Clause 4.6 Variation Request

Height of Buildings

(Clause 4.3(2D))

Pittwater Local Environmental Plan 2014

346-352 Whale Beach Road, Palm Beach

Submitted to Northern Beaches Council
On Behalf of Tzannes

MARCH 2019

REPORT REVISION HISTORY

Revision	Date Issued	Revision Description	
01	28/02/19	Revision tracking notes	
		Prepared by	**Verified by**
		Olivia Page *Assistant Project Planner*	 Stephen Kerr *Executive Director*
02	07/03/19	Revision tracking notes	
		Prepared by	**Verified by**
		Olivia Page *Assistant Project Planner*	 Stephen Kerr *Executive Director*

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1. INTRODUCTION

This is a formal written request that has been prepared in accordance with Clause 4.6 of the *Pittwater Local Environmental Plan 2014* (PLEP) to support a Development Application (DA) submitted to Northern Beaches Council for the demolition of the existing dwelling and construction of a three-storey dwelling house with basement facilities, associated landscaping and excavation at 346-352 Whale Beach Road, Palm Beach ("the subject site").

The objectives of Clause 4.6 are to provide an appropriate degree of flexibility in applying development standards to achieve better outcomes for, and from, development.

As the following request demonstrates, a better planning outcome would be achieved by exercising the flexibility afforded by Clause 4.6 in the particular circumstances of this application.

The subject site is zoned E4 Environmental Living. It is acknowledged that the maximum building height prescribed for the subject site according to Clause 4.3(2) of the current PLEP is 8.5m. However, pursuant to Clause 4.3(2D), development on land that has a maximum building height of 8.5m may exceed 8.5m but be no more than 10m if:

- *The consent authority is satisfied that the portion of the building above the maximum height shown on that land on the Height of Buildings Map is minor, and*
- *The objectives of Clause 4.3 are achieved; and*
- *The building footprint is situated on a slope that is in excess of 16.7 degrees (that is 30%); and*
- *The buildings are sited and designed to take into account the slope of the land to minimise the need for cut and fill by design that allow the building to step down the slope.*

The development standard that this request seeks approval to vary is the Height of Buildings control, in Clause 4.3(2D) of the PLEP.

This request has been prepared having regard to the Department of Planning and Environment's Guidelines to Varying Development Standards (August 2011) and relevant decisions in the New South Wales Land and Environment Court and New South Wales Court of Appeal*1*.

In **Sections 4** and **5** of this request, we have explained how flexibility is justified in this case in terms of the matters explicitly required by Cclause 4.6 to be addressed in a written request from the applicant. In **Sections 6, 7** and **8** we address additional matters that the consent authority is required to be satisfied of when exercising either the discretion afforded by Clause 4.6 or the assumed concurrence of the Secretary.

2. STANDARD TO BE VARIED

The standard seeking to be varied is Clause 4.3(2D) of the *Pittwater Local Environmental Plan 2014* where the maximum nominated building height is 10m, only where the abovementioned criteria achieved.

1 Relevant decisions include: *Winten Property Group Limited v North Sydney Council* [2001] NSWLEC 46; *Wehbe v Pittwater Council* [2007] NSWLEC 827; *Four2Five Pty Ltd v Ashfield Council* [2015] NSWLEC 1009; *Four2Five Pty Ltd v Ashfield Council* [2015] NSWLEC 90; *Four2Five Pty Ltd v Ashfield Council* [2015] NSWCA 248; and *Moskovich v Waverley Council* [2016] NSWLEC 1015

3. EXTENT OF VARIATION

Pursuant to Clause 4.3(2D), a development that has a maximum building height of 8.5m may exceed 8.5m but be no greater than 10m if all the considerations in the respective clause are addressed. A response to the criteria is provided below and justifies that the 10m building height development standard is appropriate for the subject proposal:

a) The consent authority is satisfied that the portion of the building above the maximum height shown for that land on the Height of Buildings Map is minor, and

The portion of the development above the 8.5m height limit is minor. The variation to the 8.5m are the result of the varying existing ground level and topography of the site. The minor variations as can be seen in **Figure 8** below relate to the lift, the eastern wall of the Master Bedroom and the terrace on the Second Floor. These variations result in no adverse impact on the adjoining properties and overall the proposal is generally compliant with the 8.5m building height standard.

b) The objectives of this clause are achieved, and

The proposal is consistent with the objectives of Clause 4.3 of the PLEP 2014. The proposal is consistent with the desired character of the Palm Beach Locality. The dwelling is generally compliant with the maximum 8.5m building height development standard and responds to the adjoining and nearby development in terms of bulk and scale. It is noted that some additional overshadowing of the subject site occurs as a result of the proposal. However, the sun access control of the PDCP are still met with the predominate orientation of the house facing east. The site is bounded to the east by Whale Beach Road and, a number of properties and Annie Wyatt Reserve to the west. Due to the extensive existing vegetation, especially to the west of the site, there are no adverse view loss impacts that arise and view sharing is maintained consequently. The proposed stepping nature of the development directly responds to the natural topography of the site and aims to minimise excavation. The stepping nature of the proposal minimises the impact of the building height variation through a gradual reduction in height toward the foreshore area. The visual amenity of the natural environment located on all boundaries is not adversely affected by the proposed development.

c) The building footprint is situated on a slope that is in excess of 16.7 degrees (that is 30%), and

The building footprint is situated on a slope of a minimum of 36 degrees, which is in excess of 16.7 degrees (30%) as can be seen in the below figures prepared by Tzannes.

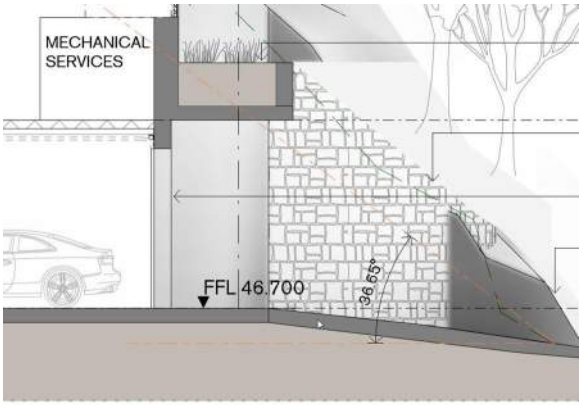

Figure 1: Extract of Section 1 from Architectural Plans showing slope of the site (Source: Tzannes)

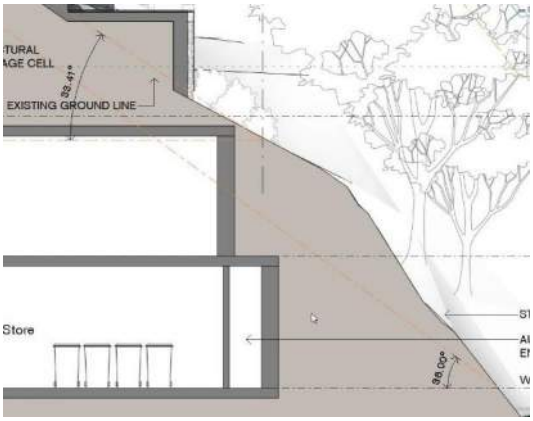

Figure 2: Extract of Section 2 of the Architectural Plans showing the slope of the site (Source: Tzannes)

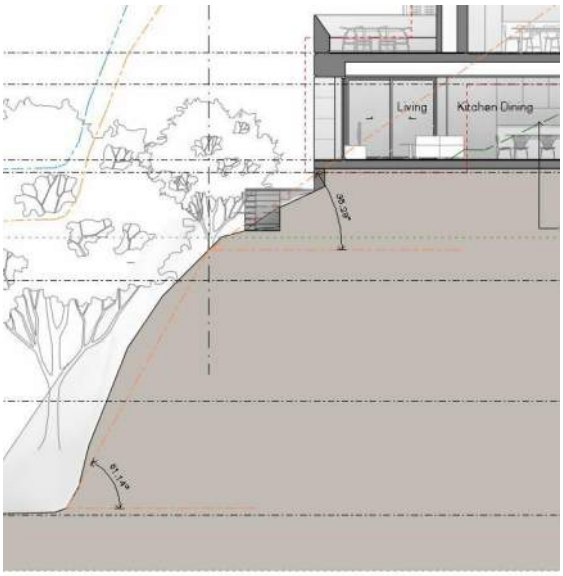

Figure 3: Extract of Section 4 of the Architectural Plans showing the slope of the site (Source: Tzannes)

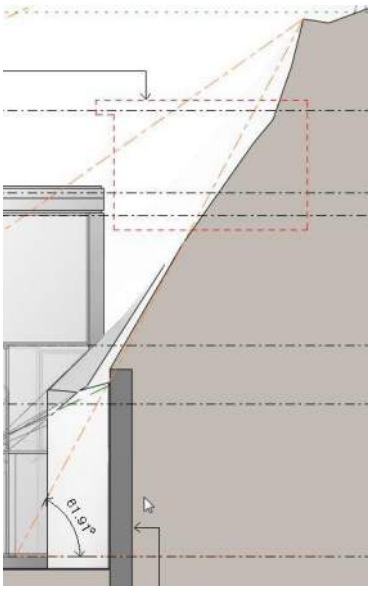

Figure 4: Extract of the Section 4 of the Architectural Plans showing slope of the site (Source: Tzannes)

d) The buildings are sited and designed to take into account the slope of the land to minimise the need for cut and fill by design that allow the building to step down the slope.

The proposed development responds to the natural topography of the site and steps from west to east from Annie Wyatt Park to Barrenjoey Road. The proposed stepping nature of the development aims to minimise excavation. The Geotechnical Report prepared by JK Geotechnics, in **Appendix 1,** has considered the suitability of the site for the proposed excavation and recommendations relating to fill similarly.

Therefore, the appropriate maximum building height control for the subject site is 10m as the required criteria in Clause 4.3(2D) is met, as shown above.

The proposal contravenes the maximum 10m building height control by 1.6m at the south-east corner of the development on the Second Floor. The proposed numerical variation to the maximum allowable building height is 1.6m, which represents a variation of 11.6% from the standard. The extent of the height variation can be seen in **Figures 5- 7** below.

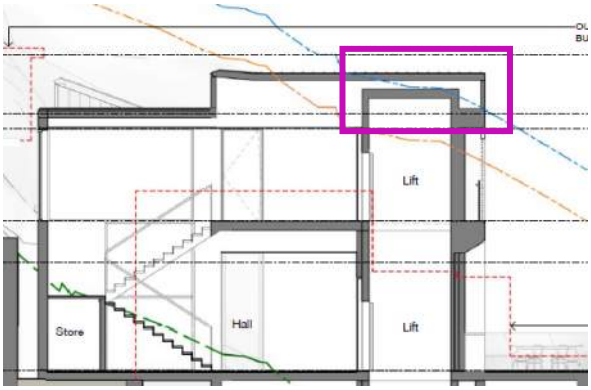

Figure 5: Extract of Section 3 showing departure from the 10m building height plane (in blue) at the lift (Source: Tzannes)

Figure 6: Extract of Section 4 showing departure from the 10m building height plane (in blue) at the Master Bedroom (Source: Tzannes)

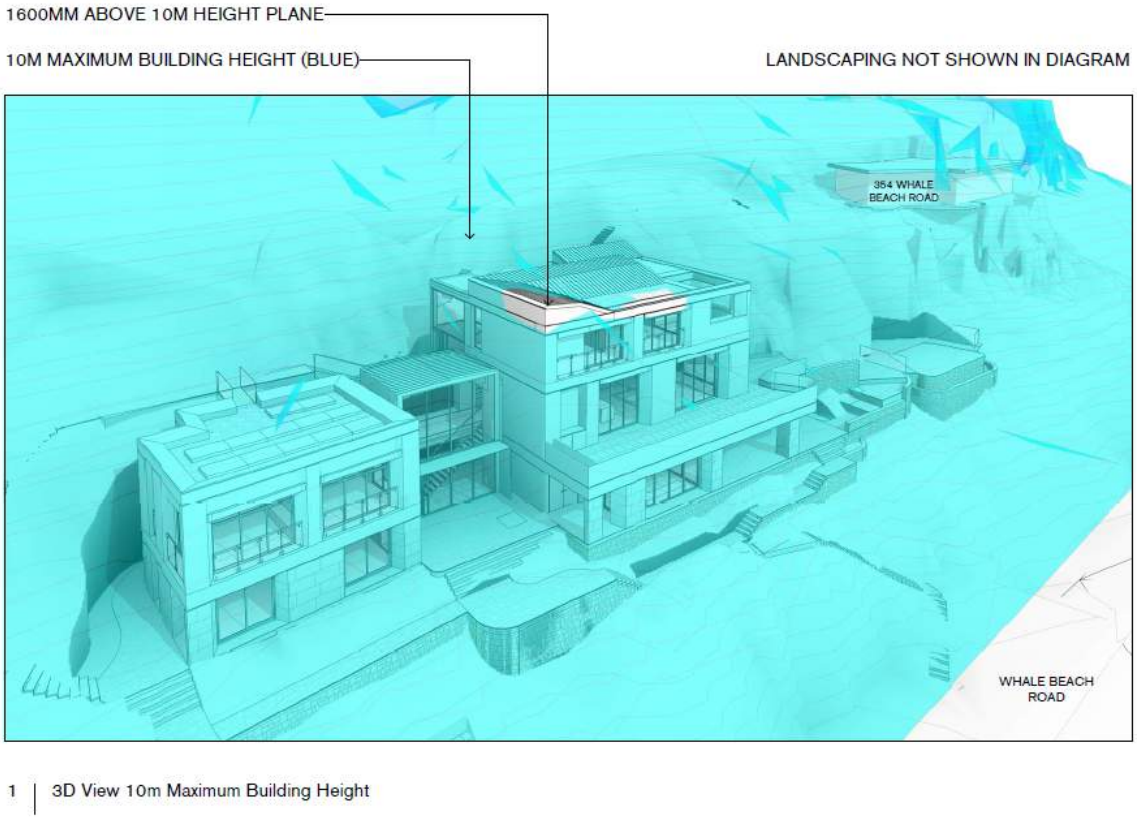

Figure 7: Extract of 3D View of 10m Building Height (Source: Tzannes)

It is important to note that the extent of the variation is related to the topography of the site, the varying existing ground level and, the desire to minimise the building footprint and disturbance of the natural features of the site.

For abundant caution, if Clause 4.3(2D) is not applicable to the subject site, the development proposes a maximum departure, from the 8.5m building height development standard, by 3.04m on the south-east corner on the Second Floor as can be seen in **Figure 8** below.

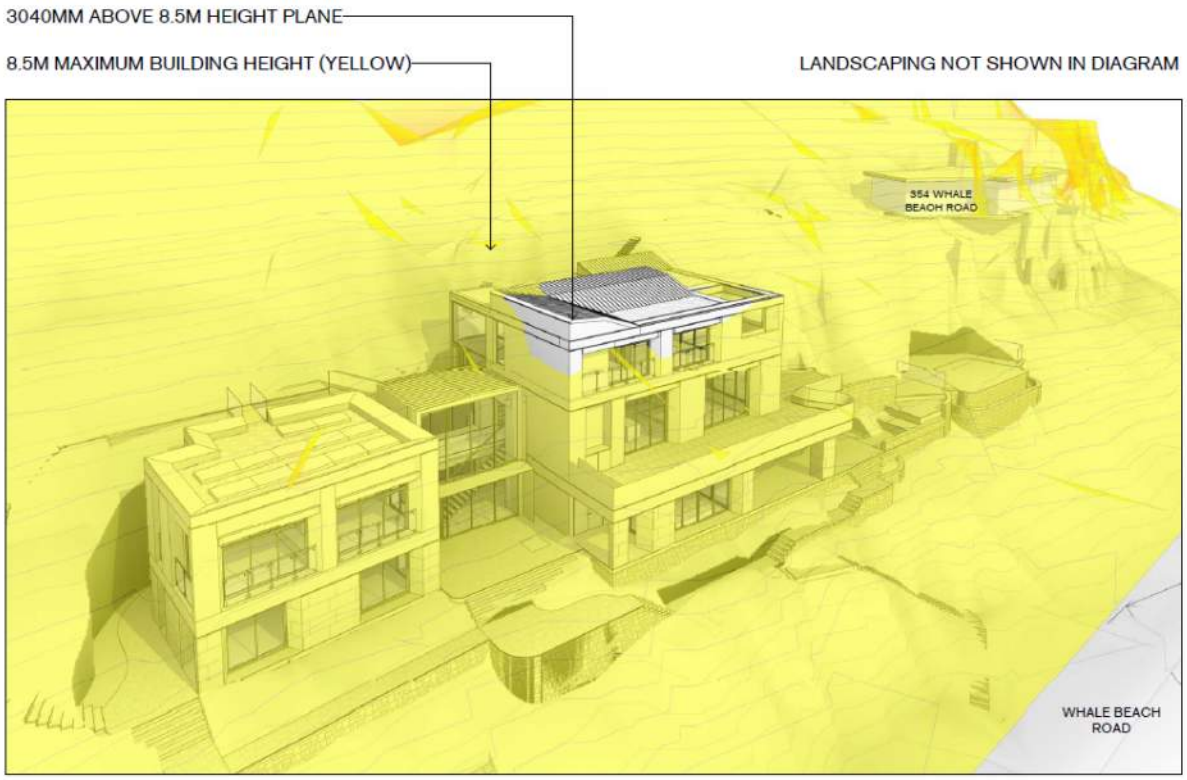

Figure 8: Extract of 3D View of Proposal with 8.5m Maximum Building Height Plane (Source: Tzannes)

4. COMPLIANCE WITH THE DEVELOPMENT STANDARD IS UNREASONABLE OR UNNECESSARY IN THE CIRCUMSTANCES OF THIS CASE. [CL.4.6 (3)(A)]

4.1. Achieves the objectives of the standard

Compliance with the Height of Buildings is unreasonable or unnecessary in the circumstances of this case because, as explained in **Table 1**. (below), the objectives of the development standard are achieved, notwithstanding non-compliance with the standard.[2]

Table 1: Achievement of Development Standard Objectives.

Objective	Discussion
(a) To ensure that any building, by virtue of its height and scale, is consistent with the desired character of the locality,	The proposed development is generally consistent with the desired character for the Palm Beach Locality as described in the Pittwater Development Control Plan (PDCP). Due consideration has been given to the character of the development when viewed from a public place. The proposal is compliant with the side and rear setbacks controls which apply to the Palm Beach Locality. The development involves a minor departure from the front building line however extensive landscaping and retention of vegetation is proposed to screen the built form. 64.5% of the site area is dedicated to landscaping, ensuring the development is secondary to the landscape. The proposed development compliments the surrounding development and overall locality of the area. The proposal is generally compliant with the 8.5m height standard (see **Figure 8** above). Given the slope of the land, the building height standard allowed is measurable to 10m for the proposal. The variation represents 5.8% of the roof area, which is based on the total area of all roofs at 331m² and the total departure of approximately 18m². This is barely perceptible.
(b) To ensure that buildings are compatible with the height and scale of surrounding and nearby development,	The proposal responds to the surrounding and nearby development in terms of height and scale, as can be seen in **Figure 9** below. 

2 In *Wehbe v Pittwater Council* [2007] NSWLEC 827 Preston CJ identified 5 ways in which an applicant might establish that compliance with a development standard is unreasonable or unnecessary and that it is sufficient for only one of these ways to be established. Although the decision concerned SEPP 1, it remains relevant to requests under clause 4.6 as confirmed by Pain J in *Four2Five Pty Ltd v Ashfield Council* [2015] NSWLEC 90, notwithstanding that if the first and most commonly applied way is used, it must also be considered in 4.6(4)(a)(ii). The 5 ways in Wehbe are: 1. The objectives of the development standard are achieved notwithstanding non-compliance with the standard; 2. The underlying objective or purpose is not relevant to the development with the consequence that compliance is unnecessary; 3. The objective would be defeated or thwarted if compliance was required with the consequence that compliance is unreasonable; 4. The development standard has been virtually abandoned or destroyed by the Council's own actions in granting consents departing from the standard and hence the standard is unreasonable and unnecessary; or 5. The zoning of the land is unreasonable or inappropriate.

Objective	Discussion
	Figure 9: Extract of Photomontage, site outlined in red (Source: Tzannes) The surrounding development, especially that located to the north, south and west of the site, have been considered in the application of the height controls.
(c) To minimise any overshadowing of neighbouring properties,	The proposal does not result in any additional overshadowing to the neighbouring property at 354 Whale Beach Road, as can be seen in **Appendix 2**. The existing overshadowing to the adjoining property on the northern boundary occurs at 3pm on the 21st June as a result of the dense vegetation and orientation of the sun in the afternoon. As the site consists of multiple allotments, the proposal does not cause any additional overshadowing to other properties in the near vicinity.
(d) To allow for reasonable sharing of views,	View sharing from the public domain and adjoining properties is unaltered due to the location of the variation on the south-east corner of the Second Floor. As the site contains dense vegetation, especially to the west and south, view sharing from Annie Wyatt Reserve and the adjoining residential properties to the rear of the site are maintained. View sharing is similarly maintained for 354 Whale Beach Road, Palm Beach. The proposed development in its skillful design and chosen location allows continued sharing view for neighbouring properties and from the adjoining reserve to the west of the site. Overall view sharing of the Pacific Ocean and surrounding vegetation is unchanged from the minor non-compliance with the building height development standard. Refer to the Photomontages in **Appendix 3.**
(e) To encourage buildings that are designed to respond sensitively to the natural topography,	The consolidation of the four (4) allotments and location of the new dwelling house on the allotments directly responds to the natural topography of the site and aims to minimise excavation. The design, how the building sits in the landscape and variation helps to minimise the building footprint and disturbance to the natural topography.
(f) To minimise the adverse visual impact of development on the natural environment, heritage conservations area and heritage items.	Generally, the proposal is not visible from public places, the site maintains an extensive amount of unbuilt area and consolidates four (4) lots which otherwise could have each contained a dwelling house. The subject site is in proximity to local heritage item 'Cox House', located at 356 Whale Beach Road, Palm Beach. However, the proposed contravention, nor the proposed development, are visible from the local heritage item.

5. THERE ARE SUFFICIENT ENVIRONMENTAL PLANNING GROUNDS TO JUSTIFY CONTRAVENING THE STANDARD. [CL. 4.6(3)(B)]

In *Initial Action Pty Ltd v Woollahra Council* [2018] NSWLEC 2018, Preston J observed that in order for there to be 'sufficient' environmental planning grounds to justify a written request under clause 4.6, the focus must be on the aspect or element of the development that contravenes the development standard and the environmental planning grounds advanced in the written request must justify contravening the development standard, not simply promote the benefits of carrying out the development as a whole.

As discussed earlier, the aspect of the development that contravenes the 10m development standard is a minor portion of the Master Bedroom and the lift at the Second Floor. In this regard the contravention of the development standard is very minor, and the environmental impacts are negligible, as explained earlier in the discussion regarding privacy, overshadowing and visual impacts in **Section 4**.

The variation does not cause environmental harm as follows:

- Most of the proposed development is under the general permissible height control of 8.5m under Clause 4.3(2) and consequently below the greater height allowance of 10m under Clause 4.3(2D) (refer to **Figure 7** on the previous page and **Figure 8** above);
- The variation is minor and only occurs at the south-east corner of the development in relation to the Second Floor at the lift and the Master Bedroom;
- The variation does not result in any additional overshadowing for adjoining properties, in particular 354 Whale Beach Road, Palm Beach, (refer to **Appendix 2** for further detail);
- The variation does not result in any adverse view loss impact and continues view sharing from the public domain of Whale Beach Road and Annie Wyatt Reserve;
- The variation of the development standard does not cause any loss of privacy for neighbouring properties, particularly 354 Whale Beach Road, Palm Beach;
- The dense vegetation on the east, west and south boundary of the site, in addition to the proposal's skillful design, ameliorates the impact of the minor variation by reducing the scale as viewed from the public domain;
- The variation helps minimise the building footprint and disturbance to natural topography, whilst dedicating 64.5% of the site area to landscaping (refer to **Appendix 4** for further detail);
- The variation does not alter the intended purpose for a dwelling house in the E4 Environmental Living zone; and
- The proposal results in a better planning outcome than if compliance were to be achieved, as it provides a development that meets the objective of the standard as well as providing circulation space around the lift, improved amenity for the Master Bedroom and the location of the lift reduces the need for deeper excavation on the site at this location.

In terms of the objects (Section 1.3) of the Environmental Planning & Assessment Act, which Preston J observed constitute 'environmental planning grounds', the consolidation of the four (4) allotments, provision of a new bushfire compliant dwelling house and extensive landscaping is highly desirable. The proposal promotes protection of the environment (s1.3(e)), sustainable management of heritage in the nearby vicinity (s1.3(f)) and, good design and amenity of the built environment (s.1.3(g)). The benefit of the minor contravention greatly outweighs the negligible harm resulting from the variation. In this regard we submit that there are sufficient environmental planning grounds to justify contravening the height of buildings development standard to extent proposed in this application.

6. THE PROPOSAL WILL BE IN THE PUBLIC INTEREST BECAUSE IT IS CONSISTENT WITH THE OBJECTIVES OF THE STANDARD AND THE OBJECTIVES OF THE ZONE. [CL.4.6(4)(A)(II)]

In **Section 3** (above), it was demonstrated that the proposal is consistent[3] with the objectives of the development standard. The proposal is also consistent with the objectives of the zone as explained in **Table 2** (below).

Table 2: Consistency with Zone Objectives.

Objective	Discussion
To provide for low-impact residential development in areas with special ecological, scientific or aesthetic values.	The proposed development is of a low impact. The proposed consolidation of four (4) allotments, which could have otherwise each individually been developed, contributes greatly to its low impact. The built form is distributed and the disturbance to the natural topography minimised. The Prescribed Ecological Assessment Report (PEARs) in **Appendix 5** details how the design of the proposal protects and preserves the main rock escarpment and rock outcrops on the site that provide habitat to native reptiles. Abel Ecology confirm that the proposal poses no adverse impact to the ecology of the site. Water sensitive urban design and improved stormwater quality contribute to the developments' low impact. The proposed development delivers great public benefit through the provision of a bushfire compliant dwelling house, compared to the existing home.
To ensure that residential development does not have an adverse effect on those values.	The proposed development does not compromise the effect of the values discussed above. The proposal duly integrates the ecological and aesthetic values of the site and the surrounding locality. In particular, the proposal responds to the topography of the site, protects and assimilates the native vegetation and species in the area, provides an improved stormwater system to promote water sensitive urban design, involves a Bushland Regeneration Strategy, proposes no works within the Littoral Rainforest and, retains some existing vegetation and provides additional landscaping to ensure the built form is secondary to the landscape.
To provide for residential development of a low density and scale integrated with the landform and landscape.	The proposal is for a single dwelling house on the site affected by sloping topography. The proposed design responds to the existing landform and landscape through a minimisation of the building footprint and disturbance to the natural topography. This is achieved through a dedication of 64.5% of the site area to landscaping. The consolidation of the four (4)

3 In *Dem Gillespies v Warringah Council* [2002] LGERA 147 and *Addenbrooke Pty Ltd v Woollahra Municipal Council* [2008] NSWLEC the term 'consistent' was interpreted to mean 'compatible' or 'capable of existing together in harmony'

	allotments distributes the built form, meaning the visual impact is ameliorated. The design of the proposal retains the existing outcrops ensuring their protection and preservation.
To encourage development that retains and enhances riparian and foreshore vegetation and wildlife corridors.	The proposed development maintains, preserves and enhances the foreshore vegetation and wildlife corridors in particular the Littoral Rainforest, Annie Wyatt Reserve and vegetation adjoining the Pacific Ocean on the east of the property. The site comprises of four (4) allotments, one of which contains a creek and Littoral Rainforest. No development is proposed on this lot or in the vicinity of riparian vegetation. The proposal also includes a Bushland Regeneration Strategy.

As can be seen from **Table 1** and **Table 2**, the proposal is consistent with the objectives of the standard and the objectives of the zone and is therefore considered to be in the public interest.

7. CONTRAVENTION OF THE DEVELOPMENT STANDARD DOES NOT RAISE ANY MATTER OF SIGNIFICANCE FOR STATE OR REGIONAL ENVIRONMENTAL PLANNING. [CL. 4.6(5)(A)]

There is no identified outcome which would be prejudicial to planning matters of state or regional significance that would result as a consequence of varying the development standard as proposed by this application.

8. THERE IS NO PUBLIC BENEFIT OF MAINTAINING THE STANDARD. [CL. 4.6(5)(B)]

The variation of the standard is minor and represents the south-east corner of the Second Floor.

There is no public benefit[4] in maintaining strict compliance with the development standard given that there are no unreasonable impacts that will result from the variation to the Height of Buildings standard and hence there are very minor disadvantages.

The benefits of the proposal including a bushfire compliant building, improved stormwater quality, consolidation of four (4) lots which could have otherwise each contained a dwelling house, provision of extensive landscaping to ensure the built form is secondary to the landcape, protection of the Littoral Rainforest to the south of the site, BASIX compliant development and provision of off-street parking which was not previously present. The benefits of the proposal outweigh any disadvantage and as such the proposal will have an overall public benefit.

9. CONCLUSION

This Clause 4.6 variation request demonstrates, as required by Clause 4.6 of the *Pittwater Local Environmental Plan 2014*, that:

- Compliance with the development standard would be unreasonable and unnecessary in the circumstances of this development;
- There are sufficient environmental planning grounds to justify the contravention;
- The development achieves the objectives of the development standard and is consistent with the objectives of the E4 Environmental Living Zone;
- The proposed development, notwithstanding the variation, is in the public interest and there is no public benefit in maintaining the standard; and
- The variation does not raise any State or Regional Significance.

On this basis, therefore, it is considered appropriate to exercise the flexibility provided by Clause 4.6 in the circumstances of this application.

4 Ex Gratia P/L v Dungog Council (NSWLEC 148) established that the question that needs to be answered to establish whether there is a public benefit is "whether the public advantages of the proposed development outweigh the public disadvantages of the proposed development"

APPENDIX 1

Geotechnical Report prepared by JK Geotechnics

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER

FORM NO. 1 – To be submitted with Development Application

Development Application for THE APPLICANT C/ TRANSET
Name of Applicant

Address of site 346-352 WHALE BEACH ROAD, WHALE BEACH

Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report

I, PAUL STUBBS *on behalf of* JK GEOTECHNICS
(Insert Name) (Trading or Company Name)

on this the 31 JANUARY 2019 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $2million.
I:

Please mark appropriate box

- ə have prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009
- ə ✓ am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009
- ə have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.
- ə have examined the site and the proposed development/alteration in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.
- ə have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.
- ə have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: GEOTECHNICAL INVESTIGATION
Report Date: 31/1/19
Author: WOODIE THEUNISSEN
Author's Company/Organisation: JK GEOTECHNICS

Documentation which relate to or are relied upon in report preparation:

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature .....
Name .....
Chartered Professional Status.....
Membership No. .....
Company.....

The Institution of Engineers, Australia
Paul Stubbs
MIEAust CPEng
Chartered Professional Engineer
Membership No. 130775

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1(a) - Checklist of Requirements For Geotechnical Risk Management Report for Development Application

Development Application for THE APPLICANT C/ TRANNIES
Name of Applicant
Address of site 346-352 WHALE BEACH ROAD, WHALE BEACH

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Geotechnical Report. This checklist is to accompany the Geotachnical Report and its certification (Form No. 1).

Geotechnical Report Details:

Report Title: GEOTECHNICAL INVESTIGATION
Report Date: 31/1/19
Author: WOODIE THEUNISSEN
Author's Company/Organisation: JK GEOTECHNICS

Please mark appropriate box

- ✓ Comprehensive site mapping conducted 23/11/18 (date)
- Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)
- ✓ Subsurface investigation required
  - No Justification .....
  - (Yes) Date conducted ..... 30/03/18 .....
- ✓ Geotechnical model developed and reported as an inferred subsurface type-section
- Geotechnical hazards identified
  - ✓ Above the site
  - On the site
  - Below the site
  - Beside the site
- ✓ Geotechnical hazards described and reported
- Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
  - ✓ Consequence analysis
  - Frequency analysis
- ✓ Risk calculation
- ✓ Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009
- ✓ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.
- Design Life Adopted:
  - (100 years)
  - Other ..... (specify)
- ✓ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified
- ✓ Additional action to remove risk where reasonable and practical have been identified and included in the report.
- — Risk assessment within Bushfire Asset Protection Zone.

I am aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ensuring that the geotechnical risk management aspects of the proposal have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated, and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature .....
Name .....
Chartered Professional Status.....
Membership No. .....
Company.....

The Institution of Engineers, Australia
Paul Stubbs
MIEAust CPEng
Chartered Professional Engineer
Membership No. 130775

REPORT

TO
THE APPLICANT

ON
GEOTECHNICAL ASSESSMENT
(In Accordance with Pittwater Council Risk Management Policy)

FOR
PROPOSED NEW RESIDENCE

AT
246-252 WHALE BEACH ROAD, PALM BEACH, NSW

31 January 2018
Ref: 31791SYrpt

JK Geotechnics

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Date: 31 January 2018
Report No: 31791SYrpt
Revision No: 2

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For and on behalf of
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1 INTRODUCTION

This report presents the results of our geotechnical investigation and stability assessment for the proposed new residence at 246 to 252 Whale Beach Road, Palm Beach, NSW. A site location plan is presented as Figure 1. The work was commissioned by the applicant and was completed in accordance with our proposal (Ref P47743LY Whale Beach, dated 3 August 2018).

Reference to the drawings prepared by Tzannes (Ref: Project 17018, Drawings: 0101, 0102, 1100, 1101, 1102, 1103, 1104, 1105, 2000, 2001, 3000, 3001, 3002 and 3004, Revision: A) indicate that the proposed new residence will comprise:

- Three levels over a basement garage and inground pool,
- The garage will provide off street parking for four cars, result in cuts to maximum depths of about 13m and provide lift access to the house above,
- The new house will run along the contours of the hill with excavation anticipated to be limited to maximum depths of about 5m.

This report has been prepared in accordance with the requirements of the Geotechnical Risk Management Policy for Pittwater (2009) as discussed in Section 5 below. It is understood that the report will be submitted to Council as part of the DA documentation. Our report is preceded by the completed Council Forms 1 and 1a.

2 ASSESSMENT METHODOLOGY

2.1 Walkover Survey

This stability assessment is based on a detailed inspection of the topographic, surface drainage and geological conditions of the site and its immediate environs. These features were compared to those of other similar lots in neighbouring locations to provide a comparative basis for assessing the risk of instability affecting the existing development. The attached Appendix A defines the terminology adopted for the risk assessment together with a flowchart illustrating the Risk Management Process based on the guidelines given in AGS 2007c (Reference 1).

A summary of our observations is presented in Section 3. Our assessment of the risk of slope instability for the site in its existing condition is discussed in Section 4.

The attached Figure 3 presents a geotechnical sketch plan showing the principal geotechnical features present at the site. Figure 3 is based on the survey plan prepared by Adam Clerke Surveyors Pty Ltd (Ref 15204 Sheets 1 to 3 and Ref 1218). Additional features on Figure 3 have been measured by hand held inclinometer and tape measure techniques and hence are approximate only. Should any of the features be critical, we recommend they be located more accurately using instrument survey techniques. Figures 4 to 6 present typical cross-sections through the site based on the survey data augmented by our mapping observations.

2.2 Subsurface Investigation

Prior to drilling commencing, a 'Dial Before You Dig" services search was completed and a specialist subcontractor electromagnetically scanned the borehole and test locations for buried services. The field work was carried out over the period of the 30 to 31 August 2018 and comprised:

- One cored borehole (BH1) drilled to a depth of 14.14m and
- Seven Dynamic Cone Penetration (DCP) tests completed to depths ranging from 0.2m to 1.8m.

Due to access constraints posed by the terrain all testing was completed using portable equipment. The purpose of the borehole was to determine the nature of the materials present, particularly the underlying bedrock, while the DCP tests were used to probe the depth to bedrock. While the DCP refusal depth is typically considered to indicate the depth to bedrock, it is possible that premature refusal may have occurred on hard layers within the soils.

BH1 was initially drilled using hand auger to a depth of 1.85m, at which depth hand auger refusal occurred. From this depth portable rotary drilling techniques were adopted and the underlying bedrock cored to a depth of 14.14m (RL42.06m).

The degree of compaction of the fill and the strength/relative density of the soils was interpreted from the DCP test results. Where the bedrock was core drilled the recovered core was returned to our NATA registered laboratory, Soil Test Services (STS) for photographing and point load strength index (I_{s50}) testing. Using established correlations the unconfined compressive strength (UCS) of the sandstone bedrock was then estimated from the I_{s50} results. These results are presented in Table A.

Groundwater observations were made in the borehole during and following completion of the auger drilling. We note that water is introduced into the borehole to facilitate the coring process and

therefore the water level measured after the completion of core drilling is artificially high and has not been recorded on the logs. No longer was term groundwater monitoring completed.

The borehole and DCP test locations, as shown on the attached Figure 2, were set out by taped measurements from existing surface features shown on the above reference survey drawings at or as close as practicable to the locations nominated by Taylor Thomson Whitting (NSW) Pty Ltd. The reduced levels shown on the top of the borehole and DCP tests have been interpolated from the spot levels shown on the survey drawing and should be considered only approximate.

Our Engineering Geologist, Bo Jonak, was present full-time during the fieldwork to set out the borehole/DCP test locations, direct the electro-magnetic scanning (by service locator), log the encountered subsurface profile and record the DCP results. The borehole log (with core photograph) and DCP test result sheets are attached, together with Report Explanatory Notes which provide details on the investigation procedures adopted and define the logging terms and symbols used.

3 RESULTS

3.1 Summary of Observations

The site is located over the upper eastern slopes of the peninsula that extends from Avalon to Palm Beach. The site drops down steeply to the east to Whale Beach Road with a total change in relief of about 19m over a horizontal distance of about 30m. The site encompasses four lots with a house present on only one of these lots, No. 350 Whale Beach Road.

Two clifflines are present across the site and generally run across the middle and rear of the site. In places these clifflines are not distinct and either merge to form one cliffline or form a jumbled series of lower height cliffs or rock shelves. At its greatest the upper cliffline is up to about 6m high and was generally assessed to be formed of medium to high strength sandstone, although in places it was of assessed low strength. Honeycomb erosion of the clifflines was visible as was undercutting in places. Detached blocks were also observed at or near the crest of sections of clifflines. Jointing in the rock typically was orientated east-north-east to west-south-west and south-south-east to north-north-west with the strike of joints varying between 200^{o} - 250^{o} and 310^{o}. Where joints ran into the face of the clifflines they were typically vertical while those running parallel dipped out of the face at between 70^{o} and 80^{o}.

Between the clifflines and the eastern site boundary slopes were typically in the order of about 15^{o} to 30^{o} but varied at some localised areas to angles of up to about 45^{o}. Boulders or floaters were noted in these lower slopes and were typically embedded and were, in places of significant size. In general the site is heavily vegetated with both mature trees and thick undergrowth and was difficult to observe in places. No obvious sign of basal curvature was noted in the trunks of the mature trees.

No. 350 Whale Beach Road is occupied by a three storey masonry house that steps up the slope and appears in good condition when viewed externally with no signs of distress in the form of cracking observed. On either side of the house landscaping has been completed to form level entertainment areas. Sandstone block walls, comprising a mix of dressed and rough-hewn and mortared and dry packed have been constructed. These walls varied in height up to about 2m but were more typically in the order of about 1m and generally appeared in good condition. To the rear of the house, located immediately adjacent to and part way up the cliffline that runs running along the rear of the site is a laundry, sauna and deck all of which are suspended on a timber structure. At this point the cliffline has been undercut to a depth of about 1.9m and an overhang is located immediately above the deck.

Access to No. 350 Whale Beach Road is via a path that snakes up the cliffline that runs along Whale Beach Road. A number of generally low height sandstone block retaining walls are present and appear in good condition. However, on the high side of the stairs sandstone flagging has been placed over a steep batter that has been formed through soils at the crest of the sandstone bedrock. This flagging is in a state of collapse. To form the path in front of the house, dressed and rough-hewn sandstone block retaining walls have been constructed to a height of about 2.9m. Although it appears that these walls are performing satisfactorily it is difficult to observe the rough-hewn portion of the wall.

To the north is a property with the same landform as the site that is occupied by a three-storey clad house that is supported, at least in part, on steel columns and appears in good condition when viewed from the site. To the east is the Whale Beach Road reserve. This road reserve encompasses not only the road but also a strip of land that varies up to about 7.5m wide and is positioned between the road pavement and the eastern site boundary. In this strip of land is a sandstone cliffline (or series of stepped clifflines) that varies in height up to about 5m. The sandstone bedrock was typically assessed to be of low strength with similar jointing noted to that noted on site. At the crest of the cliffline the topography slopes up to the eastern site boundary at

average slopes of between about 15^{o} and 30^{o}, with the site boundary set back from the cliffline between about 2.5m to 5m.

To the south is a drainage easement that is approximately 3m wide. This easement is unlined, deeply scoured and unvegetated with sandstone bedrock, boulders and soils exposed in the base and in the channel banks. Beyond this is a three-storey masonry house with suspended deck and pool that appeared in good condition when viewed from the site. Both the easement and property beyond have similar landforms to that of the site.

To the west, located at the crest of the cliffline and in the flatter slopes near the crest of the peninsula, are three houses and Annie Wyatt Reserve. All houses are set well back from the cliff line.

3.2 Subsurface Conditions

Reference to the 1:100,000 Geological Map of the Sydney Region indicates that the site is underlain by rocks of the Hawkesbury Sandstone and the Narrabeen Group. Hawkesbury Sandstone comprises quartz sandstone interbedded with siltstone and shale while the Narrabeen Group comprises lithic and quartz sandstone, siltstones, claystones and conglomerate. The geological boundary between the overlying Hawkesbury Sandstone and underlying Narrabeen Group appears to run through the site.

The investigation revealed a relatively shallow soil cover overlying sandstone bedrock. The more pertinent details of the materials encountered are discussed below. For a more detailed description of the materials encountered at a particular location or the inferred depth to bedrock reference should be made to the attached borehole logs and DCP test results.

Pavement

At BH1 a 0.1m thick sandstone paver was encountered and overlay a silty sand bedding layer that extended to a depth of 0.2m.

Fill

Below the pavement a silty gravelly or clayey sand fill was encountered to a depth of 0.7m. This fill contained traces of igneous/sandstone gravel and was assessed to be poorly compacted.

Natural Soils

Underlying the fill a mix of sands, clayey sands and sandy clays were encountered that were of stiff to very stiff strength or medium dense relative density. Where the soils were clayey they were assessed to be of medium to high plasticity.

Sandstone Bedrock

Sandstone bedrock outcrops across the site and was inferred from the DCP tests at depths ranging from 0.2m to 1.8m. Considering the prevalence of sandstone bedrock outcropping across the site it is likely that the DCP refusal depth is the depth to bedrock, however it is possible that premature refusal may have occurred on floaters or harder bands within the soils.

Based on our observation of the exposed bedrock it appears that the boundary between the Hawkesbury Sandstone and the Narrabeen Group is at the base of the clifflines present over the middle to the rear of the site with Hawkesbury Sandstone exposed in the clifflines and the Narrabeen Group represented by the scree slopes at the base of these clifflines and the lower clifflines dropping down to Whale Beach Road and the shoreline below.

The sandstone bedrock encountered in BH1 at a depth of 1.8m is part of the Narrabeen Group and was initially of poor quality to a depth of 5.3m, at which depth the quality of the bedrock improved markedly. In the poorer quality bedrock rock strengths varied from very low to low and a number of significant core loss zones occurred. Core loss typically represents areas of poor quality bedrock or clays that have been washed away during the coring process. Below a depth of 5.3m the bedrock increased to medium to high strength and contained only a few thin core loss zones. A siltstone band and claystone lenses were encountered below a depth of about 8m.

Defects within the bedrock typically comprised bedding partings and joints. Joints generally ranged in inclination from 45^{o} to 90^{o}.

Groundwater

Groundwater was not encountered during or on completion of auger drilling. Based on the location of the site in the topography and the depth of excavation it should be anticipated that seepage will occur but such flows as there are would probably emanate naturally a little further downslope and so the excavation is not considered to interfere significantly with the natural groundwater regime.

3.3 Laboratory Test Results

The results of the point load strength index tests indicate that the unconfined compressive strength (UCS) of the sandstone bedrock ranges from less than 1MPa to 56MPa. Where higher UCS values were encountered within the poorer quality bedrock this reflects not the general strength of the bedrock at this location but rather the presence of high strength ironstone bands within the sandstone bedrock.

4 GEOTECHNICAL ASSESSMENT

4.1 Potential Landslide Hazards

We consider that the potential landslide hazards associated with the site to be the following:

A Stability of detached boulders:
- (i) Of the boulder
- (ii) Below the boulder

B Stability of scree slopes:
- (i) On the slope
- (ii) Below the slope

C Stability of low height retaining walls:
- (i) Above the wall
- (ii) Below the wall

D Stability of overhangs
- (i) On the overhang
- (ii) Below the overhang

E Stability of higher sandstone block retaining walls
- (i) Above the walls
- (ii) Below the walls

F Stability of cliff lines
- (ii) Below cliffline

G Stability of boulders on slopes
- (i) Of the boulder
- (ii) Below the boulder

Some of these potential hazards are indicated in schematic form on the attached Figures 3, 4, 5 and 6.

4.2 Risk Analysis

The attached Table A summarises our qualitative assessment of each potential landslide hazard and of the consequences to property should the landslide hazard occur. Use has been made of data in MacGregor *et al* (2007) to assist with our assessment of the likelihood of a potential hazard occurring. Based on the above, the qualitative risks to property have been determined. The terminology adopted for this qualitative assessment is in accordance with Table A1 given in Appendix A. Table A indicates that the assessed risk to property is very low, which would be considered acceptable in accordance with the criteria given in Reference 1 and the Pittwater Council Risk Management Policy.

We have also used the indicative probabilities associated with the assessed likelihood of instability to calculate the risk to life. The temporal and vulnerability factors that have been adopted are given in the attached Table B together with the resulting risk calculation. Our assessed risk to life for the person most at risk is about 10^{-6}. This would be considered to be acceptable in relation to the criteria given in Reference 1 and the Pittwater Council Risk Management Policy.

4.3 Risk Assessment

The Pittwater Risk Management Policy requires suitable measures 'to remove risk'. It is recognised that, due to the many complex factors that can affect a site, the subjective nature of a risk analysis, and the imprecise nature of the science of geotechnical engineering, the risk of instability for a site and/or development cannot be completely removed. It is, however, essential that risk be reduced to at least that which could be reasonably anticipated by the community in everyday life and that landowners are made aware of reasonable and practical measures available to reduce risk as far as possible. Hence, where the policy requires that 'reasonable and practical measures have been identified to remove risk', it means that there has been an active process of reducing risk, but it does not require the geotechnical engineer to warrant that risk has been completely removed, only reduced, as removing risk is not currently scientifically achievable.

Similarly, the Pittwater Risk Management Policy requires that the design project life be taken as 100 years unless otherwise justified by the applicant. This requirement provides the context within which the geotechnical risk assessment should be made. The required 100 years baseline broadly

reflects the expectations of the community for the anticipated life of a residential structure and hence the timeframe to be considered when undertaking the geotechnical risk assessment and remedial measures that should be taken to control risk. It is recognised that in a 100 year period external factors that cannot reasonably be foreseen may affect the geotechnical risks associated with a site. Hence, the Policy does not seek the geotechnical engineer to warrant the development for a 100 year period, rather to provide a professional opinion that foreseeable geotechnical risks to which the development may be subjected in that timeframe have been reasonably considered.

Our assessment of the probability of failure of existing structural elements such as retaining walls (where applicable) is based upon a visual appraisal of their type and condition at the time of our inspection.

In preparing our recommendations given below we have adopted the above interpretations of the Risk Management Policy requirements. We have also assumed that no activities on surrounding land which may affect the risk on the subject site would be carried out. We have further assumed that all Council's buried services are, and will be regularly maintained to remain, in good condition.

We consider that our risk analysis has shown that the site and existing development achieves the 'Acceptable Risk Management' criteria in the Pittwater Risk Management Policy.

5 COMMENTS AND RECOMMENDATIONS

We consider that the provided the recommendations provided below are followed that the proposed development poses an acceptable risk to both life and property in accordance with the Pittwater Risk Management Policy.

5.1 Conditions Recommended to Establish the Design Parameters

5.1.1 All proposed footings must be founded on sandstone bedrock. The footings should be designed for an allowable bearing pressure (ABP) of 1,000kPa where they are founded on sandstone bedrock of at least very low strength, subject to inspection by a geotechnical engineer prior to pouring. Where footings are founded within the zone of influence of either existing or proposed excavations or existing clifflines (defined by a line drawn up from the base of the excavation/cliffline at 1 Vertical(V):1 Horizontal (H)) further advice must be sought from this office on the materials on which footings are to be founded. The depth at

which footings are to be founded and the ABP's that may be adopted will depend on the presence of adverse defects and the quality of the bedrock.

5.1.2 Subject to inspection by a geotechnical engineer, temporary batters for the proposed excavation should be no steeper than 1 Vertical (V) in 1 Horizontal (H) within the soil profile and extremely weathered rock. Permanent batters may be formed at no steeper than 1V:2H but must be vegetated or otherwise protected from erosion. For maintenance purposes flatter batters in the order of 1V:3H or 4H may be more appropriate.

5.1.3 For the support of soils and sandstone bedrock of extremely low strength cantilevered retaining walls to maximum heights of about 3m may be designed for a triangular earth pressure distribution and a coefficient of active lateral earth pressure of 0.35, which assumes a horizontal backfill surface. A bulk unit weight of 20kN/m^3 should be used. Appropriate hydrostatic pressures and surcharge loads should be added to the above pressures.

5.1.4 For retained heights of greater than 3m.an anchored soldier pile wall with shotcrete and mesh infill panels may be adopted. For the design of anchored retaining walls where movement sensitive structures are not located within the zone of influence of the excavation (defined by a distance 2H from the crest of the retention system where H is the retained height) a rectangular earth pressure distribution may be adopted with a pressure distribution of 4H kPa, where H is the height of retained soils and poor quality bedrock. Where movement sensitive structures are present within the zone of influence of the excavation (which is not expected to be the case) a lateral earth pressure of 8H kPa should be adopted. Appropriate hydrostatic pressures and surcharge loads (which include inclined backfill) must be added to the above pressures.

5.1.5 All anchors should be bonded in the underlying sandstone bedrock and should have a minimum bond and free length of 3m. Where bonded in sandstone bedrock of at least low strength an allowable bond stress of 150kPa may be adopted. All anchors should be proof loaded in a staged manner to 1.3 times the design load in the presence of an experienced geotechnical engineer engaged by the principal and not the contractor. All anchors should be installed by experienced and appropriately insured anchoring contractors and should be installed on a design and construct basis such that should anchors fail proof loading there is no dispute over whether the cause of the failure is the anchor installation or the recommended allowable bond stresses.

5.1.6 An alternative means of support may be to progressively install a soil nail wall as the excavation is deepened. Where this approach is adopted further advice should be sought from this office on the design of such a retention system. The benefit of this approach is that it is likely that rock bolts and mesh will be required where excavation is completed

through the more competent bedrock and as such there is no difference in the installation techniques adopted for a soil nail wall or support of adverse defects in the bedrock.

5.1.7 Sandstone bedrock of low strength or better may be cut vertically and left unsupported, provided it is free from adverse defects. The sandstone bedrock is quite heavily jointed and based on the jointing observed in the sandstone clifflines it is anticipated that adversely orientated jointing will be encountered, particularly at the rear of the cuts where it is expected to dip out of the face. Consequently, it is likely that some form of support will be required in both the short and long term. It is possible that pattern bolting may be required over the full height of the excavation which may consist of 1.5m to 3m long (possibly longer) bolts installed at 1.5m centres in both the vertical and horizontal direction. A shotcrete and mesh facing will also be required that will be tied into the bolts and will consist of a minimum of 100mm shotcrete with SL82 centrally placed. The exact support requirements, if any, will be determined as the excavation deepens following inspection by a geotechnical engineer of every 1.5m of vertical unsupported cut. Even in the event that should adverse defects are not present it is generally good practice to protect the cut faces with shotcrete and mesh to reduce long term maintenance requirements. Vertical strip drains should be installed at 1.5m centres behind the shotcrete and mesh panels. Long term support could be provided by the built structure or by use of “permanent” bolts.

5.1.8 Although not anticipated to be the case, should anchors run below adjoining properties, permission must be obtained from the owners prior to their installation.

5.1.9 Where existing slopes or batters exceed the recommended temporary or permanent batter slopes described above or where existing retaining walls are not considered suitable (such as the sandstone lagging present on the high side of the staircase providing access to the site), then slopes must be appropriately battered or engineered retaining walls constructed to support the soils.

5.1.10 Although it is not anticipated that excavation will extend below the groundwater table, seepage is anticipated at the soil bedrock interface and through defects within the bedrock, particularly during and following rainfall events. Consequently, dish drains should be constructed at the toe of all cuts to collect all groundwater flows or groundwater collected in back wall drainage to allow controlled discharge to Council’s stormwater system.

5.1.11 It is anticipated that where slabs on grade are required they will predominantly be formed over sandstone bedrock. On-grade floor slabs which are poured directly over sandstone bedrock should be provided with a separation layer and underfloor drainage. The underfloor drainage should comprise a strong, durable, single sized washed aggregate, such as ‘blue metal’ gravel. The underfloor drainage should collect groundwater seepage and direct it by gravity flow to the stormwater system. If a network of subsoil drains are used in preference

to a drainage blanket a layer of roadbase will be required to form a bond breaker between the slab and the rock.

5.1.12 Where slabs are formed over natural soils and will be trafficked, we recommend that they first be proof rolled using a small smooth drum roller in the presence of an experienced geotechnical engineer. The purpose of proof rolling is to identify any soft or unstable areas so that they may be remediated and in this regard further advice would be provided by the geotechnical engineer at this stage. It should be noted that it is quite difficult to complete earthworks on a small scale and in this regard consideration could be given to designing the slabs as suspended slabs rather than slabs on grade.

5.1.13 All trafficable slabs on grade should be provided with a minimum 100mm crushed rock to RTA QA specification 3051 (1994) unbound base material (or equivalent good quality durable fine crushed rock) which is compacted to at least 100% of SMDD. All slabs on grade should be designed with shear effective transmission by way of either dowelled or keyed joints. The need for drainage below the slabs should be considered. Perimeter subsoil drains are likely to be a minimum requirement.

5.1.14 The surface water discharging from the new roof and paved areas must be diverted to outlets for controlled discharge to the existing stormwater system and discharge at the water course at the south-western corner of the site.

5.1.15 The results of the soil aggression testing returned a pH of 5.3, chloride and sulphate contents of 22mg/kg respectively and a resistivity of 24,000ohm.cm. In accordance with AS2159-2009, Tables 6.4.2(c) and 6.5.2(c) the site poses a moderate corrosion risk to concrete structures in contact with the ground and is non-aggressive for steel structures in contact with the ground.

5.1.16 The guidelines for Hillside Construction given in Appendix B should also be adopted.

5.2 Conditions Recommended to the Detailed Design to be Undertaken for the Construction Certificate

5.2.1 All structural design drawings must be reviewed by the geotechnical engineer who should endorse that the recommendations contained in this report have been adopted in principle.

5.2.2 All hydraulic design drawings must be reviewed by the geotechnical engineer who should endorse that the recommendations contained in this report have been adopted in principle.

5.2.3 All landscape design drawings must be reviewed by the geotechnical engineer who should endorse that the recommendations contained in this report have been adopted in principle

5.2.4 Where excavation is proposed an excavation/retention methodology must be prepared prior to bulk excavation commencing. The methodology must include but not be limited to proposed excavation techniques, the proposed excavation equipment, excavation

sequencing, geotechnical inspection intervals or hold points, vibration monitoring procedures, monitor locations, monitor types, contingency plans in case of exceedances.

5.2.5 The excavation/retention methodology must be reviewed and approved by the geotechnical engineer.

5.3 Conditions Recommended During the Construction Period

5.3.1 The geotechnical engineer must inspect all footing excavations prior to placing reinforcement.

5.3.2 Where excavation is proposed the approved excavation/retention methodology must be followed. This includes periodic inspection of every 1.5m of vertical unsupported cut formed through sandstone bedrock of low strength or greater.

5.3.3 Proposed material to be used for backfilling behind retaining walls must be approved by the geotechnical engineer prior to placement.

5.3.4 The geotechnical engineer must inspect all overhangs and detached boulders once appropriate clearing and access is provided to determine whether remedial works are required. Where required detached blocks are present and remedial measures are necessary they will either require removal or anchoring. Similarly, should remedial measures be required with respect to the overhangs they either need to be removed or underpinned. Where existing retaining walls are kept as part of the development they must be inspected by the structural engineer to confirm that they have an adequate factor of safety (FOS) for the design life of the site, which is 100 years in accordance with the policy. Should the structural engineer be unable to confirm that the walls have an acceptable FOS for the required design life ongoing inspections by the structural engineer may be required at regular intervals or, alternatively the walls may be reconstructed or strengthened such that they have a suitable FOS for the site design life.

5.3.5 If they are to be retained, the existing stormwater system, sewer and water mains must be checked for leaks by using static head and pressure tests under the direction of the hydraulic engineer or architect, and repaired if found to be leaking.

5.3.6 The geotechnical engineer must inspect all subsurface drains prior to backfilling.

5.3.7 An ‘as-built’ drawing of all buried services at the site must be prepared (including all pipe diameters, pipe depths, pipe types, inlet pits, inspection pits, etc).

5.3.8 All rock anchors must be proof-tested in a staged manner to 1.3 times the working load. In addition, the anchors must be subjected to lift-off testing no sooner than 24 hours after locking off at the working load. The proof-testing and lift-off tests must be witnessed by the geotechnical engineer. The anchor contractor must provide the geotechnical engineer with all field records including anchor installation and testing records.

5.3.9 The geotechnical engineer must confirm that the proposed works have been completed in accordance with the geotechnical reports.

We note that all above Conditions must be complied with. Where this has not been done, it may not be possible for Form 3, which is required for the Occupation Certificate to be signed.

5.4 Conditions Recommended for Ongoing Management of the Site/Structure(s)

The following recommendations have been included so that the current and future owners of the subject property are aware of their responsibilities:

5.4.1 All existing and proposed surface (including roof) and subsurface drains must be subject to ongoing and regular maintenance by the property owners. In addition, such maintenance must also be carried out by a plumber at no more than ten yearly intervals including provision of a written report confirming scope of work completed (with reference to the 'as-built' drawing) and identifying any required remedial measures.

5.4.2 Where existing retaining walls are kept and the structural engineer is unable to confirm that they have an acceptable FOS for the design life of the site, they should be inspected at the period designated by the structural engineer. Following these periodic the structural engineer must provide a written report confirming the scope of work completed, any required remedial measures and required future inspections.

5.4.3 No cut or fill in excess of 0.5m (eg. for landscaping, buried pipes, retaining walls, etc), is to be carried out on site without prior consent from Pittwater Council.

5.4.4 Where the structural engineer has indicated a design life of less than 100 years then the structure and/or structural elements must be inspected by a structural engineer at the end of their design life; including a written report confirming scope of work completed and identifying the required remedial measures to extend the design life over the remaining 100 year period.

6 OVERVIEW

It is possible that the subsurface soil, rock or groundwater conditions may be different to those assumed in preparing this report. Also, we have not had the opportunity to observe surface run-off patterns during heavy rainfall and cannot comment directly on this aspect. If conditions appear to be at variance or cause concern for any reason, then we recommend that you immediately contact this office.

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. 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.

Reference 1: Australian Geomechanics Society (2007c) *'Practice Note Guidelines for Landslide Risk Management'*, Australian Geomechanics, Vol 42, No 1, March 2007, pp63-114.

Reference 2: MacGregor, P, Walker, B, Fell, R, and Leventhal, A (2007) *'Assessment of Landslide Likelihood in the Pittwater Local Government Area'*, Australian Geomechanics, Vol 42, No 1, March 2007, pp183-196.

TABLE A
SUMMARY OF RISK ASSESSMENT TO PROPERTY

Potential Landslide Hazard	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Assessed Likelihood	Possible	Unlikely	Possible	Possible	Possible	Rare	Unlikely
Assessed Consequences	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
Risk	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low	Very Low
Comments		Small scale slumps anticipated with existing house apparently founded on bedrock	Should the debris strike the house when walls fail it is likely to cause nominal damage			Failures are likely to be limited to small volumes of material rather than large defect controlled failures	

* Assumed value of site $9M

TABLE B
SUMMARY OF RISK ASSESSMENT TO LIFE

Potential Landslide Hazard	**A**	**B**	**C**	**D**	**E**	**F**	**G**
Assessed Likelihood	Possible	Unlikely	Possible	Possible	Possible	Rare	Unlikely
Indicative Annual Probability	1×10^{-3}	1×10^{-4}	1×10^{-3}	1×10^{-3}	1×10^{-3}	1×10^{-5}	1×10^{-4}
Duration of Use of Area Affected (Temporal Probability)	(i) 1 minute/month 2.4×10^{-5} (ii) 5 minutes/week 4.96×10^{-4}	(i) & (ii) 10 minute/week 9.92×10^{-4}	(i) 5 minute/day 3.47×10^{-3} (ii) 1 minutes/day 6.94×10^{-4}	(i) 1 minute/month 2.4×10^{-5} (ii) 5 minutes/week 4.96×10^{-4}	(i) 5 minute/day 3.47×10^{-3} (ii) 1 minutes/day 6.94×10^{-4}	5 minute/day 3.47×10^{-3}	(i) 1 minute/month 2.4×10^{-5} (ii) 5 minutes/week 4.96×10^{-4}
Probability of Not Evacuating Area Affected	(i) 1 (ii) 0.5	(i) 1 (ii) 0.5	(i) 0.8 (ii) 0.5	(i) 1 (ii) 1	(i) 0.8 (ii) 0.5	0.8	(i) 0.9 (ii) 0.5
Vulnerability to Life if Failure Occurs Whilst Person Present	(i) 0.5 Likely to ride fall down (ii) 1	(i) & (ii) 0.01 Likely to slide failure down and unlikely to be buried	(i) & (ii) 0.01 Likely to ride failure down and unlikely to be buried	(i) 0.5 Likely to ride fall down (ii) 1 Likely to be buried	(i) 0.1 Likely to ride failure down (ii) 0.9 Possibly buried	0. 1 Likely to be relatively small pieces falling from face	(i) 0.1 Likely to ride failure down (ii) 0.5
Risk for Person Most at Risk	(i) 1.2×10^{-8} (ii) 2.48×10^{-7}	(i) 9.92×10^{-9} (ii) 4.96×10^{-8}	(i) 2.78×10^{-8} (ii) 3.47×10^{-9}	(i) 1.2×10^{-8} (ii) 4.96×10^{-7}	(i) 2.78×10^{-7} (ii) 3.12×10^{-7}	(i) 2.78×10^{-9}	(i) 2.16×10^{-10} (ii) 1.24×10^{-8}
Total Risk for Person Most at Risk	1.46 x 10						

115 Wicks Road
Macquarie Park NSW 2113
Telephone: 02 9888 5000
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SOIL TEST SERVICES

TABLE A
POINT LOAD STRENGTH INDEX TEST REPORT

Client:	JK Geotechnics	**Ref No:**	31791SY
Project:	Proposed Residence	**Report:**	A
Location:	346-354 Whale Beach Road, Whale Beach, NSW	**Report Date:**	7/09/2018
		Page 1 of 1	

BOREHOLE NUMBER	DEPTH m	$I_{S\,(50)}$ MPa	ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (MPa)
1	2.10 - 2.13	0.7	14
	3.00 - 3.03	0.02	<1
	3.92 - 3.96	1.6	32
	4.27 - 4.31	1.3	26
	4.72 - 4.75	0.2	4
	5.34 - 5.37	2.2	44
	5.59 - 5.62	1.9	38
	6.38 - 6.41	0.2	4
	6.80 - 6.83	0.7	14
	7.40 - 7.44	0.7	14
	7.80 - 7.84	0.7	14
	8.17 - 8.20	0.4	8
	8.78 - 8.82	1.1	22
	9.12 - 9.16	0.8	16
	9.78 - 9.82	0.8	16
	10.23 - 10.26	0.5	10
	10.77 - 10.81	1.1	22
	11.34 - 11.37	1.6	32
	11.60 - 11.64	2.6	52
	12.14 - 12.17	2.8	56
	12.67 - 12.71	1.3	26
	13.25 - 13.29	0.8	16
	13.86 - 13.90	1.5	30
	14.06 - 14.09	1.3	26

NOTES:

1. In the above table testing was completed in the Axial direction.
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 by the following approximate relationship and rounded off to the nearest whole number : U.C.S. = 20 IS (50)

Envirolab Services Pty Ltd
ABN 37 112 535 645
12 Ashley St Chatswood NSW 2067
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customerservice@envirolab.com.au
www.envirolab.com.au

CERTIFICATE OF ANALYSIS 199990

Client Details

Client	JK Geotechnics
Attention	B Jonak
Address	PO Box 976, North Ryde BC, NSW, 1670

Sample Details

Your Reference	**31791SY, Whale Beach**
Number of Samples	1 Soil
Date samples received	04/09/2018
Date completed instructions received	04/09/2018

Analysis Details

Please refer to the following pages for results, methodology summary and quality control data.

Samples were analysed as received from the client. Results relate specifically to the samples as received.

Results are reported on a dry weight basis for solids and on an as received basis for other matrices.

Report Details

Date results requested by	11/09/2018
Date of Issue	10/09/2018

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Accredited for compliance with ISO/IEC 17025 - Testing. **Tests not covered by NATA are denoted with ***

Results Approved By
Nick Sarlamis, Inorganics Supervisor

Authorised By

Jacinta Hurst, Laboratory Manager

Misc Inorg - Soil		
Our Reference		199990-1
Your Reference	UNITS	BH1
Depth		1.25-1.35
Date Sampled		30/08/2018
Type of sample		Soil
Date prepared	-	05/09/2018
Date analysed	-	05/09/2018
pH 1:5 soil:water	pH Units	5.3
Chloride, Cl 1:5 soil:water	mg/kg	22
Sulphate, SO4 1:5 soil:water	mg/kg	23
Resistivity in soil*	ohm m	240

Method ID	Methodology Summary
Inorg-001	pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.
Inorg-002	Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment & Lyons. Resistivity is calculated from Conductivity.
Inorg-081	Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B. Alternatively determined by colourimetry/turbidity using Discrete Analyer.

QUALITY CONTROL: Misc Inorg - Soil						Duplicate			Spike Recovery %	
Test Description	Units	PQL	Method	Blank	#	Base	Dup.	RPD	LCS-1	199990-1
Date prepared	-			05/09/2018	1	05/09/2018	05/09/2018		05/09/2018	05/09/2018
Date analysed	-			05/09/2018	1	05/09/2018	05/09/2018		05/09/2018	05/09/2018
pH 1:5 soil:water	pH Units		Inorg-001	[NT]	1	5.3	5.3	0	102	[NT]
Chloride, Cl 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	22	28	24	87	98
Sulphate, SO4 1:5 soil:water	mg/kg	10	Inorg-081	<10	1	23	25	8	90	90
Resistivity in soil*	ohm m	1	Inorg-002	<1	1	240	220	9	[NT]	[NT]

Result Definitions

NT	Not tested
NA	Test not required
INS	Insufficient sample for this test
PQL	Practical Quantitation Limit
<	Less than
>	Greater than
RPD	Relative Percent Difference
LCS	Laboratory Control Sample
NS	Not specified
NEPM	National Environmental Protection Measure
NR	Not Reported

Quality Control Definitions

Blank	This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate	This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike	A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample)	This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike	Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform, Faecal Enterococci, & E.Coli levels are less than 1cfu/100mL. The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC & ARMC 2011.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: >10xPQL - RPD acceptance criteria will vary depending on the analytes and the analytical techniques but is typically in the range 20%-50% – see ELN-P05 QA/QC tables for details; <10xPQL - RPD are higher as the results approach PQL and the estimated measurement uncertainty will statistically increase.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

Measurement Uncertainty estimates are available for most tests upon request.

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 1
1 / 3

BOREHOLE LOG

Client: THE APPLICANT
Project: PROPOSED RESIDENCE
Location: 346-352 WHALE BEACH ROAD, PALM BEACH, NSW

Job No.: 31791SY **Method:** HAND AUGER **R.L. Surface:** ~56.2 m
Date: 30/8/18 **Datum:** AHD
Plant Type: **Logged/Checked By:** J.B.J/W.T.

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					REFER TO DCP TEST RESULTS (1)	56			-	SANDSTONE PAVING: 100mm.t.				
										FILL: Silty sand, fine to medium grained, dark brown orange.	M			APPEARS POORLY COMPACTED
										FILL: Silty gravelly sand, fine to medium grained, light grey brown, trace of sandstone, fine to coarse grained gravel and root fibres.				
									CI-CH		w>PL	St		RESIDUAL
							1		SP	FILL: Clayey sand, fine to medium grained, light grey brown, trace of sandstone, medium to coarse grained, gravel.	M	MD		
						55			CI	Sandy CLAY: medium to high plasticity, light orange brown, with ash, trace of ironstone gravel.	w>PL	St		
									SC		M	MD		
									-	SAND: fine to medium grained, brown.	XW	D		
							2			Sandy CLAY: medium plasticity, orange brown.				
						54				Clayey SAND: fine to medium grained, orange.				
										Extremely Weathered sandstone: SAND, fine to medium grained, orange grey.				
							3			REFER TO CORED BOREHOLE LOG				
						53								
							4							
						52								
							5							
						51								
							6							
						50								

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 1
2 / 3

CORED BOREHOLE LOG

Client: THE APPLICANT
Project: PROPOSED RESIDENCE
Location: 346-352 WHALE BEACH ROAD, PALM BEACH, NSW

Job No.: 31791SY **Core Size:** NMLC **R.L. Surface:** ~56.2 m
Date: 30/8/18 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** J.B.J/W.T.

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 $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		55			START CORING AT 1.85m						
		54	2		SANDSTONE: fine to coarse grained, dark orange, with bands of extremely weathered material, clayey sand, bedding at 2-5°.	HW	VL - L	0.70		(1.94m) J, 50°, P, R, Cn	Newport Formation
					NO CORE 0.64m						Newport Formation
		53	3		SANDSTONE: fine to medium grained, orange grey, bedded at 2-5°	HW	VL - L	0.020			Newport Formation
					NO CORE 0.46m						
		52	4		SANDSTONE: fine to medium grained, orange grey, with extremely weathered bands, bedding at 2-5°.	HW	L	1.6 1.3		(3.80m) J, 80°, Ir, R, Cn (3.95m) J, 80°, C, Fe Vn (4.14m) J, 80°, Ir, R, Fe Vn	Newport Formation
					NO CORE 0.19m						
		51	5		SANDSTONE: fine to medium grained, light grey, with some orange red banding, bedding at 2-5°.	HW	L	0.20		(5.28m) XWS, 20 mm.t	Newport Formation
						MW	M	2.2 1.9		(5.82m) J, 80°, Un, R, Clay, 1 mm.t	
			6		NO CORE 0.19m						
		50			SANDSTONE: fine to medium grained, light grey with slight orange staining, bedding at 2-5°.	MW	M	0.20 0.70			Newport Formation
			7							(7.13m) J, 45°, P, R, Clay, 1 mm.t	
		49			NO CORE 0.10m						
					SANDSTONE: fine to medium grained, light grey, with slight orange staining.	MW	M	0.70 0.70		(7.32m) Be, 5°, Ir, R, Cn (7.65m) J, 30°, Ir, R, Fe, 1 mm.t (7.97m) J, 50°, P, R, Fe, 3 mm.t	

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS

JK Geotechnics
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Borehole No. 1
3 / 3

CORED BOREHOLE LOG

Client: THE APPLICANT
Project: PROPOSED RESIDENCE
Location: 346-352 WHALE BEACH ROAD, PALM BEACH, NSW

Job No.: 31791SY **Core Size:** NMLC **R.L. Surface:** ~56.2 m
Date: 30/8/18 **Inclination:** VERTICAL **Datum:** AHD
Plant Type: MELVELLE **Bearing:** N/A **Logged/Checked By:** J.B.J/W.T.

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 $I_s(50)$ (VL -0.1, L -0.3, M -1, H -3, VH -10, EH)	DEFECT DETAILS: SPACING (mm) (600, 200, 60, 20)	DEFECT DETAILS: DESCRIPTION (Specific / General)	Formation
		48			SANDSTONE: fine to medium grained, light grey, trace of claystone lenses, dark grey, bedding at 2-5°.	FR	M	0.40		(8.28m) J, 45°, Ir, Vr, Cn	Newport Formation
			9					1.1			
		47						0.80			
					NO CORE 0.04m						
			10		SANDSTONE: fine to medium grained, light grey, trace ofclaystone lenses, dark grey, bedded at 2-5°.	FR	M	0.80		(9.87m) J, 90°, Ir, Qz, 1 mm.t (10.00m) Be, 5°, P, R, Clay, 1 mm.t	Newport Formation
		46						0.50		(10.34m) J, 30°, Ir, Vr, Cn	
					SILTSTONE: dark grey, bedding at 0°.		H			(10.56m) Be, 0°, St, S, Cn (10.63m) J, 25°, St, S, Cn	
			11					1.1			
					NO CORE 0.09m						
		45			SANDSTONE: fine to medium grained, light grey with bands of siltstone, bedding at 2-5°.	FR	H	1.6		(11.37m) Be, 2°, Un, S, Cn	Newport Formation
								2.6		(11.58m) Be, 0°, P, S, Cn (11.76m) Be, 2°, Un, S, Cn	
			12								
		44						2.8		(12.33m) Be, 2°, Un, S, Cn (12.43m) Be, 2°, Un, S, Cn	
										(12.62m) Be, 2°, Un, S, Cn	
								1.3			
			13								
		43			SANDSTONE: fine to medium grained, light grey, bedding at 2-5°.			0.80		(13.52m) Be, 2°, Un, S, Cn	
								1.5			
			14					1.3			
		42			END OF BOREHOLE AT 14.14 m						

FRACTURES NOT MARKED ARE CONSIDERED TO BE DRILLING AND HANDLING BREAKS


JK Geotechnics
JOB N* 3179154 BH1 START CORING AT 1.77m
2
CORE LOSS 0.64m
3
CORE LOSS 0.46m
4
CORE LOSS 0.19m
5
6
CORE LOSS 0.19
7
C/L 0.1m
8
9
C/L
10
11
C/L 0.09m
12
13
14
END OF HOLE 14.14m

JK Geotechnics

GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

DYNAMIC CONE PENETRATION TEST RESULTS

Client:	THE APPLICANT		
Project:	PROPOSED RESIDENCE		
Location:	346-352 WHALE BEACH ROAD, PALM BEACH, NSW		
Job No.	31791SY	Hammer Weight & Drop:	9kg/510mm
Date:	30-8-18	Rod Diameter:	16mm
Tested By:	J.B.J.	Point Diameter:	20mm

Test Location	1	2	3	4	5	6	7
Surface RL	≈56.2m	≈66.5m	≈65.0m	≈57.4m	≈55.0m	≈70.0m	≈71.5m
Depth (mm)	Number of Blows per 100mm Penetration						
0 - 100	PAVER	3	6	1	1	1	1
100 - 200	7	3	8	3	4	3	4/100mm
200 - 300	3	4	10	4	6	6/50mm	REFUSAL
300 - 400	3	5	REFUSAL	4	10	REFUSAL	
400 - 500	6	10		5	REFUSAL		
500 - 600	3	REFUSAL		8			
600 - 700	3			8			
700 - 800	3			8			
800 - 900	3			6/10mm			
900 - 1000	5			REFUSAL			
1000 - 1100	4						
1100 - 1200	4						
1200 - 1300	5						
1300 - 1400	5						
1400 - 1500	5						
1500 - 1600	8						
1600 - 1700	14						
1700 - 1800	20/100mm						
1800 - 1900	REFUSAL						
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 described in AS1289.6.3.2-1997 (R2013)
2. Usually 8 blows per 20mm is taken as refusal
3. Datum of levels is AHD

AERIAL IMAGE SOURCE: MAPS.AU.NEARMAP.COM, 28 DEC 2018.

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SITE LOCATION PLAN**

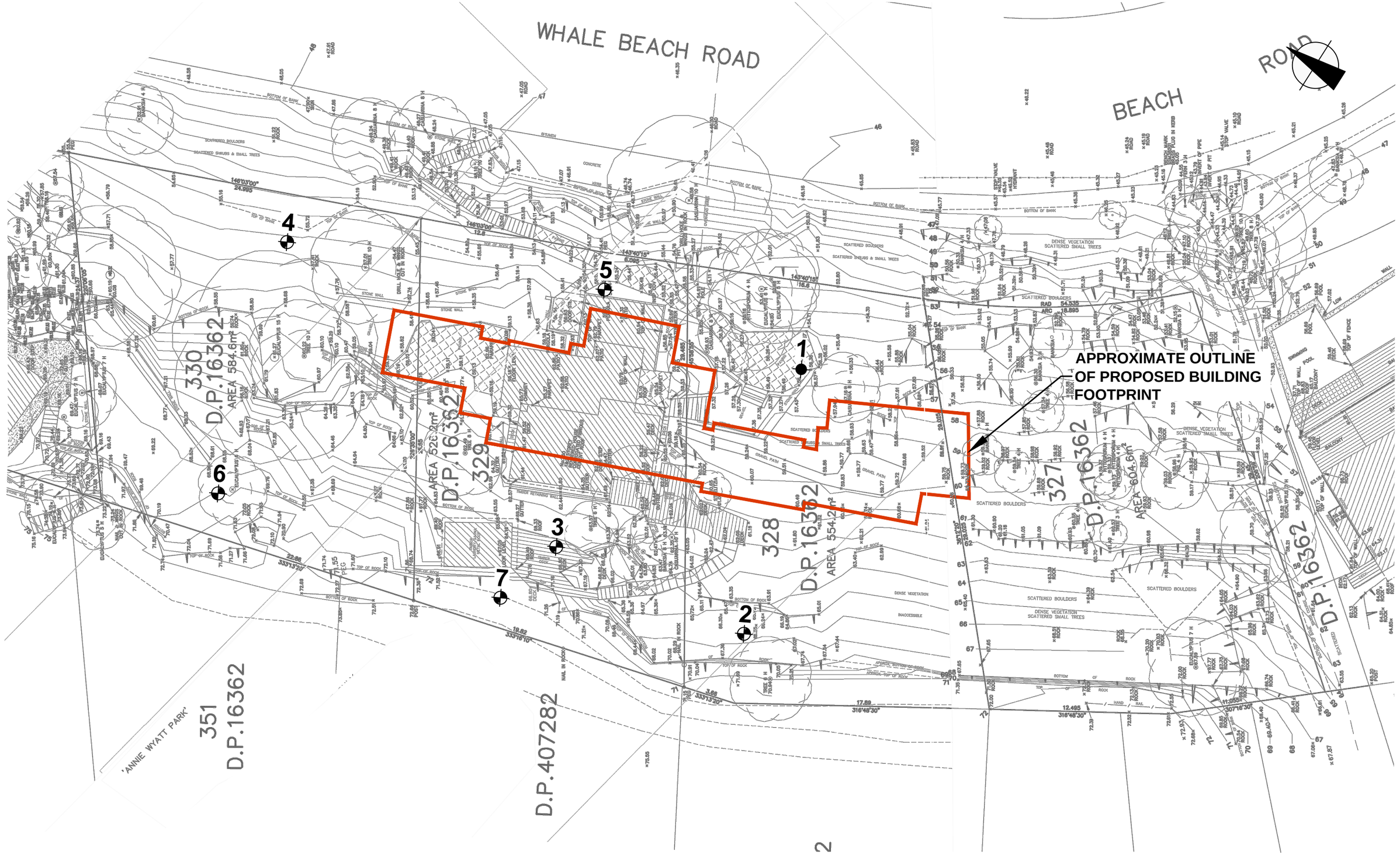
Location: 346-352 WHALE BEACH ROAD
PALM BEACH, NSW

Report No: 31791SY

Figure No: 1

J K **Geotechnics**

PLOT DATE: 8/02/2019 4:33:52 PM DWG FILE: S\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000S\31791SY WHALE BEACH\CAD\31791SY.DWG



LEGEND

- HAND AUGER AND DCP TEST
- DCP TEST

0 2.5 5 7.5 10 12.5

SCALE 1:250 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **TEST LOCATION PLAN**

Location: 346-352 WHALE BEACH ROAD PALM BEACH, NSW

Report No: 31791SY

Figure No: 2

J K **Geotechnics**

PLOT DATE: 9/02/2019 4:32:41 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000'S\31791SY WHALE BEACH\CAD\31791SY.DWG

LEGEND

- HAND AUGER AND DCP TEST
- DCP TEST

0 2.5 5 7.5 10 12.5

SCALE 1:250 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **GEOTECHNICAL SITE PLAN**

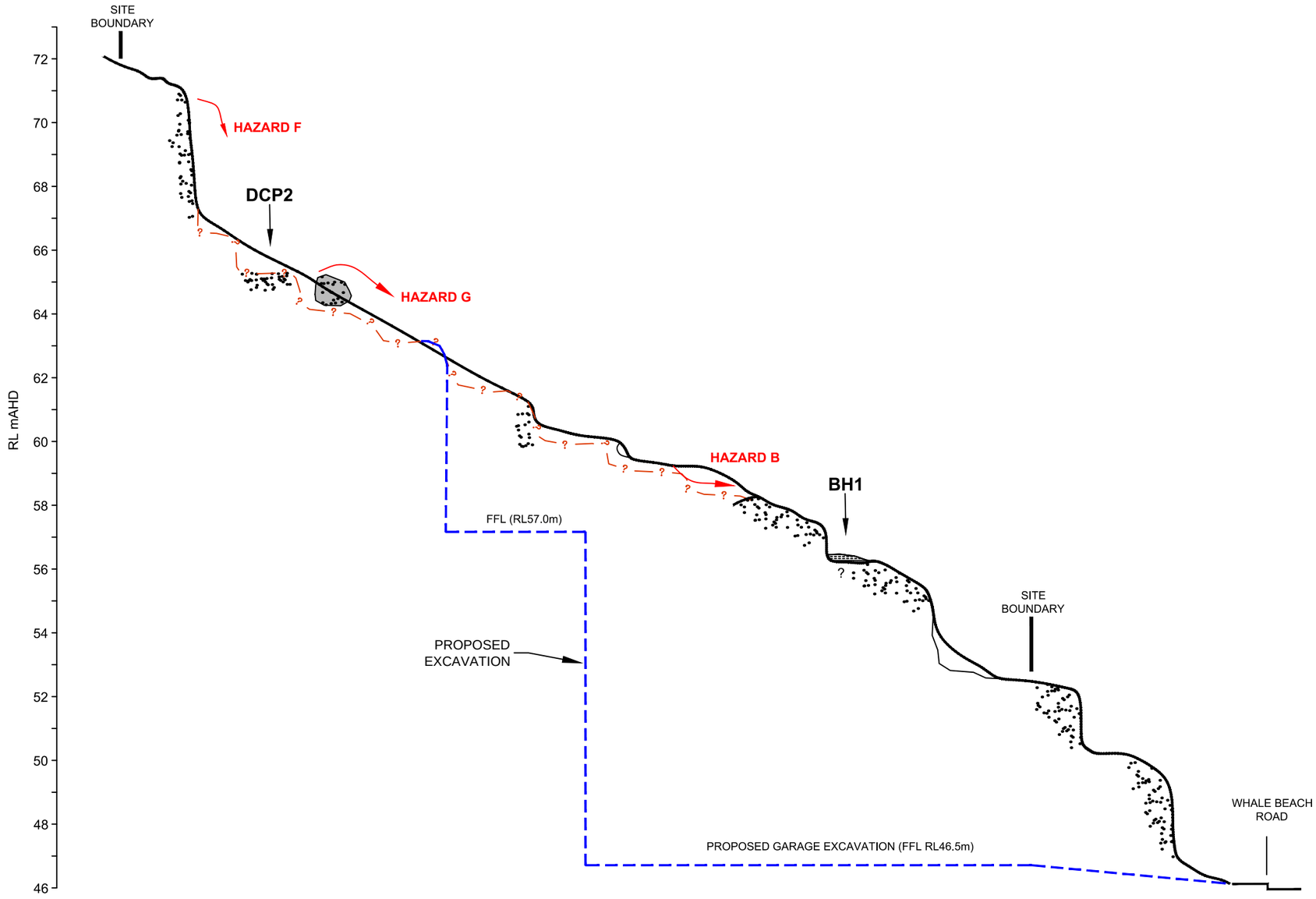
Location: 346-352 WHALE BEACH ROAD
PALM BEACH, NSW

Report No: 31791SY

Figure No: 3

JK **Geotechnics**

PLOT DATE: 8/02/2019 4:33:06 PM DWG FILE : S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000S\31791SY WHALE BEACH\CAD\31791SY.DWG



0 1.5 3 4.5 6 7.5

SCALE 1:150 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SECTION A-A**

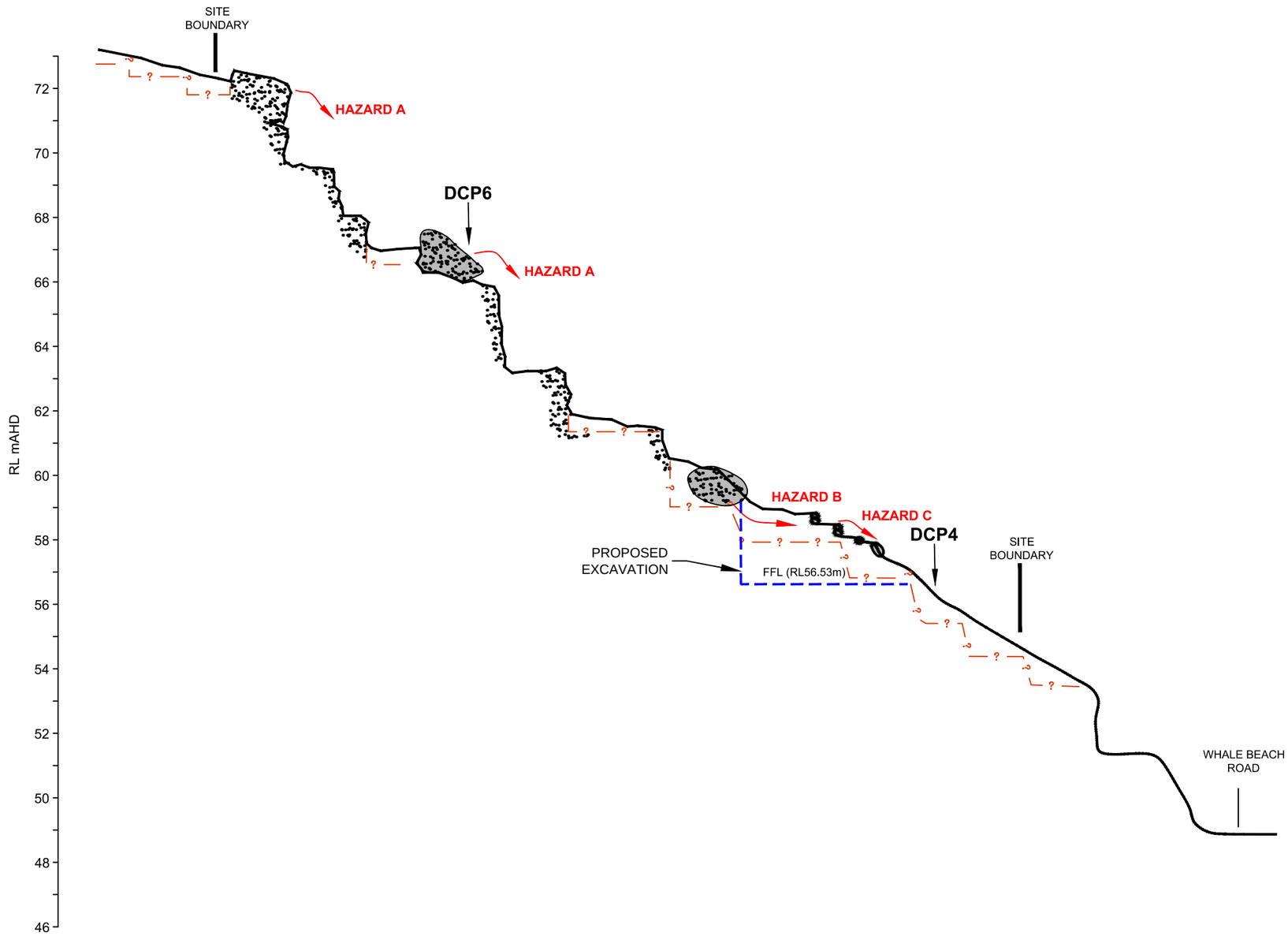
Location: 346-352 WHALE BEACH ROAD
PALM BEACH, NSW

Report No: 31791SY

Figure No: 4

J K Geotechnics

PLOT DATE: 8/02/2019 4:30:50 PM DWG FILE : S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000'S\31791SY WHALE BEACH\CAD\31791SY.DWG



0 1.5 3 4.5 6 7.5

SCALE 1:150 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SECTION B-B**

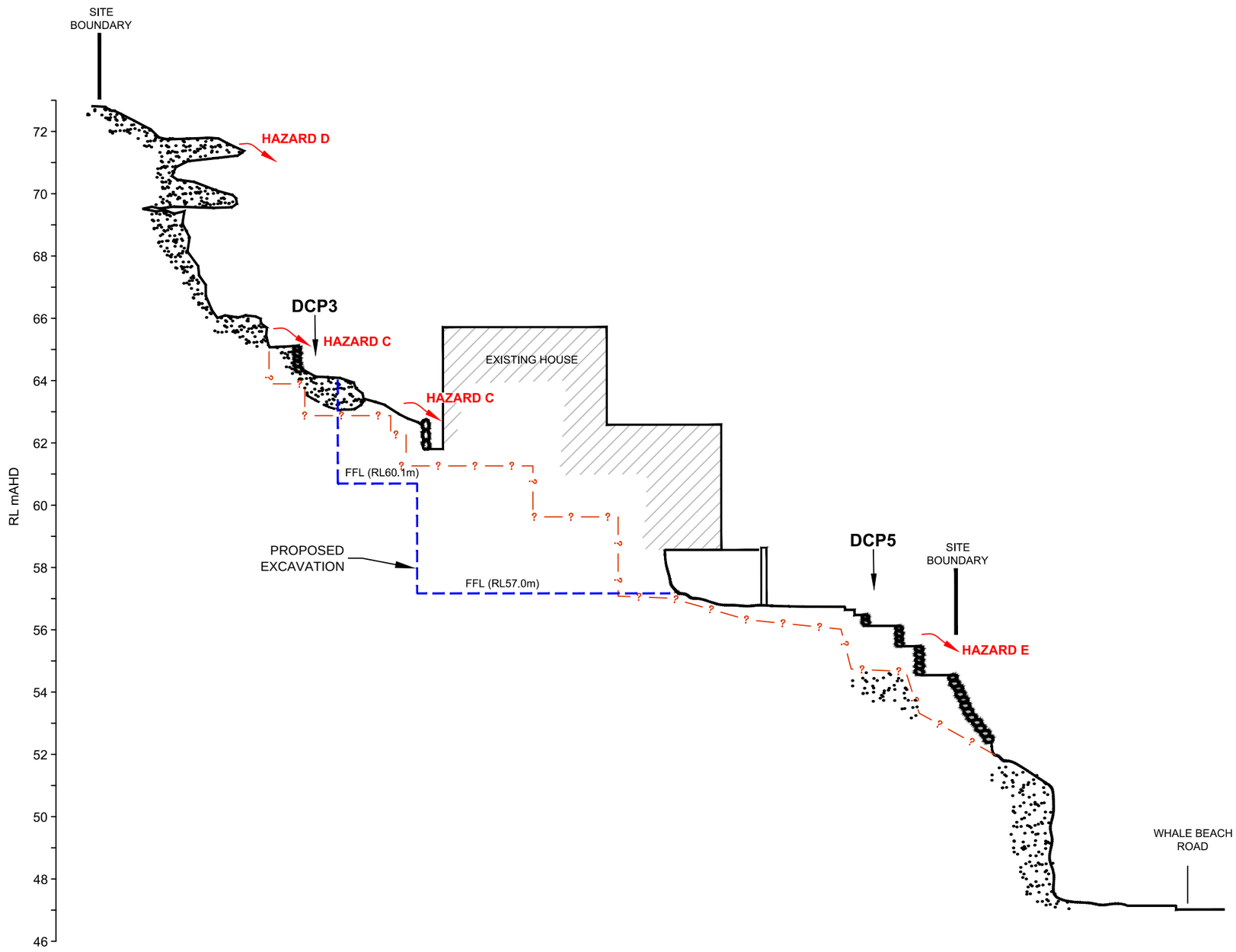
Location: 346-352 WHALE BEACH ROAD
PALM BEACH, NSW

Report No: 31791SY

Figure No: 5

J K Geotechnics

PLOT DATE: 8/02/2019 4:30:42 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000'S\31791SY WHALE BEACH\CAD\31791SY.DWG



0 1.5 3 4.5 6 7.5

SCALE 1:150 @A3 METRES

This plan should be read in conjunction with the JK Geotechnics report.

Title: **SECTION C-C**

Location: 346-352 WHALE BEACH ROAD
PALM BEACH, NSW

Report No: 31791SY

Figure No: 6

JK **Geotechnics**

PLOT DATE: 8/02/2019 4:30:57 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000'S\31791SY WHALE BEACH\CAD\31791SY.DWG

TOPOGRAPHY

Symbol *Ground Profile*

convex
concave
} well defined or angular break of slope

convex
concave
} poorly defined or smooth change of slope

breaks of slope
changes of slope
} convex and concave too close together to allow the use of separate symbols

sharp
rounded
} ridge crest

3 Cliff or escarpment or sharp break 40° or more (estimated height in metres)

15 Uniform Slope
10 Concave Slope
8 Convex Slope
} Slope direction and angle (Degrees)

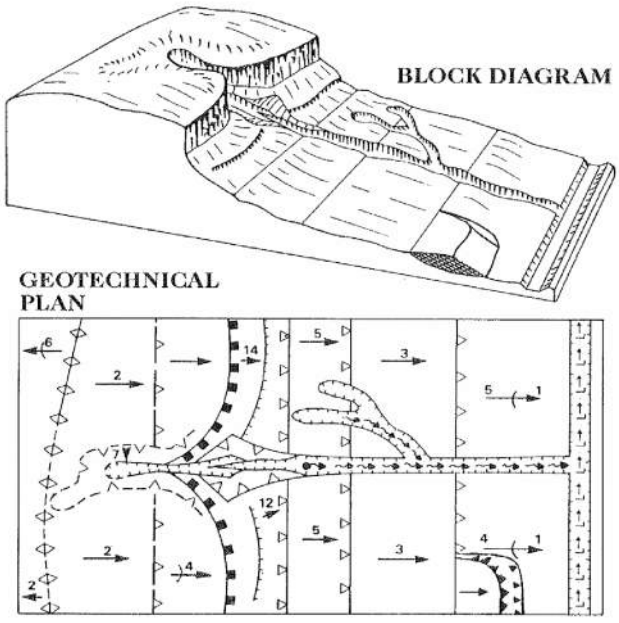
Top
Bottom
} Cut or fill slope, arrows pointing down slope

Hummocky or irregular ground

OTHER FEATURES

Boulder
Seepage/spring
Swallow hole for runoff
Natural water course
Open drain, unlined
Open drain, lined
Fenceline
Property boundary
Dry Stone Wall
J 200 J Major joint in rock face (opening in millimetres)
– T – T – 10 Tension crack (opening in millimetres)
Masonry or concrete wall
Ponding water
Boggy or swampy area

EXAMPLE OF USE OF TOPOGRAPHIC SYMBOLS:



(After Gardiner, V & Dackombe, R. V. (1983), Geomorphological Field Manual; George Allen & Unwin).

Title:	**GEOTECHNICAL MAPPING SYMBOLS**	
Location:	346-352 WHALE BEACH ROAD PALM BEACH, NSW	
Report No:	31791SY	Figure No: 7
	J K **Geotechnics**	

This plan should be read in conjunction with the JK Geotechnics report.

PLOT DATE: 8/02/2019 4:31:04 PM DWG FILE: S:\6 GEOTECHNICAL\6F GEOTECHNICAL JOBS\31000S\31791SY WHALE BEACH\CAD\31791SY.DWG

APPENDIX A

LANDSLIDE RISK MANAGEMENT TERMINOLOGY

APPENDIX A
LANDSLIDE RISK MANAGEMENT

Definition of Terms and Landslide Risk

Risk Terminology	Description
Acceptable Risk	A risk for which, for the purposes of life or work, we are prepared to accept as it is with no regard to its management. Society does not generally consider expenditure in further reducing such risks justifiable.
Annual Exceedance Probability (AEP)	The estimated probability that an event of specified magnitude will be exceeded in any year.
Consequence	The outcomes or potential outcomes arising from the occurrence of a landslide expressed qualitatively or quantitatively, in terms of loss, disadvantage or gain, damage, injury or loss of life.
Elements at Risk	The population, buildings and engineering works, economic activities, public services utilities, infrastructure and environmental features in the area potentially affected by landslides.
Frequency	A measure of likelihood expressed as the number of occurrences of an event in a given time. See also 'Likelihood' and 'Probability'.
Hazard	A condition with the potential for causing an undesirable consequence (the landslide). The description of landslide hazard should include the location, volume (or area), classification and velocity of the potential landslides and any resultant detached material, and the likelihood of their occurrence within a given period of time.
Individual Risk to Life	The risk of fatality or injury to any identifiable (named) individual who lives within the zone impacted by the landslide; or who follows a particular pattern of life that might subject him or her to the consequences of the landslide.
Landslide Activity	The stage of development of a landslide; pre failure when the slope is strained throughout but is essentially intact; failure characterised by the formation of a continuous surface of rupture; post failure which includes movement from just after failure to when it essentially stops; and reactivation when the slope slides along one or several pre-existing surfaces of rupture. Reactivation may be occasional (eg. seasonal) or continuous (in which case the slide is 'active').
Landslide Intensity	A set of spatially distributed parameters related to the destructive power of a landslide. The parameters may be described quantitatively or qualitatively and may include maximum movement velocity, total displacement, differential displacement, depth of the moving mass, peak discharge per unit width, or kinetic energy per unit area.
Landslide Risk	The AGS Australian GeoGuide LR7 (AGS, 2007e) should be referred to for an explanation of Landslide Risk.
Landslide Susceptibility	The classification, and volume (or area) of landslides which exist or potentially may occur in an area or may travel or retrogress onto it. Susceptibility may also include a description of the velocity and intensity of the existing or potential landsliding.
Likelihood	Used as a qualitative description of probability or frequency.
Probability	A measure of the degree of certainty. This measure has a value between zero (impossibility) and 1.0 (certainty). It is an estimate of the likelihood of the magnitude of the uncertain quantity, or the likelihood of the occurrence of the uncertain future event. These are two main interpretations: (i) Statistical – frequency or fraction – The outcome of a repetitive experiment of some kind like flipping coins. It includes also the idea of population variability. Such a number is called an 'objective' or relative frequentist probability because it exists in the real world and is in principle measurable by doing the experiment.

Risk Terminology	Description
Probability ***(continued)***	(ii) Subjective probability (degree of belief) – Quantified measure of belief, judgment, or confidence in the likelihood of an outcome, obtained by considering all available information honestly, fairly, and with a minimum of bias. Subjective probability is affected by the state of understanding of a process, judgment regarding an evaluation, or the quality and quantity of information. It may change over time as the state of knowledge changes.
Qualitative Risk Analysis	An analysis which uses word form, descriptive or numeric rating scales to describe the magnitude of potential consequences and the likelihood that those consequences will occur.
Quantitative Risk Analysis	An analysis based on numerical values of the probability, vulnerability and consequences and resulting in a numerical value of the risk.
Risk	A measure of the probability and severity of an adverse effect to health, property or the environment. Risk is often estimated by the product of probability x consequences. However, a more general interpretation of risk involves a comparison of the probability and consequences in a non-product form.
Risk Analysis	The use of available information to estimate the risk to individual, population, property, or the environment, from hazards. Risk analyses generally contain the following steps: scope definition, hazard identification and risk estimation.
Risk Assessment	The process of risk analysis and risk evaluation.
Risk Control or Risk Treatment	The process of decision-making for managing risk and the implementation or enforcement of risk mitigation measures and the re-evaluation of its effectiveness from time to time, using the results of risk assessment as one input.
Risk Estimation	The process used to produce a measure of the level of health, property or environmental risks being analysed. Risk estimation contains the following steps: frequency analysis, consequence analysis and their integration.
Risk Evaluation	The stage at which values and judgments enter the decision process, explicitly or implicitly, by including consideration of the importance of the estimated risks and the associated social, environmental and economic consequences, in order to identify a range of alternatives for managing the risks.
Risk Management	The complete process of risk assessment and risk control (or risk treatment).
Societal Risk	The risk of multiple fatalities or injuries in society as a whole: one where society would have to carry the burden of a landslide causing a number of deaths, injuries, financial, environmental and other losses.
Susceptibility	See 'Landslide Susceptibility'.
Temporal Spatial Probability	The probability that the element at risk is in the area affected by the landsliding, at the time of the landslide.
Tolerable Risk	A risk within a range that society can live with so as to secure certain net benefits. It is a range of risk regarded as non-negligible and needing to be kept under review and reduced further if possible.
Vulnerability	The degree of loss to a given element or set of elements within the area affected by the landslide hazard. It is expressed on a scale of 0 (no loss) to 1 (total loss). For property, the loss will be the value of the damage relative to the value of the property; for persons, it will be the probability that a particular life (the element at risk) will be lost, given the person(s) is affected by the landslide.

NOTE: Reference should be made to Figure A1 which shows the inter-relationship of many of these terms and the relevant portion of Landslide Risk Management.

Reference should also be made to the paper referenced below for Landslide Terminology and more detailed discussion of the above terminology.

This appendix is an extract from PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT as presented in Australian Geomechanics, Vol 42, No 1, March 2007, which discusses the matter more fully.

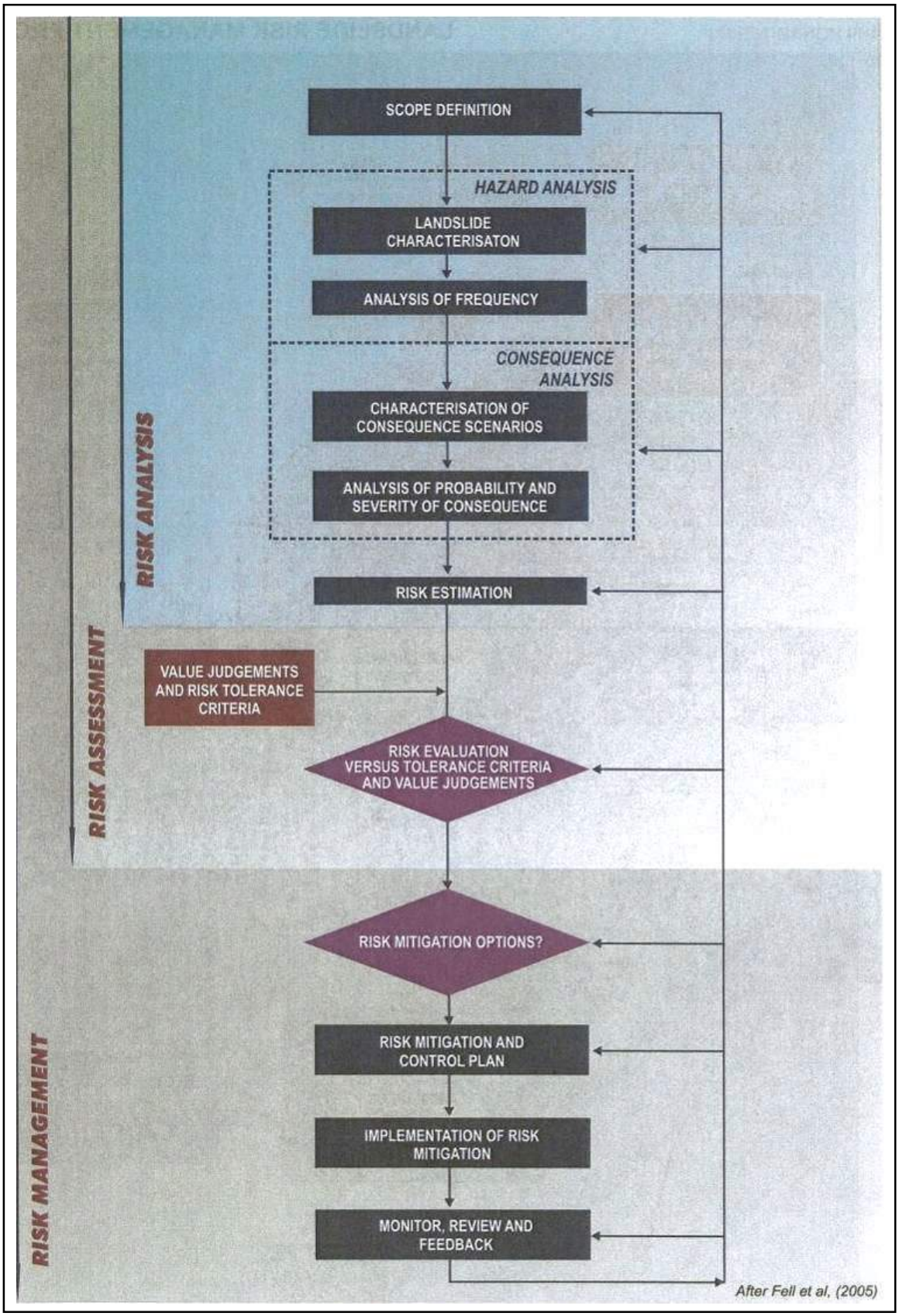


FIGURE A1: Flowchart for Landslide Risk Management.

This figure is an extract from GUIDELINE FOR LANDSLIDE SUSCEPTIBILITY, HAZARD AND RISK ZONING FOR LAND USE PLANNING, as presented in Australian Geomechanics Vol 42, No 1, March 2007, which discusses the matter more fully.

TABLE A1: LANDSLIDE RISK ASSESSMENT
QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa.

Extract from PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT as presented in Australian Geomechanics, Vol 42, No 1, March 2007, which discusses the matter more fully.

TABLE A1: LANDSLIDE RISK ASSESSMENT
QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (continued)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

Notes: (5) Cell A5 may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

Extract from PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT as presented in Australian Geomechanics, Vol 42, No 1, March 2007, which discusses the matter more fully.

AUSTRALIAN GEOGUIDE LR2 (LANDSLIDES)

What is a Landslide?

Any movement of a mass of rock, debris, or earth, down a slope, constitutes a "landslide". Landslides take many forms, some of which are illustrated. More information can be obtained from Geoscience Australia, or by visiting its Australian landslide Database at www.ga.gov.au/urban/factsheets/landslide.jsp. Aspects of the impact of landslides on buildings are dealt with in the book "Guideline Document Landslide Hazards" published by the Australian Building Codes Board and referenced in the Building Code of Australia. This document can be purchased over the internet at the Australian Building Codes Board's website www.abcb.gov.au.

Landslides vary in size. They can be small and localised or very large, sometimes extending for kilometres and involving millions of tonnes of soil or rock. It is important to realise that even a 1 cubic metre boulder of soil, or rock, weighs at least 2 tonnes. If it falls, or slides, it is large enough to kill a person, crush a car, or cause serious structural damage to a house. The material in a landslide may travel downhill well beyond the point where the failure first occurred, leaving destruction in its wake. It may also leave an unstable slope in the ground behind it, which has the potential to fall again, causing the landslide to extend (regress) uphill, or expand sideways. For all these reasons, both "potential" and "actual" landslides must be taken very seriously. The present a real threat to life and property and require proper management.

Identification of landslide risk is a complex task and must be undertaken by a geotechnical practitioner (GeoGuide LR1) with specialist experience in slope stability assessment and slope stabilisation.

What Causes a Landslide?

Landslides occur as a result of local geological and groundwater conditions, but can be exacerbated by inappropriate development (GeoGuide LR8), exceptional weather, earthquakes and other factors. Some slopes and cliffs never seem to change, but are actually on the verge of failing. Others, often moderate slopes (Table 1), move continuously, but so slowly that it is not apparent to a casual observer. In both cases, small changes in conditions can trigger a landslide with series consequences. Wetting up of the ground (which may involve a rise in groundwater table) is the single most important cause of landslides (GeoGuide LR5). This is why they often occur during, or soon after, heavy rain. Inappropriate development often results in small scale landslides which are very expensive in human terms because of the proximity of housing and people.

Does a Landslide Affect You?

Any slope, cliff, cutting, or fill embankment may be a hazard which has the potential to impact on people, property, roads and services. Some tell-tale signs that might indicate that a landslide is occurring are listed below:

- Open cracks, or steps, along contours
- Groundwater seepage, or springs
- Bulging in the lower part of the slope
- Hummocky ground
- trees leaning down slope, or with exposed roots
- debris/fallen rocks at the foot of a cliff
- tilted power poles, or fences
- cracked or distorted structures

These indications of instability may be seen on almost any slope and are not necessarily confined to the steeper ones (Table 1). Advice should be sought from a geotechnical practitioner if any of them are observed. Landslides do not respect property boundaries. As mentioned above they can "run-out" from above, "regress" from below, or expand sideways, so a landslide hazard affecting your property may actually exist on someone else's land.

Local councils are usually aware of slope instability problems within their jurisdiction and often have specific development and maintenance requirements. **Your local council is the first place to make enquiries if you are responsible for any sort of development or own or occupy property on or near sloping land or a cliff.**

TABLE 1 – Slope Descriptions

Appearance	Slope Angle	Maximum Gradient	Slope Characteristics
Gentle	0° - 10°	1 on 6	Easy walking.
Moderate	10° - 18°	1 on 3	Walkable. Can drive and manoeuvre a car on driveway.
Steep	18° - 27°	1 on 2	Walkable with effort. Possible to drive straight up or down roughened concrete driveway, but cannot practically manoeuvre a car.
Very Steep	27° - 45°	1 on 1	Can only climb slope by clutching at vegetation, rocks, etc.
Extreme	45° - 64°	1 on 0.5	Need rope access to climb slope.
Cliff	64° - 84°	1 on 0.1	Appears vertical. Can abseil down.
Vertical or Overhang	84° - 90±°	Infinite	Appears to overhang. Abseiler likely to lose contact with the face.

Some typical landslides which could affect residential housing are illustrated below:

Rotational or circular slip failures (Figure 1) - can occur on moderate to very steep soil and weathered rock slopes (Table 1). The sliding surface of the moving mass tends to be deep seated. Tension cracks may open at the top of the slope and bulging may occur at the toe. The ground may move in discrete "steps" separated by long periods without movement. More rapid movement may occur after heavy rain.

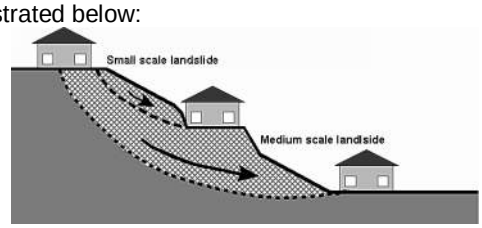


Figure 1

Translational slip failures (Figure 2) - tend to occur on moderate to very steep slopes (Table 1) where soil, or weak rock, overlies stronger strata. The sliding mass is often relatively shallow. It can move, or deform slowly (creep) over long periods of time. Extensive linear cracks and hummocks sometimes form along the contours. The sliding mass may accelerate after heavy rain.

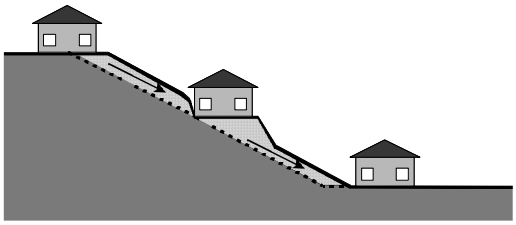


Figure 2

Wedge failures (Figure 3) - normally only occur on extreme slopes, or cliffs (Table 1), where discontinuities in the rock are inclined steeply downwards out of the face.

Rock falls (Figure 3) - tend to occur from cliffs and overhangs (Table 1).

Cliffs may remain, apparently unchanged, for hundreds of years. Collections of boulders at the foot of a cliff may indicate that rock falls are ongoing. Wedge failures and rock falls do not "creep". Familiarity with a particular local situation can instil a false sense of security since failure, when it occurs, is usually sudden and catastrophic.

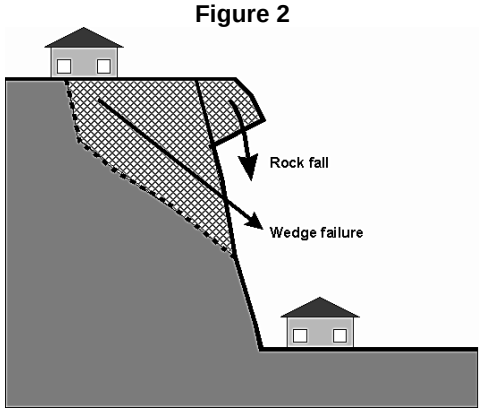


Figure 3

Debris flows and mud slides (Figure 4) - may occur in the foothills of ranges, where erosion has formed valleys which slope down to the plains below. The valley bottoms are often lined with loose eroded material (debris) which can "flow" if it becomes saturated during and after heavy rain. Debris flows are likely to occur with little warning; they travel a long way and often involve large volumes of soil. The consequences can be devastating.

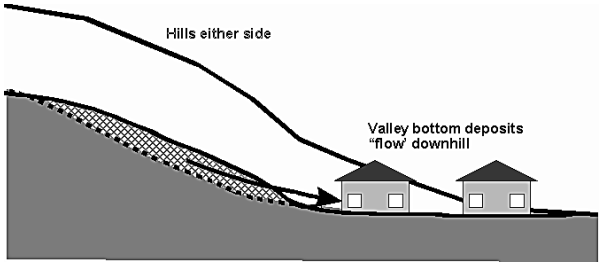


Figure 4

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR3 - Soil Slopes
- GeoGuide LR4 - Rock Slopes
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as *"a measure of the probability and severity of an adverse effect to health, property, or the environment."* This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (see GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is normally covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, then go first for information to your local council. If you have any concern that you could be dealing with a landslide hazard that your local council is not aware of you should seek advice from a geotechnical practitioner.

Landslide risk assessment must be undertaken by a geotechnical practitioner. It may involve visual inspection, geological mapping, geotechnical

investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site);
- the likelihood that they will occur;
- the damage that could result;
- the cost of disruption and repairs; and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction inevitably lacks precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. Likelihood is the chance of it happening in any one year, as indicated in Table 2. Consequences are related to the cost of the repairs and perhaps temporary loss of use. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

TABLE 1 – RISK TO PROPERTY

Qualitative Risk		Significance - Geotechnical engineering requirements
Very high	VH	**Unacceptable** without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low. May be too expensive and not practical. Work likely to cost more than the value of the property.
High	H	**Unacceptable** without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property.
Moderate	M	**May be tolerated** in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as possible.
Low	L	**Usually acceptable** to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required.
Very Low	VL	**Acceptable**. Manage by normal slope maintenance procedures.

TABLE 2 – LIKELIHOOD

Likelihood	Annual Probability
Almost Certain	1:10
Likely	1:100
Possible	1:1,000
Unlikely	1:10,000
Rare	1:100,000
Barely credible	1:1,000,000

The terms "unacceptable", "tolerable" etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others. Some local councils and planning authorities stipulate a maximum tolerable risk level. This may be lower than you feel is reasonable for your block but it is, nonetheless, a pre-requisite for development. Reasons for this include the fact that a landslide on your block may pose a risk to neighbours and passers-by and that , should you sell, subsequent owners of the block may be more risk averse than you.

Risk to Life

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in, we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in water-related activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. The data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us today. If this were not so, there would be no risk at all and clearly that is not the case.

In NSW, the planning authorities consider that 1:1,000,000 is the maximum tolerable risk for domestic housing built near an obvious hazard, such as a chemical factory. Although not specifically considered in the NSW guidelines there is little difference between the hazard presented by a neighbouring factory and a landslide: both have the capacity to destroy life and property and both are always present.

TABLE 3 – RISK TO LIFE

Risk (deaths per participant per year)	**Activity/Event Leading to Death** (NSW data unless noted)
1:1,000	Deep sea fishing (UK)
1:1,000 to 1:10,000	Motor cycling, horse riding , ultra-light flying (Canada)
1:23,000	Motor vehicle use
1:30,000	Fall
1:70,000	Drowning
1:180,000	Fire/burn
1:660,000	Choking on food
1:1,000,000	Scheduled airlines (Canada)
1:2,300,000	Train travel
1:32,000,000	Lightning strike

More information relevant to your particular situation may be found in other AUSTRALIAN GEOGUIDES:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR8 - Hillside Construction
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 - Coastal Landslides
- GeoGuide LR11 - Record Keeping

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the Australian Geomechanics Society, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.

APPENDIX B

SOME GUIDELINES

FOR

HILLSIDE CONSTRUCTION

APPENDIX B – SOME GUIDELINES FOR HILLSIDE CONSTRUCTION

	GOOD ENGINEERING PRACTICE	POOR ENGINEERING PRACTICE
ADVICE		
GEOTECHNICAL ASSESSMENT	Obtain advice from a qualified, experienced geotechnical consultant at early stage of planning and before site works.	Prepare detailed plan and start site works before geotechnical advice.
PLANNING		
SITE PLANNING	Having obtained geotechnical advice, plan the development with the risk arising from the identified hazards and consequences in mind.	Plan development without regard for the Risk.
DESIGN AND CONSTRUCTION		
HOUSE DESIGN	Use flexible structures which incorporate properly designed brickwork, timber or steel frames, timber or panel cladding. Consider use of split levels. Use decks for recreational areas where appropriate.	Floor plans which require extensive cutting and filling. Movement intolerant structures.
SITE CLEARING	Retain natural vegetation wherever practicable.	Indiscriminately clear the site.
ACCESS & DRIVEWAYS	Satisfy requirements below for cuts, fills, retaining walls and drainage. Council specifications for grades may need to be modified. Driveways and parking areas may need to be fully supported on piers.	Excavate and fill for site access before geotechnical advice.
EARTHWORKS	Retain natural contours wherever possible.	Indiscriminant bulk earthworks.
CUTS	Minimise depth. Support with engineered retaining walls or batter to appropriate slope. Provide drainage measures and erosion control.	Large scale cuts and benching. Unsupported cuts. Ignore drainage requirements.
FILLS	Minimise height. Strip vegetation and topsoil and key into natural slopes prior to filling. Use clean fill materials and compact to engineering standards. Batter to appropriate slope or support with engineered retaining wall. Provide surface drainage and appropriate subsurface drainage.	Loose or poorly compacted fill, which if it fails, may flow a considerable distance (including onto properties below). Block natural drainage lines. Fill over existing vegetation and topsoil. Include stumps, trees, vegetation, topsoil, boulders, building rubble etc. in fill.
ROCK OUTCROPS & BOULDERS	Remove or stabilise boulders which may have unacceptable risk. Support rock faces where necessary.	Disturb or undercut detached blocks or boulders.
RETAINING WALLS	Engineer design to resist applied soil and water forces. Found on bedrock where practicable. Provide subsurface drainage within wall backfill and surface drainage on slope above. Construct wall as soon as possible after cut/fill operation.	Construct a structurally inadequate wall such as sandstone flagging, brick or unreinforced blockwork. Lack of subsurface drains and weepholes.
FOOTINGS	Found within bedrock where practicable. Use rows of piers or strip footings oriented up and down slope. Design for lateral creep pressures if necessary. Backfill footing excavations to exclude ingress of surface water.	Found on topsoil, loose fill, detached boulders or undercut cliffs.
SWIMMING POOLS	Engineer designed. Support on piers to rock where practicable. Provide with under-drainage and gravity drain outlet where practicable. Design for high soil pressures which may develop on uphill side whilst there may be little or no lateral support on downhill side.	
DRAINAGE		
SURFACE	Provide at tops of cut and fill slopes. Discharge to street drainage or natural water courses. Provide generous falls to prevent blockage by siltation and incorporate silt traps. Line to minimise infiltration and make flexible where possible. Special structures to dissipate energy at changes of slope and/or direction.	Discharge at top of fills and cuts. Allow water to pond bench areas.
SUBSURFACE	Provide filter around subsurface drain. Provide drain behind retaining walls. Use flexible pipelines with access for maintenance. Prevent inflow of surface water.	Discharge of roof run-off into absorption trenches.
SEPTIC & SULLAGE	Usually requires pump-out or mains sewer systems; absorption trenches may be possible in some areas if risk is acceptable. Storage tanks should be water-tight and adequately founded.	Discharge sullage directly onto and into slopes. Use of absorption trenches without consideration of landslide risk.
EROSION CONTROL & LANDSCAPING	Control erosion as this may lead to instability. Revegetate cleared area.	Failure to observe earthworks and drainage recommendations when landscaping.
DRAWINGS AND SITE VISITS DURING CONSTRUCTION		
DRAWINGS	Building Application drawings should be viewed by a geotechnical consultant.	
SITE VISITS	Site visits by consultant may be appropriate during construction.	
INSPECTION AND MAINTENANCE BY OWNER		
OWNER'S RESPONSIBILITY	Clean drainage systems; repair broken joints in drains and leaks in supply pipes. Where structural distress is evident seek advice. If seepage observed, determine cause or seek advice on consequences.	

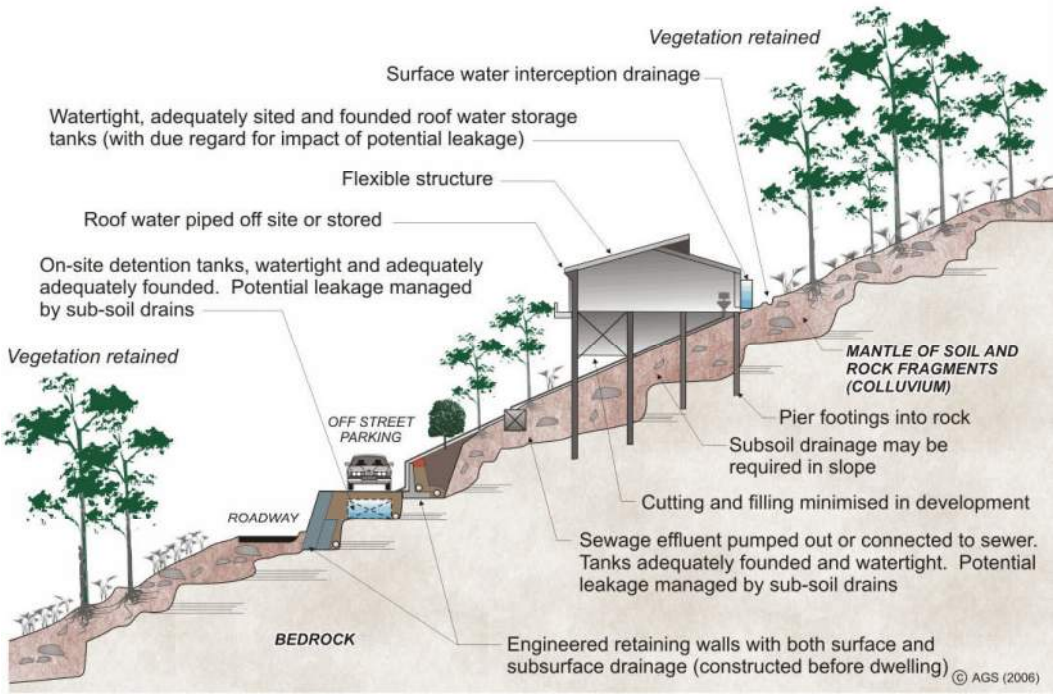
This table is an extract from PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT as presented in *Australian Geomechanics*, Vol 42, No 1, March 2007 which discusses the matter more fully.

AUSTRALIAN GEOGUIDE LR8 (CONSTRUCTION PRACTICE)

HILLSIDE CONSTRUCTION PRACTICE

Sensible development practices are required when building on hillsides, particularly if the hillside has more than a low risk of instability (GeoGuide LR7). Only building techniques intended to maintain, or reduce, the overall level of landslide risk should be considered. Examples of good hillside construction practice are illustrated below.

EXAMPLES FOR **GOOD** HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES GOOD?

Roadways and parking areas - are paved and incorporate kerbs which prevent water discharging straight into the hillside (GeoGuide LR5).

Cuttings - are supported by retaining walls (GeoGuide LR6).

Retaining walls - are engineer designed to withstand the lateral earth pressures and surcharges expected, and include drains to prevent water pressures developing in the backfill. Where the ground slopes steeply down towards the high side of a retaining wall, the disturbing force (see GeoGuide LR6) can be two or more times that due to level ground. Retaining walls must be designed taking these forces into account.

Sewage - whether treated or not is either taken away in pipes or contained in properly founded tanks so it cannot soak into the ground.

Surface water - from roofs and other hard surfaces is piped away to a suitable discharge point rather than being allowed to infiltrate into the ground. Preferably, the discharge point will be in a natural creek where ground water exits, rather than enters, the ground. Shallow, lined, drains on the surface can fulfill the same purpose (GeoGuide LR5).

Surface loads - are minimised. No fill embankments have been built. The house is a lightweight structure. Foundation loads have been taken down below the level at which a landslide is likely to occur and, preferably, to rock. This sort of construction is probably not applicable to soil slopes (GeoGuide LR3). If you are uncertain whether your site has rock near the surface, or is essentially a soil slope, you should engage a geotechnical practitioner to find out.

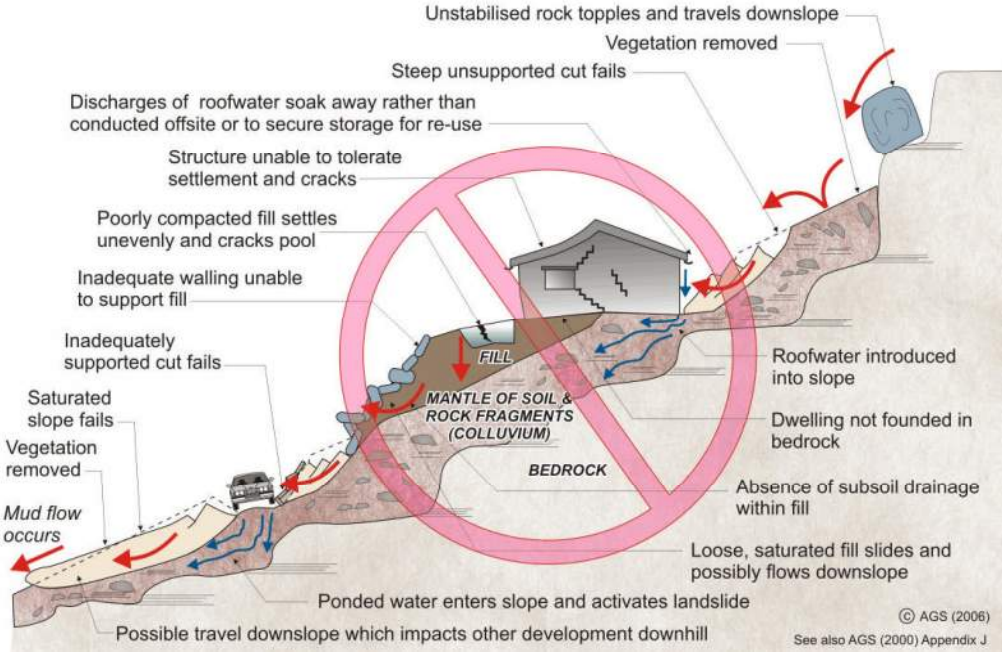
Flexible structures - have been used because they can tolerate a certain amount of movement with minimal signs of distress and maintain their functionality.

Vegetation clearance - on soil slopes has been kept to a reasonable minimum. Trees, and to a lesser extent smaller vegetation, take large quantities of water out of the ground every day. This lowers the ground water table, which in turn helps to maintain the stability of the slope. Large scale clearing can result in a rise in water table with a consequent increase in the likelihood of a landslide (GeoGuide LR5). An exception may have to be made to this rule on steep rock slopes where trees have little effect on the water table, but their roots pose a landslide hazard by dislodging boulders.

Possible effects of ignoring good construction practices are illustrated on page 2. Unfortunately, these poor construction practices are not as unusual as you might think and are often chosen because, on the face of it, they will save the developer, or owner, money. You should not lose sight of the fact that the cost and anguish associated with any one of the disasters illustrated, is likely to more than wipe out any apparent savings at the outset.

ADOPT GOOD PRACTICE ON HILLSIDE SITES
Extract from Geoguide LR8 – Hillside Construction Practice

EXAMPLES FOR **POOR** HILLSIDE CONSTRUCTION PRACTICE



WHY ARE THESE PRACTICES POOR?

Roadways and parking areas - are unsurfaced and lack proper table drains (gutters) causing surface water to pond and soaks into the ground.

Cut and fill - has been used to balance earthworks quantities and level the site leaving unstable cut faces and added large surface loads to the ground. Failure to compact the fill properly has led to settlement, which will probably continue for several years after completion. The house and pool have been built on the fill and have settled with it and cracked. Leakage from the cracked pool and the applied surface loads from the fill have combined to cause landslides.

Retaining walls - have been avoided, to minimise cost, and hand placed rock walls used instead. Without applying engineering design principles, the walls have failed to provide the required support to the ground and have failed, creating a very dangerous situation.

A heavy, rigid, house - has been built on shallow, conventional, footings. Not only has the brickwork cracked because of the resulting ground movements, but it has also become involved in a man-made landslide.

Soak-away drainage - has been used for sewage and surface water run-off from roofs and pavements. This water soaks into the ground and raises the water table (GeoGuide LR5). Subsoil drains that run along the contours should be avoided for the same reason. If felt necessary, subsoil drains should run steeply downhill in a chevron, or herringbone, pattern. This may conflict with the requirements for effluent and surface water disposal (GeoGuide LR9) and if so, you will need to seek professional advice.

Rock debris - from landslides higher up on the slope seems likely to pass through the site. Such locations are often referred to by geotechnical practitioners as "debris flow paths". Rock is normally even denser than ordinary fill, so even quite modest boulders are likely to weigh many tonnes and do a lot of damage once they start to roll. Boulders have been known to travel hundreds of metres downhill leaving behind a trail of destruction.

Vegetation - has been completely cleared, leading to a possible rise in the water table and increased landslide risk (GeoGuide LR5).

DON'T CUT CORNERS ON HILLSIDE SITES - OBTAIN ADVICE FROM A GEOTECHNICAL PRACTITIONER

More information relevant to your particular situation may be found in other Australian GeoGuides:

- GeoGuide LR1 - Introduction
- GeoGuide LR2 - Landslides
- GeoGuide LR3 - Landslides in Soil
- GeoGuide LR4 - Landslides in Rock
- GeoGuide LR5 - Water & Drainage
- GeoGuide LR6 - Retaining Walls
- GeoGuide LR7 - Landslide Risk
- GeoGuide LR9 - Effluent & Surface Water Disposal
- GeoGuide LR10 Coastal Landslides
- GeoGuide LR11 - Record Keeping

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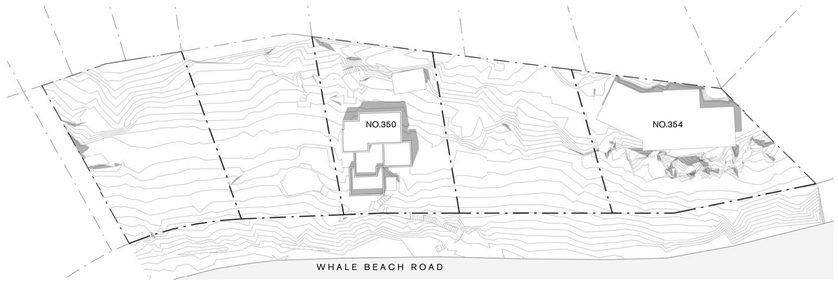
Extract from Geoguide LR8 – Hillside Construction Practice.

APPENDIX 2

Shadow Diagrams prepared by Tzannes



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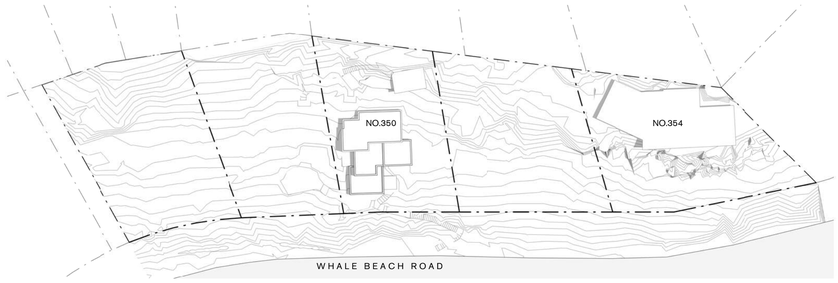

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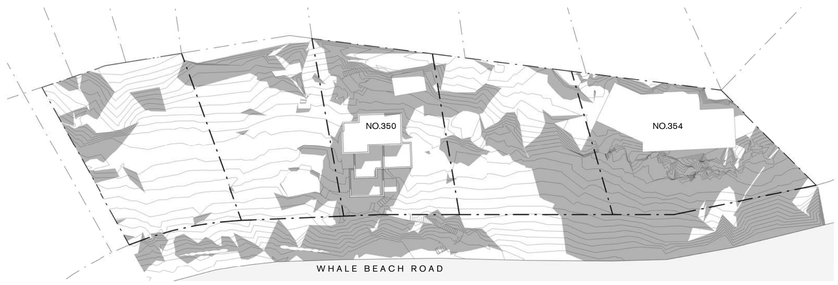

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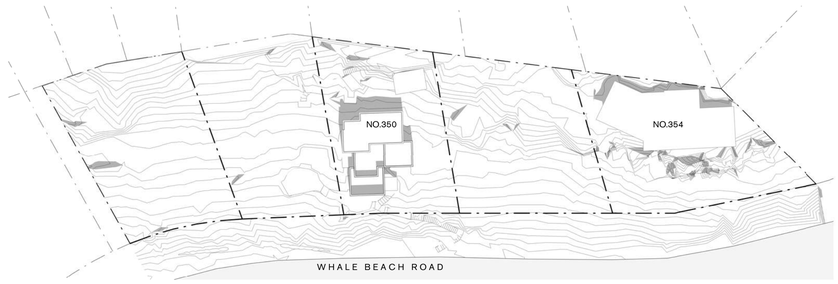

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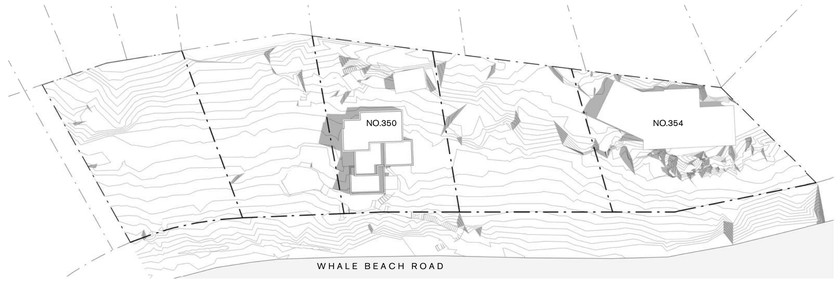

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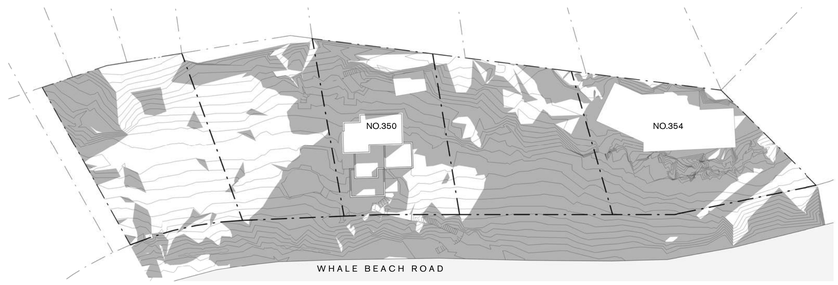

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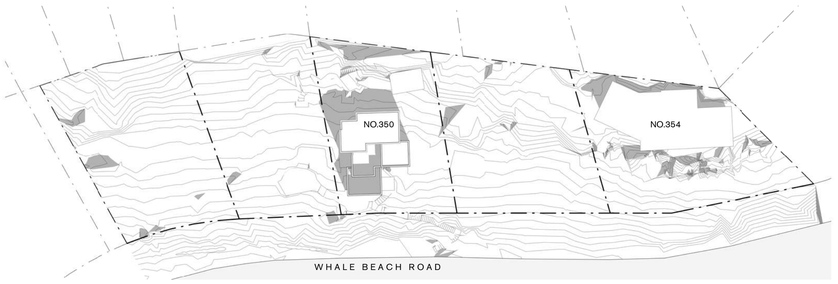

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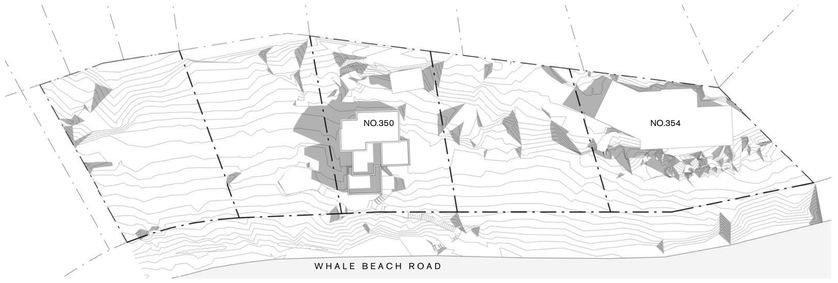

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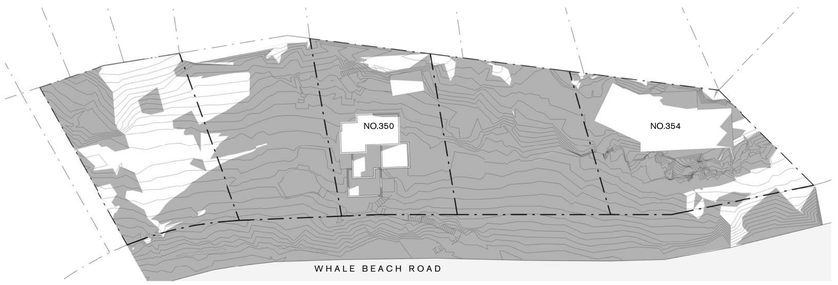

9 | Shadows Existing-Winter-3pm
1 : 500

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Jonathan Evans 6613
Mladen Prnjatovic 7468
Ben Green 7066
Chi Melhem 7754

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A	27/02/19	Development Application

Quantity Surveyor
KGCB
9906 5355 kchoo@kgcb.com.au

Planner
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Earthscape
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Landscape Architect
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Structural, Civil Engineer
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Hyd, Mech, Elec, Basix
Umow Lai
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Traffic Engineer
TEF Consulting
0414 978 067 o.s@tefconsult.com.au

Ecologyst
Abel Ecology
4751 9487 info@abelecology.com.au

Legend

Tzannes

NOT FOR CONSTRUCTION

Scale 1:500 @A1

North

0 5 10 15 20 25 m

Project
Palm Beach Residence

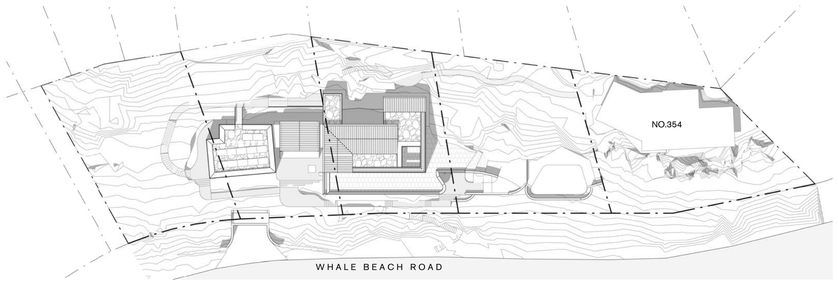
Address
346-352 Whale Beach Road, Palm Beach

Status
DEVELOPMENT APPLICATION

Drawing
Shadow Diagrams Existing

Drawn	Checked
KD	AT

Project No.	Drawing No.	Revision
17018	8100	A



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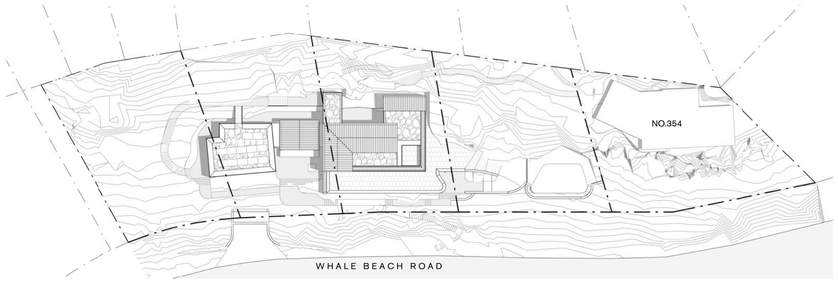

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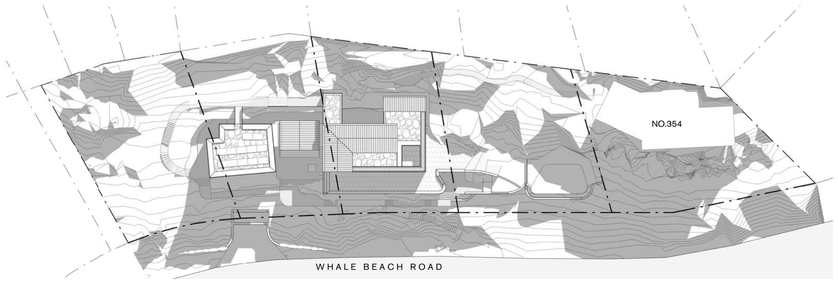

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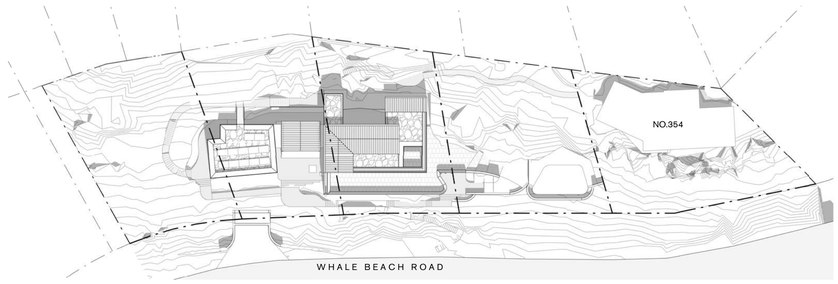

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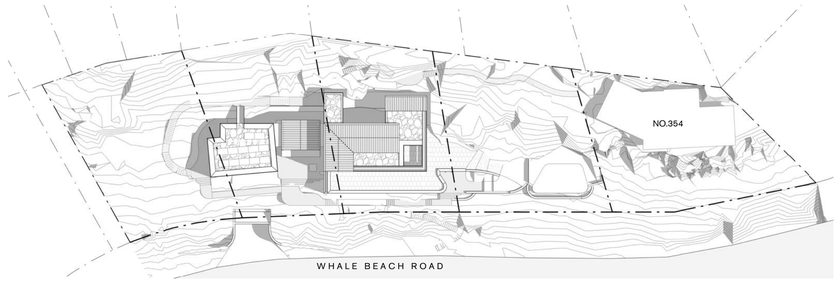

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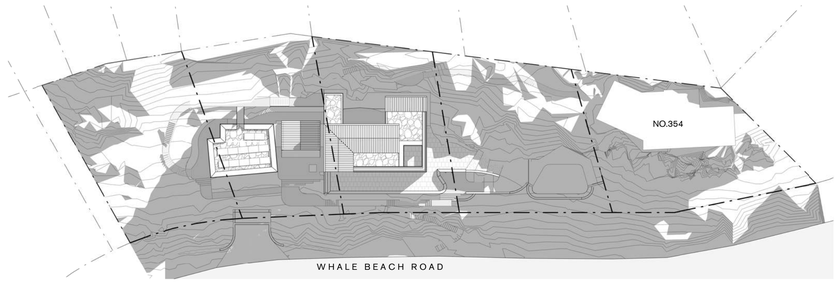

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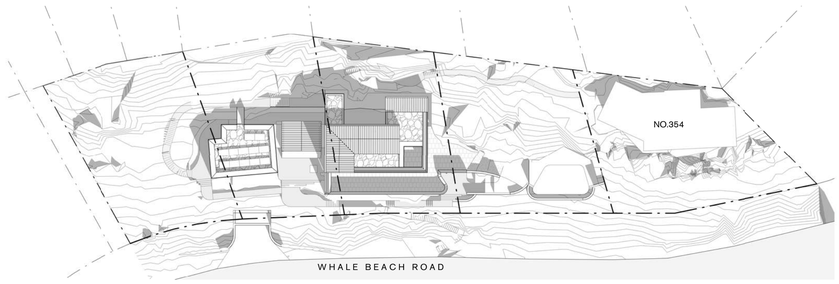

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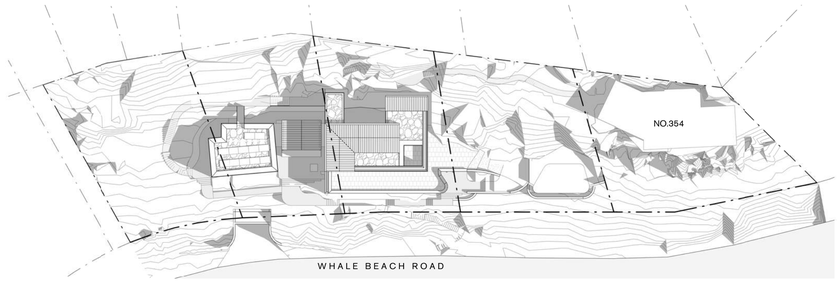

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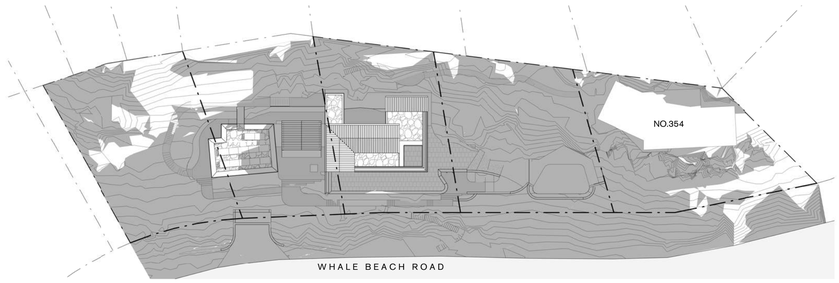

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Legend

Tzannes

NOT FOR CONSTRUCTION

Scale 1:500 @A1

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Drawing
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Drawn	Checked
KD	AT

Project No.	Drawing No.	Revision
17018	8101	A

APPENDIX 3

Photomontages prepared by Tzannes

Palm Beach Residence

346-352 Whale Beach Road, Palm Beach

Photo-montage Study

19 February 2019

Tzannes

Existing view from the ocean looking south-west

Proposed view from the ocean looking south-west

Note: The above illustration is a computer generated artists impression only and may or may not show elements obscured by landscaping.

Existing view from Whale Beach Road looking north

Proposed view from Whale Beach Road looking north

Note: The above illustration is a computer generated artists impression only and may or may not show elements obscured by landscaping.

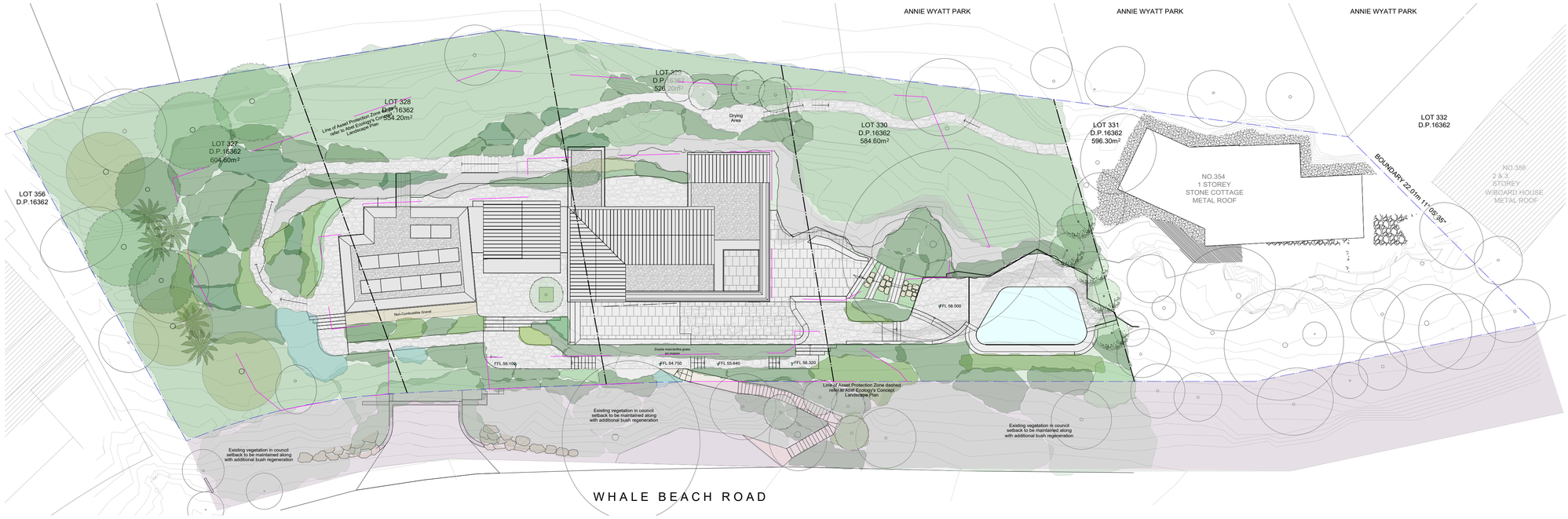
Existing view from Whale Beach Road looking south

Proposed view from Whale Beach Road looking south

Note: The above illustration is a computer generated artists impression only and may or may not show elements obscured by landscaping.

APPENDIX 4

Landscape Plans prepared by Danger Barin Smith and Abel Ecology



1 Site Plan
Scale 1:200 @ A1

PLANT SCHEDULE					
Botanic Name	Common Name	Pot Size	Mature Hgt	Qty	Notes
Plant Species					
Acacia longifolia	Sydney Golden Wattle	200mm	2-7m	6	
Allocasuarina nana	Stunted She-Oak	200mm	0.5-1.2m	44	
Aloe 'Baby Bush Yellow'	Baby Bush Yellow	200mm	0.4-0.8m	5	
Aloe 'Big Red'	Big Red Aloe	200mm	0.8-1.2m	40	
Alpinia caerulea	Native Shell Ginger	200mm	1.5-2.5m	22	
Angophora costata	Sydney Red Gum	200L	15-25m	3	
Angophora hispida	Dwarf Apple Gum	100L	2-7m	1	
Angophora hispida	Dwarf Apple Gum	400mm	2-7m	3	
Anigozanthos flavidus	Kangaroo Paw	200mm	0.4-0.6m	15	
Asplenium nidus	Birds Nest Fern	300mm	1m	42	
Banksia ericifolia	Heath-Leaved Banksia	200mm	2-5m	51	
Banksia integrifolia	Coastal Banksia	100L	5-7m	5	
Bougainvillea magnifica 'Traillii'	Trailing Bougainvillea	250mm	Climber	9	
Carpobrotus glaucescens	Pig Face	200mm	Groundcover	60	
Callicoma serratifolia	Black Wattle	100L	6-10m	20	
Ceratopetalum gummiferum	NSW Christmas Bush	300mm	2-5m	15	
Cissus antarctica	Kangaroo Vine	200mm	Groundcover	106	
Dendrobium speciosum	Sydney Rock Orchid	300mm	0.4-0.8m	29	
Dianella caerulea	Native Flax Lily	200mm	0.3-0.7m	86	
Dichondra repens	Kindey Weed	140mm	Groundcover	145	
Echium 'Cobalt Towers'	Echium	300mm	1.5-3.5m	34	
Ficinia nodosa	Knobby Headed Club Rush	200mm	0.7-1m	28	
Ficus rubiginosa	Port Jackson Fig	Advanced	8-12m	3	
Gardenia floribunda	Gardenia	300mm	1-1.5m	58	
Hedera canariensis	Canary Islands Ivy	140mm	Climber	10	
Livistona australis	Cabbage Tree Palm	Semi-Adv	6-10m	5	
Lomandra 'Hystrix'	Hystrix Matt Grass	200mm	1-1.5m	57	
Lomandra 'Little Con'	Little Con Matt Grass	200mm	0.5-0.8m	15	
Lomandra longifolia	Spiney Headed Matt Grass	200mm	1-1.5m	103	
Lomandra 'Tanika'	Fine Matt Grass	200mm	0.8-1.2m	89	
Lonicera hilderbrandiana	Burmese Honey Suckle	300mm	Climber	8	
Muehlenbeckia axillaris	Maidenhair Vine	200mm	Groundcover	65	
Neomarica gracilis	Brazilian Walking Iris	200mm	0.6m	21	
Olea europaea	European Olive	Semi-Adv	3-5m	2	
Ophiopogon japonicus	Mondo	200mm	0.3m	18	
Pandorea 'Snowbells'	Snowbells Wonga	200mm	Climber	10	
Pennisetum 'Nafray'	Dwarf Fountain Grass	200mm	0.6m	18	
Philodendron 'Rojo Congo'	Rojo Congo	200mm	0.7m	16	
Syncarpia glomulifera	Turpentine	100L	15-25m	2	
Zoysia macrantha	Zoysia	200mm	Groundcover	lawn	

Indicates new native and locally endemic plant species as per Pittwater Council Species and Communities List

GENERAL NOTES:

GRAPHIC ILLUSTRATION
Please note that the plant graphics are indicative sizes only and not an accurate representation at time of purchase

SITE PREPARATION
All existing plants marked for retention shall be protected for the duration of works. Remove from site all perennial weeds and rubbish before commencing landscape works.

SOILWORKS
Thoroughly cultivate the subsoil to a depth of 200mm. Supply and install to a depth of 300mm quality garden soil mix to all planting beds and 150mm turf underlay to lawn areas.

MULCH
Supply and install a 75mm layer of hardwood horticultural grade mulch to all planting beds set down 25mm from adjacent paving or garden edge.

MAINTENANCE
All failed or defective plant species to be replaced by landscaper for a 3 months period following completion of work.
Further maintenance during and after this period should include watering, weeding, fertilising, pest and disease control, pruning and hedging, reinstatement of mulch and keeping the site neat and tidy.

GENERAL PLANTING NOTES:

NOTE: It is recommended that all plants used be subject to an establishment period. During this period maintenance work carried out will include; watering, mowing, weeding, fertilising, pest and disease control, reseeding, returfing, staking and tying, replanting, cultivating, pruning, hedge clipping, aerating, reinstatement of mulch, top dressing and keeping the site neat and tidy.

NOTE: Plants shall be vigorous, well established, of good form consistent with species or variety, not soft or forced, free from disease and insect pests, with large healthy root systems and no evidence of having been restricted in growth or damaged. Root system shall be well balanced in relation to the size of the plant.

NOTE: install 'root barrier' or equivalent to manufacturers specifications to protect nearby structures and services.

NOTE: Install temporary drip irrigation system under mulch in tree protection zones and water on allotted days.

FIRE PRONE PLANTING NOTES:

NOTE: Shrub and feature tree plantings to be set out onsite as discontinuous clumps. Gaps are to be feature lawns of Zoysia macrantha or non-combustible gravel.

NOTE: Bush fire prone species must not be planted less than 5m from dwelling evacuation routes (ie. footpaths) or less than 10m from the dwelling and can not contribute to a continuous bed of fuel toward the dwelling.

NOTE: A pathway or non-combustible ground finish is to adjoin the dwelling for a distance of at least 1.0metre. Garden beds of flammable shrubs are not to be located under trees and must be no closer than 10 metres from an exposed window or door.

Satellite Site Location

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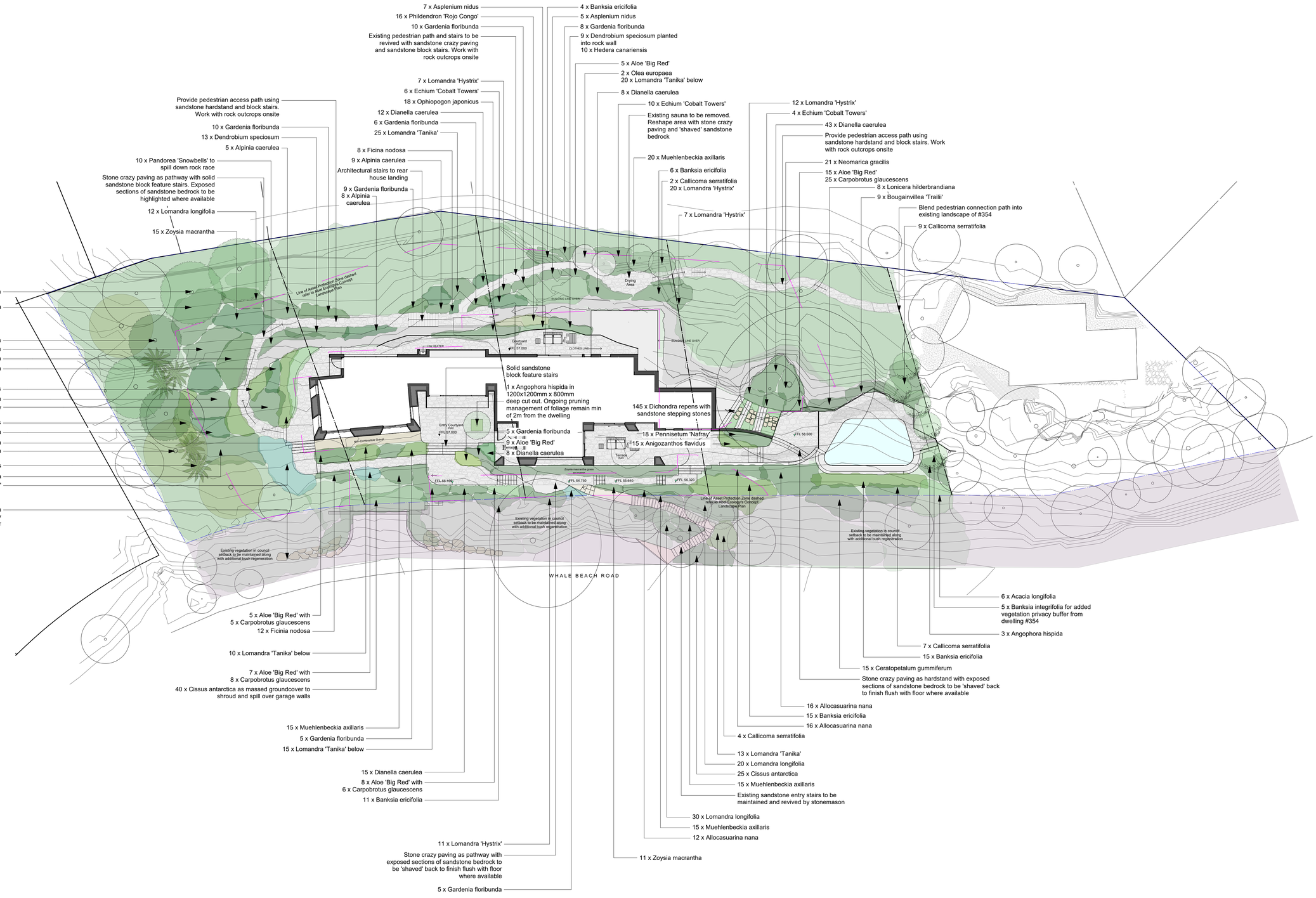
Botany NSW 2019
Tel: (02) 9316 9044
Fax: (02) 9316 9055

Project: 346-352 Whale Beach Rd
Palm Beach NSW 2108
Client: -
Dwg no: DA01-1418
Title: Site Plan
Drawn by: SGH
Checked: WD
Scale: 1:200 @ A1
Issue: 01
Revision: D
Date: 11.02.2019



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Client:
-

Dwg no:
DA02-1418

Title:
Ground Floor Landscape

Drawn by:	Checked:	Scale:
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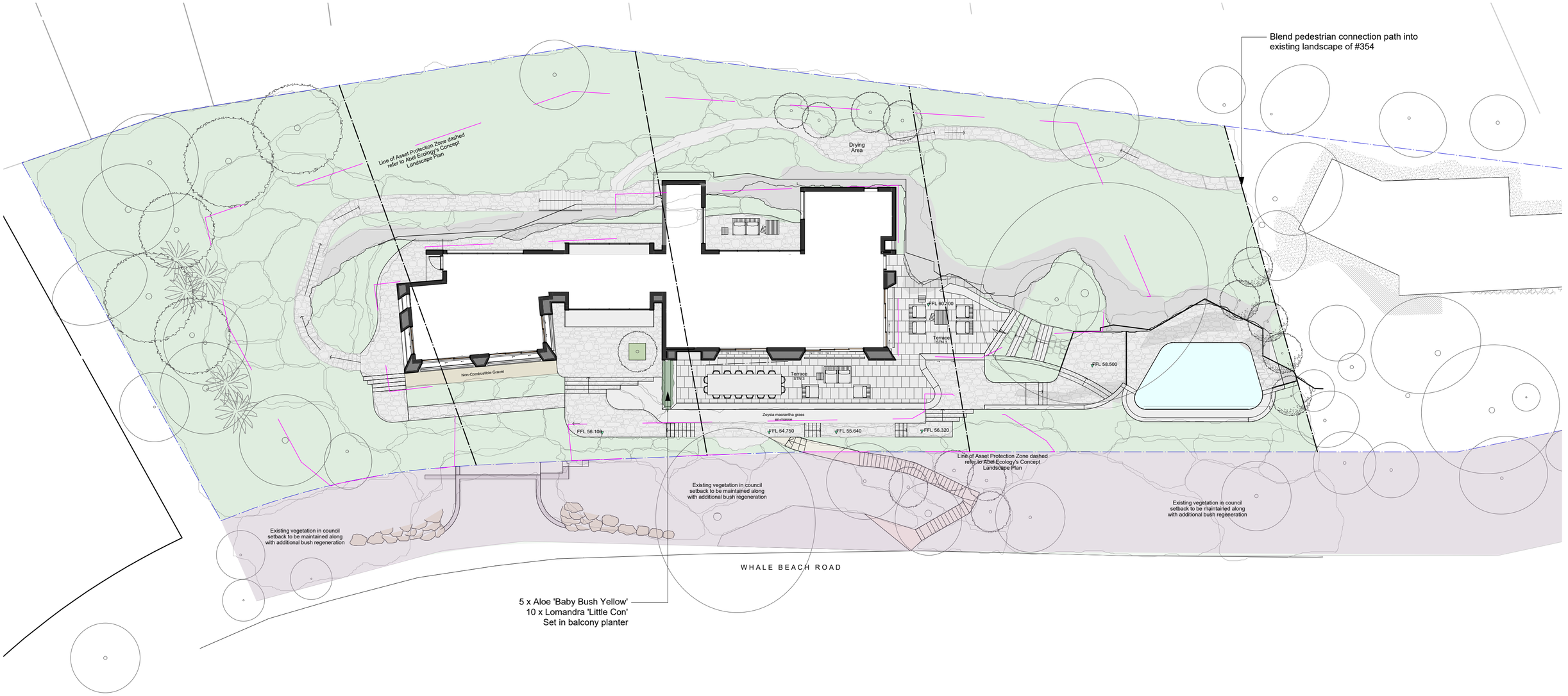
Issue:	Revision:	Date:
01	D	11.02.2019



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Project:
346-352 Whale Beach Rd
Palm Beach NSW 2108

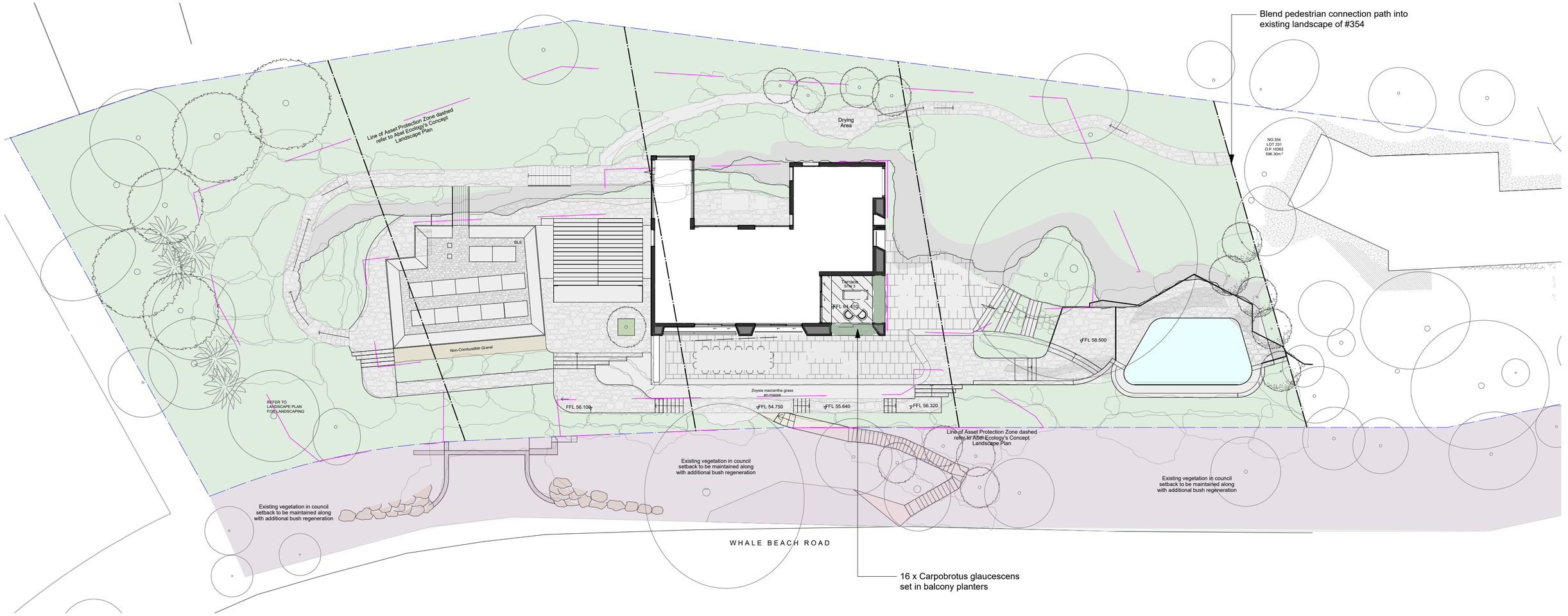
Client:
-

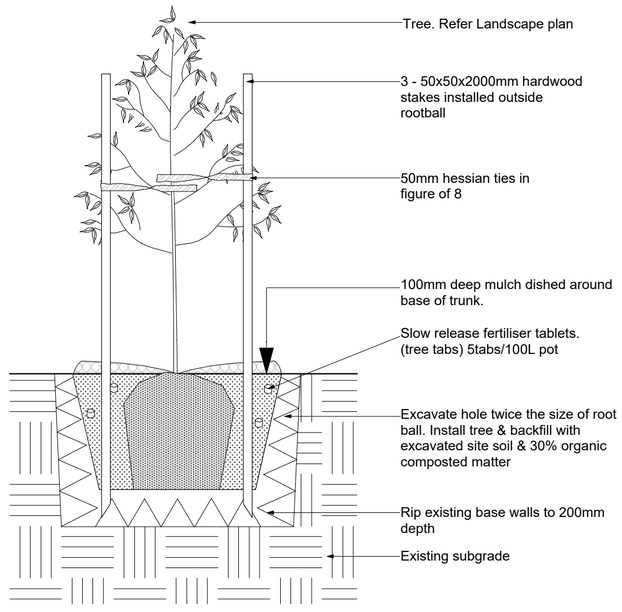
Dwg no:
DA03-1418

Title:
Level 1 Landscape Plan

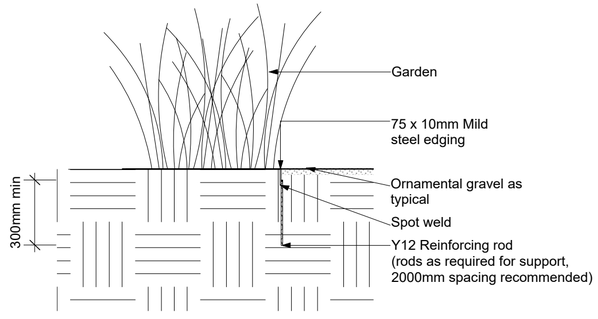
Drawn by:	Checked:	Scale:
SGH	WD	1:200 @ A2

Issue:	Revision:	Date:
01	D	11.02.2019

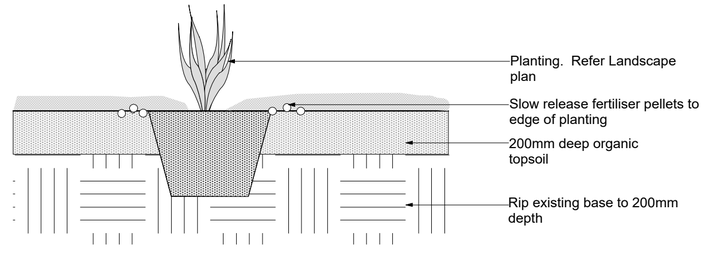




Tree in ground
Scale 1:25



Metal Edging
Scale 1:20



Shrubs in ground
Scale 1:20

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Project: 346-352 Whale Beach Rd Palm Beach NSW 2108	Dwg no: DA04-1418	Drawn by: SGH	Checked: WD	Scale: 1:200 @ A2
Client: -	Title: Level 2 Landscape Plan	Issue: 01	Revision: D	Date: 11.02.2019

Current presence of Littoral Rainforest community to southern boundary of site to be maintained and rengenerated. Interplant with locally occuring species, remove weed species, and dead wood existing trees as required

Increase privacy from southern neighbour with use of Livistona australis - Cabbage Tree Palms, Angophora costata - Sydney Red Gum and Syncarpia glomulifera - Turpentine

Current presence of Sandstone Crest – Coastal Heath community across majority of site to be maintained and rengenerated. Interplant with locally occuring species and remove weed species, as required.

Littoral Rainforest Zone

Sandstone Crest and Coastal Heath Zone

Littoral Rainforest - Palm Beach Vegetation Community

Littoral Rainforest occurs close to the sea where there is exposure to salt-laden winds. Rainforest plants, including figs, dominate the community and vines can form a major part of the canopy, along with eucalypts, banksias and cabbage palms. This mix of plants makes this vegetation community truly unique.

The locally-indigenous tree species formerly found in sheltered sites and lower slopes in this area include:
Elaeocarpus reticulatus (Blueberry Ash), *Ficus rubiginosa* (Port Jackson Fig), *Glochidion ferdinandi* (Cheese Tree), *Syzygium paniculatum* (Magenta Cherry), *Acmena smithii* (Lillypilly), *Livistona australis* (Cabbage Tree Palm) and *Ficus coronata* (Sandpaper Fig)

Sandstone Crest and Coastal Heaths - Palm Beach Vegetation Community

The original vegetation of this area consisted of coastal heath and woodland typical of the "Sandstone Crest - Coastal Heaths", subject to some coastal exposure. Exposed coastal sandstone plateaus with infertile, shallow, moderately damp soil.

The dominant locally-indigenous tree species formerly found on these site areas include: include *Angophora costata* (Sydney Red Gum), *Eucalyptus umbra* (Bastard Mahogany) and *Eucalyptus racemosa* (Scribbly Gum). Other species found in this vegetation community may include *Allocasuarina torulosa* (Forest Oak), *Syncarpia glomulifera* (Turpentine). *Banksia integrifolia* (Coast Banksia), *Banksia serrata* (Old Man Banksia) and *Eucalyptus botryoides* (Bangalay).

Bush Regeneration Strategy

Restore and maintain existing vegetation communities onsite to enhance an ecosystem in which natural regeneration can occur in degraded areas of bushland, to reverse or minimise degrading impacts and allow natural regeneration and on-site perpetuation of local species to occur.

Use bush regeneration methods, such as weeding strategically, stabilising drainage lines & stormwater management, reducing erosion, revegetation, nutrient management, feral animal control, and maintaining habitat and wildlife corridors.

Site is very steep. Many rock outcrops are not visible due to vegetation cover

Bush Regeneration Strategy within Asset Protection Zone - APZ

No trees or shrubs are to form part of the bush regeneration within the APZ - ground-covers only. Bush regeneration is to observe the conditions of Inner Protection Zone Condition as per the Rural Fire Service document - *Standards for Asset Protection Zones*. Refer to report and concept landscape plan from Abel Ecology

Arboricultural Strategy

Aboricultural strategy, to assess existing trees and tree groupings and remove dead wood, decayed and dying trees and limbs. Remove trees (less than 4m) within groups, as required, to enhance the mechanical survival and maintain the energy-saving preservation of the species.

Site is very steep. Many rock outcrops are not visible due to vegetation cover

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Client:
-

Dwg no:
DA05-1418

Title:
Landscape Strategies

Drawn by:	Checked:	Scale:
SGH	WD	1:200 @ A2

Issue:	Revision:	Date:
01	D	11.02.2019

N

Zone 1 (grey)
Constructed Zone

- House, driveway, paved areas, pool and gym

This type of rock wall terracing up the site will reduce erosion risk (example only).

Zone 3 (green)
Natural Vegetation and Restoration Zone

- Natural vegetation to be left *in situ*.
- Weedy species like **Lonicera japonica*, **Nephrolepis cordifolia*, **Hydrocotyle bonariensis*, **Hedera helix*, **Hedychium gardnerianum* and **Asparagus aethiopicus* to be removed by a qualified bush regenerator
- Supplemental planting with local mesic natives such as:
  - *Livistona australis*
  - *Todea barbara*
  - *Ficus rubiginosa*
  - *Syzygium paniculatum.*

Retained Trees

As numbered by Earthscape Horticultural Services:

Tree 27 *Eucalyptus saligna*

Tree 30 *Cassuarina cunninghamiana*

Note. These trees require further impact assessment by the arborist and branches overhanging the house are to be trimmed within 2 m as bushfire protection.

Zone 2 (orange)
Landscape / Asset Protection Zone

- Minimum one metre, up to two metres from the house - maintain a clear area – no mulch, flammable materials, shrubs or trees
- Within 2-5 m of the house - avoid overhanging species. Use only groundcovers, ferns and non-continuous low shrub plantings such as:
  - *Astroloma humifusum*
  - *Dianella caerulea*
  - *Hibbertia empetrifolia*
  - *Adiantum aethiopicum*
  - *Asplenium australasicum*
  - *Actinotus helianthi*
  - *Epacris longiflora*
  - *Pultenaea flexilis*
- Within 5 – 10 m of the house - plant local non-weedy tree species with less bark, sparser foliage and higher moisture/ lower oil content in leaves such as:
  - *Ceratopetalum gummiferum*
  - *Breynia oblongifolia*
  - *Acmena smithii*
  - *Callicoma serratifolia*

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Client: The applicant C/ Tzannes

Scale: 20m

Date: 28 February 2019

AE DOC: AE19 1933 REP ISS 3
Site Plan: Revision B (31/1/19)

Concept Landscape Plan

Proposed knockdown and rebuild dwelling, new driveway, swimming pool and gymnasium
Address 346 – 352 Whale Beach Road, Palm Beach

Tree protection measures

1. Prior to tree removal and vegetation clearing on site:

    a) Install timber slat trunk protection on trees _____

2. Prior to construction (including demolition, earthworks and installation of site sheds):

    a) Install tree protection fencing around remaining _____

Tree protection fencing details

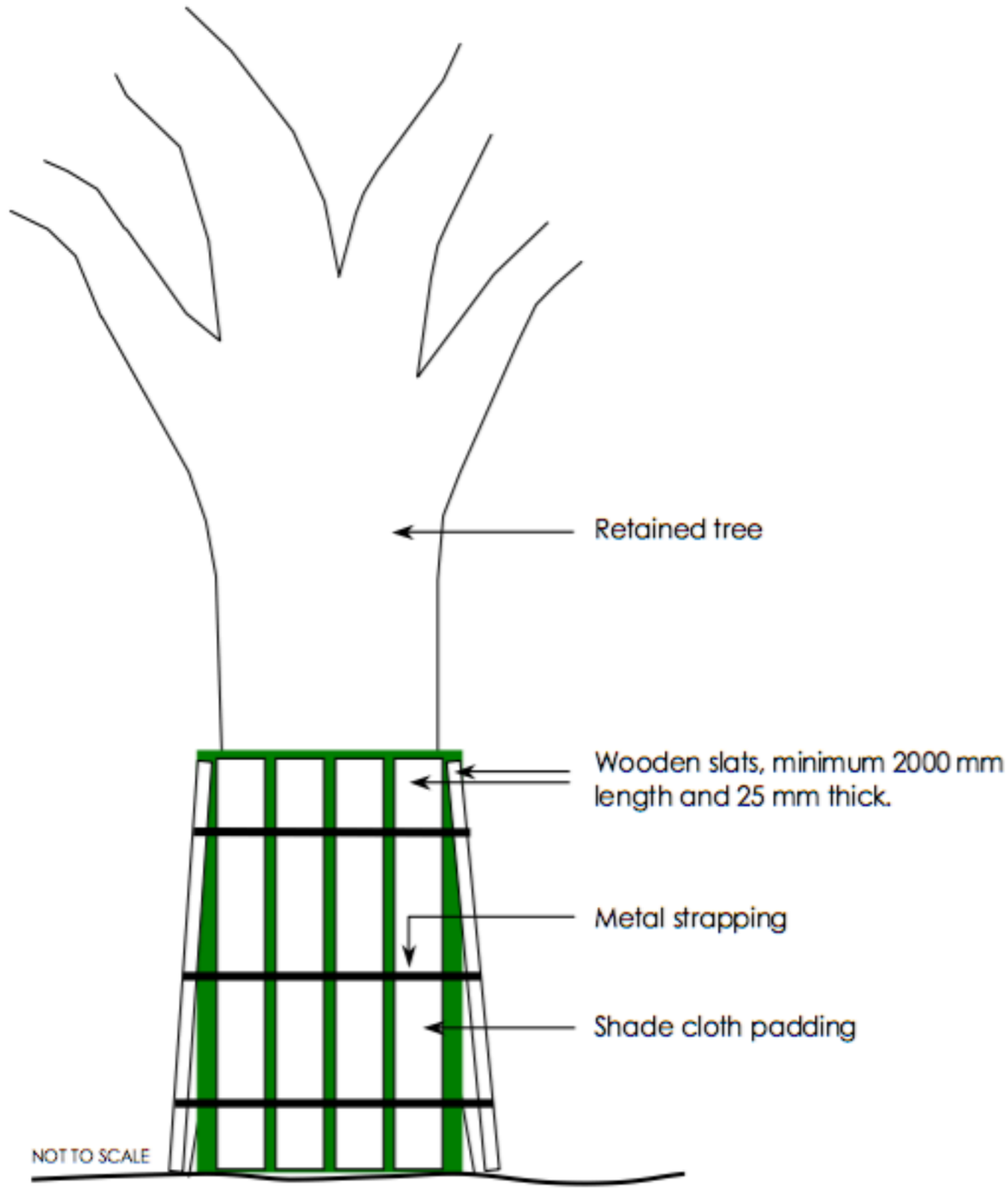
Protective fences shall be maintained in good condition for the whole period of construction.

Fences shall be built of temporary wire panels 1.8 metres high, supported by steel stakes or concrete blocks and secured together with bolted brackets to restrict sideways movement, and shall be covered in shade cloth.

Tree Protection fences shall not be moved or relocated without prior approval of the site Arborist.

Plant Schedule

Botanical name	Common name	Hgt	Spg	Qty	Size
Trees					
Livistona australis	Cabbage Tree Palm	30m	1m	4	25L
Syzygium paniculatum	Magenta Lilly Pilly	15m	4m	1	25L
Ficus rubiginosa	Rusty Fig	5m	4m	2	25L
Ceratopetalum gummiferum	NSW Christmas Bush	5m	4m	2	25L
Acmena smithii	Lilly Pilly	5m	4m	2	25L
Callicoma serratifolia	Black Wattle	15m	3m	2	25L
Clerodendrum tomentosum	Hairy Clerodendrum	8m	4m	2	25L
Shrubs					
Breynia oblongifolia	Coffee Bush	3m	4m	2	15L
Actinotus helianthi	Flannel flower	60cm	0.5m	6	20cm
Epacris longiflora	Fuschia Heath	150cm	0.5m	6	20m
Pultenaea flexilis	Graceful Bush-pea	0.8m	1m	2	20cm
Ferns					
Todea barbara	King Fern	2m	2m	2	25L
Asplenium australsicum	Bird's Nest Fern	0.4m	1m	3	20cm
Adiantum aethiopicum	Maidenhair	50cm	30cm	8	20cm
Groundcovers					
Astroloma humifusum	Native Cranberry	30cm	30cm	4	14cm
Dianella caerulea	Blue Flax-Lilly	50cm	30cm	6	14cm
Hibbertia empetrifolia		50cm	1m	2	14cm



Trunk protection detail

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Client: The applicant C/ Tzannes

Scale: 20m

Date: 28 February 2019

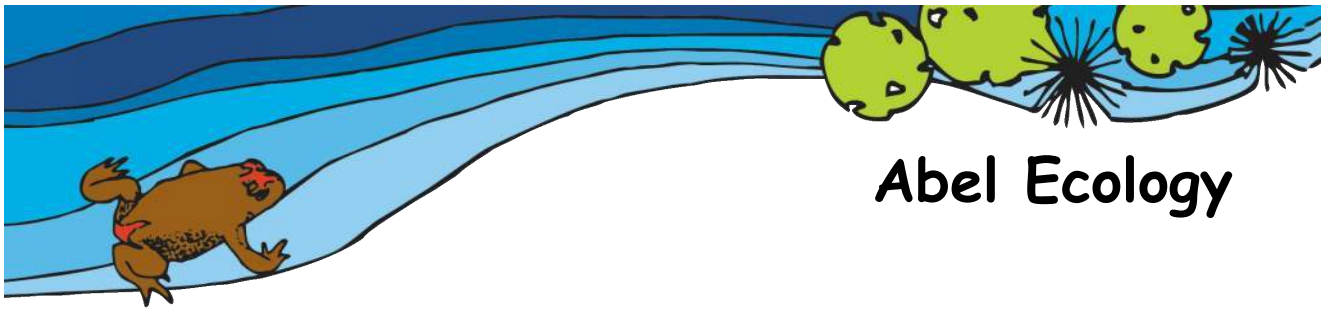
AE DOC: AE19 1933 REP ISS 3
Site Plan: Revision B (31/1/19)

Concept Landscape Plan

Proposed knockdown and rebuild dwelling, new driveway, swimming pool and gymnasium
Address 346 – 352 Whale Beach Road, Palm Beach

APPENDIX 5

Prescribed Ecological Assessment Report (PEAR) prepared by Abel Ecology



Abel Ecology

Prescribed Ecological Actions Report (PEAR)

for

346, 348, 350 & 352 Whale Beach Road
Palm Beach
Lots 327, 328, 329, 330 DP 16362

Proposed new dwelling

Prepared for:	**The applicant C/ Tzannes**
Report No:	**AE19-REP-1931-ISS 3**
Prepared by:	**Abel Ecology**
Date:	**28 February 2019**

Disclaimer

This report has been prepared in accordance with the scope of services described in agreement between Abel Ecology and the Client.

In preparing this report, Abel Ecology has relied upon data, surveys and site inspection results taken at or under the particular time and or conditions specified herein. Abel Ecology has also relied on certain verbal information and documentation provided by the Client and/or third parties, but did not attempt to independently verify the accuracy or completeness of that information. To the extent that the conclusions and recommendations in this report are based in whole or in part on such information, they are contingent on its validity. Abel Ecology assumes no responsibility for any consequences arising from any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to Abel Ecology.

The findings contained in this report are the result of discrete/specific methods used in accordance with normal practices and standards. To the best of our knowledge, they represent a reasonable interpretation of the general condition of the site in question. Under no circumstances, however, can it be considered that these findings represent the actual state of the site/sites at all points.

Any representation, statement, opinion or advice, expressed or implied in this publication is made in good faith but on the basis that Abel Ecology, its agents and employees are not liable (whether by reason of negligence, lack of care or otherwise) to any person for any damage or loss whatsoever, which has occurred or may occur in relation to that person taking or not taking (as the case may be) action in respect of any representation, statement, or advice referred to above. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client.

Furthermore, this report has been prepared solely for use by the Client. Abel Ecology accepts no responsibility for its use by other parties.

Document History

Report	Version	Prepared by	Technical Review by	Proofread by	Submission	
					Method	Date
Report	Draft A	Dr Alison Hewitt	Dr Danny Wotherspoon	Steven Smith	Dropbox	18 Oct 18
Report	Issue 1	Dr Alison Hewitt	Dr Danny Wotherspoon	Steven Smith	Dropbox	1 Feb 19
Report	Issue 2	Dr Alison Hewitt	Dr Danny Wotherspoon	Steven Smith	Dropbox	25 Feb 19
Report	Issue 3	Dr Alison Hewitt	Dr Danny Wotherspoon	Steven Smith	Dropbox	28 Feb 19

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List of Abbreviations

BAM	Biodiversity Assessment Method
BC Act	Biodiversity Conservation Act 2016
BCR	Biodiversity Conservation Regulation 2017
BDAR	Biodiversity Development Assessment Report
EEC	Endangered Ecological Community
ESD	Ecologically Sustainable Development
LEP	Local Environmental Plan
LGA	Local Government Area

Note regarding maps in this report

The diagrams/site maps used in this report have been supplied by and are used with the permission of Tzannes Architects.

With regard to maps provided by the Land Information Centre, Topographic maps used with the permission of © Land and Property Information, NSW.

Additional maps by Nearmap used under licence https://www.nearmap.com.au/

Executive summary

The proposal is to demolish an existing building, remove planted landscapes and construct a new house, swimming pool and gymnasium across Lots 327, 328, 329 and 330 Whale Beach Road, Palm Beach, NSW. Clearing of native vegetation is required to create a defendable space for bushfire and an asset protection zone.

A biodiversity survey was carried out at the site to assess the likely impacts of the proposal on species and ecological communities present on the site and whether the proposal requires a Biodiversity Development Assessment Report (BDAR) because it is a likely trigger to entry into the Biodiversity Offsets Scheme identified in s. 7.4 of the *Biodiversity Conservation Act 2016*.

This report also describes whether there is likely to be any significant effect on any endangered ecological community, endangered population, threatened species or their habitats, as per the listings in the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act 1999) (Commonwealth legislation).

The original plant community on site was most likely 'Coastal Enriched Sandstone Dry Forest' with a very small area of 'Coastal Enriched Sandstone Moist Forest' at the southern boundary of the site. Both of these communities occur in the wider area and neither are listed threatened ecological communities. While some native species of each of these communities remain on site, the vegetation has been degraded by loss of larger trees, disturbance accrued by construction and occupation, replacement with exotic gardens and weed invasion.

No threatened flora has previously been recorded from the site and none were detected on site in our surveys. None of the threatened terrestrial fauna species known from the wider locality have any specific requirements that could currently be provided by the site for breeding or other life cycle needs.

The threatened species Grey-headed Flying-fox was detected visiting the site. There is also evidence for two threatened microbat species visiting the site, the Little Bentwing-bat and the Eastern Bentwing-bat (Table 10). It is also likely that the Powerful Owl forages on site (Section 6.1). These species are highly mobile and forage / hunt over wide areas of land. None of them appear to be roosting or nesting on site. The scale of the proposal will modify a small area of potential foraging / hunting area with substantial areas of native vegetation in the surrounding area and will not place any of these species at significant risk of extinction (see 5 part test reports in Appendix 1).

The design of the proposed house appears to enable protection and preservation of the main rock escarpment and rock outcrops on site that are providing habitat to native reptiles.

The following three considerations have been assessed as triggers for entry into the Biodiversity Assessment Method.

1. Threshold 1: The proposal does not exceed the clearing threshold area as described in clause 7.2 of the BC Regulation 2017.

2. Threshold 2: The proposal does not undertake clearing of native vegetation or any prescribed activities (clause 6.1 of the BC Regulation 2017) on land shaded in the Biodiversity Values Land Map

3. Threshold 3: The proposal is not likely to significantly affect any threatened species or Endangered or Critically Endangered Species or ecological community.

None of these thresholds for entry into the Biodiversity offset Scheme are triggered by the proposal. Therefore, there is no impediment to this proposal in the scope of this report.

A report prepared using the Biodiversity Assessment Method is not recommended.

The provisions of the EPBC Act 1999 do not apply to this proposal and it does not require referral to the Commonwealth.

Recommendation:
A Biodiversity Development Assessment Report (BDAR) is not required.

Figure 1. Locality map for 346 – 352 Whale Beach Road.

Site location

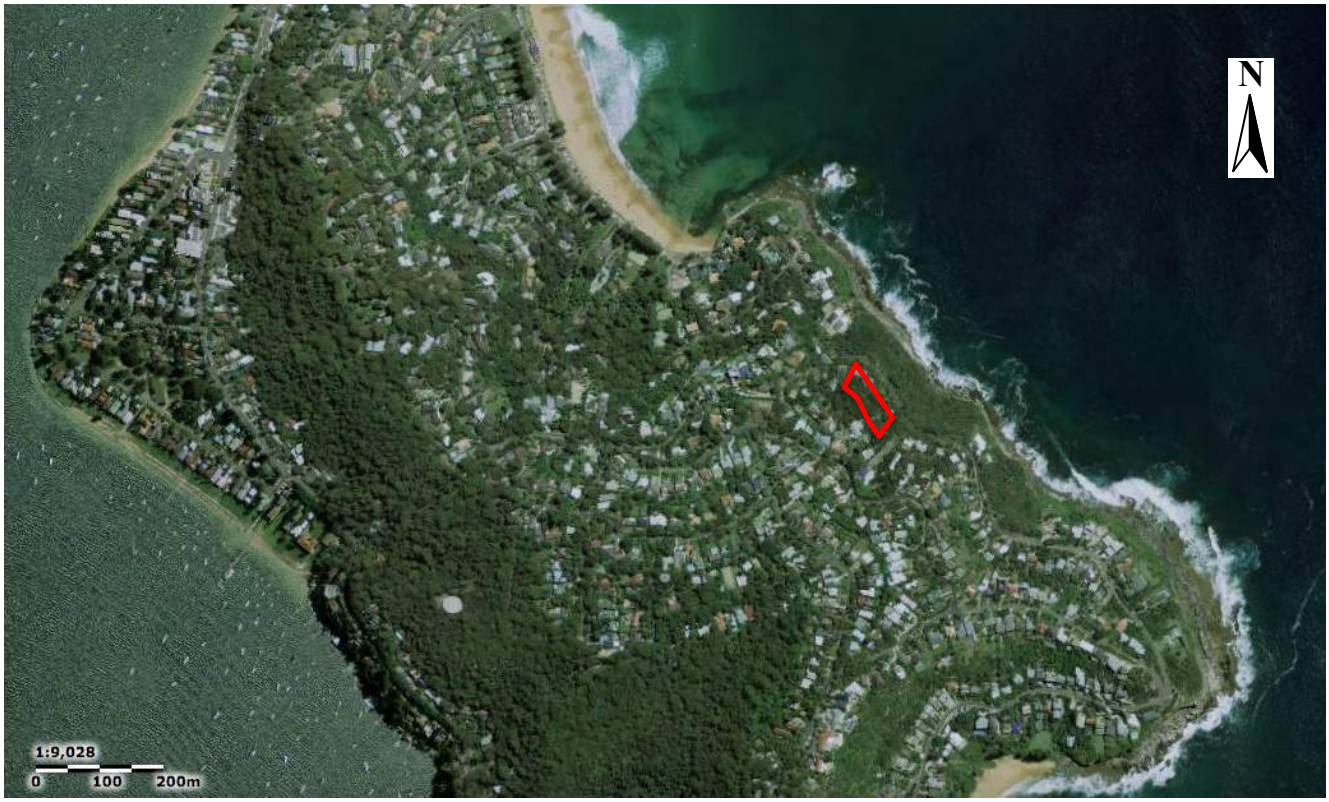

Figure 2. Aerial photo of the site and local area.

Key

Site location

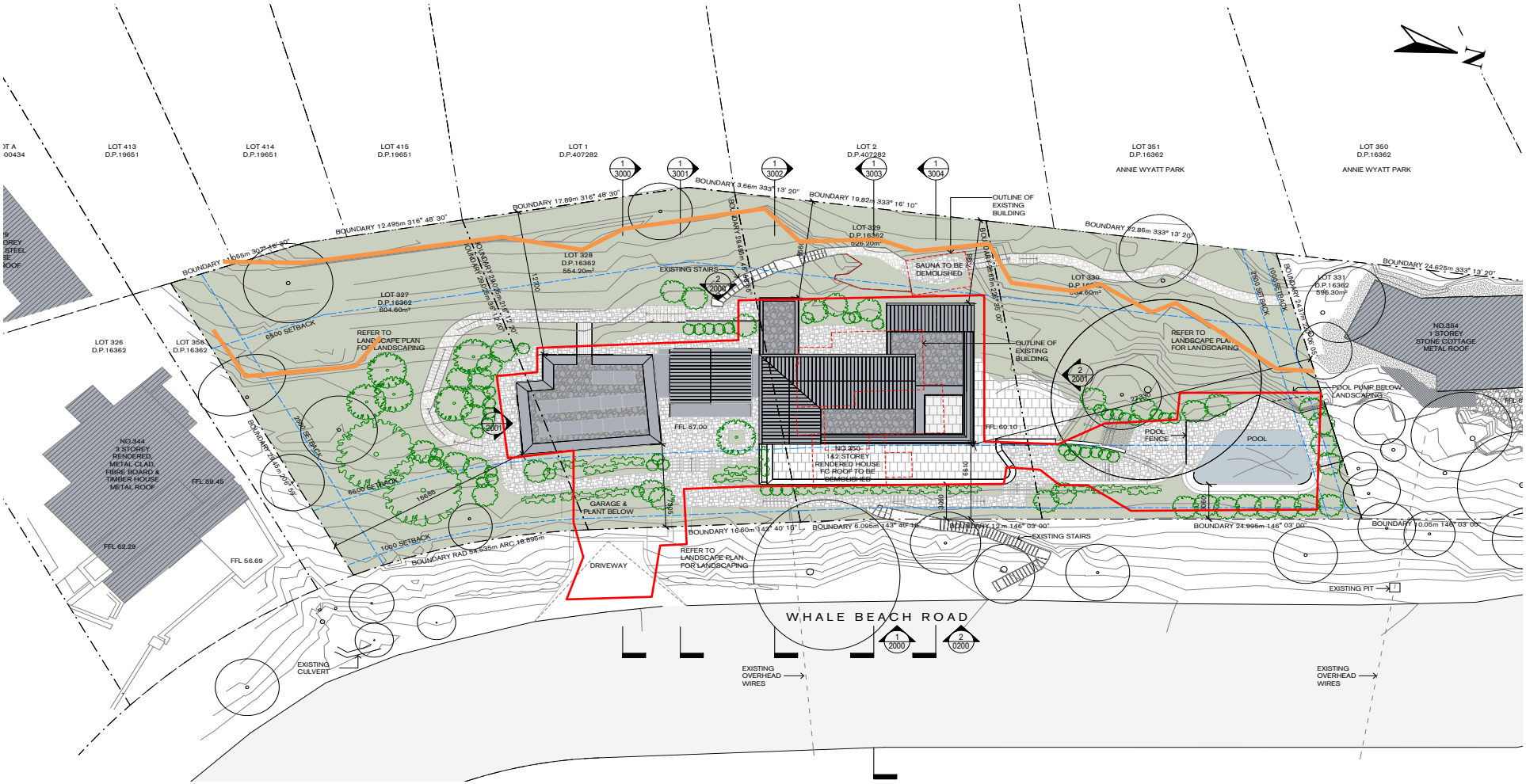

Figure 3. Site Plan (Revision B, 31/1/19). Proposed new residence across Lots 327, 328 and 329, numbers 346-350 Whale Beach Road, Palm Beach. Note that a new gym and swimming pool are proposed for Lot 330. Red line encloses new works. Orange line indicates rock faces. Source. Tzannes Architects.

Figure 4. Biodiversity values map of the site and area.

Site location

https://www.lmbc.nsw.gov.au/Maps/index.html?viewer=BVMap

Figure 5. Site LEP zone map.

Site location

Land Zoning

+ E4 - Environmental Living : (pub. 2014-05-30) E4

+ E2 - Environmental Conservation : (pub. 2014-05-30) E2

+ RE1 - Public Recreation : (pub. 2014-05-30) RE1

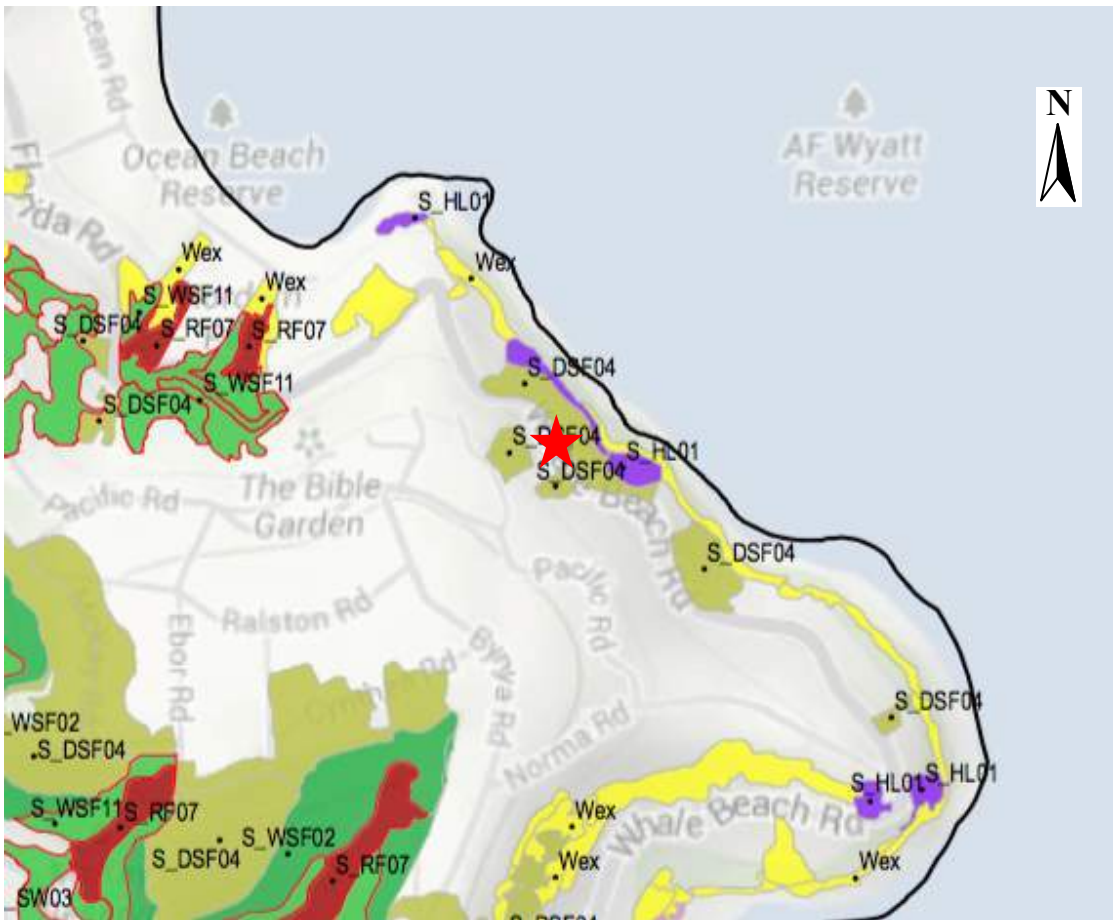

Figure 6. Vegetation Map of the area.

Key

Location of site

S_WSF02 Coastal Enriched Sandstone Moist Forest (NSW PCT No 1841)

S_HL01 Coastal Headland Clay Heath (NSW PCT No 1821)

S_DSF04 Coastal Enriched Sandstone Dry Forest (NSW PCT No 1776)

S_RF07 Coastal Escarpment Littoral Rainforest (NSW PCT No 1833) * #

WEX Weeds and Exotics (NSW PCT No 0)

Source. OEH (2013) The Native vegetation of the Sydney Metropolitan Area Volume 1, Version 2.

Figure 7. Soil Landscape map pertaining to the site and area.

Key

★ Site location

9130gy = Gymea

9130wn = Watagan

9130ha = Hawkesbury

9130tg = Tuggerah

9130na = Narrabeen

9130ww = Woy Woy

Source. https://www.environment.nsw.gov.au/eSpade2Webapp

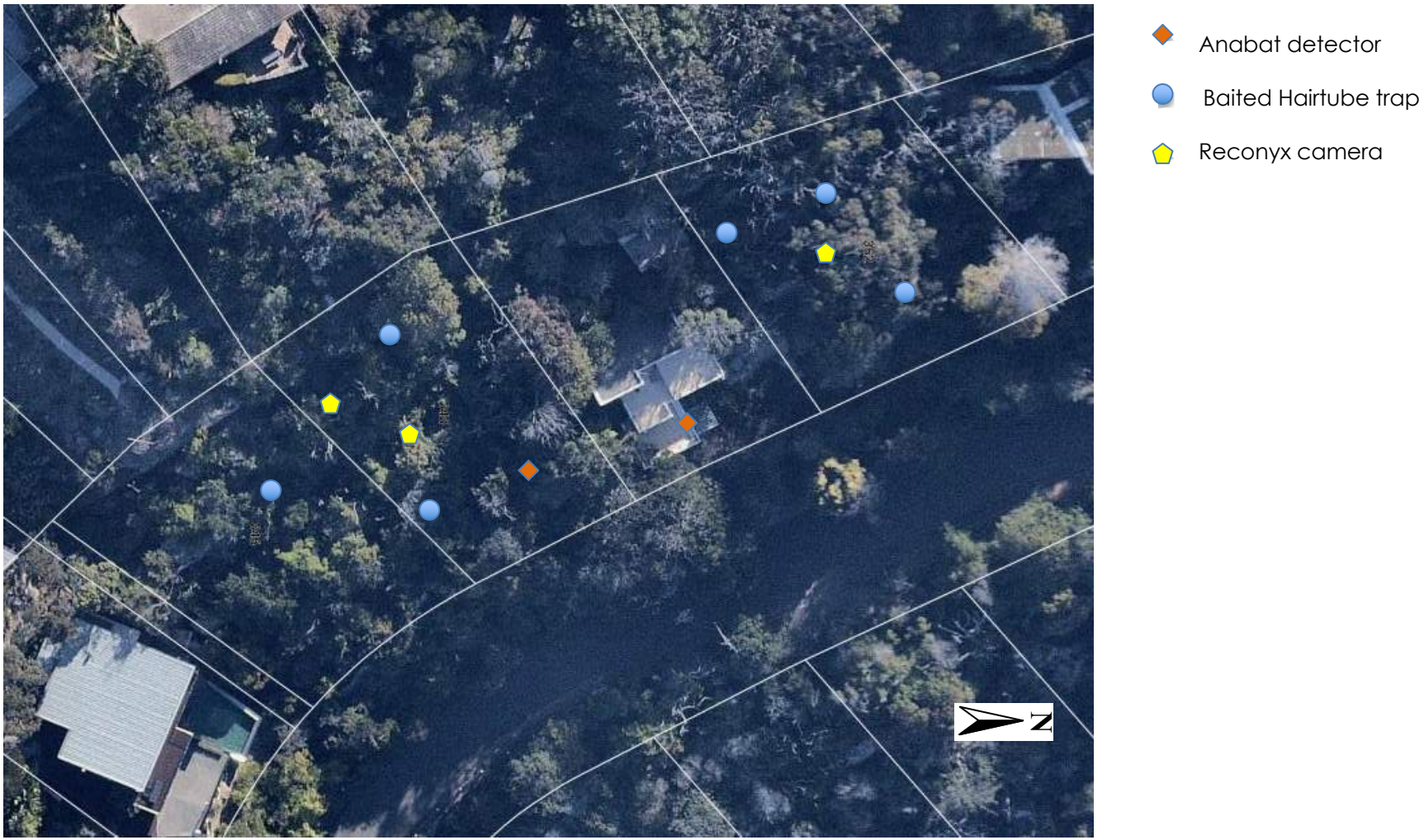

Figure 8. Location of fauna trap and camera stations set up on site.

1. Introduction

1.1 Legislative context

This Prescribed Ecological Actions Report (PEAR) meets the requirements of the *Biodiversity Conservation Act 2016* to enable a Council to issue a consent under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The consent authority (Pittwater Council) must consider the following three Biodiversity Offset Scheme Development Thresholds.

Threshold Trigger 1: Exceeding the clearing threshold on an area of native vegetation.

Threshold Trigger 2: Development or a prescribed activity is carried out on land included in the Biodiversity Values Land Map.

Threshold Trigger 3: A "significant effect" on threatened species or ecological communities.

A biodiversity survey of the proposed development site at 346 – 352 Whale Beach Road, Palm Beach ('the site' – Figure 1) was undertaken on 11th – 13th and 18th – 20th September 2018. This Prescribed Ecological Actions Report (PEAR) investigates whether the impacts of the proposal to knock down an existing dwelling on Lot 328 and build a new home, swimming pool and gym across Lots 327, 328, 329 and 330 will trigger any of the three thresholds to entry into the Biodiversity Offsets Scheme, thereby requiring a Biodiversity Development Assessment Report.

This assessment addresses both 'endangered' and 'vulnerable', as required by the *Biodiversity Conservation Act 2016* (BCA 2016). Throughout this report 'threatened' refers to those species and communities listed as 'endangered' or 'vulnerable' in Schedules 1 & 2 of the BC Act 2016.

If any of the three thresholds are triggered, then a Biodiversity Development Assessment Report (BDAR) must be prepared by an accredited assessor for the Authority to issue a consent or an approval and a calculation of offsetting required.

1.2 The proposal

The proposal (Figure 3) is to demolish an existing house on Lot 328 and 329, No. 350 Whale Beach Road and build a new dwelling and ancillary works over Lots 327, 328, 329 and 330 consisting of:

a) buildings
b) driveway
c) swimming pool
d) gymnasium
e) outdoor living and landscape areas
f) link up to sewage system
g) clearing native vegetation
h) bushfire asset protection zones
i) utilities within the lot.

Table 1. Details of lot size and size of proposed native vegetation clearing.

Component of site	Area m^2	Proportion of the site %
Whole site	2269.6	100%
Extent of proposed native vegetation clearing	~1811	~ 79%

Note. Calculated extent of clearing comprises the new works construction footprint (~586 m^2) plus the Asset Protection Zone (~1530 m^2) (Abel Ecology 2018 BAL Report AE19 1932 REP ISS 1 1Feb19), minus the existing dwelling footprint (~305 m^2).

A lesser fraction of this total clearing (~1811 m^2) will be 'native vegetation' given the modified state of vegetation on site.

1.3 Sources of information used in this assessment

Literature reviewed in order to assess possible issues relating to this site include:
Air photos (SIX maps and NearMap)
Survey map (supplied by Tzannes Architects)
Vegetation map (OEH 2013 Sydney Metro Veg Mapping)
Schedules to the BC Act 2016
Schedules to the EPBC Act 1999
OEH Atlas of NSW Wildlife

Other biodiversity survey reports in the local area include:

Abel Ecology (2016). LEC Expert Witness for 20 Chiltern Road, Ingleside, Abel Ecology, Springwood.

Abel Ecology (2016). Affidavit of Adrian Daniel Wotherspoon 26 February 2015, 2015 for Pittwater Council v Daniel Ryan in the Land and Environment Court of New South Wales proceedings 40949/2015, King & Wood Mallesons, Sydney, NSW.

Abel Ecology (2015). Flora and Fauna Report, 9-11 Beaconsfield Road, Newport, Lots 29 & 30 DP 1093125, Abel Ecology, Springwood.

Abel Ecology (2013). Vegetation management plan for 6-8 and part of 10 Macpherson Street, Warriewood, Proposed new retirement village, Abel Ecology, Springwood.

Wotherspoon, A. D. (2006). Flora and Fauna Report for 62 and 85 Hillside Road, Newport, Lot 1, DP 408800 and Lot 2 DP 1036400, Proposed 2 into 8 Lot subdivision, Abel Ecology, Faulconbridge.

Abel Ecology (2006). Flora and Fauna Report for 62 Ingleside Road, Ingleside, Lot 21, DP 11785, Proposed Residential dwelling, Abel Ecology, Faulconbridge.

Abel Ecology (2005). Flora and Fauna Report and Ecological Sustainability Plan for 13 Lane Cove Road, Ingleside, Lot 26 in DP 12115, Proposed dwelling and effluent disposal, Abel Ecology, Faulconbridge.

Wotherspoon, A. D. (2003). Flora and Fauna Report for 63 Therry Street, Avalon, Lot 20, DP 209493, Proposed subdivision and construction of a dwelling, Blue Mountain Wilderness Services Pty. Ltd., Faulconbridge.

Wotherspoon, A. D. (2003). Flora and Fauna Report with Bushfire Assessment for 15-17 Central Road, Avalon, Lot 24, DP 9151 and Lot 7 DP 415579, Proposed SEPP5 Development, Blue Mountain Wilderness Services Pty. Ltd., Faulconbridge.

2. Biodiversity offsets scheme thresholds 1 and 2

2.1 Threshold One: Biodiversity Conservation Regulation 2017 Development area assessment thresholds

Clearing of native vegetation is declared by clause 7.2(1) to exceed the biodiversity offsets scheme threshold if the area proposed to be cleared, is the area set out in Column 2 of the Table to that clause (Table 2 below) opposite the minimum lot size applicable to the land to be cleared in Column 1 of that Table.

Clearing of native vegetation will trigger entry into the offsets scheme if clearing is greater than the assessment threshold. To determine the correct threshold from Table 2 below, the appropriate minimum lot size of land must be selected. The minimum lot size of land can be found on the NSW planning portal https://www.planningportal.nsw.gov.au/find-a-property/property/.

Table 2: Areas section 7.2(4) Biodiversity Conservation Regulation 2017.

	Land to be considered	**Assessment threshold**
	Minimum lot size of land	**Area of clearing**
A	Less than 1 hectare	0.25 hectare or more
B	Less than 40 hectares but not less than 1 hectare	0.5 hectare or more
C	Less than 1,000 hectares but not less than 40 hectares	1 hectare or more
D	1,000 hectares or more	2 hectares or more

The four lots of land are zoned E4 (Figure 5) with a minimum lot size for each lot in the zone of 700 m^2 or 0.07 ha (NSW Planning Portal Minimum Lot Sizes), therefore row A is appropriate for this proposal. The size of the smallest Lot (Lot 329) is approximately 550 m^2 (i.e. less than the minimum lot size). The proposal consists of four lots which together have a total area of 2,269.6 m^2 or 0.2269.6 ha. The area of clearing even if all four lots were levelled is therefore less than the threshold of 0.25 hectares.

Conclusion

The proposed clearing does not exceed the threshold and entry into the BC Act offset scheme is not required as a result of clearing.

2.2 Threshold Two: Clearing or prescribed activities as listed in the Biodiversity Conservation Regulation 2017 on land included on the Biodiversity Values Map

No part of the site is included on the Biodiversity Values Map (Figure 4). Thus, threshold two is not breached.

If one or more of particular Prescribed Activities are included directly or indirectly as part of the proposal or proposed activity the Biodiversity Offsets Scheme will apply.

The "prescribed activities" criteria are as follows:

> *(a) the impacts of development on the following habitat of threatened species or ecological communities:*
>
> *(i) karst, caves, crevices, cliffs and other geological features of significance,*
> *(ii) rocks,*
> *(iii) human made structures,*
> *(iv) non-native vegetation,*

Response
There are no threatened ecological communities on the site.

The site was noted to have sandstone rock outcrops and crevices which may provide habitat for threatened species of fauna that occur in the locality.

The two possible threatened species that could use rock crevices as shelter are:

1. *Cercartetus nanus* Eastern Pygmy-possum
2. *Petaurus norfolcensis* Squirrel Glider

Neither species was detected on site and have not been recorded north of Avalon since 1990.

These two species prefer tree hollows for shelter, so it is most unlikely that they will be using the rock faces on the site.

The proposal does not affect the existing rock outcrops, so there is no anticipated impact under this criterion.

The existing dwelling is a *human made structure* that is proposed to be demolished. There was no indication during field survey that any microbats or other fauna were using the dwelling for a roost. Similarly, there was no indication that threatened fauna were using the non-native vegetation.

No significant impacts from the proposal will occur on karsts, caves, crevices, cliffs or other geological features of significance, or rocks, human made structures or non-native vegetation that were present on site and could be potential habitat for threatened species or ecological communities.

(b) the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range,

The three possible threatened mammal species that could use the east escarpment for a terrestrial movement corridor are:

1. *Phascolarctos cinereus* Koala
2. *Cercartetus nanus* Eastern Pygmy-possum
3. *Petaurus norfolcensis* Squirrel Glider

None of those species were detected on site and have not been recorded north of Avalon since 1990.

Other mobile or flying species are unlikely to be affected by the proposal.

The proposal is unlikely to have a significant impact on connectivity of habitat for any threatened species.

(c) the impacts of development on movement of threatened species that maintains their lifecycle,

None of the threated terrestrial fauna species in the locality are migratory or have any specific requirements that could be provided by the site for breeding or other life cycle needs.

The proposal is unlikely to have a significant impact on the movement of threatened species as required for their lifecycle.

(d) the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining or other development),

None of those features occur on the site. The proposal will be constructed to best practice Water Sensitive Urban Design so is not likely to compromise any water quality down slope of the site.

No significant impact from the proposal is anticipated on water quality, water bodies and hydrological processes that sustain threatened species or threatened ecological communities.

(e) the impacts of wind turbine strikes on protected animals,

Wind turbines are not part of the proposal.

(f) the impacts of vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

No terrestrial threatened species have been recorded north of Avalon since 1990 so it is most unlikely that the proposal will increase road kill. The proposal will not significantly increase vehicle strikes on threatened species of animals or on animals that are part of a threatened ecological community.

None of the potential species will be at any greater risk than at present with the existing dwelling.

> *(2) The additional biodiversity impacts prescribed by this clause* (above)*:*
> *(a) are prescribed for the purposes of assessment and biodiversity assessment reports under the Act, but are not additional biodiversity impacts for the purposes of calculating the number and class of biodiversity credits that are required under a biodiversity assessment report to be retired to offset the residual impact on biodiversity values of proposed development, proposed clearing of native vegetation or proposed biodiversity certification of land, and*
> *(b) may be taken into account in the determination of the biodiversity credits required to be retired (or other conservation measures required to be taken) under a planning approval or vegetation clearing approval or under a biodiversity certification of land.*

None of the prescribed biodiversity impacts described above (a, b, c, d, e, or f) are included in the proposal. Any impacts are not significant within the scope of the triggers in this consideration.

Conclusion
The threshold two trigger for entry into the Biodiversity offsets scheme is not activated by the proposal. A Biodiversity Development Assessment Report is not required.

3. Landscape features of the site and the locality

3.1 Site description

For the purposes of this report, the site (Figure 1) is defined by the property boundaries of lots 327 - 330.

It is 0.2269.6 ha. in size and the elevation is approximately 84 m above sea level.

https://www.planningportal.nsw.gov.au/find-a-property/

The site is on the eastern aspect of a ridge above the ocean with a steep slope of approximately (40 - 60°) down to Whale Beach Road before a further drop through reserve land to a rocky ocean shore.

There are no water bodies or creeks.

Stormwater management is by overland flow to the street.

The adjacent properties (Figure 1) are a mix of Council reserve to the east, a council reserve to the west of a part of the site and residential dwellings to the north, west and south.

The vegetation (Figure 6) is described in detail in Section 5 below and fauna habitat is detailed in Section 5 below.

3.2 Soils

The soil landscapes on site are mapped as Gymea adjoining Watagan (Figure 7).

Gymea soil landscapes are typified by slopes of 10 - 25%, rock outcrops and shallow to moderately deep red to yellow podsols of Hawkesbury sandstone sediment.

Watagan soil landscapes are typified by slopes of more than 25%, occasional sandstone boulders and benches and moderately deep red to yellow podsols of Narrabeen sediment.

Both landscapes are typified by imperfectly drained, non-cohesive soils posing rockfall and sheet erosion hazards with high run-off.

3.3 History of the site

The site is an old residential subdivision with existing improvements comprising a dwelling, landscaping and ancillary structures.

3.4 Landscape features

3.4.1 Site landscape features

The following landscape features are present on the site (Table 3).

Table 3. Site landscape features.

Vegetation	There is remnant local native tree canopy and understorey vegetation. A variety of exotic landscape planting and various weed species are present on the site.
Non-native vegetation	The landscape has potential for foraging habitat for threatened species of bats and birds.
Human structures	Buildings to be demolished have very little potential as bat roosts.
Wetlands/dams/watercourse	None
Karst, caves, crevices and other geological features of significance	Sandstone rock faces and outcrops.
Roads	Vehicle traffic and road mortality – A native Ring tailed Possum was noted to have been killed by a vehicle on Whale Beach Road opposite the property 19th Sept.

4. Field survey methods

4.1 BioNet Atlas of NSW Wildlife website search

Records from the BioNet Atlas of NSW Wildlife website were accessed using the following search criteria:

Licensed Report of all Valid Records of Threatened (listed on *BC Act 2016*) or Commonwealth listed Entities for a 10 x 10 km square centred on the site (selected area [North: -33.56 West: 151.29 East: 151.39 South: -33.66]). Records since 01 Jan 1990 until 20 Sept 2017 returned a total of 356 records of 42 threatened flora and fauna species.

Data used is from the BioNet Atlas website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions. Species listed under the Sensitive Species Data Policy may have their locations denatured (^ rounded to 0.1°; ^^ rounded to 0.01°). Copyright the State of NSW through the Office of Environment and Heritage.

These species (Table 4) were considered in designing field survey targets and methods. Unsuitable candidates were eliminated on the basis of habitat requirements (Appendix 4 and Appendix 5).

Table 4: BioNet threatened flora & fauna species records for a 5 km radius of the site since 1 Jan 1990.

Scientific Name	Common Name	NSW status	Comm. status
Callocephalon fimbriatum	Gang-gang Cockatoo	V	
Glossopsitta pusilla	Little Lorikeet	V	
Ninox connivens	Barking Owl	V	
Ninox strenua	Powerful Owl	V	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Mormopterus norfolkensis	Eastern Freetail-bat	V	
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Callistemon linearifolius	Netted Bottle Brush	V	

Species for which suitable habitat occurs on the site within the range of the species but which did not appear in the Atlas record were added to Appendix 4 and Appendix 5.

4.2 Field work effort

Over the one day of fieldwork a total of 31.25 hours were spent undertaking survey work on the site and surrounding habitat areas.

Table 5. Survey dates and weather conditions.

Date	Time	Temperature (°C)	Task	Hours (hrs x no. people)
11 Sep 18	14:30 - 19:00	19 - 22	Some veg survey; Baits, Hairtube traps, Anabat recorder and camera set up.	4.5 x 2 = 9
12 Sep 18	08:00 - 15:30	20 - 26	Vegetation survey, Anabat recorded set up.	7.5 x 2 = 15
13 Sep 18	0800 - 0830	17	Reptile survey, collect Anabat and Reconyx cameras.	0.5 x 1 = 0.5
18 Sep 18	10:30 – 14:30	19 - 24	Reptile survey, install Anabat and Reconyx cameras, funnel trap, pipe trap.	4 x 1 = 4
19 Sep 18	17:30-18:45	15-18	Reptile survey, Anabat and Reconyx cameras, funnel trap, pipe trap, hair tubes, spotlighting.	1.25 x 1 = 1.25
20 Sep 18	08:00-09:30	17-19	Collect Anabat and Reconyx cameras, funnel trap, pipe trap, hair tubes.	1.5 x 1 = 1.5
			Total	31.25

Survey effort was concentrated within the site boundaries, although adjacent surrounding vegetation was noted.

4.3 Flora survey method, vegetation community and habitat classification

A flora survey was conducted to compile vegetation descriptions and species lists for the site.

The vegetation community on site was derived from the site flora list and vegetation mapping of the area.

Vegetation quality is assessed as described below (Section 4.4). The plant community/communities on site were classified according to the NSW VIS.

4.4 Simplified vegetation integrity assessment

On-site vegetation may be described according to a simplified vegetation integrity classification for each vegetation zone / habitat type. The simplified vegetation integrity assessment is based upon a modified version of the vegetation integrity assessment described in the NSW Biodiversity Assessment Method (BAM) 2017. This simplified assessment is based upon a qualitative assessment; no quantitative assessment was undertaken and no vegetation integrity score is calculated. The assessment requires the assessor to compare the observed vegetation with the vegetation type presumed to be present prior to 1750 (high quality native vegetation). Vegetation with good or moderate integrity usually provide higher quality habitat for a diverse range of indigenous species.

Four main qualitative classes of vegetation integrity are recognised. There is variation within each class, and in addition the class boundaries are somewhat fluid where one grades into the other.

Good integrity vegetation
Characteristics: Relatively high indigenous species diversity, diversity of flora species growth form (mix of trees, shrubs and groundcovers etc), diversity of tree size, canopy layer regeneration observed, fallen logs present on the ground, dead vegetative litter (leaves, twigs etc) cover present, weed invasion absent or minimal

Moderate integrity vegetation
Characteristics: Remnants and regenerating areas that have experienced disturbance but appear to retain the capability of recovery. Weed invasion may be moderate.

Poor integrity vegetation
Characteristics: The vegetation is highly disturbed. It typically consists of scattered trees/shrubs or clumps of trees and shrubs. Tree size diversity significantly reduced. The groundcover layer is comprised of a mix of indigenous species and exotic species. Fallen logs rare to absent, ground vegetative litter lacking.

Cleared class
Characteristics: Indigenous canopy species are absent and the indigenous understorey (shrubs/climbers/scramblers/groundcovers) are approximately less than 50%.

Note: some vegetation types naturally lack some of the characteristics. For example, trees are rare to absent in saltmarshes, sedge swamps, alpine herbfields and arid shrublands. However, providing the other characteristics are consistent with a natural undisturbed area of the same vegetation type then these vegetation types are classified as having "good integrity".

4.5 Fauna survey method

The methods of survey undertaken to detect the various faunal groups or their habitat are outlined below. Locations for specific survey methods are shown in Figure 8. Targeted surveys were made for threatened species based on records of sightings from the BioNet Atlas website, and the Ecologist's knowledge.

From this survey nine hair samples and one owl pellet, not easily identifiable in the field were sent to Barbara Triggs for analysis.

Roads and road verges were searched for road-kill fauna. Surveys for mammals, reptiles and frogs are generally run concurrently.

Dates, weather and temperatures of all fieldwork were recorded and are tabulated in Table 5 above.

4.5.1 Diurnal fauna searches

Searching, opportunistic observations and call recording provides an indication of types of species using a site. These methods are used to identify and record live animals, or record indirect evidence of animal presence on the site. On occasions, specific surveys may be conducted for a targeted group or species, such as searching the margins of a dam for frogs. Generally though, birds, reptiles, frogs and mammals, or evidence of them, may all be present in the same habitat at the time of survey, therefore searching for these faunal groups is generally run concurrently. This involved:

a) Searching shelter sites, basking sites, opportunistic observation, and assessment of shelter site diversity suitability for reptiles.
b) Opportunistic observations and identification of calls of species, and search for indirect evidence such as nests, feathers, scratchings and feeding signs for birds.
c) Searching for indirect evidence, such as diggings, droppings, runways and burrows, and opportunistic observations for mammals.

While rigorous surveys are likely to find more species, high species richness for birds can be recorded in a relatively short amount of time. Bird surveys are used as a simple indicator of other parameters, such as biodiversity and the functioning of the ecosystem.

4.5.2 Trapping

Hair-tube trapping targets small and medium-sized mammals. Six trap stations were placed on the site (Figure 8). Three hair tubes were placed at each trap station, one with oat bait at ground level, one with oat bait, tree mounted, and one with fish bait alternating at ground level and tree mounted. Oat bait was a mixture of rolled oats, honey, truffle oil, fish oil and sesame oil. These were left out for nine nights.

4.5.3 Reconyx Wildlife camera

Two cameras were positioned on site, one in the approximate centre of Lot 329 and another in the approximate centre of Lot 327 (Figure 8). These were left out overnight 11th and 12th Sept and 18th and 19th Sept totalling four nights of camera survey.

4.5.4 Nocturnal fauna searches

Nocturnal search was undertaken by one person for a total of 1.25 hours on 19th of September.

Nocturnal searches may encompass all the surveying methods used during the day, but generally consist of either locating a live animal or recording its call. Nocturnal species, such as arboreal mammals, large forest owls and flying-foxes are specifically targeted. Survey methods for microbats are outlined below in 3.4.7.

4.5.5 Microbat ultrasonic call recording

The method for identifying free-flying bats by their species-specific echolocation calls is one that has become standard in the last two decades (Richards 2001). Insectivorous bats were surveyed on this site by Anabat recordings directly to cf storage zcaim, over five nights (Duffy et al. 2000). Any other bat survey methods, such as tape recorded calls, and brief survey time, is certain to miss bat species scheduled by the BC Act 2016. Scheduled species are recorded on average within 1.5 hours (94 ±64 minutes) of recording but up to four hours is required to record all threatened species present (Richards 2001). Of the eight threatened species in the Sydney Bioregion, Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* has the largest home range and takes up to four hours to reliably appear at any point in its range. For a small site, any bats that appear in the first half hour are likely to be roosting nearby, with probability of recording 57% in the first half hour and 68% in the first whole hour (Richards 2001). Storage to zcam provides high quality call recordings with very little noise, enabling high reliability in call identification, as opposed to storage to magnetic tape. Anabat recordings were analysed by Dr Daniel McDonald.

Table 6. Anabat recording dates and weather conditions.

Date	Times	Temperatures (°C)	Weather
11 Sept 2018	18:30 – 08:00	12 – 19	Clear, light breeze
12 Sept 2018	15.30 – 07:00	13 - 12	Clear, light breeze
18 Sept 2018	14:30 – 07:00	12 - 19	Clear, light breeze
19 Sept 2018	18:30 – 08:00	12 - 17	Clear, light breeze

4.6 Species likely to occur

Species to be listed as 'likely to occur' or 'expected' (see Appendix 3), are common species generally found in the region, which are likely to occur on site if suitable habitat is present.

Native flora may include species local to the area (occurring in local remnants). Structure and species composition will depend upon locally occurring communities.

Expected species are common and, by definition, are not threatened species.

4.7 Limitations of the survey

This survey was conducted in early Spring. The weather conditions were mild and clear with a light coastal breeze.

Species that may use the site were not detected during the survey for the following reasons:

a) The species was present during the survey but was not detected due to dormancy, inactivity or cryptic habits.
b) The species use the site at other times of the year, but was not present during the survey due to being nomadic or migratory.

4.8 Staff associated with the field work

Table 7. Staff associated with field work and analysis of field work.

	Field work	Analysis of field work
Name	Dr Danny Wotherspoon	Barbara Triggs
Name	Dr Daniel McDonald	Dr Daniel McDonald
Name	Dr Alison Hewitt	Mark Sherring

5. Survey Results: Vegetation and habitat description

5.1 Site vegetation

Site vegetation comprises rambling gardens to the house and areas in and around numerous rock outcrops on site with exotic plants such as *Cupressus*, *Strelitzia*, *Hibiscus* and *Cycads.* Many small *Cactus* varieties, *Clivea*, *Agave*, potted orchids and varied exotic shrubs are also being grown interspersed across the gardens and rock areas on site.

Native *Glochidion ferdinandi, Elaeocarpus reticulatus* and *Pittosporum undulatum* are the most common small trees occurring on site in low abundance. There are also two small *Ficus rubiginosa*, and *Livistona australis* with native ferns (*Todea barbara*, *Pteridium esculentum* and *Cyathea cooperi*) and vines (*Genoplesium cymosum*, *Pandorea pandorana* and *Smilax glyciphylla*) more common at the southern boundary area where a watercourse gully provides a wetter and more sheltered microclimate.

There is one *Eucalyptus saligna* (planted) on Lot 327 northern area of the site, one large *Eucalyptus scias* in front of the existing house, several *Syncarpia glomulifera* (native Turpentine) and scattered *Xanthorrhoea media* across the site. Several established *Casuarina cunninghamiana* trees have also been planted closer to the road / steps on site.

Weedy species in highest abundance on site include **Asparagus aethiopicus* (Asparagus fern), **Nephrolepis cordifolia* (Fishbone fern) and **Hedychium gardnerianum* (Ginger lily).

A total of 150 plant species were recorded on site during field surveys, with approximately one third (56) of these native. All plant species recorded on site are presented in Appendix 2.

In determining the most likely original native vegetation community present on site, all native plant species recorded pertaining to nearby mapped vegetation units (Figure 6) are given in Table 8 below.

Table 8. Vegetation community type species indicators.

S_DSF04 Coastal Enriched Sandstone Dry Forest	**S_DSF06 Coastal Sandstone Foreshores Forest**	**S_WSF02 Coastal Enriched Sandstone Moist Forest**
Acacia suaveolens	*Acacia longifolia*	*Ceratopetalum gummiferum*
Acacia ulicifolia	*Banksia integrifolia*	*Dianella caerulea*
Banksia serrata	*Commelina cyanea*	*Dodonaea triquetra*
Caesia parviflora	*Dianella caerulea*	*Elaeocarpus reticulatus*
Cassytha pubescens	*Dodonaea triquetra*	*Glochidion ferdinandi*
Ceratopetalum gummiferum	*Elaeocarpus reticulatus*	*Livistona australis*
Dianella caerulea	*Ficus rubiginosa*	*Lomandra longifolia*
Dodonaea triquetra	*Glochidion ferdinandi*	*Notelaea longifolia*

S_DSF04 Coastal Enriched Sandstone Dry Forest	**S_DSF06 Coastal Sandstone Foreshores Forest**	**S_WSF02 Coastal Enriched Sandstone Moist Forest**
Elaeocarpus reticulatus	*Lomandra longifolia*	*Pandorea pandorana*
Glochidion ferdinandi	*Notelaea longifolia*	*Pittosporum undulatum*
Imperata cylindrical var. major	*Omalanthus nutans*	*Platylobium formosum*
Lomandra longifolia	*Oplismenus aemulus*	*Pteridium esculentum*
Notelaea longifolia	*Pandorea pandorana*	*Smilax glyciphylla*
Pandorea pandorana	*Pittosporum undulatum*	*Syncarpia glomulifera*
Pittosporum undulatum	*Platylobium formosum*	*Todea barbara*
Platylobium formosum	*Pteridium esculentum*	
Smilax glyciphylla	*Smilax glyciphylla*	
Syncarpia glomulifera		
Themeda australis		
Total = 19	**Total = 17**	**Total = 15**

In considering each of these three possible vegetation communities it is noted that Coastal Enriched Sandstone Dry Forest and Coastal Enriched Sandstone Wet Forest fail to achieve the minimum number of positive diagnostic species for 95% confidence in assigning a vegetation community:

- The minimum number of species required to diagnose S_DSF04 Coastal Enriched Sandstone Dry Forest with 95% confidence is 21 of a minimum 38 or more native species.

- The minimum number of species required to diagnose S_DSF06 Coastal Sandstone Foreshore Forest with 95% confidence is 14 of a minimum 28 or more native species.

- The minimum number of species required to diagnose S_WSF02 Coastal Enriched Sandstone Moist Forest with 95% confidence is 17 of a minimum 33 or more native species.

We conclude that the low numbers of native species recorded to enable assignment of a vegetation community with high confidence is reflective of the disturbed nature of the site.

It should also be noted that these vegetation community diagnoses are ordinarily made based on sampling data obtained from a 400 m^2 quadrat, randomly placed on site, while we employed a census of the whole site. This was because of the steep rock outcrops across large areas of the site and the disturbed areas across the entirety of the site, which made it difficult to randomly select representative points.

In attempting to assign an original native vegetation community to the site we note that:

1. There are nineteen positive diagnostic species on site for Coastal Enriched Sandstone Dry Forest. Species include some of the trees on site that are listed as positive diagnostic indicators for this community, namely *Syncarpia glomulifera, Glochidion ferdinandi* and *Elaeocarpus reticulatus.* The site also has the aligning soils for this community, in terms of clay enrichment to the sandstone (Figure 7). Mapping by Sydney Metro (2013) also supports the assignment of this vegetation community (Figure 6. Vegetation Map of the area).
2. There are a lesser number (seventeen) positive diagnostic species on site for Coastal Sandstone Foreshores Forest including *Ficus rubiginosa*, *Elaeocarpus reticulatus* and *Glochidion ferdinandi*. However, the site perhaps lacks the more protected location and the more minor shale enrichment to sandstone soils that support this vegetation community.
3. There are fourteen positive diagnostic species on site for Coastal Enriched Sandstone Moist Forest. It is noted that these all tend to occur in the southern area of the site (Lot 330), which is also consistent in that it borders a slightly more sheltered sandstone gully enriched by clay. This area of the site may therefore be closer to an intergrade to Coastal Enriched Sandstone Moist Forest.

We therefore conclude that the original vegetation on site was, for the most part, closest in assemblage to Coastal Enriched Sandstone Dry Forest with a very small area of Coastal Enriched Sandstone Moist Forest at the southern boundary of the site.

Neither of these vegetation communities are threatened ecological communities and both are represented within nearby reserve areas in the Pittwater LGA.

In some areas of the site there are old tree stumps and coarse litter.

Hollow bearing trees are absent across the site.

The site was noted to have sandstone escarpment, outcrops and crevices which can provide habitat for fauna.

Important habitat features that have significance for fauna occupation of the site are discussed below (Table 9). These include both site disturbance and natural features.

Table 9. Significant features and observations for this zone.

Significant features	Observations
Frequency of large trees (approx. > 80 cm DBH)	Absent
Tree regeneration and Tree stem-size diversity	Tree regeneration appears absent
Logs, woody debris and litter cover	Logs, woody debris and leaf litter – moderate
Rock outcrops, crevices	Large areas of escarpment along the entire western edge of the site.
Food resources	Eucalyptus, Ficus, Glochidion and Acacia provide food resources of fruits, blossoms and seeds.

5.2 Biodiversity Significance

The southern portion of Lot 327 (346 Whale Beach Road) is indicated as containing an area of Biodiversity Significance as indicated on Council's Biodiversity Map forming part of the PDCP 2014. This is most likely the very small area of Coastal Enriched Sandstone Moist Forest at the southern boundary of the site.

6. Survey Results: Fauna

6.1 Fauna results

A total of 23 species were detected, including 13 mammals, six birds and four reptiles.

Species listed as 'likely to occur' in the area are presented in Appendix 4. Note that the majority of the 'Expected Species' would occur on the site due to the presence of habitat. All the species listed as 'likely to occur' are common throughout the locality and the region. It is unlikely that protected species will be affected at a local, regional or state-wide scale by the proposal.

The habitats for threatened species that occur in the area are tabulated in Appendix 5.

Table 10. List of fauna detected on the site.

Reptiles			
Broad Tailed Gecko	*1. Phyllurus platurus*		
Scaly-foot Lizard	*1. Pygopus lepidopodus*		
Red-throated Skink	*1. Acritoscincus platynota*		
Fence Skink	*1. Cryptoblepharus virgatus*		O
Coppertail Skink	*1. Ctenotus taeniolatus*		
Three-toed yellow-bellied Skink	*1. Saiphos equalis*		O
Eastern Water-skink	*1. Eulamprus quoyii*		
Dark-flecked Garden Sunskink	*1. Lampropholis delicata*		O
Pale-flecked Garden Sunskink	*1. Lampropholis guichenoti*		
Weasel Skink	*1. Saproscincus mustelinus*		
Eastern Blue-tongued Skink	*1. Tiliqua scincoides*		
Jacky Lizard	*1. Amphibolurus muricatus*		
Bearded Dragon	*1. Pogona barbata*		
Eastern water dragon	*1. Intellagama (Physignathus) lesueurii*		O
Red Bellied Black Snake	*1. Pseudechis porphyriacus*		
N=	4		

Birds			
Australian Wood Duck	*1. Chenonetta jubata*		
Pacific Black Duck	*1. Anas superciliosa*		
White-faced Heron	*1. Egretta novaehollandiae*		
Australian White Ibis	*1. Threskiornis molucca*		
Collared Sparrowhawk	*1. Accipiter cirrocephalus*		
Brown Goshawk	*1. Accipiter fasciatus*		
Grey Goshawk	*1. Accipiter fasciatus*		O
Nankeen Kestrel	*1. Falco cenchroides*		
Purple Swamphen	*1. Porphyrio porphyrio*		
Dusky Moorhen	*1. Gallinula tenebrosa*		
Eurasian Coot	*1. Fulica atra*		
Masked Lapwing	*1. Vanellus miles*		
Rock Dove*	*1. Columba livia*		
Spotted Turtle-dove*	*1. Streptopelia chinensis*		
Crested Pigeon	*1. Ocyphaps lophotes*		
Glossy Black-cockatoo	*1. Calyptorhynchus lathami*		
Yellow-tailed Black-cockatoo	*1. Calyptorhynchus funereus*		
Galah	*1. Eolophus roseicapilla*		

Birds			
Long-billed Corella	*1. Cacatua tenuirostris*		
Sulphur-crested Cockatoo	*1. Cacatua galerita*		
Gang-gang Cockatoo	*1. Callocephalon fimbriatum*		
Scaly-breasted Lorikeet	*1. Trichoglossus chlorolepidotus*		
Rainbow Lorikeet	*1. Trichoglossus haematodus*		W
Musk Lorikeet	*1. Glossopsitta concinna*		
Australian King-parrot	*1. Alisterus scapularis*		
Crimson Rosella	*1. Platycercus elegans*		
Eastern Rosella	*1. Platycercus eximius*		
Asian Koel	*1. Eudynamys scolopaceus*		
Channel-billed Cuckoo	*1. Scythrops novaehollandiae*		
Southern Boobook	*1. Ninox novaeseelandiae*		
Tawny Frogmouth	*1. Podargus strigoides*		
Laughing Kookaburra	*1. Dacelo novaeguineae*		
Sacred Kingfisher	*1. Todiramphus sanctus*		
Dollarbird	*1. Eurystomus orientalis*		
Satin Bowerbird	*1. Ptilonorhynchus violaceus*		
Superb Fairy-wren	*1. Malurus cyaneus*		
Variegated Fairy-wren	*1. Malurus lamberti*		
Spotted Pardalote	*1. Pardalotus punctatus*		
White-browed Scrubwren	*1. Sericornis frontalis*		
Brown Gerygone	*1. Gerygone mouki*		
White-throated Gerygone	*1. Gerygone albogularis*		
White-throated Treecreeper	*1. Cormobates leucophaea*		
Brown Thornbill	*1. Acanthiza pusilla*		
Yellow Thornbill	*1. Acanthiza nana*		
Striated Thornbill	*1. Acanthiza lineata*		
Buff-rumped Thornbill	*1. Acanthiza reguloides*		
Red Wattlebird	*1. Anthochaera carunculata*		
Little Wattlebird	*1. Anthochaera chrysoptera*		
Noisy Friarbird	*1. Philemon corniculatus*		
Bell Miner	*1. Manorina melanophrys*		
Noisy Miner	*1. Manorina melanocephala*		
Lewin's Honeyeater	*1. Meliphaga lewinii*		
Yellow-faced Honeyeater	*1. Lichenostomus chrysops*		
White-plumed Honeyeater	*1. Lichenostomus penicillatus*		
White-naped Honeyeater	*1. Melithreptus lunatus*		
New Holland Honeyeater	*1. Phylidonyris novaehollandiae*		

Birds			
Eastern Spinebill	*1. Acanthorhynchus tenuirostris*		
Eastern Yellow Robin	*1. Eopsaltria australis*		
Eastern Whipbird	*1. Psophodes olivaceus*		
Golden Whistler	*1. Pachycephala pectoralis*		
Rufous Whistler	*1. Pachycephala rufiventris*		
Grey Shrike-thrush	*1. Colluricincla harmonica*		
Magpie-lark	*1. Grallina cyanoleuca*		O
Rufous Fantail	*1. Rhipidura rufifrons*		
Grey Fantail	*1. Rhipidura fuliginosa*		
Willie Wagtail	*1. Rhipidura leucophrys*		
Olive-backed Oriole	*1. Oriolus sagittatus*		
Black-faced Cuckoo-shrike	*1. Coracina novaehollandiae*		
Grey Butcherbird	*1. Cracticus torquatus*		
Australian Magpie	*1. Cracticus tibicen*		
Pied Currawong	*1. Strepera graculina*		
Australian Raven	*1. Corvus coronoides*		
House Sparrow	*1. Passer domesticus*		
Red-browed Finch	*1. Neochmia temporalis*		
Welcome Swallow	*1. Hirundo neoxena*		
Silvereye	*1. Zosterops lateralis*		
Common Blackbird*	*1. Turdus merula*		
Common Starling*	*1. Sturnus vulgaris*		
Common Myna*	*1. Sturnus tristis*		
White-bellied Sea Eagle	*Haliaeetus leucogaster*		O
Silver Gull	*Chroicocephalus novaehollandiae*		O
Powerful Owl	*Ninox strenua*	Sch. 2, Vul.	P - Po
N =	6		

Mammals			
Brown Antechinus	*1. Antechinus stuartii*		
Long-nosed Bandicoot	*1. Perameles nasuta*		RC
Common Wombat	*1. Vombatus ursinus*		
Sugar Glider	*1. Petaurus breviceps*		
Common Ringtail Possum	*1. Pseudocheirus peregrinus*		O, RC 10:52 pm H - C
Common Brushtail Possum	*1. Trichosurus vulpecula*		S, RC
Eastern Grey Kangaroo	*1. Macropus giganteus*		
Swamp Wallaby	*1. Wallabia bicolor*		
Grey-headed Flying-fox	*1. Pteropus poliocephalus*		W
Yellow-bellied Sheathtail-bat	*1. Saccolaimus flaviventris*		
White-striped Freetail-bat	*1. Austronomus australis*		
Eastern Freetail-bat	*1. Mormopterus norfolkensis*		
White-striped Mastiff-bat	*1. Tadarida australis*		A - C
Large-eared Pied Bat	*1. Chalinolobus dwyeri*		
Gould's Wattled Bat	*1. Chalinolobus gouldii*		A - C
Chocolate Wattled Bat	*1. Chalinolobus morio*		A – P
Eastern False Pipistrelle	*1. Falsistrellus tasmaniensis*		
Golden-tipped Bat	*1. Kerivoula papuensis*		
Little Bentwing-bat	*1. Miniopterus australis*	Sch. 2, Vul.	A - P
Eastern Bentwing-bat	*1. Miniopterus schreibersii oceanensis*	Sch. 2, Vul.	A - Po
Southern Myotis	*1. Myotis macropus*		
Lesser Long-eared Bat	*1. Nyctophilus geoffroyi*		
Gould's Long-eared Bat	*1. Nyctophilus gouldi*		
Eastern Horseshoe bat	*1. Rhinolophus megaphyllus*		A - C
Greater Broad-nosed Bat	*1. Scoteanax rueppellii*		
Eastern Broad-nosed Bat	*1. Scotorepens orion*		
Large Forest Bat	*1. Vespadelus darlingtoni*		
Eastern Forest Bat	*1. Vespadelus pumilus*		
Southern Forest Bat	*1. Vespadelus regulus*		A - Po
Large Forest Eptesicus	*1. Vespadelus darlingtoni*		A - Po
Little Forest Eptesicus	*1. Vespadelus vulturnus*		
Little Forest Bat	*1. Vespadelus vulturnus*		A - Po
Bush Rat	*1. Rattus fuscipes*		
House Mouse*	*1. Mus musculus*		
Black Rat*	*1. Rattus rattus*		RC 12:25 am
Dog*	*1. Canis lupus familiaris*		
Fox*	*1. Vulpes vulpes*		
Cat*	*1. Felis catus*		

Rabbit*	*1. Oryctolagus cuniculus*		
Mammals			
Brown Hare*	*1. Lepus capensis*		
Horse*	*1. Equus caballus*		
N=	13		

Chalinolobus gouldii - confident
Chalinolobus morio - probable
Miniopterus australis - probable
Minitopterus schreibersii oceanensis / Vespedelus darlingtonii - possible
Rhinolophus megaphyllus - confident
Tadarida australis - confident
Vespadelus regulus - possible
Vespedelus darlingtonii - possible
Vespedelus vulturnus - probable

Key

*	=	Introduced fauna
A – P	=	Anabat – Probable
A – C	=	Anabat – Confident
A – Po	=	Anabat – Possible
H – P	=	Hair Tube – Probable
H – C	=	Hair Tube – Confident
H – Po	=	Hair Tube – Possible
P – Po	=	Pellet - Possible
O	=	Observed
R	=	Road kill
RC	=	Reconyx wildlife camera
S	=	Scats
W	=	Calls heard

6.2 Fauna Summary

The number of species from each faunal group, listed as 'likely to occur' can be seen in Appendix 3.

Mammals

Mammal species detected on the site totalled 13.
Reconyx wildlife cameras captured Long-nosed Bandicoot, *Black rat, Ringtail and Brushtail possum.
Anabat detectors call analysis identified nine species of bat, including two Vulnerable species: Little Bentwing Bat and Eastern Bentwing Bat.
A Ringtail Possum was also identified in hair tube trap analysis, scats, spotlighting and roadkill.

Reptiles

Reptile species detected on the site totalled four, being three species of locally occurring skink and the more conspicuous Eastern Water Dragon.

Frogs

No frog species were detected on the site.

Birds

Bird species detected on the site totalled six.

The sea birds amongst these (White-bellied Sea Eagle and Silver Gull) were noted off shore on the wing to nearby headland visible from the site.

An owl pellet was collected on site. This was sent away for analysis. The content results were hair, dentaries and other bones of **Rattus rattus*. This does not enable identification of the owl however given the many nearby records of Powerful Owl (*Ninox strenua*) and the confirmed presence on site of its preferred prey (Brushtail and Ringtail possums) it is a possible likely candidate. As a precautionary approach Powerful Owl is included in the five-part test assessment.

6.3 Microbats

Seven common bat species and two listed Vulnerable bat species were detected. Where calls were easily identifiable to species, they were classed as Confident. Where the calls were most likely to represent a particular species, they were classed as Probable. Where calls were likely to belong to a species but the quality or length of the call precluded a confident identification, they were classed as Possible. Where the calls could have belonged to two or more species, they were classified into a species group. Any calls of very poor quality, which could not be reliably placed into any species or species group category, were classified as Unknown. Many of the calls were of good quality and the poor ones most likely represented bats flying just within the bat detector's outer detection limits.

The most common microbat species detected on the site was the Gould's Wattled Bat. Calls from this species represented more than approximately 95% of the analysed microbat calls.

Foraging Habitat

This site provides potentially suitable foraging habitat for eight of the nine possible threatened species. *Myotis macropus* (syn. *Myotis adversus*) has no suitable foraging habitat in the form of open water bodies on or adjacent to the site. *Myotis macropus* is not known to forage over the ocean. Presumably the water surface is too rough. *Kerivoula papuensis* is only likely to forage in areas within a few kilometres of rainforest or rainforest gullies. It was not detected during the site survey.

However, a precautionary approach has been taken and this species is included in the five-part test assessment. Some of the vegetation in the locality has a structure similar to rainforest.

Roosting Habitat

This site has no tree hollows that provide suitable roosting habitat for *Falsistrellus tasmaniensis, Mormopterus norfolkensis, Scoteanax rueppellii, Myotis macropus, Miniopterus australis* and *Saccolaimus flaviventris*. This site has no caves, culverts, or bridges, but does have buildings and other suitable (often human-made) structures that provide potentially suitable roosting habitat for *Chalinolobus dwyeri, Miniopterus schreibersii oceanensis, Myotis macropus. Kerivoula papuensis* normally roosts in hanging bird nests or trees in rainforest gullies so is very unlikely to roost in the surveyed site.

Rock outcrops are common on the site. There are fissures and small opening between the rocks that are possibly suitable for occasional use by one or a few cave-dwelling bats. However, there was no evidence any of the rock outcrops provided roosting habitat for any larger group of microbats.

7. Discussion of results

The site comprises steep rocky hillside along Whale Beach Road, Palm Beach.

The original plant community present on site was most likely Coastal Enriched Sandstone Dry Forest with a very small area of Coastal Enriched Sandstone Moist Forest at the southern boundary of the site. While some native species of these communities remain on site, the vegetation has been degraded by loss of larger trees, disturbance by construction and occupation, replacement with exotic gardens and weed invasion.

The site is in poor - moderate condition with weed invasion evident, larger dead trees and stumps. Despite a high disturbance regime on the site, smaller native trees like *Eucalyptus scias, Glochidion ferdinandi*, *Ficus rubiginosa* and *Elaeocarpus reticulatus* would provide blossom and fruit for native birds. Native bats would occasionally forage on site. The rock outcrops on site provide habitat for native lizards and skinks.

There is evidence of threatened species of bats, Grey-headed Flying-fox and possibly Powerful Owl visiting the site. None of the threatened terrestrial fauna species in the locality have any specific requirements that could be provided by the site for breeding or other life cycle needs. Mobile or flying species are unlikely to be affected by the proposal. The proposal is unlikely to have a significant impact on threatened species.

8. Impact on biodiversity: Threshold 3

8.1 Threshold 3: Five-part test summary

Habitat requirements for locally occurring threatened faunal species, and the presence or absence of such habitat on the site, is tabulated in Appendix 4. Threatened plant species, listed in the BC Act and the EPBC Act, are shown in Appendix 5.

Under Section 7.3 of the *Biodiversity Conservation Act* several factors (listed in Appendix 1) need to be considered in deciding whether there is likely to be a Significant effect on threatened species, populations or ecological communities, or their habitats. If there is likely to be a significant effect on threatened species, the proposal must be accompanied by a Biodiversity Development Assessment Report (BDAR).

While the overall proposal incorporates mitigating considerations and offsets, these are not taken into account in determining the outcome of the five-part tests.

Table 11. Summary of the five-part tests shown in full in Appendix 1.

Species/Communities	Recorded on site	State listing BC Act '16	C-wealth listing EPBC Act '99	Result
Diurnal raptors				
Little Eagle *Hieraaetus morphnoides*	No	Sch 2, Vul.	-	No significant effect
Square-tailed Kite *Lophoictinia isura*		Sch 2, Vul.	-	
Forest birds				
Gang-gang Cockatoo *Callocephalon fimbriatum*	No	Sch 2, Vul.	-	No significant effect
Little Lorikeet *Glossopsitta pusilla*		Sch 2, Vul.	-	
Large Forest Owls				
Barking Owl *Ninox connivens*	Possibly	Sch 2, Vul.	-	No significant effect
Powerful Owl *Ninox strenua*		Sch 2, Vul.	-	
Masked Owl *Tyto novaehollandiae*		Sch 2, Vul.	-	
Sooty Owl *Tyto tenebricosa*		Sch 2, Vul.	-	
Mammals				
Grey-headed Flying-fox *Pteropus poliocephalus*	Yes	Sch. 2, Vul.	Vulnerable	No significant effect

Species/Communities	Recorded on site	State listing BC Act '16	C-wealth listing EPBC Act '99	Result
Insectivorous bats				
Eastern Freetail-bat *Mormopterus norfolkensis*	Yes	Sch. 2, Vul.	-	No significant effect
Large-eared Pied Bat *Chalinolobus dwyeri*		Sch. 2, Vul.	Vulnerable	
Eastern False Pipistrelle *Falsistrellus tasmaniensis*		Sch. 2, Vul.	-	
Little Bentwing-bat *Miniopterus australis*		Sch. 2, Vul.	-	
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*		Sch. 2, Vul.	-	
Greater Broad-nosed Bat *Scoteanax rueppellii*		Sch. 2, Vul.	-	
Golden –tipped Bat *……Kerivoula papuensis*		Sch. 2, Vul.	-	
Plants				
Callistemon linearifolius	No	Sch. 2, Vul.		No significant effect
Prostanthera densa		Sch. 2, Vul.	Vulnerable	

There is no significant effect so a Biodiversity Development Assessment Report is not required.

9. Planning Instruments

The site is zoned E4 - Environmental Living.

Objectives of this zone are:
• To provide for low-impact residential development in areas with special ecological, scientific or aesthetic values.
• To ensure that residential development does not have an adverse effect on those values.
• To provide for residential development of a low density and scale integrated with the landform and landscape.
• To encourage development that retains and enhances riparian and foreshore vegetation and wildlife corridors.

Additional planning instruments which would apply at this site include:
Pittwater council Local Environmental Plan 2014;
State Environmental Planning Policy (Vegetation in Non-Rural Areas) 2017;
Planning for Bushfire Protection 2006.

9.1 *Environment Protection and Biodiversity Conservation Act 1999*

9.1.1 Protected matters

The Protected Matters Search Tool was used to find relevant Matters of National Environmental Significance (MNES) on or near the site. The outputs are shown in Appendix 6 and summarised below (Table 12).

Table 12. Results from Protected Matters Search.

World Heritage Properties	Nil
National Heritage Places	Nil
Wetlands of International Importance	Nil
Commonwealth Marine Areas	Nil
Commonwealth Land	Nil
Critical Habitats/ Areas of Outstanding Biodiversity Value	Nil
Australian Marine Parks	Nil
Commonwealth Terrestrial Reserves	Nil
Listed Threatened Ecological Communities	Three
Listed Migratory Species	Fifty six
Listed Threatened Species	Sixty three

The three Listed Threatened Ecological Communities recorded in the area are:
1. Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland;
2. Coastal Upland Swamps in the Sydney Basin Bioregion; and
3. *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion.

These ecological communities are protected under Commonwealth legislation by the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act 1999) and are listed as Endangered. The provisions of the EPBC Act apply to this proposal. The outcome is not significant, however, and does not require referral to the Commonwealth.

There were no Critically Endangered or Endangered species or communities recorded on site.

There was one Vulnerable species recorded on the site. This was the Grey-headed Flying-fox.

9.1.2 Criteria for Vulnerable Species

An action has, will have, or is likely to have a significant impact on a Vulnerable Species if it does, will, or is likely to:

a) lead to a long-term decrease in the size of an important population of a species, or
b) reduce the area of occupancy of an important population, or
c) fragment an existing important population into two or more populations, or
d) adversely affect habitat critical to the survival of a species, or
e) disrupt the breeding cycle of an important population, or
f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat,* or
h) interfere substantially with the recovery of the species.

No significant impact on Grey-headed Flying-fox.

An Important Population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

a) key source populations either for breeding or dispersal,
b) populations that are necessary for maintaining genetic diversity, and/or
c) populations that are near the limit of the species range.

Not deemed an Important Population in this area.

(*Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.)

10. Conclusion and Recommendations

The original plant community on site was most likely 'Coastal Enriched Sandstone Dry Forest' with a very small area of 'Coastal Enriched Sandstone Moist Forest' at the southern boundary of the site. Both of these communities occur in the wider area and neither are listed threatened ecological communities. While some native species of each of these communities remain on site, the vegetation has been degraded by loss of larger trees, disturbance accrued by construction and occupation, replacement with exotic gardens and weed invasion.

No threatened flora has previously been recorded from the site and none were detected on site in our surveys. None of the threatened terrestrial fauna species known from the wider locality have any specific requirements that could currently be provided by the site for breeding or other life cycle needs.

The threatened species Grey-headed Flying-fox was detected visiting the site. There is also evidence for two threatened microbat species visiting the site, the Little Bentwing-bat and the Eastern Bentwing-bat (Table 10). It is also likely that Powerful Owl forages on site (Section 6.1). These species are highly mobile and forage/ hunt over wide areas of land. None of them appear to be roosting or nesting on site. The scale of the proposal will modify a small area of potential foraging/ hunting area with substantial areas of native vegetation in the surrounding area and will not place any of these species at significant risk of extinction (see 5 part test reports in Appendix 1).

The design of the proposed house appears to enable protection and preservation of the main rock escarpment and rock outcrops on site that are providing habitat to native reptiles.

None of the three thresholds for a Biodiversity Development Assessment Report are triggered as follows:
1. Area of clearing
2. Biodiversity Land Map and Prescribed biodiversity impacts
3. Five Part Tests.

Therefore a Biodiversity Development Assessment Report (BDAR) is not required.

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Appendix 1. Five-part tests

While the overall proposal incorporates mitigating considerations and offsets, these are not taken into account in determining the outcome of the **five-part** tests.

The Assessment of Significance (Office of Environment and Heritage (OEH)) states that "*Proposed measures that mitigate, improve or compensate for the action, development or activity should not be considered in determining the degree of the effect on threatened species, populations or ecological communities, unless the measure has been used successfully for that species in a similar situation.*"

Species addressed are as follows:

Scientific Name	Common Name	NSW status	Comm. status
Callocephalon fimbriatum	Gang-gang Cockatoo	V	
Glossopsitta pusilla	Little Lorikeet	V	
Ninox connivens	Barking Owl	V	
Lophoictinia isura	Square-tailed Kite	V	
Hieraaetus morphnoides	Little Eagle	V	
Ninox strenua	Powerful Owl	V	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Mormopterus norfolkensis	Eastern Freetail-bat	V	
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	
Chalinobus dwyeri	Large-eared Pied Bat	V	V
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	
Miniopterus australis	Little Bentwing Bat	V	
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Callistemon linearifolius	Netted Bottle Brush	V	
Prostanthera densa	Villous Mint-bush	V	V

Where applicable threatened populations are considered as threatened species in the following five part tests.

7.2 Development or activity "likely to significantly affect threatened species"

(1) For the purposes of this Part, development or an activity is **"likely to significantly affect threatened species"** if:

(a) it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3, or

(b) the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or

(c) it is carried out in a declared area of outstanding biodiversity value.

(2) To avoid doubt, subsection (1) (b) does not apply to development that is an activity subject to environmental impact assessment under Part 5 of the *Environmental Planning and Assessment Act 1979*.

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

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

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

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

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

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

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

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

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

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

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

Forest Birds

Key
CE = Critically Endangered
E = Endangered
V = Vulnerable

Scientific name	Common name	NSW status	Comm. status
Glossopsitta pusilla	Little Lorikeet	V	-
Callocephalon fimbriatum	Gang-gang Cockatoo	V	

Little Lorikeet *Glossopsitta pusilla*
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20111

- Forages primarily in the canopy of open *Eucalyptus* forest and woodland, yet also finds food in *Angophora, Melaleuca* and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.
- Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.
- Feeds mostly on nectar and pollen, occasionally on native fruits such as mistletoe, and only rarely in orchards
- Gregarious, travelling and feeding in small flocks (<10), though often with other lorikeets. Flocks numbering hundreds are still occasionally observed and may have been the norm in past centuries.
- Roosts in treetops, often distant from feeding areas.
- Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees often chosen, including species like *Allocasuarina*.
- Nesting season extends from May to September. In years when flowering is prolific, Little Lorikeet pairs can breed twice, producing 3-4 young per attempt. However, the survival rate of fledglings is unknown.

Gang-gang Cockatoo *Callocephalon fimbriatum*

- https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10975
- In spring and summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests.
- In autumn and winter, the species often moves to lower altitudes in drier more open eucalypt forests and woodlands, particularly box-gum and box-ironbark assemblages, or in dry forest in coastal areas and often found in urban areas.
- May also occur in sub-alpine Snow Gum (*Eucalyptus pauciflora*) woodland and occasionally in temperate rainforests.
- Favours old growth forest and woodland attributes for nesting and roosting. Nests are located in hollows that are 10 cm in diameter or larger and at least 9 m above the ground in eucalypts.

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

(a) in the case of a threatened species, whether the proposed development or activity is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction
No. There are very few forage trees on site making the habitat on site marginal for these species. Any Little Lorikeets or Gang-gang Cockatoos in the area will use a wide area for foraging including natural vegetation east and west of the site. The extent of habitat modification is minor considering the disturbed nature of the proposal area. The proposal is unlikely to effect the life cycle of the Little Lorikeet or Gang-gang Cockatoo such that a viable local population will be placed at risk of extinction.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable. This test is for a group of threatened species.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable. This test is for a group of threatened species.

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

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
The site is 0.2269.6 ha in size. Approximately half of the site will be modified to construct the facility. Currently there is less than 15% canopy cover on the site in terms of forest trees. It is anticipated that this will be reduced further to less than 10%.

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

No. Similar habitat occurs west of the property and east across Whale Beach Road in the form of a reserve. Little Lorikeet and Gang-gang Cockatoo are mobile and can easily travel over a house.

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

Negligible.

Criterion	Comment
Area and quality of habitat within the locality (maps, photos, survey)	The locality is a suburban matrix with areas of natural vegetation remaining on/around typically cleared or disturbed land on residential properties.
Area and quality of habitat on site in relation to the area and quality of habitat in the locality	Similar habitat is available on nearby and adjacent properties that have not been cleared. The feeding resource is moderate.
Role of habitat to be affected in sustaining habitat connectivity in the locality	Site habitat provides additional connectivity to the council reserves east and west of the site.
Ecological integrity of habitat to be affected on site, in relation to the ecological integrity, tenure and security of the habitat which will remain both on site and in locality.	The entire site is disturbed, however some local indigenous species remain. Ecological integrity on the site will remain in the locality as natural vegetation will be retained on the site and in the council reserves east and west of the site.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
No. No areas of outstanding biodiversity value have been specifically declared for these species.

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

Yes. The proposed development will require the "Clearing of native vegetation" which is a key threatening process relevant to these species. Key threatening processes are listed under the TSC Act, 1995 and the Commonwealth's EPBC Act, 1999. The nature and extent of such clearing is minimal for these species.

Conclusion

The proposed activity is unlikely to have a significant effect on Little Lorikeet or Gang-gang Cockatoo. Therefore a Biodiversity Development Assessment Report is not recommended.

Grey-headed Flying-fox

Scientific name	Common name	NSW status	Comm. status
Pteropus poliocephalus	Grey-headed Flying-fox	V,P	V

Key
V = Vulnerable
P = Protected

Habitat and ecology
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10697

- Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.
- Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.
- Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.
- Annual mating commences in January and conception occurs in April or May; a single young is born in October or November.
- Site fidelity to camps is high; some camps have been used for over a century.
- Can travel up to 50 km from the camp to forage; commuting distances are more often <20 km.
- Feed on the nectar and pollen of native trees, in particular *Eucalyptus, Melaleuca* and *Banksia*, and fruits of rainforest trees and vines.
- Also forage in cultivated gardens and fruit crops.

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

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

No. While the proposal will modify an area of foraging habitat for the Grey-headed Flying-fox, the extent of habitat modification is minor considering the disturbed nature of the proposal area. Grey-headed Flying-fox will use a wide area for foraging and the habitat on site is marginal for the species. Thus while the species may fly over or

occasionally forage on the site, the site does not provide significant habitat. The proposal is unlikely to effect the life cycle of the species such that a viable local population will be placed at risk of extinction.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable. This test is for a group of threatened species.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable. This test is for a group of threatened species.

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

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

The site is 0.2269.6 ha in size. Up to approximately half of the site will be modified to construct the facility. Currently there is less than 15% canopy cover on the site in terms of forest trees. It is anticipated that this will be reduced further to less than 10%.

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

No. Similar habitat occurs west of the property and east across Whale Beach Road in the form of council reserves. Grey-headed Flying-fox are mobile and can easily travel over a house.

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

Criterion	Comment
Area and quality of habitat within the locality (maps, photos, survey)	The locality is a suburban matrix with areas of natural vegetation remaining on/around typically cleared or disturbed land on residential properties.

Criterion	Comment
Area and quality of habitat on site in relation to the area and quality of habitat in the locality	Similar habitat is available on nearby and adjacent properties that have not been cleared. The feeding resource is moderate.
Role of habitat to be affected in sustaining habitat connectivity in the locality	Site habitat provides additional connectivity to the council reserves east and west of the site.
Ecological integrity of habitat to be affected on site, in relation to the ecological integrity, tenure and security of the habitat which will remain both on site and in locality.	The entire site is disturbed, however some local indigenous species remain. Ecological integrity on the site will remain in the locality as natural vegetation will be retained on the site and in the council reserves east and west of the site.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly), No. No area of outstanding biodiversity value has been specifically declared for this species.

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

Yes. The proposed development will require the "Clearing of native vegetation" which is a key threatening process relevant to these species. Key threatening processes are listed under the TSC Act, 1995 and the Commonwealth's EPBC Act, 1999. The nature and extent of such clearing is minimal for these species.

Conclusion

The proposed activity is unlikely to have a significant effect on Grey-headed Flying-fox. Therefore a Biodiversity Development Assessment Report is not recommended.

Nocturnal Raptors

Key
CE = Critically Endangered
E = Endangered
V = Vulnerable

Scientific name	Common name	NSW status	Comm. status
Ninox strenua	Powerful Owl	V	-
Ninox connivens	Barking Owl	V	

Powerful Owl *Ninox strenua*
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10562

- The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.
- The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.
- The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. There may be marked regional differences in the prey taken by Powerful Owls. For example in southern NSW, Ringtail Possum make up the bulk of prey in the lowland or coastal habitat. At higher elevations, such as the tableland forests, the Greater Glider may constitute almost all of the prey for a pair of Powerful Owls. Flying foxes are important prey in some areas; birds comprise about 10-50% of the diet depending on the availability of preferred mammals. As most prey species require hollows and a shrub layer, these are important habitat components for the owl.
- Pairs of Powerful Owls demonstrate high fidelity to a large territory, the size of which varies with habitat quality and thus prey densities. In good habitats a mere 400 can support a pair; where hollow trees and prey have been depleted the owls need up to 4000 ha.
- Powerful Owls 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. While the female and young are in the nest hollow the male Powerful Owl roosts nearby (10-200 m) guarding them, often choosing a dense "grove" of trees that provide concealment from other birds that harass him.
- Powerful Owls are monogamous and mate for life. Nesting occurs from late autumn to mid-winter but is slightly earlier in north-eastern NSW (late summer - mid autumn). Clutches consist of two dull white eggs and incubation lasts approximately 38 days.

Barking Owl *Ninox connivens*

- https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10561
- Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils.
- Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. During nesting season, the male perches in a nearby tree overlooking the hollow entrance.
- Preferentially hunts small arboreal mammals such as Squirrel Gliders and Common Ringtail Possums, but when loss of tree hollows decreases these prey populations the owl becomes more reliant on birds, invertebrates and terrestrial mammals such as rodents and rabbits. Can catch bats and moths on the wing, but typically hunts by sallying from a tall perch.
- Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6000 hectares, with 2000 hectares being more typical in NSW habitats.
- Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas).
- Nesting occurs during mid-winter and spring, being variable between pairs and among years. As a rule of thumb, laying occurs during August and fledging in November. The female incubates for 5 weeks, roosts outside the hollow when chicks are 4 weeks old, then fledging occurs 2-3 weeks later. Young are dependent for several months.
- Territorial pairs respond strongly to recordings of Barking Owl calls from up to 6 km away, though humans rarely hear this response farther than 1.5 km. Because disturbance reduces the pair's foraging time, and can pull the female off her eggs even on cold nights, recordings should not be broadcast unnecessarily nor during the nesting season.

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

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

No. Powerful Owls and Barking Owls use a wide area for hunting including natural vegetation east and west of the site. The extent of habitat modification is minor considering the disturbed nature of the proposal area. The site does not provide significant habitat for these species while its preferred prey species Ringtail and Brushtail possums were detected on site and would be common in the rea. The proposal is unlikely to effect the life cycle of these species such that a viable local population will be placed at risk of extinction.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable. This test is for a group of threatened species.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable. This test is for a group of threatened species.

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

(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and
The site is 0.2269.6 ha in size. Up to approximately half of the site will be modified to construct the facility. Currently there is less than 15% canopy cover on the site in terms of forest trees. It is anticipated that this will be reduced further to less than 10%.

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

No. Similar habitat occurs west of the property and east across Whale Beach Road in the form of council reserves. Powerful owl and Barking Owl are highly mobile species and can easily travel across the area.

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

Criterion	Comment
Area and quality of habitat within the locality (maps, photos, survey).	The locality is a suburban matrix with areas of natural vegetation remaining on/around typically cleared or disturbed land on residential properties.

Criterion	Comment
Area and quality of habitat on site in relation to the area and quality of habitat in the locality.	Similar habitat is available on nearby and adjacent properties that have not been cleared. The feeding resource is moderate.
Role of habitat to be affected in sustaining habitat connectivity in the locality.	Site habitat provides additional connectivity to the council reserves east and west of the site.
Ecological integrity of habitat to be affected on site, in relation to the ecological integrity, tenure and security of the habitat which will remain both on site and in locality.	The entire site is disturbed, however some local indigenous species remain. Ecological integrity on the site will remain in the locality as natural vegetation will be retained on the site and in the council reserves east and west of the site.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
No. No area of outstanding biodiversity value has been specifically declared for this species.

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

Yes. The proposed development will require the "Clearing of native vegetation" which is a key threatening process relevant to these species. Key threatening processes are listed under the TSC Act, 1995 and the Commonwealth's EPBC Act, 1999. The nature and extent of such clearing is minimal for these species.

Conclusion

The proposed activity is unlikely to have a significant effect on Powerful Owl and Barking Owl. Therefore a Biodiversity Development Assessment Report is not recommended.

Diurnal Raptor

Scientific name	Common name	NSW status	Comm. status
Hieraatus morphnoides	Little Eagle	V,P	
Lophoictinia isura	Square-tailed Kite	V	

Key
V = Vulnerable
P = Protected

Little Eagle *Hieraatus morphnoides*
Habitat and ecology
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=20131

- Occupies open eucalypt forest, woodland or open woodland. Sheoak or *Acacia* woodlands and riparian woodlands of interior NSW are also used.
- Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.
- Lays two or three eggs during spring, and young fledge in early summer.
- Preys on birds, reptiles and mammals, occasionally adding large insects and carrion.

Square-tailed Kite *Lophoictinia isura*
Habitat and ecology
https://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10495

- Found in a variety of timbered habitats including dry woodlands and open forests. Shows a particular preference for timbered watercourses.
- In arid north-western NSW, has been observed in stony country with a ground cover of chenopods and grasses, open acacia scrub and patches of low open eucalypt woodland.
- Is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage.
- Appears to occupy large hunting ranges of more than 100km2.
- Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

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

No. Little Eagles and Square-tailed Kites use a wide area for hunting including natural vegetation east and west of the site. The extent of habitat modification is minor considering the disturbed nature of the proposal area. The site does not provide significant habitat for these species. The proposal is unlikely to effect the life cycle of these species such that a viable local population will be placed at risk of extinction.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable. This test is for a group of threatened species.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable. This test is for a group of threatened species.

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

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

The site is 0.2269.6 ha in size. Up to approximately half of the site will be modified to construct the facility. Currently there is less than 15% canopy cover on the site in terms of forest trees. It is anticipated that this will be reduced further to less than 10%.

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

No. Similar habitat occurs west of the property and east across Whale Beach Road in the form of council reserves. Little Eagle and Square-tailed Kite are mobile and can easily travel over a house.

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

Criterion	Comment
Area and quality of habitat within the locality (maps, photos, survey).	The locality is a suburban matrix with areas of natural vegetation remaining on/around typically cleared or disturbed land on residential properties.
Area and quality of habitat on site in relation to the area and quality of habitat in the locality.	Similar habitat is available on nearby and adjacent properties that have not been cleared. The feeding resource is moderate.
Role of habitat to be affected in sustaining habitat connectivity in the locality.	Site habitat provides additional connectivity to the council reserves east and west of the site.
Ecological integrity of habitat to be affected on site, in relation to the ecological integrity, tenure and security of the habitat which will remain both on site and in locality.	The entire site is disturbed, however some local indigenous species remain. Ecological integrity on the site will remain in the locality as natural vegetation will be retained on the site and in the council reserves east and west of the site.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
No. No area of outstanding biodiversity value has been specifically declared for this species.

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

Yes. The proposed development will require the "Clearing of native vegetation" which is a key threatening process relevant to these species. Key threatening processes are listed under the TSC Act, 1995 and the Commonwealth's EPBC Act, 1999. The nature and extent of such clearing is minimal for these species.

Conclusion

The proposed activity is unlikely to have a significant effect on Little Eagle and Square-tailed Kite. Therefore a Biodiversity Development Assessment Report is not recommended.

Insectivorous bats

Scientific name	Common name	NSW status	Comm. status
Mormopterus norfolkensis	Eastern Freetail-bat	V,P	-
Chalinolobus dwyeri	Large-eared Pied Bat	V,P	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V,P	-
Miniopterus australis	Little Bentwing-bat	V,P	-
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V,P	-
Scoteanax rueppellii	Greater Broad-nosed Bat	V,P	Near Threatened
Kerivoula papuensis	Golden-tipped Bat	V,P	-

Key
V = Vulnerable
P = Protected

Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10741
Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. When foraging for insects, flies high and fast over the forest canopy, but lower in more open country. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn.

Eastern Freetail-bat *Mormopterus norfolkensis*
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10544
Eastern Freetail-bat occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roost mainly in tree hollows but will also roost under bark or in man-made structures. Usually solitary but also recorded roosting communally, probably insectivorous.

Large-eared Pied Bat *Chalinolobus dwyeri*
http://www.environment.nsw.gov.au/threatenedSpeciesApp/profile.aspx?id=10157
Large-eared Pied Bat 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), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves and overhangs. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies.

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. Likely to hibernate through the coolest months. It is uncertain whether mating occurs early in winter or in spring.

Eastern False Pipistrelle *Falsistrellus tasmaniensis*
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10331
Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. Hunts beetles, moths, weevils and other flying insects above or just below the tree canopy. Hibernates in winter. Females are pregnant in late spring to early summer.

Little Bentwing-bat *Miniopterus australis*
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10533
Little Bentwing-bat prefers moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW the largest maternity colony is in close association with a large maternity colony of Eastern Bentwing-bats (Miniopterus schreibersii) and appears to depend on the large colony to provide the high temperatures needed to rear its young. Maternity colonies form in spring and birthing occurs in early summer. Males and juveniles disperse in summer. Only five nursery sites /maternity colonies are known in Australia.

Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10534
Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves. Cold caves are used for hibernation in southern Australia. Breeding or roosting colonies can number from 100 to 150,000 individuals. Hunt in forested areas, catching moths and other flying insects above the tree tops.

Greater Broad-nosed Bat *Scoteanax rueppellii*
http://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10748
Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings. Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.

Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.

Golden-tipped Bat *Kerivoula papuensis*
https://www.environment.nsw.gov.au/threatenedspeciesapp/profile.aspx?id=10444
Found in rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, *Casuarina*-dominated riparian forest and coastal *Melaleuca* forests. Bats will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes. Roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes. Will use multiple roosts and change roosts regularly. Roost individually or in small colonies which can contain up to approximately 20 bats of both males and females or just a single sex. Maternity roosts may occur away from water sources with one maternity roost found 450m upslope of the nearest water course in a broken bough. Specialist feeder on small web-building spiders. There is one breeding cycle per year.

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

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

No. While the proposal will modify an area of foraging habitat for these species, the site does not provide significant habitat for any of these species and the extent of habitat modification is minor considering the disturbed nature of the proposal area. Any local viable population of threatened microbats will use a wide area for foraging including the natural vegetation reserves east and west of the site. Bats will continue to forage within and around the house. The proposal is unlikely to effect the life cycles of these species such that a viable local population will be placed at risk of extinction.

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

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction
Not applicable. This test is for a group of threatened species.

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,
Not applicable. This test is for a group of threatened species.

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

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

The site is 0.2269.6 ha in size. Up to approximately half of the site will be modified to construct the facility. Currently there is less than 15% canopy cover on the site in terms of forest trees. It is anticipated that this will be reduced further to less than 10%.

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

No. Similar habitat occurs west of the property and east across Whale Beach Road in the form of council reserves. Insectivorous bats are mobile and can easily travel between these areas.

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

Criterion	Comment
Area and quality of habitat within the locality (maps, photos, survey).	The locality is a suburban matrix with areas of natural vegetation remaining on/around typically cleared or disturbed land on residential properties.
Area and quality of habitat on site in relation to the area and quality of habitat in the locality.	Similar habitat is available on nearby and adjacent properties such as the council reserves east and west of the site.
Role of habitat to be affected in sustaining habitat connectivity in the locality.	Site habitat provides additional connectivity to fragmented council reserves east and west of the site.
Ecological integrity of habitat to be affected on site, in relation to the ecological integrity, tenure and security of the habitat which will remain both on site and in locality.	The entire site is disturbed, however some local indigenous species remain. Ecological integrity on the site will remain in the locality as natural vegetation will be retained on the site and in the council reserves east and west of the site.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
No. No area of outstanding biodiversity value has been specifically declared for this species.

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

Yes. The proposed development will require the "Clearing of native vegetation" which is a key threatening process relevant to these species. Key threatening processes are listed under the TSC Act, 1995 and the Commonwealth's EPBC Act, 1999. The nature and extent of such clearing is minimal for these species.

Conclusion

The proposed activity is unlikely to have a significant effect on Eastern Freetail-bat, Large-eared Pied Bat, Eastern False Pipistrelle, Little Bentwing-bat, Eastern Bentwing-bat, Greater Broad-nosed Bat or Golden-tipped Bat. Therefore a Biodiversity Development Assessment Report is not recommended.

Threatened Plants

Botanical name	NSW status	Comm. status
Callistemon linearifolius	V	-
Prostanthera densa	V	V

No threatened or endangered plants were recorded in site surveys 11th Oct 2017.

Key

V = Vulnerable

P = Protected

7.3 Test for determining whether proposed development or activity likely to significantly affect threatened species or ecological communities, or their habitats

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

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

No. No threatened plants were recorded on site. Much of the vegetation on the site is disturbed and it provides poor habitat for the majority of threatened species recorded in the locality. The proposal is unlikely to have an adverse effect on the life cycle of any of these species such that a viable local population will be placed at risk of extinction.

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

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

Not applicable. This test is for a group of threatened species.

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

Not applicable. This test is for a group of threatened species.

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

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

The site is 0.2269.6 ha in size. Up to approximately half of the site will be modified to construct the facility.

Weedy and natural vegetation, and rock outcrops will be disturbed by the proposal. The site generally provides poor quality habitat for these species.

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed development or activity, and
No. No threatened plants were recorded on site or in the council reserves east and west of the site. The proposal will not significantly increase isolation or fragmentation on the site.

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

Criterion	Comment
Area and quality of habitat within the locality (maps, photos, survey).	The locality is a suburban matrix with areas of often-degraded natural vegetation remaining on/around typically cleared or disturbed land on residential properties.
Area and quality of habitat on site in relation to the area and quality of habitat in the locality.	Similar habitat is available on nearby and adjacent properties that have not been cleared.
Role of habitat to be affected in sustaining habitat connectivity in the locality.	There are no records of threatened plants in the council reserves east and west of the site. Therefore dispersal opportunities are not disrupted by construction of a house on site.
Ecological integrity of habitat to be affected on site, in relation to the ecological integrity, tenure and security of the habitat which will remain both on site and in locality.	The entire site is disturbed, however some local indigenous species remain. Ecological integrity on the site will remain in the locality as natural vegetation will be retained on the site and in the council reserves east and west of the site.

(d) whether the proposed development or activity is likely to have an adverse effect on any declared area of outstanding biodiversity value (either directly or indirectly),
No. No areas of outstanding biodiversity value have been specifically declared for these species.

(e) whether the proposed development or activity is or is part of a key threatening process or is likely to increase the impact of a key threatening process.
Not applicable. *Callistemon limearifolius* and *Prostanthera densa* were not found to be present on the site, nor recorded in council reserves immediately east or west of the site.

Conclusion

The proposed activity is unlikely to have a significant effect on *Callistemon limearifolius* and *Prostanthera densa* which were not found to be present on the site. Therefore a Biodiversity Development Assessment Report is not recommended.

Appendix 2. Flora species list

FLORA LIST for Lots 327, 328, 329 and 330 DP16362 Whale Beach Road, Palm Beach

PSILOTOPSIDA

PSILOTACEAE
Psilotum nudum

FILICOPSIDA

CYATHEACEAE
Cyathea cooperi

DENNSTAEDTIACEAE
Pteridium esculentum

DRYOPTERIDACEAE
 # Cyrtomium falcatum

GLEICHENIACEAE
Gleichenia microcarpa

CONIFEROPSIDA

ARAUCARIACEAE
 # Auracaria heterophylla

ARECACEAE
 # Phoenix canariensis
 # Syagrus romanzoffiana

Sticherus flabellatus

LOMARIOPSIDACEAE
** Nephrolepis cordifolia*

OSMUNDACEAE
Todea barbara

POLYPODIACEAE
 # Platycerium sp.

CUPRESSACEAE
 # Cupressocyparis leylandii
 # Cupressus sp. *(C. lusitanica)*
 # Juniperus communis

CYCADACEAE
 # Cycas revoluta

ZAMIACEAE
 # Zamia furfuracea

MAGNOLIOPSIDA

DICOTYLEDONS

AIZOACEAE
** Lampranthus tegens*

APIACEAE

Centella asiatica

APOCYNACEAE
** Plumeria sp.*
** Trachelospermum jasminoides*

ARALIACEAE
* *Hedera helix*
* *Hydrocotyle bonariense*
# *Schefflera arboricola*

ASTERACEAE
* *Ageratina adenophora*
* *Chrysanthemoides monilifera* subsp. *monilifera*
* *Conyza bonariensis*
Cotula australis
* *Soliva anthemifolia*
* *Senecio serpens*
* *Sonchus oleraceus*

BIGNONIACEAE
Pandorea jasminoides
Pandorea pandorana

BORAGINACEAE
* *Echium fastuosum*

CACTACEAE
Rhipsalis sp.

CAPRIFOLIACEAE
* *Lonicera japonica*

CASUARINACEAE
Casuarina cunninghamiana

CELASTRACEAE
Euonymus sp.

CONVOLVULACEAE
* *Ipomoea cairica*

CRASSULACEAE
Aeonium sp.
* *Bryophyllum pinnatum*
* *Crassula ovata*
# *Graptopetalum* sp.
# *Kalanchoe luciae*

CUNONIACEAE
Ceratopetalum gummiferum

DILLENIACEAE
Hibbertia scandens

ELAEOCARPACEAE
Elaeocarpus reticulatus

EUPHORBIACEAE
Euphorbia milii
Homalanthus populifolius

FABACEAE
CAESALPINIODEAE
* *Senna pendula*

FABACEAE
FABOIDEAE
Bauhinia sp.
Platylobium formosum
Pultenaea ferruginea

FABACEAE
MIMOSOIDEAE
* *Acacia baileyana*
Acacia binervia
Acacia parvipinnula
Acacia longifolia subsp. *sophorae*
Acacia suaveolens
Acacia ulicifolia

GERANIACEAE
* *Geranium molle*

HYDRANGEACEAE
* *Hydrangea macrophylla*

LAMIACEAE
Lavandula stoechis
Rosmarinus officinalis
Westringia fruticosa

LAURACEAE
Cassytha pubescens

* *Cinnamomum camphora*

LOBELIACEAE
Lobelia anceps

MALVACEAE
* *Hibiscus rosa-sinensis*
* *Hibiscus syriacus*

MENISPERMACEAE
Stephania japonica

MORACEAE
Ficus lyrata
Ficus rubiginosa

MYRTACEAE
Callistemon citrinus
Callistemon viminalis
Eucalyptus saligna
Eucalyptus scias
Leptospermum polygalifolium
Agonis flexuosa
Syncarpia glomulifera

NYCTAGINACEAE
Bougainvillea spectabilis

OCHNACEAE
* *Ochna serrulata*

OLEACEAE
Jasminium polyanthum
* *Ligustrum sinense*
Notelaea longifolia f. *longifolia*
* *Olea europea* subsp. *cuspidata*

OXALIDACEAE
* *Oxalis corniculata* complex

PASSIFLORACEAE
**Passiflora edulis*

PHYLANTHACEAE
Glochidion ferdinandi

PITTOSPORACEAE
Pittosporum undulatum

PLANTAGINACEAE
* *Plantago lanceolata*

POLYGALACEAE
* *Polygala myrtifolia*

PROTEACEAE
Banksia integrifolia
Bankisa serrata
Grevillea (Bronze Rambler)
Grevillea (lanigera)
Grevillea sericea cv.

ROSACEAE
* *Cotoneaster (franchetii)*
* *Rhaphiolepis indica*

RUTACEAE
Calodendrum capense
Citrus x limon
Eriostemon australasius
Murraya paniculata

SAPINDACEAE
Cupaniopsis anacardioides
Dodonaea triquetra

SCROPHULARIACEAE
Veronica plebeia

SOLANACEAE
* *Physalis peruviana*

THYMELEACEAE
Pimelea linifolia subsp. *linifolia*

VERBENACEAE
**Lantana camara*

MONOCOTYLEDONS

AMARYLLIDACEAE
* *Clivia miniata*
* *Crinum pedunculatum*

ANTHERICACEAE
Caesia parviflora
* *Chlorophytum comosum*

ARACEAE
Monstera deliciosa

ARECACEAE
Archontophoenix cunninghamiana
Livistona australis
* *Syagrus romanzoffiana*

ASPARAGACEAE
* *Agave americana*
**Agave attenuata*
* *Asparagus aethiopicus*
# *Aspadistra elatior*
# *Sansevierea sp.*

ASPHODELACEAE
* *Aloe vera*
# *Haworthia* sp.

BROMELIACEAE
Aechmea chantinii
* *Bromeliad* sp.

COMMELINACEAE
Commelina cyanea
* *Tradescantia pallida*

CYPERACEAE
* *Cyperus eragrostis*
Gahnia melanocarpa

IRIDACEAE
* *Dietes sp.*
* *Freesia* sp.

LILIACEAE
* *Agapanthus praecox* var. *orientalis*
* *Lilium formosanum*

LOMANDRACEAE
Lomandra longifolia

ORCHIDACEAE
Dendrobium speciosum
Epidendrum radicans

PHORMIACEAE
Dianella caerulea var. *producta*

POACEAE
* *Briza maxima*
Imperata cylindrica
Oplismenus aemulus
* *Paspalum dilatatum* HTE
* *Paspalum urvillei*
* *Setaria parviflora*
Themeda australis

SMILACACEAE
Genoplesium cymosum
Smilax glyciphylla

STRELITZIACEAE
Strelitzia nicolai
Strelitzia reginae

XANTHORRHOEACEAE
Xanthorrhoea media

ZINGIBERACEAE
* *Hedychium gardnerianum*

Key
* Exotic weedy species
# Planted

Appendix 3. Expected fauna species in the Sydney Basin

Mammals

Common name	Scientific name
White-striped Freetail-bat	*Tadarida australis*
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Wattled Bat	*Chalinolobus morio*
Lesser Long-eared Bat	*Nyctophilus geoffroyi*
Gould's Long-eared Bat	*Nyctophilus gouldi*
Bush Rat	*Rattus fuscipes*
Swamp Rat	*Rattus lutreolus*
Long-nosed Bandicoot	*Perameles nasuta*
Brown Antechinus	*Antechinus stuartii*
Dusky Antechinus	*Antechinus swainsonii*
Yellow-footed Antechinus	*Antechinus flavipes*
Common Wombat	*Vombatus ursinus*
Common Ringtail Possum	*Pseudocheirus peregrinus*
Sugar Glider	*Petaurus breviceps*
Feathertail Glider	*Acrobates pygmaeus*
Eastern Grey Kangaroo	*Macropus giganteus*
Large Forest Bat	*Vespadelus darlingtoni*
Little Forest Bat	*Vespadelus vulturnus*
Common Wallaroo	*Macropus robustus*
Red-necked Wallaby	*Macropus rufogriseus*
Swamp Wallaby	*Wallabia bicolor*
Common Brushtail Possum	*Trichosurus vulpecula*
Greater Glider	*Petauroides volans*
Short-beaked Echidna	*Tachyglossus aculeatus*
Fox	*Vulpes vulpes*
Black Rat	*Rattus rattus*
Rabbit	*Oryctolagus cuniculus*

Frogs

Common Name	Scientific Name
Green Tree Frog	*Litoria caerulea*
Blue Mountains Tree Frog	*Litoria citropa*
Bleating Tree Frog	*Litoria dentata*
Eastern Dwarf Tree Frog	*Litoria fallax*
Jervis Bay Tree Frog	*Litoria jervisiensis*
Broad-palmed Frog	*Litoria latopalmata*
Peron's Tree Frog	*Litoria peronii*
Leaf-green Tree Frog	*Litoria phyllochroa*
Tyler's Tree Frog	*Litoria tyleri*
Verreaux's Frog	*Litoria verreauxii*
Common Eastern Froglet	*Crinia signifera*
Eastern Banjo Frog	*Limnodynastes dumerilii*
Ornate Burrowing Frog	*Limnodynastes ornatus*
Brown-striped Frog	*Limnodynastes peronii*
Spotted Grass Frog	*Limnodynastes tasmaniensis*
Haswell's Froglet	*Paracrinia haswelli*
Smooth Toadlet	*Uperoleia laevigata*
Tyler's Toadlet	*Uperoleia tyleri*

Reptiles

Common Name	Scientific Name
Diamond Python	*Morelia spilota spilota*
Common Death Adder	*Acanthophis antarcticus*
Yellow-faced Whip Snake	*Demansia psammophis*
Common Tree Snake	*Dendrelaphis punctulatus*
Golden-crowned Snake	*Cacophis squamulosus*
Eastern Small-eyed Snake	*Cryptophis nigrescens*
Red-naped Snake	*Furina diadema*
Black-bellied Swamp Snake	*Hemiaspis signata*
Tiger Snake	*Notechis scutatus*
Red-bellied Black Snake	*Pseudechis porphyriacus*
Eastern Brown Snake	*Pseudonaja textilis*
Dwyer's Snake	*Parasuta dwyeri*
Bandy Bandy	*Vermicella annulata*
Blackish Blind Snake	*Ramphotyphlops nigrescens*
Wood Gecko	*Diplodactylus vittatus*
Lesueur's Velvet Gecko	*Oedura lesueurii*
Broad-tailed Gecko	*Phyllurus platurus*
Thick-tailed Gecko	*Underwoodisaurus milii*
Burton's Snake-lizard	*Lialis burtonis*

Common Name	Scientific Name
Common Scaly-foot	*Pygopus lepidopodus*
Jacky Lizard	*Amphibolurus muricatus*
Bearded Dragon	*Pogona barbata*
Punctate Worm-skink	*Anomalopus swansoni*
Eastern Blue-tongue	*Tiliqua scincoides*
Southern Rainbow-skink	*Carlia tetradactyla*
Cream-striped Shinning-skink	*Cryptoblepharus virgatus*
Robust Ctenotus	*Ctenotus robustus*
Copper-tailed Skink	*Ctenotus taeniolatus*
Mainland She-oak Skink	*Cyclodomorphus michaeli*
Pink-tongued Skink	*Cyclodomorphus gerrardii*
Cunningham's Skink	*Egernia cunninghami*
Black Rock Skink	*Egernia saxatilis*
White's Skink	*Liopholis whitii*
Eastern Water-skink	*Eulamprus quoyii*
Barred-sided Skink	*Eulamprus tenuis*
Dark-flecked Garden Sunskink	*Lampropholis delicata*
Pale-flecked Garden Sunskink	*Lampropholis guichenoti*
Weasel Skink	*Saproscincus mustelinus*
Red-throated Skink	*Acritoscincus platynota*
Three-toed Skink	*Saiphos equalis*
Lace Monitor	*Varanus varius*
Eastern Snake-necked Turtle	*Chelodina longicollis*

Birds

Common Name	Scientific Name
Brown Quail	*Coturnix ypsilophora*
Black Swan	*Cygnus atratus*
Australian Wood Duck	*Chenonetta jubata*
Mallard	*Anas platyrhynchos*
Pacific Black Duck	*Anas superciliosa*
Grey Teal	*Anas gracilis*
Chestnut Teal	*Anas castanea*
Australasian Grebe	*Tachybaptus novaehollandiae*
Great Crested Grebe	*Podiceps cristatus*
Hoary-headed Grebe	*Poliocephalus poliocephalus*
Little Pied Cormorant	*Microcarbo melanoleucos*
Little Black Cormorant	*Phalacrocorax sulcirostris*
Great Cormorant	*Phalacrocorax carbo*
Australian Pelican	*Pelecanus conspicillatus*
White-faced Heron	*Egretta novaehollandiae*
Little Egret	*Egretta garzetta*

Common Name	Scientific Name
White-necked Heron	*Ardea pacifica*
Great Egret	*Ardea alba*
Cattle Egret	*Ardea ibis*
Intermediate Egret	*Ardea intermedia*
Australian White Ibis	*Threskiornis molucca*
Straw-necked Ibis	*Threskiornis spinicollis*
Royal Spoonbill	*Platalea regia*
Black-shouldered Kite	*Elanus axillaris*
Whistling Kite	*Haliastur sphenurus*
Wedge-tailed Eagle	*Aquila audax*
White-bellied Sea-eagle	*Haliaeetus leucogaster*
Swamp Harrier	*Circus approximans*
Brown Goshawk	*Accipiter fasciatus*
Collared Sparrowhawk	*Accipiter cirrocephalus*
Brown Falcon	*Falco berigora*
Australian Hobby	*Falco longipennis*
Nankeen Kestrel	*Falco cenchroides*
Buff-banded Rail	*Gallirallus philippensis*
Purple Swamphen	*Porphyrio porphyrio*
Dusky Moorhen	*Gallinula tenebrosa*
Eurasian Coot	*Fulica atra*
Latham's Snipe	*Gallinago hardwickii*
Black-winged Stilt	*Himantopus himantopus*
Black-fronted Dotterel	*Elseyornis melanops*
Masked Lapwing	*Vanellus miles*
Silver Gull	*Chroicocephalus novaehollandiae*
Rock Dove	*Columba livia*
White-headed Pigeon	*Columba leucomela*
Spotted Turtle-dove	*Streptopelia chinensis*
Brown Cuckoo-dove	*Macropygia amboinensis*
Emerald Dove	*Chalcophaps indica*
Common Bronzewing	*Phaps chalcoptera*
Crested Pigeon	*Ocyphaps lophotes*
Bar-shouldered Dove	*Geopelia humeralis*
Wonga Pigeon	*Leucosarcia picata*
Topknot Pigeon	*Lopholaimus antarcticus*
Yellow-tailed Black-cockatoo	*Calyptorhynchus funereus*
Galah	*Eolophus roseicapilla*
Long-billed Corella	*Cacatua tenuirostris*
Little Corella	*Cacatua sanguinea*
Sulphur-crested Cockatoo	*Cacatua galerita*
Rainbow Lorikeet	*Trichoglossus haematodus*
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*

Common Name	Scientific Name
Musk Lorikeet	*Glossopsitta concinna*
Australian King-parrot	*Alisterus scapularis*
Crimson Rosella	*Platycercus elegans*
Eastern Rosella	*Platycercus eximius*
Fan-tailed Cuckoo	*Cacomantis flabelliformis*
Horsfield's Bronze-cuckoo	*Chalcites basalis*
Channel-billed Cuckoo	*Scythrops novaehollandiae*
Asian Koel	*Eudynamys scolopaceus*
Southern Boobook	*Ninox novaeseelandiae*
Barn Owl	*Tyto alba*
Tawny Frogmouth	*Podargus strigoides*
White-throated Nightjar	*Eurostopodus mystacalis*
Australian Owlet-nightjar	*Aegotheles cristatus*
White-throated Needletail	*Hirundapus caudacutus*
Laughing Kookaburra	*Dacelo novaeguineae*
Sacred Kingfisher	*Todiramphus sanctus*
Rainbow Bee-eater	*Merops ornatus*
Dollarbird	*Eurystomus orientalis*
Superb Lyrebird	*Menura novaehollandiae*
Satin Bowerbird	*Ptilonorhynchus violaceus*
Superb Fairy-wren	*Malurus cyaneus*
Variegated Fairy-wren	*Malurus lamberti*
Spotted Pardalote	*Pardalotus punctatus*
White-browed Scrubwren	*Sericornis frontalis*
Large-billed Scrubwren	*Sericornis magnirostra*
Brown Gerygone	*Gerygone mouki*
White-throated Gerygone	*Gerygone albogularis*
White-throated Treecreeper	*Cormobates leucophaea*
Brown Thornbill	*Acanthiza pusilla*
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*
Yellow Thornbill	*Acanthiza nana*
Striated Thornbill	*Acanthiza lineata*
Buff-rumped Thornbill	*Acanthiza reguloides*
Red Wattlebird	*Anthochaera carunculata*
Little Wattlebird	*Anthochaera chrysoptera*
Noisy Friarbird	*Philemon corniculatus*
Bell Miner	*Manorina melanophrys*
Noisy Miner	*Manorina melanocephala*
Lewin's Honeyeater	*Meliphaga lewinii*
Yellow-faced Honeyeater	*Lichenostomus chrysops*
White-plumed Honeyeater	*Lichenostomus penicillatus*
Brown-headed Honeyeater	*Melithreptus brevirostris*
White-naped Honeyeater	*Melithreptus lunatus*

Common Name	Scientific Name
New Holland Honeyeater	*Phylidonyris novaehollandiae*
Eastern Spinebill	*Acanthorhynchus tenuirostris*
Scarlet Honeyeater	*Myzomela sanguinolenta*
Jacky Winter	*Microeca fascinans*
Rose Robin	*Petroica rosea*
Eastern Yellow Robin	*Eopsaltria australis*
Eastern Whipbird	*Psophodes olivaceus*
Crested Shrike-tit	*Falcunculus frontatus*
Golden Whistler	*Pachycephala pectoralis*
Rufous Whistler	*Pachycephala rufiventris*
Grey Shrike-thrush	*Colluricincla harmonica*
Black-faced Monarch	*Monarcha melanopsis*
Leaden Flycatcher	*Myiagra rubecula*
Restless Flycatcher	*Myiagra inquieta*
Magpie-lark	*Grallina cyanoleuca*
Rufous Fantail	*Rhipidura rufifrons*
New Zealand Fantail	*Rhipidura fuliginosa*
Willie Wagtail	*Rhipidura leucophrys*
Spangled Drongo	*Dicrurus bracteatus*
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*
White-bellied Cuckoo-shrike	*Coracina papuensis*
Olive-backed Oriole	*Oriolus sagittatus*
Dusky Woodswallow	*Artamus cyanopterus*
Grey Butcherbird	*Cracticus torquatus*
Australian Magpie	*Cracticus tibicen*
Pied Currawong	*Strepera graculina*
Australian Raven	*Corvus coronoides*
White-winged Chough	*Corcorax melanorhamphos*
Apostlebird	*Struthidea cinerea*
Eurasian Skylark	*Alauda arvensis*
Australasian Pipit	*Anthus novaeseelandiae rogersi*
House Sparrow	*Passer domesticus*
Red-browed Finch	*Neochmia temporalis*
Double-barred Finch	*Taeniopygia bichenovii*
Mistletoebird	*Dicaeum hirundinaceum*
Welcome Swallow	*Hirundo neoxena*
Tree Martin	*Petrochelidon nigricans*
Fairy Martin	*Petrochelidon ariel*
Cicadabird	*Coracina tenuirostris*
Red-whiskered Bulbul	*Pycnonotus jocosus*
Australian Reed-warbler	*Acrocephalus australis*
Little Grassbird	*Megalurus gramineus*
Golden-headed Cisticola	*Cisticola exilis*

Common Name	Scientific Name
Silvereye	*Zosterops lateralis*
Eurasian Blackbird	*Turdus merula*
Common Starling	*Sturnus vulgaris*
Common Myna	*Sturnus tristis*

Appendix 4. Habitat requirements for locally-occurring threatened fauna species

Frogs

Common name *Scientific name* Schedule listing	Preferred habitat	Comment
Red Crowned Toadlet *Pseudorhyne australis* BC Act, Sch. 2, Vul.	Almost totally confined to the Hawkesbury sandstone formation. Found in damp situations but not usually associated with permanent water.	No suitable natural habitat occurs on the site.

Reptiles

Common name *Scientific name* Schedule listing	Preferred habitat	Comment
Green Turtle *Chelonia mydas* BC Act, Sch. 2, Vul. EPBC Act, Vul.	Ocean dwelling species spending most of its life at sea, lays its eggs on beaches.	No suitable natural habitat occurs on the site.
Hawksbill Turtle *Eretmochelys imbricate* EPBC Act, Vul.	Ocean dwelling species spending most of its life at sea, lays its eggs on beaches in Queensland.	No suitable natural habitat occurs on the site.
Rosenberg's Goanna *Varanus rosenbergi* BC Act, Sch. 2, Vul.	Found in coastal heaths, humid woodlands and both wet and dry sclerophyll forests. Shelters in burrows, hollow logs and rock crevices.	No suitable natural habitat occurs on the site.

Birds

Common name *Scientific name* Schedule listing	Preferred habitat	Comment
Australasian Bittern *Botaurus poiciloptilus* BC Act, Sch. 2, Vul.	Inhabits wetlands that generally have permanent fresh water and dense vegetation of sedges, rushes and reeds.	No suitable natural habitat occurs on the site.

Common name ***Scientific name*** Schedule listing	Preferred habitat	Comment
Spotted Harrier *Circus assimilis* BC Act Sch. 2, Vul.	Occurs in grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	No suitable natural habitat occurs on the site.
Little Eagle *Hieraaetus morphnoides* BC Act Sch. 2, Vul.	Occupies open Eucalypt forest, woodland or open woodland. She-oak or acacia woodlands and riparian woodlands are also used. Builds a stick nests in winter in tall living trees within remnant patches.	Suitable natural habitat occurs on the site.
Square-tailed Kite *Lophoictinia isura* BC Act, Sch. 2, Vul.	Inhabits coastal forest and woodlands. Most commonly associated with ridge and gully forests dominated by Woollybutt, Spotted Gum or Peppermint Gum.	Suitable natural habitat occurs on the site.
Gang-gang Cockatoo *Callocephalon fimbriatum* BC Act, Sch. 2, Vul.	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, occurs at lower altitudes in drier, more open eucalypt forests and woodlands – also in urban areas including parks and gardens. Requires tree hollows for nesting.	Suitable natural habitat occurs on the site.
Glossy Black-cockatoo *Calyptorhynchus lathami* BC Act, Sch. 2, Vul.	Found in open forests with Allocasuarina species and hollows for nesting.	No suitable natural habitat occurs on the site.
Little Lorikeet *Glossopsitta pusilla* BC Act, Sch. 2, Vul.	Inhabits the open forests and dead timber alongside watercourses. Also occurs in eucalypt forest in mountainous regions.	Suitable foraging habitat occurs on the site.
Swift Parrot *Lathamus discolor* BC Act, Sch. 2, Vul. EPBC Act, End.	Occurs in a variety of Eucalypt forests. Migrates from Tasmania to the mainland during the winter/autumn months to feed mostly on winter flowering Eucalypts.	No suitable foraging habitat occurs on the site.
Barking Owl *Ninox connivens* BC Act, Sch. 2, Vul.	Found in open forests, woodlands, dense scrubs, river red gums and other large trees near watercourses.	Suitable natural habitat occurs on the site.
Powerful Owl *Ninox strenua* BC Act, Sch. 2, Vul.	Pairs occupy permanent territories in mountain forests, gullies and forest margins, sparser hilly woodlands, coastal forests, woodlands and scrubs.	Suitable natural habitat occurs on the site.
Masked Owl *Tyto novaehollandiae* BC Act, Sch. 2, Vul.	Forests, open woodlands and farms with large trees, e.g. river red gums adjacent to cleared country.	No suitable natural habitat occurs on the site.

Common name ***Scientific name*** Schedule listing	Preferred habitat	Comment
Sooty Owl *Tyto tenebricosa* BC Act, Sch. 2, Vul.	Tall, wet forests in sheltered mountain gullies, usually with an east and Southeast aspect.	No suitable natural habitat occurs on the site.
Speckled Warbler *Pyrrholaemus sagittatus* BC Act Sch. 2, Vul.	Inhabits Eucalypt dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	No suitable natural habitat occurs on the site.
Varied Sittella *Daphoenositta chrysoptera* BC Act Sch. 2, Vul.	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	No suitable natural habitat occurs on the site.
Dusky Woodswallow *Artamus cyanopterus cyanopterus* BC Act Sch. 2, Vul.	Often reported in woodlands and dry open sclerophyll forests, usually dominated by eucalypts, including mallee associations. It has also been recorded in shrublands and heathlands and various modified habitats, including regenerating forests; very occasionally in moist forests or rainforests.	No suitable natural habitat occurs on the site.
Flame Robin *Petroica phoenicea* BC Act Sch. 2, Vul.	In NSW it breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. It migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains.	No suitable natural habitat occurs on the site.
Diamond Firetail *Stagonopleura guttata* BC Act Sch. 2, Vul	Mostly inhabits grassy eucalypt woodlands, also occurring in open forest and riparian areas within these. Feeds exclusively on the ground, occurring in flocks between five to 40+ birds.	No suitable natural habitat occurs on the site.

Mammals

Common name ***Scientific name*** Schedule listing	Preferred habitat	Comment
Spotted-tailed Quoll *Dasyurus maculatus* BC Act, Sch. 2, Vul. EPBC Act, End.	Occurs mostly in sclerophyll forest and woodlands as well as coastal heath lands and rainforests. Requires suitable den sites such as hollows or caves and large areas of intact vegetation.	No suitable natural habitat occurs on the site.
Koala *Phascolarctos cinereus* BC Act, Sch. 2, Vul.	Eucalypt forests rich in Swamp Mahogany (E. robusta), Forest Red Gum (E. tereticornis), and Grey Gum (E. punctata).	No suitable natural habitat occurs on the site.
Yellow-bellied Glider *Petaurus australis* BC Act, Sch. 2, Vul.	Restricted to tall, mature sclerophyll forests in regions of high rainfall. Requires nesting hollows and a year-round supply of flowering trees.	No suitable natural habitat occurs on the site.
Squirrel Glider *Petaurus norfolcensis* BC Act, Sch. 2, Vul.	Inhabits dry sclerophyll forest and woodland. Requires abundant hollow-bearing trees and a mix of Eucalypts, acacias and Banksias. At least one floral species should flower heavily in the winter and one or more species of Eucalypts need to be smooth-barked.	No suitable natural habitat occurs on the site.
Grey-headed Flying-fox *Pteropus poliocephalus* BC Act, Sch. 2, Vul. EPBC Act, Vul.	Found in rainforest, wet and dry sclerophyll forest and mangroves. Camps are usually in gullies, close to water and in vegetation with a dense canopy. Feeds on a wide variety of flowering and fruiting plants.	Suitable foraging habitat occurs on the site.
Eastern Freetail-bat *Mormopterus norfolkensis* BC Act, Sch. 2, Vul.	Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in man-made structures.	Suitable foraging habitat occurs on the site.
Large-eared Pied Bat *Chalinolobus dwyeri* BC Act, Sch. 2, Vul.	Found in well-timbered areas containing gullies.	Suitable foraging habitat occurs on the site.
Eastern False Pipistrelle *Falsistrellus tasmaniensis* BC Act, Sch. 2, Vul.	Little known of habitat. Has been found roosting in stem holes of living Eucalypts.	Suitable foraging habitat occurs on the site.

Common name ***Scientific name*** Schedule listing	**Preferred habitat**	**Comment**
Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* BC Act, Sch. 2, Vul.	Well-timbered valleys. Roosts in caves and storm-water channels and similar structures. Does not roost in tree hollows.	Suitable foraging habitat occurs on the site.
Southern Myotis *Myotis macropus* BC Act, Sch. 2, Vul.	Requires open areas of water over which it hunts. Roosts in caves, under bridges and buildings and sometimes in dense foliage in rainforests. May roost in tree hollows.	No suitable natural habitat occurs on the site.
Greater Broad-nosed Bat *Scoteanax rueppellii* BC Act, Sch. 2, Vul. EPBC Act, Lower risk (near threatened)	Found in woodlands, moist and dry sclerophyll forests and rainforests. Prefers gullies. Roosts in tree hollows only.	Suitable foraging habitat occurs on the site.

Invertebrates

Common name ***Scientific name*** Schedule listing	**Preferred habitat**	**Comment**
Cumberland Plain Land Snail *Meridolum corneovirens* BC Act, Sch. 1, End. EPBC Act, Vul.	Found amongst logs and debris in Cumberland Plain and Castlereagh woodlands.	No suitable natural habitat occurs on the site.
Dural Woodland Snail *Pommerhelix duralensis* EPBC Act, End.	Forested habitats that have good native cover and woody debris. Under rocks or inside curled-up bark. It does not burrow nor climb.	No suitable natural habitat occurs on the site.

Appendix 5. Habitat requirements for locally-occurring threatened plant species

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Acacia asparagoides ROTAP, 2R	Grows in dry sclerophyll forest or occasionally heath on sandstone in the Blue Mountains.	No
Acacia baueri subsp. aspera ROTAP, 2RC – BC Act, Sch. 2, Vul.	Grows in low heath, often on exposed sandstone ridges in the Blue Mountains and Royal National Park.	No
Acacia bynoeana ROTAP, 3VC - BC Act, Sch. 1, End. EPBC Act, Vul.	Grows mainly in heath and dry sclerophyll forest, in sandy soils.	No
Acacia clunies-rossiae ROTAP, 2RC - t BC Act, Sch. 2, Vul.	Grows in dry sclerophyll forest, in valleys, on slopes and ridges, and along creeks.	No
Acacia flocktoniae ROTAP, 2VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in dry sclerophyll forest on sandstone.	No
Acacia gordonii ROTAP, 2K BC Act, Sch. 1, End. EPBC Act, End.	Grows in dry sclerophyll forest and heath on sandstone outcrops.	No
Acacia pubescens ROTAP, 3VCa BC Act, Sch. 2, Vul. EPBC Act, Vul.	Usually grows in dry sclerophyll forest and woodland in clay soils. Often in roadside and railside bushland remnants.	No
Acacia terminalis subsp. terminalis ROTAP, 2RCi BC Act, Sch. 1, End. EPBC Act, End.	Scattered or locally common in scrub and open eucalypt woodland or forest, usually in sandy soil on creek banks, hillslopes or in shallow soil in rock crevices and sandstone platforms on cliffs.	No
Acrophyllum australe ROTAP, 2VCi BC Act, – Sch. 2, Vul. EPBC Act, Vul.	Grows in damp crevices in sandstone, usually near waterfalls. Restricted to the Blue Mtns, near Springwood, Linden, Woodford and Lawson.	No
Allocasuarina glareicola ROTAP, 2E BC Act, Sch. 1, End. EPBC Act, End.	Grows in open forest on lateritic soil; restricted to a few small populations in or near Castlereagh S.F., NE of Penrith.	No
Almaleea incurvata ROTAP, 2RC – t	Grows in swamps dominated by sedges and/or shrubs, on sandstone; restricted to the Blue Mtns.	No
Amperea xiphoclada var. papillata ROTAP, 3KC	Grows with other native sedges and rushes in swamps on sandstone at altitudes of greater than 600 m.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Ancistrachne maidenii ROTAP, 2KC - BC Act, Sch. 2, Vul.	Grows on sandstone soils; north of Sydney.	No
Angophora crassifolia ROTAP, 2RCa	Locally frequent but restricted to the Ku-ring-gai Plateau region.	No
Asterolasia elegans ROTAP, 2ECa BC Act, Sch. 1, End. EPBC Act, End.	Grows in wet sclerophyll forest on moist hillsides, known from only one locality, north of Maroota.	No
Atkinsonia ligustrina ROTAP, 2RCa	Occurs in woodland and heath in exposed sites, a single plant often parasitic on the roots of many nearby plants; confined to a small area in the Blue Mtns.	No
Banksia conferta var. penicillata BC Act, Sch. 1, End.	Grows in dry sclerophyll forest or woodland, restricted to small populations in the Blue Mtns on sandstone cliffs or steep slopes and around rocky outcrops.	No
Blandfordia cunninghamii ROTAP, 3RCi	Grows in damp shallow sandy and peaty soils, often on sandstone cliff edges; chiefly in the Blue Mtns and Illawarra areas.	No
Blechnum gregsonii ROTAP, 2RCa	Pendent clumps found in cool rainforest, often in damp places near waterfalls, sometimes epiphytic; chiefly in the Blue Mtns and Illawarra coastal ranges.	No
Boronia fraseri ROTAP, 2RCa (UBBS 97 Recommend)	Grows mainly in wet sclerophyll forest and in rainforest in gullies on sandstone, chiefly in the Sydney region.	No
Boronia serrulata ROTAP, 2RC -	Grows in moist heath in sandy situations, chiefly in a coastal band in the Sydney district; record for the SWS in Jacobs & Pickard (1981) not substantiated.	No
Brasenia schreberi ROTAP, 3RC- +	Widespread but rarely common, found in shallow freshwater lagoons or backwaters.	No
Callistemon linearifolius ROTAP, 2RCi BC Act, Sch. 2, Vul.	Grows in dry sclerophyll forest on the coast and adjacent ranges, chiefly from Georges R. to the Hawkesbury R.	Yes
Callistemon shiressii ROTAP, 3RC -	Grows on shale ridges, in moist eucalypt forest and rainforest gullies, occasionally along riverbanks; chiefly from Colo R. to Gosford district, also Howes Valley to Bulga district.	No
Carex klaphakei BC Act, Sch. 1, End.	Known only from a few localities on Central Tablelands near Blackheath, Mt Werong and Penrose at 600–1200 m alt.	No
Chamaesyce psammogeton BC Act, Sch. 1, End.	Grows on dunes and sea strandlines.	No
Cryptostylis hunteriana BC Act, Sch. 2, Vul. EPBC Act, Vul.	Does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Cynanchum elegans ROTAP, 3ECi BC Act, Sch. 1, End. EPBC Act, End.	Rare, recorded from rainforest gullies scrub and scree slopes; from the Gloucester district to the Wollongong area and inland to Mt Dangar.	No
Cyphanthera scabrella ROTAP, 2RC -	Grows in dry or wet sclerophyll forest in sandstone-derived soil; restricted to Bilpin-Mt Wilson area in Blue Mtns.	No
Darwinia biflora ROTAP, 2VCa BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath on sandstone or in the understorey of woodland on shale-capped ridges; Cheltenham to Hawkesbury R., rare.	No
Darwinia diminuta ROTAP, 2RCi	Grows in heath or dry sclerophyll forest in poorly drained sandy soil; Manly to Ingleside and Loftus to Helensburgh, rare.	No
Darwinia fascicularis subsp. oligantha BC Act, Sch. 1, End. Pop. (Baulkham Hills)	Grows in heath or shallow soils; higher parts of the Blue Mtns.	No
Darwinia grandiflora ROTAP, 2RCi	Grows in dry sclerophyll forest and woodland on poorly drained sandy soil; Woronora Plateau and Illawarra region, rare.	No
Darwinia peduncularis ROTAP, 3RCi BC Act, Sch. 2, Vul.	Grows in dry sclerophyll forest on sandstone hillsides and ridges; Hornsby to Hawkesbury R. and west to Glen Davis, rare.	No
Deyeuxia appressa ROTAP, 2E BC Act, Sch. 1, End. EPBC Act, End.	Grows on wet ground; in the Hornsby area.	No
Deyeuxia microseta ROTAP, 3KC -	Grows in montane sclerophyll forest, especially wetter areas.	No
Dillwynia tenuifolia ROTAP, 2RCa BC Act, Sch. 2, Vul.	Grows in dry sclerophyll woodland on sandstone, shale or laterite; from Cumberland Plain, Blue Mtns to Howes Valley area.	No
Discaria pubescens ROTAP, 3RCa	In woodland and forest, often in rocky situations; widespread, but considered endangered.	No
Diuris aequalis ROTAP, 3VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows among grass in sclerophyll forest, mainly in the ranges and tablelands; chiefly from Braidwood to Kanangra and Liverpool.	No
Epacris hamiltonii ROTAP, 2ECi BC Act, Sch. 1, End. EPBC Act, End.	Grows in skeletal sandy soils in sheltered damp rock situations on sandstone in the Blackheath area.	No
Epacris muelleri ROTAP, – 3RC -	Grows on skeletal soils on damp rock faces on sandstone in the Blue Mtns and Wollemi N.P.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Epacris purpurascens var. purpurascens BC Act, Sch. 2, Vul.	Grows in sclerophyll forest, scrubs and swamps on sandstone from Gosford and Sydney districts.	No
Epacris sparsa ROTAP, 2VCi BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in sandy soil among rocks beside Grose R.	No
Epacris sparsa ROTAP, 2VCi BC Act, Sch. 2, Vul. EPBC Act, Vul.	Rare and localized, in mallee shrubland on skeletal sandy soil on sandstone; sporadic occurrences between Linden and Berrima.	No
Eucalyptus baeuerlenii ROTAP, 3RCa	Locally frequent but restricted, in wet forest or woodland in sheltered often sloping sites; from Wentworth Falls to Budawang Ra.	No
Eucalyptus benthamii ROTAP, 2VCi BC Act, Sch. 2, Vul. EPBC Act, Vul.	Restricted but locally abundant, in wet forest on sandy alluvial soils along valley floors; confined to the lower Nepean R. area.	No
Eucalyptus burgessiana ROTAP, 2RCa	Locally frequent but restricted, in mallee shrubland on skeletal sand on sandstone; restricted to lower Blue Mtns.	No
Eucalyptus camfieldii ROTAP, 2VCi BC Act, Sch. 2, Vul. EPBC Act, Vul.	Rare and localized, in coastal shrub heath on sandy soils on sandstone, often of restricted drainage; from Gosford to Royal N.P.	No
Eucalyptus cannonii ROTAP, 2VCi BC Act, Sch. 2, Vul.	Locally frequent but restricted, in sclerophyll woodland on shallow soil on rises; Rylstone to upper Wolgan Valley.	No
Eucalyptus copulans ROTAP, 2E BC Act, Sch. 1, End. EPBC Act, End.	Locally frequent but restricted, in sclerophyll woodland on shallow soil on rises; Rylstone to upper Wolgan Valley.	No
Eucalyptus cunninghamii ROTAP, 2RCa	Restricted but locally frequent, in mallee heath skeletal sandy soil on sandstone; confined to central Blue Mtns.	No
Eucalyptus sp. 'Cattai' BC Act, Sch. 1, End.	Grows as isolated trees or small groups of trees in scrub, heath and low woodland, in sandstone-derived soils.	No
Eucalyptus leuhmanniana ROTAP, 2RCa	Locally abundant but restricted, in mallee heath on shallow infertile sandy soils of poor drainage on sandstone; confined to coastal plateau between the Hawkesbury R. and Bulli.	No
Euphrasia bowdeniae ROTAP, 2VCit BC Act Sch. 2, Vul. EPBC Act, Vul.	Grows on sandstone cliffs in shallow soil on ledges or sometimes trailing over rock, in higher parts of Blue Mtns.	No
Genoplesium baueri BC Act, Sch. 1, End.	Prefers sandy dry Eucalyptus habitats.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Grammitis stenophylla BC Act, Sch. 1, End.	Prefers moist shaded gullies, typically grows on rocks near moss.	No
Gonocarpus longifolius ROTAP, 3RC -	Grows in shrub communities on sandstone; mainly on the ranges from Armidale to the Blue Mtns, east of Rylstone.	No
Goodenia rostrivalvis ROTAP, 2RCa	Grows on damp south-facing sandstone cliffs in Blue Mtns, in the Wentworth Falls area, rare.	No
Grevillea caleyi BC Act, Sch. 1, End. EPBC Act, End.	Grows on sandy soil with lateritic influences, typically on ridges.	No
Grevillea juniperina subsp. juniperina BC Act, Sch. 2, Vul.	Grows in open dry sclerophyll (eucalypt-dominated) forest or woodland, at altitudes of less than about 50 m, in sandy to clay-loam soils and red pseudolateritic gravels.	No
Grevillea longifolia ROTAP, 2RC -	Grows in moist areas of sclerophyll forest, often near creeks, on Hawkesbury sandstone; chiefly the southern half of Sydney Basin, and Woronora Plateau; possibly also in Lawson area.	No
Grevillea obtusiflora BC Act, Sch. 1, End. EPBC Act, End.	Grows in sandy loam soils in open low scrub beneath dry sclerophyll forest in the Kandos area.	No
Grevillea parviflora subsp. parviflora BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heathy associations or shrubby woodland, in sandy or light clay soils usually over shale substrates.	No
Gyrostemon thesioides ROTAP, 2KC - BC Act Sch. 1, End.	Grows on hillsides and riverbanks, only from sites near Georges (30 yrs ago) and Nepean Rivers (90 yrs ago). May already be extinct.	No
Hakea constablei ROTAP, 2RCa	In dry sclerophyll forest on rocky outcrops, scattered in the Blue Mtns between 500–1100 m alt., from Bell to Mt Wilson, rare.	No
Haloragodendron lucasii BC Act, Sch. 1, End. EPBC Act, End.	Grows indry sclerophyll open forest on sheltered slopes near creeks on sandstone; confined to Sydney area, rare.	No
Hibbertia hermanniifolia ROTAP, 3RCa	Open forest on sandstone; confined to Bents Basin (Nepean R), Yarrowitch district and the coastal ranges south from Wadbilliga N.P.; rare.	No
Hibbertia nitida ROTAP, 2RC -	Widespread on sandstone in the Sydney district.	No
Hibbertia superans BC Act, Sch. 1, End.	Occurs in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	No
Hymenophyllum lyallii (was *Sphaerocionium lyallii*) ROTAP, 3RC – +	Grows on rocks or trees in moist rainforest in the Blue Mtns and ranges of the south coast.	No
Hymenophyllum pumilum ROTAP, 3RC -	Epiphytic in cooler rainforest of the Blue Mtns and adjacent ranges; uncommon.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Isopogon fletcheri ROTAP, 2VCa BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in dry sclerophyll forest and heath on sandstone; confined to sheltered moist positions on the escarpment in the Blackheath district of the Blue Mtns, rare.	No
Isotoma sessiliflora (was *Hypsela sessiliflora*) ROTAP, 2X BC Act, Sch. 1, End.	Grows in damp places, on the Cumberland Plain, very rare.	No
Keraudrenia corollata var. denticulata ROTAP, 3RC -	Mostly on sandstone. Rare; recorded from near Grafton and west of Sydney.	No
Kunzea cambagei ROTAP, 2VCa BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath; known mainly from near Mt Werong and Berrima.	No
Kunzea rupestris ROTAP, 2VCa BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath on rock platforms; known only from between Lower Portland and Kuring-gai Chase N.P., one record at Ingleside.	No
Lasiopetalum joyceae ROTAP, 2RC - BC ACT, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath on sandstone; Hornsby Plateau.	No
Leionema lachnaeoides ROTAP, 2ECi BC Act, Sch. 1, End. EPBC Act, End.	Rare, from higher Blue Mtns, on barren rocky situations.	No
Lepidosperma evansianum BC Act, Sch. 2, Vul.	Grows on wet sandstone cliff faces.	No
Lepidosperma evansianum BC Act, Sch. 2, Vul. *Leptospermum rupicola* ROTAP, -3RC -	Grows in shrubby communities and heath on sandstone cliffs and escarpments.	No
Leptospermum deanei BC ACT, Sch. 2, Vul. EPBC Act, Vul.	Rare, only on forested slopes near watershed of Lane Cove R., Sydney.	
Leucopogon exolasius ROTAP, 2VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in woodland on sandstone, restricted to the Woronora and Grose Rivers and Stokes Creek, Royal N.P.	No
Leucopogon fletcheri subsp. fletcheri ROTAP, 2RC - BC Act, Sch. 1, End.	Grows in woodland on lateritic soils; rare, in the Springwood area.	No
Lissanthe sapida ROTAP, 3RCa	Grows in open woodland and dry sclerophyll forest, on rocky sandstone ridges and hillsides on sandy soil; occasional, from Bargo to Coloul Ra. and Blackheath.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Lomandra brevis ROTAP, 2RC -	Grows in dry sclerophyll forest on sandstone-derived soils in the Sydney region; not common.	No
Lomandra fluviatilis ROTAP, 3RCa	Grows in creek beds on sandy soils; in the Royal N.P. to Colo R	No
Marsdenia viridiflora subsp. viridiflora BC Act, Sch. 1, End. Pop.	Grows in woodland and scrub; north from the Razorback Ra. (Bankstn, Blacktn, Camden, Campbelltn, Fairfield, Holroyd, Liverpool & Penrith LGAs)	No
Melaleuca deanei ROTAP, 3RC- BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in wet heath on sandstone; uncommon, in coastal districts from Berowra to Nowra.	No
Micromyrtus blakelyi ROTAP, 2VCi BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath in depressions on sandstone rock platforms; restricted to areas near the Hawkesbury R.	No
Micromyrtus minutiflora ROTAP, 2V BC Act, Sch. 1, End. EPBC Act, Vul.	Grows in dry sclerophyll forest in western part of the Cumberland Plain; rare.	No
Microtis angusii BC Act, Sch. 1, End. EPBC Act, End.	Difficult to determine, growing among weeds and on a disturbed soil. Possibly prefers sandy soils with lateritic influences.	No
Monotoca ledifolia ROTAP, 3RC - *Notochloe microdon* ROTAP, 2RC -	Grows in exposed sites in dry sclerophyll forest and shrubland on sandstone in the Woronora Plateau and Blue Mtns area.	No
Notochloe microdon ROTAP, 2RC -	Grows in moist shady areas of the Blue Mtns district.	No
Olearia cordata ROTAP, 2VCi BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in dry sclerophyll forest and open shrubland, on sandstone; chiefly from Wisemans Ferry to Wollombi.	No
Olearia quercifolia ROTAP, 3RC -	Grows in swampy or moist terrain; confined to the Blue Mtns.	No
Ozothamnus adnatus ROTAP, 3KC-	Grows in sclerophyll forest and woodland, usually on sandy soil; rare, south from Guyra district.	No
Persoonia acerosa ROTAP, 2VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath or dry sclerophyll forest on sandstone; central Blue Mtns south to Hill Top.	No
Persoonia bargoensis ROTAP, 2V BC Act, Sch. 1, End. EPBC Act, Vul.	Grows in woodland to dry sclerophyll forest, on sandstone and laterite; restricted to the Bargo area.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Persoonia hirsuta/revoluta ROTAP, 3KCi BC Act, Sch. 1, End. EPBC Act, End.	Grows in woodland to dry sclerophyll forest on sandstone; both subspecies occurring as isolated individuals or very small populations.	No
Persoonia laxa BC Act, Sch. 1, Ext. EPBC Act, Ext.	Considered extinct. Probably prefers heath or sclerophyll forest with sandy soils.	No
Persoonia mollis subsp. maxima ROTAP, 2E BC Act, Sch. 1, End. EPBC Act, End.	Grows in dry to wet sclerophyll forest on Hawkesbury sandstone, Cowan–Hornsby area.	No
Persoonia nutans ROTAP, 2ECi BC Act, Sch. 1, End. EPBC Act, End.	Grows in woodland to dry sclerophyll forest on laterite and alluvial sand; confined to the Cumberland Plain.	No
Pherosphaera fitzgeraldii (was *Microstrobos fitzgeraldii*) ROTAP, 2ECi BC Act, Sch. 1, End.	Usually grows on wet rocks within the spray of waterfalls or on ledges or in caves near waterfalls; restricted to southerly aspects on sandstone near waterfalls in the Katoomba to Wentworth Falls area of the Blue Mtns.	No
Philotheca obovalis (was *Eriostemon obovalis*) ROTAP, 3RCa	Grows in heath and dry sclerophyll forest on sandstone; chiefly in the Blue Mountains, also recorded for Kydra Mountain.	No
Pilularia novae-hollandiae BC Act, Sch. 1, End.	Widespread but not common in seasonally dry depressions and margins of marshes; may grow submerged.	No
Pimelea curviflora var. curviflora BC Act, Sch. 2, Vul. EPBC Act, Vul.	Confined to coastal areas around Sydney on sandstone.	No
Pimelea spicata ROTAP, 3ECi BC Act, Sch. 1, End. EPBC Act, End.	Grows on the coast from Lansdowne to Shellharbour and inland to Penrith; rare.	No
Platysace clelandii ROTAP, 2RCa	Grows among sandstone boulders in dry sclerophyll forest, from Glen Davis to Berowra.	No
Pomaderris brunnea ROTAP, 2VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	In open forest, confined to the Colo R. and upper Nepean R.	No
Prostanthera cryptandroides BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows chiefly in the Lithgow to Sandy Hollow districts.	No
Prostanthera densa BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in sclerophyll forest and shrubland, on coastal headlands and near-coastal ranges, on sandstone	Yes
Prostanthera marifolia BC Act, Sch. 4, Ext A. EPBC Act, CE.	Occurs in sandy soils with clay-loam and ironstone on ridge tops.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Pseudanthus divaricatissimus ROTAP, 3RCa	Mostly from Muswellbrook to Bega, with outlying populations near Urbenville and Dubbo (Goonoo State Forest).	No
Pterostylis gibbosa ROTAP, 2E (X-WSyd) BC Act, Sch. 1, End. EPBC Act, End.	Grows among grass in sclerophyll forest; rare, chiefly in the southern parts of the central coast, with a disjunct population in the Hunter Valley.	No
Pterostylis saxicola ROTAP, (2E) BC Act, Sch. 1, End. EPBC Act, End.	Grows in shallow soil over sandstone sheets, often near streams; rare, from Picnic Point to Picton area.	No
Pultenaea sp. 'Genowlan Point' (NSW 417813) BC Act, Sch. 1, Crit. End. EPBC Act, Crit. End.	It is endemic to New South Wales and is only found at Genowlan Point in the Capertee Valley. At Genowlan Point, Pultenaea sp. 'Genowlan Point' (Allen s.n., 29 Nov. 1997) is restricted to well drained stoney soils.	No
Pultenaea glabra EPBC Act, Vul.	Grows in dry sclerophyll forest on sandstone; higher Blue Mtns and Glen Davis area.	No
Pultenaea parviflora ROTAP, 2E BC Act, Sch. 1, End. EPBC Act, Vul.	Grows in dry sclerophyll forest on Wianamatta Shale, laterite or alluvium, Cumberland Plain.	No
Pultenaea pedunculata BC Act, Sch. 1, End.	Grows in dry sclerophyll forest and disturbed sites on a variety of soils on the South Coast and edge of the Southern Tableland, but with disjunct restricted populations on Wianamatta Shale on the Cumberland Plain in N.S.W.	No
Pultenaea villifera var. villifera ROTAP, 3RC - BC Act, Sch. 1, End. Pop. (Lower Blue Mountains)	Grows in dry sclerophyll forest on sandy soil; lower Blue Mtns to Eden district.	No
Rhizanthella slateri ROTAP, 3KC - BC Act, Sch. 2, Vul. EPBC Act, End.	Grows in sclerophyll forest in shallow to deep loams. Collections tend to be accidental and it is not possible to determine distribution accurately; recorded for the Blue Mtns, also Bulahdelah south to Dharug N.P.	No
Rupicola apiculata ROTAP, 2RCa	Grows in skeletal sandy soils in damp situations on sandstone rock ledges between 700–1100 m alt.; restricted to the Blue Mtns.	No
Rupicola ciliata ROTAP, 2RC – t	Grows in skeletal sandy soils in rock crevices, on rock ledges and beneath cliff overhangs in Kurrajong Heights, Bilpin to lower Yarramun Creek areas in the Blue Mtns.	No
Rupicola sprengelioides ROTAP, 2RC – t	Restricted to skeletal sandy soils on sandstone ledges, cliff faces and rocky ground, in the Burragorang Valley.	No
Sprengelia monticola ROTAP, 2RC – t	Grows on wet rock faces and ledges or cliff bases on sandstone in the Blue Mtns.	No

Botanical name **Conservation status**	**Habitat description**	**Suitable habitat on site**
Syzygium paniculatum BC Act, Sch. 1, End. EPBC Act, Vul.	Rainforest and open forest near riparian zones.	No
Tetratheca glandulosa ROTAP, – 2VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in sandy or rocky heath or scrub, from Mangrove Mtn to the Blue Mtns and Sydney.	No
Tetratheca neglecta ROTAP, 3RC -	Grows in sandy heath and dry sclerophyll forest; chiefly in the Sydney district, south to Robertson.	No
Thesium australe ROTAP, 3VCi BC Act, -Sch. 2, Vul. EPBC Act, Vul.	Grows in grassland or woodland, often in damp sites; widespread but rare and possibly endangered.	No
Tylophora woollsii ROTAP, 2E BC Act, Sch. 1, End. EPBC Act, End.	Grows in wet sclerophyll forest and rainforest in the Clouds Creek area near Nymboida and in sclerophyll forest near Parramatta; rare.	No
Velleia perfoliata ROTAP, 2VC - BC Act, Sch. 2, Vul. EPBC Act, Vul.	Grows in heath on shallow sandy soil over sandstone; confined to the Hawkesbury district to the upper Hunter Valley.	No
Veronica lithophila (was *Parahebe lithophila*) ROTAP, 2RC -	Grows on cliffs or rock exposures, in pockets of soil over sandstone or quartzite; Blue Mtns-Colong region at 650–870 m alt., uncommon.	No
Wilsonia backhousei BC Act, Sch. 2, Vul.	Grows in coastal saltmarshes; chiefly in the Sydney district, also common at Jervis Bay.	No
Zieria covenyi BC Act, Sch. 1, End. EPBC Act, End.	Grows in eucalypt woodland on sandy soils; known only from Narrow Neck Peninsular in the Blue Mtns N.P.	No
Zieria involucrata ROTAP, 2VCa BC Act, Sch. 1, End. EPBC Act, Vul.	Grows in wet sclerophyll forest, chiefly in the Lower Blue Mtns; rare.	No
Zieria murphyi ROTAP, 2VC-	Grows in dry sclerophyll forest in sandy soils; on the ranges from Mt Tomah to Penrose district.	No
Zieria prostrata BC Act, Sch. 1, End. EPBC Act, End.	Restricted to low coastal heaths, near Coffs Harbour; rare.	No

Key

BC Act 2016:

Sch1 = Schedule 1: Endangered species
Part 1: endangered species
Part 2: endangered populations
Part 3: endangered ecological communities
Part 4: species presumed extinct
Sch2 = Schedule 2: Vulnerable species

EPBC Act 1999:

CE = Critically Endangered
E = Endangered
V = Vulnerable
EP = Endangered Population

ROTAP Codes

1 Known by one collection only
2 Geographic range in Australia < 100Km
3 Geographic range in Australia > 100Km
E Endangered
V Vulnerable
R Rare
X Extinct
K Poorly known
C Reserved
a > or = 1000 plants reserved
i < 1000 plants reserved
t Total known population reserved
- Reserved population size unknown
+ Overseas occurrence

Appendix 6. Matters of National Environmental Significance

The Protected Matters Search Tool was used to find relevant Matters of National Environmental Significance (MNES) on or near the site.

EPBC Act Protected Matters Report

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

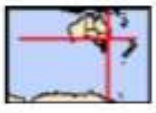
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 25/09/18 12:03:13

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 1.0Km



No World Heritage Properties, National Heritage Places, Wetlands of International Importance or Commonwealth Marine Areas are recorded for the area.

No Commonwealth Land, Commonwealth Heritage Places, Critical Habitats, Australian Marine Parks or Commonwealth Terrestrial Reserves were reported.

Three Listed Threatened Ecological Communities are recorded in the area: 1. Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland; 2. Coastal Upland Swamps in the Sydney Basin Bioregion; and 3. *Posidonia australis* seagrass meadows of the Manning-Hawkesbury ecoregion. These ecological communities are protected under Commonwealth legislation by the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999) and are listed as Endangered.

Appendix 7. Company Profile

Abel Ecology has been in the biodiversity consulting business since 1991, starting in the Sydney Region, and progressively more state wide in New South Wales since 1998, and now also in Victoria. During this time extensive expertise has been gained with regard to Master Planning, Environmental Impact assessments including flora and fauna, bushfire reports, Vegetation Management Plans, Management of threatened species, Review of Environmental Factors, Species Impact Statements, Biodiversity Development Assessment Reports and as Expert Witness in the Land and Environment Court. We have done consultancy work for industrial and commercial developments, golf courses, civil engineering projects, tourist developments as well as residential and rural projects. This process has also generated many connections with relevant government departments and city councils in NSW. Our team consists of four scientists and two administrative staff, plus casual assistants as required.

Licences

NPWS s132C Scientific licence number is SL100780 expires 30 April 2019
NPWS GIS data licence number is CON95034
DG NSW Dept of Primary Industries Animal Care and Ethics Committee Approval expires 8 December 2021
DG NSW Dept of Primary Industries Animal Research Authority expires 8 November 2019

The Consultancy Team

Dr Danny Wotherspoon

Grad Dip Bushfire Protection (University of Western Sydney 2012)
PhD (researching Cumberland Plain vegetation and fauna habitat, at Centre for Integrated Catchment Management, University of Western Sydney, 2008)
Planning for Bushfire Protection Certificate course (University of Technology, 2006)
Consulting Planners Bushfire Training Course (Planning Institute of Australia, 2003)
MA (Macquarie University, 1991)
Wildlife Photography Certificate (Sydney Technical College, 1987)
Herpetological Techniques Certificate (Sydney Technical College, 1986)
Applied Herpetology Certificate (Sydney Technical College, 1980)
Dip Ed (University of New England, 1978)
BSc (Zoology, Ecology) University of New England 1974)

Dr Daniel McDonald

B. Ag Sc; M. Agr; PhD (The University of Sydney)
Cert IV – GIS (Riverina TAFE)
Daniel is an accredited Biobanking Assessor (0075) and an accredited BAM assessor (BAAS17056)
Quantified Tree Risk Assessment (QTRA) and Visual Tree Assessment (VTA), White Card

Daniel is an experienced ecologist with expertise in fauna, plant species identification, vegetation assessment, agriculture, arboriculture, conservation genetics and seed collection and preservation. He is accredited both for BAM assessments, BioBanking assessments and Biodiversity Certification. His present research interest is in Eastern Suburbs Banksia Scrub and fragmented endangered ecological communities.

Mark Mackinnon

Qualifications: B Env. Sci. (Hons),

MEIANZ, White Card

Graduate Diploma of Bushfire Protection (enrolled)

Mark is a passionate and enthusiastic scientist who thrives in the field of natural resource management. In the last 6 years, Mark has worked for a number of inter-state government agencies and environmental consultancies. He has experience in threatened species, fire ecology, bushfire management, pest plant and animals, and landscape restoration. In particular he specializes in ornithology and bushfire management. Mark has a number of specialized field-based skills including: simple and complex tree climbing, working at heights, general firefighter departmental fire accreditation, venomous snake and reptile handling, immunization to handle bat species, and an A - class bird banding licence with mist-net endorsement. Mark is also skilled in ArcGIS mapping, first-aid, four -wheel-driving.

Dr Alison Hewitt
B. Sc. (Hons), PhD.
MESA, MAPS, MASBS, Snr 1st Aid cert, White card.
Alison has researched and published on the reproductive biology and ecology of Australian Melaleuca species, native plant responses to fire and the vegetation of western Sydney. Alison's interests include plant ecology and flora survey methodology, bush regeneration, plant identification and gardening. Alison teaches Botany and Ecology sessionally with Western Sydney University.

Dr Stephanie A Clark

BAppSc (Biochemistry), MSc, PhD
Member of the IUCN SSC Mollusc Specialist Group. Research Associate at both the Field Museum of Natural History, Chicago, IL, USA and The Australian Museum, Sydney, NSW.

Stephanie has been interested in the taxonomy, systematics and conservation of invertebrates particularly molluscs since the late 1970's when she first started volunteering at the Australian Museum. She has been an ecological consultant specialising in invertebrates since 1997. She has worked for private developers, mining companies, local community groups and local, state and federal government agencies in three countries (Australia, USA and Canada) and has been an expert witness for the NSW Land and Environment Court.
Stephanie's PhD researched the taxonomy, systematics and conservation of the NSW listed snail Meridolum corneovirens (Cumberland Plain Land Snail). She has given presentations to local, national and international conferences in Australia, Germany and USA. She has field experience in 16 countries, all states of Australia and 40 US states. Stephanie's has published more than 30 scientific papers in national and international journals and described more than 155 species.

Mark Sherring
BM, MAABR, Cert. Hort., Cert. Bush Regen, Cert. Rural Ops, White Card.

Member of the Australian Association of Bush Regenerators

Mark has extensive knowledge and experience of plant species in New South Wales. He has built up his expert knowledge on NSW native plant species over the many years that he has practised as a Botanist. He is regularly asked to contribute to the extensive (ongoing) flora surveys of the Sydney Basin and Blue Mountains carried out by the Royal Botanic Gardens, Sydney. Mark has extensive field survey experience, having worked for over ten years in various plant-related roles. His role in Abel Ecology is to provide expert advice on flora and on the full range of flora management issues encountered and in the design and management of environmental monitoring projects.