3592 Sydney Coastal Enriched Sandstone Forest

A number of other PCTs were considered in the selection process for PCT 3592 Sydney Coastal Enriched Sandstone Forest. An analysis of these PCTs is included in Table 3.

Table 3: Other PCTs considered during the selection process for PCT 3592

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
3136	Blue Gum High Forest	The tree canopy very frequently includes a high cover of *Eucalyptus saligna*, commonly with *Eucalyptus pilularis* and occasionally *Syncarpia glomulifera*. The mid-stratum is layered, with a sparse cover of small trees that very frequently includes *Pittosporum undulatum* and occasionally *Elaeocarpus reticulatus.*	Blue Gum High Forest was considered for the section of PCTs. 3136 is known to occur in the Sydney Basin Bioregion, Cumberland Subregion is known to the Kur-ring-gai LGA and has been previously mapped by DPE 2022 as occurring to the south and west of the subject land. This community is described as a very tall to extremely tall sclerophyll open forest, dominated by either *Eucalyptus pilularis* (Blackbutt) or *E. saligna* (Sydney Blue Gum), with a mean tree height of 39.3 m (±16.2 m) and a mean foliage cover of 30.7% (±13.7%). In areas located close to the shale/sandstone boundary *Angophora costata* (Smooth-barked Apple) is present frequently in the tallest tree layer. The vegetation within the north east of the subject land is tall, and approximately to 20 to 30 m (Naturally Trees 2023), however, would not be considered an extremely tall forest. The vegetation did contain *E. pilularis* as a dominant canopy species within the plot however, lacked *E. saligna*. Blue Gum High Forest is generally found at altitudes higher than 100 m above sea level on the Hornsby Plateau in the North Shore and northern

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			suburbs of Sydney. The location of the vegetation community on the downhill slope is situated at approximately 92 m above sea level. This community is slightly below the altitudes in which Blue Gum High Forest is found. Quantitative analysis using Hager/Steenebeeke 2010 analysis excel spreadsheet was conducted for each vegetation integrity plot to determine the best fit PCT using standardised ratio comparison positive native to total native score. The total number of diagnostic species for Blue Gum High Forest was 14 while it was 20 for other communities such as STIF and Hinterland sandstone Gully Forest. In summary, PCT 3136 was a possible PCT selection of the vegetation in the north-east of the subject land, however, elevation of the vegetation within the landscape, the tall rather than extremely tall forest, and comparison of diagnostic species with the Hager/Steenebeeke 2010 analysis excel spreadsheet which incorporates diagnostic species from Tozer 2003 and Tozer 2010 favouring towards either Sydney Turpentine Ironbark Forest, or Sydney Hinterland Gully Forest were considered as other options for the vegetation in the north-east portion of the subject land.
3595	Sydney Coastal Sandstone Gully Forest	A tall to very tall heathy sclerophyll open forest associated with Hawkesbury sandstone gullies found along the eastern extent of the Sydney sandstone plateaus. The tree canopy very frequently includes a high cover of *Eucalyptus piperita* and *Angophora costata* with *Corymbia gummifera* occurring less frequently and with a lower cover. The mid-stratum includes a sparse small tree layer that very frequently includes *Ceratopetalum gummiferum* and *Banksia serrata*	PCT 3595 is known to occur in the Sydney Bioregion and Cumberland subregion, this PCT had the highest number of diagnostic species present in the Quantitative (Tozer) analysis along with STIF. This PCT had the third highest number of matches against the VIS PCT filtering tool, following 3592 and 3262. Therefore this PCT was considered during the selection process, however was not selected as the best fit PCT for this community as; the position of the vegetation in the landscape was mid-slope and not within the gully, the dominant canopy did not record any *E piperita* and had contained *E. pilularis,* which is not a frequently recorded species for this community in the VIS Species by Growth Form. PCT 3595 is also described as a heathy sclerophyll open forest, whereas this community was considered to be less of a heath community and lacked some of the dominant species for this community such as *Leptospermum trinervium*, *Dillwynia retorta*, *Lomatia salicifolia* and *Persoonia spp.*. Another feature of PCT 3595 is the high occurrence of *B. serrata,* the plot data did not record any *B. serrata*
3262	Sydney Turpentine Ironbark Forest	The tree canopy very frequently includes *Syncarpia glomulifera* either as a canopy dominant or as a smaller tree or both. Other species	This PCT occurs in the Sydney Basin Bioregion and Cumberland subregion, it is known to the Ku-ring-gai LGA and was validated as the best fit PCT for the vegetation community at the top of the subject land.

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
		which are localised and occasionally dominant or co-dominant occasionally include *Eucalyptus pilularis, Angophora costata* and *Eucalyptus punctata*, rarely with *Eucalyptus paniculata, Eucalyptus globoidea* or *Eucalyptus resignifera.*	This PCT had the second highest number of matches in the PCT VIS filtering tool and received the same number of diagnostic species in the Quantitative (Tozer) analysis of plot 2 data, therefore this PCT was considered in the selection process for the vegetation in the south of the subject land. Whilst the canopy species recorded similar dominant canopy species, being *Syncarpia glomulifera Eucalyptus pilularis* and *Angophora costata,* the diversity of canopy species present in this community was higher and also included, Corymbia gummifera and a smaller canopy of *Pittosporum undulatum* and *Allocasuarina littoralis. The mdstory and groundcover layer was also much more mesic* compared to the vegetation at the top of the ridge and had a high diversity and cover of ferns and forbs. Sydney Turpentine Ironbark Forest is also known to occur on the ridgetops or crests in the landscape whereas this vegetation community was located downslope of the ridgetop and is also more likely to occur on Hawkesbury sandstone soils, both features favour the selection of a sandstone community rather than a vegetation community with a shale influence. Due to the assemblage of species present, position in the landscape and likely soils present, PCT 3592 was selected as a better fit for this community than Sydney Turpentine Ironbark Forest
3592	Sydney Coastal Enriched Sandstone Forest	*Angophora costata* commonly in combination with *Corymbia gummifera* and *Eucalyptus piperita*, with *Eucalyptus pilularis* occasionally locally abundant. A taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis* or *Allocasuarina torulosa.*	This PCT was selected as the best fit PCT for the vegetation community within the vegetation directly adjacent the southern boundary of the subject land. This PCT had the highest number of matches (34) in the VIS PCT filtering tool. Followed by the other PCTs compared; 3262 with 33 matches and PCT 3595 with 32 matches. The description of the dominant upper stratum species listed in the VIS for this PCT shared many of the same species including *A.costata* commonly in combination with *Corymbia gummifera, E.pilularis, A. littoralis* and *P.undulatum.* PCT 3592 is known to occur within the Sydney Basin Bioregion, Cumberland subregion, and is known to occur within the Ku-ring-gai LGA. The vegetation within the subject land falls within the average annual rainfall for this PCT and elevation ranges above sea level. However the frequently recorded canopy species in this PCT did not occur within the vegetation in the north east portion of the subject land, with only *E. pilularis* and *Allocasuarina littoralis* in common. Further, this PCT is more commonly known to occur on slightly enriched Hawkesbury sandstone soils on sheltered slopes and occasional crests. The soil landscape is

PCT no.	PCT Name	Dominant upper stratum species listed in the VIS	Discussion
			also likely to be Hawkesbury soil landscape, as mapped by ESspade which is more aligned with the description of this PCT occurring on Hawkesbury sandstone, rather than the likely more clay influenced Lucas heights soil landscape at the top of the ridge. The position of this vegetation within the landscape is also downslope of the ridge but it positioned higher than the gully, also matching the PCT description in the VIS for this community. Considering the assemblages of species present, the soil landscape and position in the landscape, along with the Quantitative plot analysis (Tozer) favouring a sandstone influenced community, PCT3592 was considered to be the best fit PCT to assign to this vegetation community.

1.6. Threatened ecological communities

There is one threatened ecological community (TEC) within the subject land. The listing status of the TEC and consistency of PCTs with the TECs is provided in Table 4.

PCT 3262 is consistent with the critically threatened ecological community (TEC) *Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion*. This community is critically endangered under the *Biodiversity Conservation Act 2016* (BC Act). It is also noted that this community is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), where it meets specific condition thresholds.

Occurrences of the Turpentine–Ironbark Forest in the Sydney Basin Bioregion ecological community are considered to be part of the nationally listed ecological community if patches are in good condition (Conservation Advice 2014).

'Good condition is generally determined as:

- *the vegetation has some characteristic components from all structural layers (tree canopy, small tree/shrub midstorey, and understorey); and*
- *the tree canopy cover is greater than 10%; and*
- *the patch size is greater than one hectare.*

However, patches with a tree canopy cover of less than 10% are also included in the ecological community, if:

- *the patch of the ecological community is greater than one hectare in size; and*
- *it is part of a remnant of native vegetation that is 5 hectares or more in area.'*

The plot data collected had structural characteristic components from all structural layers. The plot data collected also had a tree canopy cover of approximately 85%.

Eco Logical Australia have only validated the patch of Sydney Turpentine Ironbark Forest within the north east of the subject land and cannot comment if Sydney Turpentine Ironbark Forest is present in patches directly adjacent to the north east of the subject land and are therefore unable to comment if the Sydney Turpentine Ironbark Forest within the subject land meets the condition threshold to be listed as the Commonwealth listed community. That is, if the patch identified is greater than 1 ha in size or is part of remnant vegetation that is 5 ha or more in area. Further plot data and validation of vegetation in surrounding areas adjacent to the subject land would be required to determine whether the Sydney Turpentine Ironbark Forest on site meets the EPBC Act definition of this community.

PCT 3592 Sydney Coastal Enriched Sandstone Forest identified is not associated with any threatened ecological communities under the BC and or EPBC Acts.

Table 4: Threatened ecological communities present within the subject land

PCT ID	PCT Name	BC Act listing status and name	BC Act Associated TEC justification	EPBC Act listing status and name	EPBC Act Associated TEC justification
3262	Sydney Turpentine Ironbark Forest	Critically endangered - *Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion*	Yes – the PCT meets characteristic of the BC Act listed TEC. The assemblage of key species, formation characteristics in combination with its known occurrence in the Local Government Area (LGA) of Ku-ring-gai, and occurrence within the Cumberland IBRA-subregion of the Sydney Basin Bioregion aligns with the Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion.	Critically *endangered – Turpentine-Ironbark Forest of the Sydney Basin Bioregion*	Potential - see Section 1.6. Insufficient time for ELA to collect data to inform EPBC Act condition criteria listing.
3592	Sydney Coastal Enriched Sandstone Forest	Not listed	N/A	Not listed	N/A

The final determination for Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion listed as critically endangered under the NSW BC Act. Defines this community:

> *Section 1.6 of the Act defines an ecological community as "an assemblage of species occupying a particular area". These features of Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion are described in Parts 1 and 2 of this Determination, respectively.*

Presented in Table 5 below are the Parts 1, 2 and 4 listed in the final determination for this ecological community and a review against characteristics of the subject land to determine if the vegetation on site is likely to conform to the TEC.

Table 5: Parts presented in the Final Determination for Sydney Turpentine Ironbark Forest and review against characteristics of the subject land

Part 1. Assemblage of species	
Sydney Turpentine-Ironbark Forest in the Sydney Basin Bioregion (hereafter referred to as Sydney Turpentine-Ironbark Forest) is characterised by the assemblage of species listed below. The species collected in Plot 1 along with those species recorded around the edge of the floristic plot within the north-east of the subject land are highlighted in **bold** text.	
Acacia falcata	*Acacia floribunda*
Acacia implexa	***Acacia longifolia***
Acacia parramattensis	*Adiantum aethiopicum*
Allocasuarina torulosa	*Angophora costata*
Anisopogon avenaceus	***Aristida vagans***
Arthropodium milleflorum	*Austrostipa pubescens*
Austrostipa rudis	*Billardiera scandens*
Breynia oblongifolia	*Brunoniella australis*
Brunoniella pumilio	*Bursaria spinosa*
Cayratia clematidea	***Centella asiatica***
Cheilanthes sieberi	*Clematis aristata*
Clematis glycinoides var. *glycinoides*	*Clerodendrum tomentosum*
Commelina cyanea	*Daviesia ulicifolia*
Denhamia silvestris	*Desmodium rhytidophyllum*
Desmodium varians	***Dianella caerulea***
Dianella longifolia	*Dichelachne inaequiglumis*
Dichelachne rara	***Dichondra* spp.**
Digitaria parviflora	*Dodonaea triquetra*
Doodia aspera	*Echinopogon caespitosus* var. *caespitosus*
Echinopogon ovatus	*Einadia hastata*
Elaeocarpus reticulatus	*Entolasia marginata*
Entolasia stricta	*Eucalyptus acmenoides*
Eucalyptus fibrosa	*Eucalyptus globoidea*
Eucalyptus notabilis	***Eucalyptus paniculata* subsp. *paniculata* (likely present)**
Eucalyptus pilularis	*Eucalyptus punctata*
Eucalyptus resinifera subsp. *resinifera*	*Eucalyptus saligna* X *E. botryoides*
Eustrephus latifolius	*Exocarpos cupressiformis*
Gahnia aspera	*Geranium solanderi* var. *solanderi*
Glochidion ferdinandi var. *ferdinandi*	*Glycine clandestina*
Glycine microphylla	*Glycine tabacina*
Gonocarpus tetragynus	*Goodenia hederacea* subsp. *hederacea*
Goodenia heterophylla	*Hibbertia aspera* subsp. *aspera*
Hibbertia diffusa	*Hydrocotyle sibthorpioides*
Imperata cylindrica	*Indigofera australis*
Kennedia rubicunda	*Kunzea ambigua*
Lepidosperma laterale	*Leucopogon juniperinus*
Lindsaea microphylla	*Lomandra filiformis* subsp. *filiformis*
Lomandra longifolia	***Microlaena stipoides***
Myrsine variabilis	*Notelaea longifolia* forma *longifolia*
Opercularia hispida	*Opercularia varia*

Oplismenus aemulus	*Oplismenus imbecillis*
Oxalis exilis	***Ozothamnus diosmifolius***
Pandorea pandorana	*Panicum simile*
Paspalidium distans	*Passiflora herbertiana* subsp. *herbertiana*
Persoonia linearis	*Pittosporum revolutum*
Pittosporum undulatum	*Poa affinis*
Poa sieberiana var. *sieberiana*	*Polyscias sambucifolia*
Pomaderris intermedia	*Poranthera microphylla*
***Pratia purpurascens* *(now *Lobelia purpurascens*)**	*Pseuderanthemum variabile*
Pultenaea villosa	*Rubus parvifolius*
Rumex brownii	*Sarcopetalum harveyanum*
Sigesbeckia orientalis subsp. *orientalis*	*Smilax australis*
Smilax glyciphylla	*Solanum prinophyllum*
Syncarpia glomulifera subsp. *glomulifera*	*Themeda triandra*
Trema tomentosa var. *viridis*	*Tylophora barbata*
Veronica plebeia	*Zieria smithii*

Of the 112 species listed in the final determination for this ecological community. There are 18, (potentially 19) species present in the north east perimeter of the subject land. This is a promising indication for this community to meet the TEC listing given the general lack of understorey species present due to historical land disturbance.

Part 2. Particular area occupied by the ecological community occupied by Sydney Turpentine Ironbark Forest as listed in the final determination against the characteristics of the subject land

2.1.1 The assemblage of species listed in Part 1.1 above which characterises the Sydney Turpentine-Ironbark Forest occurs within the Sydney Basin Bioregion	The subject land occurs within the Sydney Basin IBRA region and is consistent with the final determination.
2.2 It is the intent of the NSW Threatened Species Scientific Committee that all occurrences of the ecological community (both recorded and as yet unrecorded, and independent of their condition) that occur within this bioregion be covered by this Determination.	Given the information collected over one rapid field day, and review of existing mapping and information collected on soil landscapes that the vegetation within the subject land may be included as the TEC due to the assemblage of species present and the location of this vegetation within the Sydney Basin Bioregion, despite the disturbance history at this location.

Part 4 Additional information about the ecological community. The following information is additional to that required to meet the definition of an ecological community under the Act but is provided to assist in the recognition of the Sydney Turpentine- Ironbark Forest in the Sydney Basin Bioregion

4.1 Sydney Turpentine-Ironbark Forest typically has the structural form of Open Forest (*sensu* Specht 1970) with a tree canopy ranging in height from the mid to upper range for this form (10-30 m) and with projected foliage cover at the mid to lower end of the range (30-50%)	The structure of the vegetation within the north east portion of the subject land had an open forest structure and ranged between 20 to 30 m in height, which fits the description of the TEC. However, the projected foliage cover recorded in plot 1 was 85.1%. Which is considerably higher than that listed in the final determination for the community, which the upper limit is around 50%.
4.2 Sydney Turpentine-Ironbark Forest has been reported as occurring in areas receiving moderate rainfall (900-1100 mm) on soils derived either from Wianamatta Shale or from Wianamatta Shale interbedded with Hawkesbury Sandstone (Benson and Howell 1994, Tozer 2003). In most of these locations STIF occurs up to approximately 100 m above sea level although it is found as high as 200 m above sea level on the western edge of the Hornsby Plateau where average annual rainfall falls below 1050 mm (Tozer 2003).	The subject land's highest point is approximately 110 m above sea level where the Plot 1 floristic data was collected. The subject land is mapped as occurring on the Lucas Heights soil landscape which contains Yellow Podzolic Soils which are likely overlain on Ashfield Shale from the Mittagong formation which contains alternating bands of shale and fine-grained sandstones which is over Hawkesbury Sandstone. The average annual rainfall taken from BOM Station data at the Gordon Golf Club (66120) with the mean annual rainfall 1241 for the area. The subject land falls within the range of average annual rainfall for this TEC.
4.3 Sydney Turpentine-Ironbark Forest occurs on low rolling hills characteristic of the Cumberland Lowlands and the broad, shale-capped ridges of the surrounding plateaux.	The landscape position of the vegetation was located on the top of the ridge, which is consistent with the shale-capped ridges as described in the Final Determination.

4.5 Based on plot samples analysed by Tozer et al. (2010), species which have been recorded more frequently in Blue Gum High Forest (WSFp153) compared with STIF (WSFp87) include, in decreasing order of diagnostic power*, *Platylobium formosum, Calochlaena dubia, Alphitonia excelsa, Smilax glyciphylla, Morinda jasminoides, Blechnum cartilagineum and Marsdenia rostrata.* **Species which have been recorded more frequently in STIF include,** in decreasing order of diagnostic power*, *Clematis glycinoides* var. *glycinoides, Solanum prinophyllum,* ***Glycine microphylla,*** *Bursaria spinosa, Echinopogon caespitosus* var. *caespitosus, Eucalyptus punctata, Acacia parramattensis, Panicum simile,* ***Centella asiatica, Acacia floribunda,*** *Hydrocotyle sibthorpioides, Veronica plebeia,* ***Aristida vagans****, Lomandra filiformis* subsp. *filiformis* and *Billardiera scandens.*	The vegetation within the north east boundary contains the highlighted in bold diagnostic species recorded more frequently in Sydney Turpentine Ironbark Forest than Blue Gum High Forest
4.7 Sydney Turpentine-Ironbark Forest is characterised by a number of frequently recorded species which are highly diagnostic of STIF but are much less frequently recorded in samples of the adjacent Sandstone Ridgetop Woodland and Sandstone Gully Forest (map units DSFp131 and DSFp142 of Tozer et al. (2010). These include, in decreasing order of diagnostic power*, ***Pratia purpurascens, Dichondra* spp**., *Eustrephus latifolius, Oplismenus imbecillis, Entolasia marginata,* ***Breynia oblongifolia****, Pittosporum undulatum, Bursaria spinosa, Hibbertia aspera* subsp. *aspera,* ***Imperata cylindrica,*** *Clematis glycinoides var. glycinoides, Pseuderanthemum variabile,* ***Ozothamnus diosmifolius****, Adiantum aethiopicum, Notelaea longifolia* forma *longifolia, Pittosporum revolutum, Solanum prinophyllum, Echinopogon caespitosus* var. *caespitosus,* ***Leucopogon juniperinus, Glycine microphylla,*** *Acacia parramattensis,* ***Oplismenus aemulus****, Panicum simile, Myrsine variabilis,* ***Acacia floribunda****, Echinopogon ovatus, Themeda triandra, Clerodendrum tomentosum, Tylophora barbata, Veronica plebeia* and ***Aristida vagans*** (Tozer et al. 2010).	A number of the highly diagnostic species of STIF listed, were recorded within the north portion of vegetation within the subject land, as highlighted in bold text.
Considering all the information above, it was determined that PCT 3262 was likely to fit the descriptions of Part 1, 2 and additional information in Part 4 of the Final Determination to list assign PCT 3262 as *Sydney Turpentine Ironbark Forest of the Sydney Basin Bioregion*.	

Appendix A Vegetation floristic plot data

Two full floristic plots were undertaken as part of the assessment of PCTs. One plot (Plot 1) was undertaken within vegetating to the north-eastern portion of the subject land. Plot 2 was undertaken in vegetation directly adjacent to the south of the subject land. Table 6 presents the locations of the plots and Table 7 contains the floristic plot data collected.

Table 6: Plot locations

Plot ID	PCT ID	PCT Name	Zone	Eastings	Northings	Bearing
Plot 1	3262	Sydney Turpentine Ironbark Forest	56	330986	6262320	117
Plot 2	3592	Sydney Coastal Enriched Sandstone Forest	56	330808	6262153	90

Table 7: 20 m x 20 m full floristic plot data taken for Plot 1 and Plot 2.

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Acacia implexa	Hickory Wattle			Shrub (SG)				M	3	2
Acacia ulicifolia	Prickly Moses			Shrub (SG)				G	0.1	1
Acer spp.		*			G	0.1	1			
Agapanthus spp.		*						G	4	20
Ageratina adenophora	Crofton Weed	*	1					G	0.1	2
Allocasuarina littoralis	Black She-Oak			Tree (TG)				U	5	2
Angophora costata	Sydney Red Gum			Tree (TG)				U	25	8
Araujia sericifera	Moth Vine	*	1		G	0.1	1			
Aristida vagans	Threeawn Speargrass			Grass & grasslike (GG)	G	0.1	10			
Asparagus aethiopicus	Asparagus Fern	*	1		G	8	50	G	0.1	1
Asparagus spp.		*						G	0.1	10
Bidens pilosa var. *pilosa*		*			G	0.1	1	G	0.1	1
Billardiera scandens	Hairy Apple Berry			Other (OG)				G	0.2	5
Bromus catharticus	Praire Grass	*			G	0.1	1			
Calochlaena dubia	Rainbow Fern			Other (OG)				G	35	100
Centella asiatica	Indian Pennywort			Forb (FG)	G	0.1	10			
Ceratopetalum gummiferum	Christmas Bush			Tree (TG)				M	2	5
Cestrum parqui	Green Cestrum	*	1					G	0.1	1

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Chlorophytum spp.		*			G	0.2	1			
Cinnamomum camphora	Camphor Laurel	*	1		G	0.1	1	G	3	2
Corymbia gummifera	Red Bloodwood			Tree (TG)				U	2	1
Cirsium vulgare	Spear Thistle	*			G	0.1	1			
Commelina cyanea	Native Wandering Jew			Forb (FG)	G	0.1	10			
Conyza spp.	A Fleabane	*			G	0.1	1	G	0.1	1
Cordyline australis				Other (OG)				G	0.5	1
Coronidium elatum subsp. *elatum*				Shrub (SG)				G	0.2	1
Corymbia gummifera	Red Bloodwood			Tree (TG)				U		
Cotoneaster spp.		*	1					G	0.1	5
Cynodon dactylon	Common Couch			Grass & grasslike (GG)	G	0.1	1			
Dianella caerulea var. *producta*				Forb (FG)	G	8	50	G	0.2	10
Dichondra repens	Kidney Weed			Forb (FG)	G	0.1	10			
Dietes spp.				Forb (FG)	G	0.1	1			
Digitaria spp.	A Finger Grass			Grass & grasslike (GG)	G	0.1	100			
Dodonaea triquetra	Large-leaf Hop-bush			Shrub (SG)				G	0.2	1
Ehrharta erecta	Panic Veldtgrass	*	1		G	1	100			
Elaeocarpus reticulatus	Blueberry Ash			Shrub (SG)	M	4	1	M	2	5
Entolasia marginata	Bordered Panic			Grass & grasslike (GG)				G	0.1	1

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Entolasia stricta	Wiry Panic			Grass & grasslike (GG)	G	1	100	G	0.5	1000
Eucalyptus microcorys	Tallowwood			Tree (TG)	U	15	4			
Eucalyptus sp.				Tree (TG)	U	50	8			
Eucalyptus pilularis	Blackbutt			Tree (TG)	U	20	1	U	35	2
Ficus rubiginosa	Port Jackson Fig			Tree (TG)				G	0.1	1
Geranium spp.				Forb (FG)				G	0.1	5
Glochidion ferdinandi var. *ferdinandi*	Cheese Tree			Tree (TG)				G	0.1	1
Hedychium gardnerianum	Ginger Lily	*						G	0.2	5
Hydrocotyle tripartita	Pennywort			Forb (FG)				G	0.1	1
Hypolepis muelleri	Harsh Ground Fern			Fern (EG)				G	0.1	1
Jacaranda spp.		*			G	0.1	2			
Juncus usitatus				Grass & grasslike (GG)				G	0.2	2
Lantana camara	Lantana	*	1					G	0.1	1
Leucopogon juniperinus	Prickly Beard-heath			Shrub (SG)				M	2	5
Ligustrum sinense	Small-leaved Privet	*	1					G	0.1	2
Lindsaea microphylla	Lacy Wedge Fern			Fern (EG)				G	0.1	1
Lobelia purpurascens	whiteroot			Forb (FG)	G	0.2	100	G	0.1	20
Lomandra filiformis subsp. *filiformis*				Grass & grasslike (GG)				G	0.1	2
Lomandra longifolia	Spiny-headed Mat-rush			Grass & grasslike (GG)				G	10	50

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Melia azedarach	White Cedar			Tree (TG)	G	0.1	1			
Microlaena stipoides var. *stipoides*	Weeping Grass			Grass & grasslike (GG)	G	0.5	100	G	1	50
Nephrolepis cordifolia	Fishbone Fern			Fern (EG)				G	0.1	10
Ochna serrulata	Mickey Mouse Plant	*	1		G	0.5	1	G	0.1	5
Oplismenus aemulus				Grass & grasslike (GG)	G	0.1	10			
Oplismenus imbecillis				Grass & grasslike (GG)				G	0.2	100
Acianthus spp.	Mosquito Orchid			Forb (FG)				G	0.2	4
Osteospermum spp.	South African daisy	*			G	0.5	10			
Oxalis spp.				Forb (FG)	G	0.1	1	G	0.1	1
Ozothamnus diosmifolius	White Dogwood			Shrub (SG)	M	0.2	1	G	0.2	10
Parsonsia straminea	Common Silkpod			Other (OG)				G	0.1	2
Passiflora edulis	Common Passionfruit	*						G	0.1	1
Phoenix canariensis	Canary Island Date Palm	*	1		G	0.5	1			
Physalis peruviana	Cape Gooseberry	*						G	0.1	1
Pittosporum undulatum	Sweet Pittosporum			Shrub (SG)				M	0.5	1
Plectranthus parviflorus				Forb (FG)				G	0.1	1
Polyscias sambucifolia				Shrub (SG)				G	0.2	5
Pteridium esculentum	Bracken			Fern (EG)				G	0.5	1
Pultenaea flexilis				Shrub (SG)				G	0.1	3

Species	Common Name	Exotic	High Threat Weed	Growth Form Group	Plot 1			Plot 2		
					Stratum & Layer	Cover	Abundance	Stratum & Layer	Cover	Abundance
Richardia brasiliensis	Mexican Clover	*			G	0.1	1			
Sigesbeckia orientalis subsp. *orientalis*	Indian Weed			Forb (FG)				G	0.1	5
Smilax glyciphylla	Sweet Sarsparilla			Other (OG)				G	0.1	10
Solanum americanum	Glossy Nightshade			Forb (FG)				G	0.1	2
Solanum mauritianum	Wild Tobacco Bush	*						G	0.2	2
Solanum nigrum	Black-berry Nightshade	*			G	0.1	10			
Sonchus oleraceus	Common Sowthistle	*			G	0.1	1			
Syagrus spp.		*						G	0.2	1
Syncarpia glomulifera subsp. *glomulifera*				Tree (TG)	U			U	15	4
Triadica sebifera	Chinese Tallowood	*	1		G	0.1	1	G	0.1	4
Veronica plebeia	Trailing Speedwell			Forb (FG)				G	0.1	1
Xanthorrhoea media				Other (OG)				G	0.1	1
Zieria smithii	Sandfly Zieria			Shrub (SG)				G	0.1	1

Appendix B Floristic analysis results

Plot	Vegetation analysis tool (Tozers Metro)	Selected PCT rational
Plot 1	Blue Gum High Forest Sydney Turpentine-Ironbark Forest	The plot located within the north east of the subject land has undergone historical disturbances, and therefore generally lacks a diverse number of species. The required minimum + positive diagnostic species was not achieved for either Sydney Turpentine Ironbark Forest nor Blue Gum High Forest, there the analysis relied on the presence of total diagnostic species between Sydney Turpentine Ironbark Forest and Blue Gum High Forest. The plot data contained 12 diagnostic species belonging to Sydney Turpentine Ironbark Forest and 6 against Blue Gum High Forest. It was determined that Sydney Turpentine Ironbark Forest (PCT 3262) was the most appropriate PCT for the vegetation based on numerous factors outlined in Table 2, in conjunction with the results of the Tozer analysis.
Plot 2	Blue Gum High Forest Sydney Turpentine-Ironbark Forest Hinterland Sandstone Gully Forest	Sydney Turpentine-Ironbark Forest had 20 diagnostic species as did Sydney Hinterland Sandstone Gully Forest, and Blue Gum High Forest with 14 diagnostic species. However, the Hinterland Sandstone Gully Forest was the only vegetation community between the three which had the highest count of diagnostic species and also achieved the ratio of positive diagnostic species to total native species ratio. Given this outcome, Sandstone PCTs were investigated in the PCT selection process. Whilst Hinterland Sandstone Gully Forest was not selected as the final vegetation community. A similar community 3592, Sydney Coastal Enriched Sandstone Forest was selected, based on the number of characteristic canopy species present, including *Angophora costata Corymbia gummifera, Eucalyptus pilularis, Ceratopetalum gummiferum* and *Syncarpia glomulifera* subsp. *glomulifera* and a taller mid-stratum is characterised by very frequent however sparse cover of *Pittosporum undulatum* and *Allocasuarina littoralis.* This PCT is primarily distributed at elevations of less than 200 metres asl downslope of shale soils on the north shore of Sydney. The landscape position fit this PCT the best as it is downslope of shale soils on north shore of Sydney, but is not located higher upslope before it grads into a gully below. This PCT was the best fit PCT for the vegetation directly adjacent to the subject land and was therefore selected as the most appropriate PCT to assign to the vegetation along the southern portion of the subject land, including the vegetation within the detention basin.

B1 Analysis of vegetation plot 1 – identified as PCT 3262 Sydney Turpentine Ironbark Forest

The images below show the outputs from the Hager / Steenbeecke tool.

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
1	Community Type	DSF p1	Ove p2	DSF p6	DSF p7	DSF p4	Ove p28	Ove p29	DSF p102	WSF p97	Fore p73	WSF p98	Sc p14	RF p13	Ove p114	Fore p44	DSF p64	WSF p102	Wet p133	Fore p88	DSF p148	DSF p142	DSF p143	DSF p146	DSF p131	DSF p128	HL p50
2	Correct ID	CIF	SSTF	BNHW	CSGW	CSW	SHW	SPW	SGTF	STF	CRFF	NSCF	GMDR	WSDR	MSW	SIF	CSF	LBMWF	BGHF	SRS	CSGF	HSGF	SSCF	SHTW	CSRW	ABW	SCS
3	Total diagnostic species	8	6	2	0	3	4	9	6	12	8	1	8	4	3	3	3	4	9	1	3	8	2	7	1	0	0
4	Required minimum +ve diagnostic species	21	25	17	38	19	20	25	25	23	16	6	16	22	19	9	10	20	18	8	23	28	25	31	31	20	16
5	Achieved?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
6	No. by which required minimum +ve diagnostic spp. is exceeded?																										
7	Ratio of actual : required +ve diagnostic species	24%	23%	18%	10%	16%	20%	36%	24%	52%	50%	17%	25%	18%	16%	33%	30%	20%	40%	13%	13%	29%	8%	23%	3%	0%	0%
8	Total native species	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
9	Required minimum total native species	35	39	37	43	37	31	31	37	40	34	27	31	32	30	17	21	35	38	25	35	38	43	47	41	30	24
10	Achieved?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	Yes	No	No	No	No	No	No	No	No	No	No	No
11	Ratio of +ve diagnostic species : total native species	26%	32%	16%	10%	16%	21%	47%	32%	63%	42%	5%	26%	21%	16%	16%	16%	21%	32%	5%	16%	26%	11%	37%	5%	0%	0%
12	Native Species																										
13	Aristida vagans	1	1	1	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
14	Centella asiatica	0	0	0	0	1	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
15	Commelina cyanea	0	0	0	0	0	1	1	0	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0
16	Cynodon dactylon	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	Dianella caerulea var. producta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0
18	Dichondra repens	0	1	0	0	0	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
19	Digitaria sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Eleocarpus reticulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	0
21	Entolasia stricta	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0
22	Eucalyptus microcorys	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	Eucalyptus pilularis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	1	1	1	0	0
24	pteris purpurascens	1	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	1	1	0	0	0	0	1	0	0	0
25	Melia azedarach	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	Microlaena stipoides	1	1	0	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
27	Oplismenus aemulus	0	0	0	0	0	1	1	0	1	1	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0
28	Oxalis sp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Opithamnus diosmifolius	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0

B2 : Analysis of Plot 2 - identified as Sydney Coastal Enriched Sandstone Forest

	A	B	C	D	E	F	G	H	I	J	K	L	N	O	P	Q	R	S	T	U	V	W	X
1	Community Type	DSF p1	DSF p2	DSF p6	DSF p7	DSF p4	GRF p28	GRF p29	DSF p502	WSF p87	Folk p33	WSF p88	RF p38	RF p39	GRF p14	Folk p44	DSF p84	WSF p102	wet p153	Folk p48	DSF p140	DSF p142	DSF p143
2	Cornor ID	CIF	SSTF	BNHV	CSCW	CSW	SHV	SPW	SCTF	STIF	CRFF	NSCF	CRDF	VSDF	MSV	SSF	CSF	LBMVF	BCHF	SAS	CSCF	HSCF	SSICF
3	Total diagnostic species	7	10	2	2	3	3	6	8	20	8	2	6	4	1	5	7	15	14	5	12	20	12
4	Required minimum +ve diagnostic species	21	28	17	30	19	20	28	25	23	16	6	18	22	19	9	10	20	15	8	23	26	26
5	Achieved?	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
6	No. by which required minimum +ve diagnostic spp. is exceeded?																						
7	Ratio of actual : required +ve diagnostic species	33%	36%	12%	7%	16%	15%	21%	32%	87%	50%	33%	33%	18%	5%	56%	70%	75%	93%	63%	52%	77%	46%
8	Total native species	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38	38
9	Required minimum total native species	35	39	37	43	37	31	31	37	40	28	27	31	32	30	17	21	35	39	25	38	38	43
10	Achieved?	Yes	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
11	Ratio of +ve diagnostic species : total native species	18%	26%	5%	5%	8%	8%	21%	21%	53%	21%	5%	16%	11%	3%	13%	18%	39%	37%	13%	32%	53%	32%
12	Native Species																						
13	Acacia ulicifolia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
14	Allocasuarina littoralis	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1
15	Angophora costata	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1
16	Billardiera scandens	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1
17	Calochlaena dubia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0
18	Ceratopetalum gummiferum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1
19	Corymbia gummifera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
20	Dianella caerulea var. producta	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	1	0
21	Dodonaea triquetra	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	1
22	Elaeocarpus reticulatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	0
23	Entolasia marginata	0	1	0	0	0	0	1	0	1	1	1	0	0	0	1	0	0	1	0	0	0	0
24	Entolasia stricta	1	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1
25	Eucalyptus pilularis	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	1
26	Ficus rubiginosa	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
27	Glochidion ferdinandi var. ferdinandi	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0
28	Hypolepis muelleri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Juncus usitatus	0	0	0	0	1	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
30	Leucopogon juniperinus	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
31	Lindsaea microphylla	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1
32	Pratia purpurascens	1	1	1	0	1	0	1	1	1	1	1	1	0	0	1	0	1	1	0	0	0	0
33	Lomandra filiformis subsp. filiformis	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0
34	Lomandra longifolia	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	0
35	Microlaena stipoides	1	1	0	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0
36	Oplismenus imbecillis	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0
37	Ozothamnus diosmifolius	1	1	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0
38	Parsonsia straminea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
39	Pittosporum undulatum	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0
40	Plectranthus parviflorus	0	0	0	0	0	1	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0
41	Pteridium esculentum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1	1

REPORT TO

STOCKLAND

ON

PRELIMINARY GEOTECHNICAL INVESTIGATION

FOR

PROPOSED REDEVELOPMENT

AT

LOURDES RETIREMENT VILLAGE,
95 STANHOPE ROAD, KILLARA, NSW

Date: 29 September 2022
Ref: 34446Arpt

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1 INTRODUCTION

This report presents the results of a preliminary geotechnical investigation for the proposed redevelopment of Lourdes Retirement Village at 95 Stanhope Road, Killara, NSW. The location of the site is shown in Figure 1. The investigation was commissioned by Lucas Flecha of Stockland by email on 15 September 2021. The commission was on the basis of our fee proposal, Ref. P54758A dated 10 September 2021.

We have been provided with the following relevant information:

- 'Urban Design Report to Support Planning Proposal' prepared by Plus Architecture (Job No. 20576, dated 17 June 2022);
- Lower Ground 01, Ground, Level 01, Level 02 & Level 03 floor plans prepared by Plus Architecture (Job No. 20576, dated 5 August 2022);
- Survey plans prepared by Norton Survey Partners (Ref. 21388, Sheets S1 to S10, dated 22 April 2015). The survey datum is the Australian Height Datum (AHD).

Based on the supplied information and a meeting held with representatives from Stockland, Plus Architecture and FPD Planning on 10 August 2022, we understand that the proposed redevelopment will include the following:

- Demolition of all existing buildings, except for one (Headfort House) located towards the north-western corner of the site;
- Demolition of all existing pavements and retaining walls;
- Construction of four, five and six storey buildings over the northern half of the site. These buildings will be underlain by a common 'Lower Ground 01' car parking level, which we have assumed will be constructed at about RL103m. At the south-western corner of the 'Lower Ground 01' car parking level will be a loading dock. We have assumed that the loading dock will be constructed at about RL101m. Due to the sloping nature of the site, the proposed car parking level and load dock will require excavation to a maximum depth of about 4m. The western of the two northernmost buildings will be a residential aged care facility (RACF) operated by Opal HealthCare. This building, and its portion of the common 'Lower Ground 01' car parking level, may be constructed separately;
- Construction of 63, two or three storey, detached and semi-detached townhouses along the eastern and southern sides of the site. Due to the sloping nature of these portions of the site, cut and fill earthworks to a maximum depth/height of about 3m are envisaged;
- Construction of an internal road network.

Since 1981, JK Geotechnics (JKG) [formerly Jeffery and Katauskas Pty Ltd] has completed numerous geotechnical investigations at Lourdes Retirement Village. Details of our previous investigations are presented in Section 2.

The purpose of the current investigation was to review the results of our previous investigations and to assess the subsurface conditions at six additional cored borehole locations. Three additional augered boreholes were also completed. Based on the information obtained, we present our preliminary comments and recommendations on site preparation, earthworks, excavation conditions, drainage, retaining walls and shoring systems, footings, 'Lower Ground 01' and loading dock floor slabs, and additional investigations during detailed design.

2 BACKGROUND INFORMATION

A summary of our previous investigations is provided in the table below:

Investigation ID	Report Ref.	Report Date	Proposed Development	Relevant Geotechnical Scope of Work
JKG 1981	1885J	3/12/1981	New one and two storey buildings with a basement car parking level.	Seven boreholes were auger drilled and tested to depths of either 1.6m or 3.1m below original grade.
JKG 1989	6414K/vm	5/01/1989	Hostel extension.	Three boreholes were core drilled to depths between 2.13m and 5.69m below original grade.
JKG 2001	16420SPlet	27/11/2001	One level extension over a basement car parking level.	Four boreholes were auger and core drilled to depths between 3.93m and 4.30m below original grade.
JKG 2010A	23897SBrpt	19/04/2010	Alterations and additions to existing garages and a new raised walkway.	Three boreholes were auger drilled and tested to depths of either 1.4m or 3.0m below original grade. A Dynamic Cone Penetrometer (DCP) test was completed at one of the boreholes.
JKG 2010B	24367VTrpt	22/10/2010	Two new two storey buildings, each with a basement car parking level.	Three boreholes were auger drilled and tested to 4.0m depth below original grade.
JKG 2014	27850ZAlet	10/12/2014	Existing batter slope remedial works.	Two boreholes were hand auger drilled and DCP tested to refusal depths of 1.4m and 0.65m below original grade.

The locations of our previous boreholes have been plotted onto the attached Figure 2. Surface RL's were not assigned to the JKG 1981, JKG 1989 and JKG 2010A boreholes.

The borehole logs and DCP test results sheets from our previous investigations are presented in Appendices A to F.

3 CURRENT INVESTIGATION PROCEDURE

The fieldwork for the investigation was carried out between 14 & 18 October 2021 and comprised the drilling and testing of nine boreholes (BH1 to BH9), at the locations shown on Figure 2, to depths between 1.40m (BH7 & BH8) and 9.06m (BH3) below existing grade. The boreholes were completed using our track mounted JK308 drill rig, which is equipped for site investigation purposes.

Prior to the commencement of the fieldwork, a specialist sub-consultant reviewed available 'Dial Before You Dig' information and electro-magnetically scanned the borehole locations for buried services.

The soil and upper weathered bedrock profiles were spiral auger drilled. The relative compaction/strength of the soil profile was assessed from the Standard Penetration Test (SPT) 'N' values, together with hand penetrometer readings on cohesive samples recovered in the SPT split-spoon sampler, and by tactile examination. The strength of the underlying bedrock was assessed by observation of auger penetration resistance when using a twin-pronged tungsten carbide (TC) bit, together with examination of recovered cuttings and correlations with subsequent laboratory moisture content test results. From depths between 1.00m (BH5) and 2.81m (BH4), BH1 to BH6 were extended into the bedrock to their final depths by rotary diamond coring techniques, using an NMLC or HQ triple tube core barrel with water flush. The strength of the cored bedrock was assessed by examination of the recovered rock cores, together with correlations with subsequent Point Load Strength Index ($I_{S(50)}$) test results.

Groundwater observations were made in the boreholes. In BH2, BH3 and BH5, groundwater monitoring wells comprising 50mm diameter, slotted PVC standpipes were installed to depths of 8.93m, 9.06m and 8.15m, respectively, and were sealed within the bedrock profile. The installation details are presented on the attached borehole logs. The top of each groundwater monitoring well was protected by a cast-iron Gatic cover, which was concreted flush with the ground surface.

Further details of the methods and procedures employed in the investigation are presented in the attached Report Explanation Notes.

The borehole locations were set out by tape measurements from existing surface features. The surface RL's indicated on the attached borehole logs were interpolated between spot level heights and ground contour lines shown on the supplied survey plans, and are therefore approximate. The survey datum is AHD. The supplied survey plans form the basis of Figure 2.

Our geotechnical engineer (Quang Minh Vu) was present full-time during the fieldwork to set out the borehole locations, direct the electro-magnetic scanning, nominate testing and sampling, prepare the attached borehole logs, and direct the groundwater monitoring well installations. The Report Explanation Notes define the logging terms and symbols used.

Selected soil and rock cutting samples were returned to Soil Test Services Pty Ltd (STS), a NATA accredited laboratory, for moisture content, Atterberg Limits, linear shrinkage, Standard compaction and four day soaked CBR testing. The test results are presented in the attached STS Tables A & B.

The recovered rock cores from BH1 to BH6 were photographed and Point Load Strength Index tested. The rock core photographs are enclosed with the borehole logs. The Point Load Strength Index test results are plotted on the borehole logs and summarised in the attached Table C. The unconfined compressive strengths (UCS), as estimated from the Point Load Strength Index test results, are also summarised in Table C.

On 1 November 2021, we returned to site to install water level data loggers into the BH2, BH3 and BH5 monitoring wells to assess long-term equilibrium groundwater levels and responses to rainfall. The data loggers were programmed to take readings at five minute intervals. The groundwater level monitoring was completed on 3 December 2021 when we returned to site to retrieve and download the data loggers. The results, presented as groundwater RL (mAHD) and daily rainfall (mm) versus time plots, are shown on the attached Figures 3, 4 & 5. The plotted rainfall data was obtained from the Bureau of Meteorology's (BOM) rainfall records for their nearby monitoring station at Gordon Golf Club (Station No. 66120).

On 11 August 2022, we returned to site to measure the groundwater level in each well. The groundwater level monitoring results are presented in Section 4.2.6 below.

Contamination testing of site soils, bedrock and groundwater was outside the scope of this investigation.

4 RESULTS OF THE CURRENT INVESTIGATION

4.1 Site Description

The site (Lourdes Retirement Village) is located over the crest of a relatively wide ridge, which runs in a north-west to south-east direction. Stanhope Road bounds the northern site boundary. Within the site itself, the topography varies from relatively level to slopes to a maximum of 20° down towards the south. Based on the supplied survey plans, the maximum elevation relief across the site, between the northern relatively level portion and the lower lying southernmost road is about 14m. Beyond the southern and eastern site boundaries, the steep bushland covered hillsides grade between 15° and 45°.

At the time of our fieldwork, the site contained numerous one to three storey brick buildings (some with a single basement car parking level), garages and carports, suspended concrete footbridges and ramps, concrete and brick paved footpaths, and an internal road network with adjoining car parking areas, which were surfaced with asphaltic concrete (AC) or concrete. The internal roads and footpaths longitudinally graded to a maximum of about 12°. Lawns, garden beds and trees were scattered across the site.

Along the northern and north eastern site boundaries, batter slopes grading between 26° and 35° and up to 3m high were present. Beyond the toes of the batter slopes, the ground surface gently graded between 2° and 3° towards Stanhope Road. These portions of the site were covered by trees, shrubs and leaf litter.

To the south and east of the northern relatively level portion of the site, surface levels typically fell at grades between 2° and 12°. This portion of the site was terraced by numerous retaining walls, which were up to 3m high. The retaining walls were of either concrete block, brick, dry stacked sandstone block, dry stacked sandstone boulder, or timber construction, and generally appeared to be in good condition. Batter slopes generally between 10° and 25° and up to approximately 2.5m high were also present across the lower sloping portion of the site.

Sandstone rock outcrops and exposed sandstone cut faces between 1.2m and 1.6m high were exposed across the site. The exposed sandstone was assessed to be of at least medium strength when struck with a geological hammer. Rock defects including extremely weathered bands and clay bands up to 130mm thick were also observed.

The neighbouring property to the west of the site (91 Stanhope Road) contained a two storey brick residence, which was set back approximately 1m from the common boundary. The neighbouring surface level was about 0.4m lower than the subject site.

4.2 Subsurface Conditions

The 1:100,000 geological map of Sydney (Geological Survey of NSW, Geological Series Sheet 9130) indicates the site to be underlain by Hawkesbury Sandstone. Generally, the boreholes encountered pavements and/or fill, overlying residual clays, then sandstone bedrock at relatively shallow depths. Reference should be made to the attached borehole logs for specific details at each location. A summary of the encountered subsurface characteristics is provided below:

4.2.1 Pavements

In BH4, BH5, BH6 and BH9, AC surfacing was encountered and ranged in thicknesses between 30mm and 90mm. A 70mm thick granular unbound roadbase layer was encountered below the AC surfacing in BH5. A roadbase layer was not found below the AC surfacing in BH4, BH6 and BH9.

4.2.2 Fill

Fill, comprising sandy or clayey soils, was encountered below the pavement in BH4, BH5, BH6 and BH9, and from the surface level in the remaining boreholes, to depths between 0.2m and 1.0m. In BH1, BH2, BH3 and BH7, the fill was either grass or garden bed covered. Inclusions of igneous and sandstone gravel, ash, asphalt and brick fragments were found in the fill. Based on the SPT result, the deep fill in BH6 was assessed to be moderately compacted.

4.2.3 Residual Clays

Residual silty clay or sandy clay were encountered below the fill in BH1, BH6, BH7 and BH9. The residual clays were of low or medium plasticity, and of stiff or hard strength.

4.2.4 Extremely Weathered Sandstone

Extremely weathered sandstone of hard (soil) strength was encountered below the soil profile in all boreholes, except BH3 and BH8, at depths between 0.2m (BH2) and 1.5m (BH1 & BH6). This 'weak' profile ranged in thickness between 0.2m (BH6 & BH7) and 0.5m (BH1 & BH5).

4.2.5 Sandstone Bedrock

Sandstone bedrock was encountered in the previous and current boreholes at the depths and RL's tabulated below:

Investigation ID	Borehole	Approximate Surface RL (mAHD)	Depth to Sandstone Bedrock below Original Surface Level (m)	Approximate Sandstone Bedrock Surface RL (mAHD)
Current	BH1	105.5	2.0	103.5
	BH2	103.0	0.6	102.4
	BH3	103.8	0.2	103.6
	BH4	99.0	0.9	98.1
	BH5	106.6	0.8	105.8
	BH6	102.3	1.7	100.6
	BH7	98.8	0.9	97.9
	BH8	95.3	0.3	95.0
	BH9	95.2	1.3	93.9
JKG 1981	BH1	-	1.4	-
	BH2	-	1.2	-
	BH3	-	0.8	-
	BH4	-	1.0	-
	BH5	-	0.9	-
	BH6	-	0.6	-
	BH7	-	0.4	-
JKG 1989	BH1	-	1.8	-
	BH2	-	0.3	-
	BH3	-	0.4	-
JKG 2001	BH1	105.5	1.0	104.5
	BH2	105.8	0.5	105.3
	BH3	106.5	1.0	105.5
	BH4	106.2	0.5	105.7
JKG 2010A	BH1	-	1.1	-
	BH2	-	1.1	-
	BH8[1]	-	≥1.4	-
JKG 2010B	BH1	104.2	2.0	102.2
	BH2	104.6	1.4	103.2
	BH3	99.5	1.3	98.2
JKG 2014	BH2[1]	100.9	≥1.6	≤99.3
	BH4[1]	100.4	≥2.2	≤98.2

Note 1: These borehole were completed using portable hand operated equipment. Based on the inherent limitations of the hand auger and DCP, the stratum on which refusal occurred cannot be confirmed.

Based on the investigation results, it appears that the bedrock surface level deepens in both southerly and easterly (downhill) directions. Based on the known weathering pattern of Hawkesbury Sandstone, the change in bedrock levels occurs across a number of 'steps', which create buried cliff lines.

In the current boreholes, the weathering of the sandstone bedrock generally decreased with depth, from moderately weathered at first contact, to slightly weathered, and then to fresh with depth. The sandstone bedrock was mostly of medium or high strength. In most boreholes, the sandstone on first contact was of low or medium strength. This upper profile was generally less than 1.3m thick.

In BH3, a 450mm thick highly weathered siltstone band of very low or low strength was encountered below 6.7m depth.

Based on the cored lengths of BH1 to BH6, minor rock defects (ie. joints, clay seams, extremely weathered seams and crushed seams), were encountered, but generally with a greater frequency within the upper sandstone profile. In BH1 and BH2, 'no core' (core loss) zones were encountered within the upper sandstone profile and were 150mm and 220mm thick, respectively; presumably 'weaker' rock washed out by the introduced drill flush water.

Where sandstone bedrock was proven by our previous investigations, it was generally of low, medium or high strength. The three cored boreholes from JKG 1989 similarly encountered minor rock defects. The four cored boreholes from JKG 2001 encountered either very few or no rock defects.

An indicative engineering classification of the sandstone bedrock has been carried out for BH1 to BH6 from the current investigation, and for the four cored boreholes from JKG 2001, which are located within the proposed lower ground floor car parking level, as shown on Figure 2. The rock classification has been carried out in accordance with 'Classification of Sandstones and Shales in the Sydney Region: A Forty Year Review' by Pells et al., Australian Geomechanics, June 2019), and is tabulated below:

Borehole	Approx. Surface RL (mAHD)	Indicative Engineering Classification of Sandstone Bedrock Depths (m) [RL at top of Unit (mAHD)]			
		Class V	Class IV	Class III	Class II/I
Current BH1	105.5	2.0-3.4 [103.5]	-	3.4-7.0 [102.1]	7.0-8.6 [98.5]
Current BH2	103.0	0.6-2.2 [102.4]	2.2-5.6 [100.8]	-	5.6-8.9 [97.4]
Current BH3	103.8	-	0.2-7.2 [103.6]	-	7.2-9.1 [96.6]
Current BH4[2]	99.0	0.9-3.1 [98.1]	-	3.1-4.4 [95.9]	4.4-8.6 [94.6]
Current BH5	106.6	-	0.8-3.5 [105.8]	3.5-6.5 [103.1]	6.5-8.4 [100.1]
Current BH6	102.3	-	1.7-4.1 [100.6]	4.1-5.0 [98.2]	5.0-8.3 [97.3]
JKG 2001 BH1	105.5	-	-	1.1-3.9 [104.4]	-
JKG 2001 BH2	105.8	-	0.5-2.3 [105.3]	2.3-2.9 [103.5]	2.9-4.0 [102.9]
JKG 2001 BH3	106.5	-	1.0-3.4 [105.5]	-	3.4-4.3 [103.1]
JKG 2001 BH4	106.2	-	-	0.5-2.9 [105.7]	2.9-3.9 [103.3]

Note 2: The Class V profile in the current BH4 contains medium and high strength sandstone.

4.2.6 Groundwater

All current boreholes were 'dry' during and on completion of auger drilling. No meaningful groundwater observations were made on completion of rock coring due to the introduced drill flush water.

The groundwater level monitoring period between 1 November 2021 and 3 December 2021 included several heavy rainfall events, as recorded at the BOM's Gordon Golf Club monitoring station. The pertinent details of the recorded daily rainfall data are summarised below:

- Negligible rainfall fell during the 17 days (ie. 15 October 2021 to 31 October 2021) prior to the commencement of the groundwater level monitoring;
- 15mm rainfall fell on 4 November 2021 (1st rainfall event);
- 69.3mm total rainfall fell between 8 & 14 November 2021 (2nd rainfall event);
- 106.7mm total rainfall fell between 21 & 27 November 2021 (3rd rainfall event).

A summary of the continuous groundwater level monitoring results completed between 1 November 2021 and 3 December 2021, and during the return measurement made on 11 August 2022 is summarised below:

- **BH2 Groundwater Monitoring Well**: At the commencement of the monitoring period, the groundwater level was at about 8.4m depth (RL94.6m). There was no groundwater level response to the three rainfall events. On our return visit on 11 August 2022, the groundwater level was measured at 2.9m depth (RL100.1m). This delayed response is likely due to a combination of the relatively impermeable nature of the bedrock, and the very heavy rainfall events which occurred in February/March 2022 and July 2022.
- **BH3 Groundwater Monitoring Well**: At the commencement of the monitoring period, the groundwater level was at RL97.0m. During the 2nd rainfall event, the groundwater level rose to RL98.0m. During the 3rd rainfall event, the groundwater level again rose to RL98.5m. On our return visit on 11 August 2022, the groundwater level was measured at RL100.4m; most likely due to the very heavy rainfall events which occurred in February/March 2022 and July 2022.
- **BH5 Groundwater Monitoring Well**: At the commencement of the monitoring period, the groundwater level was at RL103.8m. There was negligible groundwater level response to the three rainfall events. On our return visit on 11 August 2022, the groundwater level was measured at RL103.2m.

No longer term groundwater level monitoring has been carried out.

4.3 Laboratory Test Results

The moisture content and Atterberg Limits test results confirmed our field classification of the site soils. The Atterberg Limits and linear shrinkage test results indicated that the sampled residual clay of low or medium plasticity from BH1, BH6 and BH9, and the sampled clayey fill of low plasticity from BH4 to have a slight to moderate potential for shrink-swell reactivity with changes in moisture content.

The four day soaked CBR tests carried out on residual clay samples from BH1, BH7 and BH9 and on an extremely weathered sandstone sample from BH5 resulted in values between 4% and 14%, when compacted to 98% of Standard Maximum Dry Density (SMDD) and surcharged with 9kg. The samples were compacted prior to CBR testing at close to their Standard Optimum Moisture Contents (SOMC), which were generally within 4.5% of their respective insitu moisture contents, except for the extremely weathered sandstone sample from BH5 where its SOMC was 9.1% 'dry' of its insitu moisture content. During the four day soaking period, swells of 1.5% and 1% were measured on the BH5 and BH9 samples, respectively.

The results of the moisture content tests carried out on recovered rock cuttings correlated well with our field assessment of bedrock strength. The results of the Point Load Strength Index tests carried out on the recovered rock cores from BH1 and BH6 correlated well with our field assessment of bedrock strength. The estimated UCS's, based on the correlation provided in AS1726:2017 'Geotechnical Site Investigations' (ie. UCS = 20 x $I_{S(50)}$), generally ranged up to 34MPa.

5 PRELIMINARY COMMENTS AND RECOMMENDATIONS

At the time of preparing this report, the design was still at a concept stage. As such, the comments and recommendations provided in this report are generalised and of a preliminary nature. Once the architectural and civil designs have been finalised, additional geotechnical investigations will most likely be required. Following completion of the additional investigations, the advice provided in the sections below will need to be reviewed and updated as appropriate by JK Geotechnics.

5.1 Primary Geotechnical Issues

Based on the results of our preliminary investigation, we consider the following to be the primary geotechnical issues for the proposed redevelopment:

1. Expected groundwater seepage inflows into the proposed excavations;
2. Excavation of low, medium and high strength sandstone bedrock.

The effects of the above geotechnical issues on design and construction are detailed in the sections which follow.

5.2 Lower Ground 01 Structure

Of relevance to the proposed Lower Ground 01 level and loading dock with respect to groundwater level monitoring are the current BH5 and our previous BH1 to BH4 from JKG 2001, where the highest recorded groundwater levels were RL103.8m, RL103.6m, RL103.8m, RL104.7m and RL104.3m, respectively. We have assumed that the proposed Lower Ground 01 level floor slab will be constructed at RL103m; that is, up to 1.7m below the recorded groundwater levels.

In order to quantify groundwater inflows into the Lower Ground 01 level excavation during construction, additional wells will need to be installed within the proposed excavation footprint, and permeability testing of the rock profile and seepage analyses will need to be carried out. A drained Lower Ground 01 floor slab may be found to be feasible. However, the decision on whether the proposed Lower Ground 01 structure is partially drained or tanked rests with the relevant authorities (ie. Ku-ring-gai Council, and WaterNSW or Natural Resources Access Regulator). If a tanked basement structure is nominated, then a hydrostatic basement slab will be required. A tanked Lower Ground 01 structure will require a deeper bulk excavation level in order to accommodate the thickness of the hydrostatic slab.

In the preparation of this report, we have assumed that a drained Lower Ground 01 structure will be found to be feasible. This will be confirmed following completion of the additional investigation and seepage analyses.

5.3 Site Preparation

5.3.1 Dilapidation Survey

Prior to the commencement of any site work, we recommend that a detailed dilapidation survey report be compiled on the neighbouring property to the west (91 Stanhope Road) and on Headfort House.

The dilapidation reports can be used as a benchmark against which to set vibration limits for trafficking and operation of plant, rock excavation, and soil compaction, and for assessing possible future claims for damage arising from the works.

The owner of 91 Stanhope Road should be asked to confirm in writing that the dilapidation report presents a fair assessment of existing conditions. As dilapidation reports are relied upon for the assessment of potential damage claims, they must be carried out thoroughly by reputable companies with all defects rigorously described (ie. defect type, defect location, crack width, crack length etc) and photographed. The dilapidation survey reports should be reviewed by JK Geotechnics and the structural engineer.

5.3.2 Vibration Monitoring

We recommend that full-time quantitative vibration monitoring be carried out on the neighbouring house at 91 Stanhope Road, and on Headfort House, whenever tracked plant, rock hammers, and compaction equipment are operating on site. The vibrations on the neighbouring house and Headfort House should be tentatively limited to a peak particle velocity (PPV) of 5mm/sec, subject to review of the dilapidation survey reports and confirmation by the structural engineer. An acoustic consultant will need to be engaged to carry out the vibration monitoring. The monitoring locations should be jointly nominated by the acoustic consultant and JK Geotechnics (following review of the dilapidation survey reports).

If it is found that transmitted vibrations are excessive, particularly during rock excavation, then further advice will need to be sought from JK Geotechnics. Notwithstanding, if higher vibrations are recorded, then they should be assessed against the attached Vibration Emission Design Goals as higher vibrations may be acceptable depending on the associated vibration frequency. Reference should be made to Section 5.4.2 below if it is confirmed that transmitted vibrations are excessive during rock excavation.

5.3.3 Early Works

The proposed redevelopment will require demolition of all existing structures, retaining walls and pavements, and removal of existing vegetation. Following this, all topsoil, root affected soils and any deleterious or contaminated fill should be stripped. Reference should be made to Section 6 for guidance on the offsite disposal of site soils. Care must be taken during demolition, site stripping and excavation not to undermine or remove lateral support from the site boundaries and particularly Headfort House.

5.4 Excavation

Prior to any excavation commencing, we recommend that reference be made to the NSW Government 'Code of Practice, Excavation Work' dated January 2020.

5.4.1 Excavation Conditions

Excavation of the soil and extremely weathered sandstone profiles can be carried out using a 'digging bucket' fitted to a large hydraulic excavator (say, at least 30 tonnes), using a ripping tyne where necessary, and/or by using a dozer.

Large dozers and hydraulic rock hammers will be required for the excavation of the low, medium and high strength sandstone bedrock. 'Hard ripping' or 'hard rock' excavation conditions should be expected for the medium and high strength sandstone bedrock; ripping may only just be possible with a Caterpillar D10 dozer and a generous allowance would need to be made for hydraulic rock hammer assistance to the ripping. Notwithstanding, rock hammers will need to be used for detailed footing, lift pit and trench excavations.

Grid rock sawing the bedrock would facilitate excavation when using rock hammers, and would also assist in dampening the transmission of ground borne vibrations to nearby buildings (ie. would reduce vibrations) provided the base of the saw slot is maintained below excavation level. Dust suppression by spraying with water should be carried out whenever rock saws are being used.

5.4.2 Potential Vibration Risks

As discussed in Section 5.3.2, excavation using rock hammers will need to be strictly controlled as there may be direct transmission of ground vibrations to the neighbouring house at 91 Stanhope Road and to Headfort House. If it is found that the transmitted vibrations are excessive, then it would be necessary to change to alternative rock excavation methods such as a tighter grid of rock saw slots and/or a smaller rock hammer.

The following procedures are recommended to reduce vibrations:

- Rock saw the faces of the proposed excavations. This will effectively reduce ground borne vibrations on nearby structures. The base of the rock saw slot must be maintained at a lower level than the adjacent excavation at all times;
- Maintain the rock hammer oriented towards the face and enlarge the excavation by breaking small wedges off the face. Grid sawing the base would facilitate removal;
- Operate the hammer in short bursts only, to reduce amplification of vibrations;
- Use excavation contractors with appropriate experience and a competent supervisor who is aware of vibration damage risks, etc. The contractor should have all appropriate statutory and public liability insurances and should be provided with a full copy of this report and any future geotechnical reports.

5.4.3 Drainage

Groundwater inflows into the excavations are expected to occur as local seepage flows above the soil/bedrock interface, and through joints and bedding partings within the bedrock profile, particularly after heavy rain. Any concentrated leakage from the sandstone cut faces, emanating from these joints and bedding partings, may need to be rectified by rock grouting.

We recommend that all cut faces and retaining walls incorporate spoon drains and/or subsoil drains to intercept potential seepage. Seepage volumes into the excavations are expected to be controllable by sump and pump methods and/or gravity discharge methods. Discharge from the drainage system should be piped to the stormwater system. The excavations should be monitored by the contractor and JK Geotechnics as they progress to confirm the drainage requirements and to assess whether rock grouting is required to reduce groundwater seepage inflows.

5.5 Excavation Retention

5.5.1 Temporary Batter Slopes

Where space permits, the shallow soil and extremely weathered sandstone profiles should be temporarily battered back at no steeper than 1 Vertical (V) on 1.5 Horizontal (H) for stability considerations. Surcharge loads (eg. soil stockpiles, plant and equipment, etc.) must be kept well away from the crests of the temporary batter slopes. Where temporary batter slopes descend onto cut rock faces, then a bench width of at least 0.5m should be provided between the crest of the rock face and the toe of the batter slope. This bench width would provide sufficient space for sand bagging if groundwater seepage is encountered.

All temporary cut batter slopes should be inspected by JK Geotechnics to assess whether untoward conditions exist. If present, the temporary batter slopes will need to be appropriately flattened or stabilised.

We expect that the low strength and stronger sandstone can be cut vertically. However, based on the rock defects encountered in the current cored boreholes and observed within the rock outcrops, we strongly recommend that all vertically cut rock faces be progressively inspected by an experienced geotechnical engineer or engineering geologist at no more than 1.5m depth increments and on completion of each stage of excavation (including lift pits) to identify features which may require stabilisation (eg. underpinning, rock bolting and/or shotcrete and mesh).

Provision must be made in the construction program and budget for the batter slope and rock face inspections and stabilisation works.

Cantilever block retaining walls can then be constructed in front of the temporary cut batter slopes and cut rock faces, and then backfilled. Where battering cannot be accommodated and/or is not preferred, then further advice from JK Geotechnics should be sought.

5.5.2 Retention Design Parameters

The major consideration in the selection of earth pressures for the design of retaining walls is the need to limit deformations occurring outside the excavation. The following characteristic earth pressure coefficients and subsoil parameters may be adopted for the design of the retaining walls:

- For cantilevered block retaining walls where movements are undesirable (eg. if movement sensitive buried services are present behind the walls) and/or are incorporated into the proposed buildings), a triangular earth pressure distribution with an 'at-rest' earth pressure coefficient (K_0) of 0.55 should be adopted for the soil and extremely weathered sandstone profiles, assuming a horizontal retained surface. The vertically cut low strength or stronger sandstone can be taken to be self-supporting, assuming the inspections and stabilisation works (if required) recommended in Section 5.5.1 are undertaken.
- For cantilevered block retaining walls supporting areas where some movement can be accepted and which are independent of the proposed buildings, a triangular lateral earth pressure distribution, with an 'active' earth pressure coefficient (K_a) of 0.35 for the soil and extremely weathered sandstone profiles, assuming a horizontal retained surface. Again, the vertically cut low strength or stronger sandstone can be taken to be self-supporting, assuming the inspections and stabilisation works (if required) recommended in Section 5.5.1 are undertaken.
- An average bulk unit weight of 21kN/m^3 should be adopted for the soil and extremely weathered sandstone profiles.
- Any surcharge affecting the retaining walls (eg. construction traffic, compaction stresses during backfilling, pavement/slab loads, inclined retained surfaces, etc.) should be allowed in the design using the appropriate earth pressure coefficient from above.
- All retaining walls should be tentatively founded in Class IV or better quality sandstone bedrock and designed in accordance with the advice provided in Section 5.6.
- Block retaining walls should be secured against sliding by the provision of dowels, which should be designed in shear. Permanent dowels must be designed for corrosion resistance and for long-term durability (eg. stainless steel or hot dipped galvanised with protective sheathing).
- Further, for resistance to sliding for block retaining walls, an effective angle of friction (ϕ') of 35° can be adopted for the Class IV or better quality sandstone bedrock. To optimise frictional resistance, the surface of the foundation material should be roughened using the teeth of a 'digging bucket' (parallel to the wall alignment), with the loose debris then cleaned off.
- Block retaining walls should be designed as permanently drained. Subsurface drains should incorporate (1) an appropriately sized 'ag' pipe with filter sock, surrounded by (2) free draining, single size, durable aggregate, such as 'Blue Metal' gravel or crushed concrete aggregate, and encapsulated within (3) a non-woven geotextile filter fabric such as Bidim A34 to control subsoil erosion. All drainage water should be piped to the stormwater system.

5.5.3 Backfilling Behind Retaining Walls

All earthworks recommendations provided below should be complemented by reference to AS3798-2007 'Guidelines on Earthworks for Commercial and Residential Developments'.

Backfilling behind retaining walls must be carried out using engineered fill in order to reduce post-construction settlements. From a geotechnical perspective, the excavated soil and extremely weathered sandstone are considered suitable for reuse as engineered fill on condition that they are free of organic matter, and contain a maximum particle size not exceeding 50mm. Excavated low strength or stronger sandstone will require crushing in order to meet this maximum particle size requirement. Crushing will most likely not be practical or cost effective.

Compaction of the engineered fill behind retaining walls should be carried out using a hand operated vertical rammer compactor for the lower layers and immediately behind the wall in the upper layers. Elsewhere a small static roller can be used. Engineered fill comprising site won materials should be compacted in maximum 150mm thick loose layers to a density ratio of at least 95% of Standard Maximum Dry Density (SMDD) and at a moisture content within 2% of Standard Optimum Moisture Content (SOMC). This specification assumes that the retaining walls will be supporting landscaped areas only. If the backfill is to support pavements, then engineered fill comprising site won materials should be compacted in maximum 150mm thick loose layers to a density ratio of at least 98% of SMDD and at a moisture content within 2% of SOMC.

Compaction of engineered fill behind retaining walls is very difficult. The use of a single sized durable aggregate, such as 'Blue Metal' gravel or crushed concrete aggregate (free of fines), which do not require significant compactive effort is often preferred if good performance is a priority; at least in the lower layers. We expect that the gap between the back of the retaining walls and vertically cut rock faces would be backfilled with aggregate. The aggregate should be nominally compacted using a hand operated vibrating plate (sled) compactor in maximum 200mm thick loose layers. A non-woven geotextile filter fabric such as Bidim A34 should be placed as a separation layer immediately above the cut batter slope (prior to backfilling) to control subsoil erosion. Provided the aggregate backfill is placed as recommended above, density testing would not be required. The geotextile should then be wrapped over the surface of the aggregate backfill and capped with at least a 0.3m thick compacted layer of engineered fill.

Density tests must be carried out on the engineered backfill (for material other than single sized aggregate) to confirm the above specifications are achieved. The frequency of density testing for retaining wall backfill should be at least one test per two layers per 50m^2 (assumes maximum 150mm thick loose layers). This implies that at each test location, the full depth of two compacted layers will be tested simultaneously.

Based on the scale of the proposed backfilling works, we recommend that Level 1 control of fill placement and compaction in accordance with Section 8 of AS3798-2007 should be carried out. Due to a potential conflict of interest, the geotechnical inspection and testing authority (GITA) should be directly engaged by Stockland (or their representative) or by the Head Contractor, and not by the earthworks contractor.

As discussed in Section 5.3.2, vibration monitoring on the neighbouring house at 91 Stanhope Road and on Headfort House must be completed whenever vibratory compaction of engineered backfill is being undertaken in close proximity.

5.6 Footings

Where bedrock is exposed, we recommend that the proposed buildings be supported on pad and strip footings. Where bedrock is not exposed, we recommend that the proposed buildings be supported on conventional bored piles. For the proposed townhouses, we recommend that the lowest floor slabs be fully suspended off the footings/piles.

Pad and strip footings founded on Class IV or better quality sandstone bedrock may be tentatively designed for an allowable bearing pressure of 2,000kPa. Similarly, retaining wall footings founded on Class IV or better quality sandstone bedrock below bulk excavation level may also be tentatively designed for an allowable bearing pressure of 2,000kPa.

Conventional bored piles socketed at least 0.3m into Class IV or better quality sandstone bedrock may be tentatively designed for an allowable end bearing pressure of 2,000kPa. Pile sockets formed below the minimum 0.3m length requirement may be tentatively designed for an allowable shaft adhesion value of 200kPa in compression, on condition that the pile shafts are suitably roughened. Long rock socket lengths should be avoided in design as penetration through the medium and high strength sandstone will be difficult. Provision should be made to the support the pile holes through the soil profile using sacrificial Formatube liners, particularly where collapsible sandy soils are encountered.

Footings (including retaining wall footings) founded immediately behind the crest of a vertically cut sandstone rock face on Class IV or better quality sandstone bedrock may be tentatively designed for an allowable bearing pressure of 1,000kPa, on condition that the rock face below the footing is inspected by an experienced geotechnical engineer or engineering geologist, as recommended in Section 5.5.1.

The bearing pressures provided above are based upon serviceability criteria of deflections at the footing/pile base of less than 1% of the minimum footing dimension/pile diameter. We note that these footing settlements will be of an elastic nature and are expected to occur as construction proceeds.

We recommend that all pad, strip and retaining wall footing excavations be inspected by a geotechnical engineer (prior to the installation of reinforcement cages) to confirm that a satisfactory bearing stratum has been achieved. This is particularly important for all footings located immediately outside excavations that may be founded on potentially unstable bedrock. All footing excavations must be cleaned out prior to inspection and pouring.

All bored piles should be cleaned out, inspected and poured on the same day as drilling. We recommend that the pile drilling be inspected by a geotechnical engineer during the initial stages and then periodically during the works, and compared to the borehole information to confirm that a satisfactory bearing stratum and embedment have been achieved.

5.7 Lower Ground 01 Floor Slab

The Lower Ground 01 floor slab should be constructed independent of the building footings and walls (ie. designed as 'floating' slabs). Slab joints should be designed to resist shear forces but not bending moments by providing dowelled or keyed joints. The floor slab should be provided with at least a 100mm thick sub-base of good quality, durable, single size, crushed rock (free of fines) such as 'Blue Metal' gravel or crushed concrete aggregate (free of fines), which will also act as underfloor drainage.

The underfloor drainage should include a sump and pump drainage system and/or a gravity discharge system. The drainage from behind surrounding block retaining walls should be connected into the underfloor drainage system. Again, groundwater seepage monitoring should be carried out during excavation prior to finalising the design of the pump out facilities. In order to avoid flooding, appropriately sized sumps with automatic level control pumps will be required to intermittently discharge the seepage water to the stormwater system. Discharge from the drainage system should be piped to the stormwater system.

5.8 Internal Road Network

5.8.1 Earthworks

All earthworks recommendations provided below should be complemented by reference to AS3798-2007.

Subgrade Preparation

The proposed internal road network will require cut and fill earthworks. Following stripping and excavation, the exposed subgrade should be proof rolled with at least six passes of a static (non-vibratory) smooth drum roller of at least 12 tonnes deadweight. The final pass of proof rolling should be carried out under the direction of an experienced geotechnical engineer for the detection of unstable or soft areas.

Subgrade heaving during proof rolling may occur in areas where clayey soils have become 'saturated' and/or where under-compacted existing fill exists. Heaving areas should be locally removed to a stable base and replaced with engineered fill, as outlined below. Alternative subgrade improvement options, as appropriate, should be provided by the geotechnical engineer following the proof rolling inspection.

If soil softening occurs after rainfall periods, then the subgrade should be over-excavated to below the depth of moisture softening and replaced with engineered fill. If clayey subgrade exhibits shrinkage cracking, then the surface must be moistened with a water cart and rolled until the shrinkage cracks are no longer evident.

Engineered fill must be reused to raise site levels up to the design subgrade levels.

Engineered Fill

From a geotechnical perspective, the excavated soil and extremely weathered sandstone are considered suitable for reuse as engineered fill on condition that they are free of organic matter, and contain a maximum particle size not exceeding 50mm. Excavated low strength or stronger sandstone will require crushing in order to meet this maximum particle size requirement. Crushing will most likely not be practical or cost effective.

Engineered fill comprising site won materials should be compacted in maximum 250mm thick loose layers using a large static (non-vibratory) pad-foot roller (say, at least 15 tonnes deadweight) to a density ratio of at least 98% of SMDD and at a moisture content within 2% of SOMC.

Backfilling of service trenches must be carried out using engineered fill in order to reduce post-construction settlements. Due to the reduced energy output of compaction plant that can be placed in trenches, backfilling should be carried out in maximum 150mm thick loose layers and compacted using a trench roller, a pad foot roller attachment fitted to an excavator, and/or a vertical rammer compactor (also known as a 'Wacker Packer'). The compaction specification provided above is applicable.

Density tests must be carried out on the engineered fill to confirm the above specification is achieved, as outlined below:

- The frequency of density testing for general engineered fill should be at least one test per layer per 500m^2, or one test per 100m^3 distributed reasonably evenly throughout the full depth and area, or 3 tests per visit, whichever requires the most tests (assumes maximum 250mm thick loose layers);
- The frequency of density testing for trench backfill should be at least one test per two layers per 40 linear metres (assumes maximum 150mm thick loose layers). This implies that at each test location, the full depth of two compacted layers will be tested simultaneously.

Based on the scale of the proposed earthworks, we recommend that Level 1 control of fill placement and compaction in accordance with Section 8 of AS3798-2007 should be carried out, including for the trench backfill. Due to a potential conflict of interest, the GITA should be directly engaged by Stockland (or their representative) or by the Head Contractor, and not by the earthworks contractor or service installation sub-contractors.

5.8.2 Design and Construction

Based on the laboratory test results and our experience with similar site soils, we recommend that all proposed new pavements be tentatively designed for a CBR value of 4% for the compacted clayey subgrade.

If proposed concrete pavements are to be supported on an unbound granular sub-base, then it should be at least 100mm thick and comprise DGB20 (TfNSW QA Specification 3051 unbound granular material) and compacted to a density ratio of at least 98% of Modified Maximum Dry Density (MMDD). Adequate moisture conditioning to within 2% of Modified Optimum Moisture Content (MOMC) should be provided during placement so as to reduce the potential for material breakdown during compaction. The sub-base material

would provide more uniform slab support and would reduce 'pumping' of subgrade 'fines' at joints due to vehicular movements. Slab joints should be designed to resist shear forces but not bending moments by providing dowelled or keyed joints.

For new AC pavements, we recommend that all base course materials comprise DGB20. The base course material should be compacted in maximum 200mm thick loose layers using a large static smooth drum roller to at least 98% of MMDD. Adequate moisture conditioning to within 2% of MOMC should be provided during placement. We further recommend that all sub-base materials comprise DGS20 or DGS40 (TfNSW QA Specification 3051). The sub-base material should be compacted in maximum 200mm thick loose layers using a large static smooth drum roller to at least 95% of MMDD. Again, adequate moisture conditioning to within 2% of MOMC should be provided during placement.

Density tests should be carried out on the granular pavement materials to confirm the above specifications are achieved. The frequency of density testing should be at least one test per layer per 1000m^2, or three tests per layer, or three tests per visit, whichever requires the most tests. Level 2 testing of fill compaction is the minimum permissible in AS3798-2007. The geotechnical testing authority (GTA) should be directly engaged by Stockland (or their representative) or by the Head Contractor.

In order to protect the pavement edges, subsoil drains should be provided at least along the high side of all new road/car parking areas, with invert levels of at least 200mm below design subgrade level. Where the new roads and car parking areas are in relatively level ground, then the subsoil drains should be provided along all sides. The drainage trenches should be excavated with a uniform/consistent longitudinal fall to appropriate discharge points so as to reduce the risk of water ponding. The subgrade should be graded to promote water flow towards the subsoil drains. Discharge from the subsoil drains should be piped to the stormwater system.

5.9 Further Geotechnical Input

The following is a summary of the further geotechnical input which is required and which has been detailed in the preceding sections of this report:

- Additional geotechnical investigations, including installation of groundwater monitoring wells and seepage analyses, once the architectural and civil designs have been finalised;
- Review and update of this report, as appropriate, following completion of the additional investigations;
- Dilapidation survey reports on the neighbouring property to the west (91 Stanhope Road) and on Headfort House, prior to the commencement of demolition;
- Review of the dilapidation survey reports;
- Full-time quantitative vibration monitoring on the neighbouring property to the west (91 Stanhope Road) and on Headfort House whenever tracked plant, rock hammers, and compaction equipment are operating on site;
- Inspection of all temporary cut batter slopes and of all vertically cut rock faces;
- Groundwater seepage monitoring;
- Pad, strip and retaining wall footing and conventional bored pile inspections;
- Proof rolling inspections for all new pavement areas;
- Density testing of all engineered fill, including retaining wall and service trench backfill, to Level 1 control by a GITA;
- Density testing of all granular pavement materials to Level 2 control by a GTA.

6 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the design and construction phases of the project. As an example, special treatment of soft spots may be required as a result of their discovery during proof-rolling, etc. In the event that any of the advice presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

The long term successful performance of pavements is dependent on the satisfactory completion of the earthworks. In order to achieve this, the quality assurance program should not be limited to routine compaction density testing only. Other critical factors associated with the earthworks may include subgrade preparation, selection of fill materials, control of moisture content and drainage, etc. The satisfactory control and assessment of these items may require judgment from an experienced engineer. Such judgment often cannot be made by a technician who may not have formal engineering qualifications and experience. In order to identify potential problems, we recommend that a pre-construction meeting be held so that all

parties involved understand the earthworks requirements and potential difficulties. This meeting should clearly define the lines of communication and responsibility.

Occasionally, the subsurface conditions between the completed boreholes may be found to be different (or may be interpreted to be different) from those expected. Variation can also occur with groundwater conditions, especially after climatic changes. If such differences appear to exist, we recommend that you immediately contact this office.

A waste classification is required for any soil and/or bedrock excavated from the site prior to offsite disposal. Subject to the appropriate testing, material can be classified as Virgin Excavated Natural Material (VENM), Excavated Natural Material (ENM), General Solid, Restricted Solid or Hazardous Waste. Analysis can take up to seven to ten working days to complete, therefore, an adequate allowance should be included in the construction program unless testing is completed prior to construction. If contamination is encountered, then substantial further testing (and associated delays) could be expected. We strongly recommend that this requirement is addressed prior to the commencement of excavation on site.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

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Macquarie Park, NSW 2113
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North Ryde, Bc 1670
Telephone: 02 9888 5000
Facsimile: 02 9888 5001

SOIL TEST SERVICES

ABN 43 002 145 173

TABLE A
MOISTURE CONTENT, ATTERBERG LIMITS AND LINEAR SHRINKAGE TEST REPORT

Client:	JK Geotechnics	**Report No.:**	34446A - A
Project:	Proposed Redevelopment	**Report Date:**	16/11/2021
Location:	Lourdes Retirement Village, 95 Stanhope Road, Killara, NSW	**Page 1 of 1**	

AS 1289	TEST METHOD	2.1.1	3.1.2	3.2.1	3.3.1	3.4.1
BOREHOLE NUMBER	**DEPTH m**	**MOISTURE CONTENT %**	**LIQUID LIMIT %**	**PLASTIC LIMIT %**	**PLASTICITY INDEX %**	**LINEAR SHRINKAGE %**
1	0.50 - 0.95	15.2	47	22	25	10.5
1	2.00 - 2.70	5.4	-	-	-	-
2	1.00 - 1.30	4.2	-	-	-	-
3	0.30 - 0.60	3.5	-	-	-	-
3	1.00 - 1.20	3.2	-	-	-	-
4	0.10 - 0.30	9.6	25	12	13	4.0
4	1.00 - 1.30	5.3	-	-	-	-
4	1.70 - 2.00	5.4	-	-	-	-
6	1.10 - 1.20	8.3	30	24	6	4.0
6	2.20 - 2.60	6.1	-	-	-	-
8	0.70 - 1.00	10.4	-	-	-	-
9	0.50 - 0.95	17.6	25	17	8	3.5
9	1.50 - 2.00	5.6	-	-	-	-

Notes:

- The test sample for liquid and plastic limit was air-dried & dry-sieved
- The linear shrinkage mould was 125mm
- Refer to appropriate notes for soil descriptions
- Date of receipt of sample: 01/11/2021.
- Sampled and supplied by client. Samples tested as received.

NATA

NATA Accredited Laboratory Number:1327

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the items tested or sampled.

16/11/2021

Authorised Signature / Date
(D. Treweek)

All services provided by STS are subject to our standard terms and conditions. A copy is available on request.

115 Wicks Road
Macquarie Park, NSW 2113
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SOIL TEST SERVICES
ABN 43 002 145 173

TABLE B
FOUR DAY SOAKED CALIFORNIA BEARING RATIO TEST REPORT

Client: JK Geotechnics
Project: Proposed Redevelopment
Location: Lourdes Retirement Village, 95 Stanhope Road, Killara, NSW

Report No.: 34446A - B
Report Date: 16/11/2021
Page 1 of 1

BOREHOLE NUMBER	BH 1	BH 5	BH 7	BH 9
DEPTH (m)	0.30 - 0.50	0.30 - 0.60	0.20 - 0.70	0.50 - 0.70
Surcharge (kg)	9.0	9.0	9.0	9.0
Maximum Dry Density (t/m^3)	1.83 STD	2.09 STD	1.93 STD	1.97 STD
Optimum Moisture Content (%)	14.2	9.9	11.8	11.4
Moulded Dry Density (t/m^3)	1.79	2.05	1.89	1.92
Sample Density Ratio (%)	98	98	98	98
Sample Moisture Ratio (%)	104	97	101	101
Moisture Contents				
Insitu (%)	9.7	19.0	8.7	13.5
Moulded (%)	14.8	9.6	11.9	11.5
After soaking and				
After Test, Top 30mm(%)	20.5	12.1	16.4	15.2
Remaining Depth (%)	17.9	11.3	15.4	13.3
Material Retained on 19mm Sieve (%)	4*	0	0	0
Swell (%)	0.0	1.5	0.0	1.0
C.B.R. value:				
@5.0mm penetration	12	12	4.0	14

NOTES: Sampled and supplied by client. Samples tested as received.
- Refer to appropriate Borehole logs for soil descriptions
- Test Methods : AS 1289 6.1.1, 5.1.1 & 2.1.1.
- BH's 5, 7 & 9 had insufficient material provided - unable to complete 4 point compaction curve & material recycled for CBR.
- * Denotes not used in test sample.
- Date of receipt of sample: 01/11/2021.
- BH 5 & 9 dried back prior to testing as too saturated.

NATA
NATA Accredited Laboratory Number:1327

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the items tested or sampled.

16/11/2021
Authorised Signature / Date
(D. Treweek)

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TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client: STOCKLAND

Ref No: 34446A

Project: PROPOSED REDEVELOPMENT

Report: C

Location: LOURDES RETIREMENT VILLAGE,
95 STANHOPE ROAD, KILLARA, NSW

Report Date: 22/10/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
BH1	2.91 - 2.95	1.7	34	A
	3.51 - 3.54	1.2	24	A
	3.90 - 3.93	0.5	10	A
	4.14 - 4.17	0.5	10	A
	4.73 - 4.77	0.7	14	A
	5.21 - 5.25	0.7	14	A
	5.84 - 5.87	0.6	12	A
	6.15 - 6.19	0.4	8	A
	6.77 - 6.81	0.9	18	A
	7.20 - 7.24	0.9	18	A
	7.80 - 7.83	1.1	22	A
	8.12 - 8.16	1.1	22	A
	8.47 - 8.50	1.4	28	A
BH2	1.63 - 1.67	0.2	4	A
	2.20 - 2.24	0.8	16	A
	2.75 - 2.79	1	20	A
	3.34 - 3.38	0.7	14	A
	3.82 - 3.86	0.7	14	A
	4.05 - 4.09	0.7	14	A
	4.54 - 4.58	0.4	8	A
	5.29 - 5.33	1.1	22	A
	5.85 - 5.89	1.7	34	A
	6.14 - 6.17	1	20	A
	6.73 - 6.77	1	20	A
	7.23 - 7.26	1.3	26	A

NOTE: SEE PAGE 4

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client: STOCKLAND

Ref No: 34446A

Project: PROPOSED REDEVELOPMENT

Report: C

Location: LOURDES RETIREMENT VILLAGE,
95 STANHOPE ROAD, KILLARA, NSW

Report Date: 22/10/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
BH2	7.78 - 7.82	1.7	34	A
	8.39 - 8.42	1.3	26	A
	8.89 - 8.92	1.6	32	A
BH3	1.37 - 1.40	0.2	4	A
	1.78 - 1.82	0.5	10	A
	2.22 - 2.26	0.3	6	A
	2.77 - 2.80	0.5	10	A
	3.18 - 3.22	0.5	10	A
	3.72 - 3.75	0.4	8	A
	4.17 - 4.21	0.3	6	A
	4.74 - 4.78	0.6	12	A
	5.07 - 5.11	0.6	12	A
	5.70 - 5.73	0.8	16	A
	6.26 - 6.30	0.5	10	A
	6.83 - 6.86	0.1	2	A
	7.04 - 7.08	0.2	4	A
	7.75 - 7.79	1.3	26	A
	8.11 - 8.15	1.5	30	A
	8.79 - 8.83	1.2	24	A
	9.02 - 9.06	1.4	28	A
BH4	2.89 - 2.92	1	20	A
	3.16 - 3.19	0.8	16	A
	3.79 - 3.83	1	20	A
	4.14 - 4.18	1.2	24	A
	4.72 - 4.75	0.7	14	A

NOTE: SEE PAGE 4

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client: STOCKLAND

Ref No: 34446A

Project: PROPOSED REDEVELOPMENT

Report: C

Location: LOURDES RETIREMENT VILLAGE,
95 STANHOPE ROAD, KILLARA, NSW

Report Date: 22/10/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S\,(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
BH4	5.16 - 5.19	0.6	12	A
	5.78 - 5.82	1.4	28	A
	6.22 - 6.25	0.9	18	A
	6.77 - 6.81	1.3	26	A
	7.21 - 7.25	0.8	16	A
	7.63 - 7.67	1.1	22	A
	8.12 - 8.16	1.1	22	A
	8.53 - 8.57	1.1	22	A
BH5	1.10 - 1.14	0.3	6	A
	1.72 - 1.76	0.6	12	A
	2.13 - 2.18	0.5	10	A
	2.71 - 2.76	0.3	6	A
	3.12 - 3.16	0.4	8	A
	3.76 - 3.80	0.8	16	A
	4.32 - 4.36	0.7	14	A
	4.76 - 4.81	0.8	16	A
	5.12 - 5.15	0.7	14	A
	5.60 - 5.64	0.8	16	A
	6.17 - 6.21	0.9	18	A
	6.76 - 6.79	0.9	18	A
	7.37 - 7.42	0.9	18	A
	7.90 - 7.94	1	20	A
	8.14 - 8.19	1.1	22	A
	8.35 - 8.39	1.4	28	A
BH6	2.94 - 2.97	0.3	6	A

NOTE: SEE PAGE 4

TABLE C
POINT LOAD STRENGTH INDEX TEST REPORT

Client: STOCKLAND

Ref No: 34446A

Project: PROPOSED REDEVELOPMENT

Report: C

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Report Date: 22/10/21

BOREHOLE NUMBER	DEPTH (m)	$I_{S(50)}$ (MPa)	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)	TEST DIRECTION
BH6	3.19 - 3.22	0.2	4	A
	3.70 - 3.74	0.3	6	A
	4.29 - 4.32	0.8	16	A
	4.77 - 4.80	0.8	16	A
	5.26 - 5.30	0.7	14	A
	5.81 - 5.85	0.7	14	A
	6.16 - 6.20	1.2	24	A
	6.84 - 6.88	1.3	26	A
	7.30 - 7.34	1.2	24	A
	7.79 - 7.83	0.9	18	A
	8.06 - 8.10	1	20	A

NOTES

1. In the above table, testing was completed in test direction A for the axial direction, D for the diametral direction, B for the block test and L for the lump test.
2. The above strength tests were completed at the 'as received' moisture content.
3. Test Method: RMS T223.
4. For reporting purposes, the $I_{S(50)}$ has been rounded to the nearest 0.1MPa, or to one significant figure if less than 0.1MPa.
5. The estimated Unconfined Compressive Strength was calculated from the Point Load Strength Index based on the correlation provided in AS1726:2017 'Geotechnical Site Investigations' and rounded off to the nearest whole number: U.C.S. = 20 $I_{S(50)}$.

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BOREHOLE LOG

Borehole No.
1

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A
Date: 15/10/21
Plant Type: JK308
Method: SPIRAL AUGER
Logged/Checked By: Q.V./A.J.
R.L. Surface: ~105.5 m
Datum: AHD

Groundwater Record	Samples ES	Samples U50	Samples B	Samples D	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/Consistency	Strength/Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY OR CONDITION										FILL: Silty sand, fine to medium grained dark brown, with fine to medium grained sandstone and igneous gravel, trace of root fibres	M			GRASS COVER
						105			CI	Silty CLAY: medium plasticity, yellow brown and red brown, with fine to medium grained sand, trace of root fibres	w<PL	Hd		RESIDUAL
					N = 15 6,6,9		1						>500 >500	
										as above, but light grey mottled red brown				
					N > 13 10,13/ 100mm REFUSAL	104				Extremely Weathered sandstone: Silty CLAY, medium plasticity, light grey and red brown, with fine to medium grained sand	XW	Hd	>600 >600	HAWKESBURY SANDSTONE
							2			SANDSTONE: fine to medium grained, light grey and red brown	MW	-		VERY LOW TO NIL RESISTANCE
						103								
										REFER TO CORED BOREHOLE LOG		M		LOW RESISTANCE
							3							
						102								
							4							
						101								
							5							
						100								
							6							
						99								

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CORED BOREHOLE LOG

Borehole No.
1
2 / 2

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A	**Core Size:** NMLC	**R.L. Surface:** ~105.5 m
Date: 15/10/21	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** Q.V./A.J.

Water Loss/Level	Barrel Lift	R.L. (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX (Is50)	SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and infills, aperture and thickness Specific / General	Formation
		105			START CORING AT 2.75m						
					NMLC CORE 0.15m						
			3		Extremely Weathered sandstone: silty CLAY, medium plasticity, light grey with medium and high strength iron indurated bands, trace of fine to medium grained sand.	XW	HW				
		102			SANDSTONE: fine to medium grained grey and red brown with orange brown laminae, bedded at 0-25°	MW	H M	1.2			
			4					0.50 0.50			
		101									
					SANDSTONE: fine to medium grained light grey with orange brown laminae, bedded at 0-20°	SW		0.70 0.70			
			5								
		100			SANDSTONE: fine to medium grained light grey with grey laminae, trace of carbonaceous specks, bedded at 0-20°	FR					Hawkesbury Sandstone
			6					0.60 0.40			
		99									
			7					0.90 0.90			
		98					H	1.1 1.1			
			8								
		97			END OF BOREHOLE AT 8.55m			1.4			

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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Job No: 34446A
Borehole No: BH1
Depth: 2.75m - 8.55m

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BOREHOLE LOG

Borehole No.
2

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A
Method: SPIRAL AUGER
R.L. Surface: ~103.0 m
Date: 19/10/21
Datum: AHD
Plant Type: JK308
Logged/Checked By: Q.V./A.J.

Groundwater Record	Samples ES	Samples USC	Samples DB	Samples DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/Weathering	Strength/Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										FILL: Silty sand, fine to medium grained, dark brown, with fine to medium grained igneous gravel, trace of root fibres.	M			VEGETATION COVER
					N=SPT 11/ 100mm REFUSAL					Extremely Weathered Sandstone: Sandy CLAY, medium plasticity, yellow brown fine to medium grained sand.	AW	HW		HAWKESBURY SANDSTONE
										SANDSTONE: fine to medium grained, light grey, red brown and yellow brown	MW	L		VERY LOW TO BIT RESISTANCE
						102	1			as above but light grey and red brown		M		LOW RESISTANCE
						101	2			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 9.93m: CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.3m TO 8.93m. CASING 0.05m TO 1.3m. 2mm SAND FILTER PACK 1.3m TO 8.93m. BENTONITE SEAL 0.3m TO 1.3m. COMPLETED WITH A CONCRETED GATIC COVER.
						100	3							
						99	4							
						98	5							
						97	6							

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CORED BOREHOLE LOG

Borehole No. 2

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A	**Core Size:** NMLC	**R.L. Surface:** ~103.0 m
Date: 19/10/21	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** Q.V./A.J.

Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX (MPa)	SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, spaceness and thickness) Specific / General	Formation
					START CORING AT 1.30m						
					NO CORE 0.22m						
95% RETURN		101	2		SANDSTONE fine to medium grained, light grey and red brown, bedded at 0-20°	VW	L - M	0.20			Hawkesbury Sandstone
							M	0.80			
		100	3					1.0			
								0.70			
95% RETURN		99	4		SANDSTONE fine to medium grained, light grey with grey laminae and red brown seams, bedded at 0-25°.	SW		0.70			
								0.70			
								0.40			
		98	5				H	1.1			
		97	6		SANDSTONE fine to medium grained, light grey with grey laminae, trace of carbonaceous lenses, bedded at 0-25°.	FR		1.7			
								1.0			
								1.0			
		96	7					1.3			
								1.7			

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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CORED BOREHOLE LOG

Borehole No.
2
3 / 3

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A | **Core Size:** NMLC | **R.L. Surface:** ~103.0 m
Date: 19/10/21 | **Inclination:** VERTICAL | **Datum:** AHD
Plant Type: JK30B | **Bearing:** N/A | **Logged/Checked By:** Q.V./A.J.

Water Loss/Gain	Barrel Lift	RL (~ AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX ($I_{S(50)}$)	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
NO RETURN					SANDSTONE: fine to medium grained, light grey with grey laminae, trace of carbonaceous lenses, bedded at 0-20°. *(continued)*	FH	H	1.0			
		94	9		END OF BOREHOLE AT 8.93 m						
		93	10								
		92	11								
		91	12								
		90	13								
		89	14								

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FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

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Job No: 34446A
Borehole No: BH2
Depth: 1.3m - 8.93m

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BOREHOLE LOG

Borehole No. 3

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A **Method:** SPIRAL AUGER **R.L. Surface:** ~103.8 m
Date: 14/10/21 **Datum:** AHD
Plant Type: JK308 **Logged/Checked By:** Q.V./A.J.

Groundwater Record	SAMPLES PS	SAMPLES VSD	SAMPLES DB	SAMPLES DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
										FILL: Silty sand, fine to medium grained, dark brown, with fine to medium grained igneous gravel, trace of root fibres.	M			VEGETATION COVER
										SANDSTONE: fine to medium grained, light grey.	MW	L		HAWKESBURY SANDSTONE VERY LOW TO 0.0 RESISTANCE
						103	1			as above but light grey and red brown		M		LOW RESISTANCE
						102	2			REFER TO CORED BOREHOLE LOG				GROUNDWATER MONITORING WELL INSTALLED TO 9.06m CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.3m TO 9.06m CASING 0.05m TO 1.3m 2mm SAND FILTER PACK 1.3m TO 9.06m BENTONITE SEAL 0.3m TO 1.3m COMPLETED WITH A CONCRETED GATIC COVER
						101	3							
						100	4							
						99	5							
						98	6							
						97								

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CORED BOREHOLE LOG

Borehole No.
3

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A	**Core Size:** NMLC	**R.L. Surface:** ~103.8 m
Date: 14/10/21	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** O.V./A.J.

Water Loss/Gain	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure and fabric features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX Is(50) (MPa)	SPACING (mm)	DEFECT DETAILS DESCRIPTION Specific	General	Formation
					START CORING AT 1.32m							
		102	2		SANDSTONE: fine to medium grained, light grey, orange brown and red brown, bedded at 0-10°	MW	L - M	0.20, 0.50, 0.30				
		101	3		SANDSTONE: fine to medium grained, light grey with grey laminae and occasional red brown seams, trace of carbonaceous lenses, bedded at 0-20°	SW	M	0.50, 0.50, 0.40, 0.30				
CORE RETURN		100	4									Hawkesbury Sandstone
		99	5			FR		0.60, 0.60				
		98	6		SANDSTONE: fine to medium grained, light grey with grey laminae, trace of carbonaceous lenses, bedded at 0-30°.			0.80, 0.50				
		97	7		SILTSTONE: dark grey with light grey, fine grained sandstone laminae, bedded sub horizontally.	HW	VL - L	0.10, 0.20				
		96			SANDSTONE: fine to medium grained, light grey with dark grey laminae, trace of carbonaceous lenses, bedded at 0-25°.	FR	H	1.3				

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CORED BOREHOLE LOG

Borehole No.
3
3 / 3

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A	**Core Size:** NMLC	**R.L. Surface:** ~103.8 m
Date: 14/10/21	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** Q.V./A.J.

Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX (I_s50)	SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
Water Loss/Level		95	9		SANDSTONE: fine to medium grained, light grey with dark grey laminae. Trace of carbonaceous lenses, bedded at 0-25° (continued)	FR	H	1.5 1.2 1.4		[illegible]	Hawkesbury Sandstone
		94	10		END OF BOREHOLE AT 8.96 m						
		90	11								
		92	12								
		91	13								
		90	14								
		89									

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Job No: 34446A
Borehole No: BH3
Depth: 1.32m - 9.06m

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BOREHOLE LOG

Borehole No.
4

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A
Method: SPIRAL AUGER
R.L. Surface: ~99.0 m
Date: 14/10/21
Datum: AHD
Plant Type: JK308
Logged/Checked By: Q.V./A.J.

Groundwater Record	Samples ES	Samples U50	Samples DB	Samples U75	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF DRILLING				■						ASPHALTIC CONCRETE 90mm				
										FILL: Sandy clay, low plasticity, red brown, brown and grey, fine to medium grained sand with fine to medium grained sandstone and igneous gravel, trace of brick fragments	w>PL			
				■	N > 15 13,15/ 100mm REFUSAL					Extremely Weathered sandstone: Sandy CLAY, low plasticity, light grey, red brown and yellow brown, fine to medium grained sand	XW	Hd	>600 >600	HAWKESBURY SANDSTONE
				■		98	1			SANDSTONE: fine to medium grained, light grey, yellow brown and red brown	MW	L		VERY LOW TO NIL RESISTANCE
				■		97	2			as above, but light grey and yellow brown		M		LOW RESISTANCE
						96	3			REFER TO CORED BOREHOLE LOG				
						95	4							
						94	5							
						93	6							

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CORED BOREHOLE LOG

Borehole No. 4

Client: STOCKLAND

Project: PROPOSED REDEVELOPMENT

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A	**Core Size:** NMLC	**R.L. Surface:** ~99.0 m
Date: 14/10/21	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** Q.V./A.J.

Water Loss/Level	Barrel Lift	RL in AHD	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX (I50)	SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
					START CORING AT 2.8 m						
		99	3		SANDSTONE: fine to medium grained, grey, red brown and orange brown bedded at 0-10°.	MW	M - H	1.0			
					SANDSTONE: fine to medium grained orange brown with dark brown and light grey bands, bedded at 0-25°			0.80			
		96	4					1.0			
								1.2			
					SANDSTONE: fine to medium grained, light grey with grey laminae, bedded at 3-20°	FR		0.70			
		94	5					0.60			
								1.4			
		93	6					0.90			Hawkesbury Sandstone
					as above, but with a trace of carbonaceous laminae			1.2			
		92	7					0.80			
							H	1.1			
		91	8					1.1			
					END OF BOREHOLE AT 8.64 m						

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Job No: 34446A
Borehole No: BH4
Depth: 2.81m - 8.64m

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BOREHOLE LOG

Borehole No. 5

Client: STOCKLAND

Project: PROPOSED REDEVELOPMENT

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A **Method:** SPIRAL AUGER **R.L. Surface:** ~106.8 m

Date: 14/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** Q.V./A.J.

Groundwater Record	SAMPLES: FS	SAMPLES: USG	SAMPLES: LB	SAMPLES: CS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
										ASPHALTIC CONCRETE 30mm Lower granular road base 70mm	w<PL			
										FILL: Sandy clay, low plasticity, red brown and yellow brown, fine to medium grained sand, with fine to coarse grained ironstone and igneous gravel.	XW	Hd		HAWKESBURY SANDSTONE
					N = 12 13,12/ 50mm REFUSAL	105							>600 >600	
							1			Extremely Weathered sandstone, silty CLAY, medium plasticity, light grey and red brown, with fine to medium grained sand.	MW	M		LOW TO MODERATE TO UIT RESISTANCE
										SANDSTONE: fine to medium grained, light grey and red brown.				GROUNDWATER MONITORING WELL INSTALLED TO 8.15m CLASS 18 MACHINE SLOTTED 50mm DIA. PVC STANDPIPE 1.25m TO 8.15m. CASING 0.05m TO 1.25m. 2mm SAND FILTER PACK 1.0m TO 8.15m. BENTONITE SEAL 0.2m TO 1.0m COMPETED WITH A CONCRETED GATIC COVER
										REFER TO CORED BOREHOLE LOG				
						105								
							2							
						104								
							3							
						103								
							4							
						102								
							5							
						101								
							6							
						100								

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CORED BOREHOLE LOG

Borehole No. 5

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A	**Core Size:** HQ	**R.L. Surface:** ~106.6 m
Date: 14/10/21	**Inclination:** VERTICAL	**Datum:** AHD
Plant Type: JK308	**Bearing:** N/A	**Logged/Checked By:** Q.V./A.J.

Water Loss/Level	Bore Lift	R.L. (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX (Is50)	SPACING (mm)	DEFECT DETAILS — DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, occurrence and thickness) Specific / General	Formation
		106			START CORING AT 1.0m						
40% RETURN		105	1		SANDSTONE: fine to medium grained red brown and yellow brown, bedded at 0-15°	MW	M	0.30			Hawkesbury Sandstone
		104	2					0.60			
			3		SANDSTONE: fine to medium grained light grey with yellow brown seams, bedded at 0-15°	SW		0.30			
40% RETURN		103			SANDSTONE: fine to medium grained light grey with grey laminae, trace of carbonaceous lenses, bedded at 0-20°	FR		0.40			
		102	4					0.10			
			5					0.70			
		101			as above but bedded at 0-25°			0.80			
		100	6					0.70			
								0.90			

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CORED BOREHOLE LOG

Borehole No.
5
3 / 3

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A
Core Size: HQ
R.L. Surface: ~106.6 m
Date: 14/10/21
Inclination: VERTICAL
Datum: AHD
Plant Type: JK308
Bearing: N/A
Logged/Checked By: Q.V./A.J.

Water Loss/Level	Barrel Lift	RL (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components	Weathering	Strength	POINT LOAD STRENGTH INDEX (MPa)	DEFECT DETAILS SPACING (mm)	DESCRIPTION Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness Specific / General	Formation
		100			SANDSTONE: fine to medium grained, light grey with grey laminae, trace of carbonaceous lenses, bedded at 0-25°	FR	M	0.90			Hawkesbury Sandstone
			8				H	1.0 1.1 1.4			
		98			END OF BOREHOLE AT 8.41 m						
			9								
		97									
			10								
		96									
			11								
		95									
			12								
		94									
			13								
		93									

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Job No: 34446A
Borehole No: BH5
Depth: 1.0m - 8.41m

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BOREHOLE LOG

Borehole No.
6
1 / 2

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34448A
Date: 15/10/21
Plant Type: JK308

Method: SPIRAL AUGER
Logged/Checked By: Q.V./A.J

R.L. Surface: ~102.3 m
Datum: AHD

Groundwater Record	Samples ES	Samples U50	Samples DB	Samples DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING										ASPHALTIC CONCRETE: 80mm.				
						102			-	FILL: Sandy clay, low plasticity, brown and red brown, fine to medium grained sand, with fine to medium grained igneous gravel. Trace of asphalt fragments and ash.	w<PL			APPEARS MODERATELY COMPACTED
					N = 12 14,7,5									
							1		CL	Silty CLAY, low plasticity, yellow brown, with fine to medium grained sand.	w~PL	St		RESIDUAL
						101								
					N=SPT @ 150mm REFUSAL					Extremely Weathered sandstone: Sandy CLAY, low plasticity, grey and yellow brown, fine to medium grained sand, with fine to medium grained ironstone gravel.	XW	Hd	>600 >600	HAWKESBURY SANDSTONE
											MW	L		VERY LOW TO BIT RESISTANCE
							2			SANDSTONE: fine to medium grained, grey and red brown and yellow brown.				
						100						M		LOW RESISTANCE
										As above, but light grey and yellow brown.				
										REFER TO CORED BOREHOLE LOG				
							3							
						99								
							4							
						98								
							5							
						97								
							6							
						96								

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CORED BOREHOLE LOG

Borehole No. 6

2 / 2

Client: STOCKLAND

Project: PROPOSED REDEVELOPMENT

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A | **Core Size:** NMLC | **R.L. Surface:** ~102.3 m

Date: 15/10/21 | **Inclination:** VERTICAL | **Datum:** AHD

Plant Type: JK308 | **Bearing:** N/A | **Logged/Checked By:** D.V./A.J.

Water	Barrel Lift	R.L. (m AHD)	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, texture and fabric, features, inclusions and minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX (Is50)	DEFECT DETAILS: SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Type, orientation, defect shape and roughness, defect coatings and seams, openness and thickness) Specific / General	Formation
		100			START CORING AT 2.76m						
			3		SANDSTONE: fine to medium grained light grey and light red brown with orange brown seams, bedded at 0-10°.	W/A	L - M	0.30			Hawkesbury Sandstone
		99			SANDSTONE: fine to medium grained light red brown and light grey with grey laminae, bedded at 0-25°			0.20			
								0.30			
			4								
		98			SANDSTONE: fine to medium grained light grey with grey laminae, trace of carbonaceous lenses, bedded at 0-25°	FR	M	0.80			
								0.80			
			5								
		97						0.70			
								0.70			
			6				M - H				
		96						1.2			
								1.3			
			7								
		95						1.2			
								0.80			
			8					1.0			
		94			END OF BOREHOLE AT 8.32 m						

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Job No: 34446A
Borehole No: BH6
Depth: 2.76m - 8.32m

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BOREHOLE LOG

Borehole No. 7

1 / 1

Client: STOCKLAND

Project: PROPOSED REDEVELOPMENT

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A **Method:** SPIRAL AUGER **R.L. Surface:** ~98.8 m

Date: 14/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** Q.V./A.J.

Groundwater Record	SAMPLES ES	UNI	UB	DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION										FILL: Silty sand, fine to medium grained, brown and dark brown, with fine to medium grained igneous and ironstone gravel, trace of root fibres	M			GRASS COVER
									CI		WPL	Hd		RESIDUAL
					N = 15 7,10,8 100mm REFUSAL					Sandy CLAY, medium plasticity, yellow brown, fine to medium grained sand, with fine to medium grained ironstone gravel, trace of root fibres.			>600 >600	
						98			-		XW	Hd		HAWKESBURY SANDSTONE
							1			Extremely Weathered sandstone, sandy CLAY, medium plasticity, yellow brown, fine to medium grained sand	MW	M		LOW TO MODERATE TO BIT RESISTANCE
										SANDSTONE, fine to medium grained light grey, red brown and yellow brown		H		HIGH RESISTANCE
										END OF BOREHOLE AT 1.40 m				TO BIT REFUSAL
						97	2							
						96	3							
						95	4							
						94	5							
						93	6							
						92								

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BOREHOLE LOG

Borehole No. 8

1 / 1

Client: STOCKLAND

Project: PROPOSED REDEVELOPMENT

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34446A **Method:** SPIRAL AUGER **R.L. Surface:** ~95.3 m

Date: 15/10/21 **Datum:** AHD

Plant Type: JK308 **Logged/Checked By:** Q.V./A.J.

Groundwater Record	SAMPLES: ES	SAMPLES: USD	SAMPLES: DB	SAMPLES: DS	Field Tests	RL (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION				■		95				FILL: Silty clay, medium plasticity, dark grey and grey, with fine to medium grained sand and fine to medium grained ironstone and ingeous gravel, trace of root fibres	w~Pl			
				■					-	SANDSTONE: fine to medium grained light grey and yellow brown	MW	L		HAWKESBURY SANDSTONE
				■								M		VERY LOW TO LOW TC BIT RESISTANCE
							1							MODERATE RESISTANCE
				■		94						H		HIGH RESISTANCE
										END OF BOREHOLE AT 1.40 m				TC BIT REFUSAL
							2							
						93								
							3							
						92								
							4							
						91								
							5							
						90								
							6							
						89								

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BOREHOLE LOG

Borehole No.
9
1 / 1

Client: STOCKLAND
Project: PROPOSED REDEVELOPMENT
Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No.: 34448A
Method: SPIRAL AUGER
R.L. Surface: 95.2 m
Date: 15/10/21
Datum: AHD
Plant Type: JK308
Logged/Checked By: G.V./A.J.

Groundwater Record	Samples ES	Samples U50	Samples DB	Samples DS	Field Tests	R.L. (m AHD)	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel Density	Hand Penetrometer Readings (kPa)	Remarks
						95			-	ASPHALTIC CONCRETE 50mm ±				
										FILL: Silty clay, low plasticity, grey and dark grey, with fine to medium grained sand and fine to medium grained igneous, sandstone and ironstone gravel, trace of root fibres	w<PL			
					N = 5 5,2,3				CL	Sandy CLAY: low plasticity, orange brown and yellow brown mottled light grey, fine to medium grained sand, with fine to medium grained ironstone gravel, trace of root fibres	w<PL	St	150 150 110	RESIDUAL
						94				Extremely Weathered sandstone: Sandy CLAY, low plasticity, orange brown and yellow light grey, fine to medium grained sand, with fine to medium grained ironstone gravel	XW	Hd		HAWKESBURY SANDSTONE
							2			SANDSTONE: fine to medium grained, light grey and yellow brown	MW	M		LOW TO MODERATE TO BIT RESISTANCE
						93				END OF BOREHOLE AT 2.00 m				
							3							
						92								
							4							
						91								
							5							
						90								
							6							
						89								

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AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SITE LOCATION PLAN**

Location: LOURDES VILLAGE, STANHOPE ROAD, KILLARA, NSW

Report No: 34446A

Figure No: 1

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PLOT DATE: 16/05/2023 3:22:34 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34446A KILLARA\CAD (P54758A)\34446A.DWG

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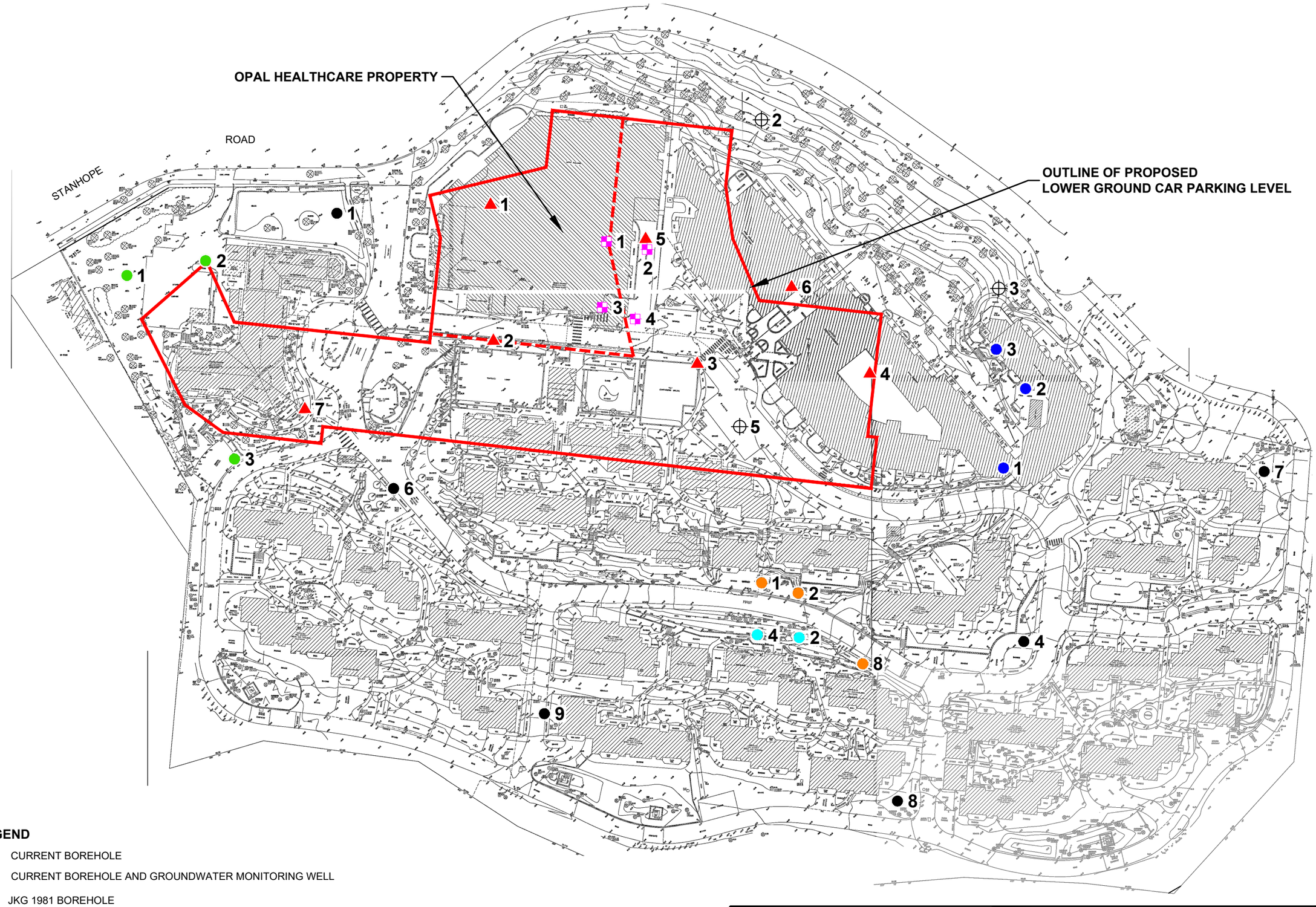

LEGEND

- CURRENT BOREHOLE
- CURRENT BOREHOLE AND GROUNDWATER MONITORING WELL
- JKG 1981 BOREHOLE
- JKG 1989 BOREHOLE
- JKG 2001 BOREHOLE
- JKG 2010A BOREHOLE
- JKG 2010B BOREHOLE
- JKG 2014 BOREHOLE

0 10 20 30 40 50

SCALE 1:1000 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **BOREHOLE LOCATION PLAN**

Location: LOURDES VILLAGE, STANHOPE ROAD, KILLARA, NSW

Report No: 34446A

Figure No: 2

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PLOT DATE: 16/05/2023 3:23:24 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\34000'S\34446A KILLARA\CAD (PS4758A)\34446A.DWG

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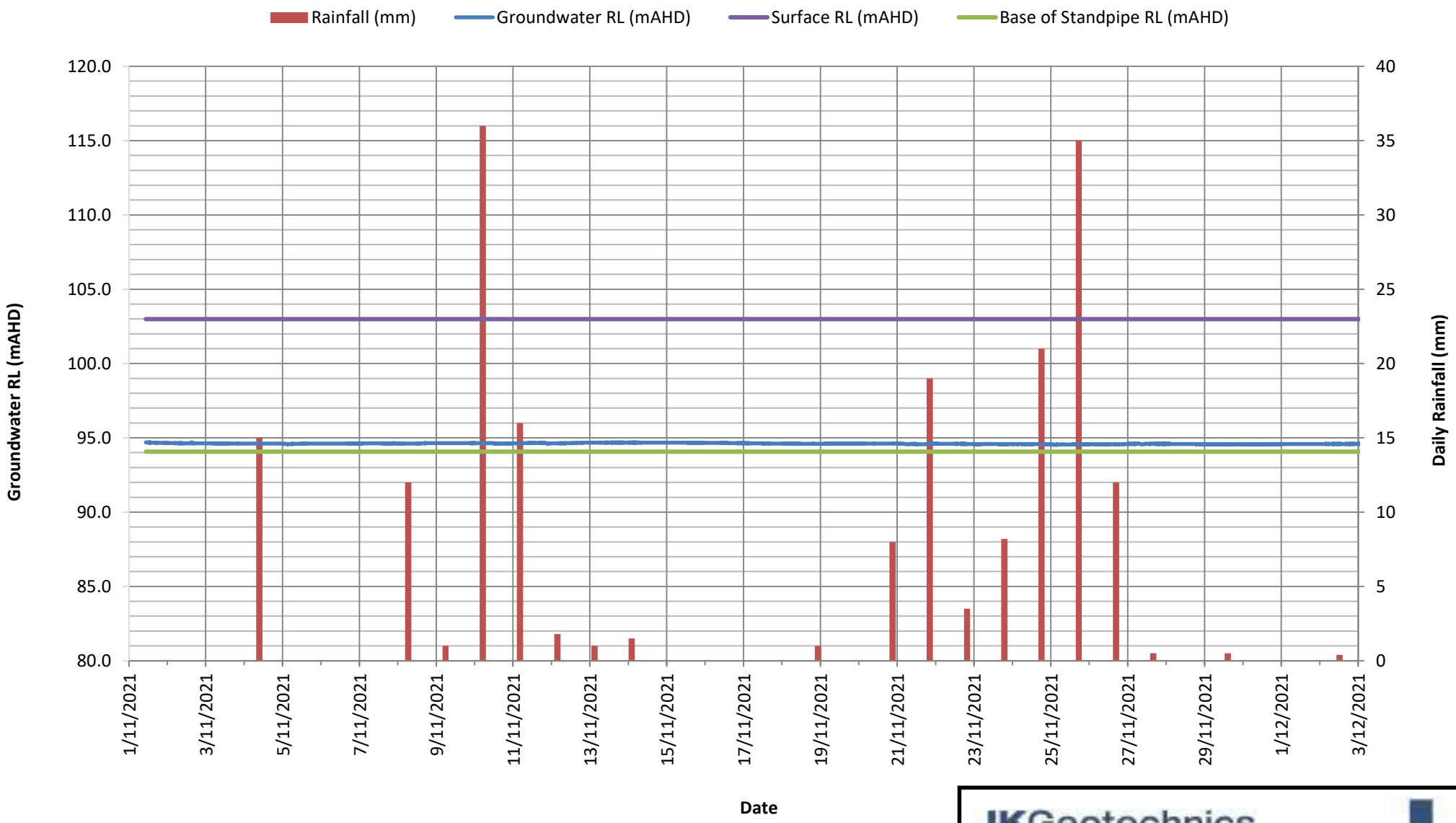
BH2

Groundwater Level and Daily Rainfall -v- Time Plot



Rainfall Data from Gordon Golf Club, Station No. 066120

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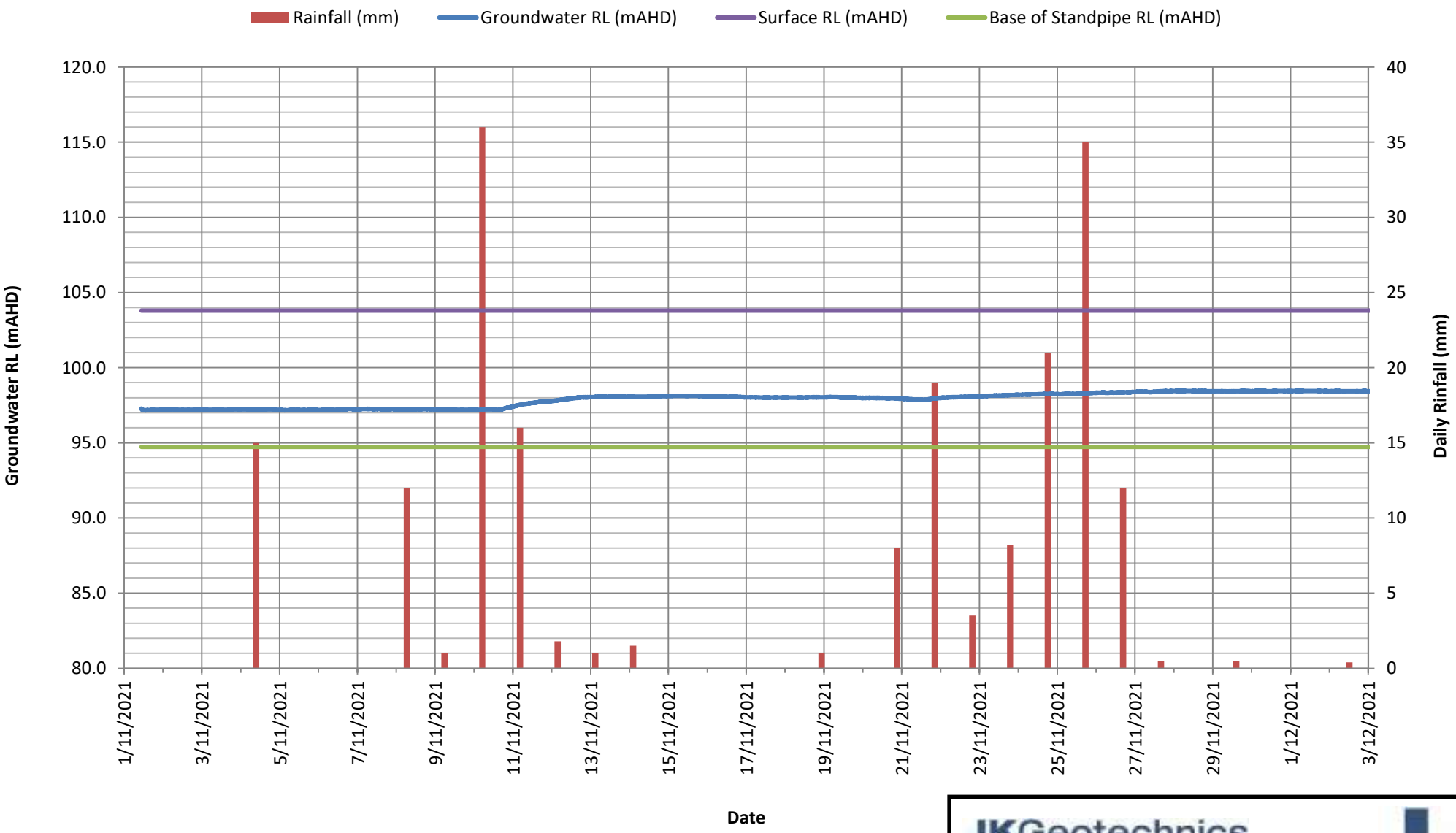
Report No. 34446A Figure No. 3

BH3

Groundwater Level and Daily Rainfall -v- Time Plot



Rainfall Data from Gordon Golf Club, Station No. 066120

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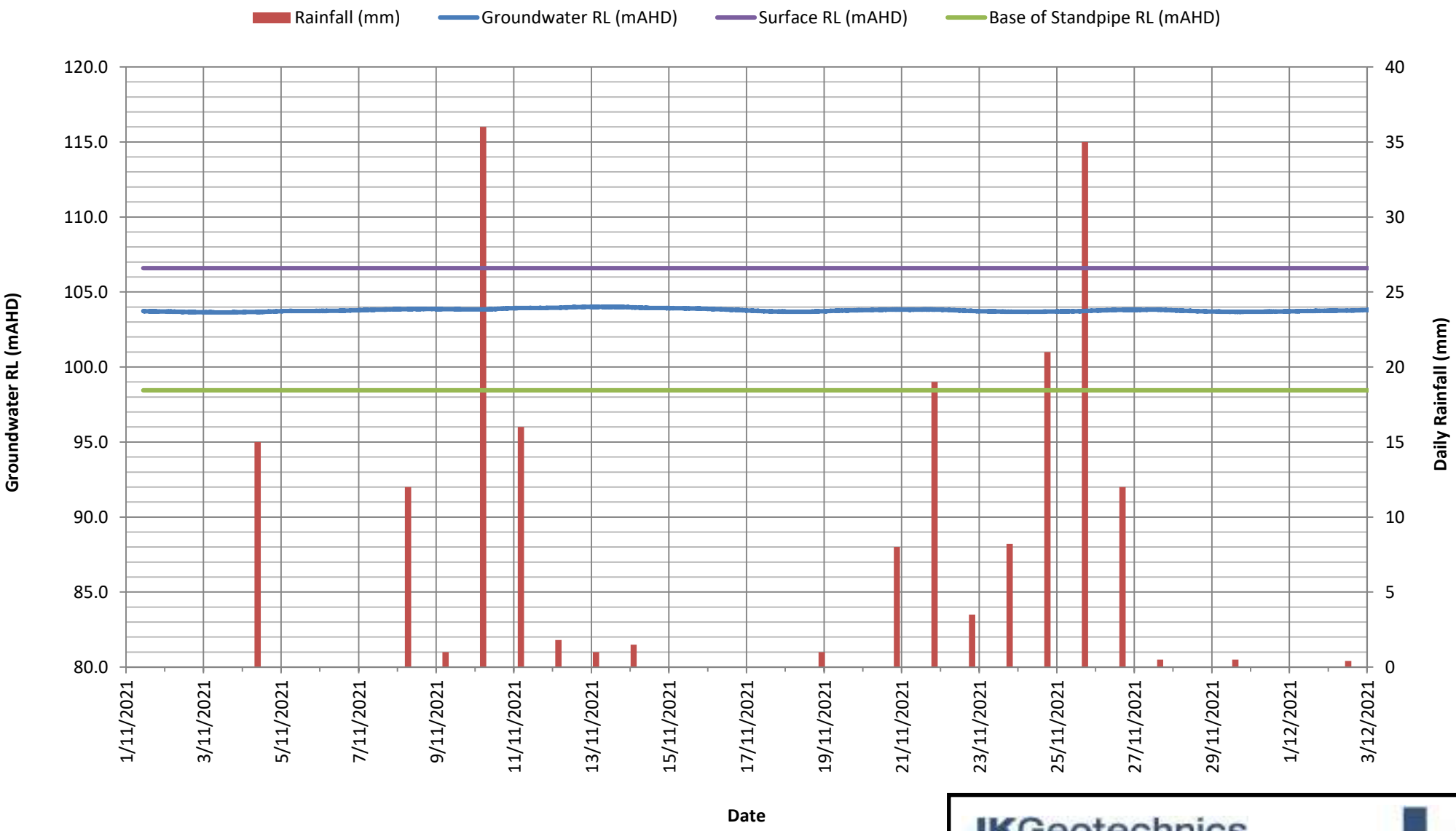
Report No. 34446A Figure No. 4

BH5

Groundwater Level and Daily Rainfall -v- Time Plot



Rainfall Data from Gordon Golf Club, Station No. 066120

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Report No. 34446A Figure No. 5

VIBRATION EMISSION DESIGN GOALS

German Standard DIN 4150 – Part 3: 1999 provides guideline levels of vibration velocity for evaluating the effects of vibration in structures. The limits presented in this standard are generally recognised to be conservative.

The DIN 4150 values (maximum levels measured in any direction at the foundation, OR, maximum levels measured in (x) or (y) horizontal directions, in the plane of the uppermost floor), are summarised in Table 1 below.

It should be noted that peak vibration velocities higher than the minimum figures in Table 1 for low frequencies may be quite 'safe', depending on the frequency content of the vibration and the actual condition of the structure.

It should also be noted that these levels are 'safe limits', up to which no damage due to vibration effects has been observed for the particular class of building. 'Damage' is defined by DIN 4150 to include even minor non-structural effects such as superficial cracking in cement render, the enlargement of cracks already present, and the separation of partitions or intermediate walls from load bearing walls. Should damage be observed at vibration levels lower than the 'safe limits', then it may be attributed to other causes. DIN 4150 also states that when vibration levels higher than the 'safe limits' are present, it does not necessarily follow that damage will occur. Values given are only a broad guide.

Table 1: DIN 4150 – Structural Damage – Safe Limits for Building Vibration

Group	Type of Structure	Peak Vibration Velocity in mm/s			
		At Foundation Level at a Frequency of:			Plane of Floor of Uppermost Storey
		Less than 10Hz	10Hz to 50Hz	50Hz to 100Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use.	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 and 2 and have intrinsic value (eg. buildings that are under a preservation order).	3	3 to 8	8 to 10	8

Note: For frequencies above 100Hz, the higher values in the 50Hz to 100Hz column should be used.

REPORT EXPLANATION NOTES

INTRODUCTION

These notes have been provided to amplify the geotechnical report in regard to classification methods, field procedures and certain matters relating to the Comments and Recommendations section. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726:2017 *'Geotechnical Site Investigations'*. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached soil classification table qualified by the grading of other particles present (eg. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	< 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2.36mm
Gravel	2.36 to 63mm
Cobbles	63 to 200mm
Boulders	> 200mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose (VL)	< 4
Loose (L)	4 to 10
Medium dense (MD)	10 to 30
Dense (D)	30 to 50
Very Dense (VD)	> 50

Cohesive soils are classified on the basis of strength (consistency) either by use of a hand penetrometer, vane shear, laboratory testing and/or tactile engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength (kPa)	Indicative Undrained Shear Strength (kPa)
Very Soft (VS)	≤ 25	≤ 12
Soft (S)	> 25 and ≤ 50	> 12 and ≤ 25
Firm (F)	> 50 and ≤ 100	> 25 and ≤ 50
Stiff (St)	> 100 and ≤ 200	> 50 and ≤ 100
Very Stiff (VSt)	> 200 and ≤ 400	> 100 and ≤ 200
Hard (Hd)	> 400	> 200
Friable (Fr)	Strength not attainable – soil crumbles	

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'shale' is used to describe fissile mudstone, with a weakness parallel to bedding. Rocks with alternating inter-laminations of different grain size (eg. siltstone/claystone and siltstone/fine grained sandstone) is referred to as 'laminite'.

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shrink-swell behaviour, strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All methods except test pits, hand auger drilling and portable Dynamic Cone Penetrometers require the use of a mechanical rig which is commonly mounted on a truck chassis or track base.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils and 'weaker' bedrock if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for a large excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Refusal of the hand auger can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of limited reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock cuttings. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be assessed from the cuttings, together with some information from "feel" and rate of penetration.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, NMLC or HQ triple tube core barrels, which give a core of about 50mm and 61mm diameter, respectively, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as NO CORE. The location of NO CORE recovery is determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the bottom of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289.6.3.1–2004 (R2016) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – Standard Penetration Test (SPT)'*.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63.5kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of, say, 4, 6 and 7 blows, as

  N = 13
  4, 6, 7

- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as

  N > 30
  15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

A modification to the SPT is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as 'N_c' on the borehole logs, together with the number of blows per 150mm penetration.

Cone Penetrometer Testing (CPT) and Interpretation: The cone penetrometer is sometimes referred to as a Dutch Cone. The test is described in Australian Standard 1289.6.5.1–1999 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Static Cone Penetration Resistance of a Soil – Field Test using a Mechanical and Electrical Cone or Friction-Cone Penetrometer'*.

In the tests, a 35mm or 44mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a specially designed truck or rig which is fitted with a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the frictional resistance on a separate 134mm or 165mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck. The CPT does not provide soil sample recovery.

As penetration occurs (at a rate of approximately 20mm per second), the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- Cone resistance – the actual end bearing force divided by the cross sectional area of the cone – expressed in MPa. There are two scales presented for the cone resistance. The lower scale has a range of 0 to 5MPa and the main scale has a range of 0 to 50MPa. For cone resistance values less than 5MPa, the plot will appear on both scales.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio – the ratio of sleeve friction to cone resistance, expressed as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between CPT and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of CPT values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

There are limitations when using the CPT in that it may not penetrate obstructions within any fill, thick layers of hard clay and very dense sand, gravel and weathered bedrock. Normally a 'dummy' cone is pushed through fill to protect the equipment. No information is recorded by the 'dummy' probe.

Flat Dilatometer Test: The flat dilatometer (DMT), also known as the Marchetti Dilometer comprises a stainless steel blade having a flat, circular steel membrane mounted flush on one side.

The blade is connected to a control unit at ground surface by a pneumatic-electrical tube running through the insertion rods. A gas tank, connected to the control unit by a pneumatic cable, supplies the gas pressure required to expand the membrane. The control unit is equipped with a pressure regulator, pressure gauges, an audio-visual signal and vent valves.

The blade is advanced into the ground using our CPT rig or one of our drilling rigs, and can be driven into the ground using an SPT hammer. As soon as the blade is in place, the membrane is inflated, and the pressure required to lift the membrane (approximately 0.1mm) is recorded. The pressure then required to lift the centre of the membrane by an additional 1mm is recorded. The membrane is then deflated before pushing to the next depth increment, usually 200mm down. The pressure readings are corrected for membrane stiffness.

The DMT is used to measure material index (I_D), horizontal stress index (K_D), and dilatometer modulus (E_D). Using established correlations, the DMT results can also be used to assess the 'at rest' earth pressure coefficient (K_o), over-consolidation ratio (OCR), undrained shear strength (C_u), friction angle (ϕ), coefficient of consolidation (C_h), coefficient of permeability (K_h), unit weight (γ), and vertical drained constrained modulus (M).

The seismic dilatometer (SDMT) is the combination of the DMT with an add-on seismic module for the measurement of shear wave velocity (V_s). Using established correlations, the SDMT results can also be used to assess the small strain modulus (G_o).

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod with a 20mm diameter cone end with a 9kg hammer dropping 510mm. The test is described in Australian Standard 1289.6.3.2–1997 (R2013) *'Methods of Testing Soils for Engineering Purposes, Soil Strength and Consolidation Tests – Determination of the Penetration Resistance of a Soil – 9kg Dynamic Cone Penetrometer Test'*.

The results are used to assess the relative compaction of fill, the relative density of granular soils, and the strength of cohesive soils. Using established correlations, the DCP test results can also be used to assess California Bearing Ratio (CBR).

Refusal of the DCP can occur on a variety of materials such as obstructions within any fill, tree roots, hard clay, gravel or ironstone, cobbles and boulders, and does not necessarily indicate rock level.

Vane Shear Test: The vane shear test is used to measure the undrained shear strength (C_u) of typically very soft to firm fine grained cohesive soils. The vane shear is normally performed in the bottom of a borehole, but can be completed from surface level, the bottom and sides of test pits, and on recovered undisturbed tube samples (when using a hand vane).

The vane comprises four rectangular blades arranged in the form of a cross on the end of a thin rod, which is coupled to the bottom of a drill rod string when used in a borehole. The size of the vane is dependent on the strength of the fine grained cohesive soils; that is, larger vanes are normally used for very low strength soils. For borehole testing, the size of the vane can be limited by the size of the casing that is used.

For testing inside a borehole, a device is used at the top of the casing, which suspends the vane and rods so that they do not sink under self-weight into the 'soft' soils beyond the depth at which the test is to be carried out. A calibrated torque head is used to rotate the rods and vane and to measure the resistance of the vane to rotation.

With the vane in position, torque is applied to cause rotation of the vane at a constant rate. A rate of 6° per minute is the common rotation rate. Rotation is continued until the soil is sheared and the maximum torque has been recorded. This value is then used to calculate the undrained shear strength. The vane is then rotated rapidly a number of times and the operation repeated until a constant torque reading is obtained. This torque value is used to calculate the remoulded shear strength. Where appropriate, friction on the vane rods is measured and taken into account in the shear strength calculation.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment, but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The terms and symbols used in preparation of the logs are defined in the following pages.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than 'straight line' variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if reliable water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after the groundwater level has stabilised at intervals ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably assess the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 *'Methods of Testing Soils for Engineering Purposes'* or appropriate NSW Government Roads & Maritime Services (RMS) test methods. Details of the test procedure used are given on the individual report forms.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. a three storey building) the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Reasonable care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. However, the Company cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions – the potential for this will be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.
- Details of the development that the Company could not reasonably be expected to anticipate.

If these occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. Licence to use the documents may be revoked without notice if the Client is in breach of any obligation to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed <u>or</u> where only a limited investigation has been completed <u>or</u> where the geotechnical conditions/constraints are quite complex, it is prudent to have a joint design review which involves an experienced geotechnical engineer/engineering geologist.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types and appropriate footing or pile founding depths, or

iii) full time engineering presence on site.

SYMBOL LEGENDS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CI, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CI, CH)
- SILTY CLAY (CL, CI, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CI, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML, MH)
- PEAT AND HIGHLY ORGANIC SOILS (Pt)

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE/MUDSTONE
- SILTSTONE
- CLAYSTONE
- COAL
- LAMINITE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

OTHER MATERIALS

- BRICKS OR PAVERS
- CONCRETE
- ASPHALTIC CONCRETE

CLASSIFICATION OF COARSE AND FINE GRAINED SOILS

Major Divisions		Group Symbol	Typical Names	Field Classification of Sand and Gravel	Laboratory Classification	
Coarse grained soil (more than 65% of soil excluding oversize fraction is greater than 0.075mm)	GRAVEL (more than half of coarse fraction is larger than 2.36mm	GW	Gravel and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 4$ $1 < C_c < 3$
		GP	Gravel and gravel-sand mixtures, little or no fines, uniform gravels	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		GM	Gravel-silt mixtures and gravel-sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	Fines behave as silt
		GC	Gravel-clay mixtures and gravel-sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	Fines behave as clay
	SAND (more than half of coarse fraction is smaller than 2.36mm)	SW	Sand and gravel-sand mixtures, little or no fines	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	$C_u > 6$ $1 < C_c < 3$
		SP	Sand and gravel-sand mixtures, little or no fines	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	≤ 5% fines	Fails to comply with above
		SM	Sand-silt mixtures	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	≥ 12% fines, fines are silty	N/A
		SC	Sand-clay mixtures	'Dirty' materials with excess of plastic fines, medium to high dry strength	≥ 12% fines, fines are clayey	

Major Divisions		Group Symbol	Typical Names	Field Classification of Silt and Clay			Laboratory Classification
				Dry Strength	Dilatancy	Toughness	% < 0.075mm
ine grained soils (more than 35% of soil excluding oversize fraction is less than 0.075mm)	SILT and CLAY (low to medium plasticity)	ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or silt with low plasticity	None to low	Slow to rapid	Low	Below A line
		CL, CI	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay	Medium to high	None to slow	Medium	Above A line
		OL	Organic silt	Low to medium	Slow	Low	Below A line
	SILT and CLAY (high plasticity)	MH	Inorganic silt	Low to medium	None to slow	Low to medium	Below A line
		CH	Inorganic clay of high plasticity	High to very high	None	High	Above A line
		OH	Organic clay of medium to high plasticity, organic silt	Medium to high	None to very slow	Low to medium	Below A line
	Highly organic soil	Pt	Peat, highly organic soil	–	–	–	–

Laboratory Classification Criteria

A well graded coarse grained soil is one for which the coefficient of uniformity $Cu > 4$ and the coefficient of curvature $1 < C_c < 3$. Otherwise, the soil is poorly graded. These coefficients are given by:

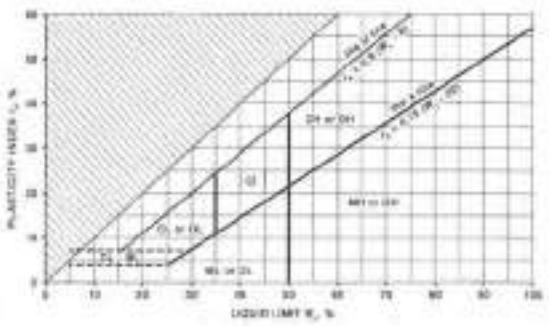
$$C_U = \frac{D_{60}}{D_{10}} \qquad and \qquad C_C = \frac{(D_{30})^2}{D_{10}\,D_{60}}$$

Where D_{10}, D_{30} and D_{60} are those grain sizes for which 10%, 30% and 60% of the soil grains, respectively, are smaller.

NOTES:

1. For a coarse grained soil with a fines content between 5% and 12%, the soil is given a dual classification comprising the two group symbols separated by a dash; for example, for a poorly graded gravel with between 5% and 12% silt fines, the classification is GP-GM.
2. Where the grading is determined from laboratory tests, it is defined by coefficients of curvature (C_c) and uniformity (C_u) derived from the particle size distribution curve.
3. Clay soils with liquid limits > 35% and ≤ 50% may be classified as being of medium plasticity.
4. The U line on the Modified Casagrande Chart is an approximate upper bound for most natural soils.

Modified Casagrande Chart for Classifying Silts and Clays according to their Behaviour



LOG SYMBOLS

Log Column	Symbol	Definition
Groundwater Record	▼	Standing water level. Time delay following completion of drilling/excavation may be shown.
	C	Extent of borehole/test pit collapse shortly after drilling/excavation.
	▶	Groundwater seepage into borehole or test pit noted during drilling or excavation.
Samples	ES	Sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos analysis.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'Refusal' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60° solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25 PID = 100	Vane shear reading in kPa of undrained shear strength. Photoionisation detector reading in ppm (soil sample headspace test).
Moisture Condition (Fine Grained Soils)	w > PL	Moisture content estimated to be greater than plastic limit.
	$w \approx$ PL	Moisture content estimated to be approximately equal to plastic limit.
	w < PL	Moisture content estimated to be less than plastic limit.
	$w \approx$ LL	Moisture content estimated to be near liquid limit.
	w > LL	Moisture content estimated to be wet of liquid limit.
(Coarse Grained Soils)	D	DRY – runs freely through fingers.
	M	MOIST – does not run freely but no free water visible on soil surface.
	W	WET – free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – unconfined compressive strength ≤ 25kPa.
	S	SOFT – unconfined compressive strength > 25kPa and ≤ 50kPa.
	F	FIRM – unconfined compressive strength > 50kPa and ≤ 100kPa.
	St	STIFF – unconfined compressive strength > 100kPa and ≤ 200kPa.
	VSt	VERY STIFF – unconfined compressive strength > 200kPa and ≤ 400kPa.
	Hd	HARD – unconfined compressive strength > 400kPa.
	Fr	FRIABLE – strength not attainable, soil crumbles.
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other assessment.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** / **SPT 'N' Value Range (Blows/300mm)**
	VL	VERY LOOSE – ≤ 15 – 0 – 4
	L	LOOSE – > 15 and ≤ 35 – 4 – 10
	MD	MEDIUM DENSE – > 35 and ≤ 65 – 10 – 30
	D	DENSE – > 65 and ≤ 85 – 30 – 50
	VD	VERY DENSE – > 85 – > 50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other assessment.
Hand Penetrometer Readings	300 250	Measures reading in kPa of unconfined compressive strength. Numbers indicate individual test results on representative undisturbed material unless noted otherwise.

Log Column	Symbol	Definition
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Twin pronged tungsten carbide bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.
	Soil Origin	The geological origin of the soil can generally be described as:
		RESIDUAL – soil formed directly from insitu weathering of the underlying rock. No visible structure or fabric of the parent rock.
		EXTREMELY WEATHERED – soil formed directly from insitu weathering of the underlying rock. Material is of soil strength but retains the structure and/or fabric of the parent rock.
		ALLUVIAL – soil deposited by creeks and rivers.
		ESTUARINE – soil deposited in coastal estuaries, including sediments caused by inflowing creeks and rivers, and tidal currents.
		MARINE – soil deposited in a marine environment.
		AEOLIAN – soil carried and deposited by wind.
		COLLUVIAL – soil and rock debris transported downslope by gravity, with or without the assistance of flowing water. Colluvium is usually a thick deposit formed from a landslide. The description 'slopewash' is used for thinner surficial deposits.
		LITTORAL – beach deposited soil.

Classification of Material Weathering

Term		Abbreviation		Definition
Residual Soil		RS		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are no longer visible, but the soil has not been significantly transported.
Extremely Weathered		XW		Material is weathered to such an extent that it has soil properties. Mass structure and material texture and fabric of original rock are still visible.
Highly Weathered	Distinctly Weathered (Note 1)	HW	DW	The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Rock strength is significantly changed by weathering. Some primary minerals have weathered to clay minerals. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Moderately Weathered		MW		The whole of the rock material is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable, but shows little or no change of strength from fresh rock.
Slightly Weathered		SW		Rock is partially discoloured with staining or bleaching along joints but shows little or no change of strength from fresh rock.
Fresh		FR		Rock shows no sign of decomposition of individual minerals or colour changes.

NOTE 1: The term 'Distinctly Weathered' is used where it is not practicable to distinguish between 'Highly Weathered' and 'Moderately Weathered' rock. 'Distinctly Weathered' is defined as follows: *'Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores'*. There is some change in rock strength.

Rock Material Strength Classification

Term	Abbreviation	Uniaxial Compressive Strength (MPa)	Guide to Strength	
			Point Load Strength Index $Is_{(50)}$ (MPa)	Field Assessment
Very Low Strength	VL	0.6 to 2	0.03 to 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30mm thick can be broken by finger pressure.
Low Strength	L	2 to 6	0.1 to 0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium Strength	M	6 to 20	0.3 to 1	Scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High Strength	H	20 to 60	1 to 3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High Strength	VH	60 to 200	3 to 10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High Strength	EH	> 200	> 10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Abbreviations Used in Defect Description

Cored Borehole Log Column		Symbol Abbreviation	Description
Point Load Strength Index		• 0.6	Axial point load strength index test result (MPa)
		x 0.6	Diametral point load strength index test result (MPa)
Defect Details	– Type	Be	Parting – bedding or cleavage
		CS	Clay seam
		Cr	Crushed/sheared seam or zone
		J	Joint
		Jh	Healed joint
		Ji	Incipient joint
		XWS	Extremely weathered seam
	– Orientation	Degrees	Defect orientation is measured relative to normal to the core axis (ie. relative to the horizontal for a vertical borehole)
	– Shape	P	Planar
		C	Curved
		Un	Undulating
		St	Stepped
		Ir	Irregular
	– Roughness	Vr	Very rough
		R	Rough
		S	Smooth
		Po	Polished
		Sl	Slickensided
	– Infill Material	Ca	Calcite
		Cb	Carbonaceous
		Clay	Clay
		Fe	Iron
		Qz	Quartz
		Py	Pyrite
	– Coatings	Cn	Clean
		Sn	Stained – no visible coating, surface is discoloured
		Vn	Veneer – visible, too thin to measure, may be patchy
		Ct	Coating ≤ 1mm thick
		Filled	Coating > 1mm thick
	– Thickness	mm.t	Defect thickness measured in millimetres

APPENDIX A

Borehole Logs 1 to 7 from JKG 1981

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 1

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location: STANHOPE ROAD, KILLARA.

Job No. 1885 Method: SPIRAL AUGER
Date: 1·12·81

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
dry on completion						TOPSOIL grass				
					CL	SILTY SANDY CLAY medium plasticity, yell. brown sand, fine to med. grained, some flakes ironstone gravel	MC>PL	st to v.st.		Possibly fill
	DS	N=16 2.6.10	1		SC-CL	CLAYEY SAND/SANDY CLAY low to med. plast. sand is fine to med. grained, grey some ironstone				extremely weathered sandstone structure evident ← 'V' bit refusal
	DS									
	DS									
			2			SANDSTONE fine to medium grain. highly weathered, medium strong. dk brown				
						AS ABOVE but becoming weak to medium strong grey, yell. brown & red brown mottled				
	DS		3							
						END OF BOREHOLE AT 3·1 m				
			4							
			5							
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 2

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location. STANHOPE ROAD. KILLARA.

Job No. 1885 Method: SPIRAL AUGER
Date: 1·12·81

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel Density	Hand Penetrometer Readings kPa.	Remarks
dry						TOPSOIL grey				
					CL	SANDY CLAY medium plasticity. Yell. brown red brown and grey	MC>PL	st to V.st.		
13.3	DS	N>16 3.16.-	1		CL-SC	SANDY CLAY/CLAYEY SAND fines of low to med. plasticity sand is medium grained. grey				extremely weathered sandstone str. evident
11.4										'V' but refusal
5.4	DS					SANDSTONE fine to med. grain highly weathered. weak to medium strong. grey with some harder ironstained bands				
			2			AS ABOVE but becoming medium strong. grey & red br. mottled				
5.8	DS		3			AS ABOVE but becoming weak				
						END OF BOREHOLE AT 3·1 m				
			4							
			5							
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 3

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location: STANHOPE ROAD. KILLARA.

Job No. 1885
Date: 1·12·81
Method: SPIRAL AUGER

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
dry						FILL silty clay and gravel				
	DS					SANDSTONE fine-med. grain extremely weathered. extremely weak. grey some hard ironstained bands				← 'V' bit refusal
	DS		1			SANDSTONE fine-med. grain highly weathered. weak to medium strong. grey. yellow brown and dark brown laminated some red brown mottling				
	DS		2			AS ABOVE but highly weathered. moderately strong				
	DS		3			AS ABOVE but becoming grey and yellow brown mottled and some ferric ironstaining				
						END OF BOREHOLE AT 3·1 m				
			4							
			5							
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 4

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location: STANHOPE ROAD. KILLARA.

Job No. 1885 Method: SPIRAL AUGER
Date: 1·12·81

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
dry.						FILL Sandstone gravel and clay				
	DS					SANDSTONE fine - med. grain extremely weathered. extremely weak to weak. grey and red brown				← 'V' bit refusal
			1			AS ABOVE but becoming medium strong. purple and grey mottled with grey and yellow brown laminations				
	DS									
			2							
						weaker band				
	DS		3							
						END OF BOREHOLE AT 3·1 m				
			4							
			5							
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 5

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location: STANHOPE ROAD. KILLARA.

Job No. 1885
Date: 1·12·81
Method: SPIRAL AUGER

Groundwater record	Samples	FIELD TESTS	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
dry.						FILL silty sandy clay low to medium plasticity. grey and red brown. some extremely weath. sandstone gravel				
1·5	DS									'V' bit refusal
			1			SANDSTONE fine to med. grain extremely weathered. extremely weak. grey				
2·7	DS					AS ABOVE but becoming highly weathered. medium strong grey and yellow brown laminat. and dark brown ironstaining				
			2			AS ABOVE but becoming moderately weathered. medium strong to strong. grey with some ironstaining				
3·0	DS		3							
						END OF BOREHOLE AT 3·1 m				
			4							
			5							
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 6

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location: STANHOPE ROAD, KILLARA.

Job No. 1885
Date: 1·12·81
Method: SPIRAL AUGER

Groundwater record	Samples	FIELD TESTS	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel Density	Hand Penetrometer Readings kPa.	Remarks
dry.						FILL silty sandy clay + s'stone gravel				
	DS					SANDSTONE fine to med. brown extremely weathered. extremely weak. Grey & red br. laminations				'V' bit refusal
			1			SANDSTONE fine to med. brown highly to moderately weathered. medium strong becoming strong with depth. Grey with some red and yellow brown staining				
	DS									
						END OF BOREHOLE AT 1·6 m				
			2							
			3							
			4							
			5							
			6							

JEFFERY AND KATAUSKAS PTY. LTD.

BOREHOLE LOG

Borehole No. 7

Client:
Project: PROPOSED LOURDES RETIREMENT VILLAGE
Location: STANHOPE ROAD. KILLARA.

Job No. 1885 Method: SPIRAL AUGER
Date: 1-12-81

Groundwater record	Samples	FIELD TESTS	Depth (m.)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition	Consistency/ Rel. Density	Hand Penetrometer Readings kPa.	Remarks
dry.						FILL silty sand and ceramic tiles. dark grey				
										'V' bit refusal
			1			SANDSTONE medium grained. highly to moderately weathered. weak to medium strong. grey with yellow and red brown mottling. Some weaker clayey bands				
6.9	D.S.									
			2							
6.8	D.S.		3							
						END OF BOREHOLE AT 3.1 m				
			4							
			5							
			6							

APPENDIX B

Borehole Logs 1 to 3 from JKG 1989

JEFFERY AND KATAUSKAS PTY. LTD.

CORED BOREHOLE LOG

Borehole No. 1

Client:
Project: ADDITIONS TO LOURDES RETIREMENT VILLAGE
Location: STANHOPE DRIVE, KILLARA.

Job No: 6414 K
Date Drilled: 13 - 12 - 88
Drill Type: EDSON 3000

Core Size: N.M.L.C.
Inclination: 90°
Bearing: —

R.L. Surface:
Datum:

Water Loss Level	Bore-Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, mineral components.	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_s(50)$	DEFECT DETAILS: DEFECT SPACING (mm)	DEFECT DETAILS: DESCRIPTION Type, inclination, thickness, planarity, roughness, coating Specific / General
				TOPSOIL: clayey sand over fill START CORING AT 0.40m.					
				FILL: Sandy Clay, ripped sandstone, fordrete pieces, ironstone gravel, roots.					(SOIL PROPERTIES ONLY)
		1		TOPSOIL: silty sand clay, low to medium plasticity, grey brown					
				SANDSTONE FLOATER: medium to coarse grained pale grey with orange ironstaining.	HW	VW/W			
				SANDY CLAY: medium plasticity orange with a trace of roots					(SOIL PROPERTIES ONLY)
				0.17m CORE LOSS.					
		2		SANDSTONE: medium grained, pale grey with subtle red brown & orange iron stained zones & bleached zones.	MW	MS/S			— SANDY CLAY SEAM, 5°, 10mm — CLAY SEAM, 0°, 10mm
				as above but medium to coarse grained.		MS			
		3							— BEDDING PARTING, 5°, SMOOTH, PLANAR — IRON INDURATED ZONE, 5°, 10mm — JOINT, 5°, ROUGH, PLANAR. — IRON INDURATED ZONE, 0°, 25mm — JOINT, 5°, ROUGH, PLANAR.
		4		as above but fine to medium grained and grey with dark grey laminations and occasional orange ironstained zones.	MW/SW				— HW SEAM, 10°, 5mm ⇒ 2 MICACEOUS PARTINGS, 0°-5°, IRREGULAR
		5							— IRON INDURATED ZONE 10°, 80mm (SOME FRAGMENTED ZONES)
				END OF BOREHOLE AT 5.48m					
		6							
		7							

JEFFERY AND KATAUSKAS PTY. LTD.

CORED BOREHOLE LOG

Borehole No. 2

Client:
Project: ADDITIONS TO LOURDES RETIREMENT VILLAGE
Location: STANHOPE DRIVE, KILLARA.

Job No: 6414 K
Date Drilled 13 · 12 - 88
Drill Type: EDSON 3000

Core Size: N M L C.
Inclination: 90°
Bearing: —

R. L. Surface:
Datum:

Water Loss Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$	DEFECT SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating Specific / Generic
				GLAZED SAND START CORING AT 0·28m.					
		1		SANDSTONE - medium to coarse grained, bleached greyish white with orange ironstained zones. —as above but pale grey with red brown and orange ironstained zones.	MW	MS			—SANDY CLAY & ROOT SEAM 15-20°, 10mm —EW-HW SEAM, 3°, 40mm —EW-HW SEAM, 3°, 10mm
		2		END OF BOREHOLE AT 2·13m.					
		3							
		4							
		5							
		6							
		7							

JEFFERY AND KATAUSKAS PTY. LTD.

CORED BOREHOLE LOG

Borehole No. 3

Client:
Project: ADDITIONS TO LOURDES RETIREMENT VILLAGE
Location: STANHOPE DRIVE, KILLARA.

Job No. 6414 K
Date Drilled 13-12-88
Drill Type: EDSON 3000
Core Size: N M L C
Inclination: 90°
Bearing: —
R. L. Surface.
Datum:

Water Loss Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components)	Weathering	Strength	POINT LOAD INDEX STRENGTH $I_S(50)$	DEFECT SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating) Specific / General
				SANDY CLAY START CORING AT 0.43m					
		1		SANDSTONE: medium to coarse grained, bleached greyish white with orange and red brown mottling and banding.	MW SW	MS			SANDY CLAY & ROOT SEAM, 10°, 15 mm
					MW				HW - EW SEAM, 5°, 65mm
		2		as above but pale grey with orange ironstain mottle and bands and some pale brown laminations.	MW SW.				
		3							2 IRON INDURATED SEAMS, 0-5°, 10mm & 20mm
				0.02 CORE LOSS					
				as above but pale grey with occassional thin micaceous seams.	MW SW	MS			BEDDING PARTING 10° SMOOTH, PLANAR
		4		as above but orange ironstaining.	MW	MS/S			IRON INDURATED ZONE 0-5°, 90mm, SOME FRAGMENTED ZONES.
				as above but grey with dark grey laminations.	SW				BEDDING PARTING 5°, SMOOTH, PLANAR.
		5		END OF BOREHOLE AT 4.90m					
		6							
		7							

APPENDIX C

Borehole Logs 1 to 4 from JKG 2001

Jeffery and Katauskas Pty Ltd
CONSULTING GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No. 1 1/2

Client:

Project: PROPOSED BUILDING

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 15420SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ± 105.5m

Date: 23-11-01 **Datum:** AHD

Logged/Checked by: A.J.H./FW

Groundwater Record	SAMPLES ES	USD	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING				■	N=5,11 13,11/ 100mm	0			ASPHALTIC CONCRETE: 20mm; over FILL: Sand, fine to coarse grained, light brown, with clay fines and a trace of igneous gravel.	M			
									SANDSTONE: fine to medium grained, light grey, with clay bands and medium to high strength ironstone seams.	XW	E.		
						1			REFER TO CORED BOREHOLE LOG				W/BIT REFUSAL AT 0.84m DEPTH
						2							
						3							
						4							
						5							
						6							

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CORED BOREHOLE LOG

Borehole No. **1** 2/2

Client:
Project: PROPOSED BUILDING
Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 16420SP | **Core Size:** NMLC | **R.L. Surface:** ≡ 105.5m
Date: 23-11-01 | **Inclination:** VERTICAL | **Datum:** AHD
Drill Type: JK550 | **Bearing:** | **Logged/Checked by:** A.J.H./PW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT SPACING (mm)	DEFECT DETAILS: DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific	General
		0								
				START CORING AT 0.84m						
				CORE LOSS 0.12m						
		1		SANDSTONE: fine to medium grained, light grey, bedded at 0-5°.	DW	M			CS, 0°, 50mm t	
				as above, but red brown, light orange brown and brown						
▼		2								
FULL RETURN									Bc, Cr, P, S, S	
		3		SANDSTONE: fine to medium grained, light grey, with dark grey laminae, bedded at 0-10° spacing 5-50mm.	SW					
		4		END OF BOREHOLE AT 3.99m						
		5								
		6								
		7								

Jeffery and Katauskas Pty Ltd
16420SP BH1 START CORING AT 0.84m
CORE LOST 0-19m
1
2
3
END OF BH AT 3.93m

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BOREHOLE LOG

Borehole No. **2** 1/2

Client:

Project: PROPOSED BUILDING

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 16420SP
Date: 23-11-01

Method: SPIRAL AUGER JK550

R.L. Surface: ≈ 105.8m
Datum: AHD

Logged/Checked by: A.J.H./pw

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
BY DIMPLETION OF AUGERING				■		0		CL	ASPHALTIC CONCRETE: 20mm SANDY CLAY: low plasticity, brown SANDSTONE: fine to medium grained, light grey SANDSTONE: fine to medium grained, red brown	MC<PL KW DW	ISO EL M		RFS DUAL 'V' BIT REFUSAL AT 0.4m DEPTH CONTINUE DRILLING USING 'TC' BIT MODERATE 'TC' BIT RESISTANCE
						1			REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							
						7							

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CORED BOREHOLE LOG

Borehole No. **2** 2/2

Client:
Project: PROPOSED BUILDING
Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 16420SP **Core Size:** NMLC **R.L. Surface:** ≅ 105.8m
Date: 23-11-01 **Inclination:** VERTICAL **Datum:** AHC
Drill Type: JK550 **Bearing:** **Logged/Checked by:** A.J.H./FW

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT SPACING (mm)	DEFECT DETAILS DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific / Genera
		0							
		1		START CORING AT 0.93m SANDSTONE: fine to medium grained, red brown and light orange brown, bedded at 0-5°	DW	M	×		
▼ FULL RETURN		2		SANDSTONE: fine to medium grained, light grey, bedded at 0-5°.	DW	L M	×		
		3		as above, but with dark grey laminae, bedded at 0-10°.		M-H	×		
		4		END OF BOREHOLE AT 3.98m			×		KWS, 0° (0mm)
		5							
		6							
		7							

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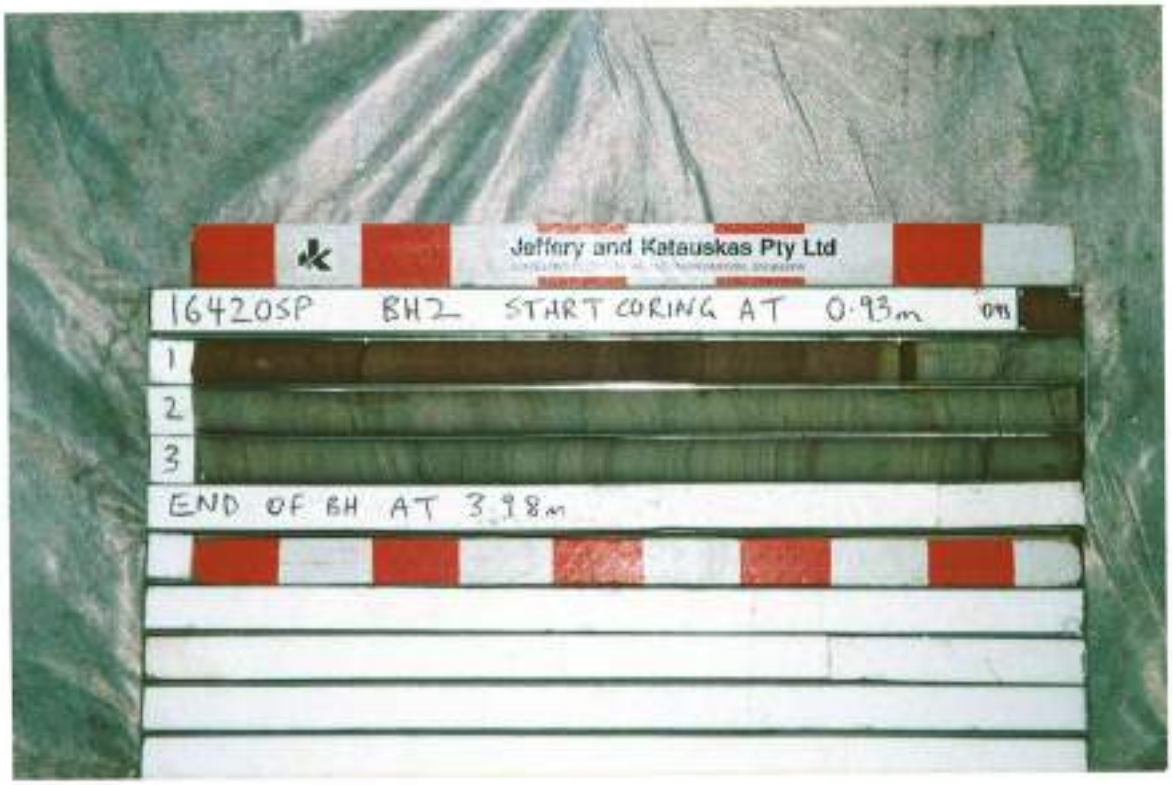
Jeffery and Katauskas Pty Ltd
164205P BH2 START CORING AT 0.93m
1
2
3
END OF BH AT 3.98m

Jeffery and Katauskas Pty Ltd
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BOREHOLE LOG

Borehole No. **3** 1/2

Client:

Project: PROPOSED BUILDING

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 16420SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ~ 106.5m

Date: 23-11-01 **Datum:** AHD

Logged/Checked by: A.J.H / [illegible]

Groundwater Record	SAMPLES ES	SAMPLES USD	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION OF AUGERING						0		CL	ASPHALTIC CONCRETE, 20mm.t over FILL. Gravelly sand, fine to medium grained, dark grey.	MC<PL	(St)	-	RESIDUAL
									SANDY CLAY: low plasticity, red brown and brown, with a trace of fine grained sub rounded ironstone gravel.	XW	FL	-	'V' BIT REFUSAL AT 0.5m. CONTINUE DRILLING USING 'TC' BIT
						1			SANDSTONE: fine to medium grained, light grey, with high strength iron indurated and clay bands.	DW	M		BANDED VERY LOW TO MODERATE 'TC' BIT RESISTANCE
									SANDSTONE: fine to medium grained, light orange brown.				
									REFER TO CORED BOREHOLE LOG				
						2							
						3							
						4							
						5							
						6							

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CORED BOREHOLE LOG

Borehole No. **3** 2/2

Client:

Project: PROPOSED BUILDING

Location: 95 STANHOPE ROAD, KILLARA NSW

Job No. 16420SP **Core Size:** NMLC **R.L. Surface:** ≈ 106.5m

Date: 23-11-01 **Inclination:** VERTICAL **Datum:** AHD

Drill Type: JK550 **Bearing:** **Logged/Checked by:** A.J.H./

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION (Rock Type, grain characteristics, colour, structure, minor components)	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT DETAILS: DEFECT SPACING (mm)	DEFECT DETAILS: DESCRIPTION (Type, inclination, thickness, planarity, roughness, coating) Specific	General
		0								
				START CORING AT 1.23m						
				SANDSTONE: fine to medium grained, light orange brown and light red brown, bedded at 0-5°	DW	M				
▼		2								
FULL RETURN				SANDSTONE: fine to medium grained, light grey, with occasional dark grey laminae bedded at 0-10°	SW/Fr					
		3								
						M-H				
		4								
				END OF BOREHOLE AT 4.3m						
		5								
		6								
		7								

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16420SP BH3 START CORING AT 1.23m
1
2
3
4
END OF BH AT 4.30m

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BOREHOLE LOG

Borehole No. **4** 1/2

Client:

Project: PROPOSED BUILDING

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 15420SP **Method:** SPIRAL AUGER JK550 **R.L. Surface:** ~ 106.2m

Date: 23-11-01 **Datum:** AHD

Logged/Checked by: A.J.H./PW

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
NIL ON COMPLETION OF AUGERING			0		CC	ASPHALTIC CONCRETE: 20mm. FILL: Sandy gravel, fine to medium grained, dark grey.	MC<PL	(St)		RESIDUAL "V" BIT REFUSAL AT 0.2m DEPTH. CONTINUE DRILLING USING TC BIT.
						SANDY CLAY: low plasticity, brown.	XW	EL		
						SANDSTONE: fine to medium grained, light grey, with high strength iron stained seams.	DW	V		BANDS OF MODERATE TO HIGH TC BIT RESISTANCE
			1			SANDSTONE: fine to medium grained, dark red brown.				
						REFER TO CORED BOREHOLE LOG				
			2							
			3							
			4							
			5							
			6							
			7							

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Borehole No.

CORED BOREHOLE LOG

4 2/2

Client:

Project: PROPOSED BUILDING

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 16420SP | Core Size: NMLC | R.L. Surface: ≅ 106.2m

Date: 23-11-01 | Inclination: VERTICAL | Datum: AHD

Drill Type: JK550 | Bearing: | Logged/Checked by: A.J.H./[illegible]

Water Loss/Level	Barrel Lift	Depth (m)	Graphic Log	CORE DESCRIPTION: Rock Type, grain characteristics, colour, structure, minor components.	Weathering	Strength	POINT LOAD STRENGTH INDEX $I_s(50)$	DEFECT SPACING (mm)	DEFECT DETAILS: DESCRIPTION Type, inclination, thickness, planarity, roughness, coating. Specific	General
		0								
		1		START CORING AT 0.87m SANDSTONE: fine to medium grained, red brown and light grey, bedded at 0-5°.	DW	M			-25.0°, 1mm, P, S	
				as above. but light red brown and light brown.						
FULL RETURN		2		SANDSTONE: fine to medium grained, light grey with dark grey laminae, bedded at 0-10°, spacing 5-50mm.	SW/Fr					
		3				M-H				
		4		END OF BOREHOLE AT 3.93m						
		5								
		6								
		7								

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16420SP BH4 START CORING AT
1
2
3
END OF BH AT 3.93m

APPENDIX D

Borehole Logs 1, 2 & 8 and Dynamic Cone Penetration Test Results Sheet from JKG 2010A

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BOREHOLE LOG

Borehole No. **1**
1/1

Client:

Project: PROPOSED ADDITIONS AND ALTERATIONS TO GARAGE AND RAISED WALKWAY

Location: LOURDES VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No. 235975B **Method:** SPIRAL AUGER JK350 **R.L. Surface:** N/A

Date: 31-3-10 **Datum:**

Logged/Checked by: A.M./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION		N = 2 1,1,2	0.5			DECK PAVING 50mm FILL: Clayey sand, fine to coarse grained, brown, red brown and grey, with fine to coarse grained and angular sandstone and igneous gravel				APPEARS POORLY COMPACTED
			1		SC	CLAYEY SAND: fine to medium grained, yellow brown, red brown and grey.	M	L-I		RESIDUAL
						SANDSTONE: fine to medium grained, red brown and grey.	DW	L		VERY LOW TO LOW 'TC' BIT RESISTANCE
			2			SANDSTONE: fine to medium grained, yellow brown, with clay bands.				LOW RESISTANCE
			2.5			SANDSTONE: fine to medium grained, light grey		L-M		LOW TO MODERATE RESISTANCE
			3			END OF BOREHOLE AT 2.0m				
			3.5							

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BOREHOLE LOG

Borehole No. **2**
1/F

Client:

Project: PROPOSED ADDITIONS AND ALTERATIONS TO GARAGE AND RAISED WALKWAY

Location: LOURDES VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No. 2399/SB **Method:** SPIRAL AUGER JK350 **R.L. Surface.** N/A

Date: 31-3-10 **Datum:**

Logged/Checked by: A.M./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition/ Weathering	Strength/ Relative Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION			0			MULCH				
						FILL: Clayey sand, fine to coarse grained, yellow brown and grey, with fine to medium grained sub angular sandstone gravel, and a trace of	M			APPEARS POORLY COMPACTED
			0.5		SC	Vitreous gravel. CLAYEY SAND: fine to medium grained, yellow brown, red brown and grey	M			RESIDUAL
		N = 5 2,2,3								
			1			SANDSTONE: fine to medium grained, red brown and yellow brown	DW			LOW TO SLIT RESISTANCE
			1.5							
			2			SANDSTONE: fine to medium grained, yellow brown, with clay bands.				
			2.5							
						SANDSTONE: fine to medium grained, light grey		L-M		LOW TO MODERATE RESISTANCE
			3			END OF BOREHOLE AT 3.0m				
			3.5							

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BOREHOLE LOG

Borehole No. **8**
1/1

Client:

Project: PROPOSED ADDITIONS AND ALTERATIONS TO GARAGE AND RAISED WALKWAY

Location: LOURDES VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No. 2369/SB **Method:** HAND AUGER **R.L. Surface:** N/A

Date: 31-3-10 **Datum:**

Logged/Checked by: A.P.C./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION		REFER TO DCP TEST RESULTS	0.5			FILL: Silty sand, fine to medium grained, brown grey, with fine to coarse grained sub angular to sub rounded sandstone and igneous gravel, ash and roots.	M			APPEARS POORLY COMPACTED
						FILL: Silty gravel, fine to coarse grained sub angular sandstone, yellow brown and red brown, fine to medium grained sand	D			
			1			FILL: Silty sand, fine grained, light brown, with fine to coarse grained sub rounded sandstone and ironstone gravel, organic material and root fibres.				
						FILL: Silty sand, fine grained, orange brown, with fine to medium grained sub rounded sandstone and ironstone gravel.	M			
			1.5			END OF BOREHOLE AT 1.4m				HAND AUGER REFUSAL ON INFERRED SANDSTONE
			2							
			2.5							
			3							
			3.5							

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DYNAMIC CONE PENETRATION TEST RESULTS

Client:			
Project	PROPOSED ADDITIONS & ALTERATIONS TO GARAGES AND RAISED WALKWAY		
Location	LOURDES VILLAGE 96 STANHOPE ROAD KILLARA, NSW		
Job No.	23897SB	Hammer Weight & Drop: 9kg/510mm	
Date.	31 3 10	Rod Diameter 16mm	
Tested By:	A M	Point Diameter: 20mm	

Number of Blows per 100mm Penetration

Test Location / Depth (mm)	4	4A	6	7	8	9	
0 - 100	EXCAVATED	EXCAVATED	2	3	2	1	
100 - 200	↓	↓	2	3	6	↓	
200 - 300	↓	↓	4	3	4	7	
300 - 400	↓	↓	3	3	4	3	
400 - 500	↓	↓	7	6	[illegible]	2	
500 - 600	↓	↓	5	10/110mm	2	5	
600 - 700	2	2	3	REFUSAL	2	5	
700 - 800	3	4	10/110mm	↓	↓	5	
800 - 900	8/110mm	6	REFUSAL	↓	↓	8/70mm	
900 - 1000	REFUSAL	10/50mm	↓	↓	[illegible]	REFUSAL	
1000 - 1100	↓	REFUSAL	↓	↓	2	↓	
1100 - 1200	↓	↓	↓	↓	5	↓	
1200 - 1300	↓	↓	↓	↓	5	↓	
1300 - 1400	↓	↓	↓	↓	7/50mm	↓	
1400 - 1500	↓	↓	↓	↓	REFUSAL	↓	
1500 - 1600	↓	↓	↓	↓	↓	↓	
1600 - 1700	↓	↓	↓	↓	↓	↓	
1700 - 1800	↓	↓	↓	↓	↓	↓	
1800 - 1900	↓	↓	↓	↓	↓	↓	
1900 - 2000	↓	↓	↓	↓	↓	↓	
2000 - 2100	↓	↓	↓	↓	↓	↓	
2100 - 2200	↓	↓	↓	↓	↓	↓	
2200 - 2300	↓	↓	↓	↓	↓	↓	
2300 - 2400	↓	↓	↓	↓	↓	↓	
2400 - 2500	↓	↓	↓	↓	↓	↓	
2500 - 2600	↓	↓	↓	↓	↓	↓	
2600 - 2700	↓	↓	↓	↓	↓	↓	
2700 - 2800	↓	↓	↓	↓	↓	↓	
2800 - 2900	↓	↓	↓	↓	↓	↓	
2900 - 3000	↓	↓	↓	↓	↓	↓	

Remarks: 1. The procedure used for this test is similar to that described in AS1289 6.3.2-1997, Method 6.3.2
2. Usually 8 blows per 20mm is taken as refusal

Ref: 23897SB 2 (9/10)

APPENDIX E

Borehole Logs 1 to 3 from JKG 2010B

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BOREHOLE LOG

Borehole No. **1**

1/

Client:

Project: PROPOSED NEW INDEPENDENT LIVING UNITS

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No. 24367VT

Date: 11-10-10

Method: SPIRAL AUGER JK305

Logged/Checked by: A.M./[illegible]

R.L. Surface: ≈ 104.2m

Datum: AHD

Groundwater Record	SAMPLES DS	SAMPLES UDG	SAMPLES DB	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION & AFTER 2 SOILS				N = 14 5,7,7	0		CL	TOPSOIL: Sandy clay, friable, dark brown, fine to medium grained sand, with root fibres.	MC>PL	VSt		GRASS COVER
								SILTY CLAY: medium plasticity, light brown mottled yellow and light grey, with lenses of medium grained sand.			300 350 320	RES DUAL
					1							
				N = 36 10,11,27			SC	CLAYEY SAND: medium grained, light grey and red brown, low plasticity clay, with iron indurated bands.	M	D		
					2			SANDSTONE: fine to medium grained, light grey and red brown with iron indurated bands	DW	L		LOW "TO" BIT RESISTANCE
										L-M		MODERATE RESISTANCE
					3							
								as above but light grey and light brown.		M		MODERATE TO HIGH RESISTANCE
									SW	H		HIGH RESISTANCE
					4			END OF BOREHOLE AT 4.0m				
					5							
					6							
					7							

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BOREHOLE LOG

Borehole No. **2**

Client:

Project: PROPOSED NEW INDEPENDENT LIVING UNITS

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No. 24367VT **Method:** SPIRAL AUGER JK305 **R.L. Surface:** = 104.6m

Date: 11-10-10 **Datum:** AHD

Logged/Checked by: A.M./

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION & AFTER 1.75 HRS		N = 20 6,8,12	0		CL	ASPHALTIC CONCRETE: 80mm. FILL: Sandy gravel, fine to medium grained sub angular igneous and sandstone gravel; brown and grey, fine to coarse grained sand. SILTY CLAY: medium plasticity, yellow brown, mottled grey and red brown, with lenses of medium grained sand and ironstone bands, as above.	M	-	-	
							MC>PL	VSt	350 380 380	RESIDUAL
			1			but with sandstone bands	DW	L		LOW "TOOL" RESISTANCE
			2			SANDSTONE: fine to medium grained, light grey and red brown, with a trace of iron induced bands				
										LOW RESISTANCE WITH MODERATE BANDS
			3			as above, but light grey and light brown		L-M		MODERATE RESISTANCE
							SW	V		HIGH RESISTANCE
			4			END OF BOREHOLE AT 4.0m				
			5							
			6							
			7							

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BOREHOLE LOG

Borehole No. **3**
1/

Client:

Project: PROPOSED NEW INDEPENDENT LIVING UNITS

Location: LOURDES RETIREMENT VILLAGE, 95 STANHOPE ROAD, KILLARA, NSW

Job No. 24367VT **Method:** SPIRAL AUGER JK305 **R.L. Surface:** ≈ 99.5m

Date: 1[illegible]-10-10 **Datum:** AHD

Logged/Checked by: A.M./[illegible]

Groundwater Record	Samples	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa)	Remarks
DRY ON COMPLETION AFTER 30 MINS		N = 14 8,6,6	0		SC	ASPHALTIC CONCRETE 70mm. FILL: Sandy gravel, fine to medium grained sub angular ignous gravel, dark grey and brown, fine to coarse grained sand.	M			
						CLAYEY SAND: fine to medium grained, light grey mottled yellow brown, low plasticity clay with ironstone bands.	M	MD		RESIDUAL
			1			SANDSTONE: fine to medium grained, light grey.	DW	VL L		VERY LOW TO LOW TO [illegible] RESISTANCE
			2							LOW RESISTANCE
								L M		LOW TO MODERATE RESISTANCE
			3							
										MODERATE RESISTANCE
			4			END OF BOREHOLE AT 4.0m				
			5							
			6							
			7							

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APPENDIX F

Borehole Logs 2 & 4 and Dynamic Cone Penetration Test Results Sheet from JKG 2014

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

BOREHOLE LOG

Borehole No.
2
1/1

Client:

Project: PROPOSED REMEDIAL MEASURES

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 27850ZA **Method:** HAND AUGER **R.L. Surface:** ≈ 100.9m

Date: 17-10-14 **Datum:** AHD

Logged/Checked by: N.C./A.J.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION					REFER TO DCP TEST RESULTS	0			FILL: Silty sand, fine to medium grained, brown, trace of roots and root fibres.	M			APPEARS POORLY COMPACTED
				■		0.5			FILL: Clayey sand, fine to medium grained, brown mottled light brown, trace of fine to medium grained ironstone and sandstone gravel, and roots.				
				■					as above, but light grey and orange brown.	MC<PL			
						1			FILL: Sandy clay, low to medium plasticity, light grey and light brown, fine to medium grained sand, trace of fine to coarse grained sandstone and ironstone gravel, and ash.	M			
				■					FILL: Silty sand, fine to medium grained, brown, trace of fine to medium grained sandstone gravel.				
						1.5			END OF BOREHOLE AT 1.4m				HAND AUGER REFUSAL ON OBSTRUCTION IN FILL
						2							
						2.5							
						3							
						3.5							

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BOREHOLE LOG

Borehole No.
4
1/1

Client:

Project: PROPOSED REMEDIAL MEASURES

Location: 95 STANHOPE ROAD, KILLARA, NSW

Job No. 27850ZA **Method:** HAND AUGER **R.L. Surface:** ≈ 100.4m

Date: 17-10-14 **Datum:** AHD

Logged/Checked by: N.C./A.J.

Groundwater Record	SAMPLES ES	U50	DB	DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION				■	REFER TO DCP TEST RESULTS	0			FILL: Silty sand, fine to medium grained, brown, trace of roots and root fibres.	M			APPEARS POORLY COMPACTED
						0.5			FILL: Clayey sand, fine to medium grained, brown mottled light brown, trace of fine to medium grained sandstone gravel, glass, ash, roots and root fibres.				
									FILL: Sandy gravel, fine to coarse grained igneous, grey, fine to medium grained sand.				HAND AUGER REFUSAL ON OBSTRUCTION IN FILL
									END OF BOREHOLE AT 0.65m				
						1							
						1.5							
						2							
						2.5							
						3							
						3.5							

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GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

DYNAMIC CONE PENETRATION TEST RESULTS

Client:			
Project:	PROPOSED REMEDIAL MEASURES		
Location:	95 STANHOPE ROAD, KILLARA, NSW		
Job No.	27850ZA	Hammer Weight & Drop: 9kg/510mm	
Date:	17-10-14	Rod Diameter: 16mm	
Tested By:	N.C.	Point Diameter: 20mm	

Number of Blows per 100mm Penetration							
Test Location	RL ~99.5m	RL ~100.9m	RL ~100.3m	RL ~100.4m			
Depth (mm)	**1**	**2**	**3**	**4**			
0 - 100	2	2	1	1			
100 - 200	2	2	1	2			
200 - 300	3	2	1	1			
300 - 400	8	1	1	1			
400 - 500	12	1	1	8			
500 - 600	16	2	2	4			
600 - 700	5	1	2	8			
700 - 800	2	7	3	12			
800 - 900	3	3	3	6			
900 - 1000	2	4	9	5			
1000 - 1100	1	3	7	6			
1100 - 1200	1	2	6	6			
1200 - 1300	1	1	4	6			
1300 - 1400	9	6	7	3			
1400 - 1500	7	2	10	2			
1500 - 1600	5	50/70mm	REFUSAL	2			
1600 - 1700	REFUSAL	REFUSAL		3			
1700 - 1800				2			
1800 - 1900				2			
1900 - 2000				3			
2000 - 2100				6			
2100 - 2200				25/60mm			
2200 - 2300				REFUSAL			
2300 - 2400							
2400 - 2500							
2500 - 2600							
2600 - 2700							
2700 - 2800							
2800 - 2900							
2900 - 3000							

Remarks:
1. The procedure used for this test is similar to that described in AS1289.6.3.2-1997, Method 6.3.2.
2. Usually 8 blows per 20mm is taken as refusal
3. The survey datum is AHD.

Ref: JK Geotechnics DCP 0-3m July 2012

LOURDES RETIREMENT VILLAGE
95 STANHOPE RD, KILLARA

URBAN DESIGN REPORT

RESPONSE TO COUNCIL SUBMISSION

PREPARED FOR LEVANDE
PLUS ARCHITECTURE

4/07/2023

1
INTRODUCTION

Exhibited Master Plan 3
Previously Proposed Master Plan 4
Updated Master Plan 5

EXHIBITED MASTER PLAN

The exhibited master plan presented in the Planning Proposal report demonstrates a robust structure plan that carefully establishes land uses, public and private open spaces, facilities, site features and road networks based on a range of key design drivers that reflect the findings of a site analysis and provides improved community infrastructure that are already experiencing a decline in their useful life.

The master plan for Lourdes Retirement Village provides a new seniors housing development consisting of approximately 110 suites as well as approximately 141 new independent living units arranged within a series of buildings ranging from 3 to 6 storeys in height. Additionally, the redevelopment of the southern portion of the site provides approximately 63 townhouses with a separate road network and private amenities.

The adjacent plan shows the proposed locations of the new community facilities in the northern portion of the site off the proposed Main Street interface. The Headfort House which is to be retained under this Planning Proposal will continue to serve as a Chapel for the community.

INDICATIVE DWELLING YIELD

141
INDEPENDENT LIVING UNITS

110
RESIDENTIAL AGED CARE FACILITY BEDS

63
TOWN HOUSES

1. New Entry to Stanhope Road
2. Headfort House Gardens
3. Lady of the Lourdes Grotto
4. RAC drop-off
5. Main Street
6. The Village Green
7. Dementia Garden
8. RAC Courtyard Landscape
9. Terraced Landscape
10. Pedestrian Connection
11. Landscape Mounding
12. Green Corridors
13. Service Trail
14. Existing Landscape
15. NewRoad Connection

PREVIOUSLY PROPOSED MASTER PLAN (04/05/23)

The master plan underwent significant amendment to address key points and recommendations that were raised by Ku-ring-gai Council as part of their assessment of the Planning Proposal. The key features of the updated master plan included:

- A reduction in the perceived scale of the proposal by accommodating the ILU programme within four smaller buildings, rather than three, increasing visual permeability and the potential for through-site links.

- A further reduction in building height from 4 storeys to 3 storeys for the building adjacent to the western boundary, minimising impacts on the adjoining neighbour.

- The introduction of variations in built form and height, length, architectural expression and upper level setbacks across the development that serve to increase solar amenity and reduce the visual presence of the proposal.

- The further integration of the proposal with the existing levels on site through the use of stepped building forms to ensure that the design is appropriately embedded within the landscape.

- The proposed principal entry into the basement carpark (including loading and servicing vehicle docks) moved to the eastern portion of the site to reduce any perceived impacts to the developments western neighbours.

- A proposed new road connection from Stanhope Road to the townhouse precinct, allowing for the creation of precincts within the development that have a greater sense of urban identity.

- The unique bushland setting serving as the inspiration of an evolved landscape design response.

- The identification through further resolution of the design to retain a greater number of existing trees.

- The articulation of massing envelopes to ensure buildings that are fine-grain and in their expression and materiality reflective of the residential context that they sit within.

- The use of apartments at the interface of the ILU carpark and the townhouses to minimise the visual impact of the basement carpark.

- More granular building expression at the interfaces of the townhouse precinct with the surrounding bushland by creating a staggered built form.

- The total floor space and indicative yield has not changed as a result of the amended master plan.

1. RAC drop-off
2. Headfort House Gardens
3. Lady of the Lourdes Grotto
4. Main Street
5. Dementia Garden
6. The Village Square
7. ILU drop-off
8. The Village Green
9. Green Corridors
10. Road Connections

UPDATED MASTER PLAN

In response to EHG RtS (06/06/23), the master plan has undergone further amendment to increase the achievable tree retention.

The key features of the updated master plan include:

- The adjustment of the western road and the building adjacent to the road to increase retention of high value trees.

- The further realignment of the fire trail connection to the western road to minimise vegetation clearing and increase retained tree canopy.

- The use of more compact townhouse typologies at the interface of the fire trail located at the southwestern perimeter of the site to increase tree retention.

- The further adjustment of the ILU building adjacent to the northeast boundary facing Stanhope Road to retain more high value trees.

1. RAC drop-off
2. Headfort House Gardens
3. Lady of the Lourdes Grotto
4. Main Street
5. Dementia Garden
6. The Village Square
7. ILU drop-off
8. The Village Green
9. Green Corridors
10. Road Connections

2
LANDSCAPE RESPONSE

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LOCAL CHARACTER

LANDSCAPE CHARACTER → **URBAN CHARACTER**

Swain Gardens + Gordon Creek + Lane Cove + Garigal National Park

Killara is located within the Lower East of Ku-ring-gai council area and is surrounded by vegetation corridors distinctive of Sydney's bushland. Within close vicinity to the site you have Swain Gardens, Seven Little Australians Park, Gordon Creek, Lane Cove National Park and Garigal National Park National Park.

Detahed houses on large lots within garden settings feature heavily in the north of the Lower East. Complemented by mature well-planted streets, these areas are synonymous with the idea of the idyllic and leafy North Shore.

Killara Neighourhood

Key characteristics of the Lower East Killara neighbourhood include:
- Streets running perpendicular to the Pacific Highway
- High amount of heritage items
- Consistent street layout reflecting the urban development of the early 1900's
- Large residential lots with considerable private open space
- Many houses with pools and tennis courts
- Archbold and Eastern Arterial roads bisect this area as a major traffic cartery
- Dense tree canopy
- Undulating topography that drops away quickly from the Pacific Highway to Middle Harbour
- Excellent areas of flora and fauna habitat

GREENERY CONNECTIONS

SWAIN GARDEN

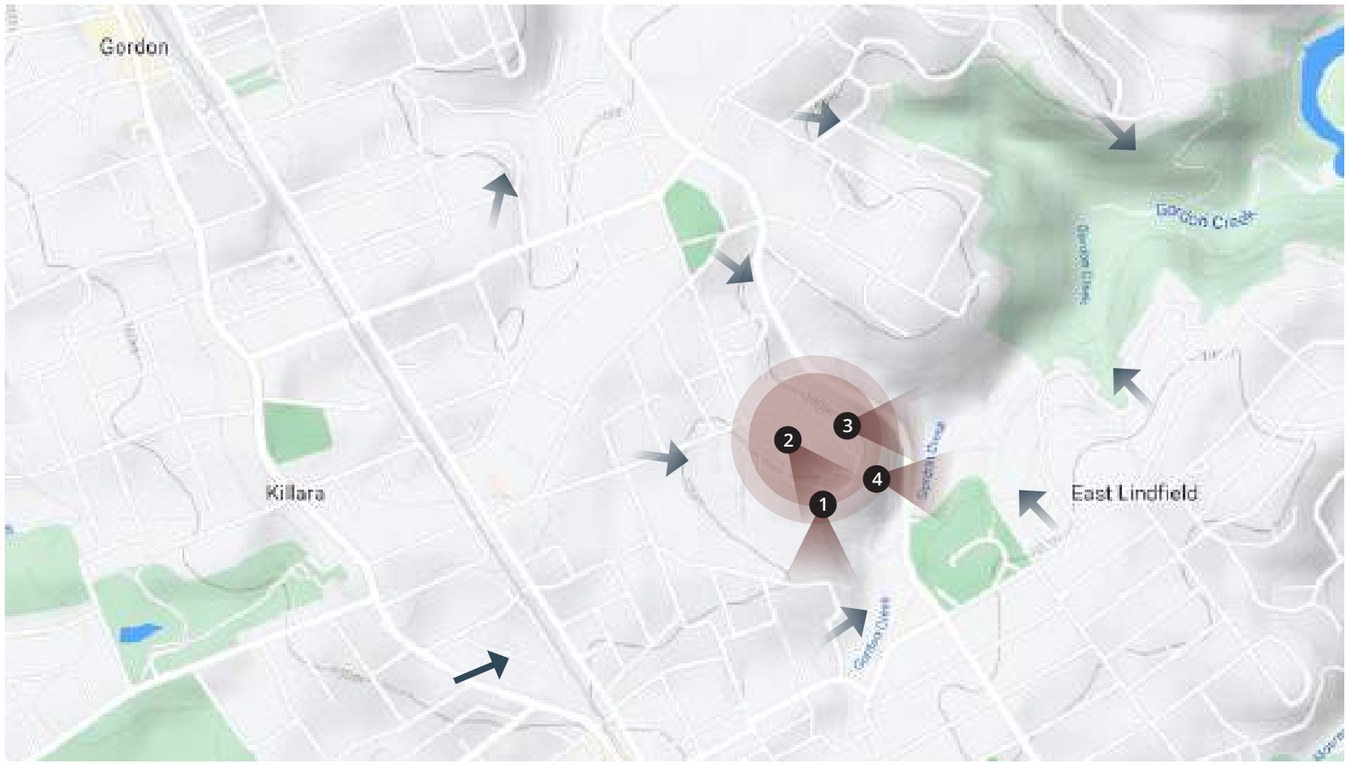
GORDON CREEK

QUARRY MASONS RESERVE

LANE COVE NATIONAL PARK

GARINGAI NATIONAL PARK

TOPOGRAPHY & VIEWS



The site's topography is a defining characteristic which falls approximately 13 meters from the northern boundary with Stanhope Road to the southern boundary along Lourdes Avenue and the bushland edge. This level change and elevation provides valuable views of Chatswood and Sydney city skylines. Many existing roads and access paths are steep. Our design will make use of this challenge in creating safe access and movement for residents.

1 View of bushland to southern site boundary

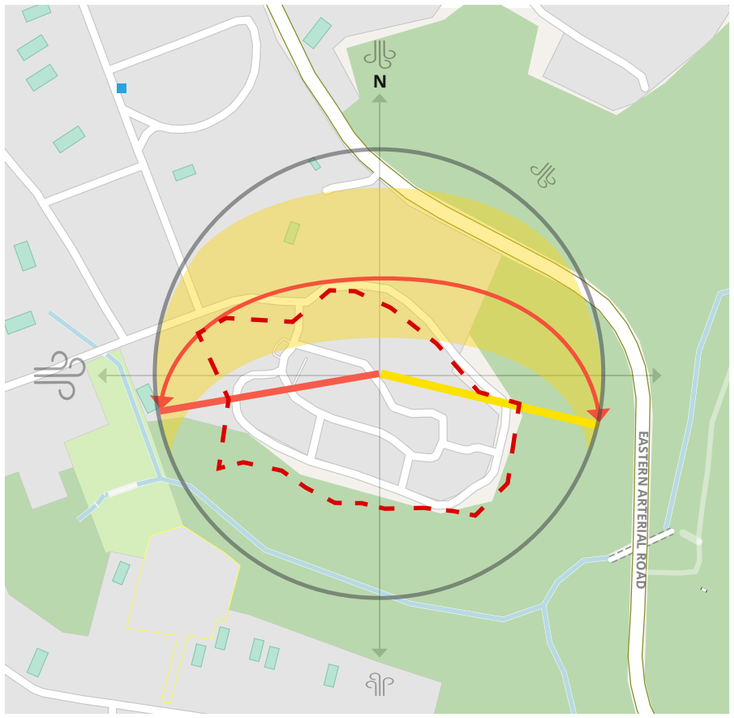
2 View from First Avenue

3 View of embankment along Stanhope Avenue

4 Access road along eastern site boundary

LOCAL ANALYSIS

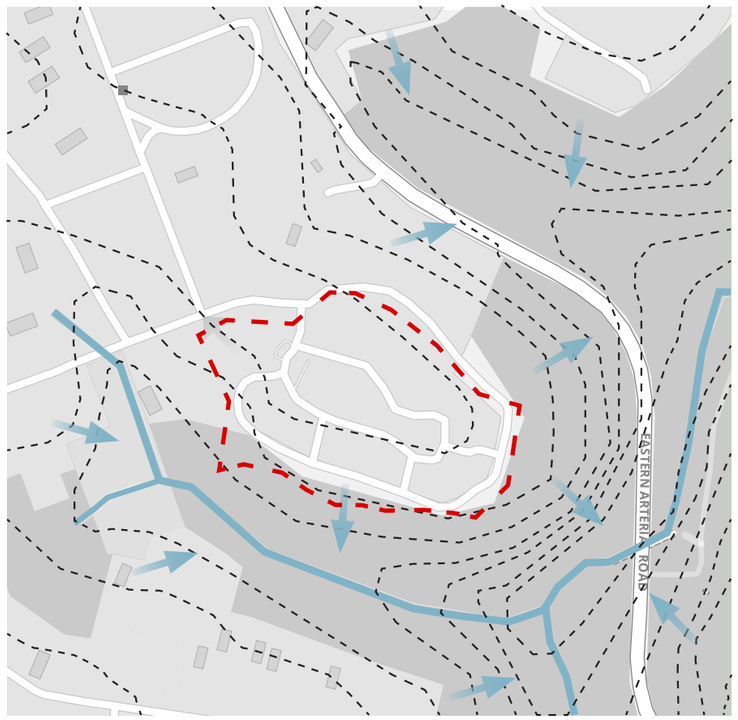
Solar Access



KEY

- SUNRISE
- SUNSET
- SOLAR PATH
- PREVAILING WINDS

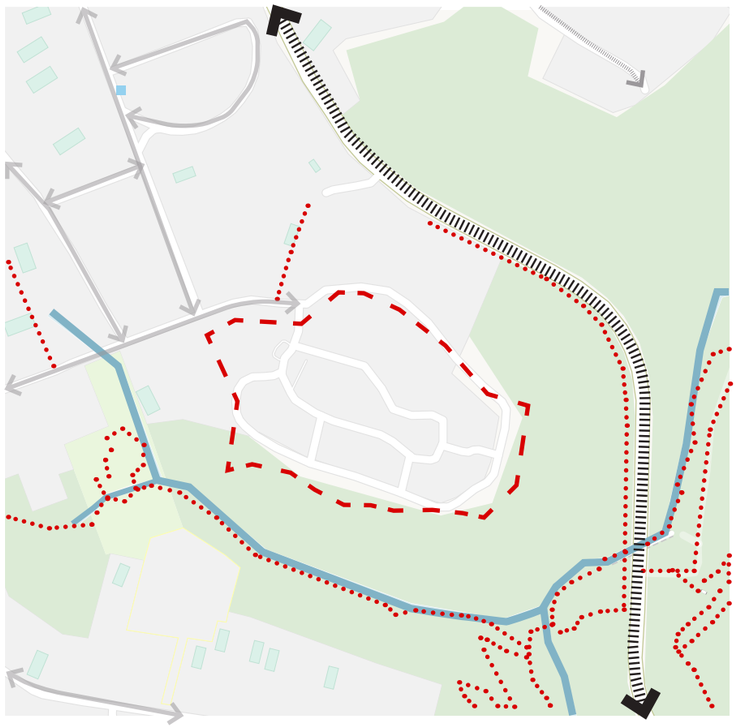
Hydrology



KEY

- 10M CONTOURS
- WATER FLOW
- WATER BODY

Circulation



KEY

- WALKING TRAILS
- WATER FLOW
- WATER BODY

LANDSCAPE MASTER PLAN

KEY

1. POCKET PARK OPPORTUNITY
2. SHAREWAY
3. VILLAGE HEART
4. WALKING TRACK
5. GREEN CORRIDORS WITH DRAINGE SWALES
6. GROTTO
7. CENTRAL BUSH WALKING SPINE

EXISTING TREE CANOPY

LEGEND

TREE CANOPY AREA = 11,518m² (22% OF SITE)

TOTAL SITE AREA = 52,906m²

PROPOSED TREE RETENTION: TREE CLASSIFICATION

KEY: CURRENT PROPOSAL

- **TOTAL TREES REMOVED = 215**
- **TOTAL TREES RETAINED = 164**
  - **ADDITIONAL RETAINED AA1 TREES = 2**
  - **ADDITIONAL RETAINED A1 TREES = 18**
  - **ADDITIONAL TREES RETAINED = 24**

PREVIOUS PROPOSAL

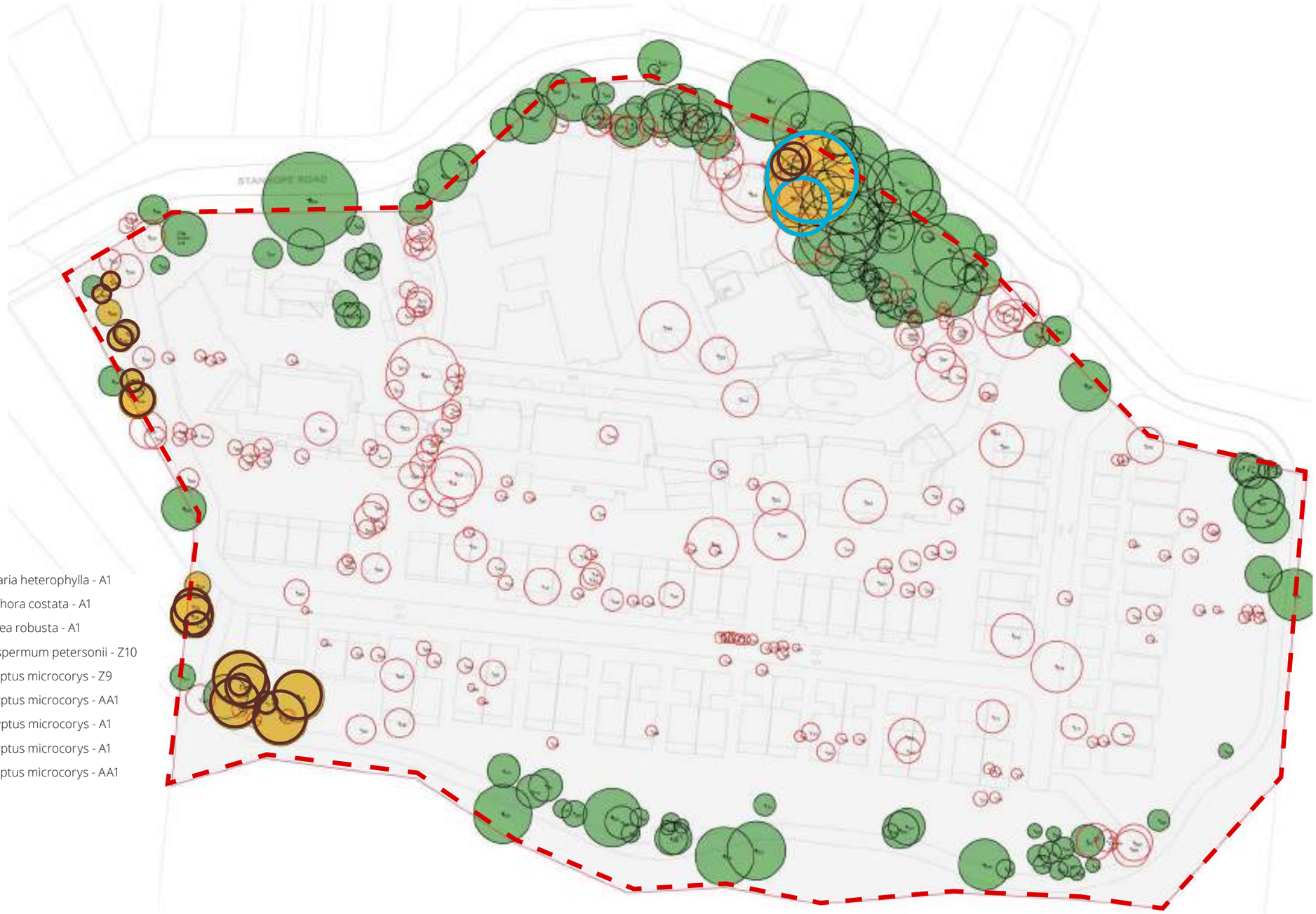
	IMPORTANCE (A/AA)	TOTAL TREES
TREES RETAINED	82	140
TREES REMOVED	82	239
TOTAL		379

CURRENT PROPOSAL

	IMPORTANCE (A/AA)	TOTAL TREES
TREES RETAINED	102	164
TREES REMOVED	62	215
TOTAL		379

ADDITIONAL RETAINED TREES

- 32 - Corymbia gummifera - A1
- 34 - Corymbia gummifera - A1
- 40 - Eucalptus robusta - Z10
- 41 - Melaleuca linariifolia - A1
- 42 - Eucalptus robusta - A1
- 44 - Syncarpia glomulufera - ZZ9
- 45 - Pittosporum undulatum - Z1
- 46 - Syncarpia glomulifera - A1
- 108 - Corymbia maculata - A1
- 110 - Casuarina cunninghamiana - A1
- 111 - Melaleca quinquenervia - A1
- 114 - Corymbia maculata - A1
- 116 - Eucalyptus pilularis - A1
- 117 - Melaleuca quinquenervia - A1
- 118 - Eucalyptus pilularis - A1
- 123 - Araucaria heterophylla - A1
- 124 - Angophora costata - A1
- 125 - Grevillea robusta - A1
- 126 - Leptospermum petersonii - Z10
- 324 - Eucalyptus microcorys - Z9
- 325 - Eucalyptus microcorys - AA1
- 368 - Eucalyptus microcorys - A1
- 369 - Eucalyptus microcorys - A1
- 371 - Eucalyptus microcorys - AA1



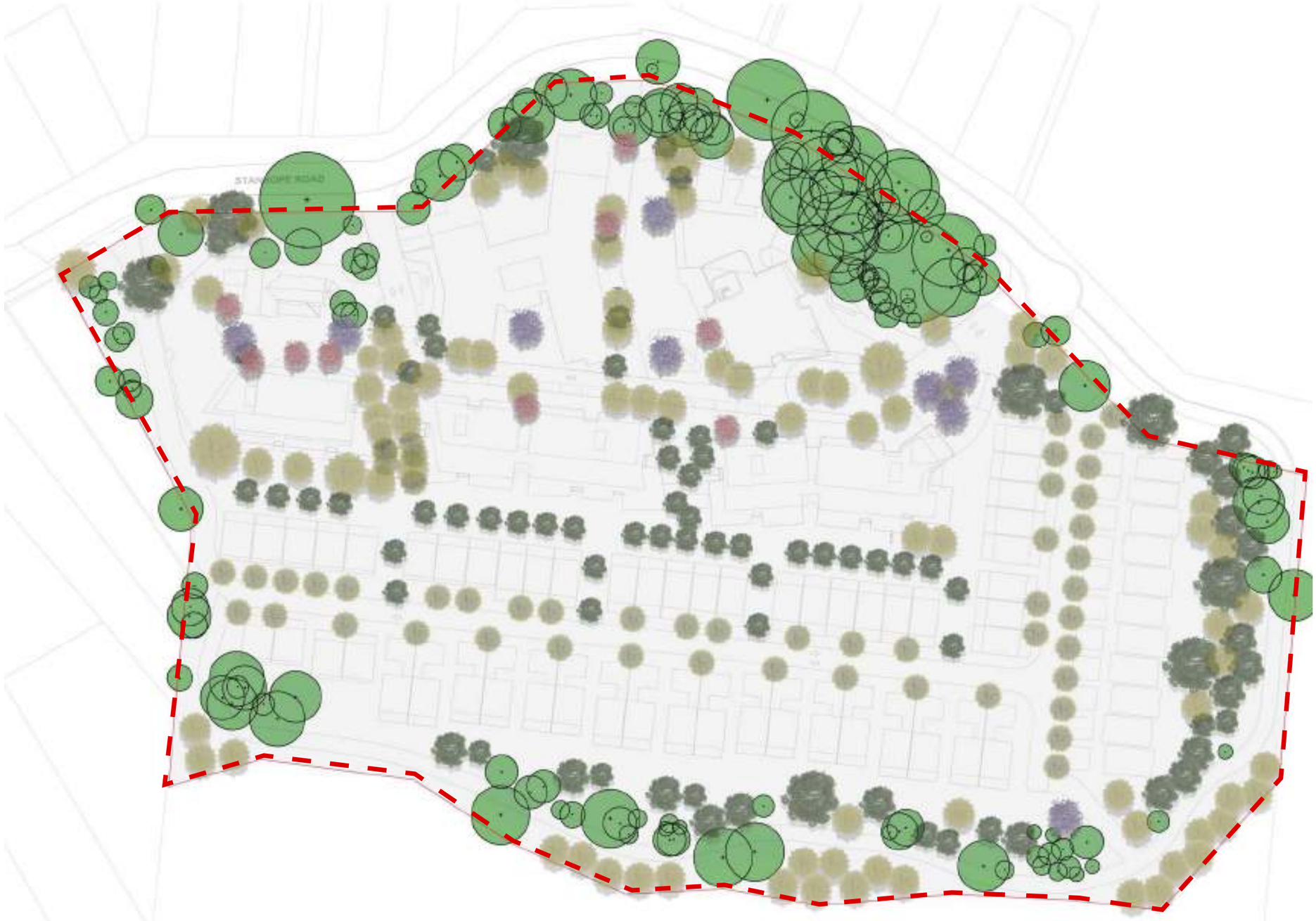
PROPOSED TREES

LEGEND

- **NATIVE TREES = 87**
- **NATIVE FEATURE TREES = 83 NATIVE**
- **NATIVE FEATURE TREES = 9 EXOTIC**
- **EXOTIC FEATURE TREES = 9**
- **STREET TREES = 51**
- **TOTAL TREES RETAINED = 164**

TOTAL TREES PROPOSED = 239

TOTAL TREES = 403



MATERIALITY

A practical and robust proposal of materials sympathetic with the natural surroundings and local ecotones of the Lourdes Development Site...

The materials strategy will curate a range of finishes which will express the unique characteristics of the Site. Priority will be given to materials of local provenance, visibly grounding the development in its connection to the surrounding bushland which defines the landscape character.

Feature finishes will be used to elevate key outdoor areas and provide definition to active and passive open spaces, and express a journey through a narrative of diverse and inter-connected web of landscape typologies.

In addition, the materials and finishes will be:

- Locally sourced from Australia and sustainable
- Durable and age gracefully over time
- Low maintenance solutions that can also minimise waste and reduce carbon footprint where possible
- Where possible, have high Solar Reflectance Index (SRI) value and/or lighter coloured materials to mitigate heat island effect.
- Robust, self-finished materials
- Considered materials that are non-combustible and protect from bushfire threat

SURFACES

Natural materials reinforcing the bush character

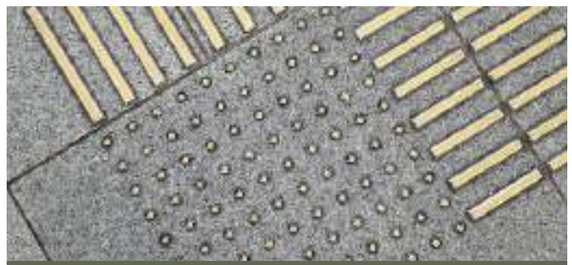
Decomposed gravel

Permeable trihex treatment to shared ways

Decking

Warmer tones in pavement types

Concrete pavements


Coherent and safe pathway design

FURNITURE

Loose furniture to hardstand

Precast concrete seat

Rocks as incidental seating and wayfinding

PLANTING

Proposed plants that generate 'cooler' spaces, define areas, highlight views, create visual interest and provide shade...

The site is surrounded by ecologically rich bushland. The landscape design will incorporate appropriate plant species and design where land is managed as an Asset Protection Zone (APZ). The APZ Planting Palette will aim to aid reduction of potential bush fire impacts in nominated zones.

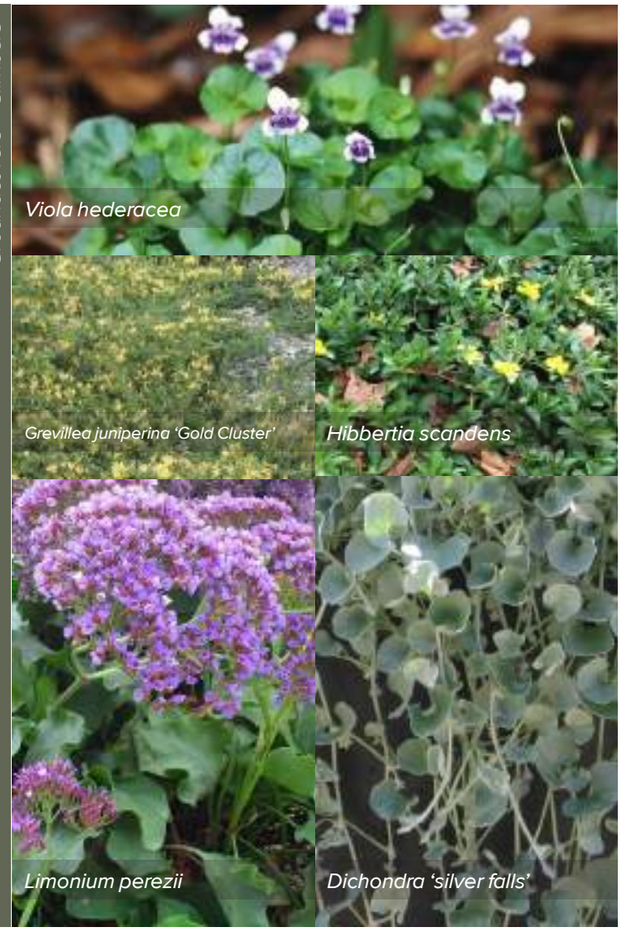
The strategic distribution of the Architecture will enable landscaping to be spaced around and between building form, delivering:

- Easy to maintain soft landscaping
- Uncomplicated landform and landscape structure - native trees and open grassland
- Plants the require minimal water and will generate 'cooler' green spaces, which in turn assist in transforming the urban heat island effect
- Level grass areas for flexible use
- Use of tree planting to provide visual interest, define areas, highlight views and provide shade
- Utilisation of locally native species to reinforce key landscape character zones
- Utilisation of native species to support year-round comfort to outdoor spaces

Trees

Grasses

Groundcovers + Climbers



Shrubs + Accents

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