northern
beaches
council

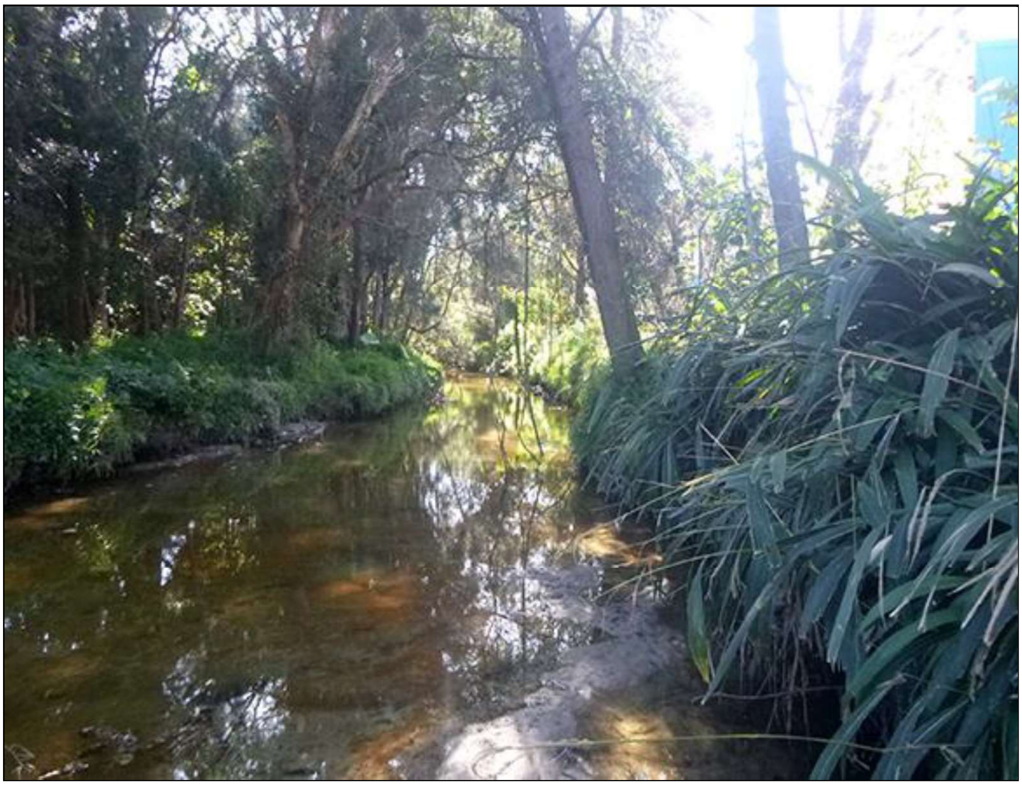
2 April 2024

The following is provided as **reference documentation** in accordance with the Department of Planning, Housing and Infrastructure's letter dated 21 February 2024 to;

- ***include updated technical information prepared as part of the current development application for the golf clubhouse.***

The following technical documentation is provided:

- Aboriginal Heritage Due Diligence Assessment Report – as submitted for DA2022/2081
- Acid Sulphate Management Plan – as submitted for DA2022/2081
- Acid Sulphate Assessment – as submitted for DA2022/2081
- Acoustic Assessment – as submitted for DA2022/2081
- Arboricultural Impact Assessment – as submitted for DA2022/2081
- Flood Management Report - as submitted for DA2022/2081
- Flora and Fauna Assessment Report and Waterway Impact Statement – as submitted for DA2022/2081
- Geotechnical assessment – as submitted for DA2022/2081
- Preliminary Site Investigation - as submitted for DA2022/2081



View north along Brookvale Creek adjacent to the study area.

ABORIGINAL DUE DILIGENCE ASSESSMENT REPORT

WARRINGAH GOLF CLUB

WARRINGAH, SYDNEY

AUGUST 2023

Report prepared by

OzArk Environment & Heritage

for Warringah Golf Club

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Document Controls

Proponent	Warringah Golf Club	
Document Description	*Aboriginal Due Diligence Assessment Report: Warringah Golf Club, North Manly*	
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Acknowledgement

OzArk acknowledge the traditional custodians of the area on which this assessment took place and pay respect to their beliefs, cultural heritage, and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the Elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

Executive Summary

OzArk Environment & Heritage (OzArk) has been engaged by Warringah Golf Club (the proponent) to complete an Aboriginal due diligence heritage assessment for the proposed construction of the Warringah Golf & Community Clubhouse (the proposal). The proposal is in the Northern Beaches Council Local Government Area (LGA).

The study area is located at Lot 2742 DP752038 on Kentwell Road in North Manly and encompasses approximately 1.1 hectares (ha) of land, of which most has been developed for existing tennis courts, buildings, and car parking.

A search of the Aboriginal Heritage Information Management System (AHIMS) shows there are no previously recorded Aboriginal sites within the study area, however, landform modelling shows there are landforms with identified archaeological sensitivity (landforms within 200 metres [m] of 'water'). As such, the assessment progressed to a visual inspection.

The visual inspection of the study area was undertaken on 11 August 2023 by OzArk Archaeologist, Harrison Rochford, and Josh Muir, representing Metropolitan Local Aboriginal Land Council. No Aboriginal sites or areas with potential to contain subsurface deposits were identified.

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *Aboriginal Heritage Impact Permit application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 9873 8500 (heritagemailbox@environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

The proposed work may proceed without further archaeological investigation under the following conditions:

1) All land and ground disturbance activities must be confined to within the study area, as this will eliminate the risk of harm to Aboriginal objects that may be in adjacent landforms. Should the parameters of the proposal extend beyond the assessed areas, then further archaeological assessment may be required.
2) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 2**) should be followed.

3) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 3**) and are aware of the legislative protection of Aboriginal objects under the *National Parks and Wildlife Act 1974* and the contents of the *Unanticipated Finds Protocol.*

4) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

Contents

FIGURES

TABLES

PLATES

1 INTRODUCTION

1.1 BRIEF DESCRIPTION OF THE PROPOSAL

OzArk Environment & Heritage (OzArk) has been engaged by Warringah Golf Club (the proponent) to complete an Aboriginal due diligence heritage assessment for the proposed construction of the new Warringah Golf & Community Club Clubhouse (the proposal). The proposal is in the Northern Beaches Council Local Government Area (LGA).

Warringah Golf Club propose to construct a new club house, to be located on the existing footprint of the current tennis courts at Lot 2742 DP752038 on Kentwell Road in North Manly (**Figure 1-1**).

Figure 1-1: Club House and Tennis Courts location.

1.2 STUDY AREA

The study area is located at Lot 2742 DP752038 on Kentwell Road in North Manly which encompasses approximately 1.1 hectares (ha) of land, most of which has been developed for tennis courts, buildings, and car parking.

The study area consists of a flat landform with a small drainage channel running along the north-eastern corner and Brookvale Creek along its western boundary. Brookvale Creek joins Manly Creek and drains into the ocean at the northern end of Manly Beach, approximately two kilometres (km) to the east. The study area is extensively developed in the centre with native vegetation remaining along the northern and western boundaries (**Figure 1-2**).

Figure 1-2: Aerial view of study area.

1.3 ASSESSMENT APPROACH

Aboriginal cultural heritage

The desktop and visual inspection component for the study area follows the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (due diligence; DECCW 2010). The field inspection followed the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in New South Wales* (OEH 2011).

2 ABORIGINAL DUE DILIGENCE ASSESSMENT

2.1 INTRODUCTION

Section 57 of the National Parks and Wildlife Regulation 2019 (NPW Regulation) made under the *National Parks and Wildlife Act 1974* (NPW Act) advocates a due diligence process to determining likely impacts on Aboriginal objects. Carrying out due diligence provides a defence to the offence of harming Aboriginal objects and is an important step in satisfying Aboriginal heritage obligations in NSW.

2.2 DEFENCES UNDER THE NPW REGULATION

2.2.1 Low impact activities

The first step before application of the due diligence process itself is to determine whether the proposed activity is a "low impact activity" for which there is a defence in the NPW Regulation. The exemptions are listed in Section 58 of the NPW Regulation (DECCW 2010: 6).

The proposal is not considered to be a 'low impact activity' and the due diligence process must be applied.

2.2.2 Disturbed lands

Relevant to this process is the assessed levels of previous land-use disturbance.

The NPW Regulation Section 58 (DECCW 2010: 18) define disturbed land as follows:

> *Land is disturbed if it has been the subject of a human activity that has changed the land's surface, being changes that remain clear and observable.*
>
> *Examples include ploughing, construction of rural infrastructure (such as dams and fences), construction of roads, trails and tracks (including fire trails and tracks and walking tracks), clearing vegetation, construction of buildings and the erection of other structures, construction or installation of utilities and other similar services (such as above or below ground electrical infrastructure, water or sewerage pipelines, stormwater drainage and other similar infrastructure) and construction of earthworks.*

The proposal is largely located in areas where the land's surface has been changed in a clear and observable manner for the construction of the tennis courts, car parking, and existing structures. However, study area may contain landforms that do not meet the criteria of 'disturbed land' at the northern and eastern boundaries. As such, the due diligence process must be applied.

In summary, it is determined that the proposal must be assessed under the Due Diligence Code of Practice. The reasoning for this determination is set out in **Table 2-1**.

Table 2-1: Determination of whether Due Diligence Code of Practice applies.

Item	Reasoning	Answer
Is the activity to be assessed under Division 4.7 (state significant development) or Division 5.2 (state significant infrastructure) of the EP&A Act?	The proposal will be assessed under Part 4 of the EP&A Act.	No
Is the activity exempt from the NPW Act or NPW Regulation?	The proposal is not exempt under this Act or Regulation.	No
Do either or both apply: Is the activity in an Aboriginal place? Have previous investigations that meet the requirements of this Code identified Aboriginal objects?	The activity will not occur in an Aboriginal place. No previous investigations have been undertaken for this proposal.	No
Is the activity a low impact one for which there is a defence in the NPW Regulation?	The proposal is not a low impact activity for which there is a defence in the NPW Regulation.	No
Is the activity occurring entirely within areas that are assessed as 'disturbed lands'?	The proposal is not entirely within areas of high modification.	No
Due Diligence Code of Practice assessment is required		

2.3 Application of the Due Diligence Code of Practice to the proposal

To follow the generic due diligence process, a series of steps in a question/answer flowchart format (DECCW 2010:10) are applied to the proposed impacts and the study area, and the responses documented.

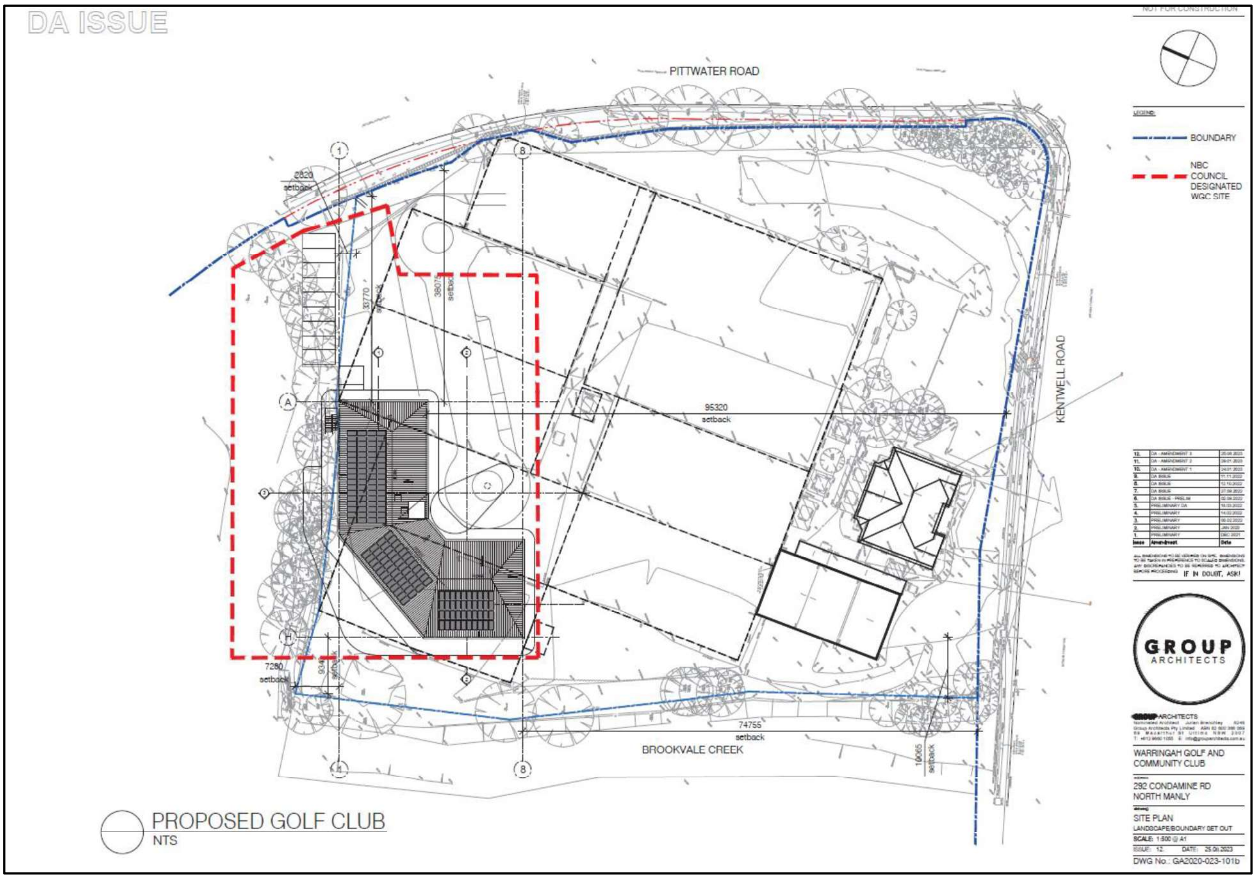
2.3.1 Step 1

Will the activity disturb the ground surface or any culturally modified trees?

Yes, the proposal will impact the ground surface and may impact culturally modified trees.

The proposed works will impact ground surface associated with the demolition of existing structures and the excavation of foundation pylons for the new club house to a depth of approximately two metres (m). The proposal will include the removal of mature, possibly native vegetation and this activity could harm culturally modified trees if they are present (**Figure 2-1**).

Figure 2-1: New club house plans.



2.3.2 Step 2a

<u>Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?</u>

No, there are no previously recorded sites within the study area.

A search of the Aboriginal Heritage Information Management System (AHIMS) on 8 August 2023 was undertaken over a 10 x 10 km area centred on the study area. The search returned 29 previously registered Aboriginal sites. None of the previously recorded sites are in the study area, with the closest recorded site, AHIMS site 45-6-2177, located 600 m to the northwest of the north-western corner of the study area.

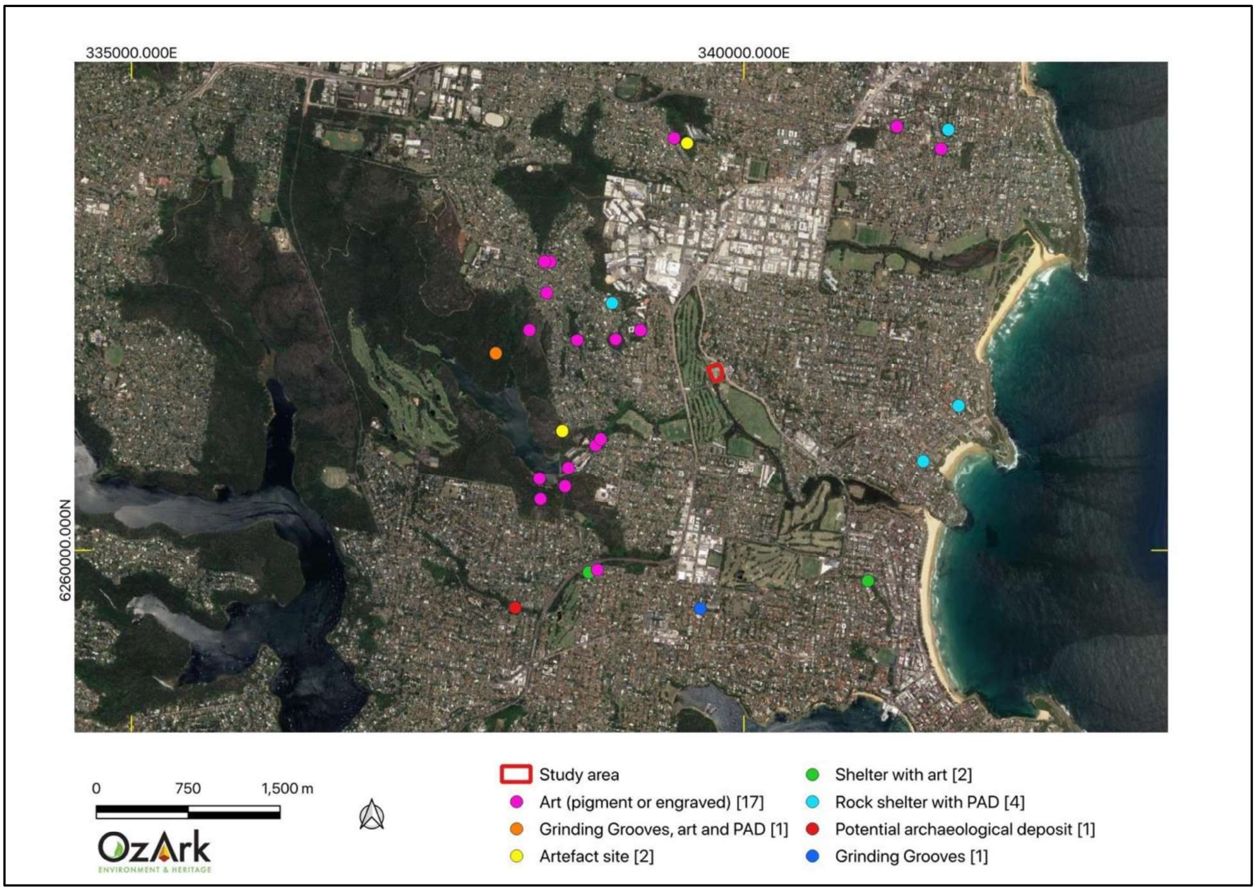
Figure 2-2 shows all previously recorded sites in relation to the study area and **Table 2-2** shows the types of sites that are close to the study area.

The most frequently recorded sites in the search are art sites (pigment or engraved), and rock shelters with potential archaeological deposits. Grinding grooves and artefact sites are also identified. The art sites have been recorded in areas with limited disturbance and rocky outcrops The grinding grooves have been located in undisturbed areas surrounding the waterways of Manly Dam (approximately 1.5 km west of the study area).

Table 2-2: Site types and frequencies of AHIMS sites near the study area.

Site Type	Number	% Frequency
Art (pigment or engraved)	17	58.62
Rock shelter with potential archaeological deposit (PAD)	4	13.79
Artefact site	2	6.89
Rock shelter with art	2	6.89
Rock shelter with PAD	1	3.44
Grinding grooves	1	3.44
Grinding grooves, art and PAD	1	3.44
Potential archaeological deposit	1	3.44
Total	29	100

Figure 2-2: Previously recorded sites in relation to the study area.



2.3.3 Step 2b

<u>Are there any other sources of information of which a person is already aware?</u>

No, there are no other sources of information that would indicate the presence of Aboriginal objects in the study area.

2.3.3.1 Ethnohistoric context

The proposal sits on the traditional land of the Garigal or Caregal people (formerly known as Guringai). The Garigal lived in family groups and moved around the area. The coast provided an abundant food supply. Fish was the staple diet, including shellfish such as oysters, whelks, and mussels. Other food sources were birds, reptiles, marsupials, as well as roots, fruits, berries, and nuts (AHO 2015). Numerous open and rock shelter sites associated with shell middens and remains of fish and mammals dating to the past 4500 years are known around Sydney Harbour (Attenbrow 2010). Igneous stone suitable for hatchet heads and stone for flaking, cutting, and scraping were not naturally available in the area and could be traded from long distances. Applied art in rock shelters and engravings on sandstone platforms were common in this part of Sydney, although their fragility means that many have been lost in the past two centuries.

2.3.3.2 Regional archaeological context

<u>Gunn 1992</u>

In 1992 R.G. Gunn conducted an archaeological survey of the Garigal National Park for the NSW National Parks and Wildlife Service (NPWS) (approximately 9 km from study area). To date this survey is still the most comprehensive study of Aboriginal archaeological sites within the local area. Based on the results of the survey and on other relevant studies, Gunn developed a model for Aboriginal land use in the area, which is summarised below:

- The coastal headland sand of Narrabeen Lake would have been an inhabitation focal point for a band or clan consisting of potentially 6–8 groupings
- Subsistence activities during the summer months by the coastline may have been focussed on the ocean coastline where food and water were plentiful, only occasionally venturing west into the creek lines and hills
- During the spring, the valleys of Deep and Middle Creeks in the Garigal National Park would have been utilised for the vast variety of fruit and other plant foods
- During the winter months, when food resources were less abundant, the family groups that had come together during the warmer months would have dispersed and moved across the local region, inhabiting various smaller short duration camps.

Gunn (1992) further asserts that engravings of sandstone away from the Narrabeen Lakes were part of formal events undertaken during the summer months by certain individuals and not undertaken on mass. Gunn suggests occupation of the inland areas would only have been inhabited during the winter months by small family groups or clans.

Navin Officer 1995

Survey was carried out in 1995 for a proposed gas pipeline route along Mona Vale Road between Forest Way, Terrey Hills and Beaconsfield Street, Newport (approximately 10 km from study area). Seven engraving sites and one midden site had previously been recorded within the study corridor; however, the survey was unable to locate three of these due to incorrect coordinates registered on AHIMS. Two previously unrecorded sites, both rock engravings, were identified during the field survey.

Oakley 1998

A section of Mona Vale Road was investigated ahead of a proposed upgrade by Oakley in 1998 (approximately 10 km from study area). Archaeological field survey confirmed the presence of a previously recorded rock engraving site 45-6-0071. Recorded by Sim in 1964, the motifs are two echidnas, three ovals, and one possible snake patterned with traverse lines. The ovals and a further unidentified figure recorded by Koettig in 1981 were not visible at the time. The engravings described by Koettig (1981) as 'Area B' of existing site 45-6-0071, were identified and found to be within an area to be impacted by the proposed works. Redesign of the road project avoided impact to the site.

AMBS 2012

An archaeological survey and Aboriginal heritage assessment for the Northern Beaches Hospital site was prepared by AMBS in 2012 (approximately 4 km from study area). AMBS concluded that overall, the Northern Beaches Hospital site demonstrated high levels of surface disturbance from residential development and other historical activities. As such 'the apparent lack of substantial intact topsoil, indicates that there is unlikely to be any archaeological potential for intact or substantial Aboriginal stone artefact deposits within the study area' (AMBS 2012:31).

KNC 2014

Kelleher Nightingale Consulting (KNC) prepared an archaeological survey report for road works near the Northern Beaches Hospital, along Warringah Road and Frenchs Forest Road West. With regard to the archaeological record of the area, KNC (2014:36) noted that '*The principal remaining physical evidence of Aboriginal landscape use around the study area consists of shelters with art and archaeological deposit, and rock engravings located on outcropping sandstone slabs and benches*'.

KNC identified two shelter sites within Trefoil Creek (approximately 4.5 km from study area). Hand stencils were identified at one of these and a potential archaeological deposit was identified at the second shelter site.

Conclusion

The previous archaeological investigations undertaken near the study area indicate that the study area has a low potential to record sites because specific topographic features, such as rock platforms/shelters, are absent. While the now-modified land within the study area may have had potential for artefact or midden sites in the past, much of this potential has been lost due to the long-term disturbances from post-1788 land use.

2.3.4 Step 2c

Are there any landscape features that are likely to indicate presence of Aboriginal objects?

Yes, portions of the study area contain landforms with identified archaeological sensitivity.

The study area includes environments that could be considered once suitable for occupation by pre-1788 Aboriginal communities. The due diligence guidelines outline a series of landscape features which are known to be archaeologically sensitive and therefore are likely to contain Aboriginal objects. Included in this list is any land within 200 m of 'waters' (DECCW 2010). Due to this classification, the western portion of the study area, which is bounded by Brookvale Creek, is regarded as archaeologically sensitive. Brookvale Creek drains into Manly Creek and exits at the northern end of Manly Beach, approximately 2 km to the east.

The study area is predominantly level and is underlain by Quaternary Period alluvium. This formation is described as 'silty to peaty quartz sand, silt, and clay. Ferruginous and humic cementation in places, commonly shell layers'. The site is also located near Hawkesbury sandstone of Wianamatta Group from the east, which is described as medium to coarse-grained quartz sandstone, very minor shale, and laminate lenses'.

The land is extensively cleared with some native shrubs and trees, including swamp oaks (*Casuarina glauca),* remaining along the boundaries.

Based on previous investigations, the most likely site types to be recorded in the region of the study area are art sites (pigment or engraved), which make up 58% of all sites in the area. These site types may occur where the underlying sandstone geology rises above the ground surface. As the valley floor location of the study area is unlikely to have exposed rock, these site types are unlikely. Artefact sites are also considered to have a low probability of being present in the study area given the long-term nature of the post-1788 land use that would have removed or scattered any archaeological deposits had they been present.

2.3.5 Step 3

Can harm to Aboriginal objects or disturbance of archaeologically sensitive landscape features be avoided?

No. Landforms with identified archaeological sensitivity may be impacted by the proposal.

Aboriginal sites identified through the AHIMS search do not occur within the study area, thus there is no risk of harm to previously recorded sites. However, the study area is within 200 m of Brookvale Creek and a visual inspection of the study area is required to assess whether Aboriginal objects exist within the landforms of the study area and to determine whether any harm will occur.

2.3.6 Step 4

Does a desktop assessment and visual inspection confirm that there are Aboriginal objects or that they are likely?

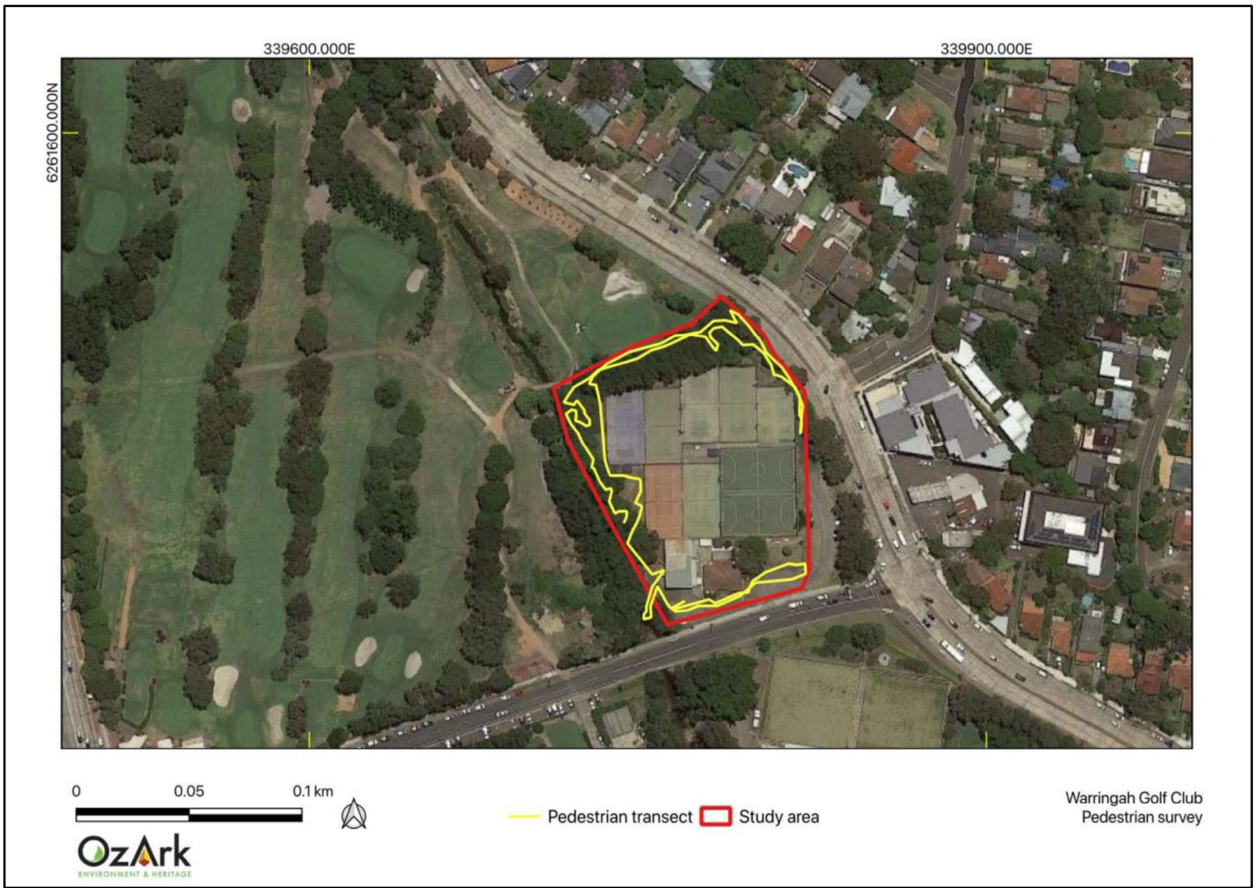
No, the visual inspection confirmed there are no Aboriginal objects within the study area.

The visual inspection of the study area was undertaken on 11 August 2023 by OzArk Archaeologist, Harrison Rochford, and Josh Muir, representing Metropolitan Local Aboriginal Land Council. The inspection focused on the named waterway, Brookvale Creek, which borders the study area on the western side and the drainage channel and wetlands on the north-eastern boundary. Josh Muir noted that the casuarinas provide good habitat for cockatoos and was satisfied that the cleared trees will be replaced on site with the same species for a continuation of habitat.

The study area was inspected on foot to ground-truth levels of disturbance unable to be distinguished at a desktop level and assess areas with increased archaeological potential. The inspection was recorded by photograph and GPS (**Figure 2-3**). **Plates 1** to **6** show representative examples of the environment.

It is concluded that there are no areas of subsurface archaeological potential within the study area. While the study area is adjacent to Brookvale Creek, the inspection confirmed that it has been highly modified with landscaped edges and boulders placed along the banks to prevent erosion. The landforms of the study area have low elevation above the creek and do not have the characteristics of desirable locations for repeated habitation in the past. Inspection of the native vegetation confirmed that there were casuarinas and a large fig tree, however, no culturally modified trees were identified. No areas of exposed rock that may have included engravings were recorded.

Figure 2-3: Survey coverage within the study area.



<u>Discussion</u>

The predictive model discussed in **Section 2.3.4** indicated that engraved rock art sites, grinding grooves, and rock shelters were the most likely sites to be present within the study area and these sites were most likely to be identified within 200 m of Brookvale Creek. No Aboriginal sites were identified within those landforms. The absence of artefact sites may be attributed to the level of modification that the creek has undergone and the generally low-lying landscape that would have not been a favourable camping location.

The native trees within these landforms show no evidence of being culturally modified.

2.4 CONCLUSION

The due diligence process has resulted in the outcome that an Aboriginal Heritage Impact Permit (AHIP) is not required. The reasoning behind this determination is set out in **Table 2-3**.

Table 2-3: Due Diligence Code of Practice application.

Step	Reasoning	Answer
Step 1 Will the activity disturb the ground surface or any culturally modified trees?	The proposed works will disturb the ground surface through the sinking of foundational pylons to 2 m and may impact culturally modified trees if present.	Yes
If the answer to Step 1 is 'yes', proceed to Step 2		

Step	Reasoning	Answer
Step 2a Are there any relevant records of Aboriginal heritage on AHIMS to indicate presence of Aboriginal objects?	AHIMS indicated that there are no Aboriginal sites within the study area.	No
Step 2b Are there other sources of information to indicate presence of Aboriginal objects?	There are no other sources of information to indicate that Aboriginal objects are likely in the study area, although it is noted that there is a general likelihood for landforms in the region to contain Aboriginal objects.	No
Step 2c Will the activity impact landforms with archaeological sensitivity as defined by the Due Diligence Code?	Landforms with identified archaeological sensitivity are present in the study area.	Yes
If the answer to any stage of Step 2 is 'yes', proceed to Step 3		
Step 3 Can harm to Aboriginal objects listed on AHIMS or identified by other sources of information and/or can the carrying out of the activity at the relevant landscape features be avoided?	The proposal will impact landforms with archaeological sensitivity as identified in the Due Diligence Code: landforms within 200 m of 'waters'.	No
If the answer to Step 3 is 'no', a visual inspection is required. Proceed to Step 4.		
Step 4 Does the visual inspection confirm that there are Aboriginal objects or that they are likely?	The visual inspection recorded no Aboriginal objects in the study area. Landforms with identified archaeological sensitivity that were identified at a desk-top level were found during the inspection to have low archaeological potential.	No
Conclusion		
AHIP not necessary. Proceed with caution.		

3 MANAGEMENT RECOMMENDATIONS

The undertaking of the due diligence process resulted in the conclusion that the proposed works will have an impact on the ground surface, however, no Aboriginal objects or intact archaeological deposits will be harmed by the proposal. This moves the proposal to the following outcome:

> *AHIP application not necessary. Proceed with caution. If any Aboriginal objects are found, stop work, and notify Heritage NSW (02) 9873 8500 (heritagemailbox @environment.nsw.gov.au). If human remains are found, stop work, secure the site, and notify NSW Police and Heritage NSW.*

The proposed work may proceed without further archaeological investigation under the following conditions:

1) All land and ground disturbance activities must be confined to within the study area, as this will eliminate the risk of harm to Aboriginal objects that may be in adjacent landforms. Should the parameters of the proposal extend beyond the assessed areas, then further archaeological assessment may be required.

2) This assessment has concluded that there is a low likelihood that the proposed work will adversely harm Aboriginal cultural heritage items or sites. If during works, however, Aboriginal artefacts or skeletal material are noted, all work should cease and the procedures in the *Unanticipated Finds Protocol* (**Appendix 2**) should be followed.

3) Inductions for work crews should include a cultural heritage awareness procedure to ensure they recognise Aboriginal artefacts (see **Appendix 3**) and are aware of the legislative protection of Aboriginal objects under the NPW Act and the contents of the *Unanticipated Finds Protocol.*

4) The information presented here meets the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales*. It should be retained as shelf documentation for five years as it may be used to support a defence against prosecution in the event of unanticipated harm to Aboriginal objects.

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PLATES

Plate 1: View north along Brookvale Creek.

Plate 2: View west along a minor drainage and wetlands in the northeast of the study area.

Plate 3: Casuarinas that are proposed to be removed.

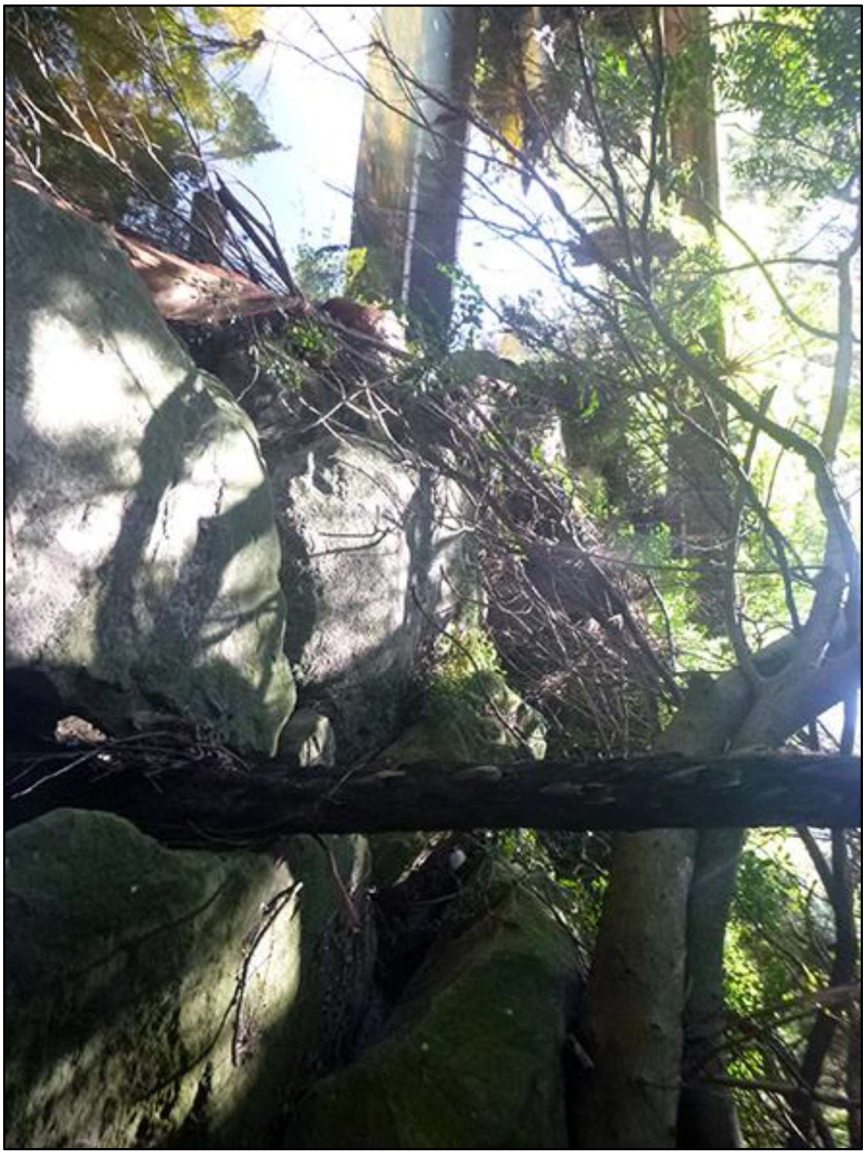

Plate 4:View north along Brookvale Creek showing the modified banks and imported boulders for erosion control.

Plate 5: Sandy soil was evident where exposures were present.

Plate 6: View north along Brookvale Creek in the southwest of the study area.

APPENDIX 1: AHIMS SEARCH RESULTS

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : WGC

Client Service ID : 807708

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-6-0689	Frenchs Forest;Allambie Road;	AGD	56	338536	6261528	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	ASRSYS					Permits		
45-6-0699	Frenchs Forest;Flat Rocks;	AGD	56	338850	6261534	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	Ms.Lisa Campbell					Permits		
45-6-0700	Beacon Hill;Frenchs Forest;	AGD	56	339327	6263177	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	Ms.Lisa Campbell					Permits		
45-6-1255	Allambie Heights;	AGD	56	338287	6261912	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	ASRSYS					Permits		
45-6-1233	Manly Dam; Manly Vale	GDA	56	338540	6260523	Closed site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	ASRSYS,Sydney Water - Parramatta,Sydney Water - Parramatta,Ms.Yvonne Kaiser,!					Permits		
45-6-2085	Hydro Cave	GDA	56	338568	6260671	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	1809
	Contact	Recorders	Michael Guider,Sydney Water - Parramatta,Sydney Water - Parramatta,Ms.Yvonne					Permits		
45-6-2177	Malinya Rd;	AGD	56	339052	6261610	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	Michael Guider					Permits		
45-6-0721	Manly!	GDA	56	341014	6259750	Closed site	Valid	Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Deposit	
	Contact	Recorders	Unknown Author					Permits		
45-6-0727	Dee Why;	AGD	56	341507	6263089	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	ASRSYS					Permits		
45-6-0881	Allambie Heights;	AGD	56	338315	6262166	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	Charles.D Power					Permits		
45-6-0964	Balgowlah	GDA	56	338804	6259840	Open site	Destroyed	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	Mr.R Taplin					Permits		
45-6-0965	Balgowlah;200 FT Cave;	GDA	56	338734	6259820	Closed site	Destroyed	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	Recorders	Mr.R Taplin					Permits		
45-6-0904	Allambie Heights;	AGD	56	338268	6262167	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	Contact	Recorders	ASRSYS					Permits		

Report generated by AHIMS Web Service on 08/08/2023 for Harrison Rochford for the following area at Datum :GDA, Zone : 56, Eastings : 337737.0 - 341775.0, Northings : 6259444.0 - 6263461.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 29

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : WGC

Client Service ID : 807708

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-6-2958	Undercliff Road RS and Midden	GDA	56	341465	6260726	Open site	Valid	Potential Archaeological Deposit (PAD) : -, Shell : -		
	Contact	Recorders	Doctor.Alan Williams					Permits		
45-6-2975	CS1 (Brookvale)	GDA	56	339537	6263325	Open site	Valid	Artefact : 1		
	Contact	Recorders	Biosis Pty Ltd - Sydney,Ms.Samantha Higgs					Permits		
45-6-3080	WGC 1 WARR214	GDA	56	337975	6261610	Open site	Valid	Art (Pigment or Engraved) : 1, Grinding Groove : 1, Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Aboriginal Heritage Office					Permits		
45-6-3048	Ronald Reserve Shelter WARR 194	GDA	56	341754	6261180	Closed site	Valid	Shell : -		
	Contact	Recorders	Aboriginal Heritage Office					Permits		
45-6-3127	Manly Dam Art Shelter Art 1	GDA	56	338340	6260420	Open site	Valid	Art (Pigment or Engraved) : -		
	Contact	Recorders	Mr.Gareth Birch					Permits		
45-6-3147	Mermaid Pool (South)	GDA	56	338790	6260855	Closed site	Valid	Art (Pigment or Engraved) : -, Water Hole : -		
	Contact	Recorders	Sydney Water - Parramatta,Ms.Yvonne Kaiser					Permits		
45-6-3139	Monserra Engraving WARR350	GDA	56	338250	6261800	Open site	Valid	Art (Pigment or Engraved) : -		
	Contact	Recorders	Mr.Phil Hunt					Permits		
45-6-3140	Delmar Parade Engraving WARR191	GDA	56	341250	6263460	Open site	Valid	Art (Pigment or Engraved) : -		
	Contact	Recorders	Mr.Phil Hunt					Permits		
45-6-3148	Manly Dam 1	GDA	56	338518	6260973	Open site	Valid	Artefact : -		
	Contact	Recorders	Sydney Water - Parramatta,Ms.Yvonne Kaiser					Permits		
45-6-3149	Mermaid Pool (North)	GDA	56	338831	6260908	Closed site	Valid	Water Hole : -, Art (Pigment or Engraved) : -, Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Sydney Water - Parramatta,Ms.Yvonne Kaiser					Permits		
45-6-3167	MANLY WEST PUBLIC 1. MAN120	GDA	56	339645	6259523	Open site	Valid	Grinding Groove : -		
	Contact	Recorders	Mr.Phil Hunt					Permits		

Report generated by AHIMS Web Service on 08/08/2023 for Harrison Rochford for the following area at Datum :GDA, Zone : 56, Eastings : 337737.0 - 341775.0, Northings : 6259444.0 - 6263461.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 29

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NSW GOVERNMENT

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : WGC

Client Service ID : 807708

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-6-3192	30 Lyly Rd Rockshelter	GDA	56	338924	6262018	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Mr.Ashley O'Sullivan					Permits		
45-6-3229	Derribong Shelter 1 WARR188	GDA	56	341670	6263435	Open site	Valid	Shell : 1		
	Contact	Recorders	Mr.Phil Hunt,Aboriginal Heritage Office					Permits		
45-6-3497	Manly Dam Contact Art	GDA	56	338332	6260585	Open site	Valid	Art (Pigment or Engraved) : 5		
	Contact	Recorders	Ms.Lorien Perchard					Permits		
45-6-3498	Manly Dam 9 Grinding Grooves	GDA	56	338484	6260611	Open site	Valid	Grinding Groove : 9		
	Contact	Recorders	Ms.Lorien Perchard					Permits		
45-6-3363	BURNT BRIDGE CREEK PAD	GDA	56	338134	6259532	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	Contact	Recorders	Mr.Andrew Costello,Jacobs Group (Australia) Pty Ltd - North Sydney					Permits		

** **Site Status**

Valid - The site has been recorded and accepted onto the system as valid

Destroyed - The site has been completely impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There is nothing left of the site on the ground but proponents should proceed with caution.

Partially Destroyed - The site has been only partially impacted or harmed usually as consequence of permit activity but sometimes also after natural events. There might be parts or sections of the original site still present on the ground

Not a site - The site has been originally entered and accepted onto AHIMS as a valid site but after further investigations it was decided it is NOT an aboriginal site. Impact of this type of site does not require permit but Heritage NSW should be notified

Report generated by AHIMS Web Service on 08/08/2023 for Harrison Rochford for the following area at Datum :GDA, Zone : 56, Eastings : 337737.0 - 341775.0, Northings : 6259444.0 - 6263461.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 29

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APPENDIX 2: ABORIGINAL HERITAGE: UNANTICIPATED FINDS PROTOCOL

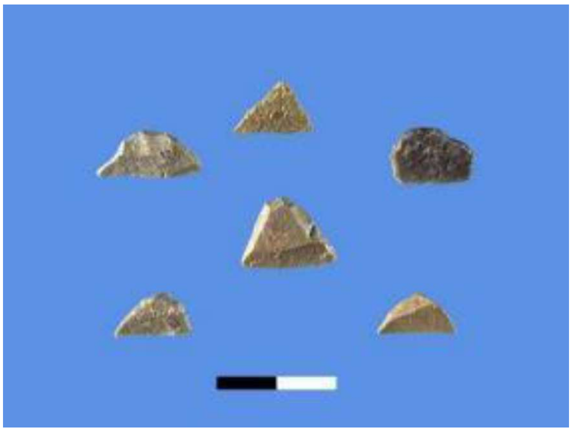
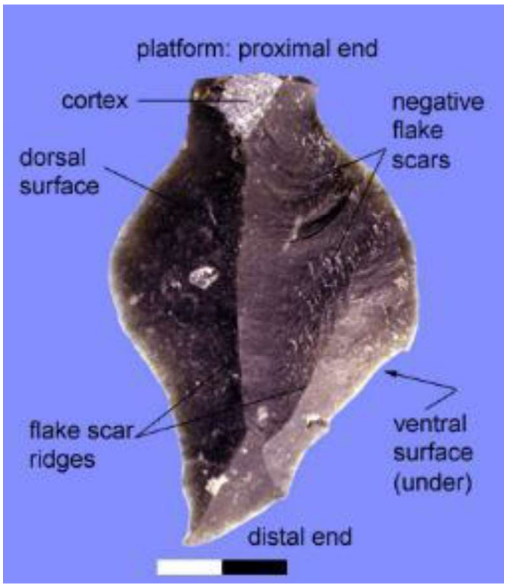
An Aboriginal artefact is anything which is the result of past Aboriginal activity. This includes stone (artefacts, rock engravings etc.), plant (culturally scarred trees) and animal (if showing signs of modification; i.e. smoothing, use). Human bone (skeletal) remains may also be uncovered while onsite.

Cultural heritage significance is assessed by the Aboriginal community and is typically based on traditional and contemporary lore, spiritual values, and oral history, and may also consider scientific and educational value.

Protocol to be followed if previously unrecorded or unanticipated Aboriginal object(s) are encountered:

1. If any Aboriginal object is discovered and/or harmed in, or under the land, while undertaking the proposed development activities, the proponent must:
   a. Not further harm the object
   b. Immediately cease all work at the particular location
   c. Secure the area to avoid further harm to the Aboriginal object
   d. Notify Heritage NSW as soon as practical on (02) 9873 8500 (heritagemailbox @environment.nsw.gov.au), providing any details of the Aboriginal object and its location; and
   e. Not recommence any work at the particular location unless authorised in writing by Heritage NSW.
2. If Aboriginal burials are unexpectedly encountered during the activity, work must stop immediately, the area secured to prevent unauthorised access and NSW Police and Heritage NSW contacted.
3. Cooperate with the appropriate authorities and relevant Aboriginal community representatives to facilitate:
   a. The recording and assessment of the find(s)
   b. The fulfilment of any legal constraints arising from the find(s), including complying with Heritage NSW directions
   c. The development and implementation of appropriate management strategies, including consultation with stakeholders and the assessment of the significance of the find(s).
4. Where the find(s) are determined to be Aboriginal object(s), recommencement of work in the area of the find(s) can only occur in accordance with any consequential legal requirements and after gaining written approval from Heritage NSW (normally an Aboriginal Heritage Impact Permit).

APPENDIX 3: ABORIGINAL HERITAGE: ARTEFACT IDENTIFICATION

	
A retouched silcrete flake	A quartz flake
	
Microliths (scale = 1 cm)	Volcanic flakes
	
Flake characteristics (scale = 1 cm)	A mudstone/tuff core from which flakes have been removed

Acid Sulphate Management Plan

Prepared for: Warringah Golf Club

Address: 433 Pittwater Road, North Manly

Job No: 60025A-IDF

Date: November 2022

TABLE OF CONTENTS

1.0 INTRODUCTION

Ideal Geotech was commissioned to undertake an acid sulfate soils management plan for the proposed works at Warringah Golf Club, 433 Pittwater Road, North Manly.

An acid sulphate soil investigation was undertaken previously by Ideal Geotech (refer to report number 60025). The report indicated that a management plan would be required for excavation and disposal of soil from the site.

Following field tests, two soil samples were submitted to ALS Environmental for SPOCAS testing. The soil was assessed against the guidelines set out in the Acid Sulfate Soils Management Advisory Committee (ASSMAC) (1998).

The results of the laboratory analysis show signs of actual acid sulfate soils within the samples taken at 1.0m and 2.0m below existing surface level at the location of BH2.

Excavation of soils will require treatment prior to disposal.

2.0 OBJECTIVES OF THE ACID SULFATE MANAGEMENT PLAN

The objectives of this ASSMP is to consider both the existing and potential future environmental impacts relating to PASS material in and around the project site and to detail mitigation measures to minimise the potential impacts within the surrounding areas.

The control measures in this ASSMP to mitigate the environmental impacts of the proposed excavations to acceptable levels have been developed to achieve the following objectives:

- Control and, where possible, minimisation of acid sulphate soils;
- Confirming the success of impact control measures by the means of validation monitoring;
- Compliance with statutory requirements
- Preserving the water quality on an ongoing basis

Each environmental protection measure is based on proven and industry best practice methodology.

The ASSMP is designed for the excavation phase of the project. It is based on tabulated checklists for management measures, maintenance, reporting, failure identification and corrective action for each identified use.

The control measures proposed in this ASSMP are for:

- Assessment procedures for AASS/PASS utilising a sampling protocol, set criteria to measure and agreed standards for those criteria to evaluate acid potential;
- Ongoing monitoring program (if required);

- Treatment of potential acid sulphate soils if encountered and control structures to prevent leachate discharge offsite without meeting specific soil quality criteria

3.0 SITE IDENTIFICATION

The subject site is roughly rectangular in shape and approximately 1550m^2 in area and is bound by Pittwater Road to the north east, Kentwell Road to the south, Brookvale Creek to the west and by Warringah Golf Course on all remaining sides.

The site is currently occupied by tennis courts and sports facilities. The site is relatively flat with no notable slopes that will impact construction with a line of large mature trees along the western, northern and eastern boundaries.

4.0 SUBSURFACE CONDITIONS

4.1 Soil Profile

Reference to the Sydney 1:100,000 geological map (Geological Series Sheet 9130) indicates that the site is underlain by Quaternary Deposits consisting of silty to peaty quartz sand, silt and clay along with Ferruginous and humic cementation in places with common shell layers.

Two boreholes (BH1 & BH2) were drilled using a 4wd mounted drill rig to a maximum depth of 2.0m. The sub-surface soil profile encountered at the site generally comprised;

- Silty sand up to at least 3.0m.

Groundwater was not observed at the time of investigation. It should be noted that groundwater levels are likely to fluctuate with variations in climatic and site conditions.

4.2 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are naturally occurring and usually form in low lying coastal areas, creeks, rivers and flood plains. The sulphates present in the soil are stable when in the saturated/waterlogged state, but react to form sulphuric acid when disturbed and exposed to oxygen.

Maps showing the areas identified as being affected by ASS have been prepared by the Department of Land and Water Conservation. These maps identify the probability of acid sulphate soils occurring in these areas and as such any areas should be specifically investigated before a particular site is classified.

Disturbance of these soil materials will result in an environmental risk that will vary with elevation and depth of disturbance. Any works below natural ground surface or affecting the water table has a risk of being contaminated with acid sulphate soils.

Reference to the Acid Sulphate Soils Map of Sydney Heads indicates that the site is located on the border between disturbed terrain and no known occurrence of acid sulphate soil materials.

5.0 SAMPLING & ANALYSIS PLAN

Sampling and analysis was undertaken in order to assess the presence or absence, location and likely distribution of any AASS or PASS present at the subject site in the area of the proposed development.

5.1 Sampling

Soil sampling was undertaken in general accordance with the Acid Sulphate Soil Guidelines. Test results were compared to the relevant New South Wales Environment Protection Authority (NSW EPA) criteria.

BH1 was terminated at a depth of approximately 3.0m below ground level with samples collected at 0.5m and 1.5m below ground level. BH2 was terminated at a depth of approximately 3.0m below ground level with samples collected at 1.0m and 2.0m below ground level. The samples were placed directly into labelled clean zip lock bags and placed on ice until delivery to the laboratory for testing. All analyses were performed by a NATA registered laboratory using NATA accredited methods.

6.0 ACID SULPHATE SOILS ASSESSMENT

6.1 Field Screening

The field screening involved the testing of the samples for field pH and peroxide pH, using 30% hydrogen peroxide to oxidise the soil, and comparing both results.

A positive peroxide test, indicating the potential presence of acid sulphate soil, may include one or more of the following.

- Change in colour from grey tones to brown tones.
- Effervescence.
- Release of sulphurous odours.
- pH following oxidation with H_2O_2 (pH_{fox}) <3.
- Lowering of the pH (pH_f - pH_{fox}) by 1 or greater.
- Field pH (pH_f) <4.

The results of the field and peroxide tests are provided in Table 1 below.

Table 1: Results of Field Screening Tests

Location/Depth	Field pH	Peroxide pH	Reaction to 30% h_2O_2
BH1/0.5m	6.8	3.2	Strong
BH1/1.5m	6.1	3.0	Strong
BH2/1.0m	6.2	2.6	Strong
BH2/2.0m	6.0	3.6	Slight

Based on findings of the field screenings, indications of PASS were observed. Two samples were tested by quantitative laboratory analysis to confirm the presence or absence of acid sulphate soil.

6.2 Laboratory Test Results

Two samples were analysed for SPOCAS to confirm the presence or absence of AASS or PASS in the soil. The sample was dispatched to ALS Environmental services for the quantitative analysis for Suspension Peroxide Oxidation Combined Acidity & Sulphate (SPOCAS).

6.3 Assessment Criteria for Acid Sulphate Soils (Laboratory)

The results of analysis for the soils are compared to the below ASSMAC assessment criteria. It is assumed that <1000 tonnes of material would be disturbed hence the action criteria for less than 1000 tonnes have been applied.

6.4 NSW ASSMAC Action Criteria

The NSW ASSMAC action criteria is detailed in Table 2 below for less than 1000 tonnes of disturbance.

Table 2: NSW ASSMAC Action Criteria

Type of Material Texture	Approx Clay Content (% <0.002mm)	Action Criteria <1000 tonnes Sulfur Trail Spos or Stos%	Action Criteria <1000 tonnes Acid Trail TPA or TSA mole H+/t
Coarse e.g. sands	**< 5**	**0.03**	**18**
Loams/light clays	5 – 40	0.06	36
Fine clays/silts	$\geq$ 40	0.1	62

Note: The assessment values chosen are based on fine sands which are in bold

6.5 SPOCAS Test Results

The SPOCAS testing identified exceedances of the threshold criteria at 1.0m and 2.0m below ground surface in BH2 which suggests there is a presence of acid sulphate soils. Refer to Table 3 below.

Table 3: Results of SPOCAS Testing

Sample	pH_{OX}	TAA pH 6.5 moles H+/tonne	TPA pH 6.5 moles H+/tonne	TSA pH 6.5 moles H+/tonne	Spos %w/w
BH2/1.0m	3.0	**34**	**214**	**179**	**0.069**
BH2/2.0m	3.9	**27**	**80**	**52**	<0.020

6.6 Aggressiveness to Steel and Concrete

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of pH and types of salts present. In order to determine the degree of aggressiveness, the test values obtained are compared to tables 6.4.2 (C) and 6.5.2 (C) in AS2159 Piling - Design and Installation and tables 5.1 to 5.4 in AS2870-2011 “Residential Slabs and Footings”. The following testing suite was undertaken with results summarised within table 4 below;

- pH
- Electrical Conductivity (EC µS/cm)
- Chloride (Cl)
- Resistivity (ohm.cm)
- Sulphate

Table 4: Results of Aggressivity Testing

Location/Depth	pH	EC_e dS/m	Resistivity Ohm.cm	Cl mg/kg	Sulfate mg/kg
BH1/0.5m	5.9	0.578	5880	<10	20
BH1/1.5m	5.4	0.782	7040	<10	170

Based on test results detailed in Table 4 the soil conditions are mildly aggressive to concrete and non-aggressive to steel in high permeability soils. An exposure classification of A2 for concrete has been determined.

7.0 MANAGEMENT METHOD

Neutralising with agricultural lime is a widely accepted method to minimise the generation of acid and acid products associated with the disturbance of ASS. Agricultural lime is readily available, relatively easy to handle and less hazardous than some other agents.

To be conservative and adopt the precautionary principle it would seem appropriate to adopt a lime application rate to treat the soil that is adequate to neutralise the existing acidity and the potential acid generation due to future oxidisation of sulfidic sediments. It is recognised that the calculated lime application rate includes a 50% safety factor to cater for the inefficient mixing and isolated “hotspots”.

Using the worst case scenario (TPA moles H+/tonne 214) for samples collected within the potential excavation zone, calculations for proposed agricultural lime application rates are shown in Table 5 below.

Table 5: Lime Application Rates

Site	%S	TPA mol H+/T	Min. Kg lime/m^3 soil (assume BD = 1.6g/cm^3)	Min. Kg lime/m^2/300mm layer
Excavation of batter and footings	0.069	214	10	3.5

A bunded treatment pad would be required for the site. Excavated material would be placed into a maximum 300mm deep layer and the appropriate agricultural lime applied and mechanically incorporated into the soil. The layer ensures proper aeration of excavated material when mixing with the lime agent.

7.1 ASS Treatment Area and Procedure

- Provide a non-ASS bunded soil treatment area. The rate of excavated material should be in accordance with appropriate mixing rates on the bunded treatment as stated in Table 5 above.
- Apply a guard layer (5kg/m^2) of agricultural lime to the base of the treatment area.
- Apply lime at adopted application rate and mechanically incorporate into the excavated material.
- Repeat the process until manageable volume of treated material is available for validation testing.
- Undertake soil validation testing at a rate of 1/50m^3 of excavated soil or once per day (whichever is greater). The soil pH should be measured in distilled water as well as in peroxide. This will verify if neutralisation treatment is succeeding as well as confirm that oxidation of acid sulfate soils is not occurring.
- If validation testing indicates excavation material below action criteria remove soil from site as required for final disposal otherwise incorporate required lime and repeat validation testing.

7.2 Dewatering

From investigation of the site, groundwater was not encountered. If groundwater is encountered during excavation, a management plan is included below;

- Should the water table be encountered during excavation attempt to minimise dewatering depth required for the installation.
- Time and volume of exposure to acid sulfate soils should be minimised during excavation and dewatering
- Should any discharged water pH levels be below natural groundwater levels then neutralisation via Magnesium calcite (Magnesium hydroxide) should be employed.

- Following any neutralisation the groundwater can be discharged to a bunded area away from the excavation or to stormwater/sewer, subject to regulation.

7.3 Contingency Plan

Remedial action will be required if the agreed standards or acceptance criteria are not being achieved. Remedial action shall comprise mixing of additional lime through the excavated material and neutralisation of leachate. The required mixing rate to remediate the soil or leachate should be confirmed by monitoring tests.

If overland discharge of groundwater is proposed, a contingency plan should be in place to allow neutralisation and confirmation monitoring prior to injection if pH levels are low or fall below natural background levels.

During periods of heavy or prolonged rainfall, stockpiling of acid sulphate soils should be appropriately contained/bunded to collect leachate for testing and neutralisation (if required) prior to disposal. Alternatively backfilling of acid sulphate soils could be undertaken to prevent the migration of leachate.

Sufficient lime should be stored on site during construction for the neutralisation of acid sulphate soils and contingency measures along with access to appropriate application equipment.

8.0 RECOMMENDATIONS

1. All excavated material on site is to be managed to minimise and ameliorate the existing and potential acidity. Grade 1 agricultural lime (80% ENV) shall be thoroughly incorporated into the material at the application rate shown in Table 5 of this report.

2. Any encounter with the water table and or water below that of natural groundwater pH levels should follow the management plan as in 7.2 above.

3. The management strategy and monitoring schedule is provided as an attachment in appendix A.

9.0 CONCLUSION

Acid sulphate soils have been identified as being a constraint to development at Warringah Golf Club, 433 Pittwater Road, North Manly. An acid sulfate management plan has been prepared to address treatment of the actual acidity and minimizing the potential generation of acidity during the proposed earthworks.

Should you have any queries, please do not hesitate to contact the undersigned.

For and on behalf of Ideal Geotech

D. Dwyer

Dane Dwyer
Geotechnical Engineer

REFERENCES:

Stone, Y, and Hopkins G (1998). *Acid Sulfate Soils Planning Guidelines.* Published by the Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia.

Ahern C R, Stone, Y, and Blunden B (1998). *Acid Sulfate Soils Assessment Guidelines* Published by the Acid Sulfate Soil Management Advisory Committee, Wollongbar, NSW, Australia

Appendix A – Management Strategy

Appendix A **_Management Strategy_**

ELEMENT ASS1 **Acid Sulfate Soil Treatment**

Why:

- To minimise acid generation and acid products due to oxidation of ASS
- To treat the acid generated by excavation of material.

Performance Objective:

- Compliance with the *Protection of the Environment and Operations Act 1997, NSW Acid Sulfate Soil Manual 1998* and other relevant statutes, policy and guidelines
- Implement best practice environmental management of ASS

Responsible Person:

- Site Manager/representative.

Control Actions:

- Minimise disturbance of acid sulfate soils
- Identify treatment area on site or off-site. Note minimal area available on site unless excavation staged. If off-site approval to be sought from statutory authorities prior to commencement of earthworks.
- Prior to disturbance of ASS install non – ASS bunds to stockpile/treatment areas
- Any stockpiling/treatment pad will require the placement of an agricultural lime guard layer under the stockpile/treatment pad. The guard layer shall be 0.3 times the average liming rate/m^2 for each vertical metre of the stockpile/treatment pad. Maximum stockpiling period = 14 days
- Place all excavated material in bunded area. Wet material will require spreading to allow dewatering to occur prior to further treatment
- Place excavated material in maximum 0.3m deep layers and incorporate agricultural lime at the following rates

Site	%S	TPA mol H+/T	Min. Kg lime/m3 soil (assume BD = 1.6g/cm^3)	Min. Kg lime/m^2/300mm layer
Any excavation	0.069	214	10	3.5

Monitoring

- Mechanical mixing methods eg rotary hoeing/disc ploughing shall be used.
- Site Manager or representative shall monitor the works daily for evidence of
  1. Yellow efflorescence on soil surface
  2. Iron staining
  3. Sulphurous odour.
- Regular monitoring of any leachate (see ELEMENT ASS2)
- Lime delivery dockets to be collected and checked against calculated lime application rate

Reporting:

- Records to be kept by the Site Manager on the monitoring activities, complaints received, and control actions subsequently taken. Records to be made available to Council, OEH, and OW if requested.

ELEMENT ASS2 **ASS Leachate Treatment**

Why:

- To avoid negative off-site impacts on water quality from acid generation or acid products

Performance Objective:

- Compliance with the *Protection of the Environment and Operations Act 1997, NSW Acid Sulfate Soil Manual 1998* and other relevant statutes, policy and guidelines
- Implement best practice environmental management of ASS

Responsibe Person:

- Site Manager

Control Actions:

- Provide surface water controls to divert surface water run-on
- Isolate soil treatment areas in non-ASS bunded areas.
- All water discharged from the site to be contained, collected and treated to meet adopted water quality criteria.
- Treatment of water within bunded areas may include dosing with hydrated lime at appropriate rates to ensure discharge pH 6.5 – 8.5. (Note extreme care required with hydrated lime to avoid "overshooting" target pH.)

Monitoring: (if leachate evident)

- Daily monitor leachate pH and Electrical Conductivity in treatment and stockpile areas

Action Criteria

- pH < 6.5 or >8.5

Reporting:

- Records to be kept by the Site Manager on the monitoring activities, complaints received, and control actions subsequently taken. Records to be made available to Council, OEH, and OW as requested.
- Event = >25mm rainfall in 24hr

Acid Sulphate Assessment

Prepared for: Warringah Golf Club

Address: 433 Pittwater Road, North Manly

Job No: 60025-IDF

Date: November 2022

Accredited for compliance
With ISO/IEC 17025
NATA Accreditation No. 19226

16-18 Sammut Street Smithfield NSW 2164
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www.idealgeotech.com.au

Contents

1.0 INTRODUCTION

Ideal Geotech has undertaken a Preliminary Acid Sulphate Soils Assessment for the proposed commercial development located at Warringah Golf Club; 433 Pittwater Road, North Manly. It is understood that a proposed two-storey commercial development is to be constructed with minimal cut and fill with possible excavation for footings.

2.0 OBJECTIVES AND SCOPE OF WORK

The objectives of the work are outlined below:

- Summarise the relevant environmental characteristics of the site that may impact Actual Acid Sulphate Soils (AASS) and result in the release of acidity and the potential leaching and transport of contaminants.
- Outline potential environmental impacts associated with the proposed works.
- Summarise the presence or the absence of AASS and Potential Acid Sulphate Soils (PASS).
- Summarise soil aggressiveness to steel and concrete.

The scope of work includes the following:

- Review of soils and geological maps.
- A Preliminary soil sampling and analysis program to investigate the presence and distribution of AASS and PASS within the site.
- Analysis (SPOCAS suite) by a NATA accredited laboratory.
- Assessment of the results of the chemical analysis against the appropriate guidelines to assess if management is required so as to minimise potential environmental impacts caused by the disturbance of ASS.

Provide recommendations for the need to undertake an ASS Management Plan.

3.0 SITE DETAILS

Site Address	433 Pittwater Road, North Manly
Client	Warringah Golf Club
Council Area	Northern Beaches Council

3.1 Geology

Reference to the Sydney 1:100,000 geological map (Geological Series Sheet 9130) indicates that the site is underlain by Quaternary Deposits consisting of silty to peaty quartz sand, silt and clay along with Ferruginous and humic cementation in places with common shell layers.

3.2 Site Description

The subject site is roughly rectangular in shape and approximately 1550m^2 in area and is bound by Pittwater Road to the north east, Kentwell Road to the south, Brookvale Creek to the west and by Warringah Golf Course on all remaining sides.

The site is currently occupied by tennis courts and sports facilities. The site is relatively flat with no notable slopes that will impact construction with a line of large mature trees a long the western, northern and eastern boundaries.

4.0 Subsurface Conditions

Fieldwork was undertaken on 26 October 2022 and included drilling two boreholes (BH1 & BH2) using a 4wd mounted drill rig using solid flight spiral augers to a maximum depth of 3.0m at the locations shown on Figure 1, attached in Appendix A.

Borehole logs and field observations are presented in Appendix B.

4.1 Soil Profile

A general summary of the subsurface conditions encountered across the site is presented in Table 2 below.

Table 1: Summary of Subsurface Conditions

Borehole	Depth of fill/topsoil (m)	Depth to water table (m)	Termination depth (m)	Summary of sub-surface profiles
BH1	0.2	NE	3.0	Topsoil- Silty SAND / Natural - Silty SAND
BH2	NE	NE	3.0	Natural - Silty SAND / Silty SAND trace Clay

XW *Extremely Weathered*

NE *Not Encountered*

Groundwater was not observed at the time of investigation. It should be noted that groundwater levels are likely to fluctuate with variations in climatic and site conditions.

4.2 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are naturally occurring and usually form in low lying coastal areas, creeks, rivers and flood plains. The sulphates present in the soil are stable when in the saturated/waterlogged state, but react to form sulphuric acid when disturbed and exposed to oxygen.

Maps showing the areas identified as being affected by ASS have been prepared by the Department of Land and Water Conservation. These maps identify the probability of acid sulphate soils occurring in these areas and as such any areas should be specifically investigated before a particular site is classified.

Disturbance of these soil materials will result in an environmental risk that will vary with elevation and depth of disturbance. Any works below natural ground surface or affecting the water table has a risk of being contaminated with acid sulphate soils.

Reference to the Acid Sulphate Soils Map of Sydney Heads indicates that the site is located on the border between disturbed terrain and no known occurrence of acid sulphate soil materials.

5.0 SAMPLING & ANALYSIS PLAN

Sampling and analysis was undertaken in order to assess the presence or absence, location and likely distribution of any AASS or PASS present at the subject site in the area of the proposed development.

5.1 Sampling

Soil sampling was undertaken in general accordance with the Acid Sulphate Soil Guidelines (Refer to Figure 1 for the borehole locations). Test results were compared to the relevant New South Wales Environment Protection Authority (NSW EPA) criteria.

BH1 was terminated at a depth of approximately 3.0m below ground level with samples collected at 0.5m and 1.5m below ground level. BH2 was terminated at a depth of approximately 3.0m below ground level with samples collected at 1.0m and 2.0m below ground level. The samples were placed directly into labelled clean zip lock bags and placed on ice until delivery to the laboratory for testing. All analyses were performed by a NATA registered laboratory using NATA accredited methods.

6.0 ACID SULPHATE SOILS ASSESSMENT

6.1 Field Screening

The field screening involved the testing of the samples for field pH and peroxide pH, using 30% hydrogen peroxide to oxidise the soil, and comparing both results.

A positive peroxide test, indicating the potential presence of acid sulphate soil, may include one or more of the following.

1. Change in colour from grey tones to brown tones.
2. Effervescence.
3. Release of sulphurous odours.
4. pH following oxidation with H_2O_2 ($_{pHfox}$) <3.
5. Lowering of the pH (pH_f - pH_{fox}) by 1 or greater.
6. Field pH (pH_f) <4.

The results of the field and peroxide tests are provided in Table 1 below

Table 2: Results of Field Screening Tests

Location/Depth	Field pH	Peroxide pH	Reaction to 30% h_2O_2
BH1/0.5m	6.8	3.2	Strong
BH1/1.5m	6.1	3.0	Strong
BH2/1.0m	6.2	2.6	Strong
BH2/2.0m	6.0	3.6	Slight

Based on findings of the field screenings, indications of PASS were observed. Two samples were tested by quantitative laboratory analysis to confirm the presence or absence of acid sulphate soil.

6.2 Laboratory Test Results

The samples were analysed for SPOCAS to confirm the presence or absence of ASS or PASS in the soil. The samples were dispatched to ALS Environmental services for the quantitative analysis for Suspension Peroxide Oxidation Combined Acidity & Sulphate (SPOCAS).

6.3 Assessment Criteria for Acid Sulphate Soils (Laboratory)

The results of analysis for the soils are compared to the below ASSMAC assessment criteria. It is assumed that <1000 tonnes of material would be disturbed hence the action criteria for less than 1000 tonnes have been applied.

6.4 NSW ASSMAC Action Criteria

The NSW ASSMAC action criteria is detailed in Table 2 below for less than 1000 tonnes of disturbance.

Table 3: NSW ASSMAC Action Criteria

Type of Material Texture	Approx Clay Content (% <0.002mm)	Action Criteria <1000 tonnes Sulfur Trail Spos or Stos%	Action Criteria <1000 tonnes Acid Trail TPA or TSA mole H+/t
Coarse e.g. sands	**< 5**	**0.03**	**18**
Loams/light clays	5 – 40	0.06	36
Fine clays/silts	$\geq$ 40	0.1	62

Note: The assessment values chosen are based on sands which are in bold

6.5 SPOCAS Test Results

The SPOCAS testing identified exceedances of the threshold criteria in both samples which suggests there is a presence of acid sulphate soils. Refer to Table 3 below.

Table 4: Results of SPOCAS Testing

Sample	pH_{OX}	TAA pH 6.5 moles H+/tonne	TPA pH 6.5 moles H+/tonne	TSA pH 6.5 moles H+/tonne	Spos %w/w
BH2/1.0m	3.0	**34**	**214**	**179**	**0.069**
BH2/2.0m	3.9	**27**	**80**	**52**	<0.020

6.6 Aggressiveness to Steel and Concrete

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of pH and types of salts present. In order to determine the degree of aggressiveness, the test values obtained are compared to tables 6.4.2 (C) and 6.5.2 (C) in AS2159 Piling - Design and Installation and tables 5.1 to 5.4 in AS2870-2011 "Residential Slabs and Footings". The following testing suite was undertaken with results summarised within table 4 below;

- pH
- Electrical Conductivity (EC μS/cm)
- Chloride (Cl)
- Resistivity (ohm.cm)
- Sulphate

Table 5: Results of Aggressivity Testing

Location/Depth	pH	EC_e dS/m	Resistivity Ohm.cm	Cl mg/kg	Sulphate mg/kg
BH1/0.5m	5.9	0.578	5880	<10	20
BH1/1.5m	5.4	0.782	7040	<10	170

Based on test results detailed in Table 4 the soil conditions are considered to be mildly aggressive to concrete and non-aggressive to steel in high permeability soils. An exposure classification of A2 for concrete has been determined.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Ideal Geotech has undertaken a Preliminary Acid Sulphate Soils Assessment for the proposed commercial development at Warringah Golf Club; 433 Pittwater Road, North Manly. Our preliminary site investigation included site observation of the soil retrieved from the borehole and sampling of soil for laboratory testing. Upon completion of our onsite investigation and laboratory analysis the following conclusions are made:

- An exposure classification of A2 for concrete with the soil mildly aggressive to concrete and non-aggressive to steel structures.

- Laboratory sample analysis indicates that test levels exceeded the action criteria in SPOCAS testing and it has been determined that an acid sulphate management plan will be required for excavation activities on the site.

This report is based on a limited sampling and testing regime. It is possible that acid sulphate soils and differing ground conditions may be present between sampling locations, or in the remainder of the site not intrusively investigated.

Should you have any queries, please do not hesitate to contact the undersigned.

For and on behalf of Ideal Geotech

D. Dwyer

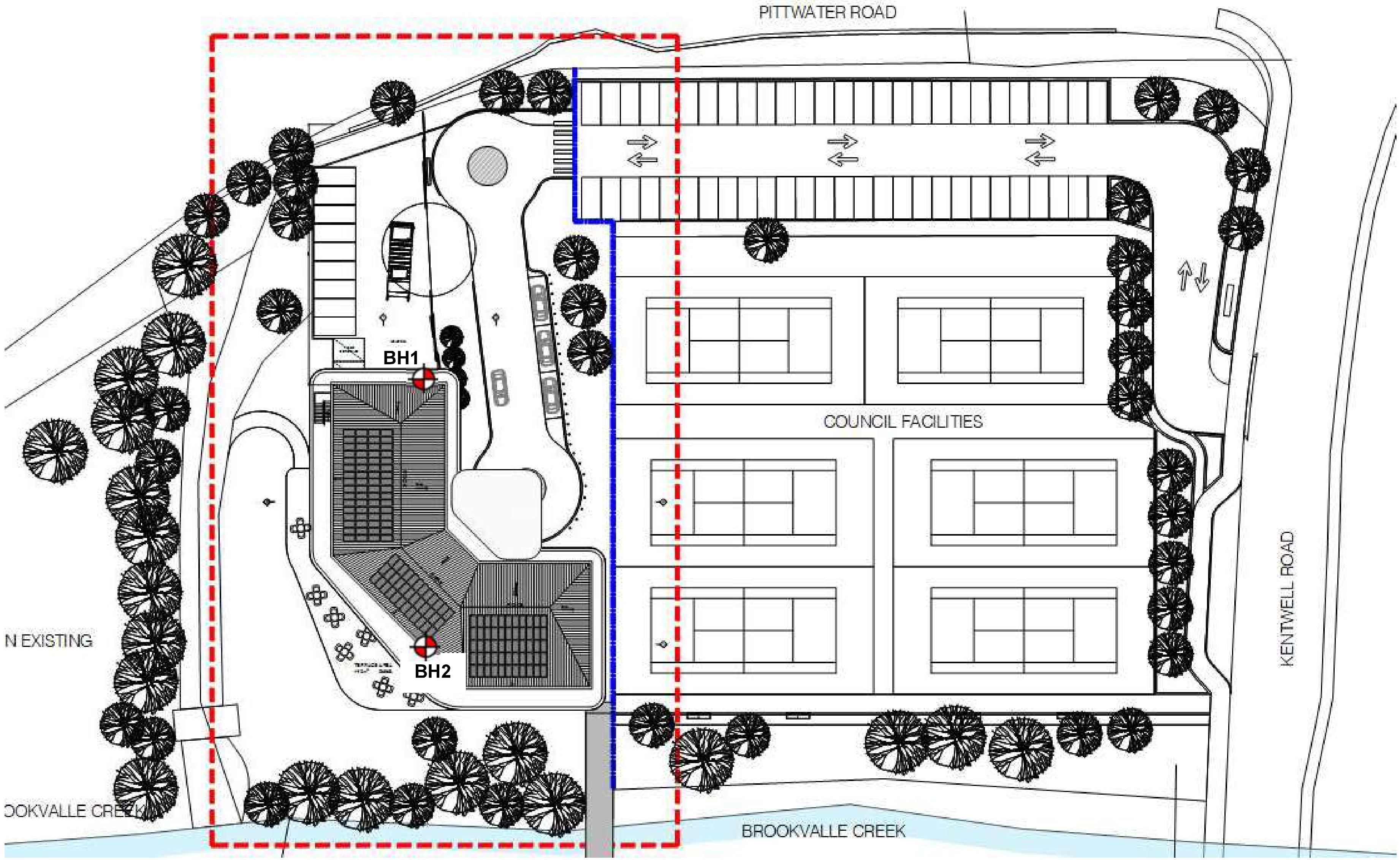
Dane Dwyer
Geotechnical Engineer

8.0 REFERENCES

- *Geological Series Sheet 9130, Map of Sydney, scale 1:100,000*
- *Stone, Y, and Hopkins G (1998). Acid Sulphate Soils Planning Guidelines.* Published by the Acid Sulphate Soil Management Advisory Committee, Wollongbar, NSW, Australia.
- Ahern C R, Stone, Y, and Blunden B (1998). *Acid Sulphate Soils Assessment Guidelines* Published by the Acid Sulphate Soil Management Advisory Committee, Wollongbar, NSW, Australia

9.0 APPENDICES

9.1 Appendix A – Borehole Location Plan



idealgeotech a division of idealcorp	**DRAWING TITLE:** Borehole Location Plan **PROJECT NAME:** Acid Sulphate Soils Assessment **SITE LOCATION:** Warringah Golf Club – North Manly	**COUNCIL NAME:** Northern Beaches Council **JOB NUMBER:** 60025-IDF **FIGURE NUMBER:** Figure 1	**DRAWN BY:** Ben **CHECKED BY:** Dane **DATE:** November 2022

9.2 Appendix B – Borehole Logs

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5.1 FIELD LOG

Date: 26/10/2022
Customer Job: -
Ideal Job: 60025
Site Address: Warringah Golf Club - 397 Condamine Street, NORTH MANLY, NSW, 2100

Borehole: BH1
Surface RL:
Easting:
Northing:

Water	Depth (m)	DCP	PP	Sample	Classification Code	Material Description	Moisture	Density / Consistency	Fill
	0.1				SM	(Topsoil) Silty Sand	Moist	L	
	0.2					Grey			
	0.3				SM	Silty Sand	Very Moist	MD	
	0.4					Grey			
	0.5			Soil Sample 1					
	0.6								
	0.7								
	0.8								
	0.9								
	1.0								
	1.1								
	1.2								
	1.3								
	1.4								
	1.5			Soil Sample 2					
	1.6								
	1.7								
	1.8								
	1.9								
	2.0								
	2.1								
	2.2								
	2.3								
	2.4								
	2.5								
	2.6								
	2.7								
	2.8								
	2.9								
	3.0								
	3.1					End Bore 3m			
	3.2								
	3.3								

Water Table **UTP** - Unable to penetrate **DCP** - 9kg Dynamic Cone Penetrometer **PP** - Pocket Penetrometer

AND – Density Index vs Approx. Penetrometer results				**SILTS & CLAY** – Cu vs Approx. Penetrometer results					**MOISTURE**	
DENSITY		**Density Index**	**DCP Blow Count** (blows/100mm)	**CONSISTENCY**		**Undrained Shear Strength** (kPa)	**DCP Blow Count** (blows/100mm)	**PP Dial Indicator**		
VL	Very Loose	< 15 %	< 1	VS	Very Soft	0 – 12	< 1	0 – 0.2	D	Dry
L	Loose	15 – 35 %	1 – 3	S	Soft	12 – 25	1 – 2	0.2 – 0.5	M	Moist
MD	Medium Dense	35 – 65 %	3 – 9	F	Firm	25 – 50	2 – 3	0.5 – 1.0	W	Wet
D	Dense	65 – 85 %	9 – 15	St	Stiff	50 – 100	3 – 5	1.0 – 2.0	W_P	Plastic Limit
VD	Very Dense	> 85 %	> 15	VSt	Very Stiff	100 – 200	5 – 8	3.0 – 4.0	W_L	Liquid Limit
				H	Hard	> 200	> 8	> 4.0		

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5.2 FIELD LOG

Date: 26/10/2022
Customer Job: -
Ideal Job: 60025
Site Address: Warringah Golf Club - 397 Condamine Street,
NORTH MANLY, NSW, 2100

Borehole: BH2
Surface RL:
Easting:
Northing:

Water	Depth (m)	DCP	PP	Sample	Classification Code	Material Description	Moisture	Density / Consistency	Fill
	0.1				SM	Silty Sand	Very Moist	MD	
	0.2					Grey			
	0.3								
	0.4								
	0.5								
	0.6								
	0.7								
	0.8								
	0.9								
	1.0			Soil Sample 1					
	1.1								
	1.2								
	1.3								
	1.4								
	1.5								
	1.6								
	1.7								
	1.8								
	1.9								
	2.0			Soil Sample 2					
	2.1				SM	Silty Sand with trace Clay	Very Moist	MD	
	2.2					Grey			
	2.3								
	2.4								
	2.5								
	2.6								
	2.7								
	2.8								
	2.9								
	3.0								
	3.1					End Bore 3m			
	3.2								
	3.3								

Water Table   **UTP** - Unable to penetrate   **DCP** - 9kg Dynamic Cone Penetrometer   **PP** - Pocket Penetrometer

AND – Density Index vs Approx. Penetrometer results

DENSITY		Density Index	DCP Blow Count (blows/100mm)
VL	Very Loose	< 15 %	< 1
L	Loose	15 – 35 %	1 – 3
MD	Medium Dense	35 – 65 %	3 – 9
D	Dense	65 – 85 %	9 – 15
VD	Very Dense	> 85 %	> 15

SILTS & CLAY – Cu vs Approx. Penetrometer results

CONSISTENCY		Undrained Shear Strength (kPa)	DCP Blow Count (blows/100mm)	PP Dial Indicator
VS	Very Soft	0 – 12	< 1	0 – 0.2
S	Soft	12 – 25	1 – 2	0.2 – 0.5
F	Firm	25 – 50	2 – 3	0.5 – 1.0
St	Stiff	50 – 100	3 – 5	1.0 – 2.0
VSt	Very Stiff	100 – 200	5 – 8	3.0 – 4.0
H	Hard	> 200	> 8	> 4.0

MOISTURE	
D	Dry
M	Moist
W	Wet
W_P	Plastic Limit
W_L	Liquid Limit

9.3 Appendix C – Laboratory Test Results

ALS Environmental

CERTIFICATE OF ASSESSMENT

Work Order	: **ES2238866**	Page	: 1 of 4
Client	: **IdealCorp Pty Ltd**	Laboratory	: Environmental Division Sydney
Contact	: DANE DWYER	Contact	: Customer Services ES
Address	: 16-18 Sammut Street SMITHFIELD NSW, AUSTRALIA 2164	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: ----	Telephone	: +61-2-8784 8555
Project	: 600255	Date Samples Received	: 28-Oct-2022 15:20
Order number	: ----	Date Analysis Commenced	: 31-Oct-2022
C-O-C number	: ----	Issue Date	: 04-Nov-2022 16:28
Sampler	: MK		
Site	: ----		
Quote number	: SY/386/19 V8		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Senior Chemist - Inorganics	Sydney Inorganics, Smithfield, NSW
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EA032 (Saturated Paste EC): NATA accreditation does not cover the performance of this service.
- ASS: EA029 (SPOCAS): Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA029 (SPOCAS): Excess ANC not required because pH OX less than 6.5.
- ASS: EA029 (SPOCAS): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from kg/t dry weight to kg/m3 in-situ soil, multiply reported results x wet bulk density of soil in t/m3.
- ASS: EA003 (NATA Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- ALS is not NATA accredited for the calculation of saturated resistivity in a soil.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1-0.5m	BH1-1.5m	BH2-1.0m	BH2-2.0m	----
			Sampling date / time	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	----
Compound	CAS Number	LOR	Unit	ES2238866-001	ES2238866-002	ES2238866-003	ES2238866-004	--------
				Result	Result	Result	Result	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.9	5.4	----	----	----
EA003 :pH (field/fox)								
pH (F)	----	0.1	pH Unit	6.8	6.1	6.2	6.0	----
pH (Fox)	----	0.1	pH Unit	3.2	3.0	2.6	3.6	----
Reaction Rate	----	1	Reaction Unit	3	3	3	1	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	34	46	----	----	----
EA029-A: pH Measurements								
pH KCl (23A)	----	0.1	pH Unit	----	----	5.0	5.1	----
pH OX (23B)	----	0.1	pH Unit	----	----	3.0	3.9	----
EA029-B: Acidity Trail								
Titratable Actual Acidity (23F)	----	2	mole H+ / t	----	----	34	27	----
Titratable Peroxide Acidity (23G)	----	2	mole H+ / t	----	----	214	80	----
Titratable Sulfidic Acidity (23H)	----	2	mole H+ / t	----	----	179	52	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.020	% pyrite S	----	----	0.055	0.044	----
sulfidic - Titratable Peroxide Acidity (s-23G)	----	0.020	% pyrite S	----	----	0.342	0.128	----
sulfidic - Titratable Sulfidic Acidity (s-23H)	----	0.020	% pyrite S	----	----	0.288	0.084	----
EA029-C: Sulfur Trail								
KCl Extractable Sulfur (23Ce)	----	0.020	% S	----	----	<0.020	<0.020	----
Peroxide Sulfur (23De)	----	0.020	% S	----	----	0.069	<0.020	----
Peroxide Oxidisable Sulfur (23E)	----	0.020	% S	----	----	0.069	<0.020	----
acidity - Peroxide Oxidisable Sulfur (a-23E)	----	10	mole H+ / t	----	----	43	<10	----
EA029-D: Calcium Values								
KCl Extractable Calcium (23Vh)	----	0.020	% Ca	----	----	<0.020	<0.020	----
Peroxide Calcium (23Wh)	----	0.020	% Ca	----	----	<0.020	<0.020	----
Acid Reacted Calcium (23X)	----	0.020	% Ca	----	----	<0.020	<0.020	----
acidity - Acid Reacted Calcium (a-23X)	----	10	mole H+ / t	----	----	<10	<10	----
sulfidic - Acid Reacted Calcium (s-23X)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-E: Magnesium Values								
KCl Extractable Magnesium (23Sm)	----	0.020	% Mg	----	----	<0.020	<0.020	----
Peroxide Magnesium (23Tm)	----	0.020	% Mg	----	----	<0.020	<0.020	----
Acid Reacted Magnesium (23U)	----	0.020	% Mg	----	----	<0.020	<0.020	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	BH1-0.5m	BH1-1.5m	BH2-1.0m	BH2-2.0m	----
			Sampling date / time	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	26-Oct-2022 00:00	----
Compound	CAS Number	LOR	Unit	ES2238866-001	ES2238866-002	ES2238866-003	ES2238866-004	--------
				Result	Result	Result	Result	----
EA029-E: Magnesium Values - Continued								
Acidity - Acid Reacted Magnesium (a-23U)	----	10	mole H+ / t	----	----	<10	<10	----
sulfidic - Acid Reacted Magnesium (s-23U)	----	0.020	% S	----	----	<0.020	<0.020	----
EA029-H: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	----	----	1.5	1.5	----
Net Acidity (sulfur units)	----	0.02	% S	----	----	0.12	0.04	----
Net Acidity (acidity units)	----	10	mole H+ / t	----	----	77	27	----
Liming Rate	----	1	kg CaCO3/t	----	----	6	2	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	----	----	0.12	0.04	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	----	----	77	27	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	----	----	6	2	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	10.3	50.2	----	----	----
EA084: Saturated Resistivity								
Resistivity at 25°C	----	10	ohm cm	5880	7040	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	170	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	----	----	----

Inter-Laboratory Testing

Analysis conducted by ALS Brisbane, NATA accreditation no. 825, site no. 818 (Chemistry) 18958 (Biology).

(SOIL) EA029-F: Excess Acid Neutralising Capacity
(SOIL) EA029-H: Acid Base Accounting
(SOIL) EA029-G: Retained Acidity
(SOIL) EA029-A: pH Measurements
(SOIL) EA029-C: Sulfur Trail
(SOIL) EA029-D: Calcium Values
(SOIL) EA029-E: Magnesium Values
(SOIL) EA029-B: Acidity Trail
(SOIL) EA003 :pH (field/fox)

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Warringah Golf Clubhouse

DA Acoustic Assessment

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Project ID	20221047.1
Document Title	DA Acoustic Assessment
Attention To	Warringah Golf Club Limited

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	9/09/2022	20221047.1/0909A/R0/PF	PF		
1	12/10/2022	20221047.1/1210A/R1/PF	TA		TA
2	29/08/2023	20221047.1/2908A/R2/PF	PF		PF

TABLE OF CONTENTS

1 INTRODUCTION

This report has been prepared to assess noise impacts associated with the proposed new club house development located at to 433 Pittwater Road, North Manly, known as Warringah Recreation Centre.

This document addresses noise impacts assessed with the following:

- Noise emission from the proposed operation of the club house. This will include patron activity and music within the club house, and
- Noise emissions from mechanical plant to service the project site (in principle).

Acoustic Logic (AL) have utilised the following documents and regulations in the assessment of external noise emission criteria for the development:

- North Beaches Council *Pre-DA meeting advice on Noise*, 25/07/2022
- North Beaches Council *Warringah Development Control Plan* (DCP) 2011, and
- The Environmental Protection Authority (EPA) *NSW Noise Policy for Industry* (NPI) 2017

This assessment has been conducted based on the architectural drawings provided to AL, prepared by Group Architects, dated 18.03.2022.

2 SITE DESCRIPTION

The proposed new club house will be located adjacent to the golf course in the Warringah recreation area in the northern corner of the land bounded by Kentwell Road and Pittwater Road, North Manly.

The proposed club will be comprised of:

- Two storey community-based club house providing office, meal, bar and function services with a maximum occupancy of 320 patrons (including staff)
- The proposed operation hours for each space are detailed in Warringah Golf Club documentation '*Plan of Management September 2022*' and has been reproduced below:

Day	Hours of Operation	Days Open
Pro Shop	Winter 6:30am-6pm Summer 6am-7pm	Monday-Sunday
Commercial office/meeting	9am-5pm	Monday-Friday
Garden Lounge	7am-10pm	Monday-Sunday
Dining & function Rooms	12pm-10pm	Monday-Sunday
Bar	10am-10pm	Monday-Sunday

- The major noise sources are the use of garden lounge (including an outdoor terrace), dining & function rooms and bar

The proposed site plan is presented in Figure 2.

A site survey has been carried out by this office to identify surrounding noise sensitive receivers and the existing acoustic environment. It is noted that the site is located within Warringah recreation area and residential receivers are identified to the northeast across Pittwater Road. Nearest sensitive receivers are as follows:

- **R1: Residential Receiver 1**: Residential houses to the north of the project site at 518-528 Pittwater Road, North Manly.
- **C1: Commercial Receiver 1**: Mixed use buildings to the east of the project site at 512 Pittwater Road and 3 Corrie Road, North Manly.

A site map, measurement locations and surrounding receiver are presented in Figure 1

Figure 1 – Project Site and Noise Measurement (Source from: Six Map NSW)

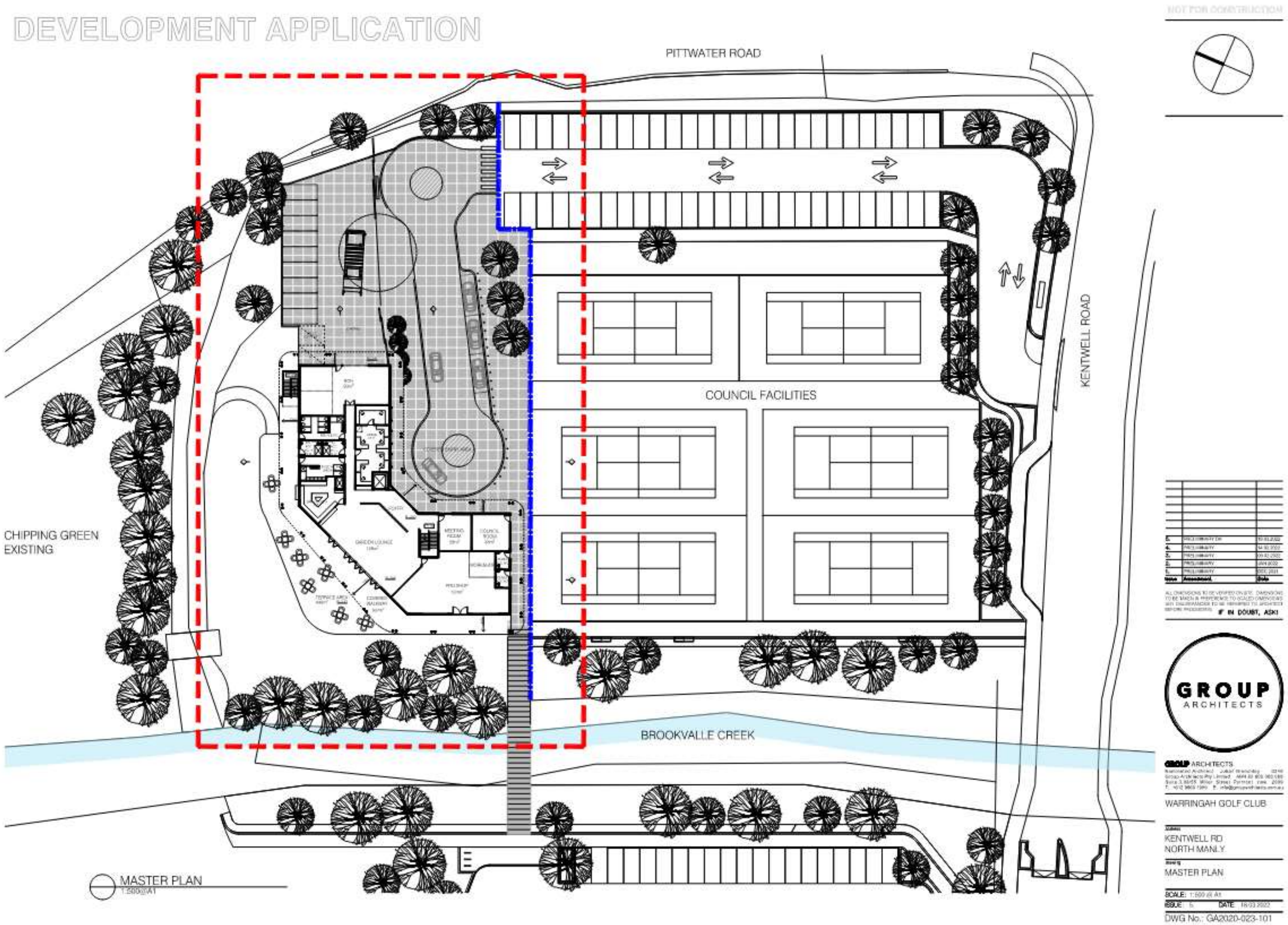


Figure 2 – Site Plan (sourced from Group Architects)

3 NOISE DESCRIPTORS

Ambient noise constantly varies in level from moment to moment, so it is not possible to accurately determine prevailing noise conditions by measuring a single, instantaneous noise level.

To quantify ambient noise, a 15 minute measurement interval is typically utilised. Noise levels are monitored continuously during this period, and then statistical and integrating techniques are used to characterise the noise being measured.

The principal measurement parameters obtained from the data are:

L_{eq} - represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the measurement period. L_{eq} is important in the assessment of noise impact as it closely corresponds with how humans perceive the loudness of time-varying noise sources (such as traffic noise).

L_{90} – This is commonly used as a measure of the background noise level as it represents the noise level heard in the typical, quiet periods during the measurement interval. The L_{90} parameter is used to set noise emission criteria for potentially intrusive noise sources since the disturbance caused by a noise source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

L_{10} is used in some guidelines to measure noise produced by an intrusive noise source since it represents the average of the loudest noise levels produced at the source. Typically, this is used to assess noise from licenced venues.

L_{max} is the highest noise level produced during a noise event, and is typically used to assess sleep arousal impacts from short term noise events during the night. It is also used to assess internal noise levels resulting from aircraft and railway ground vibration induced noise.

L_1 is sometimes used in place of L_{max} to represent a typical noise level from a number of high level, short term noise events.

4 ENVIRONMENTAL NOISE SURVEY

4.1 MEASUREMENT LOCATION

One unattended noise monitor was located at the north boundary of the site facing golf course. Refer to Figure 1 for detailed location. Attended measurements were conducted to the north east of the project site on Pittwater Road.

4.2 MEASUREMENT PERIOD

Unattended noise monitoring was conducted from Thursday 1st of September 2022 to Monday 12th of September 2022. Attended measurements were conducted on Thursday 1st of September 2022 between 4:00 pm – 5:00 pm.

4.3 MEASUREMENT EQUIPMENT

Unattended noise monitoring was conducted using one Acoustic Research Laboratories Pty Ltd noise logger. The logger was set to A-weighted fast response mode and was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted.

Attended noise measurements were conducted using a Norsonic 140 Sound Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

4.4 SUMMARISED RATING BACKGROUND NOISE LEVELS

NSW EPA's RBL assessment procedure requires determination of background noise levels for each day (the ABL) then the median of the individual days as set out for the entire monitoring period.

Appendix A provides detailed results of the unattended noise monitoring. Weather affected data was excluded from the assessment. The processed Rating Background Noise Levels (lowest 10th percentile noise levels during operation time period) are outlined in the table below.

Table 1 – Rating Background Noise Levels

Time of Day	Measured Background Noise Level dB(A)$L_{90(period)}$
Morning Shoulder (6am – 7am)	46
Day (7am – 6pm)	51
Evening (6pm – 10pm)	46

The following background noise spectrum for day and evening time is obtained based on attended measurements and unattended noise monitoring:

Table 2 – Summarised Background Noise Spectrum dB(A) $L_{90,\ 15mins}$

Time of Day	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-wt
Day	55	56	51	48	45	48	44	35	24	**51**
Evening	50	51	46	43	40	43	39	30	19	**46**

5 NOISE EMISSION CRITERIA

Noise emissions from the proposed club house tenancy will be assessed to comply with the criteria outlined in the following documents/regulations:

- North Beaches Council *Pre-DA meeting advice on Noise*, 25/07/2022
- NSW Liquor & Gaming requirements, and
- The Environmental Protection Authority (EPA) *NSW Noise Policy for Industry* (NPI) 2017

5.1 NORTH BEACHES COUNCIL – PRE-DA MEETING ADVICE ON NOISE

Noise

Licenced premises have the potential to cause noise impacts on surrounding residential receptors through patron noise and noise from mechanical plant. There are a number of potential residential receptors located on the northern side of Pittwater Road.

As such, to support any submitted application, Environmental Health would typically require a Noise Assessment by a suitably qualified and experienced acoustic engineer be submitted with the application. Any submitted acoustic assessment is to be in accordance with relevant standards and guidelines including NSW EPA's Noise Policy for Industry. The acoustic assessment should include an assessment of all the potential noise sources from the club house including but not limited to:

- *Noise from patrons including use of the outdoor terrace*
- *Noise from amplified music/live music; and*
- *Noise from mechanical plant.*

In accordance with the North Beaches Council *Pre-DA meeting advice on Noise*, 25/07/2022, noise emissions from mechanical plant and the car park will be assessed against the NSW Noise Policy for Industry.

Noise emissions from club house operation (patrons, music, etc) is to be assessed against the NSW Liquor and Gaming requirements, detailed below.,

5.2 NSW LIQUOR & GAMING

NSW Liquor & Gaming requirements are as follows:

- *The L_{10} noise level emitted from the premises shall not exceed 5dB above the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) between the hours of 7.00am to 12.00 midnight when assessed at the boundary of the nearest affected residential premises.*
- *L_{10} noise level emitted from the premises shall not exceed the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) after midnight when assessed at the boundary of the nearest affected residential premises.*

After midnight, noise emissions from the Place of Public Entertainment are to be inaudible within any habitable rooms in nearby residential properties.

5.3 NSW EPA INDUSTRIAL NOISE POLICY FOR INDUSTRY 2017

For noise emissions associated with the car park and mechanical plant, the NSW EPA Noise Policy for Industry has been adopted.

The EPA NPI has two criteria which both are required to be satisfied, namely Intrusiveness and amenity. The NPI sets out acceptable noise levels for various localities. The policy indicates four categories to assess the appropriate noise level at a site. They are rural, suburban, urban and urban/industrial interface. Under the policy the nearest residential receivers would be assessed against the urban criteria.

Noise levels are to be assessed at the property boundary or nearby dwelling, or at the balcony or façade of an apartment.

5.3.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5dB(A). The intrusiveness criteria applicable to the development are presented in the table below.

Table 3 – NPfI Intrusiveness Criteria

Time of Day	Rating background Noise Level dB(A)$L_{90(15min)}$	Intrusiveness Criteria dB(A) $L_{eq(15min)}$
Morning shoulder (6am - 7am)	46	51
Day (7am – 6pm)	51	56
Evening (6pm – 10pm)	46	51

5.3.2 Project Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment.

The EPA's NPI sets out acceptable noise levels for various localities. The recommended noise amenity area is based upon the measured background noise levels at the sensitive receiver. Based on the measured background noise levels detailed in Section 4.4, the Noise Policy for Industry suggests the adoption of the 'urban' categorisation.

The NPI requires project amenity noise levels to be calculated in the following manner:

$$L_{Aeq,15min} = \textit{Recommended Amenity Noise Level} - 5\ dB(A) + 3\ dB(A)$$

The amenity levels appropriate for the commercial receivers surrounding the site are presented below.

Table 4 – EPA Amenity Noise Levels

Type of Receiver	Time of day	Recommended Noise Level dB(A)$L_{eq(period)}$	Project Amenity Noise Level dB(A)$L_{eq(15\ minute)}$
Residential (Urban)	Morning Shoulder	45	43
	Day	60	58
	Evening	50	48
Commercial	When in Use	65	63

The NSW EPA Noise Policy for Industry (2017) defines:

- Day as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays.
- Evening as the period from 6pm to 10pm.
- Night as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sunday and public holidays.

5.3.3 Sleep Arousal Criteria

The Noise Policy for Industry recommends the following noise limits to mitigate sleeping disturbance:

Where the subject development / premises night -time noise levels at a residential location exceed:

- *$L_{eq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
- *L_{Fmax} 52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,*

a detailed maximum noise level even assessment should be undertaken.

Table 5-5 – Sleep Arousal Criteria for Residential Receivers

Receiver	Rating Background Noise Level (Night) dB(A)L_{90}	Emergence Level
Residences Surrounding Site Morning Shoulder (6am – 7am)	46 dB(A) L_{90}	51 dB(A)$L_{eq, 15min}$; 61 dB(A)L_{Fmax}

5.4 SUMMARISED NOISE EMISSION CRITERIA

Based on the noise emission criteria detailed above, a summary of the noise emission criteria for the usage of the proposed premises are presented below. For licensed spaces, the noise emission criteria for patron and music noise between 10:00am -10:00pm is presented in the table below.

Table 6 – Summarised Patron/Music Noise Emission Goals – Residential Receivers (External)

Time of Day	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	A-wt
Day 7am-6pm (BG + 5)	60	61	56	53	50	53	49	40	29	**56**
Evening 6pm-10pm (BG + 5)	55	56	51	48	45	48	44	35	24	**51**

For the entire proposed development, the noise emission criteria for any proposed new mechanical plant and the car park are summarised below:

Table 7 – Noise Emissions Criteria – Mechanical Noise to Surrounding Receivers

Location	Time Period	Assessment Background Noise Level dB(A)L_{90}	Project Amenity Criteria dB(A) L_{eq}	Intrusiveness Criteria $L_{eq(15min)}$	NPI Criteria for Sleep Disturbance
Nearby Residences – Suburban Receiver	Moring Shoulder	46	**43**	51	51 dB(A)$L_{eq, 15min}$; 61 dB(A)L_{Fmax}
	Day (7am-6pm)	51	58	**56**	N/A
	Evening (6pm-10pm)	46	**48**	51	N/A
Nearby commercial receivers	When in use	65	**63**	N/A	N/A

The project noise trigger levels are indicated by the bolded values in the table above.

6 NOISE EMISSION ASSESSMENT

Noise emissions from the site are addressed for the following noise sources:

- Patron and background music noise from the proposed licensed premises,
- Use of the car park; and
- Mechanical plant noise in principle.

6.1 PATRON/MUSIC NOISE

This section of the report examines the potential noise impacts from patron noise from the proposed tenancy. The major potential noise sources are from the use of following licensed spaces:

- Ground floor garden lounge and outdoor terrace to the west of the development, and
- First floor dining, function and sports bar to the north and west of the development.

The emission levels present within this assessment were corrected for distance attenuation and barrier effects (building shielding) where applicable.

Predicted noise levels from patron noise have been assessed using the following assumptions:

- There is a maximum capacity of 320 people using the facility (including patron and staff) and it is assumed the max capacity at all times during the operation (10:00am -10:00pm)
- The distribution of the number of patrons & staff is assumed as follows to present a conservative assessment:
  - Ground floor outdoor terrace: 50
  - Ground floor indoor garden lounge: 100
  - First floor dining/ function: 60
  - First floor function: 60, and
  - First sports bar: 50

  The number of patrons presented above is a conservative assumption as all spaces will not operate at full capacity for normal operation of the club house. In the case that the above assumption complies with the criteria, all other conditions will comply with the criteria.
- Patron noise is subject to 1 in 3 patrons talking at a moderately loud level at any one time. A sound power level of 77dB(A)L_{10} was used for patron voice levels for this assessment, see table below

Table 8 – Patron Speech Spectrum

Noise Level dB(A) – Frequency (Hz)									
31.5Hz	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**A-weighted**
62	62	67	70	74	75	70	51	48	**77**

- Music within the internal spaces is assumed to be limited to background music, creating a spatially averaged sound pressure level of 75dB(A), see table below

Table 9 – Music Spectrum

Noise Level dB(A) – Frequency (Hz)									
31.5Hz	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**A-weighted**
71	71	77	73	72	71	66	57	59	**75**

- The recommendations set out in Section 7 of this report have been implemented.

6.1.1 SoundPlan Modelling

Noise levels have been predicted at the receiver locations using SoundPlan™ 8.0 modelling software implementing the ISO 9613-2:1996 "Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation" noise propagation standard.

Noise enhancing meteorological have been adopted as recommended by the NPI, noting that the ISO 9613 modelling approach assumes that all receivers are 'downwind' (i.e., that noise enhancing wind conditions are in effect at all times).

The following figures detail computational noise modelling for closest noise sensitive receivers and façades relating to the operational noise emissions of the site through the presentation of a façade noise map onto the respective buildings and a grid noise map at 1.5m above the digital ground model. Numerical results are presented in the section below.

Ground absorption was conservatively calculated with a ground factor of 0 for all roads and golf course fronting the site with a ground factor of 0.6 as recommended in *Engineering Noise Control* (Bies & Hanson).

In line with Factsheet C of the NPI, penalties for annoying noise characteristics should be applied at the receiver, where applicable. Based on the predicted noise levels, no penalty should be applied (either for tonality, intermittency, or otherwise).

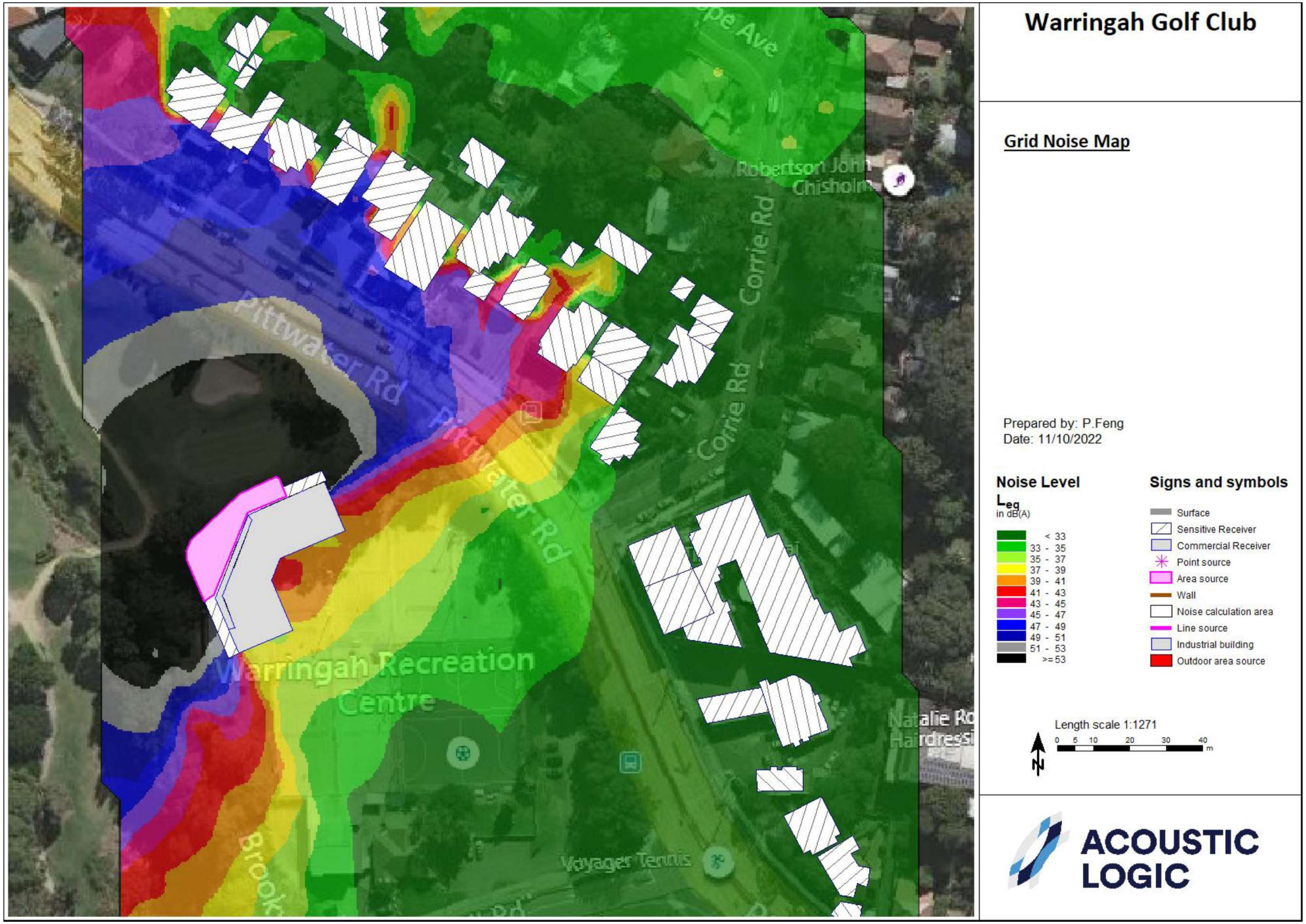


Figure 3 – Soundplan modelling results, grid noise map at 1.5m from Ground RL

6.1.2 Summarised Predicted Noise Levels at Surrounding Receivers

Assessment of noise emissions against the relevant acoustic criteria for all nearby commercial development is presented in the following tables. Predicted noise levels factor in losses due to distance and barrier effects, calculated at the nearest affected facade.

Table 10 – Patron/Music Noise Emission to R1 (Worst affected façade, Externally)

	31.5 Hz	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**	**A-wt**
Predicted Noise Level Day & Evening 7am-10pm dB(A)L_{10}	38	38	40	42	45	47	42	25	17	50
Noise Emission Goal Day 7am-6pm (BG + 5)	**60**	**61**	**56**	**53**	**50**	**53**	**49**	**40**	**29**	**56**
Compliance ?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noise Emission Goal Evening 6pm-10pm (BG + 5)	**55**	**56**	**51**	**48**	**45**	**48**	**44**	**35**	**24**	**51**
Compliance ?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

6.2 PEAK NOISE FROM CAR PARK USAGE

Peak noise levels from the use of the car park have been predicted and assessed against the relevant noise criteria detailed in Section 5.3.3. Peak noise events have been assessed to determine the potential for sleep disturbance amongst the nearest residences to the development. The assessment has been conducted with reference to the following assumptions:

- During typical 15 min period, we assumed one car door slam. A sound power level of 95dB(A)L_{max} has been adopted for a car door slam.

Table 11 – Patron/Music Noise Emission to R1 (Worst affected façade, Externally)

Receiver	**Predicted Noise Level – dB(A)L_{Max}**	**Criteria**	**Compliance?**
R1 Residential houses to the north of the project site at 518-528 Pittwater Road, North Manly	45	61 dB(A)L_{Fmax}	Yes

Table Note:

1. An assessment of sleep disturbance from peak noise events emanating from carpark usage is only undertaken at residential receivers.

6.3 NOISE FROM MECHANICAL PLANT WITHIN PROPOSED SITE GENERALLY

Detailed plant selection and location has not been undertaken at this stage. Satisfactory levels will be achievable through appropriate plant selection, location and if necessary, standard acoustic treatments such as duct lining, acoustic silencers and enclosures.

Noise emissions from all mechanical services to the closest residential and commercial receivers should comply with the requirements of Section 5.5.

6.3.1 Preliminary Mechanical Treatment Advice

An indicative assessment of initial design of primary plant items is presented below.

- Refrigeration equipment:
    - Refrigeration plant is recommended to be located within enclosure plant rooms.
    - Noise screening (using either a dedicated noise screen or the building shell between the plant and noise sensitive buildings) is recommended. This will include blanking off any plant room louvres.
    - Night time operational speeds shall be restricted.
- Major fans (typically with a sound power over 85dB(A) – such as kitchen exhaust, major toilet exhaust and major relief air fans) may require acoustic treatment if located externally near sensitive receivers. It is recommended that axial (as opposed to roof mounted fans) are to be used as this will enable acoustic treatment to be incorporated within ductwork running to atmosphere and with attenuators if necessary. In addition to the location of the equipment, acoustic treatments to the major plant items may include silencers, treatment to ducting, time control, operational limitations, and vibration isolation.
- Supply and exhaust fans may be located within plant rooms or in rooftop plant areas. These units typically emit high noise levels and require acoustic treatment such as silencers and internal lined ductwork. Silencer requirements would be determined once fan selections have been completed.
- Other minor plant items, such as bathroom or kitchen exhaust fans, may also be required. These items typically emit relatively low noise levels and may require minimal acoustic treatment of a standard nature, such as internally lining of ductwork.

Cumulative assessment of both plant noise with other noise sources is recommended when conducting acoustic design of plant items. Compliance with EPA acoustic criteria (as set out in Section 5.3) will be achievable, provided that detailed acoustic review of plant items is undertaken once plant is selected, and acoustic treatments similar to those outlined above are adopted.

The above recommendations are indicative. Detailed acoustic review should be undertaken at CC stage to determine acoustic treatments to control noise emissions to satisfactory levels.

7 RECOMMENDATIONS

The following noise emission controls should be imposed for the proposed development:

- Operating hours for the licensed premises are not to exceed 7am – 10pm Monday to Sunday.
- Speakers for the proposed bar are to be vibration isolated from the building structure using Embelton NRD mounts or similar.
- Allowed a maximum of up to 320 patrons. The distribution of the patrons for each space are not to exceed the assumptions presented in Section 6.1.
- Music speakers within the internal spaces not to exceed a spatially averaged sound pressure level of 75dB(A) L_{10}.
- External disposal of bottles/waste should be done prior to 10:00pm, but not before 7am.
- Signs are to be displayed at the entrance of the development reminding patrons to minimise noise when departing the premise.
- It is recommended that the management keep a complaint register on site and that noise complaints are registered (if any) and what course of remedial action has been taken. This register should be stored on site and be accessible at all times.

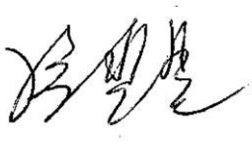
8 CONCLUSION

This report has been prepared to assess noise impacts associated with the new club house development as part of Warringah Golf Club located at 433 Pittwater Road, North Manly.

A soundplan model has been developed to predict the noise emission from patron and music from the proposed club. Provided that the recommendations in Section 7 of this report are adopted, noise emissions to all nearby development will be compliant with the noise emission guidelines.

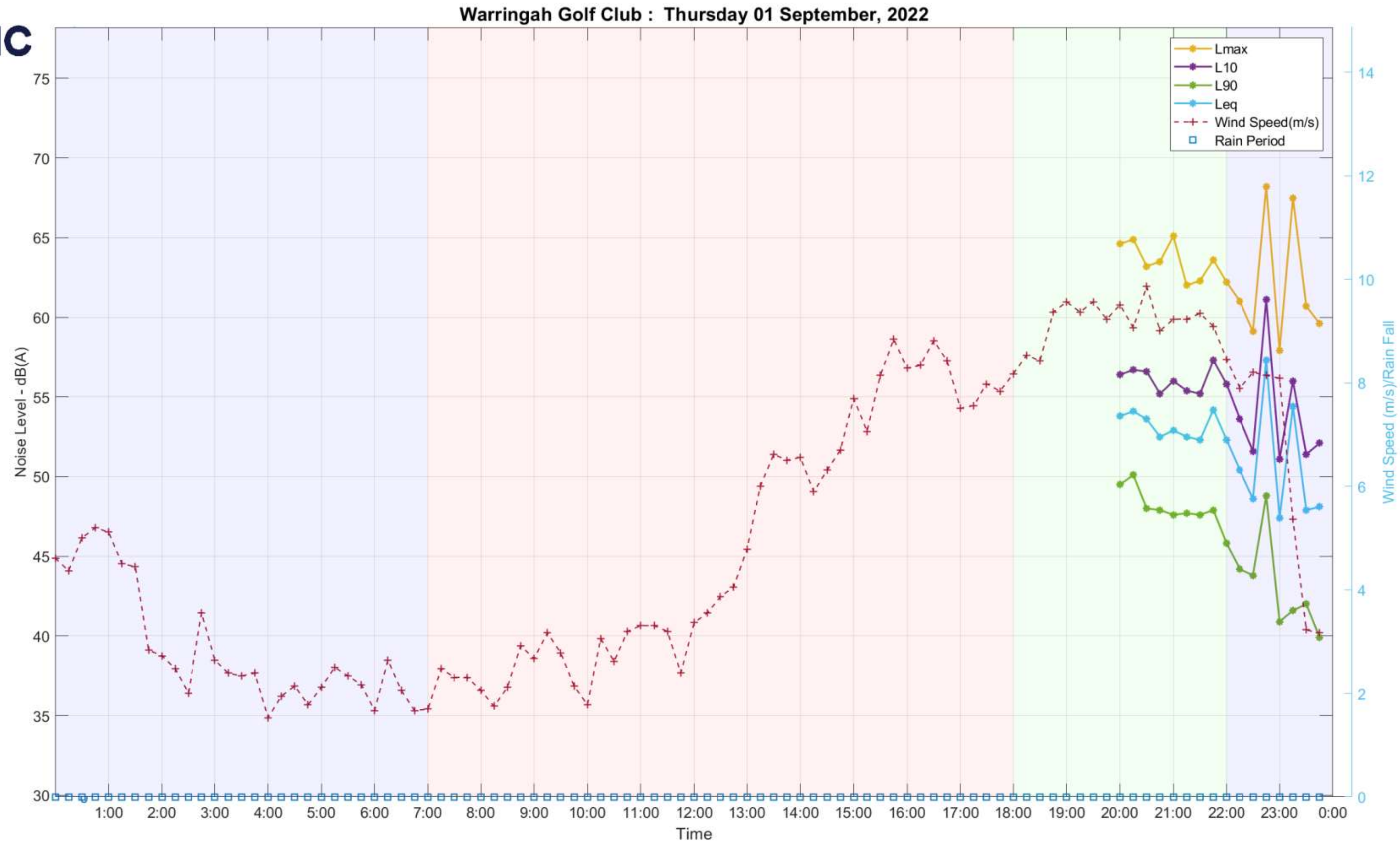
Please contact us should you have any further queries.

Yours faithfully,

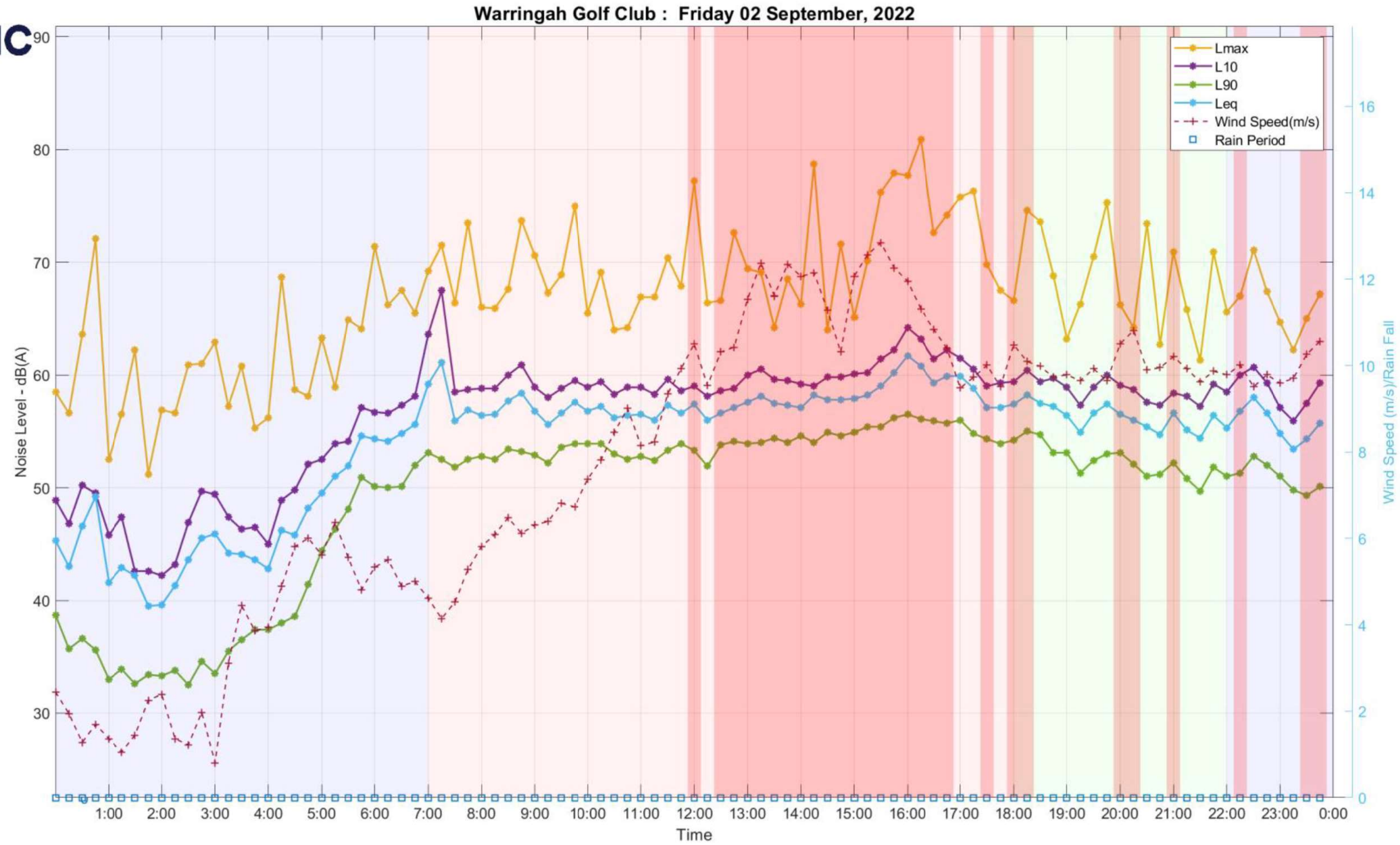


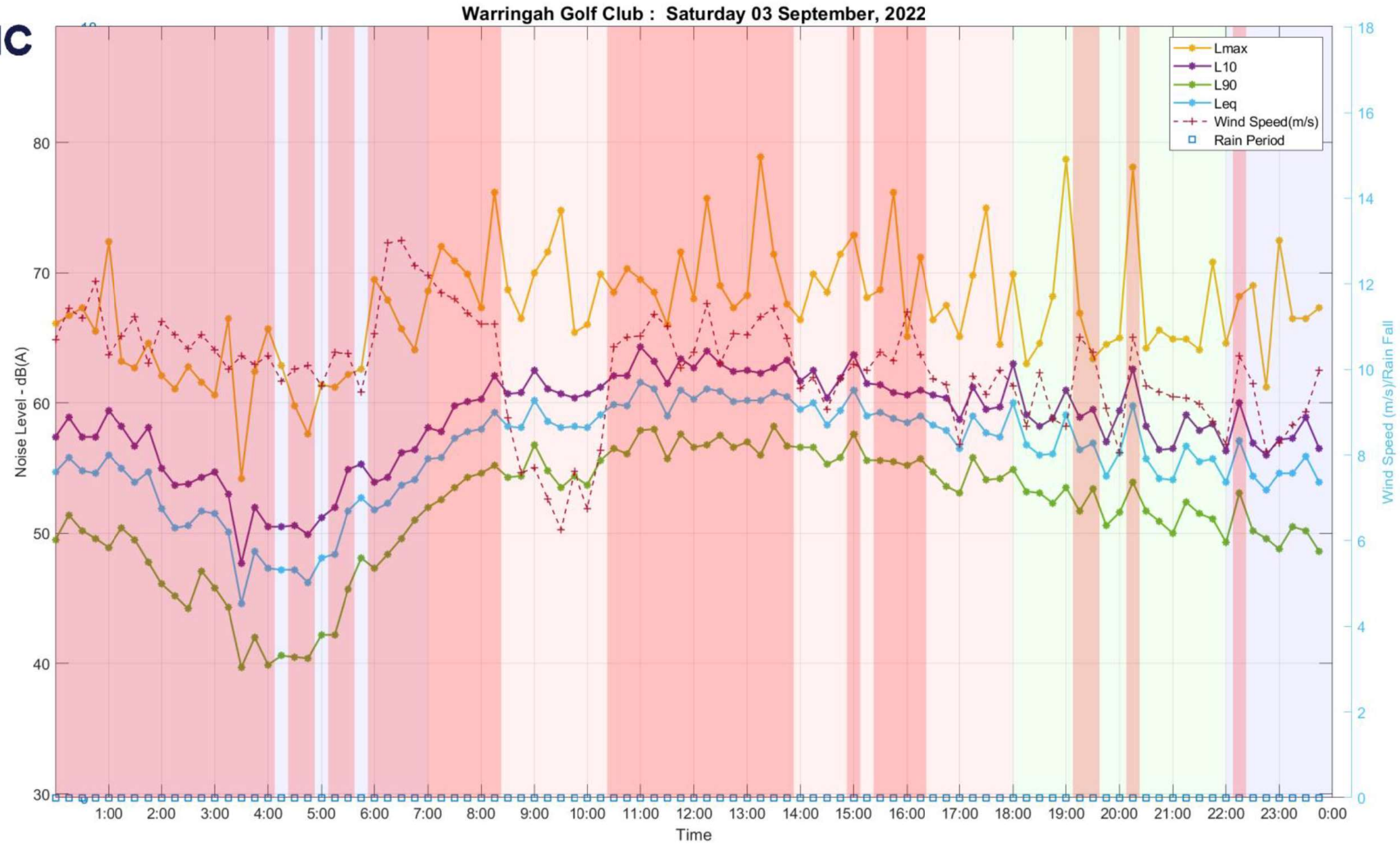
Acoustic Logic Pty Ltd
PeiPei Feng

APPENDIX A – UNATTENDED NOISE MONITORING DATA



Warringah Golf Club : Thursday 01 September, 2022
Noise Level - dB(A)
75
70
65
60
55
50
45
40
35
30
Wind Speed (m/s)/Rain Fall
14
12
10
8
6
4
2
0
Time
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period


Warringah Golf Club : Friday 02 September, 2022
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
90
80
70
60
50
40
30
16
14
12
10
8
6
4
2
0
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00


Warringah Golf Club : Saturday 03 September, 2022
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
80
70
60
50
40
30
18
16
14
12
10
8
6
4
2
0
1:00
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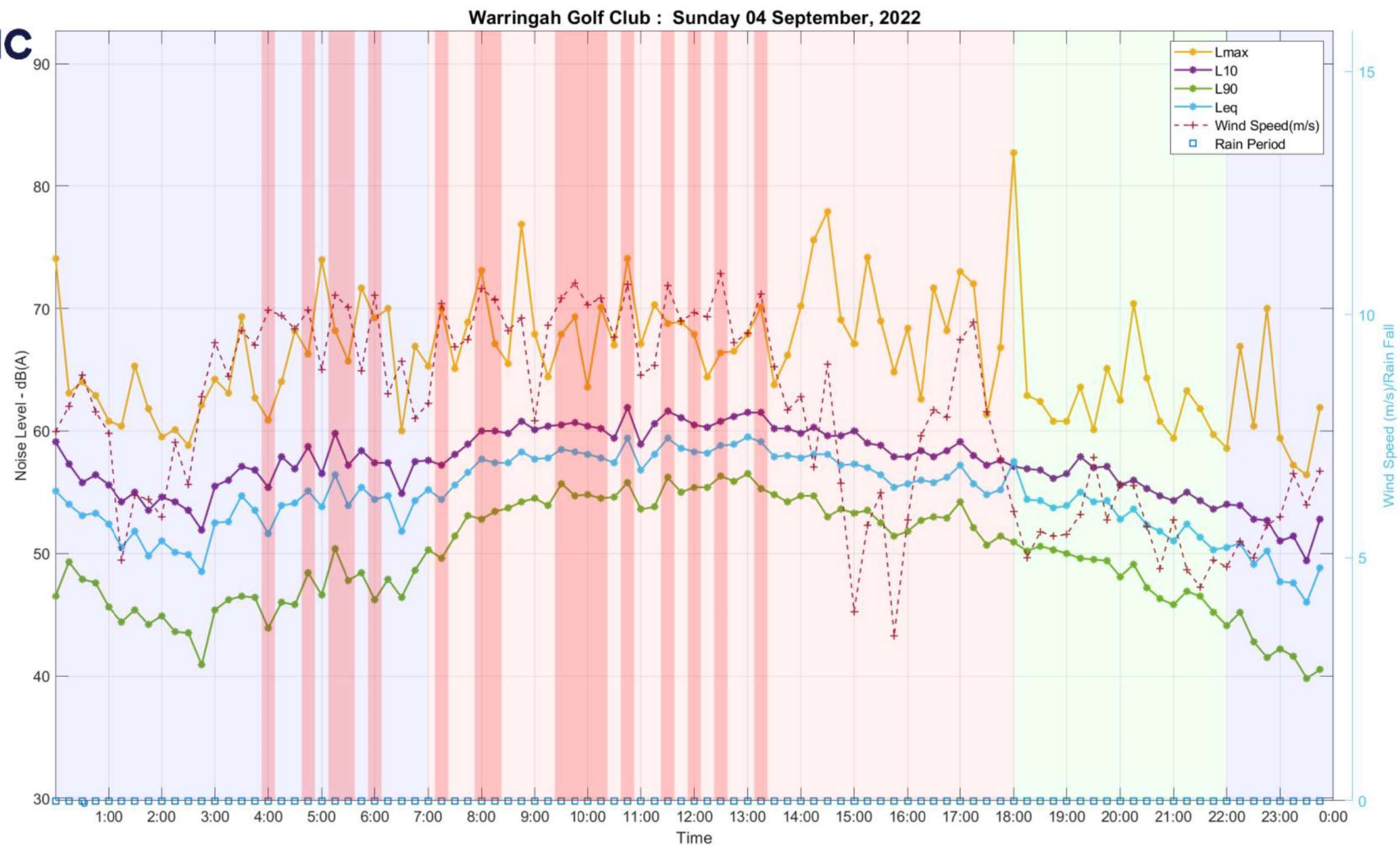
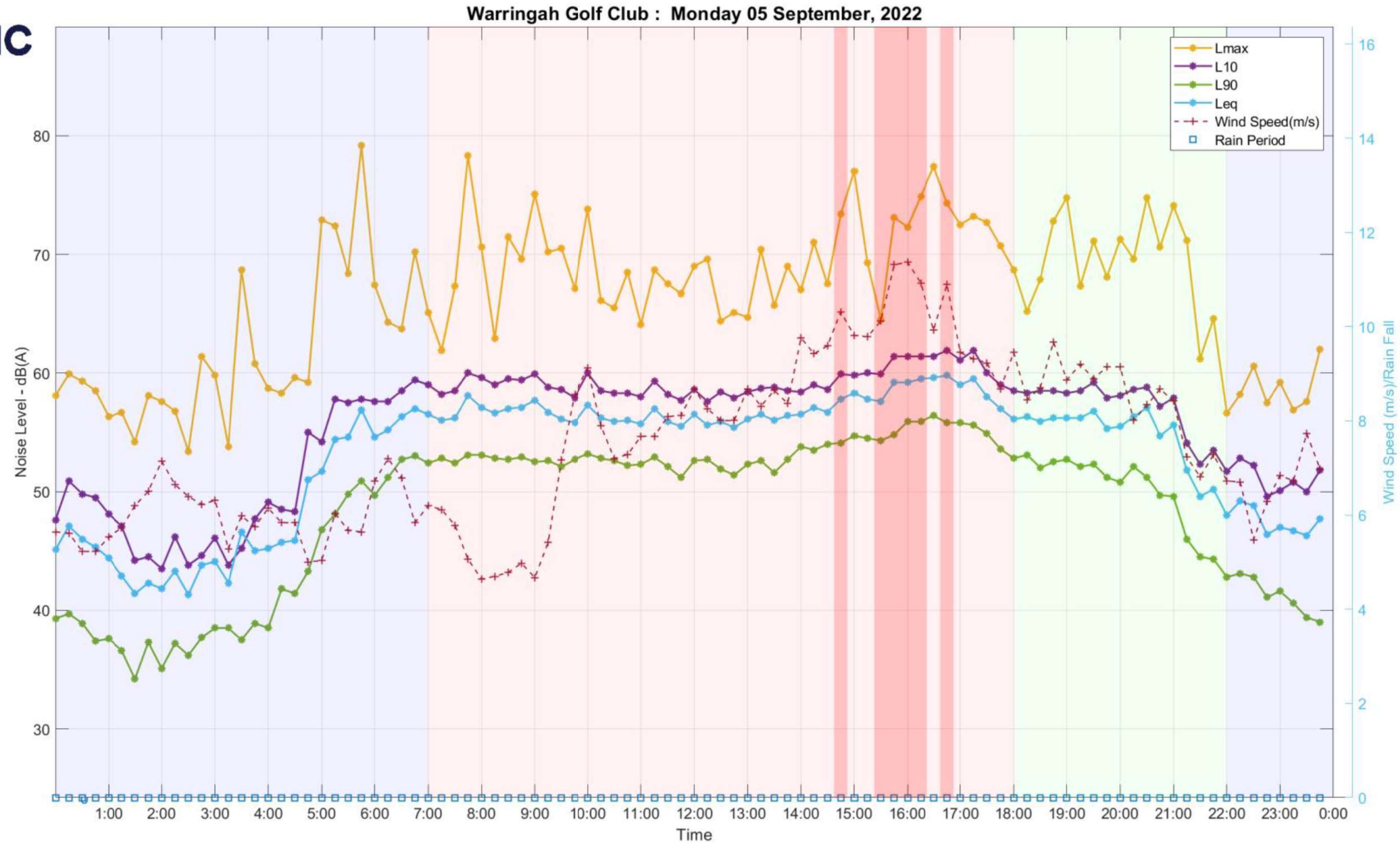
0:00


Warringah Golf Club : Sunday 04 September, 2022
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
90
80
70
60
50
40
30
15
10
5
0
1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00


Warringah Golf Club : Monday 05 September, 2022
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
80
70
60
50
40
30
16
14
12
10
8
6
4
2
0
1:00
2:00
3:00
4:00
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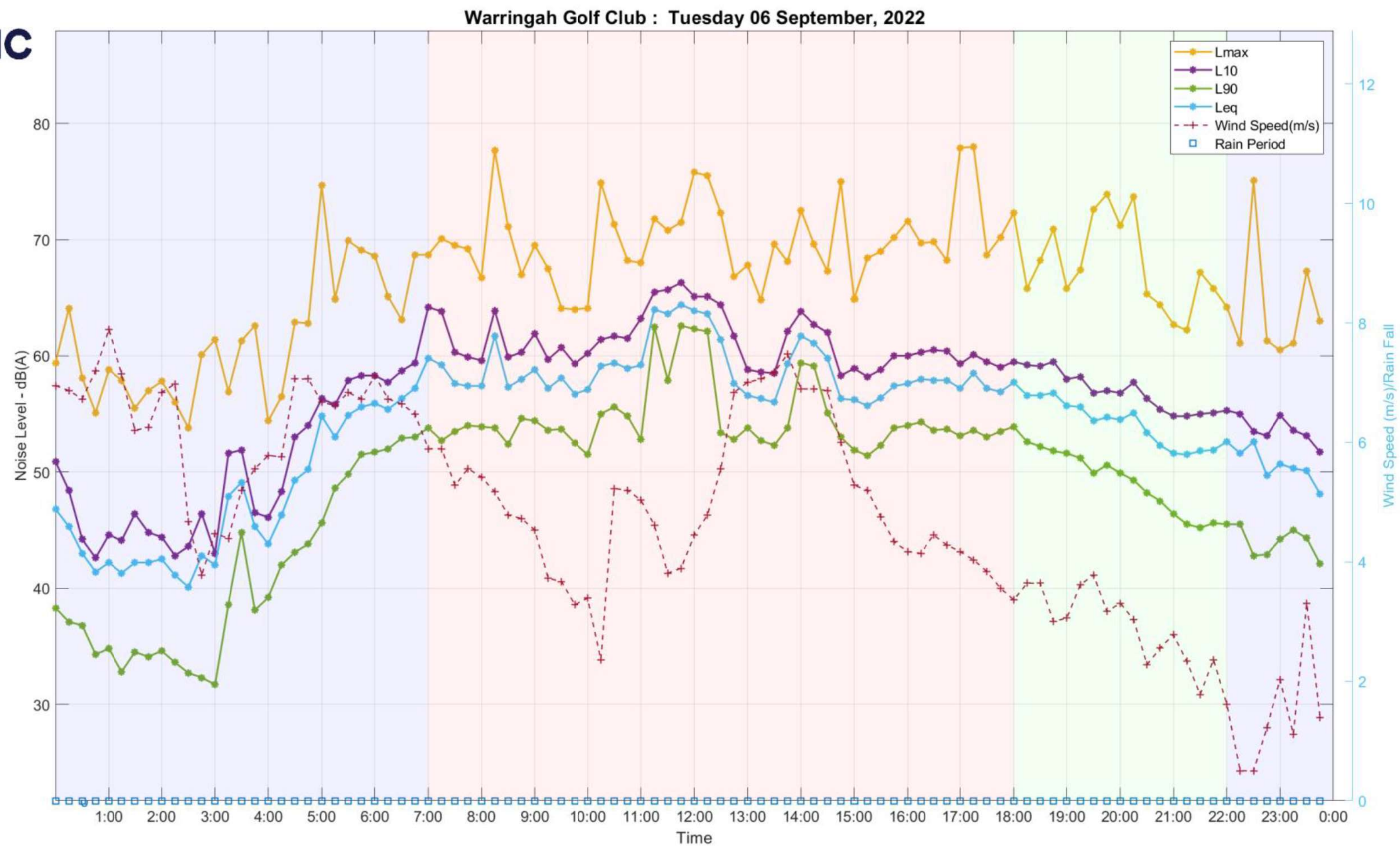
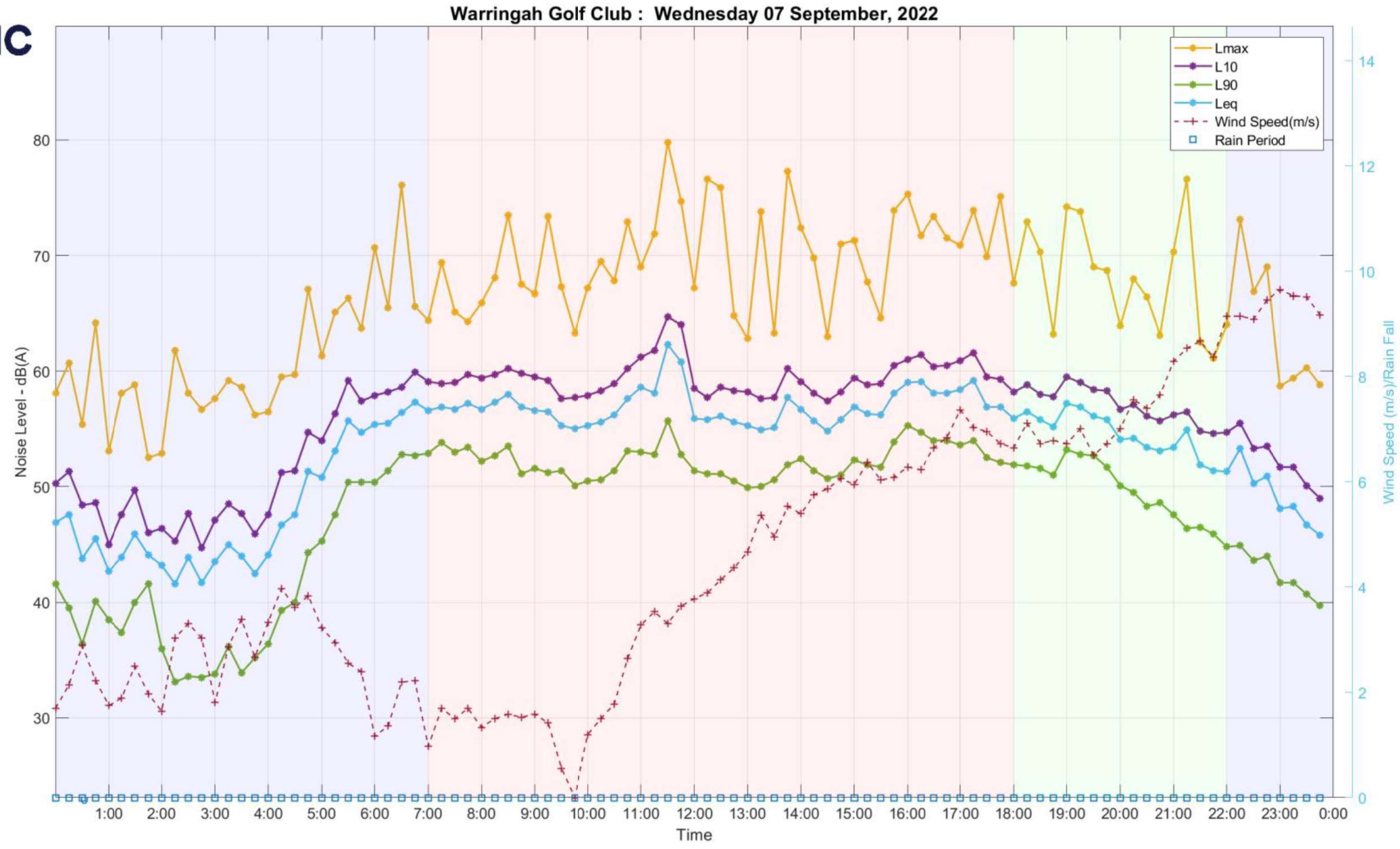


Warringah Golf Club : Tuesday 06 September, 2022
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period


Warringah Golf Club : Wednesday 07 September, 2022
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
30
40
50
60
70
80
0
2
4
6
8
10
12
14
1:00
2:00
3:00
4:00
5:00
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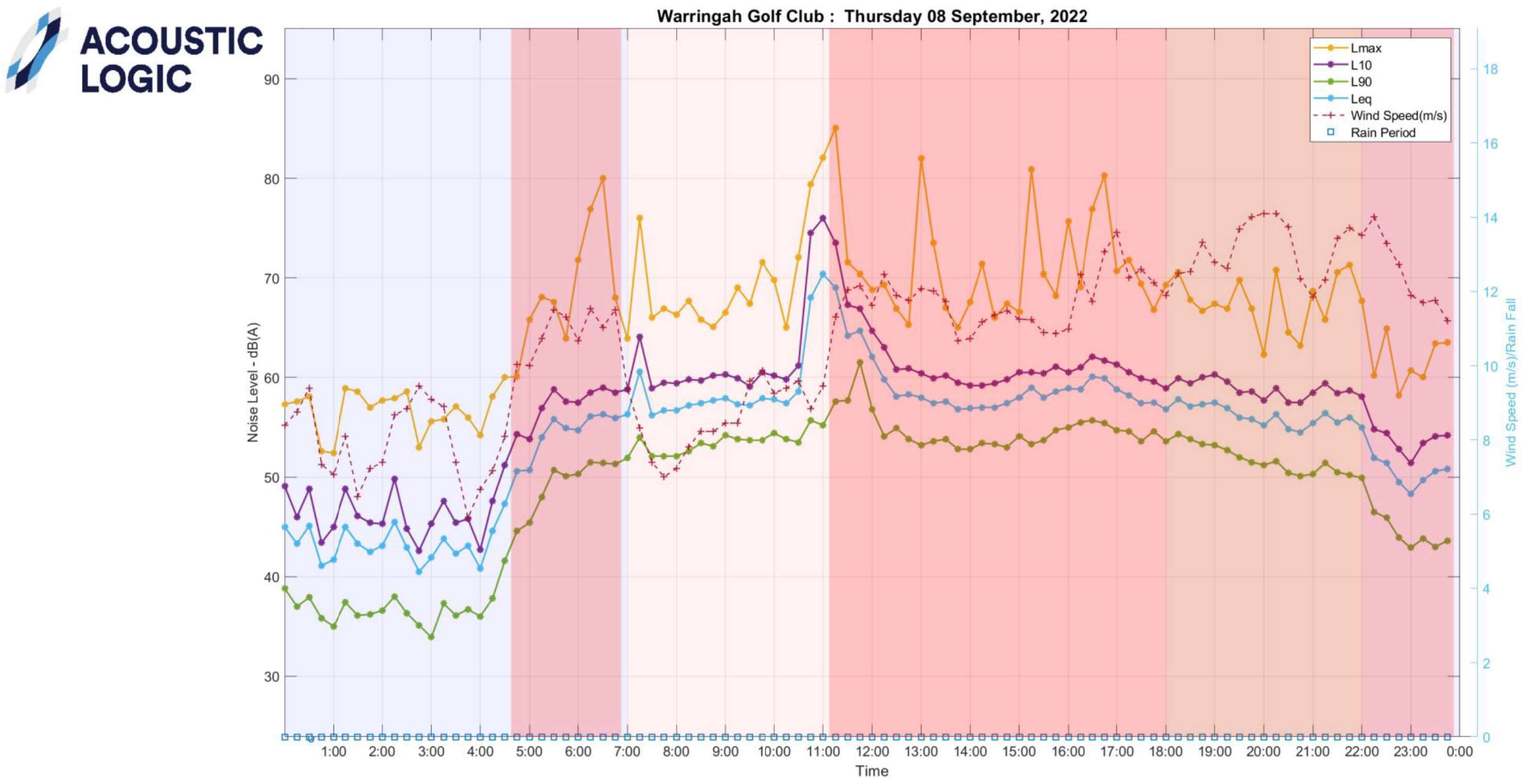
Warringah Golf Club : Thursday 08 September, 2022
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
90
80
70
60
50
40
30
18
16
14
12
10
8
6
4
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3:00
4:00
5:00
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18:00
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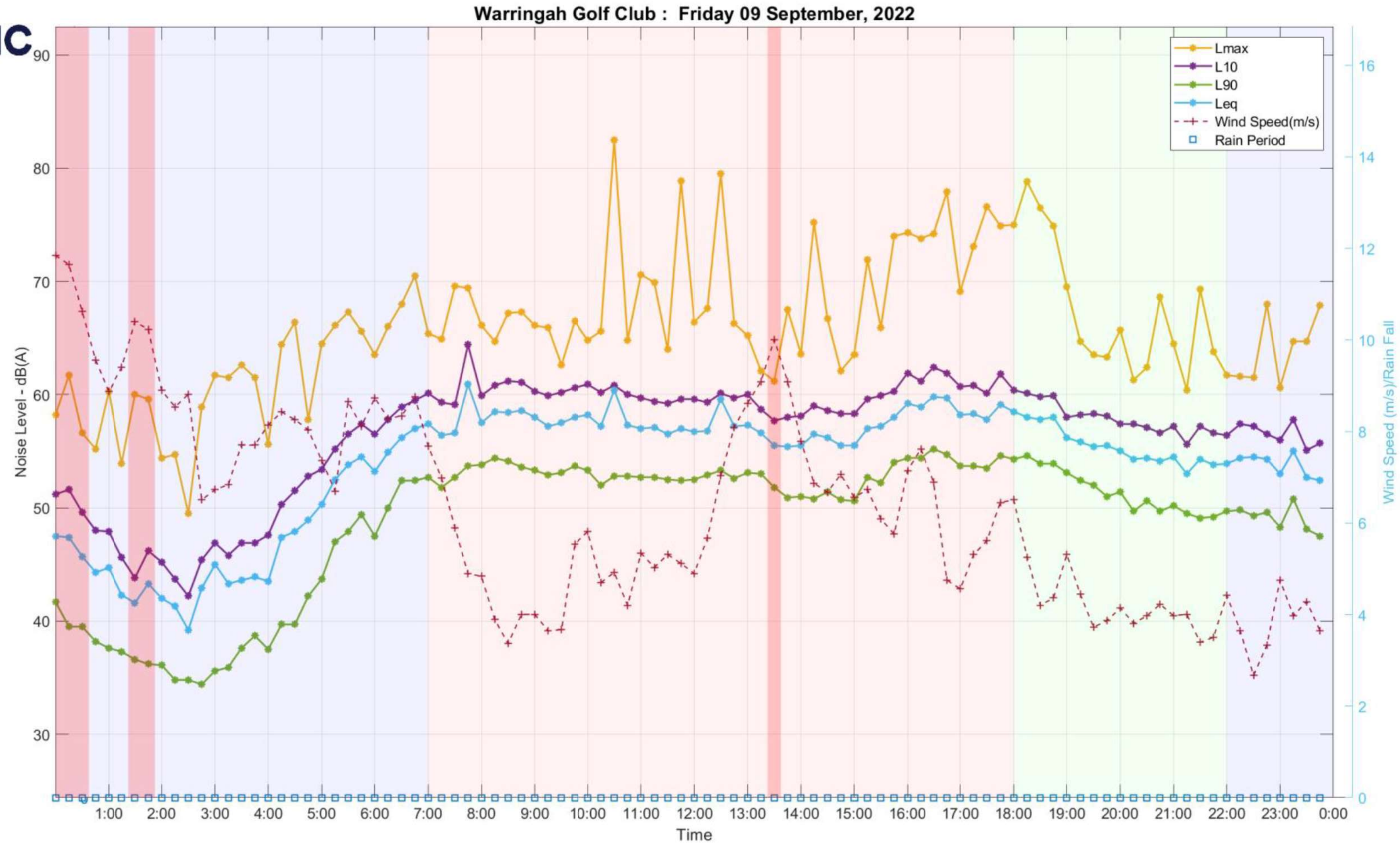
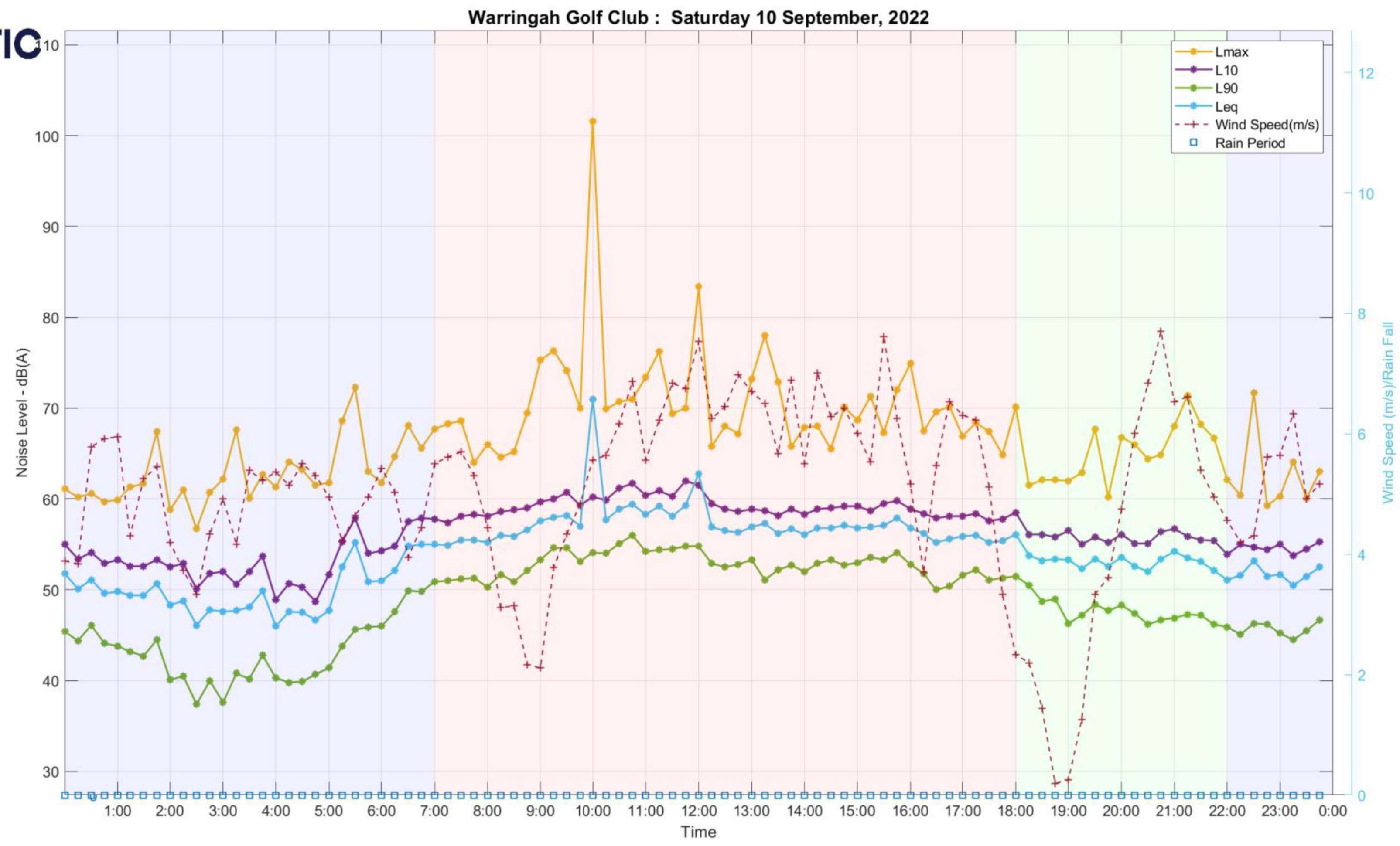
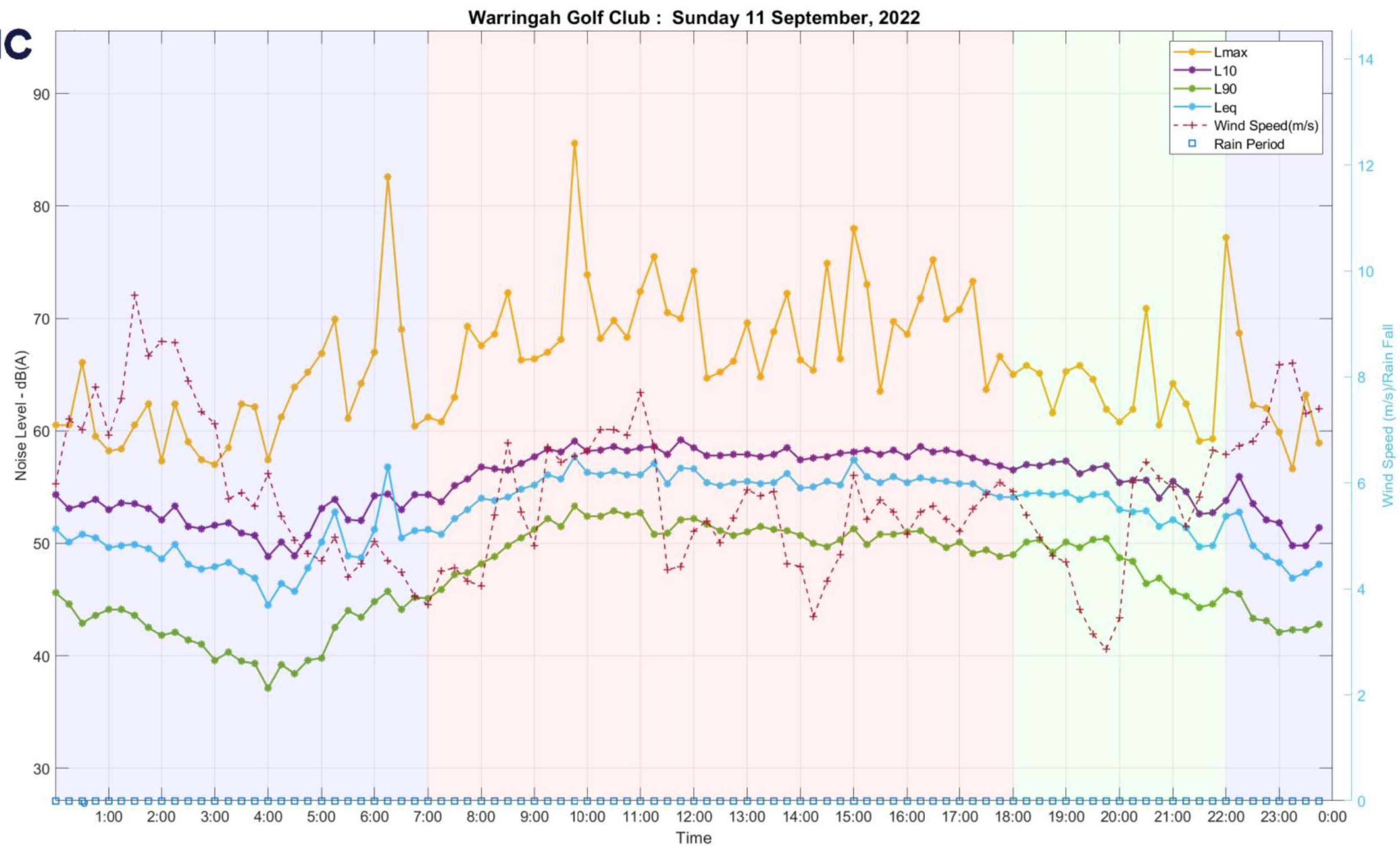
20:00
21:00
22:00
23:00
0:00



Warringah Golf Club : Friday 09 September, 2022
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time



Warringah Golf Club : Saturday 10 September, 2022
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period


Warringah Golf Club : Sunday 11 September, 2022
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
90
80
70
60
50
40
30
14
12
10
8
6
4
2
0
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
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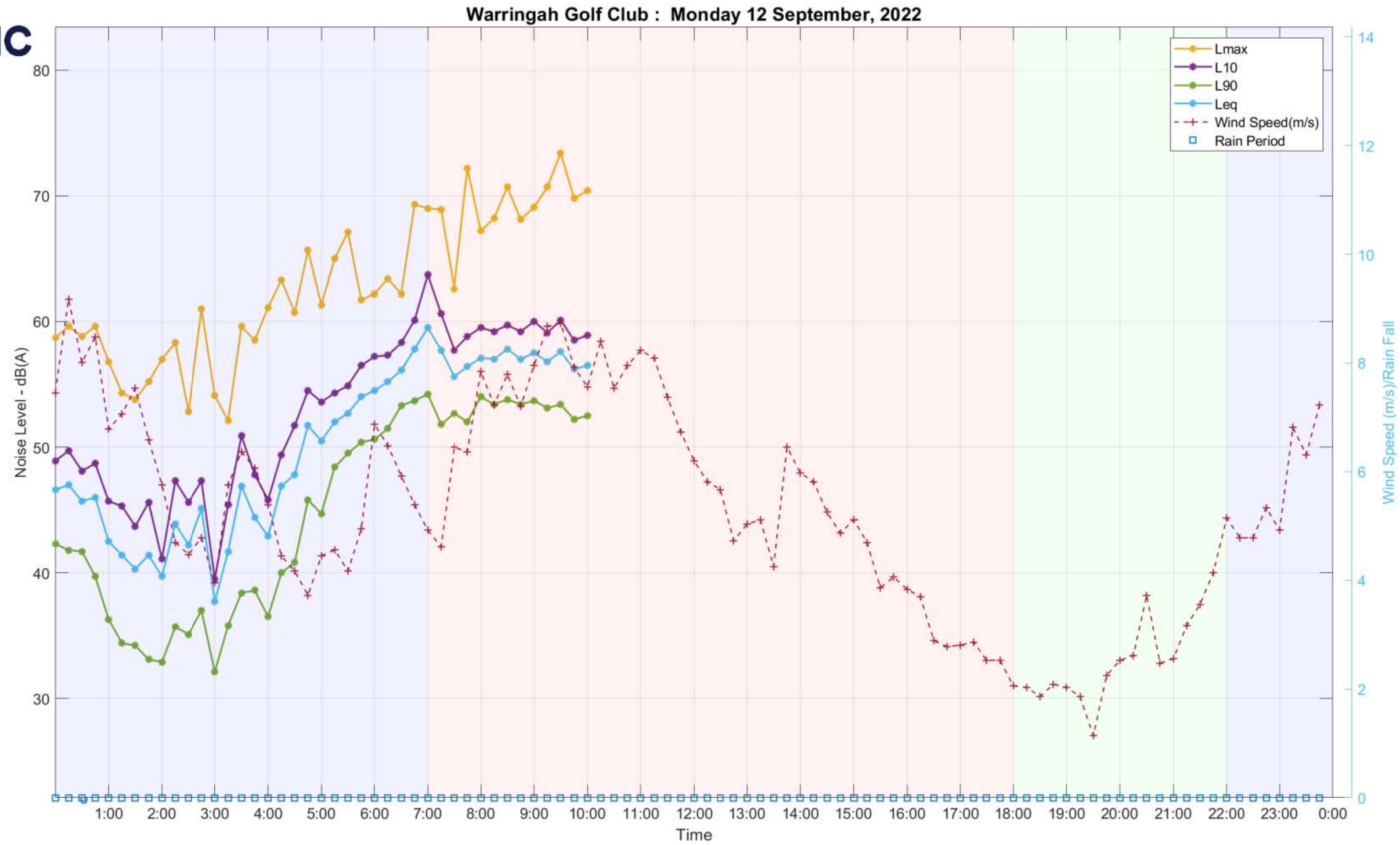
22:00
23:00
0:00


Warringah Golf Club : Monday 12 September, 2022
Lmax
L10
L90
Leq
Wind Speed(m/s)
Rain Period
Noise Level - dB(A)
Wind Speed (m/s)/Rain Fall
Time
80
70
60
50
40
30
14
12
10
8
6
4
2
0
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
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17:00
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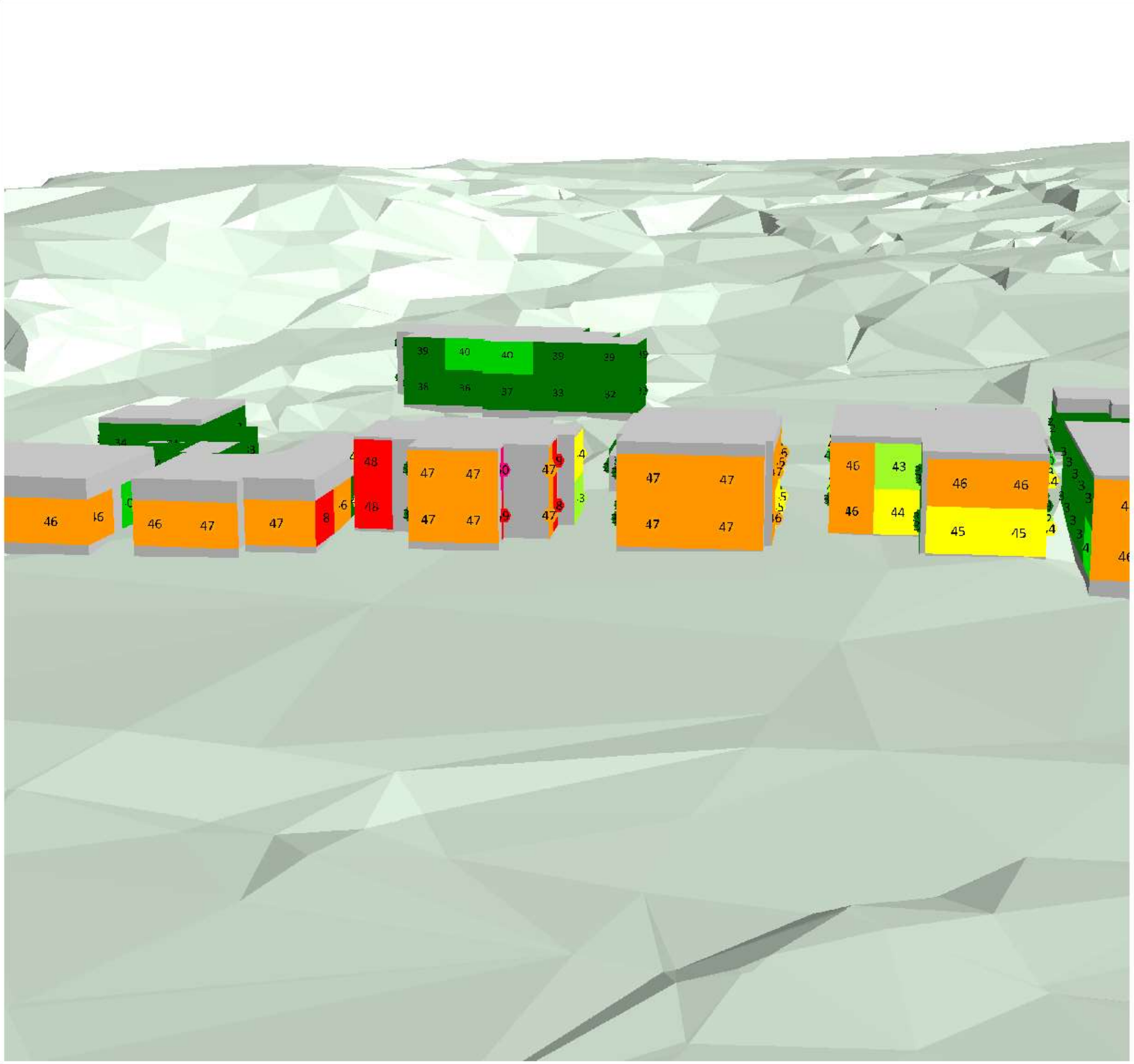
0:00

APPENDIX B – SOUNDPLAN MODELLING RESULTS

Façade noise map – R1



Warringah Golf Club

Facade Noise Map

Residential receivers R1

Prepared by: P. Feng
Date: 11/10/2022

Noise Level
L_{eq}
in dB(A)

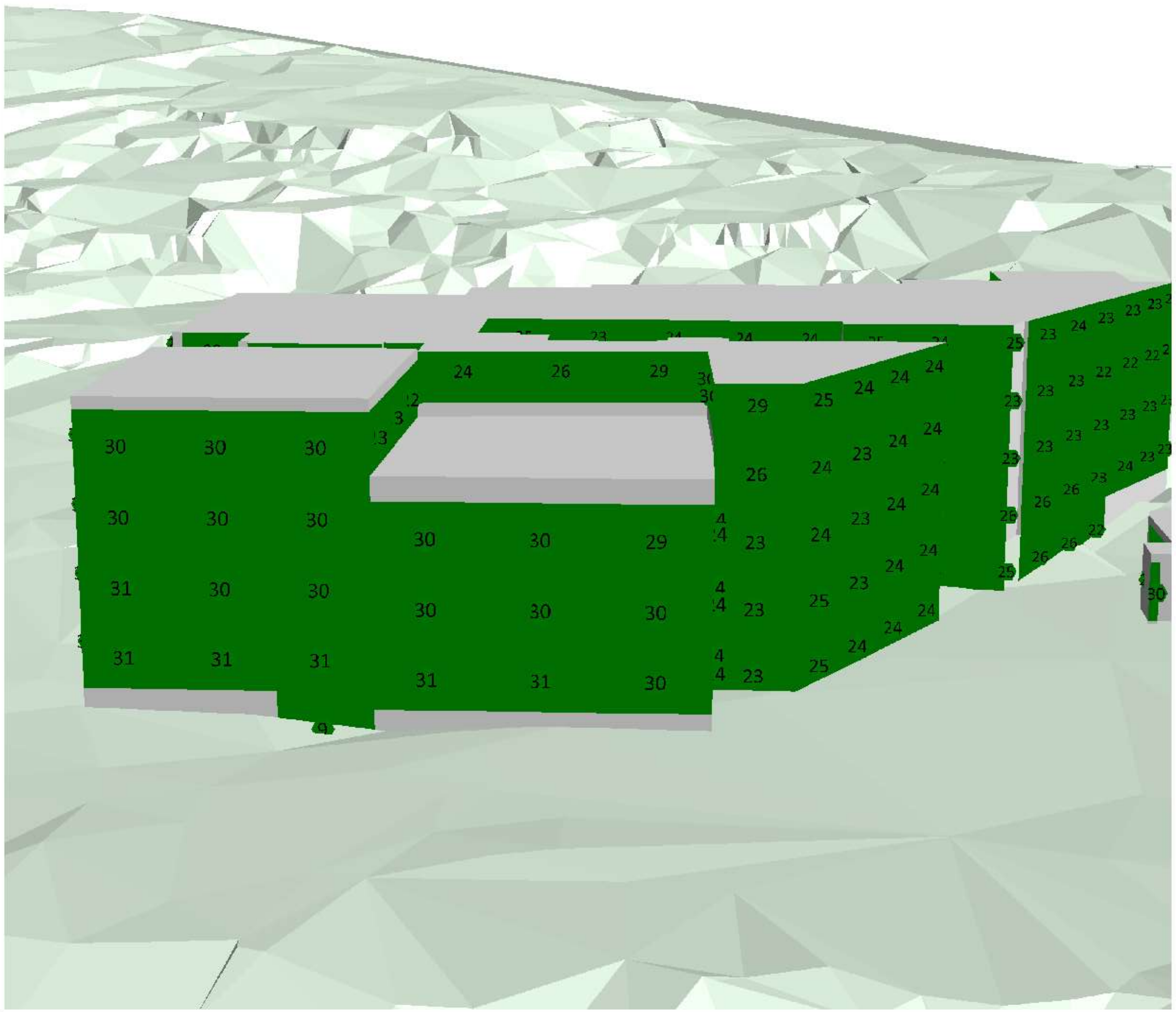
Noise Level dB(A)
< 40
40 - 42
42 - 44
44 - 46
46 - 48
48 - 50
50 - 52
52 - 54
54 - 56
56 - 58
58 - 60
>= 60

Length scale 1:3184
0 15 30 60 90 120 m

N

ACOUSTIC LOGIC

Façade noise map – C1



Warringah Golf Club

Facade Noise Map

Commercial receivers C1

Prepared by: P. Feng
Date: 11/10/2022

Noise Level
L_{eq}
in dB(A)

	< 40
	40 - 42
	42 - 44
	44 - 46
	46 - 48
	48 - 50
	50 - 52
	52 - 54
	54 - 56
	56 - 58
	58 - 60
	>= 60

Length scale 1:3184
0 15 30 60 90 120 m

N

ACOUSTIC LOGIC

ABNOBA ARBOR
Arboricultural Services

ARBORICULTURAL IMPACT ASSESSMENT| 433 PITTWATER RD. NORTH MANLY

Prepared For Warringah Golf Club

14.06.23

Prepared By Liam Strachan

1 EXECUTIVE SUMMARY

On the 4th July 2023 Graeme McMullan (representing the Warringah Golf Club commissioned Abnoba Arbor to prepare an Arboricultural Impact Assessment to be linked to a joint development application (Northern beaches Council & WGC) for an upgrade of the Tennis/Recreation Centre & surrounds. The development proposes a new clubhouse plus other major works.

The property lies within the Northern Beaches Council LGA (Warringah).

The proposed development includes the demolition of existing structures and the installation of a new double storey building at the northern end of the subject site as well as extensive realignment of the existing stormwater and wetland area.

The recommendations and comments in this report are based on the following:

- Conduct a basic ground based visual tree assessment
- Provide information regarding tree species, dimensions, Landscape amenity value, health and vigour assessment, structural condition including potential mitigation options, priority rating for all recommended works.
- Ascertain Tree Protection Zones and Structural Root Zones.
- Determine the impact of the development on all of the trees.
- The amenity of adjoining neighbours and members community is to be considered.
- That report contains all relevant information as outlined in Warringah DCP 2011.

A total of 114 trees were assessed in total. 51 trees have been recommended for removal.

Table 1

Retention Value	To Retain	Tree Numbers	To Remove	Tree Numbers
Very High	0		0	
High	47	T42, T43, T48, T49, T54, T55, T56, T57, T58, T59, T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93, T94, T95, T96, T97, T98, T99, T100, T101, T102, T103, T104, T105, T109, T110, T113	24	T2, T3, T4, T7, T8, T9, T10, T11, T12, T13, T18, T19, T20, T23, T24, T25, T26, T28, T29, T31, T32, T33, T63, T65
Medium	13	T47, T51, T52, T53, T60, T61, T70, T71, T106, T107, T108, T111, T112	9	T1, T14, T17, T22, T27, T39, T44, T62, T68
Low	1	T46	6	T5, T15, T16, T21, T30, T64
Exempt	2	T45, T50	12	T6, T34, T35, T36, T37, T38, T40, T41, T66, T67, T69, T114
Total	63		51	

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3 INTRODUCTION

On the 4th July 2023 Graeme McMullan (representing the Warringah Golf Club commissioned Abnoba Arbor to prepare an Arboricultural Impact Assessment to be linked to a joint development application (Northern beaches Council & WGC) for an upgrade of the Tennis/Recreation Centre & surrounds. The development proposes a new clubhouse plus other major works.

The property lies within the Northern Beaches Council LGA (Warringah).

The proposed development includes the demolition of existing structures and the installation of a new double storey building at the northern end of the subject site as well as extensive realignment of the existing stormwater and wetland area.

Site inspection was conducted by Liam Strachan AQF Level 5 Arborist on the 7th July 2023.

3.1 SCOPE

The purpose of this report is to provide information on any trees that may be affected by the proposed demolition and development at 433 Pittwater Rd. North Manly.

The recommendations and comments in this report are based on the following:

- Conduct a basic ground based visual tree assessment
- Provide information regarding tree species, dimensions, Landscape amenity value, health and vigour assessment, structural condition including potential mitigation options, priority rating for all recommended works.
- Ascertain Tree Protection Zones and Structural Root Zones.
- Determine the impact of the development on all of the trees.
- The amenity of adjoining neighbours and members community is to be considered.
- That report contains all relevant information as outlined in Warringah DCP 2011.

In preparing this report, the author has considered the objectives of:

- The State environmental Planning Policy 'Biodiversity and Conservation' 2021
- The State environmental Planning Policy 'Vegetation in Non-Rural Areas' 2017,
- Warringah Local Environment Plan 2011
- Warringah Development Control Plan 2011
- AS 4373 'Pruning of Amenity Trees' 2007.

Australian Standard AS4970-2009 Protection of Trees on Development Sites has been used as a benchmark in the preparation of this report.

The report will also assess the on-going viability of the tree and if deemed appropriate, provide recommendations for pruning or the removal of the subject trees. The following report will focus on the trees sustainability within the landscape and will provide recommendations on the most appropriate course of action. The determination will be reached through the assessment of the tree's health, vigour, and structural condition at the time of inspection. The assessment did not include any internal diagnostics such as picus, resistograph, woody tissue examination, nor has any soil testing been conducted.

4 METHOD

4.1 METHODOLOGY SUMMARY

Table 2

Characteristic	Method
Photos	Digital camera
Tree measurements • **Height** • **DBH(Diameter at breast height)** • **SRZ (Structural root zone)** • **TPZ (Tree protection zone)**	 • Clinometer, Tape measure • Diameter tape • SRZ = (DAB x 50)$^{0.42}$ x 0.64 • DBH x 12 (AS4970-2009)
Documents Reviewed	• Warringah DCP 2011 • Warringah LEP 2011
Drawings Reviewed	• Group Architects DWG No. GA2020-023-D01 • Group Architects DWG No. GA2020-023-100 • Group Architects DWG No. GA2020-023-101 • Group Architects DWG No. GA2020-023-101a • Group Architects DWG No. GA2020-023-101b • Group Architects DWG No. GA2020-023-101c • Group Architects DWG No. GA2020-023-102 • Group Architects DWG No. GA2020-023-103 • Group Architects DWG No. GA2020-023-104 • Group Architects DWG No. GA2020-023-200 • Group Architects DWG No. GA2020-023-201 • Group Architects DWG No. GA2020-023-202 • Group Architects DWG No. GA2020-023-300 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 1 of 7 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 2 of 7 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 3 of 7 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 4 of 7 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 5 of 7 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 6 of 7 • C.M.S Surveyors Pty Ltd. DWG 19741 detail Sheet 7 of 7
Tree retention assessment	ULE (Useful life expectancy) STARS METHOD (IACA, 2010)
Tree health assessment	Visual Tree Assessment, (VTA) as per (Mattheck, et al., 2015) Inspection limited to ground based visual examination of the tree.

4.2 LIMITATIONS

Care has been taken to obtain all information from reliable sources. All data has been verified as far as possible. However, Liam Strachan - Consulting Arborist can neither guarantee nor be responsible for the accuracy of information provided by others. Unless stated otherwise:

- Information contained in this report covers only the trees examined and reflects the health and structure of the tree at the time of inspection. The documented, observations, results, recommendations and conclusions given may vary after the site visit due to environmental conditions. Liability will not be accepted for damage to person or property as a result of natural processes, unforeseeable actions or occurrences.
- Observations recorded for trees located within adjacent properties have been made without entering that property. Deciduous trees inspected during winter and all trees obscured by other vegetation are not able to be properly assessed. As a result, measurements for these trees are estimated. Similarly, these trees were not subject to a complete visual inspection and defects or abnormalities may be present but not recorded.
- The inspection was limited to visual examination from the base of the subject tree without dissection, excavation, probing or coring (unless specifically noted otherwise).
- There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the subject tree may not arise in the future.

4.3 SITE INSPECTION

A visual inspection of the tree/s was performed from ground level, data collected includes:

- Genus, Species, Common Name;
- Height, Width, DBH (Diameter at Breast Height), DRB (Diameter above Root Buttress);
- Age, Health & Vigour;
- Significance, Amenity and Ecological Value;
- Form and Structural Condition;
- Visible Defects or Evidence of Wounding.

4.4 MEASUREMENTS

- Tree locations are supplied by client on the survey plan or triangulated using a measuring tape.
- Diameter at breast height (DBH) and Diameter above Root Buttress (DRB) are measured using a diameter tape.
- Height is measured using a clinometer.
- Canopy width is measuerd using a laser measure or tape measure.
- Structural Root Zone (SRZ) and Tree Protection Zone (TPZ) radii are calculated (in accordance with *AS 4970-2009*).
- TPZ or SRZ incursions are measured from the nearest face of the trunk to the face of the structure.

Tree schedule data is recorded in Appendix1.

4.5 REFERENCE DOCUMENTS

This report was written in coordination with:

- Australian Standard AS4970-2009 Protection of Trees on Development Sites
- Warringah DCP 2011
- Warringah LEP 2011
- Narla Environmental 'Flora & Fauna Constraints Assessment Report', dated February 2021,

4.6 DETERMINING A TREES SIGNIFICANCE

Tree health assessments were carried out using VTA as per Mattheck and significance and retention determinations were carried out using the STAR's method which combines ULE (useful life expectancy of subject tree) and significance rating based on characteristics such as health, form, vigour, cultural, heritage and amenity value. The 2 results are placed within a matrix which determines the retention value.

1. Is the tree a locally native remnant; an endangered species; a part of an endangered ecological community; or does the tree provide critical habitat for an endangered species?
2. Is the tree of botanical interest; Is it included in a significant tree register or listed as a heritage item under the Federal State or Local Regulations?
3. Is the tree visually prominent in the locality?
4. Is the tree well structured?
5. Is the tree in good health and/or does it display signs of good vigour?
6. Is the tree typically formed for the species?
7. Is the tree currently located in a position that will accommodate future growth?

Please see Appendix 2: STARS.

4.7 PLANNING GUIDELINES AND SPECIFIC LEGISLATION

Tree management measures are in place for Norther Beaches Council under the provisions of the trees and vegetation preservation for properties covered under Warringah DCP 2011.

- According to the NSW Planning Portal, the site is listed as RE1 Public Recreation.
- The site does not contain, nor does it form part of a heritage item.
- The site is not listed on the Warringah terrestrial biodiversity map.
- The site is not located on the NSW State Biodiversity Values map.

4.8 TREE MANAGEMENT CONTROLS

Northern Beaches Council definition of a prescribed tree is a palm or woody perennial plant with a single or multi stem greater than five (5) metres in height.

Part E1 of Warringah DCP States that:

A person shall not ringbark, cut down, top, lop, remove, poison, injure, or wilfully destroy tree or bushland vegetation that requires a Vegetation Clearing Permit under the provisions of Part 3 of the Vegetation SEPP. This includes damage to a tree or bushland vegetation by:

- Damaging or tearing live branches and roots;

- Damaging the bark, including attachment of objects using invasive fastenings, the fastening of materials around the trunk of trees which may result in a detrimental impact on tree health;
- Tree topping, where large branches and/or the trunk of the tree is removed from the top of the trees canopy;
- Tree lopping, where branches are removed to reduce the height and spread of the tree.
- Damaging the root zone of a tree by way of compaction, including storage and stockpiling materials;
- Changing of ground levels within the root zone of a tree by way of excavation, trenching, filling or stockpiling;
- Underscrubbing of bushland vegetation;
- Burning of vegetation (not part of a Hazard Reduction Certificate); or
- Any other act or activity that causes the destruction of, the severing of trunks or stems of, or any other substantial damage to, some or all of the native vegetation in an area.

A Vegetation Clearing Permit is required for:

a) Removal or cutting down of any tree over five (5) metres in height;
b) Pruning of more than ten percent (10%) of a tree canopy.
c) The removal or cutting down of vegetation in "Bushland".

4.8.1 EXEMPTIONS

You can remove trees without a permit in the following circumstances. The tree is:

- Under 5 metres in height
- On the Exempt Tree Species List
- In an area in which the Council has authorised their removal as part of a hazard reduction program, where that removal is necessary in order to manage risk
- Required to be removed under other legislation (including the NSW Rural Fires Act 1997 and the Environmental Planning and Assessment Act 1979)
- Can be removed under the 10/50 Legislation. Some clearing of vegetation is allowed if your property is mapped in the 10/50 entitlement area. Development Application Approval conditions in some circumstances prevent the use of the RFS 10/50 entitlement area from being used.
- Removed by Rural Fire Services because they pose or will pose a significant threat to access along required fire trails or to human life, buildings or other property during a bush fire
- Located within two metres of an existing approved building (not including decks, pergolas, sheds, patios or the like, even if they are attached to a building). The measurement is made from the building to the base of the tree trunk.
- Is considered a high risk/imminent danger certified by a Level 5 qualified arborist. These trees can be removed without Council consent by the owner of the tree subject to the owner obtaining written confirmation from the arborist that clearly states:
    a) The arborist qualifications: AQF Level 5 Arborist or equivalent
    b) That the tree(s) is declared an imminent danger and high risk to life and property
    c) That immediate removal of the tree(s) is recommended
    d) A copy of the report must be sent to Council for record keeping purpose
- Any tree listed as a priority weed under the Bio Security Act 2015 and identified in the Greater Sydney Regional Weed Management Plan.
- Dead, and not required as the habitat of native animals - photographic evidence recommended

- Has fallen or partially fallen as a result of a storm and still present a danger (photos required)
- Part of the pruning or removal of hedges (unless hedge is conditioned to be retained in a development consent). “Hedge” means groups of two or more trees that:
  - (a) are planted (whether in the ground or otherwise) so as to form a hedge, and
  - (b) rise to a height of at least 2.5 metres (above existing ground level).

You can prune trees or clear vegetation in the following circumstances:

- Reasonable pruning of up to 10% of a tree's canopy within 12 calendar months. Pruning must be in accordance with Australian Standards AS 4373 – 2007
- The removal of deadwood from a tree
- Removal of any species of parasite mistletoe or parasitic plant from any part of a tree
- It meets the criteria of other legislation eg under 10/50 Legislation some clearing of vegetation is allowed if your property is mapped in the 10/50 entitlement area.

4.8.2 EXEMPT SPECIES

Table 3

Acacia baileyana (Cootamundra Wattle)	*Acacia salicina* (Golden wreath wattle)	Ficus species except *F. macrophylla, F. rubiginosa, F. coronata*	*Alnus jorullensis* (Evergreen alder)
Araucaria bidwillii (Bunya Pine)	*Brachychiton acerfolius* (Illawarra Flame Tree)	*Cassia spp* (Cassia)	*Castanospermum australe* (Black bean/Moreton Bay Chestnut)
Celtis australis (S-Hackberry)	*Cinnamomum camphora* (Camphor Laurel)	*Citharexylum spinosum* (Fiddlewood)	*Cotoneaster species* (Red Cotoneaster)
Cupaniopsis anacardioides (Tuckeroo)	*Cupressus species* (Conifer)	*Eriobotrya japonica* (Loquat)	*Citrus Spp.* (Citrus)
Malus spp. (Apple)	*Erythrina spp.* (Coral Tree)	*Eucalyptus nicholii* (Narrow-Leaved Peppermint)	*Eucalyptus scoparia* (Willow/Wallangarra White Gum)
Fraxinus grifithii (Evergreen Ash)	*Gleditsia triacanthos* (Honey Locust)	*Grevillia robusta* (Silky Oak)	*Harpophyllum caffrum* (Kaffir Plum)
Jacaranda mimosifolia (Jacaranda)	*Lagerstroemia indica* (Crepe Myrtle)	*Lagunaria patersonia* (Norfolk Island Hibiscus)	*Ligustrum lucidum* (Broad-leafed Privet)
Liquidamber styraciflua (Liquidamber/Sweet Gum)	*Nerium oleander* (oleander)	*Olea spp.* (Olive)	All Palms except *Livistona australis*
Pinus sp (Pine species)	*Pittosporum undulatum* (up to 8m) (Sweet Pittosporum)	*Populus sp.* (Poplar species)	*pyracantha angustifolia* (Orange fire Thorn)
Rhaphiolepsis indica (Indian Hawthorn)	*Robinia pseudoacacia* (False acacia)	*Salix spp.* (Willow)	*Sapium sebiferum* (Chinese Tallow Tree)
Schefflera actinophylla (Qld Umbrella Tree)	*Spathodea campanulata* (African Tulip Tree)	*Syagrus romanzoffiana* (Cocos Palm)	*Ulmus parvifolia* (Chinese Elm)

4.9 SIGNIFICANCE IN THE ENVIRONMENT.

Trees are subject to the following legislation:

- Biodiversity Conservation Act NSW (BIO Act 2016): Provides provisions for conserving biodiversity.
- The State environmental Planning Policy 'Biodiversity and Conservation' 2021
- Threatened Species Conservation Act NSW (1995 TCS Act): Provides provisions for conserving threatened species, populations and ecological communities of animals and plants as well as managing key threatening processes.
- Environmental Protection and Biodiversity Conservation Act NSW (EPBC Act 1999): Provides provision to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places.
- Biosecurity Act NSW (BIO Act 2015): Refers to the protection of native plant communities, reducing the risk to human's health and the risk to agricultural production from invasive weeds.
- NSW Bushfire Brigade 10/50 Legislation is not enforced for this site.

4.10 VTA

The VTA system is based on the theory of tree biology, physiology and tree architecture and structure. This method is used by Arborists to identify visible signs on trees that indicate good health or potential problems. Symptoms of decay, growth patterns and defects are identified and assessed as to their potential to cause whole tree, part tree or branch failure, this system is based around methods discussed by Claus Mattheck in `The Body Language of Trees' (1994). For the purpose of this report, parts of the VTA system will be used along with other industry standard literature and other relevant studies that provide an insight into potential hazards in trees. This assessment is a snapshot of what could be reasonably seen or determined from a basic visual inspection. The VTA system is generally used as a means to identify hazardous trees, it is important to realize that for a tree to be hazardous there must be a target.

4.11 AUSTRALIAN STANDARD AS4970-2009

- The Australian Standard AS4970–2009 Protection of trees on development sites has been used as a benchmark in the preparation of this report and the terminology and impact assessment methodology have been adopted from this document. This AIA complies with 2.3.5 Arboricultural Impact Assessment of AS4970-2009.

- Recommendations have been based on tree Retention Value, Vigour, Condition and ULE. Trees with a high Retention Value should be given greater priority for retention than trees with Medium Retention Value. Trees with Long (40 years +) ULE should be given greater priority for retention than trees with Short (5-15 years) ULE

- **ULE –** Useful Life Expectancy. The length of time from the date of inspection that the Arborist estimates the tree will live and provide a useful positive contribution to the landscape amenity of the site. ULE ratings are Long (retainable for 40 years or more), Medium (retainable for 16-39 years), Short (retainable for 5-15 years) and Removal (tree requiring immediate removal due to imminent risk or absolute unsuitability).

- **VIGOUR –** Good (G), Fair (F) or Poor (P). The general appearance of the canopy/foliage of the tree at the time of inspection. Vigour can vary with the season and rainfall frequency. A tree can have Good vigour but be hazardous due to Poor condition. A tree in Good vigour has the ability to sustain its life processes. Vigour is synonymous with health.

- **CONDITION –** Good (G), Fair (F) or Poor (P). The general form and structure of the trunk/s and branching. Trunk lean, trunk/branch structural defects, canopy skewness or other hazard features are considered.

- Tree Protection Zones (TPZ) and Structural Root Zones (SRZ) are as per Section 3 of AS4970-2009 and are defined in the rear of this report. It should be noted that the TPZs and SRZs indicated on the site drawings are notional areas only and do not reflect actual root locations.

- **SRZ RADIUS –** Structural Root Zone. The area around a tree required for tree stability. Earthworks should be prohibited within the SRZ. The area is calculated from the formula and graph at Figure 1 ofAS4970-2009. The SRZ graph has been adapted from the work of Claus Mattheck (1994). DBH + 10% has been used for the calculation of SRZ. Where DBH is measured at grade or at a height other than 1.4m above grade, 10% has not been added.

- **TPZ RADIUS –** Tree Protection Zone. Radial offset (m) of twelve times (12x) trunk DBH measured from centre of trunk (for trees less than 0.3 metre DBH minimum TPZ is 2.0 metres). To satisfactorily retain the tree, construction activity (both soil cut and fill) must be restricted within this offset. TPZ offsets are rounded to the nearest 0.1 metre. Existing constraints to root spread can vary. Generally, an area equivalent to the TPZ should be available to the tree post development. Encroachment occupying up to 10% of the TPZ area is acceptable without detailed rootzone assessment. Encroachments greater than 10% require specific arboricultural assessment.

- “Construction” for the purpose of this AIA means excavation (greater than 100mm), compacted fill or machine trenching. “Excavation” includes cut batters, boxing–out for the various pavement types, trenching for utilities and footings for retaining walls.

- Trees within proposed construction footprints are recommended for removal (Rm).

- 3.4.6 Where construction is proposed within Structural Root Zone (SRZ) offsets, those trees have been similarly recommended for removal (Rm). Fully elevated, pier and beam type construction or hand dug services trenches (or horizontal boring) is recommended and an accepted form of construction methodology for this type of structure.

- Trees with greater than 25% of the Tree Protection Zone (TPZ) impacted by construction are generally recommended for removal (Rm). There are however different types of construction incursions proposed (e.g. fill, cut, services, pavement type, retaining walls) with varying tree impacts likely. Existing constraints to root development also vary the notional TPZ. Compacted fill can be equally as damaging to tree longevity: root development is restricted within heavily compacted soils.

- Trees to be retained with construction impacting less than 25% of the TPZ area were rated as. Specific construction monitoring will be required for these trees (refer to Recommendations).

- TPZ encroachments of >10% are defined (3.3.3 of AS4970) as 'major'. This does not mean that the tree will be fatally injured, but that 'the project arborist must demonstrate that the tree(s) would remain viable'.

- Where construction is proposed beyond the TPZ, those trees are rated as Retain (R) with no specific tree protection design or tree protection monitoring required.

.

5 FINDINGS

5.1 SITE CONTROL MAPS

According to the NSW Planning Portal, the site is listed as R3 Medium Density Residential. Please see Figure 1

Figure 1

The following relevant Government environmental and heritage mapping overlays have been reviewed (SEED – NSW Government 2020).

- According to the NSW Planning Portal, the site is listed as RE1 Public Recreation.
- The site does not contain, nor does it form part of a heritage item.
- The site is not listed on the Warringah terrestrial biodiversity map. Please see Figure 2.

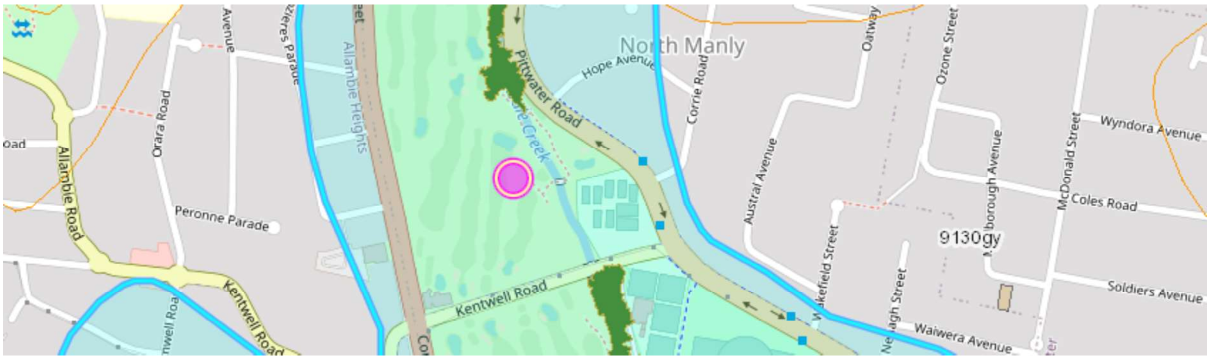
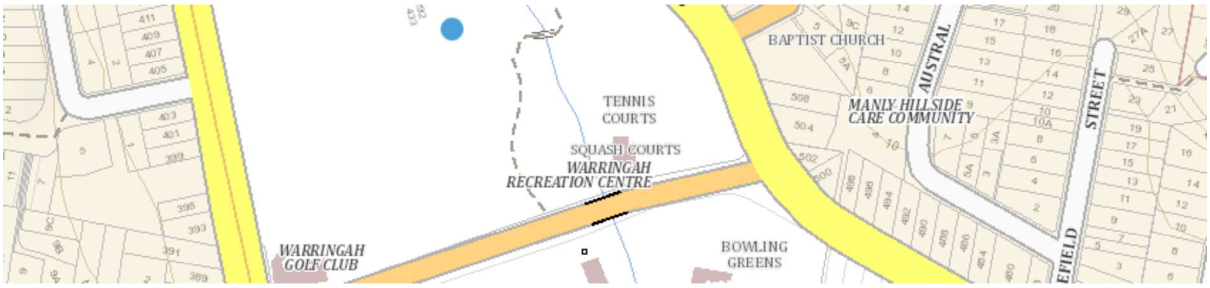


Figure 2

The site is not located on the NSW State Terrestrial Biodiversity Values map. Please see Figure 3.



5.2 THE SITE

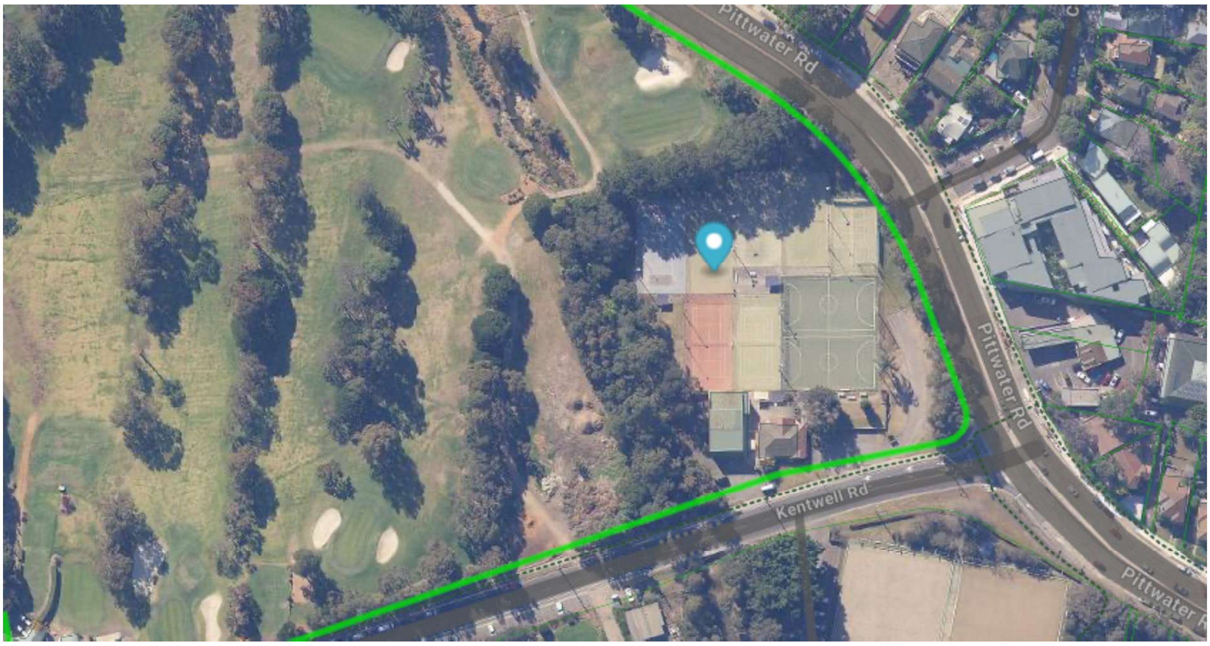


Figure 3

By Site Survey the subject site is best described as being within lands bordered by Kentwell Road, Pittwater Road & the Warringah Golf Club. Trees discussed are located within the subject site, adjacent to the subject site & within the Pittwater Road reserve. Documents provided describe the subject site as the Warringah Recreation Centre.

The site currently contains two stand alone buildings, a series of tennis courts and Astro turf soccer courts with a bitumen carpark at the south eastern corner of the site. Due to the nature of the site, past development means that the project area is flat. A sandstone retaining wall separates the site from the road on the western boundary.

Site soils are likely to deviate from their natural state due to past urban development, however, site soils are classified as 9130wa (Warriewood) swamp soil characterised as:

Landscape – level to gently undulating swales, depressions and infilled lagoons on Quaternary sands. Local relief <10 m, slopes <3%. Watertable at <2 m. Mostly cleared of native vegetation.

Soils – deep (>150 cm), well sorted, sandy Humus Podzols (Uc2.32) and dark, mottled Siliceous Sands (Uc1.21), overlying buried Acid Peats (O) in depressions; deep (>200 cm) Podzols (Uc2.12, Uc2.32) and pale Siliceous Sands (Uc1.2) on sandy rises.

Limitations – localised flooding and run-on, high watertables, highly permeable soil.

Vegetation is characterised as extensively cleared, sclerophyll scrub and woodland. Remaining native tree species include broad- leaved paperbark *Melaleuca quinquenervia*, coastal banksia *Banksia integrifolia*, swamp oak *Casuarina glauca* and swamp mahogany *Eucalyptus robusta*. Remaining scrub and understorey species include coastal teatree *Leptospermum laevigatum,* spike rushes *Eleocharis spp*., and tall swamp sedge *Gahnia sieberiana.*

Areas to the north and south of the subject site contain areas of the Threatened Ecological Community, Swamp oak Floodplain of the NSW North Coast, Sydney Basin & South east Corner Bioregion, which runs along the banks of Brookvale Creek.

The Narla Environmental 'Flora & Fauna Constraints Assessment Report', dated February 2021, commissioned by the Northern Beaches Council states that "The vegetation within the Subject Site (adjacent Brookvale Creek) conforms to the BC Act (NSW) listed EEC Swamp oak Floodplain of the NSW North Coast, Sydney Basin & South east Corner Bioregions". The Narla document also acknowledges other Acts that may apply to portions of the total Subject Site. Tree species discussed within this document are confirmed to be members of the naturally occurring (original) communities.

5.3 SWAMP OAK FLOODPLAIN OF THE NSW NORTH COAST, SYDNEY BASIN & SOUTH EAST CORNER BIOREGION

The Coastal Swamp Oak Forest ecological community is characterised by the dominance of *Casuarina glauca* in the canopy, with an understorey of rushes, sedges, forbs and grasses. Coastal Swamp Oak Forest is typically found on loose or alluvial soil on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. Sometimes the ecological community can intergrade with mangroves or saltmarsh communities (on the seaward side), or with *Melaleuca* species and eucalypts (more landward).

Remnant patches of Coastal Swamp Oak Forest that retain mature trees and/or with diverse and good native understorey, particularly those that are closely connected with another area of native vegetation have very high conservation value. Like other coastal ecosystems, the ecological community provides an important protective role, by buffering the land from the impacts of seawater incursions and storms.

This community is found on the coastal floodplains of NSW. It has a dense to sparse tree layer in which *Casuarina glauca* (swamp oak) is the dominant species northwards from Bermagui.

Other trees including *Acmena smithii* (lilly pilly), *Glochidion* spp. (cheese trees) and *Melaleuca* spp. (paperbarks) may be present as subordinate species, and are found most frequently in stands of the community northwards from Gosford. Tree diversity decreases with latitude, and *Melaleuca ericifolia* is the only abundant tree in this community south of Bermagui.

The understorey is characterised by frequent occurrences of vines, *Parsonsia straminea, Geitonoplesium cymosum* and *Stephania japonica* var. *discolor*, a sparse cover of shrubs, and a continuous groundcover of forbs, sedges, grasses and leaf litter.

The composition of the ground stratum varies depending on levels of salinity in the groundwater. Under less saline conditions prominent ground layer plants include forbs such *Centella asiatica, Commelina cyanea, Persicaria decipiens*and *Viola banksii*; graminoids such as *Carex appressa, Gahnia clarkei, Lomandra longifolia, Oplismenus imbecillis*; and the fern *Hypolepis muelleri*.

On the fringes of coastal estuaries, where soils are more saline, the ground layer may include the threatened grass species, *Alexfloydia repens*, as well as *Baumea juncea, Juncus kraussii, Phragmites australis, Selliera radicans* and other saltmarsh species.

5.4 SUMMARY OF PROPOSED DEVELOPMENT

The proposed development includes the demolition of existing structures and the installation of a new double storey building at the northern end of the subject site as well as extensive realignment of the existing stormwater and wetland area.

5.5 SUMMARY OF SITE INSPECTION DATA

Generally, the sites vegetation was observed to have a mixture of exotic and endemic tree canopy. The existing surveyed trees are shown in Appendix 1.

Other vegetation on site does not meet the dimensions for Northern Beaches Council to consider them as trees, trees as defined on Northern Beaches Council website as being over 5 metres in height.

5.6 CURRENT TREE POPULATION

A total of 114 trees were assessed in total. Table 4 summarises the origins of the surveyed tree species:

Table 4

Species Origin	Number of Trees
Endemic	89
Native	13
Exotic	10
Noxious Weed	2
Total	114

Table 5 documents the species on site, the amount of each species and the origin of said species.

Table 5

Tree Species	Species Origin	Tree Numbers	Total
Casuarina glauca (Swamp-Oak)	Endemic	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30, T31, T32, T33, T54, T55, T56, T57, T58, T59, T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93, T94, T95, T96, T97, T98, T99, T100, T101, T112	**70**
Harpophyllum caffrum (Kaffir Plum)	Exotic	T34, T36, T37, T41	**4**
Cupressus species (Conifer)	Exotic	T35, T40, T66, T67	**4**
Cinnamomum camphora (Camphor Laurel)	Noxious Weed	T38	**1**
Glochidion ferdinandi (Cheese Tree)	Endemic	T39, T106, T107, T108, T111	**5**
Eucalyptus robusta (Swamp Mahogany)	Endemic	T42, T43, T44, T47, T48, T49	**6**

Tree Species	Species Origin	Tree Numbers	Total
Syagrus romanzoffiana (Cocos Palm)	Exotic	T45, T114	**2**
Angophora costata (Sydney Red Gum)	Native	T46, T52, T53	**3**
Pittosporum undulatum (Sweet Pittosporum)	Native	T50	**1**
Melaleuca linarifolia (Snow in Summer)	Native	T51	**1**
Callistemon viminalis (Weeping Bottlebrush)	Native	T60, T61, T70, T71	**4**
Magnolia grandiflora (White magnolia)	Exotic	T62	**1**
Melaleuca quinquenervia (Broad-Leafed Paperbark)	Endemic	T63, T102, T103, T104, T105, T109, T110, T113	**8**
Syzygium paniculatum (Magenta Lilly Pilly)	Native	T64, T65	**2**
Archontophoenix spp. (Alex/Bagalow Palm)	Native	T68	**1**
Ficus benjimina (Weeping Fig)	Native	T69	**1**

5.7 U.L.E

Useful Life Expectancy (Barrell, 2009). The length of time from the date of inspection that the Arborist estimates the tree will live and provide a useful positive contribution to the landscape amenity of the site. ULE ratings are Long (retainable for 40 years or more), Medium (retainable for 16-39 years), Short (retainable for 5-15 years) and Removal (tree requiring immediate removal due to imminent risk or absolute unsuitability).

Table 6

U.L.E	Number of Trees	Tree Numbers
40 Plus	64	T2, T3, T9, T10, T13, T18, T20, T25, T28, T32, T33, T35, T37, T38, T42, T45, T48, T49, T52, T58, T59, T60, T62, T63, T65, T68, T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93, T94, T95, T96, T97, T98, T99, T100, T101, T103, T104, T105, T109, T110, T111, T113, T114
15-40yrs	40	T1, T4, T7, T8, T11, T14, T17, T19, T22, T23, T24, T26, T27, T29, T31, T34, T36, T39, T40, T41, T43, T44, T47, T50, T51, T53, T54, T55, T56, T57, T61, T66, T67, T70, T71, T102, T106, T107, T108, T112
5-15yrs	7	T5, T12, T15, T21, T30, T64, T69
1-5yrs	2	T16, T46
Remove Hazardous	0	
Dead	1	T6
Total		**114**

5.8 LANDSCAPE SIGNIFICANCE

Landscape significance was deemed using IACA Significance of a Tree, Assessment Rating System (STARS). Results are published in the table below.

Table 7

Landscape Significance	Number of Trees	Tree Numbers
High	72	T2, T3, T4, T5, T7, T8, T9, T10, T11, T12, T13, T18, T19, T20, T23, T24, T25, T26, T28, T29, T31, T32, T33, T42, T43, T48, T49, T54, T55, T56, T57, T58, T59, T63, T65, T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93, T94, T95, T96, T97, T98, T99, T100, T101, T102, T103, T104, T105, T109, T110, T113
Medium	20	T14, T17, T22, T27, T39, T44, T47, T51, T52, T53, T60, T61, T64, T68, T70, T71, T106, T107, T108, T111
Low	8	T1, T15, T16, T21, T30, T46, T62, T112
Exempt	12	T6, T34, T35, T36, T37, T40, T41, T50, T66, T67, T69, T114
Environmental Weed	2	T38, T45
Total		**114**

IACA 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arborculturists, Australia, www.iaca.org.au Appendix 2.

5.9 RETENTION VALUES

Retention values were recorded using IACA Significance of a Tree, Assessment Rating System (STARS). Results are published in the table below.

Table 8

Retention Value	Number of Trees	Tree Numbers
Very High	0	
High	71	T2, T3, T4, T7, T8, T9, T10, T11, T12, T13, T18, T19, T20, T23, T24, T25, T26, T28, T29, T31, T32, T33, T42, T43, T48, T49, T54, T55, T56, T57, T58, T59, T63, T65, T72, T73, T74, T75, T76, T77, T78, T79, T80, T81, T82, T83, T84, T85, T86, T87, T88, T89, T90, T91, T92, T93, T94, T95, T96, T97, T98, T99, T100, T101, T102, T103, T104, T105, T109, T110, T113
Medium	22	T1, T14, T17, T22, T27, T39, T44, T47, T51, T52, T53, T60, T61, T62, T68, T70, T71, T106, T107, T108, T111, T112
Low	7	T5, T15, T16, T21, T30, T46, T64
Exempt	14	T6, T34, T35, T36, T37, T38, T40, T41, T45, T50, T66, T67, T69, T114
Total		**114**

IACA 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arborculturists, Australia, www.iaca.org.au Appendix 2.

6 PROPOSED DEVELOPMENT IMPACT

Tree Protection Zones (TPZ's) and Structural Root Zones (SRZ's) are defined as per Section 3 of Australian Standard AS4970-2009 Protection of Trees on Development Sites. It should be noted that TPZ's and SRZ's are notional areas only and do not reflect actual root locations. All TPZ's and SRZ's are marked on plans located at the rear of this document. At this time no exploratory root investigation has been undertaken, it may be recommended based on the findings within this report.

6.1 TREES UNAFFECTED BY PROPOSED DEVELOPMENT

Table 9

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	Generic Tree Protection Measures
T43	Eucalyptus robusta (Swamp Mahogany)	11	High	Deadwood Moderate (30-100mm) , Dieback (isolated) , Previous Failures (isolated)		TPZ Fencing
T44	Eucalyptus robusta (Swamp Mahogany)	2.2	Medium	Deadwood Minor (0-30mm)		TPZ Fencing
T45	Syagrus romanzoffiana (Cocos Palm)	2.6	Exempt			TPZ Fencing
T46	Angophora costata (Sydney Red Gum)	2.6	Low	Deadwood Moderate (30-100mm) , Dieback (major)		TPZ Fencing
T47	Eucalyptus robusta (Swamp Mahogany)	2.0	Medium	Suppressed		TPZ Fencing
T49	Eucalyptus robusta (Swamp Mahogany)	3.7	High	Deadwood Moderate (30-100mm) , Dieback (isolated) , Epicormic Shoots (minor) , Included Bark (branches)		TPZ Fencing
T50	Pittosporum undulatum (Sweet Pittosporum)	2.2	Exempt	Co-Dominant Stems		TPZ Fencing
T51	Melaleuca linarifolia (Snow in Summer)	2.6	Medium	Co-Dominant Stems (included bark)		TPZ Fencing
T52	Angophora costata (Sydney Red Gum)	4.3	Medium	Co-Dominant Stems , Deadwood Minor (0-30mm)		TPZ Fencing
T53	Angophora costata (Sydney Red Gum)	2.3	Medium	Deadwood Minor (0-30mm)		TPZ Fencing

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	Generic Tree Protection Measures
T54	Casuarina glauca (Swamp-Oak)	2.8	High	Deadwood Minor (0-30mm) , Included Bark (branches) , Weak Branch Attachments (isolated)		TPZ Fencing
T55	Casuarina glauca (Swamp-Oak)	2.0	High	Co-Dominant Stems (included bark) , Suppressed		TPZ Fencing
T56	Casuarina glauca (Swamp-Oak)	5.5	High	Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm)		TPZ Fencing
T57	Casuarina glauca (Swamp-Oak)	3.1	High	Co-Dominant Stems , Deadwood Minor (0-30mm)		TPZ Fencing
T58	Casuarina glauca (Swamp-Oak)	3.8	High	Deadwood Minor (0-30mm)		TPZ Fencing
T59	Casuarina glauca (Swamp-Oak)	3.7	High	Co-Dominant Stems , Deadwood Minor (0-30mm) , Suppressed		TPZ Fencing
T70	Callistemon viminalis (Weeping Bottlebrush)	4.3	Medium	Co-Dominant Stems (included bark) , Included Bark (natural for species)		TPZ Fencing
T71	Callistemon viminalis (Weeping Bottlebrush)	5.3	Medium	Poor Pruning (powerlines)		TPZ Fencing
T72	Casuarina glauca (Swamp-Oak)	4.1	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T73	Casuarina glauca (Swamp-Oak)	3.4	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T74	Casuarina glauca (Swamp-Oak)	2.4	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T75	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T76	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	Generic Tree Protection Measures
T77	Casuarina glauca (Swamp-Oak)	4.3	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T78	Casuarina glauca (Swamp-Oak)	2.4	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T79	Casuarina glauca (Swamp-Oak)	3.8	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T80	Casuarina glauca (Swamp-Oak)	3.6	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T81	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T82	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T83	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T84	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T85	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T86	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T87	Casuarina glauca (Swamp-Oak)	5.6	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	Generic Tree Protection Measures
T88	Casuarina glauca (Swamp-Oak)	4.1	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T89	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T90	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T91	Casuarina glauca (Swamp-Oak)	3.4	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T92	Casuarina glauca (Swamp-Oak)	4.3	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T93	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T94	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T95	Casuarina glauca (Swamp-Oak)	3.8	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T96	Casuarina glauca (Swamp-Oak)	4.9	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T98	Casuarina glauca (Swamp-Oak)	3.0	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T99	Casuarina glauca (Swamp-Oak)	3.5	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	Generic Tree Protection Measures
T100	Casuarina glauca (Swamp-Oak)	3.6	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	TPZ Fencing
T106	Glochidion ferdinandi (Cheese Tree)	4.1	Medium	Co-Dominant Stems	Root spread likely constrained due to sandstone retaining wall	TPZ Fencing
T107	Glochidion ferdinandi (Cheese Tree)	5.5	Medium	Co-Dominant Stems (included bark)	Root spread likely constrained due to sandstone retaining wall	TPZ Fencing
T108	Glochidion ferdinandi (Cheese Tree)	4.1	Medium	Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm)	Root spread likely constrained due to sandstone retaining wall	TPZ Fencing
T110	Melaleuca quinquenervia (Broad-Leafed Paperbark)	8.0	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Included Bark (natural for species)	Root spread likely constrained due to sandstone retaining wall	TPZ Fencing
T111	Glochidion ferdinandi (Cheese Tree)	4.8	Medium	Co-Dominant Stems		TPZ Fencing
T112	Casuarina glauca (Swamp-Oak)	2.0	Medium	Co-Dominant Stems (included bark)		TPZ Fencing

6.2 TREES WITH MINOR INCURSIONS

When the extent of TPZ incursion is deemed minor as per AS4970 Protection of Trees on Development Sites i.e., less than 10%, excavation may be undertaken using traditional methods. Excavation for Benching and Shoring must be considered.

Table 10

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	TPZ Enc. %	Encroachment Type	Generic Tree Protection Measures
T48	Eucalyptus robusta	4.3	High	Co-Dominant Stems , Deadwood Minor (0-30mm) , Dieback (isolated) , Over Extended Limbs (isolated)		1.25%	TPZ extends on to the subject site, encroachment marginal	TPZ Fencing

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	TPZ Enc. %	Encroachment Type	Generic Tree Protection Measures
	(Swamp Mahogany)							
T60	Callistemon viminalis (Weeping Bottlebrush)	4.8	Medium	Co-Dominant Stems (included bark) , Included Bark (natural for species)		8.47%	TPZ extend onto subject site, minor encroachment	TPZ Fencing
T61	Callistemon viminalis (Weeping Bottlebrush)	4.6	Medium	Co-Dominant Stems (included bark) , Dieback (minor) , Included Bark (natural for species)		6.52%	TPZ extend onto subject site, minor encroachment	TPZ Fencing
T97	Casuarina glauca (Swamp-Oak)	5.5	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	3.45%	New carpark	TPZ Fencing
T101	Casuarina glauca (Swamp-Oak)	7.2	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	5.88%	New carpark	TPZ Fencing
T103	Melaleuca quinquenervia (Broad-Leafed Paperbark)	10.6	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated) , Included Bark (natural for species) , Wounds (minor)		7.88%	New carpark	TPZ Fencing
T104	Melaleuca quinquenervia (Broad-Leafed Paperbark)	10.7	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated) , Included Bark (natural for species) , Root Scalping , Wounds (minor)		6.95%	New carpark	TPZ Fencing

6.3 TREES WITH MAJOR INCURSIONS

Table 11

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	TPZ Encroachment %	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T102	Melaleuca quinquenervia (Broad-Leafed Paperbark)	11.9	High	Cavity (minor) , Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm) , Decay , Dieback (isolated) , Included Bark (natural for species)	Tree species renowned for having expansive root system, root concentration maybe higher in the carpark due to the curbstone on the Pittwater Rd. side of the tree	12.72%	New carpark	Retain	TPZ Fencing	Employ tree sensitive construction for the carpark i.e. build at grade with no excavation (see section 7.2.2), or project arborist supervision to ensure all roots are cut cleanly and employ remediation plan for remainder of TPZ to encourage replacement root growth. Section 7.4. Any excavation should be limited to the car park area only, natural ground should be retained at the eastern side of the car park between the proposed parking area and Pittwater Rd.
T105	Melaleuca quinquenervia (Broad-Leafed Paperbark)	12.0	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated) , Included Bark (natural for species) , Over Extended Limbs (isolated) , Root Scalping , Weak Branch Attachments (isolated) , Wounds (minor)		10.57%	New carpark	Retain	TPZ Fencing	Employ tree sensitive construction for the carpark i.e. build at grade with no excavation (see section 7.2.2), or project arborist supervision to ensure all roots are cut cleanly and employ remediation plan for remainder of TPZ to encourage replacement root growth. Section 7.4. Any excavation should be limited to the car park area only, natural ground should be retained at the eastern side of the car park between the proposed parking area and Pittwater Rd.
T109	Melaleuca quinquenervia (Broad-Leafed Paperbark)	14.8	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (natural for species)	Root spread likely constrained due to sandstone retaining wall	21.15%	New carpark and access road	Retain	TPZ Fencing	Tree is located on Pittwater Rd. which is separated from the subject site via a sandstone retaining wall. No foreseen impact.
T113	Melaleuca quinquenervia (Broad-Leafed Paperbark)	10.7	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark	Root spread likely constrained due to sandstone retaining wall	20.93%	Realligned stormwater and wetland area	Retain	TPZ Fencing	Tree is located on Pittwater Rd. which is separated from the subject site via a sandstone retaining wall. No foreseen impact.

Tree ID	Tree Species	TPZ Radius (M)	Retention Value (STARS)	Observations and Defects	Notes	TPZ Encroachment %	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
				(natural for species) , Over Extended Limbs (isolated)						

6.4 TREES TO BE REMOVED

Table 12

Tree ID	Tree Species	Retention Value (STARS)	Observations and Defects	Notes	Encroachment Type
T1	Casuarina glauca (Swamp-Oak)	Medium	Cavity (minor) , Co-Dominant Stems , Deadwood Moderate (30-100mm) , Decay , Weak Branch Attachments (isolated) , Wounds (moderate)		Realigned stormwater and wetland area
T2	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems , Deadwood Moderate (30-100mm) , Included Bark (natural for species) , Included Union (insignificant)		Realigned stormwater and wetland area
T3	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems , Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm)		Realigned stormwater and wetland area
T4	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated)		Realigned stormwater and wetland area
T5	Casuarina glauca (Swamp-Oak)	Low	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (moderate) , Included Bark (branches) , Included Union (poor) , Weak Branch Attachments (isolated)		Realigned stormwater and wetland area
T6	Casuarina glauca (Swamp-Oak)	Exempt	Dead tree		Realigned stormwater and wetland area

Tree ID	Tree Species	Retention Value (STARS)	Observations and Defects	Notes	Encroachment Type
T7	Casuarina glauca (Swamp-Oak)	High	Crown Density (60-80%) , Deadwood Moderate (30-100mm)		Realigned stormwater and wetland area
T8	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Dieback (isolated)		Realigned stormwater and wetland area
T9	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (branches) , Over Extended Limbs (isolated) , Previous Failures (isolated)		Realigned stormwater and wetland area
T10	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Included Bark (branches) , Included Union (insignificant) , Over Extended Limbs (isolated) , Phototropism (moderate) , Wounds (minor)		Bulk Earthworks for new clubhouse
T11	Casuarina glauca (Swamp-Oak)	High	Crown Density (60-80%) , Deadwood Moderate (30-100mm)		Bulk Earthworks for new clubhouse
T12	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Minor (0-30mm) , Suppressed		Bulk Earthworks for new clubhouse
T13	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (moderate) , Mechanical Damage , Over Extended Limbs (isolated)		Bulk Earthworks for new clubhouse
T14	Casuarina glauca (Swamp-Oak)	Medium	Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed		Bulk Earthworks for new clubhouse
T15	Casuarina glauca (Swamp-Oak)	Low	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Dieback (moderate) , Included Union (moderate) , Suppressed		Bulk Earthworks for new clubhouse
T16	Casuarina glauca (Swamp-Oak)	Low	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Major (>100mm) ,		Bulk Earthworks for new clubhouse

Tree ID	Tree Species	Retention Value (STARS)	Observations and Defects	Notes	Encroachment Type
			Dieback (major) , Included Union (poor) , Suppressed , Weak Branch Attachments (systemic)		
T17	Casuarina glauca (Swamp-Oak)	Medium	Deadwood Moderate (30-100mm) , Suppressed		Bulk Earthworks for new clubhouse
T18	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated)		Bulk Earthworks for new clubhouse
T19	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Suppressed		Bulk Earthworks for new clubhouse
T20	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant)		Bulk Earthworks for new clubhouse
T21	Casuarina glauca (Swamp-Oak)	Low	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (moderate) , Included Union (moderate) , Suppressed , Wounds (moderate)		Bulk Earthworks for new clubhouse
T22	Casuarina glauca (Swamp-Oak)	Medium	Co-Dominant Stems , Deadwood Moderate (30-100mm) , Suppressed		Bulk Earthworks for new clubhouse
T23	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Suppressed , Weak Branch Attachments (isolated)		Bulk Earthworks for new clubhouse
T24	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed		Bulk Earthworks for new clubhouse
T25	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Mechanical Damage , Over Extended Limbs (isolated) , Wounds (minor)		Bulk Earthworks for new clubhouse

Tree ID	Tree Species	Retention Value (STARS)	Observations and Defects	Notes	Encroachment Type
T26	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed , Weak Branch Attachments (isolated) , Wounds (minor)		Bulk Earthworks for new clubhouse
T27	Casuarina glauca (Swamp-Oak)	Medium	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Included Union (moderate) , Suppressed		Bulk Earthworks for new clubhouse
T28	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Over Extended Limbs (isolated)		Bulk Earthworks for new clubhouse
T29	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed		Bulk Earthworks for new clubhouse
T30	Casuarina glauca (Swamp-Oak)	Low	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Minor (0-30mm) , Epicormic Shoots (moderate) , Suppressed		Bulk Earthworks for new clubhouse
T31	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Over Extended Limbs (isolated) , Suppressed		Bulk Earthworks for new clubhouse
T32	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (branches) , Included Union (insignificant) , Over Extended Limbs (isolated) , Weak Branch Attachments (isolated) , Wounds (minor)		Bulk Earthworks for new clubhouse
T33	Casuarina glauca (Swamp-Oak)	High	Co-Dominant Stems , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated)		Bulk Earthworks for new clubhouse
T34	Harpophyllum caffrum (Kaffir Plum)	Exempt	Co-Dominant Stems (included bark)		Bulk Earthworks for new clubhouse

Tree ID	Tree Species	Retention Value (STARS)	Observations and Defects	Notes	Encroachment Type
T35	Cupressus species (Conifer)	Exempt	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm)		Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T36	Harpophyllum caffrum (Kaffir Plum)	Exempt	Co-Dominant Stems		Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T37	Harpophyllum caffrum (Kaffir Plum)	Exempt	Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm) , Epicormic Shoots (minor) , Included Bark (branches) , Over Extended Limbs (isolated) , Previous Failures (isolated) , Weak Branch Attachments (isolated) , Wounds (minor)		Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T38	Cinnamomum camphora (Camphor Laurel)	Exempt	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Epicormic Shoots (moderate)		tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T39	Glochidion ferdinandi (Cheese Tree)	Medium	Deadwood Minor (0-30mm) , Included Bark (branches)		Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T40	Cupressus species (Conifer)	Exempt	Co-Dominant Stems		Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T41	Harpophyllum caffrum (Kaffir Plum)	Exempt	Co-Dominant Stems (included bark)		Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area
T42	Eucalyptus robusta (Swamp Mahogany)	High	Deadwood Moderate (30-100mm) , Dieback (isolated) , Epicormic Shoots (minor)		TPZ Fencing
T62	Magnolia grandiflora (White magnolia)	Medium	Co-Dominant Stems		New tennis courts
T63	Melaleuca quinquenervia (Broad-Leafed Paperbark)	High	Co-Dominant Stems , Deadwood Moderate (30-100mm) , Dieback (isolated)		New tennis courts
T64	Syzygium paniculatum (Magenta Lilly Pilly)	Low	Co-Dominant Stems (included bark) , Suppressed		New tennis courts
T65	Syzygium paniculatum (Magenta Lilly Pilly)	High	Co-Dominant Stems , Deadwood Minor (0-30mm) , Dieback (isolated)		New tennis courts

Tree ID	Tree Species	Retention Value (STARS)	Observations and Defects	Notes	Encroachment Type
T66	Cupressus species (Conifer)	Exempt	Co-Dominant Stems (included bark)		New tennis courts
T67	Cupressus species (Conifer)	Exempt	Co-Dominant Stems		New tennis courts
T68	Archontophoenix spp. (Alex/Bagalow Palm)	Medium		Group of 4 clumping palms	New tennis courts
T69	Ficus benjimina (Weeping Fig)	Exempt	Co-Dominant Stems (included bark)		New tennis courts
T114	Syagrus romanzoffiana (Cocos Palm)	Exempt			New Tennis courts

7 TREE SENSITIVE DESIGN

Tree sensitive design is site responsive design - designing in harmony with the existing conditions of the site, including the trees. Considerations include the condition, location, size /age and relative construction tolerances of the subject trees. How the project will be constructed, site access and equipment manoeuvring should also be considered during design, to ensure the design can be delivered without existing trees being compromised.

Tree sensitive design may be employed to gain further acceptable encroachments to the TPZ. Structures that require little or no excavation are considered tree sensitive design. Consideration should be given to tree sensitive measures such as pier and beam, suspended slabs, cantilevered building sections, screw piles and contiguous piling.

In order for trees to remain viable buildings could be raised on piers above ground level. When soil or any type of fill is placed over the existing root system, it causes a reduction in the oxygen supply to the tree roots and slows down the rate of gas exchange between the roots and the air in the soil pore space. Both oxygen and water are essential to the growth, development and nutrient uptake by the roots. Many of the soil organisms also utilize the water and oxygen in their normal growth processes. Lack of oxygen in the soil may result in accumulation of noxious gases and chemicals detrimental to good growth. When this occurs, the feeder roots fail to develop, the root system and the above-ground portion of the tree begin to decline. Many factors (including tree species, depth and type of fill, drainage, soil structure below the fill and the general vigour of the existing tree) have a determining influence upon the time it takes for the above-ground symptoms to appear. Thus, it might take anywhere from several months to as much as 3 to 5 years before tree death would occur.

7.1 FOOTINGS

Consideration should be given to tree sensitive measures such as pier and beam, suspended slabs, cantilevered building sections, screw piles and contiguous piling.

Tree sensitive design may be employed to gain further acceptable encroachments to the TPZ. Structures that require little or no excavation are considered tree sensitive design.

Isolated pier locations should be assessed for roots prior to piling. When placing piers in the TPZ, the first 800mm should be undertaken by hand digging only. Care should be taken not to damage roots 50mm and over. Pier holes should be flexible in design and be placed in such a manner that significant roots are bridged rather than severed.

Loss of permeable surfaces will be taken into consideration.

7.2 LANDSCAPING WITHIN THE TPZ

7.2.1 FENCES AND WALLS

If a new fence is to be installed within the TPZ of trees to be retained must be constructed with suspended sections 100mm clear above or beside any structural woody root or further as required, or any new wall to be built only to the depth of that existing. Structural woody roots to be further protected by utilising the construction techniques of pier or bridge footings, or screw piles between or over them with a minimum clearance above or beside of 100mm, or further as required to allow for future and ongoing growth.

When placing piers in the TPZ, the first 800mm should be undertaken by hand digging only. Care should be taken not to damage roots 50mm and over. Pier holes should be flexible in design and be placed in such a manner that significant roots are bridged rather than severed. Root investigation should be conducted using non-destructive techniques.

Techniques include:

- Hand excavation
- Vacuum excavation
- High pressure water jet excavation
- Air Spade

All excavation should be undertaken or supervised by an AQF Level 5 Arborist.

7.2.2 HARDSTAND SURFACES

A hardstand surface may be constructed at ground level without any excavation, by first killing with herbicide the plants to be removed from the pathway area, and then removing that plant material by cutting the trunks of woody shrubs to ground level and by raking all other plant material to expose the top soil surface without organic matter. This will remove the need for physically disturbing the soil and the roots of the tree.

If a hardstand surface is to be constructed near a protected tree, careful excavation is to be undertaken manually by using non-motorized hand tools to determine the location of first order and lower order structural roots with a diameter of 20mm or greater, without damaging them Where a driveway or footpath is to pass by the tree a suspended slab is to be constructed or approved similar, to protect the roots that may be encountered at, near, or above ground, and may be constructed on structural soil. Where such a driveway or footpath is to be constructed the edge of the structure closest to the tree is to terminate no closer than 0.5m from the outside edge of the trunk, or further depending on the species and its likely further growth to allow for future development and expansion of the trunk, buttresses, and first order and lower order roots as may be advised by a Consultant Arboriculturist.

7.2.3 LEVEL CHANGES

Soil level changes are outlined as non-permissible in AS4970–2009. The soils on the site are classified as shallow which will make lowering the soil levels within the TPZ virtually impossible. Upon the site inspection I noted many large roots protruding from the soil.

Making the soil levels higher is an easier task if done correctly and can have little impact on tree vitality. Raising the grade or soil level over existing roots can have an even greater effect on the future growth and survival of existing trees. When soil or any type of fill is placed over the existing root system, it causes a reduction in the oxygen supply to the tree roots and slows down the rate of gas exchange between the roots and the air in the soil pore space.

Both oxygen and water are essential to the growth, development and nutrient uptake by the roots. Many of the soil organisms also utilize the water and oxygen in their normal growth processes. Lack of oxygen in the soil may result in accumulation of noxious gases and chemicals detrimental to good growth. When this occurs, the feeder roots fail to develop, the root system and the above-ground portion of the tree begin to decline. Many factors (including tree species, depth and type of fill, drainage, soil structure below the fill and the general vigour of the existing tree) have a determining influence upon the time it takes for the above-ground symptoms to appear. Thus, it might take anywhere from several months to as much as 3 to 5 years before tree death would occur.

In order for the root conditions to remain favourable all vegetation should be removed, including sod and underbrush beneath the branch spread of the tree. Organic matter, as it decomposes beneath a soil fill, can create noxious gases detrimental to the tree roots. The top 3 to 6 inches of the soil surface should be cultivated or broken up carefully so as to disturb the least possible number of roots. This treatment allows better contact with the fill soil and prevents a sharp line of demarcation between the existing soil surface and the fill and where internal soil drainage is good. The fill should consist of large aggregate or sandy soil so that aeriation and drainage is achieved and then the organic layer on top.

Such amendments may even improve the root conditions as breaking up the topsoil would alleviate the surface compaction and improve oxygen flow and water infiltration. Adding more porous topsoil would also aid in preventing future compaction and would also protect the exposed roots from damage.

If the fill is no more than 600mm, and internal soil drainage is good. Starting at the outer extremities of the branches, apply from 75 to 150mm of coarse gravel or crushed stone. The depth towards the trunk of the tree should be increased gradually until it is 200 to 300mm or deeper within 2 feet of the trunk. The gravel can reach the surface of the fill in the area extending 600mm around the trunk of the tree (see Figure 3). The gravel can be covered with a thin layer of straw, woven plastic or other porous material to keep soil from filtering into the coarse gravel and sealing the air spaces. Some good topsoil should be spread over the area to the desired depth.

7.3 SERVICES

All underground services should be placed outside the TPZs of the retained trees. When routing services outside the TPZ becomes unavoidable, trenching must be undertaken using tree sensitive excavation.

Techniques include:

- Hand excavation
- Vacuum excavation
- High pressure water jet excavation
- Air Spade
- Horizontal Directional Drilling (Entry and exit pits must be located outside of the TPZ)

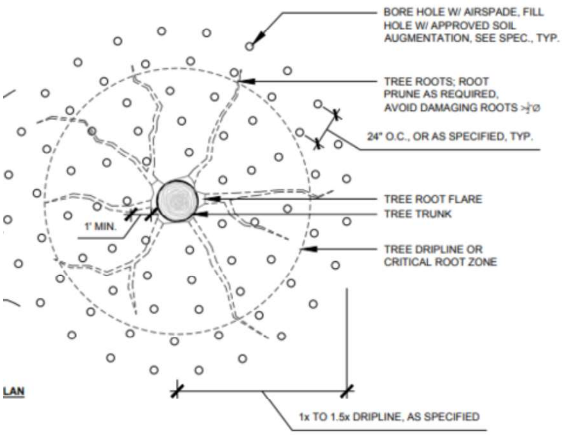
All excavation should be undertaken or supervised by an AQF Level 5 Arborist.

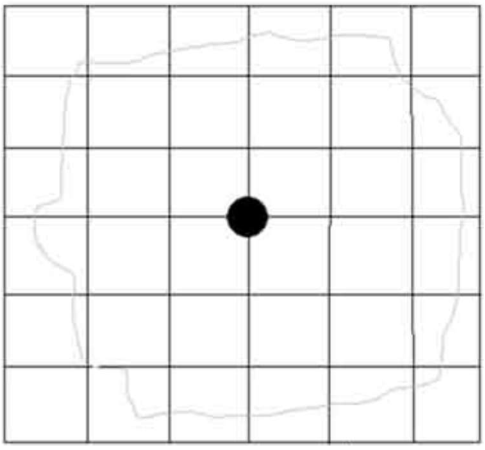
7.4 SOIL REMEDIATION FOLLOWING ROOT PRUNING

“When intentionally cutting roots, it is important to make clean cuts, perpendicular to the line of the root. Clean cuts offer a smaller surface for drying and compartmentalize better. Roots that are torn by large grading equipment can develop cracks that run laterally along the root, increasing the extent of damage. When grading near trees, always prune the roots in advance.” (Urban 2008)

It is also recommended that a remediation plan is put in place to compensate for the root loss, in the form of vertical mulching and soil inoculation to stimulate new root growth.

Vertical mulching, a method that is known to invigorate root growth and improve tree vigour. Using air excavation tools, 150-230 mm deep holes with a 150mm diameter, should be created and then filled with composted mulch. Mulch details to be outlined in 6.4 Recommended Materials. The effects of vertical mulching are greatly enhanced when combined with surface mulching. (Urban, 2008). The holes should be spaced approximately 750mm apart in a grid formation and should be done to a radius of one to one and a half times the dripline. Please refer to Figure 11. Air spade works should be carried out when soil is of adequate field capacity and not in too dry or saturated conditions. Vertical mulching should be undertaken using an organic soil blend of 80% double washed sand 20% natural washed soil, mixed with worm casting. Worm castings make soil more absorbent; they can remove toxins from soil and introduce beneficial microbes and bacteria into the soil including phosphorous and nitrogen. They can also increase CEC.





Following the root pruning, the soil should also be inoculated with products such as Nutri-life TrichoShield. Tricoshield is a talc-based formulation containing the beneficial fungal species *Trichoderma harzianum*, *Trichoderma lignorum* and *Gliocladium virens*, and the plant growth promoting, bio-balancing bacteria Bacillus subtilis. Trichoderma is also a root growth promoter.

Trichoderma spp. are proposed as major plant growth-promoting fungi that widely exist in the natural environment. These strains have the abilities of rapid growth and reproduction and efficient transformation of soil nutrients. Moreover, they can change the plant rhizosphere soil environment and promote plant growth. (Halifu, Deng, Song, & Song, 2019)

8 CONCLUSIONS AND RECOMMENDATIONS

Table 13 summarises the number of trees to be removed and their assigned retention values.

Table 13

Retention Value	Total
Very High	0
High	25
Medium	8
Low	6
Exempt	12
Total	**51**

Given the environmental mapping and the Narla document dated February 2021, the following table details the trees being removed and their origin. A total of 36 trees endemic to the EEC Swamp oak Floodplain of the NSW North Coast, Sydney Basin & South east Corner Bioregions have been recommended for removal due to development impacts.

Table 14

Species Origin	**Number of Trees**	**Tree Numbers**
Endemic	36	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T18, T19, T20, T21, T22, T23, T24, T25, T26, T27, T28, T29, T30, T31, T32, T33, T39, T42, T63
Native	4	T64, T65, T68, T69
Exotic	10	T34, T35, T36, T37, T40, T41, T62, T66, T67, T114
Noxious Weed	1	T38
Total		**51**

The following trees suffer development impacts that are not able to be mitigated and will require to be removed and replaced.

Table 15

Tree ID	Tree Species	Retention Value (STARS)
T1	Casuarina glauca (Swamp-Oak)	Medium
T2	Casuarina glauca (Swamp-Oak)	High
T3	Casuarina glauca (Swamp-Oak)	High
T4	Casuarina glauca (Swamp-Oak)	High
T5	Casuarina glauca (Swamp-Oak)	Low

Tree ID	Tree Species	Retention Value (STARS)
T6	Casuarina glauca (Swamp-Oak)	Exempt
T7	Casuarina glauca (Swamp-Oak)	High
T8	Casuarina glauca (Swamp-Oak)	High
T9	Casuarina glauca (Swamp-Oak)	High
T10	Casuarina glauca (Swamp-Oak)	High
T11	Casuarina glauca (Swamp-Oak)	High
T12	Casuarina glauca (Swamp-Oak)	High
T13	Casuarina glauca (Swamp-Oak)	High
T14	Casuarina glauca (Swamp-Oak)	Medium
T15	Casuarina glauca (Swamp-Oak)	Low
T16	Casuarina glauca (Swamp-Oak)	Low
T17	Casuarina glauca (Swamp-Oak)	Medium
T18	Casuarina glauca (Swamp-Oak)	High
T19	Casuarina glauca (Swamp-Oak)	High
T20	Casuarina glauca (Swamp-Oak)	High
T21	Casuarina glauca (Swamp-Oak)	Low
T22	Casuarina glauca (Swamp-Oak)	Medium
T23	Casuarina glauca (Swamp-Oak)	High
T24	Casuarina glauca (Swamp-Oak)	High
T25	Casuarina glauca (Swamp-Oak)	High
T26	Casuarina glauca (Swamp-Oak)	High
T27	Casuarina glauca (Swamp-Oak)	Medium
T28	Casuarina glauca (Swamp-Oak)	High
T29	Casuarina glauca (Swamp-Oak)	High
T30	Casuarina glauca (Swamp-Oak)	Low

Tree ID	Tree Species	Retention Value (STARS)
T31	Casuarina glauca (Swamp-Oak)	High
T32	Casuarina glauca (Swamp-Oak)	High
T33	Casuarina glauca (Swamp-Oak)	High
T34	Harpophyllum caffrum (Kaffir Plum)	Exempt
T35	Cupressus species (Conifer)	Exempt
T36	Harpophyllum caffrum (Kaffir Plum)	Exempt
T37	Harpophyllum caffrum (Kaffir Plum)	Exempt
T38	Cinnamomum camphora (Camphor Laurel)	Exempt
T39	Glochidion ferdinandi (Cheese Tree)	Medium
T40	Cupressus species (Conifer)	Exempt
T41	Harpophyllum caffrum (Kaffir Plum)	Exempt
T42	Eucalyptus robusta (Swamp Mahogany)	High
T62	Magnolia grandiflora (White magnolia)	Medium
T63	Melaleuca quinquenervia (Broad-Leafed Paperbark)	High
T64	Syzygium paniculatum (Magenta Lilly Pilly)	Low
T65	Syzygium paniculatum (Magenta Lilly Pilly)	High
T66	Cupressus species (Conifer)	Exempt
T67	Cupressus species (Conifer)	Exempt
T68	Archontophoenix spp. (Alex/Bagalow Palm)	Medium
T69	Ficus benjimina (Weeping Fig)	Exempt
T114	Syagrus romanzoffiana (Cocos Palm)	Exempt

The following trees may be retained and subject to the following tree protection measures;

Table 16

Tree ID	Tree Species	TPZ Radius (M)	SRZ Radius (M)	Retention Value (STARS)	Generic Tree Protection Measures	Specific Tree Protection Measures
T43	Eucalyptus robusta (Swamp Mahogany)	4.4	2.3	High	TPZ Fencing	
T44	Eucalyptus robusta (Swamp Mahogany)	2.2	1.8	Medium	TPZ Fencing	
T45	Syagrus romanzoffiana (Cocos Palm)	2.6	1.9	Exempt	TPZ Fencing	
T46	Angophora costata (Sydney Red Gum)	2.6	2.0	Low	TPZ Fencing	
T47	Eucalyptus robusta (Swamp Mahogany)	2.0	1.8	Medium	TPZ Fencing	
T48	Eucalyptus robusta (Swamp Mahogany)	4.3	2.3	High	TPZ Fencing	
T49	Eucalyptus robusta (Swamp Mahogany)	3.7	2.2	High	TPZ Fencing	
T50	Pittosporum undulatum (Sweet Pittosporum)	2.2	1.6	Exempt	TPZ Fencing	
T51	Melaleuca linarifolia (Snow in Summer)	2.6	1.9	Medium	TPZ Fencing	
T52	Angophora costata (Sydney Red Gum)	4.3	2.3	Medium	TPZ Fencing	
T53	Angophora costata (Sydney Red Gum)	2.3	1.8	Medium	TPZ Fencing	
T54	Casuarina glauca (Swamp-Oak)	2.8	1.9	High	TPZ Fencing	
T55	Casuarina glauca (Swamp-Oak)	2.0	1.8	High	TPZ Fencing	

Tree ID	Tree Species	TPZ Radius (M)	SRZ Radius (M)	Retention Value (STARS)	Generic Tree Protection Measures	Specific Tree Protection Measures
T56	Casuarina glauca (Swamp-Oak)	5.5	2.1	High	TPZ Fencing	
T57	Casuarina glauca (Swamp-Oak)	3.1	2.1	High	TPZ Fencing	
T58	Casuarina glauca (Swamp-Oak)	3.8	2.3	High	TPZ Fencing	
T59	Casuarina glauca (Swamp-Oak)	3.7	2.2	High	TPZ Fencing	
T60	Callistemon viminalis (Weeping Bottlebrush)	4.8	2.3	Medium	TPZ Fencing	
T61	Callistemon viminalis (Weeping Bottlebrush)	4.6	2.2	Medium	TPZ Fencing	
T70	Callistemon viminalis (Weeping Bottlebrush)	4.3	2.3	Medium	TPZ Fencing	
T71	Callistemon viminalis (Weeping Bottlebrush)	5.3	2.4	Medium	TPZ Fencing	
T72	Casuarina glauca (Swamp-Oak)	4.1	2.3	High	TPZ Fencing	
T73	Casuarina glauca (Swamp-Oak)	3.4	2.2	High	TPZ Fencing	
T74	Casuarina glauca (Swamp-Oak)	2.4	2.3	High	TPZ Fencing	
T75	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T76	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T77	Casuarina glauca (Swamp-Oak)	4.3	2.3	High	TPZ Fencing	
T78	Casuarina glauca (Swamp-Oak)	2.4	1.9	High	TPZ Fencing	
T79	Casuarina glauca (Swamp-Oak)	3.8	2.3	High	TPZ Fencing	

Tree ID	Tree Species	TPZ Radius (M)	SRZ Radius (M)	Retention Value (STARS)	Generic Tree Protection Measures	Specific Tree Protection Measures
T80	Casuarina glauca (Swamp-Oak)	3.6	2.1	High	TPZ Fencing	
T81	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T82	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T83	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T84	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T85	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T86	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T87	Casuarina glauca (Swamp-Oak)	5.6	2.4	High	TPZ Fencing	
T88	Casuarina glauca (Swamp-Oak)	4.1	2.3	High	TPZ Fencing	
T89	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T90	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T91	Casuarina glauca (Swamp-Oak)	3.4	2.1	High	TPZ Fencing	
T92	Casuarina glauca (Swamp-Oak)	4.3	2.2	High	TPZ Fencing	
T93	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T94	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T95	Casuarina glauca (Swamp-Oak)	3.8	2.3	High	TPZ Fencing	
T96	Casuarina glauca (Swamp-Oak)	4.9	2.4	High	TPZ Fencing	

Tree ID	Tree Species	TPZ Radius (M)	SRZ Radius (M)	Retention Value (STARS)	Generic Tree Protection Measures	Specific Tree Protection Measures
T97	Casuarina glauca (Swamp-Oak)	5.5	2.5	High	TPZ Fencing	
T98	Casuarina glauca (Swamp-Oak)	3.0	2.0	High	TPZ Fencing	
T99	Casuarina glauca (Swamp-Oak)	3.5	2.1	High	TPZ Fencing	
T100	Casuarina glauca (Swamp-Oak)	3.6	2.1	High	TPZ Fencing	
T101	Casuarina glauca (Swamp-Oak)	7.2	2.8	High	TPZ Fencing	
T102	Melaleuca quinquenervia (Broad-Leafed Paperbark)	11.9	3.5	High	TPZ Fencing	Employ tree sensitive construction for the carpark i.e. build at grade with no excavation (see section 7.2.2), or project arborist supervision to ensure all roots are cut cleanly and employ remediation plan for remainder of TPZ to encourage replacement root growth. Section 7.4. Any excavation should be limited to the car park area only, natural ground should be retained at the eastern side of the car park between the proposed parking area and Pittwater Rd.
T103	Melaleuca quinquenervia (Broad-Leafed Paperbark)	10.6	3.3	High	TPZ Fencing	
T104	Melaleuca quinquenervia (Broad-Leafed Paperbark)	10.7	3.3	High	TPZ Fencing	
T105	Melaleuca quinquenervia (Broad-Leafed Paperbark)	12.0	3.3	High	TPZ Fencing	Employ tree sensitive construction for the carpark i.e. build at grade with no excavation (see section 7.2.2), or project arborist supervision to ensure all roots are cut cleanly and employ remediation plan for remainder of TPZ to encourage replacement root growth. Section 7.4. Any excavation should be limited to the car park area only, natural ground should be retained at the eastern side of the car park between the proposed parking area and Pittwater Rd.
T106	Glochidion ferdinandi (Cheese Tree)	4.1	2.3	Medium	TPZ Fencing	
T107	Glochidion ferdinandi (Cheese Tree)	5.5	2.6	Medium	TPZ Fencing	
T108	Glochidion ferdinandi (Cheese Tree)	4.1	2.4	Medium	TPZ Fencing	
T109	Melaleuca quinquenervia (Broad-Leafed Paperbark)	14.8	3.8	High	TPZ Fencing	Tree is located on Pittwater Rd. which is separated from the subject site via a sandstone retaining wall. No foreseen impact.

Tree ID	Tree Species	TPZ Radius (M)	SRZ Radius (M)	Retention Value (STARS)	Generic Tree Protection Measures	Specific Tree Protection Measures
T110	Melaleuca quinquenervia (Broad-Leafed Paperbark)	8.0	3.0	High	TPZ Fencing	
T111	Glochidion ferdinandi (Cheese Tree)	4.8	2.6	Medium	TPZ Fencing	
T112	Casuarina glauca (Swamp-Oak)	2.0	1.6	Medium	TPZ Fencing	
T113	Melaleuca quinquenervia (Broad-Leafed Paperbark)	10.7	3.7	High	TPZ Fencing	Tree is located on Pittwater Rd. which is separated from the subject site via a sandstone retaining wall. No foreseen impact.

Two trees (T105 and T109) suffer major encroachments of more than 10% but less than 15%. Recommendations have been made pertaining to the trees longevity. It is recommended that tree sensitive design is employed in regard to installation of the new car park (see section 7.2.2). Failing that a project arborist should be employed to supervise the excavation and undertake correct root pruning and soil remediation should be undertaken to encourage new root growth (see section 7.4). Any excavation should be limited to the car park area only, natural ground should be retained at the eastern side of the car park between the proposed parking area and Pittwater Rd.

It is important to stress as this stage that the tree protection requirements and project consulting arborist instructions are to be strictly adhered to at all times, due to the fine tolerances and potential catastrophic impacts if not adhered to by the project consulting arborists instructions.

Failure to comply will result in not obtaining final sign off/practical completion, and upon a discovery of failure to comply, it is recommended the certifier be immediately notified.

It is therefore the responsibility of the builder/foreman to ensure no breaches into the TPZ exclusion zones occur by anyone on site / any contractor / sub-contractor.

9 TREE PROTECTION MEASURES

9.1 FENCING

It will not be practical or possible to erect a TPZ fence encompassing the entire TPZ as access will be required to perform the works, however, an exclusion zone should be erected around the tree to limit activities that take place within the TPZ. *AS4970-2009 Protection of Trees on Development sites* states that the following activities are prohibited within the TPZs;

- Storage.
- Preparation of chemicals, including preparation of cement products.
- Refueling.
- Dumping of waste.
- Washing down and cleaning of equipment.

AS 4687 specifies applicable fencing requirements, 1.8M Mesh fence. Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter and liquids into the protected area.

Fencing must

- be 1.8m high fully supported chainmesh protective fencing. The fencing shall be secure and fastened to prevent movement. The fencing shall have a lockable opening for access. Roots greater than 40mm in diameter shall not be pruned, damaged or destroyed during the installation or maintenance of the fencing. The fencing shall not be moved, altered or removed without the approval of the Project Arborist;
- have a minimum of two signs that include the words "Tree Protection Zone – Keep Out". Each sign shall be a minimum size of 600mm x 500mm and the name and contact details of the Project Arborist. Signs shall be attached facing outwards in prominent positions at 10 metre intervals or closer where the fence changes direction. The signs shall be visible within the site;
- be kept free of weeds and, except where the existing surface is grass, grass. Weeds shall be removed by hand; and
- unless the existing surface is grass, have mulch installed and maintained to a depth of 75mm.

Fencing should be installed before any machinery or materials are brought onto the site and before the commencement of works including demolition. Once erected, protective fencing must not be removed or altered without approval by the project arborist. Fencing must be clearly signed and adhere to the standard as outlined in *AS4970-2009 Protection of Trees on Development Sites*.

9.2 TRUNK PROTECTION

Trunk protection as outlined in *Australian Standard AS4970-2009 Protection of Trees on Development Sites* should be installed. This should be installed by or signed off by an AQF Level 5 arborist.

Trunk protection is achieved when the vertical trunk of exposed trees is protected by the placement of 1.8m lengths of 50 x 100mm hardwood timbers, spaced vertically, at 150mm centres and secured by 2mm wire at 300mm wide spacing over suitable protective padding material e.g. Jute Matting. The trunk protection shall be maintained intact until the completion of all work on site. Additionally, smaller fences can be erected around the trunks to avoid damage.

Trunk protection should be installed before any machinery or materials are brought onto the site and before the commencement of works including demolition. Once erected, trunk protection should be certified by the project arborist and adhere to the standard as outlined in *AS4970-2009 Protection of Trees on Development Sites*.

9.3 GROUND PROTECTION

It is also recommended that the trees are mulched within the TPZ's. Section 4.6 of Australian Standard AS4970-2009 Protection of Trees on Development Sites states that the area within the TPZ should be mulched. The mulch must be maintained to a depth of 50–100 mm using material that complies with AS 4454. Mulch should be applied at no greater depth than 50-75 mm. Mulch should be spread beyond the dripline (Shigo, 1991). The mulch should be no closer than 200mm away from the base of the trunk as this can cause collar rot and increase the incidence of disease.

This will also allow for a favourable root environment for the trees possibly improving tree health throughout the development period. Benefits of mulching include:

- Conservation of soil moisture.
- Soil erosion and runoff are reduced, slowing water movement and keeping water in contact with soil.
- Soil fertility is increased by nutrients from mulch.
- Soil microorganism activity is enhanced.
- Protects surface soil from compactive forces, such as vehicles, people and rain impact.

The mulch should be suitably coarse and broken down to ensure a Carbon: Nitrogen ratio of no more than 25:1 or less and should be no less than 75mm and no more than 100mm in depth. It is important to choose the correct mulch for improving soil fertility. The mulches must have high C:N ratios. Mulches with low C:N ratios may develop nitrogen deficiency (Carlson, 2001) Mulching should be arranged by a project arborist.

Soil moisture levels should be regularly monitored by the project arborist. "Benefits of mulch to the soil environment and ultimately plant health and growth are accrued both immediately after application as the mulch protects the soil surface, and over time as the organic mulch decomposes. Immediate benefits include conserving soil moisture, reducing salt build up in the surface soil, reducing soil erosion and water runoff, protection from compactive forces, insulating the soil from temperature extremes, reducing reflection and reradiation of heat, and suppressing weed growth. Benefits that accrue over time from the use of organic mulches involve improvements to soil structure, permeability, aeration, fertility, and biological activity. Improved aeration, temperature, and moisture conditions near the surface encourage rooting and other biological activities that enhance soil structure. Just the absence of cultivation and the low amount of compaction will allow soil structure to improve through wetting and drying cycles and biological activity. Improved soil structure increases the infiltration rate and allows more uniform water distribution and less soil erosion, all of which favour plant growth." (Harris, Clark & Matheny, 2004)

If access for machinery is required within the TPZ ground protection measures will be required. The purpose of ground protection is to prevent root damage and soil compaction within the TPZ.

Although heavy machinery is not permitted within the TPZ, access is permitted when additional ground protection measures are employed in accordance with *AS4970-2009 Protection of Trees on Development sites* specifically section 4.5.3 Ground Protection . A permeable geotextile membrane should be laid over the required area beneath a layer of coarse mulch and then covered with rumble boards. The boards should be placed on their flat edge, side by side with a 30-50mm gap to form a rumble strip. The boards are to be held together with a metal bracing straps.

9.4 TREE SENSITIVE METHODOLOGY

9.4.1 PRUNING RETAINED TREES

Trees that require pruning in order to facilitate the new build should be directed by an AQF Level 5 project arborist and undertaken by a minimum AQF Level 3 arborist adhering to *AS4373-2007* and NSW Workcover Code of Practice *Amenity Tree Industry 1998* and Safe Work *Guide to Managing Risks of Tree Trimming and Removal Work 2016*.

9.4.2 EXCAVATION WITHIN THE TPZ

When the extent of TPZ incursion is deemed minor as per AS4970 Protection of Trees on Development Sites i.e., less than 10%, excavation may be undertaken using traditional methods. Excavation for Benching and Shoring must be considered.

When the encroachment is deemed to be major i.e., greater than 10% of the TPZ of trees to be retained; exploratory root investigation using non-destructive root sensitive techniques should be undertaken at the perimeter of the required penetration point nearest the tree, bearing in mind compensation for benching and battering.

Techniques include:

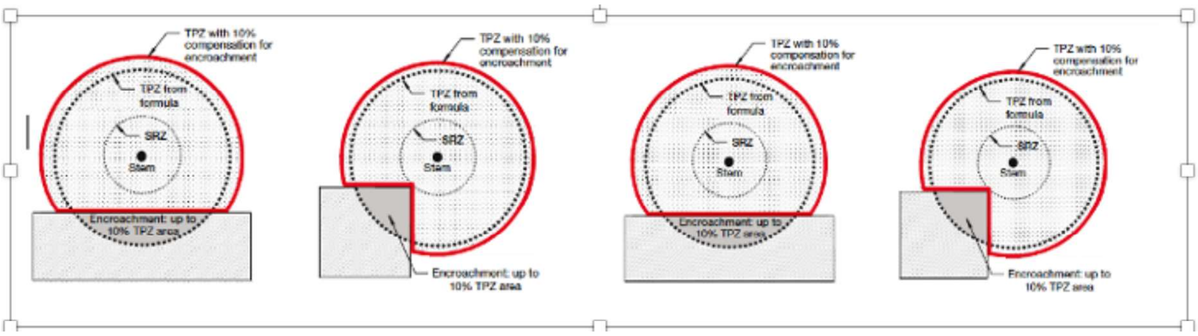
- Hand excavation
- Vacuum excavation
- High pressure water jet excavation
- Air Spade

The exploratory root investigation should be undertaken at the outer limits of the of the penetration point to a maximum of 700mm or when compacted sub-soil or rock bed is encountered. Roots greater than 50mm in diameter should be retained and advice from a project arborist sought.

Any roots less than 50mm in diameter that will require pruning should be undertaken by a suitably qualified arborist using sharp tools to ensure clean cuts. “When intentionally cutting roots, it is important to make clean cuts, perpendicular to the line of the root. Clean cuts offer a smaller surface for drying and compartmentalize better. Roots that are torn by large grading equipment can develop cracks that run laterally along the root, increasing the extent of damage. When grading near trees, always prune the roots in advance.” (Urban 2008)

9.4.3 TPZ COMPENSATION

TPZ area lost to incursions should be compensated for elsewhere on the site and contiguous to the TPZ.



9.4.4 INSTALLATION OF SERVICES WITHIN TPZ

All underground services should be placed outside the TPZs of the retained trees. When routing services outside the TPZ becomes unavoidable, trenching must be undertaken using tree sensitive excavation.

Techniques include:

- Hand excavation
- Vacuum excavation
- High pressure water jet excavation
- Air Spade
- Horizontal Directional Drilling (Entry and exit pits must be located outside of the TPZ)

All excavation should be undertaken or supervised by an AQF Level 5 Arborist.

9.4.5 PIER PLACEMENT WITHIN TPZ

When placing piers in the TPZ, the first 800mm should be undertaken by hand digging only. Care should be taken not to damage roots 50mm and over. Pier holes should be flexible in design and be placed in such a manner that significant roots are bridged rather than severed.

9.4.6 DEMOLITION OF HARDSTAND AREAS WITHIN TPZ

Demolition of hardstand areas within the TPZ's of trees may be undertaken using machinery but must be done so with care. Demolition should commence at the outer most point of the hard stand area nearest the tree working backwards away from the tree, with the machinery remaining on hard stand surfaces.

Where hard stand surfaces aren't available for machinery ground protection will be required.

This should be done under the supervision of a project arborist.

Once the hardstand surface has been demolished, ground protection as per AS4970 should be installed to limit the incidence of compaction and soil contamination.

9.4.7 LANDSCAPING WITHIN THE TPZ

Any landscaping works that require excavation within the TPZ should be done so using the methods outlined in 7.1.4.

Any pier holes for retaining walls should be done so by hand prior to piling.

Any excavation within the SRZ of trees should be done so under the direct supervision of a project arborist.

9.4.8 FILL WITHIN THE TPZ

Fill placed in the TPZ of trees to be retained shall be well-drained material equivalent or finer in texture than the existing site topsoil material and should comply with AS4419:2003 (Soils for Landscaping and Garden Use).

In order for the root conditions to remain favourable all vegetation should be removed, including sod and underbrush beneath the branch spread of the tree. Organic matter, as it decomposes beneath a soil fill, can create noxious gases detrimental to the tree roots. The top 75 to 150 mm of the soil surface should be cultivated or broken up carefully using non-motorized hand tools only, so as to disturb the least possible number of roots. This treatment allows better contact with the fill soil and prevents a sharp line of demarcation between the existing soil surface and the fill and where internal soil drainage is good. The fill should consist of large aggregate or sandy soil so that aeriation and drainage is achieved and then the organic layer on top.

9.5 HOLD POINTS, INSPECTION AND CERTIFICATION

To ensure all plans are implemented hold points have been specified in a schedule of works (below). Once each stage is reached the work will be inspected and certified by the project arborist and the next stage may commence.

9.5.1 SCHEDULE OF WORKS AND RESPONSIBILITIES

Table 5

Hold Point	Task	Responsibility	Certification	Timing of Inspection
1	Review construction plan and update TPP	Principle Contractor	Project Arborist	Prior to CC being granted
2	Install TPZ Fencing, trunk and branch protection.	Principle Contractor	Project Arborist	Prior to site establishment.
3	Supervise earthworks within TPZ of T102 and T105	Principle Contractor	Project Arborist	When required
4	Monthly inspection of site	Principle Contractor	Project Arborist	Monthly as required
5	Final inspection of Trees by Project Arborist	Principle Contractor	Project Arborist	Prior to issue of occupancy certificate.

10 WORKS CITED

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11 GLOSSARY OF TERMS

Borers: larvae beetles, moths or wasps that cause damage within the phloem/cambium, sapwood and heartwood of the tree. Borers generally attack weakened trees or stressed trees.

Cambium: The layer of cells between the exterior bark and the inner wood which control cell division, hence stem, branch and shoot expansion.

Cavity: A void, initiated by a wound within the trunk, branches or roots. These voids are referred to as hollows.

Co-dominant: Stems or branches equal in size and relative importance.

Crown: The width of the foliage in the upper canopy of the assessed tree to the four cardinal points.

Crown lifting: The removal of the lower branches of the tree.

Crown thinning: The portion of the tree consisting of branches and leaves and any part of the stem from which branches arise.

Drip line: Where the canopy releases water shed from the foliage during precipitation.

DBH/Diameter: Diameter of trunk at 14meters in height of assessed tree.

Dead wooding: The removal dead branches from a tree.

Dieback: Tree deterioration where the branches and leaves die.

Flush cut: A cut that damages or removes the branch collar or removes the branch and stem tissue and is inconsistent with the branch attachment as indicated by the bark branch ridge.

Genus/ Species: Identified using its scientific name. Where the species name is not known, species is used. The common name for trees may vary considerably in each area of geographical differences and so will not be used in the field survey.

Height: Height has been estimated to + / - 2 meters.

Maturity: Tree age, Assessed as over mature (last 1/3 of life expectancy), mature (1/3 to 2/3 life expectancy) and semi mature (less than 1/3 life expectancy).

Remedial (restorative) pruning: includes: Removing damaged, deadwood; trimming diseased or infested branches. Trimming branches back to undamaged tissue in order to induce the production of shoots from latent or adventitious buds, from which a new crown will be established.

SRZ- Structural Root Zone: An area within the trees root zone in which roots stabilize the tree. Roots cut in this zone can cause instability and lead to anchorage loss.

Structural Integrity: Describes the internal supporting timber. (Substantial to frail)

Target: risk targets are people, property or activities that could injure, damage or disrupted.

Tree Numbering: All trees listed in the tree survey have been numbered and plotted.

TULE- Tree Useful Life

Expectancy: An estimation of the trees useful life expectancy using appropriate industry methods with an inspection regime.

Vigour: This is an indication of the tree health. Trees have either been assessed as Good Vigour, Normal Vigour or Low Vigour.

12 APPENDIX 1: TREE SCHEDULE

12.1 SCHEDULE 1: ATTRIBUTES

Table 17

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
T1	Casuarina glauca (Swamp-Oak)	12	5,2,3,2	0.26	0.31	3.1	30.6	2.0	12.9	Juvenile	Fair	Fair	15-40yrs	Low	Medium	Cavity (minor) , Co-Dominant Stems , Deadwood Moderate (30-100mm) , Decay , Weak Branch Attachments (isolated) , Wounds (moderate)		Endemic
T2	Casuarina glauca (Swamp-Oak)	15	5,5,5,5	0.44	0.56	5.3	87.6	2.6	21.1	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems , Deadwood Moderate (30-100mm) , Included Bark (natural for species) , Included Union (insignificant)		Endemic
T3	Casuarina glauca (Swamp-Oak)	15	5,5,2,2	0.6	0.74	7.2	162.9	2.9	26.7	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems , Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm)		Endemic
T4	Casuarina glauca (Swamp-Oak)	15	3,3,3,3	0.54	0.69	6.5	131.9	2.8	25.2	Mature	Good	Fair	15-40yrs	High	High	Co-Dominant Stems , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated)		Endemic
T5	Casuarina glauca (Swamp-Oak)	15	4,4,4,4	0.47	0.53	5.6	99.9	2.5	20.2	Mature	Fair	Poor	5-15yrs	High	Low	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (moderate) , Included Bark (branches) , Included		Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
																Union (poor) , Weak Branch Attachments (isolated)		
T6	Casuarina glauca (Swamp-Oak)	11	2,2,2,2	0.2	0.27	2.4	18.1	1.9	11.5	Dead	Very Poor	Dead	Dead	Exempt	Exempt			Endemic
T7	Casuarina glauca (Swamp-Oak)	15	6,5,4,6	0.42	0.53	5.0	79.8	2.5	20.2	Mature	Good	Fair	15-40yrs	High	High	Crown Density (60-80%) , Deadwood Moderate (30-100mm)		Endemic
T8	Casuarina glauca (Swamp-Oak)	16	4,6,4,5	0.44	0.53	5.3	87.6	2.5	20.2	Mature	Good	Fair	15-40yrs	High	High	Co-Dominant Stems , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Dieback (isolated)		Endemic
T9	Casuarina glauca (Swamp-Oak)	17	8,8,8,7	0.65	0.77	7.8	191.1	3.0	27.6	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (branches) , Over Extended Limbs (isolated) , Previous Failures (isolated)		Endemic
T10	Casuarina glauca (Swamp-Oak)	18	9,6,7,8	0.78	0.91	9.4	275.2	3.2	31.8	Mature	Fair	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Included Bark (branches) , Included Union (insignificant) , Over Extended Limbs (isolated) , Phototropism (moderate) , Wounds (minor)		Endemic
T11	Casuarina glauca (Swamp-Oak)	19	4,4,4,4	0.34	0.4	4.1	52.3	2.3	15.9	Early Mature	Good	Fair	15-40yrs	High	High	Crown Density (60-80%) , Deadwood Moderate (30-100mm)		Endemic
T12	Casuarina glauca (Swamp-Oak)	14	2,2,2,2	0.19	0.23	2.3	16.3	1.8	10.0	Semi Mature	Fair	Fair	5-15yrs	High	High	Co-Dominant Stems (included bark) , Crown Density (60-80%) ,		Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
																Deadwood Minor (0-30mm) , Suppressed		
T13	Casuarina glauca (Swamp-Oak)	17	8,6,7,6	0.42	0.55	5.0	79.8	2.6	20.8	Mature	Fair	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (moderate) , Mechanical Damage , Over Extended Limbs (isolated)		Endemic
T14	Casuarina glauca (Swamp-Oak)	14	3,3,3,3	0.31	0.38	3.7	43.5	2.2	15.3	Semi Mature	Good	Fair	15-40yrs	Medium	Medium	Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed		Endemic
T15	Casuarina glauca (Swamp-Oak)	13	2,2,2,2	0.18	0.22	2.2	14.7	1.8	9.6	Juvenile	Fair	Fair	5-15yrs	Low	Low	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Dieback (moderate) , Included Union (moderate) , Suppressed		Endemic
T16	Casuarina glauca (Swamp-Oak)	13	6,3,2,3	0.22	0.3	2.6	21.9	2.0	12.5	Semi Mature	Poor	Poor	1-5yrs	Low	Low	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Major (>100mm) , Dieback (major) , Included Union (poor) , Suppressed , Weak Branch Attachments (systemic)		Endemic
T17	Casuarina glauca (Swamp-Oak)	14	2,2,2,2	0.23	0.29	2.8	23.9	2.0	12.2	Semi Mature	Fair	Fair	15-40yrs	Medium	Medium	Deadwood Moderate (30-100mm) , Suppressed		Endemic
T18	Casuarina glauca (Swamp-Oak)	18	7,6,5,6	0.44	0.56	5.3	87.6	2.6	21.1	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated)		Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
T19	Casuarina glauca (Swamp-Oak)	17	4,2,2,4	0.4	0.55	4.8	72.4	2.6	20.8	Semi Mature	Fair	Fair	15-40yrs	High	High	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Suppressed		Endemic
T20	Casuarina glauca (Swamp-Oak)	17	6,4,6,5	0.52	0.66	6.2	122.3	2.8	24.3	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant)		Endemic
T21	Casuarina glauca (Swamp-Oak)	13	2,2,2,2	0.24	0.29	2.9	26.1	2.0	12.2	Semi Mature	Poor	Poor	5-15yrs	Low	Low	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (moderate) , Included Union (moderate) , Suppressed , Wounds (moderate)		Endemic
T22	Casuarina glauca (Swamp-Oak)	14	3,2,2,3	0.24	0.29	2.9	26.1	2.0	12.2	Semi Mature	Fair	Fair	15-40yrs	Medium	Medium	Co-Dominant Stems , Deadwood Moderate (30-100mm) , Suppressed		Endemic
T23	Casuarina glauca (Swamp-Oak)	19	6,5,6,7	0.44	0.46	5.3	87.6	2.4	17.9	Early Mature	Good	Good	15-40yrs	High	High	Co-Dominant Stems (included bark) , Crown Density (40-60%) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Suppressed , Weak Branch Attachments (isolated)		Endemic
T24	Casuarina glauca (Swamp-Oak)	16	5,5,4,4	0.32	0.41	3.8	46.3	2.3	16.3	Semi Mature	Fair	Fair	15-40yrs	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed		Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
T25	Casuarina glauca (Swamp-Oak)	19	4,5,4,6	0.41	0.53	4.9	76.0	2.5	20.2	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Mechanical Damage , Over Extended Limbs (isolated) , Wounds (minor)		Endemic
T26	Casuarina glauca (Swamp-Oak)	18	4,5,6,5	0.39	0.52	4.7	68.8	2.5	19.9	Early Mature	Fair	Good	15-40yrs	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed , Weak Branch Attachments (isolated) , Wounds (minor)		Endemic
T27	Casuarina glauca (Swamp-Oak)	16	3,3,3,3	0.32	0.4	3.8	46.3	2.3	15.9	Semi Mature	Fair	Fair	15-40yrs	Medium	Medium	Co-Dominant Stems (included bark) , Crown Density (60-80%) , Deadwood Moderate (30-100mm) , Included Union (moderate) , Suppressed		Endemic
T28	Casuarina glauca (Swamp-Oak)	19	8,4,4,8	0.57	0.77	6.8	147.0	3.0	27.6	Mature	Fair	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Over Extended Limbs (isolated)		Endemic
T29	Casuarina glauca (Swamp-Oak)	19	5,5,5,5	0.46	0.66	5.5	95.7	2.8	24.3	Early Mature	Fair	Good	15-40yrs	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Suppressed		Endemic
T30	Casuarina glauca (Swamp-Oak)	7	2,3,4,2	0.15	0.19	1.8	10.2	1.6	8.5	Juvenile	Fair	Fair	5-15yrs	Low	Low	Co-Dominant Stems (included bark) , Crown		Endemic

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																Density (60-80%) , Deadwood Minor (0-30mm) , Epicormic Shoots (moderate) , Suppressed		
T31	Casuarina glauca (Swamp-Oak)	16	4,2,5,3,	0.3	0.38	3.6	40.7	2.2	15.3	Early Mature	Good	Fair	15-40yrs	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Union (insignificant) , Over Extended Limbs (isolated) , Suppressed		Endemic
T32	Casuarina glauca (Swamp-Oak)	18	5,4,5,4	0.41	0.46	4.9	76.0	2.4	17.9	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems , Crossing Rubbing Branches , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (branches) , Included Union (insignificant) , Over Extended Limbs (isolated) , Weak Branch Attachments (isolated) , Wounds (minor)		Endemic
T33	Casuarina glauca (Swamp-Oak)	19	4,5,5,4	0.42	0.5	5.0	79.8	2.5	19.2	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated)		Endemic
T34	Harpophyllum caffrum (Kaffir Plum)	9	5,5,5,5	0.25	0.32	3.0	28.3	2.1	13.2	Semi Mature	Fair	Fair	15-40yrs	Exempt	Exempt	Co-Dominant Stems (included bark)		Exotic
T35	Cupressus species (Conifer)	14	5,4,2,5	0.4	0.56	4.8	72.4	2.6	21.1	Mature	Good	Good	40 plus	Exempt	Exempt	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm)		Exotic

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T36	Harpophyllum caffrum (Kaffir Plum)	14	5,5,5,5	0.4	0.66	4.8	72.4	2.8	24.3	Mature	Good	Good	15-40yrs	Exempt	Exempt	Co-Dominant Stems		Exotic
T37	Harpophyllum caffrum (Kaffir Plum)	16	9,9,9,9	1.21	1.11	14.5	662.3	3.5	37.6	Mature	Fair	Good	40 plus	Exempt	Exempt	Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm) , Epicormic Shoots (minor) , Included Bark (branches) , Over Extended Limbs (isolated) , Previous Failures (isolated) , Weak Branch Attachments (isolated) , Wounds (minor)		Exotic
T38	Cinnamomum camphora (Camphor Laurel)	9	4,4,4,4	0.34	0.66	4.1	52.3	2.8	24.3	Juvenile	Fair	Good	40 plus	Environmental Weed	Exempt	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Epicormic Shoots (moderate)		Noxious Weed
T39	Glochidion ferdinandi (Cheese Tree)	12	4,4,4,5	0.28	0.31	3.4	35.5	2.0	12.9	Semi Mature	Fair	Good	15-40yrs	Medium	Medium	Deadwood Minor (0-30mm) , Included Bark (branches)		Endemic
T40	Cupressus species (Conifer)	11	2,2,2,2	0.13	0.15	1.6	7.6	1.5	7.0	Juvenile	Good	Fair	15-40yrs	Exempt	Exempt	Co-Dominant Stems		Exotic
T41	Harpophyllum caffrum (Kaffir Plum)	8	6,5,6,6	0.56	0.77	6.7	141.9	3.0	27.6	Early Mature	Fair	Good	15-40yrs	Exempt	Exempt	Co-Dominant Stems (included bark)		Exotic
T42	Eucalyptus robusta (Swamp Mahogany)	16	6,5,6,4	0.36	0.42	4.3	58.6	2.3	16.6	Semi Mature	Good	Fair	40 plus	High	High	Deadwood Moderate (30-100mm) , Dieback (isolated) , Epicormic Shoots (minor)		Endemic
T43	Eucalyptus robusta (Swamp Mahogany)	12	6,6,6,6	0.37	0.42	4.4	61.9	2.3	16.6	Semi Mature	Good	Fair	15-40yrs	High	High	Deadwood Moderate (30-100mm) , Dieback (isolated) , Previous Failures (isolated)		Endemic
T44	Eucalyptus robusta	14	2,2,2,2	0.18	0.23	2.2	14.7	1.8	10.0	Juvenile	Good	Fair	15-40yrs	Medium	Medium	Deadwood Minor (0-30mm)		Endemic

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	(Swamp Mahogany)																	
T45	Syagrus romanzoffiana (Cocos Palm)	9	2,2,2,2	0.22	0.28	2.6	21.9	1.9	11.8	Semi Mature	Good	Good	40 plus	Environmental Weed	Exempt			Noxious Weed
T46	Angophora costata (Sydney Red Gum)	11	3,2,4 e	0.22	0.29	2.6	21.9	2.0	12.2	Juvenile	Good	Very Poor	1-5yrs	Low	Low	Deadwood Moderate (30-100mm) , Dieback (major)		Native
T47	Eucalyptus robusta (Swamp Mahogany)	8	5,3,2,5	0.17	0.22	2.0	13.1	1.8	9.6	Juvenile	Fair	Fair	15-40yrs	Medium	Medium	Suppressed		Endemic
T48	Eucalyptus robusta (Swamp Mahogany)	14	4,5,6,4	0.36	0.42	4.3	58.6	2.3	16.6	Semi Mature	Good	Good	40 plus	High	High	Co-Dominant Stems , Deadwood Minor (0-30mm) , Dieback (isolated) , Over Extended Limbs (isolated)		Endemic
T49	Eucalyptus robusta (Swamp Mahogany)	14	5,6,5,5	0.31	0.39	3.7	43.5	2.2	15.6	Semi Mature	Good	Good	40 plus	High	High	Deadwood Moderate (30-100mm) , Dieback (isolated) , Epicormic Shoots (minor) , Included Bark (branches)		Endemic
T50	Pittosporum undulatum (Sweet Pittosporum)	6	3,3,3,3	0.18	0.19	2.2	14.7	1.6	8.5	Juvenile	Fair	Good	15-40yrs	Exempt	Exempt	Co-Dominant Stems		Native
T51	Melaleuca linarifolia (Snow in Summer)	6	3,2,4,3	0.22	0.28	2.6	21.9	1.9	11.8	Semi Mature	Good	Good	15-40yrs	Medium	Medium	Co-Dominant Stems (included bark)		Native
T52	Angophora costata (Sydney Red Gum)	12	4,4,3,4	0.36	0.44	4.3	58.6	2.3	17.3	Semi Mature	Good	Good	40 plus	Medium	Medium	Co-Dominant Stems , Deadwood Minor (0-30mm)		Native
T53	Angophora costata	10	3,2,2,4	0.19	0.22	2.3	16.3	1.8	9.6	Semi Mature	Good	Fair	15-40yrs	Medium	Medium	Deadwood Minor (0-30mm)		Native

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	(Sydney Red Gum)																	
T54	Casuarina glauca (Swamp-Oak)	12	2,2,3,2	0.23	0.26	2.8	23.9	1.9	11.1	Semi Mature	Fair	Good	15-40yrs	High	High	Deadwood Minor (0-30mm) , Included Bark (branches) , Weak Branch Attachments (isolated)		Endemic
T55	Casuarina glauca (Swamp-Oak)	12	2,2,2,2	0.17	0.22	2.0	13.1	1.8	9.6	Juvenile	Fair	Good	15-40yrs	High	High	Co-Dominant Stems (included bark) , Suppressed		Endemic
T56	Casuarina glauca (Swamp-Oak)	14	3,3,3,4	0.46	0.35	5.5	95.7	2.1	14.2	Semi Mature	Good	Good	15-40yrs	High	High	Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm)		Endemic
T57	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.26	0.33	3.1	30.6	2.1	13.6	Semi Mature	Good	Good	15-40yrs	High	High	Co-Dominant Stems , Deadwood Minor (0-30mm)		Endemic
T58	Casuarina glauca (Swamp-Oak)	14	4,4,4,4	0.32	0.4	3.8	46.3	2.3	15.9	Semi Mature	Good	Good	40 plus	High	High	Deadwood Minor (0-30mm)		Endemic
T59	Casuarina glauca (Swamp-Oak)	15	4,4,3,2	0.31	0.36	3.7	43.5	2.2	14.6	Semi Mature	Fair	Good	40 plus	High	High	Co-Dominant Stems , Deadwood Minor (0-30mm) , Suppressed		Endemic
T60	Callistemon viminalis (Weeping Bottlebrush)	6	4,5,6,4	0.4	0.41	4.8	72.4	2.3	16.3	Mature	Good	Good	40 plus	Medium	Medium	Co-Dominant Stems (included bark) , Included Bark (natural for species)		Native
T61	Callistemon viminalis (Weeping Bottlebrush)	6	4,3,5,4	0.38	0.39	4.6	65.3	2.2	15.6	Mature	Good	Good	15-40yrs	Medium	Medium	Co-Dominant Stems (included bark) , Dieback (minor) , Included Bark (natural for species)		Native
T62	Magnolia grandiflora (White magnolia)	7	3,3,3,3	0.27	0.3	3.2	33.0	2.0	12.5	Semi Mature	Good	Good	40 plus	Low	Medium	Co-Dominant Stems		Exotic
T63	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	5,6,7,5	0.8	1.11	9.6	289.5	3.5	37.6	Mature	Fair	Good	40 plus	High	High	Co-Dominant Stems , Deadwood Moderate (30-100mm) , Dieback (isolated)		Endemic

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T64	Syzygium paniculatum (Magenta Lilly Pilly)	9	1,2,3,1	0.33	0.4	4.0	49.3	2.3	15.9	Semi Mature	Fair	Poor	5-15yrs	Medium	Low	Co-Dominant Stems (included bark) , Suppressed		Native
T65	Syzygium paniculatum (Magenta Lilly Pilly)	15	6,4,6,3	0.55	0.6	6.6	136.8	2.7	22.4	Mature	Fair	Good	40 plus	High	High	Co-Dominant Stems , Deadwood Minor (0-30mm) , Dieback (isolated)		Native
T66	Cupressus species (Conifer)	9	2,3,2,3	0.22	0.31	2.6	21.9	2.0	12.9	Early Mature	Good	Good	15-40yrs	Exempt	Exempt	Co-Dominant Stems (included bark)		Exotic
T67	Cupressus species (Conifer)	10	3,3,3,2	0.29	0.33	3.5	38.0	2.1	13.6	Early Mature	Good	Good	15-40yrs	Exempt	Exempt	Co-Dominant Stems		Exotic
T68	Archontophoenix spp. (Alex/Bagalow Palm)	8	2,2,2,2	0.18	0.44	2.2	14.7	2.3	17.3	Semi Mature	Fair	Good	40 plus	Medium	Medium		Group of 4 clumping palms	Native
T69	Ficus benjimina (Weeping Fig)	6	4,4,4,4	0.29	0.3	3.5	38.0	2.0	12.5	Juvenile	Good	Poor	5-15yrs	Exempt	Exempt	Co-Dominant Stems (included bark)		Native
T70	Callistemon viminalis (Weeping Bottlebrush)	6	4,4,4,4	0.36	0.44	4.3	58.6	2.3	17.3	Early Mature	Good	Good	15-40yrs	Medium	Medium	Co-Dominant Stems (included bark) , Included Bark (natural for species)		Native
T71	Callistemon viminalis (Weeping Bottlebrush)	6	5,4,3,5	0.44	0.47	5.3	87.6	2.4	18.2	Early Mature	Fair	Good	15-40yrs	Medium	Medium	Poor Pruning (powerlines)		Native
T72	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.34	0.4	4.1	52.3	2.3	15.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T73	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.28	0.39	3.4	35.5	2.2	15.6	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted	Endemic

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																	growing through existing bitumen	
T74	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.2	0.4	2.4	18.1	2.3	15.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T75	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T76	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T77	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.36	0.41	4.3	58.6	2.3	16.3	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T78	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.2	0.28	2.4	18.1	1.9	11.8	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T79	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.32	0.43	3.8	46.3	2.3	16.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T80	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.3	0.35	3.6	40.7	2.1	14.2	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
T81	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T82	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T83	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T84	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T85	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T86	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T87	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.47	0.45	5.6	99.9	2.4	17.6	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T88	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.34	0.4	4.1	52.3	2.3	15.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted	Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
																	growing through existing bitumen	
T89	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T90	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T91	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.28	0.32	3.4	35.5	2.1	13.2	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T92	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.36	0.39	4.3	58.6	2.2	15.6	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T93	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T94	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T95	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.32	0.4	3.8	46.3	2.3	15.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
T96	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.41	0.47	4.9	76.0	2.4	18.2	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T97	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.46	0.49	5.5	95.7	2.5	18.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T98	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.25	0.3	3.0	28.3	2.0	12.5	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T99	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.29	0.35	3.5	38.0	2.1	14.2	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T100	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.3	0.34	3.6	40.7	2.1	13.9	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T101	Casuarina glauca (Swamp-Oak)	13	3,3,3,3	0.6	0.67	7.2	162.9	2.8	24.6	Semi Mature	Good	Good	40 plus	High	High		Stand of trees with integrated root system, roots noted growing through existing bitumen	Endemic
T102	Melaleuca quinquenervia (Broad-Leafed Paperbark)	18	7,8,7,8	0.99	1.12	11.9	443.4	3.5	37.8	Mature	Good	Good	15-40yrs	High	High	Cavity (minor) , Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm) , Decay , Dieback (isolated) , Included Bark (natural for species)	Tree species renowned for having expansive root system, root concentration maybe higher in the carpark due to the curbstone	Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
																	on the Pittwater Rd. side of the tree	
T103	Melaleuca quinquenervia (Broad-Leafed Paperbark)	14	6,7,6,7	0.88	1	10.6	350.3	3.3	34.4	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated) , Included Bark (natural for species) , Wounds (minor)		Endemic
T104	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	7,7,8,7	0.89	0.98	10.7	358.3	3.3	33.8	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated) , Included Bark (natural for species) , Root Scalping , Wounds (minor)		Endemic
T105	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	8,6,6,8	1	0.99	12.0	452.4	3.3	34.1	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Dieback (isolated) , Included Bark (natural for species) , Over Extended Limbs (isolated) , Root Scalping , Weak Branch Attachments (isolated) , Wounds (minor)		Endemic
T106	Glochidion ferdinandi (Cheese Tree)	6	5,5,5,5	0.34	0.43	4.1	52.3	2.3	16.9	Semi Mature	Good	Good	15-40yrs	Medium	Medium	Co-Dominant Stems	Root spread likely constrained due to sandstone retaining wall	Endemic
T107	Glochidion ferdinandi (Cheese Tree)	7	5,4,4,5	0.46	0.55	5.5	95.7	2.6	20.8	Semi Mature	Good	Good	15-40yrs	Medium	Medium	Co-Dominant Stems (included bark)	Root spread likely constrained due to sandstone retaining wall	Endemic

Tree ID	Tree Species	Height (M)	Spread (M) N, E, S, W	DBH (M)	DRB (M)	TPZ Radius (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	Age Class	Structure	Health	E.L.E	Landscape Significance (STARS)	Retention Value (STARS)	Observations and Defects	Notes	Species Origin
T108	Glochidion ferdinandi (Cheese Tree)	8	5,6,7,5	0.34	0.48	4.1	52.3	2.4	18.6	Semi Mature	Good	Good	15-40yrs	Medium	Medium	Co-Dominant Stems (included bark) , Deadwood Minor (0-30mm)	Root spread likely constrained due to sandstone retaining wall	Endemic
T109	Melaleuca quinquenervia (Broad-Leafed Paperbark)	18	8,2,3,8	1.23	1.4	14.8	684.4	3.8	45.6	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (natural for species)	Root spread likely constrained due to sandstone retaining wall	Endemic
T110	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	5,6,4,6	0.67	0.78	8.0	203.1	3.0	27.9	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Crossing Rubbing Branches , Deadwood Minor (0-30mm) , Included Bark (natural for species)	Root spread likely constrained due to sandstone retaining wall	Endemic
T111	Glochidion ferdinandi (Cheese Tree)	8	4,5,4,5	0.4	0.55	4.8	72.4	2.6	20.8	Semi Mature	Fair	Fair	40 plus	Medium	Medium	Co-Dominant Stems		Endemic
T112	Casuarina glauca (Swamp-Oak)	7	2,2,2,2	0.16	0.19	2.0	12.6	1.6	8.5	Juvenile	Fair	Good	15-40yrs	Low	Medium	Co-Dominant Stems (included bark)		Endemic
T113	Melaleuca quinquenervia (Broad-Leafed Paperbark)	18	6,7,5,6	0.89	1.33	10.7	358.3	3.7	43.7	Mature	Good	Good	40 plus	High	High	Co-Dominant Stems (included bark) , Deadwood Moderate (30-100mm) , Dieback (isolated) , Included Bark (natural for species) , Over Extended Limbs (isolated)	Root spread likely constrained due to sandstone retaining wall	Endemic
T114	Syagrus romanzoffiana (Cocos Palm)	12	4,4,4,4	0.28	0.33	3.4	35.5	2.1	13.6	Mature	Good	Good	40 plus	Exempt	Exempt			Exotic

12.2 SCHEDULE 2: DEVELOPMENT IMPACT

Table 18

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T1	Casuarina glauca (Swamp-Oak)	12	30.6	2.0	12.9	Yes		0.73	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T2	Casuarina glauca (Swamp-Oak)	15	87.6	2.6	21.1	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T3	Casuarina glauca (Swamp-Oak)	15	162.9	2.9	26.7	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T4	Casuarina glauca (Swamp-Oak)	15	131.9	2.8	25.2	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T5	Casuarina glauca (Swamp-Oak)	15	99.9	2.5	20.2	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T6	Casuarina glauca (Swamp-Oak)	11	18.1	1.9	11.5	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T7	Casuarina glauca (Swamp-Oak)	15	79.8	2.5	20.2	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T8	Casuarina glauca (Swamp-Oak)	16	87.6	2.5	20.2	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T9	Casuarina glauca (Swamp-Oak)	17	191.1	3.0	27.6	Yes		0	0.00%	In Footprint	Realligned stormwater and wetland area	Remove		
T10	Casuarina glauca (Swamp-Oak)	18	275.2	3.2	31.8	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T11	Casuarina glauca (Swamp-Oak)	19	52.3	2.3	15.9	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T12	Casuarina glauca (Swamp-Oak)	14	16.3	1.8	10.0	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T13	Casuarina glauca (Swamp-Oak)	17	79.8	2.6	20.8	Yes		6.13	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T14	Casuarina glauca (Swamp-Oak)	14	43.5	2.2	15.3	Yes		4.26	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T15	Casuarina glauca (Swamp-Oak)	13	14.7	1.8	9.6	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T16	Casuarina glauca (Swamp-Oak)	13	21.9	2.0	12.5	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T17	Casuarina glauca (Swamp-Oak)	14	23.9	2.0	12.2	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T18	Casuarina glauca (Swamp-Oak)	18	87.6	2.6	21.1	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T19	Casuarina glauca (Swamp-Oak)	17	72.4	2.6	20.8	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T20	Casuarina glauca (Swamp-Oak)	17	122.3	2.8	24.3	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T21	Casuarina glauca (Swamp-Oak)	13	26.1	2.0	12.2	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T22	Casuarina glauca (Swamp-Oak)	14	26.1	2.0	12.2	Yes			0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T23	Casuarina glauca (Swamp-Oak)	19	87.6	2.4	17.9	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T24	Casuarina glauca (Swamp-Oak)	16	46.3	2.3	16.3	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T25	Casuarina glauca (Swamp-Oak)	19	76.0	2.5	20.2	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T26	Casuarina glauca (Swamp-Oak)	18	68.8	2.5	19.9	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T27	Casuarina glauca (Swamp-Oak)	16	46.3	2.3	15.9	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T28	Casuarina glauca (Swamp-Oak)	19	147.0	3.0	27.6	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T29	Casuarina glauca (Swamp-Oak)	19	95.7	2.8	24.3	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T30	Casuarina glauca (Swamp-Oak)	7	10.2	1.6	8.5	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T31	Casuarina glauca (Swamp-Oak)	16	40.7	2.2	15.3	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T32	Casuarina glauca (Swamp-Oak)	18	76.0	2.4	17.9	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T33	Casuarina glauca (Swamp-Oak)	19	79.8	2.5	19.2	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T34	Harpophyllum caffrum (Kaffir Plum)	9	28.3	2.1	13.2	Yes		0	0.00%	In Footprint	Bulk Earthworks for new clubhouse	Remove		
T35	Cupressus species (Conifer)	14	72.4	2.6	21.1	Yes		0	0.00%	In Footprint	Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area	Remove		
T36	Harpophyllum caffrum (Kaffir Plum)	14	72.4	2.8	24.3	Yes		0	0.00%	In Footprint	Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area	Remove		
T37	Harpophyllum caffrum (Kaffir Plum)	16	662.3	3.5	37.6	Yes		0	0.00%	In Footprint	Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area	Remove		
T38	Cinnamomum camphora (Camphor Laurel)	9	52.3	2.8	24.3	Yes		0	0.00%	In Footprint	tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area	Remove		
T39	Glochidion ferdinandi (Cheese Tree)	12	35.5	2.0	12.9	Yes		0	0.00%	In Footprint	Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades	Remove		

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
											to the stormwater and wetland area			
T40	Cupressus species (Conifer)	11	7.6	1.5	7.0	Yes		0	0.00%	In Footprint	Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area	Remove		
T41	Harpophyllum caffrum (Kaffir Plum)	8	141.9	3.0	27.6	Yes		0	0.00%	In Footprint	Exempt species, tree is earmarked for removal on demolition plan, presumably for upgrades to the stormwater and wetland area	Remove		
T42	Eucalyptus robusta (Swamp Mahogany)	16	58.6	2.3	16.6	Yes		0	0.00%	In Footprint	Endemic tree species earmarked for removal on demolition plan from carpark passes through SRZ	Remove		
T43	Eucalyptus robusta (Swamp Mahogany)	12	61.9	2.3	16.6	Yes		0	0.00%	In Footprint	Endemic tree species earmarked for removal on demolition plan	Retain	TPZ Fencing	
T44	Eucalyptus robusta (Swamp Mahogany)	14	14.7	1.8	10.0	Yes		0	0.00%	In Footprint	Endemic tree species earmarked for removal on demolition plan	Retain	TPZ Fencing	
T45	Syagrus romanzoffiana (Cocos Palm)	9	21.9	1.9	11.8	No		0	0.00%	Nil		Retain	TPZ Fencing	
T46	Angophora costata (Sydney Red Gum)	11	21.9	2.0	12.2	No		0	0.00%	Nil		Retain	TPZ Fencing	
T47	Eucalyptus robusta	8	13.1	1.8	9.6	No		0	0.00%	Nil		Retain	TPZ Fencing	

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
	(Swamp Mahogany)													
T48	Eucalyptus robusta (Swamp Mahogany)	14	58.6	2.3	16.6	No		0	1.25%	Minor	TPZ extends on to the subject site, encroachemnt marginal	Retain	TPZ Fencing	
T49	Eucalyptus robusta (Swamp Mahogany)	14	43.5	2.2	15.6	No		0	0.00%	Nil		Retain	TPZ Fencing	
T50	Pittosporum undulatum (Sweet Pittosporum)	6	14.7	1.6	8.5	No		3.3	0.00%	Nil		Retain	TPZ Fencing	
T51	Melaleuca linarifolia (Snow in Summer)	6	21.9	1.9	11.8	No		0	0.00%	Nil		Retain	TPZ Fencing	
T52	Angophora costata (Sydney Red Gum)	12	58.6	2.3	17.3	No		0	0.00%	Nil		Retain	TPZ Fencing	
T53	Angophora costata (Sydney Red Gum)	10	16.3	1.8	9.6	No		0	0.00%	Nil		Retain	TPZ Fencing	
T54	Casuarina glauca (Swamp-Oak)	12	23.9	1.9	11.1	No		9.57	0.00%	Nil		Retain	TPZ Fencing	
T55	Casuarina glauca (Swamp-Oak)	12	13.1	1.8	9.6	No		56.4	0.00%	Nil		Retain	TPZ Fencing	
T56	Casuarina glauca (Swamp-Oak)	14	95.7	2.1	14.2	No		27.6	0.00%	Nil		Retain	TPZ Fencing	
T57	Casuarina glauca (Swamp-Oak)	13	30.6	2.1	13.6	No		24.9	0.00%	Nil		Retain	TPZ Fencing	

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T58	Casuarina glauca (Swamp-Oak)	14	46.3	2.3	15.9	No		47.8	0.00%	Nil		Retain	TPZ Fencing	
T59	Casuarina glauca (Swamp-Oak)	15	43.5	2.2	14.6	No		0	0.00%	Nil		Retain	TPZ Fencing	
T60	Callistemon viminalis (Weeping Bottlebrush)	6	72.4	2.3	16.3	No		0	8.47%	Minor	TPZ extend onto subject site, minor encroachment	Retain	TPZ Fencing	
T61	Callistemon viminalis (Weeping Bottlebrush)	6	65.3	2.2	15.6	No		0	6.52%	Minor	TPZ extend onto subject site, minor encroachment	Retain	TPZ Fencing	
T62	Magnolia grandiflora (White magnolia)	7	33.0	2.0	12.5	Yes		144.73	0.00%	In Footprint	New tennis courts	Remove		
T63	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	289.5	3.5	37.6	Yes		0	0.00%	In Footprint	New tennis courts	Remove		
T64	Syzygium paniculatum (Magenta Lilly Pilly)	9	49.3	2.3	15.9	Yes		0	0.00%	In Footprint	New tennis courts	Remove		
T65	Syzygium paniculatum (Magenta Lilly Pilly)	15	136.8	2.7	22.4	Yes		0	0.00%	In Footprint	New tennis courts	Remove		
T66	Cupressus species (Conifer)	9	21.9	2.0	12.9	Yes		75	0.00%	In Footprint	New tennis courts	Remove		
T67	Cupressus species (Conifer)	10	38.0	2.1	13.6	Yes			0.00%	In Footprint	New tennis courts	Remove		
T68	Archontophoenix spp.	8	14.7	2.3	17.3	Yes			0.00%	In Footprint	New tennis courts	Remove		

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
	(Alex/Bagalow Palm)													
T69	Ficus benjimina (Weeping Fig)	6	38.0	2.0	12.5	Yes			0.00%	In Footprint	New tennis courts	Remove		
T70	Callistemon viminalis (Weeping Bottlebrush)	6	58.6	2.3	17.3	No			0.00%	Nil		Retain	TPZ Fencing	
T71	Callistemon viminalis (Weeping Bottlebrush)	6	87.6	2.4	18.2	No			0.00%	Nil		Retain	TPZ Fencing	
T72	Casuarina glauca (Swamp-Oak)	13	52.3	2.3	15.9	No			0.00%	Nil		Retain	TPZ Fencing	
T73	Casuarina glauca (Swamp-Oak)	13	35.5	2.2	15.6	No			0.00%	Nil		Retain	TPZ Fencing	
T74	Casuarina glauca (Swamp-Oak)	13	18.1	2.3	15.9	No			0.00%	Nil		Retain	TPZ Fencing	
T75	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T76	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T77	Casuarina glauca (Swamp-Oak)	13	58.6	2.3	16.3	No			0.00%	Nil		Retain	TPZ Fencing	
T78	Casuarina glauca (Swamp-Oak)	13	18.1	1.9	11.8	No			0.00%	Nil		Retain	TPZ Fencing	
T79	Casuarina glauca (Swamp-Oak)	13	46.3	2.3	16.9	No			0.00%	Nil		Retain	TPZ Fencing	
T80	Casuarina glauca (Swamp-Oak)	13	40.7	2.1	14.2	No			0.00%	Nil		Retain	TPZ Fencing	
T81	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T82	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T83	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T84	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T85	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T86	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T87	Casuarina glauca (Swamp-Oak)	13	99.9	2.4	17.6	No			0.00%	Nil		Retain	TPZ Fencing	
T88	Casuarina glauca (Swamp-Oak)	13	52.3	2.3	15.9	No			0.00%	Nil		Retain	TPZ Fencing	
T89	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T90	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T91	Casuarina glauca (Swamp-Oak)	13	35.5	2.1	13.2	No			0.00%	Nil		Retain	TPZ Fencing	
T92	Casuarina glauca (Swamp-Oak)	13	58.6	2.2	15.6	No			0.00%	Nil		Retain	TPZ Fencing	
T93	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T94	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	
T95	Casuarina glauca (Swamp-Oak)	13	46.3	2.3	15.9	No			0.00%	Nil		Retain	TPZ Fencing	
T96	Casuarina glauca (Swamp-Oak)	13	76.0	2.4	18.2	No			0.00%	Nil		Retain	TPZ Fencing	
T97	Casuarina glauca (Swamp-Oak)	13	95.7	2.5	18.9	No			3.45%	Minor	New carpark	Retain	TPZ Fencing	
T98	Casuarina glauca (Swamp-Oak)	13	28.3	2.0	12.5	No			0.00%	Nil		Retain	TPZ Fencing	

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T99	Casuarina glauca (Swamp-Oak)	13	38.0	2.1	14.2	No			0.00%	Nil		Retain	TPZ Fencing	
T100	Casuarina glauca (Swamp-Oak)	13	40.7	2.1	13.9	No			0.00%	Nil		Retain	TPZ Fencing	
T101	Casuarina glauca (Swamp-Oak)	13	162.9	2.8	24.6	No			5.88%	Minor	New carpark	Retain	TPZ Fencing	
T102	Melaleuca quinquenervia (Broad-Leafed Paperbark)	18	443.4	3.5	37.8	No			12.72%	Major	New carpark	Retain	TPZ Fencing	Employ tree sensitive construction for the carpark i.e. build at grade with no excavation, or project arborist supervision to ensure all roots are cut cleanly and employ remediation plan for remainder of TPZ to encourage replacement root growth.
T103	Melaleuca quinquenervia (Broad-Leafed Paperbark)	14	350.3	3.3	34.4	No			7.88%	Minor	New carpark	Retain	TPZ Fencing	
T104	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	358.3	3.3	33.8	No			6.95%	Minor	New carpark	Retain	TPZ Fencing	
T105	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	452.4	3.3	34.1	No			10.57%	Major	New carpark	Retain	TPZ Fencing	Employ tree sensitive construction for the carpark i.e. build at grade with no excavation, or project arborist supervision to ensure all roots are cut cleanly and employ remediation plan for remainder of TPZ to encourage replacement root growth.
T106	Glochidion ferdinandi (Cheese Tree)	6	52.3	2.3	16.9	No			0.00%	Nil		Retain	TPZ Fencing	
T107	Glochidion ferdinandi (Cheese Tree)	7	95.7	2.6	20.8	No			0.00%	Nil		Retain	TPZ Fencing	

Tree ID	Tree Species	Height (M)	TPZ Area (M2)	SRZ Radius (M)	SRZ Area (M2)	In Development Footprint	In SRZ	TPZ Encroachment (M2)	TPZ Encroachment %	In Footprint/ Major/ Minor/ Nil	Encroachment Type	Retain/ Remove	Generic Tree Protection Measures	Specific Tree Protection Measures
T108	Glochidion ferdinandi (Cheese Tree)	8	52.3	2.4	18.6	No			0.00%	Nil		Retain	TPZ Fencing	
T109	Melaleuca quinquenervia (Broad-Leafed Paperbark)	18	684.4	3.8	45.6	No			21.15%	Major	New carpark and access road	Retain	TPZ Fencing	Tree is loacted on Pittwater Rd. which is separated from the subject site via a sandstone retaining wall. No foreseen impact.
T110	Melaleuca quinquenervia (Broad-Leafed Paperbark)	15	203.1	3.0	27.9	No			0.00%	Nil		Retain	TPZ Fencing	
T111	Glochidion ferdinandi (Cheese Tree)	8	72.4	2.6	20.8	No			0.00%	Nil		Retain	TPZ Fencing	
T112	Casuarina glauca (Swamp-Oak)	7	12.6	1.6	8.5	No			0.00%	Nil		Retain	TPZ Fencing	
T113	Melaleuca quinquenervia (Broad-Leafed Paperbark)	18	358.3	3.7	43.7	No			20.93%	Major	Realligned stormwater and wetland area	Retain	TPZ Fencing	Tree is loacted on Pittwater Rd. which is separated from the subject site via a sandstone retaining wall. No foreseen impact.
T114	Syagrus romanzoffiana (Cocos Palm)	12	35.5	2.1	13.6	Yes			0.00%	In Footprint	New Tennis courts	Remove		

13 APPENDIX 2: STARS

IACA Significance of a Tree, Assessment Rating System (STARS)© (IACA 2010)©

In the development of this document IACA acknowledges the contribution and original concept of the Footprint Green Tree Significance & Retention Value Matrix, developed by Footprint Green Pty Ltd in June 2001.

The landscape significance of a tree is an essential criterion to establish the importance that a particular tree may have on a site. However, rating the significance of a tree becomes subjective and difficult to ascertain in a consistent and repetitive fashion due to assessor bias. It is therefore necessary to have a rating system utilising structured qualitative criteria to assist in determining the retention value for a tree. To assist this process all definitions for terms used in the *Tree Significance - Assessment Criteria* and *Tree Retention Value - Priority Matrix*, are taken from the IACA Dictionary for Managing Trees in Urban Environments 2009.

This rating system will assist in the planning processes for proposed works, above and below ground where trees are to be retained on or adjacent a development site. The system uses a scale of *High*, *Medium* and *Low* significance in the landscape. Once the landscape significance of an individual tree has been defined, the retention value can be determined. An example of its use in an Arboricultural report is shown as Appendix A.

Tree Significance - Assessment Criteria

INSTITUTE OF AUSTRALIAN IACA CONSULTING ARBORICULTURISTS ®

1. High Significance in landscape

- The tree is in good condition and good vigour;
- The tree has a form typical for the species;
- The tree is a remnant or is a planted locally indigenous specimen and/or is rare or uncommon in the local area or of botanical interest or of substantial age;
- The tree is listed as a Heritage Item, Threatened Species or part of an Endangered ecological community or listed on Councils significant Tree Register;
- The tree is visually prominent and visible from a considerable distance when viewed from most directions within the landscape due to its size and scale and makes a positive contribution to the local amenity;
- The tree supports social and cultural sentiments or spiritual associations, reflected by the broader population or community group or has commemorative values;
- The tree's growth is unrestricted by above and below ground influences, supporting its ability to reach dimensions typical for the taxa *in situ* - tree is appropriate to the site conditions.

2. Medium Significance in landscape

- The tree is in fair-good condition and good or low vigour;
- The tree has form typical or atypical of the species;
- The tree is a planted locally indigenous or a common species with its taxa commonly planted in the local area
- The tree is visible from surrounding properties, although not visually prominent as partially obstructed by other vegetation or buildings when viewed from the street,
- The tree provides a fair contribution to the visual character and amenity of the local area,
- The tree's growth is moderately restricted by above or below ground influences, reducing its ability to reach dimensions typical for the taxa *in situ*.

3. Low Significance in landscape

- The tree is in fair-poor condition and good or low vigour;
- The tree has form atypical of the species;
- The tree is not visible or is partly visible from surrounding properties as obstructed by other vegetation or buildings,
- The tree provides a minor contribution or has a negative impact on the visual character and amenity of the local area,
- The tree is a young specimen which may or may not have reached dimension to be protected by local Tree Preservation orders or similar protection mechanisms and can easily be replaced with a suitable specimen,
- The tree's growth is severely restricted by above or below ground influences, unlikely to reach dimensions typical for the taxa *in situ* - tree is inappropriate to the site conditions,
- The tree is listed as exempt under the provisions of the local Council Tree Preservation Order or similar protection mechanisms,
- The tree has a wound or defect that has potential to become structurally unsound.

Environmental Pest / Noxious Weed Species

- The tree is an Environmental Pest Species due to its invasiveness or poisonous/ allergenic properties,
- The tree is a declared noxious weed by legislation.

Hazardous/Irreversible Decline

- The tree is structurally unsound and/or unstable and is considered potentially dangerous,
- The tree is dead, or is in irreversible decline, or has the potential to fail or collapse in full or part in the immediate to short term.

The tree is to have a minimum of three (3) criteria in a category to be classified in that group.

Note: The assessment criteria are for individual trees only, however, can be applied to a monocultural stand in its entirety e.g. hedge.

IACA 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arboriculturists, www.iaca.org.au

		Tree Significance				
		High	Medium	Low		
Tree Life Expectancy	Long >40 years					
	Medium 15-40 years					
	Short <1-15 years					
	Remove / Dead					

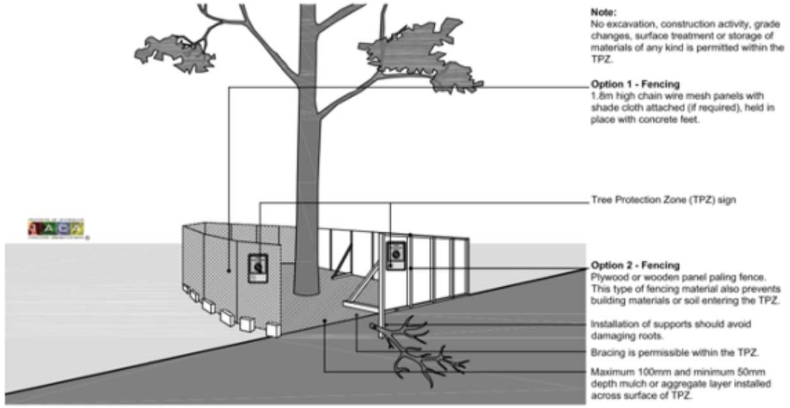
Legend for Matrix Assessment	
	Priority for Retention (High) – These trees are considered important for retention and should be retained and protected. Design modification and re-location of building/s should be considered to accommodate the setbacks as prescribed by the Australian Standard 4970 *Protection of tree on development sites*. Tree sensitive construction measures must be implemented if works are to proceed within the Tree Protection Zone.
	Consider for Retention (Medium) – These trees may be retained and protected. These are considered less critical; however, their retention should remain priority with removal considered only if adversely affecting the proposed building/works and all other alternatives have been considered and exhausted.
	Consider for Removal (Low) – These trees are not considered important for retention, nor require special works or design modification to be implemented for their retention.
	Priority for Removal – These trees are considered hazardous, or in irreversible decline, or weeds and should be removed irrespective of development.

IACA, 2010, *IACA Significance of a Tree, Assessment Rating System (STARS)*, Institute of Australian Consulting Arboriculturists, Australia, http://www.iaca.org.au

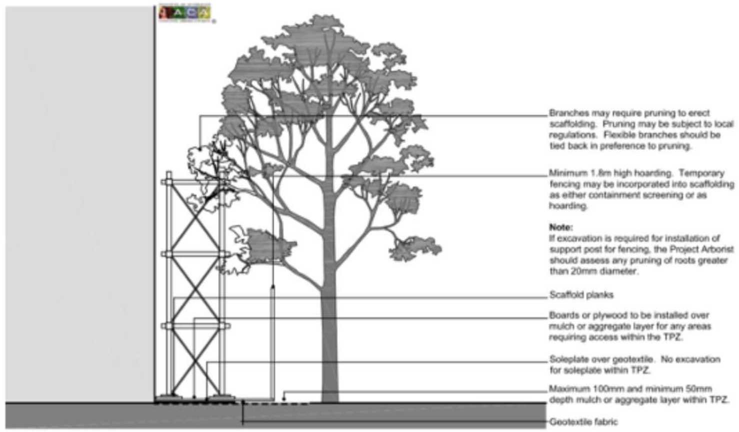
14 APPENDIX 3: SULE

	1. Long	2. Medium	3. Short	4. Removal	5. Moved or Replaced
	Trees that appeared to be retainable at the time of assessment for more than 40 years with an acceptable level of risk.	Trees that appeared to be retainable at the time of assessment for 15 – 40 years with an acceptable level of risk.	Trees that appeared to be retainable at the time of assessment for 5 – 15 years with an acceptable level of risk.	Trees that should be removed within the next 5 years.	Trees which can be reliably moved or replaced.
A	Structurally sound trees located in positions that can accommodate future growth.	Trees that may only live between 15 and 40 years.	Trees that may only live between 5 and 15 more years.	Dead, dying, suppressed or declining trees through disease or inhospitable conditions.	Small trees less than 5m in height.
B	Trees that could be made suitable for retention in the long term by remedial tree care.	Trees that may live for more than 40 years but would be removed for safety or nuisance reasons.	Trees that may live for more than 15 years but would be removed for safety or nuisance reasons.	Dangerous trees through instability on recent loss of adjacent trees.	Young trees less than 15 years old but over 5m in heights
C	Trees of special significance for historical, commemorative or rarity reasons that would warrant extraordinary efforts to secure their long term retention.	Trees that may live for more than 40 years but would be removed to prevent interference with more suitable individuals or to provide space for new planting.	Trees that may live for more than 15 years but should be removed to prevent interference with more suitable individuals or to provide space for new planting.	Damaged trees through structural defects including cavities, decay, included bark, wounds or poor form.	Trees that have been pruned to artificially control growth.
D		Trees that could be made suitable for retention in the medium term by remedial tree care.	Trees that require substantial remedial tree care and are only suitable for retention in the short term.	Damaged trees that are clearly not safe to retain.	
E				Trees that may live for more than 5 years but should be removed to prevent interference with more suitable individuals or to provide space for new plantings.	
F				Trees that are damaging or may cause damage to existing structures within 5 years.	
G				Trees that will become dangerous after removal of other trees for reasons given in (A) to (F).	

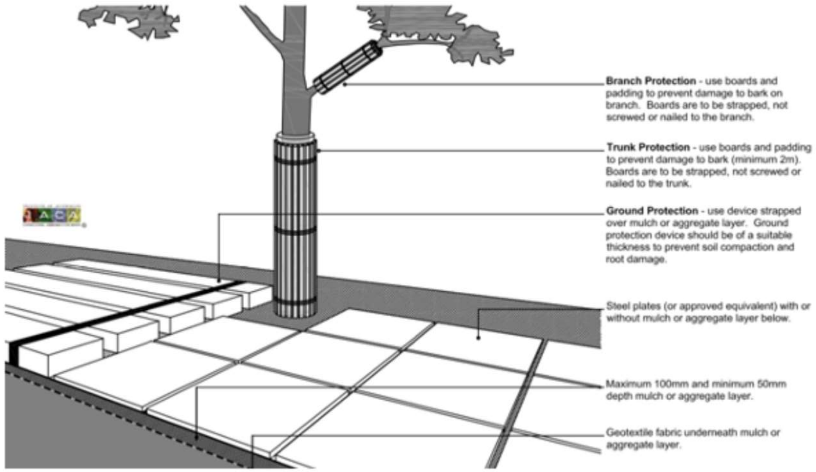
15 APPENDIX 4: TREE PROTECTION (GENERIC)



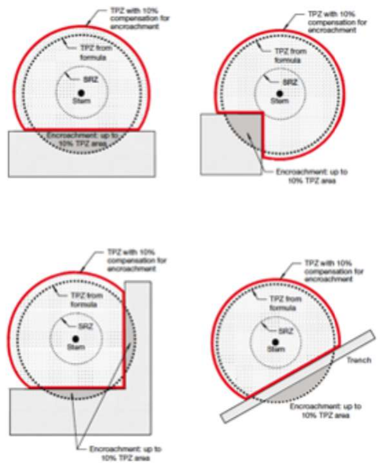
1. Tree Protection Fencing



2. Scaffolding Within TPZ

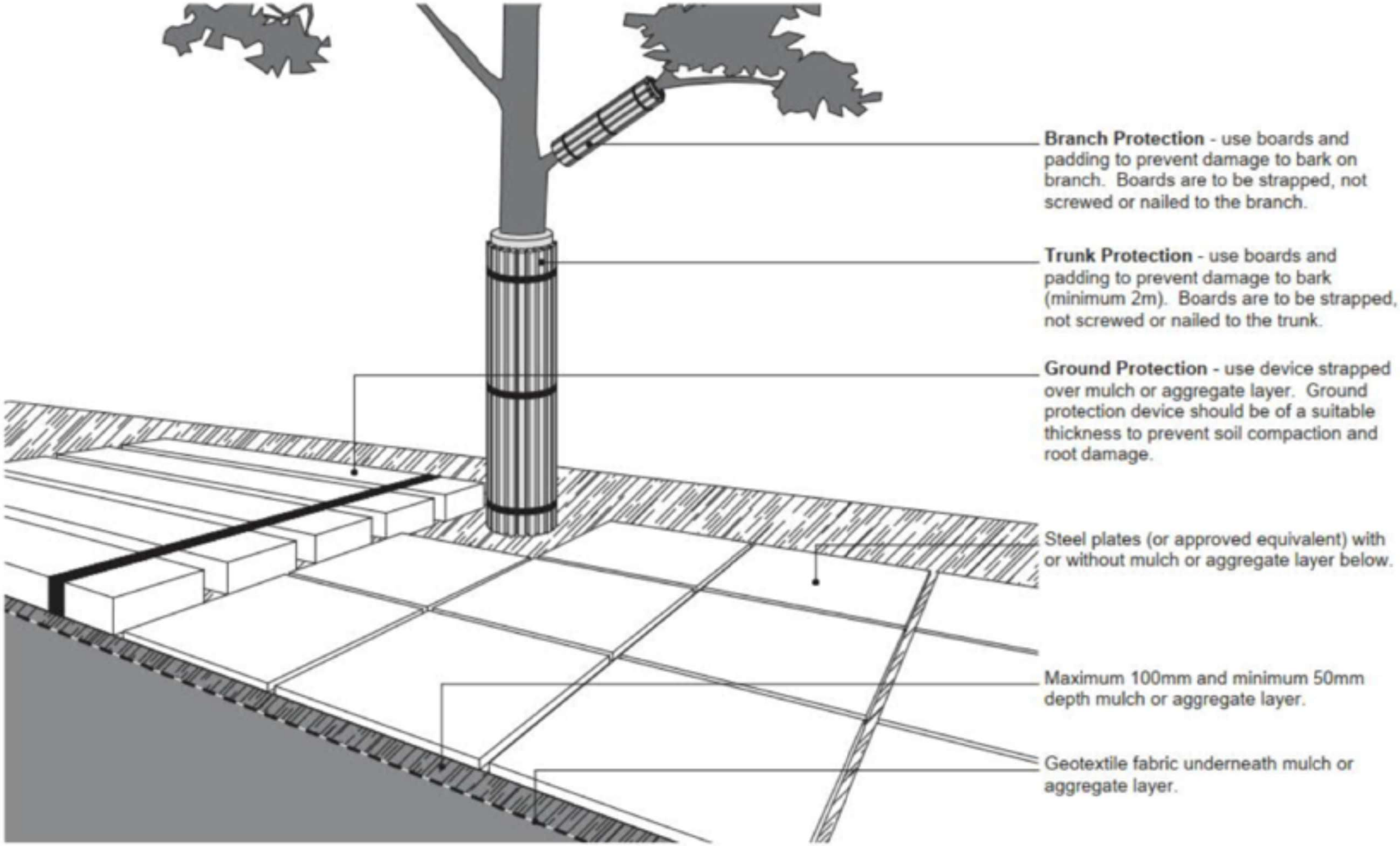


3. Examples Of Trunk, Branch and Ground Protection

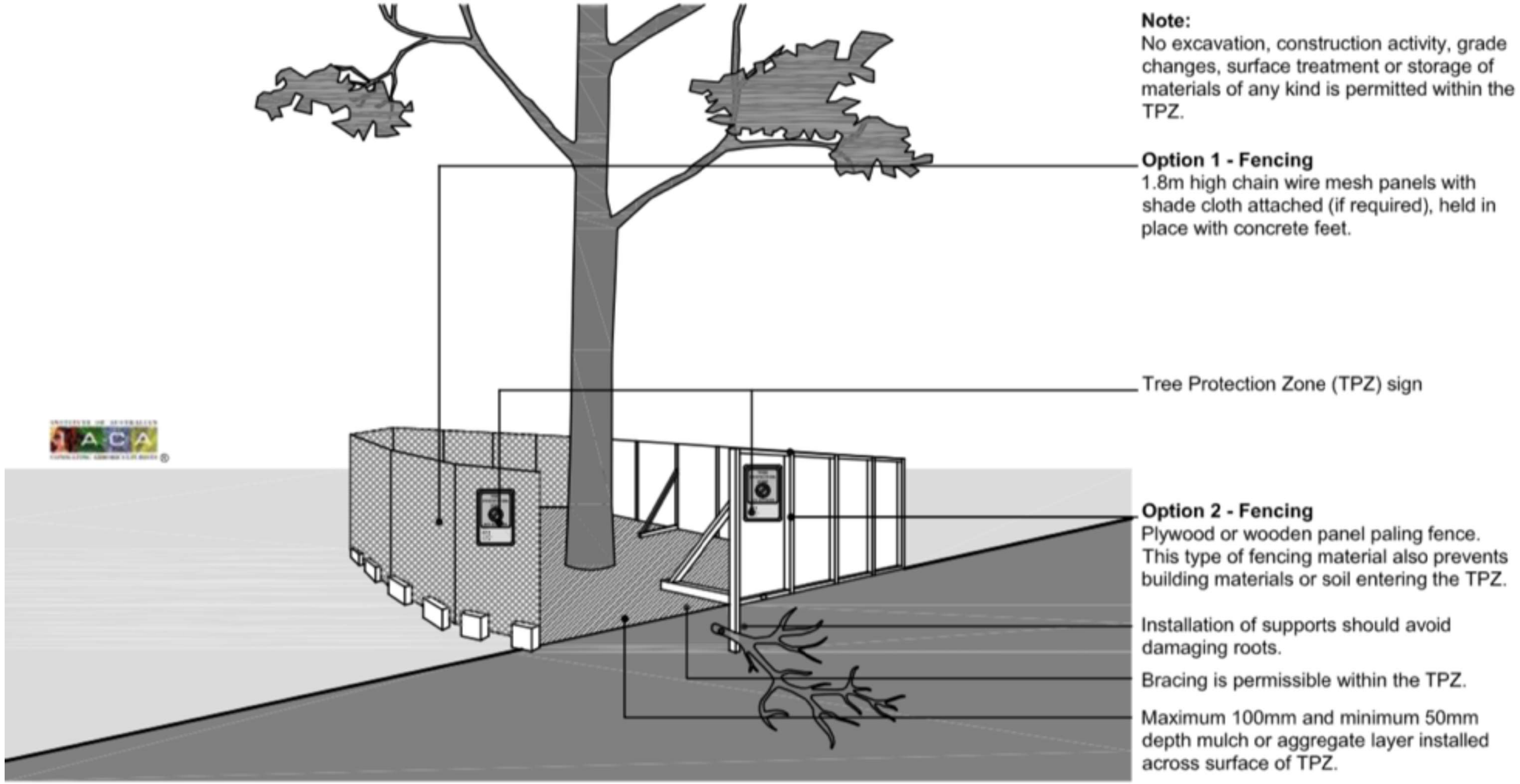


4. TPZ Encroachment Compensation

16 TRUNK AND GROUND PROTECTION



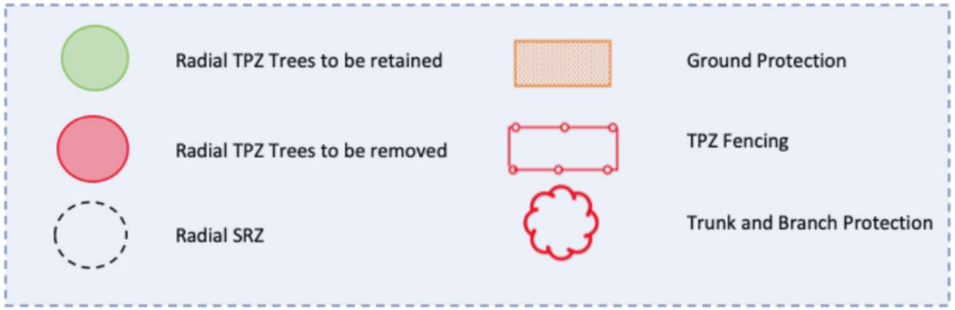
17 TPZ FENCING

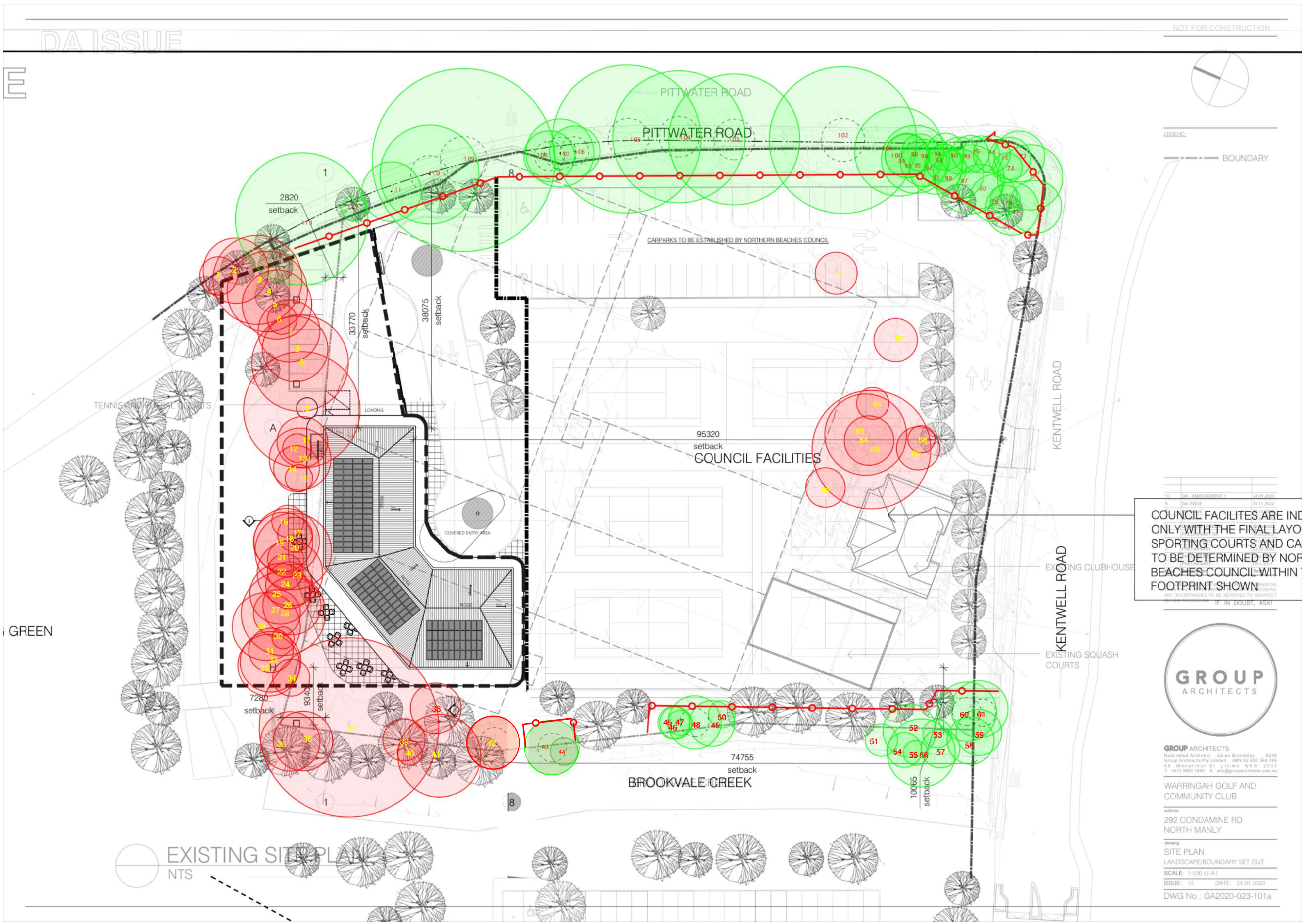


18 SITE DRAWINGS

DRAWING 1: TREE LOCATION PLAN/TREE PROTECTION PLAN

SITE DRAWING LEGEND




DA ISSUE
NOT FOR CONSTRUCTION
LEGEND:
BOUNDARY
PITTWATER ROAD
PITTWATER ROAD
CARPARKS TO BE ESTABLISHED BY NORTHERN BEACHES COUNCIL
2820
setback
33770
setback
38075
setback
95320
setback
COUNCIL FACILITIES
KENTWELL ROAD
KENTWELL ROAD
EXISTING CLUBHOUSE
EXISTING SQUASH COURTS
COUNCIL FACILITES ARE IND
ONLY WITH THE FINAL LAYO
SPORTING COURTS AND CA
TO BE DETERMINED BY NOF
BEACHES COUNCIL WITHIN
FOOTPRINT SHOWN
TENNIS
LOADING
COVERED ENTRY AREA
GREEN
7280
setback
9340
setback
74755
setback
10065
setback
BROOKVALE CREEK
EXISTING SITE PLAN
NTS
GROUP
ARCHITECTS
GROUP ARCHITECTS
WARRINGAH GOLF AND COMMUNITY CLUB
292 CONDAMINE RD
NORTH MANLY
SITE PLAN
LANDSCAPE/BOUNDARY SET OUT
SCALE: 1:500 @ A1
ISSUE: 10.
DATE: 24.01.2023
DWG No.: GA2020-023-101a

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09 November 2022

Warringah Golf Club
397 Condamine Street
North Manly
NSW 2100

c/o Graeme McMullan <graeme@cleanenergyengineering.com.au>

Flood Management Report for the development of the New Warringah Golf & Community Club House at 433 Pittwater Road North MANLY

Dear Graeme,

1.0 Introduction

Stellen Consulting was engaged to assess the proposed development (Lot 2742 DP 752038) at 433 Pittwater Road, North Manly in reference to potential impacts arising from overland flow in Brookvale Creek. This report provides a detailed assessment of the flow information specific to the site and development.

The following documentation has been used in the preparation of this Flood Risk Management Report:

- Design drawings listed in Appendix A
- Council provided flood information and pre-DA advice flooding extract in Appendix B

The proposed development has been assessed in accordance with the flood requirements of Clause E11 of the Warringah Development Control Plan, using the information provided by the Council from the Manly Lagoon Flood Study (2013).

2.0 Description of the Development

The site, known as Warringah Recreation Area (Lot 2742 DP 752038), is approximately 1.04 ha. The existing development of the site consists of a clubhouse, squash court, sporting courts, driveway, and car parks (the existing site is shown below in Figure 1).

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Figure 1 - Site locality and previous development (SIX Maps)

The proposed master plan is shown in Figure 2. It introduces 6 new tennis courts, a club building with a loading area, parking, and car access. The architecture plans listed in Appendix A show the scope of the DA application of the new main building with a loading area of approximately 0.26 ha as part of the master plan. The design drawings also highlight the layout of the tennis courts, car parks, and the access driveway as shown in Figure 3.

Figure 2 - Proposed master plan layout

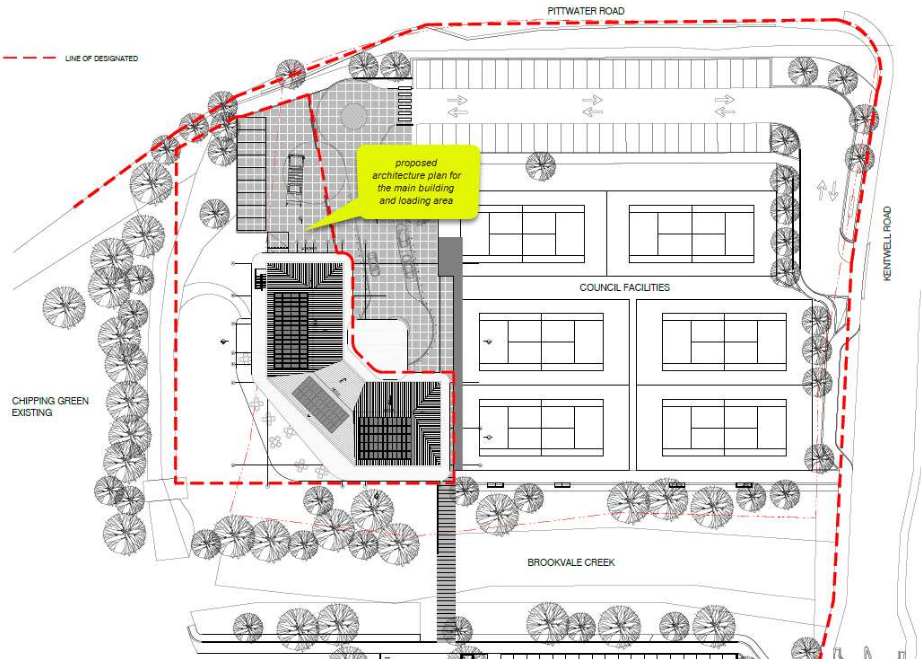

Figure 3 - Proposed architectural plan

The main building proposes two floors: Ground floor at RL 3.60 and the first floor at RL 8.00. The proposed works also include site grading according to the civil design prepared by Stellen Consulting (Ref: P171112-DR-CV-002-01). The proposed work and design levels are shown in the architectural and civil drawings in Appendix A.

Advice from Northern Beaches Council at the time of preparation of this report is that the council will be removing the trees, removing the fencing and floodlights, demolishing the squash courts and tennis offices and digging up / demolishing the tennis courts to provide a clear and level site. Stellen Consulting, at the Clients direction, has considered that in all Flood & Overland Flow calculations

3.0 Flood Analysis & Assessment

Council's flood data predicts that during the 1% AEP event, the club will be inundated with floodwaters arising from flooding within Brookvale Creek. The overland flow path runs northeast through the site toward Pittwater Road. The main building has areas designated as medium risk, and Brookvale Creek is identified as being within the High Flood Risk Precinct, as shown in Figure 4.

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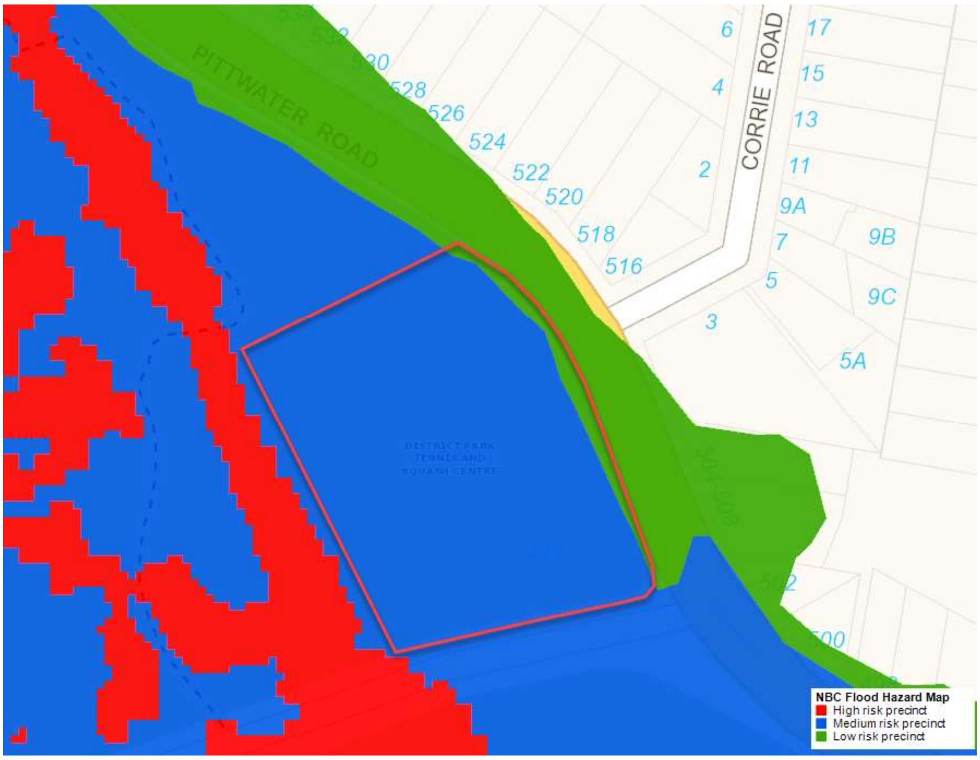

Figure 4 - Flood Risk Precinct

The following information was provided by Council for the vicinity of the main building:

- 1% AEP (100-year) maximum water level: 3.2-3.3m AHD
- Probable Maximum Flood (PMF) maximum water level: 5.69m AHD

Council's flood data suggests the floodwater depth across the site during a 1% AEP event peaks are not more than 0.3 and the velocity x depth product is less than $0.3m^2s^{-1}$ presenting a Flood Fringe hydraulic category.

For the main building assessment, the council has suggested that all floor levels within the development shall be at or above the Flood Planning Level (FPL) (flood level + 300mm freeboard). For this site, a Flood Planning Level (FPL) of 3.6m AHD has been adopted for the main building.

FPL = 3.60m AHD

The design has the proposed main building at RL 3.60 which is at the FPL.

4.0 Assessment of Council Conditions

The proposed development is categorised as a "business and industrial use, entertainment or recreation facility" development type. The main building has areas designated as medium risk. Below address the relevant controls that apply to the development.

Flood Effects Caused by Development - A1

– The proposed main building results in a significant fill of approximately 670.50 m^3. However, the master plan along with the civil design proposes a conservative compensatory net cut volume of 134.47 $m^{3,}$

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considering that the council will be removing the trees, removing the fencing and floodlights, demolishing the squash courts and tennis offices, and digging up / demolishing the tennis courts to provide a clear and level site. Considering the provision of the compensatory cut as described in the civil design prepared by Stellen consulting:

- The development will not likely have significant adverse impacts on flood levels or velocities caused by alterations to the flood conveyance;
- There will be no adverse impacts on surrounding properties; and
- Flood hazards will likely remain unchanged due to the development.

Flood Effects Caused by Development - A2

- Considering the provision of the compensatory cut as described in the civil design prepared by Stellen consulting, the development results in a net increase in the flood storage of at least 134.47 m^3.

Building Components and Structural Soundness - B1

- The proposed development shall be constructed as flood compatible in accordance with the *Reducing Vulnerability of Buildings to Flood Damage: Guidance on Building in Flood Prone Areas*, Hawkesbury-Nepean Floodplain Management Steering Committee (2006), up to the flood planning level of 3.6m AHD.

Building Components and Structural Soundness – B2

- New development must be designed and constructed to ensure structural integrity up to the Flood Planning Level, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. The structural integrity of the refuge is to be up to the Probable Maximum Flood level. Structural certification shall be provided confirming the above.

Building Components and Structural Soundness – B3

- New electrical equipment, power points, wiring, fuel lines, sewerage systems or other service pipes and connections to be located above the Flood Planning Level of 3.6m AHD.

Floor Levels – C1

- The floor levels within the main building are proposed at or above the Flood Planning Level of 3.6m AHD.

Floor Levels – C2

- NA

Floor Levels – C3

- The main building at the development is categorised in a flood fringe in a 1% AEP event. It proposes a compensatory cut of 57.46 m^3 (minimum) described in the civil design prepared by Stellen consulting. This results in a net increase in flood storage.

Floor Levels – C4

- NA

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Floor Levels – C5

- the proposed works improve the flood storage within site.

Floor Levels – C6

- NA

Floor Levels – C7

- No floor level is proposed below the flood planning level

Car Parking – D1

- Proposed car park within the loading area is proposed within Flood Fringe hydraulic category during the 1% AEP

Car Parking – D2

- No car park is proposed below the natural ground level; however, the whole site is graded a maximum of 0.5% according to the civil design for the cut and fill plan. As a result, the water depths at 9 car parks within the loading area are expected to be greater than 300mm. Vehicle barriers or restraints are to be provided to prevent floating vehicles from leaving the site.

Car Parking – D3

- NA

Car Parking – D4

- Vehicle barriers or restraints are to be provided to prevent floating vehicles from leaving the site. Protection must be provided for all event up to the 1 % AEP flood event.

Car Parking – D5, D6, and D7

- NA

Emergency Response – E1

- The flood life hazard category within the site is H5, and therefore flood emergency response plan is required.

The recommended Flood Emergency Response Plan during critical storm events is to shelter-in-place until floodwaters subside or emergency services advise otherwise. In the event that floodwaters begin to overtop Brookvale Creek, the recommended actions are:

- The occupants of the property shall be directed to the first floor (set at RL 8.00 m AHD), which is higher than the predicted PMF water level (5.69m AHD).

- The occupants must not exit until advised by emergency services or floodwaters subside.

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- Emergency services shall be contacted stating the property's location; the situation faced, the number of people on the property and any additional measures to be carried out.

It is also recommended that a copy of this Flood Emergency Response plan is kept on the premises at all times.

Fencing – F1

– Any proposed fencing within the area affected by the 1% AEP floodwaters level up to the 1% AEP flood level of 3.3m AHD must be an open style fencing to allow clear passage of floodwaters and not to increase flood affectation on surrounding land. The fencing must be designed with a minimum of 50% open area from the natural ground level up to the 1% AEP flood level of 5.69m AHD. Openings should be minimum of 75 mm x 75 mm.

Storage of Goods – G1

– All proposed stores are located in the main building area, which is adequately protected from floodwaters to above the applicable Flood Planning Level (refer to architectural drawings). Given that all hazardous or potentially polluting materials will be stored above the FPL, all goods will be adequately protected from floodwater.

Pools – H1

– NA

5.0 Conclusions and Recommendations

This Flood Management Report has been undertaken by Stellen Consulting based on information provided by Northern Beaches Council (Warringah) and available architectural plans and proposed civil design for site grading and levelling. The site has been identified by Council as within the 1% AEP flood and PMF extents.

Based on the information, the proposed main building results in a significant fill of approximately 670.50m^3. However, the master plan, with the support of the civil design, propose a conservative compensatory net cut of 134.47 m^3. Considering the provision of the compensatory cut as described in the civil design prepared by Stellen consulting:

- The proposed works will not likely have adverse impacts on flood levels or velocities caused by alterations to the flood conveyance;
- There are no significant adverse impacts on surrounding properties; and
- Flood hazards will likely remain unchanged due to the development.

As noted in this report, the proposed development, if carried out in accordance with the recommendations within this report, is consistent with the flood-related requirements of Clause E11 of the Warringah DCP.

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Appendix A

Architectural Drawings

The driveway design is described in the following Group Architects drawings dated 12/10/2022

- Sheets and Views
  - CLEANED WARRINGAH-000
  - CLEANED WARRINGAH-001
  - CLEANED WARRINGAH-002
  - CLEANED WARRINGAH-003
  - CLEANED WARRINGAH-D01
  - CLEANED WARRINGAH-100
  - CLEANED WARRINGAH-101
  - CLEANED WARRINGAH-101a
  - CLEANED WARRINGAH-101b
  - CLEANED WARRINGAH-101c
  - CLEANED WARRINGAH-102
  - CLEANED WARRINGAH-103
  - CLEANED WARRINGAH-104
  - CLEANED WARRINGAH-200
  - CLEANED WARRINGAH-201
  - CLEANED WARRINGAH-202
  - CLEANED WARRINGAH-300
  - CLEANED WARRINGAH-900

Civil Design Drawings

The driveway design is described in the following Stellen Consulting drawings dated 09/11/2022:

CV-000	*Revision 1*	*Master Plan*
CV-001	*Revision 2*	*Civil Design Master Plan*
CV-100	*Revision 1*	*Cut/Fill Plan – Main Building and Access*
CV-102	*Revision 2*	*Cut/Fill Plan – Tennis Court*

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Appendix B
Council Supplied Flood Information

Flooding
The site for the proposed Warringah Golf Club main building is identified in the Manly Lagoon Flood Study (2013) as being located in the Medium Flood Risk Precinct, with the following flood data applicable in the vicinity of the main building:
• 1% AEP flood level: 3.2-3.3m AHD
• Freeboard: 0.3m, since the depth is less than 0.3m and the velocity x depth product is less than 0.3m^2/s
• Flood Planning Level (FPL): 3.5-3.6m AHD
• Probable Maximum Flood (PMF) Level: 5.69m AHD
• Hydraulic Category in 1% AEP flood: Flood Fringe

• Hydraulic Category in PMF: Floodway
• Flood Life Hazard Category: H5
Brookvale Creek and part of the car park on the western side of the creek are identified as being within the High Flood Risk Precinct. For more detailed flood information, a comprehensive Flood Information Report should be obtained from Council, from https://www.northernbeaches.nsw.gov.au/council/forms/flood-information-report-application. As part of the application for the Flood Information Report, flood information can be provided at multiple, specific locations if requested.
A Flood Management Report would need to be submitted with the DA, demonstrating that the proposed development meets all of the flood requirements of Clause E11 of the Warringah DCP. In particular for this site please note:
• There are to be no adverse impacts (defined in Clause A.8 of the Warringah DCP) on flood levels or velocities caused by alterations to the flood conveyance (Control A1).
• All structures are to be designed and constructed to ensure structural integrity up to the PMF, taking into account the forces of floodwater, wave action, flowing water with debris, buoyancy and immersion. (Control B2).
• All electrical equipment, power points, wiring, fuel lines, sewerage systems or any other service pipes and connections are to be waterproofed and/or located above the FPL (Control B3).
• All floor levels must be set at or above the FPL (Control C1).
• Where there is more than 300mm depth of flooding in the car park during a 1% AEP flood event, vehicle barriers or restraints are to be provided to prevent floating vehicles from leaving the site (Control D4).
• There must be an appropriately sized area to safely shelter in place above the PMF level and appropriate access to this area is to be available from all areas within the development (Control E1).
• Any hazardous or potentially polluting materials are not to be stored below the FPL unless adequately protected from floodwaters in accordance with industry standards. (Control G1).

FLOOD INFORMATION REPORT – COMPREHENSIVE

Property: Lot 2742/9999 Condamine Street MANLY VALE NSW 2093
Lot DP: Lot 2742 DP 752038
Issue Date: 09/05/2022
Flood Study Reference: Manly Lagoon Flood Study 2013, BMT WBM

Flood Information for lot [1]:

Flood Risk Precinct – See Map A

Flood Planning Area – See Map A

Maximum Flood Planning Level (FPL) [2, 3, 4]: 9.46 m AHD

1% AEP Flood – See Flood Map B

1% AEP Maximum Water Level [2, 3]: 8.89 mAHD

1% AEP Maximum Depth from natural ground level[3]: 2.84 m

1% AEP Maximum Velocity: 6.62 m/s

1% AEP Hydraulic Categorisation: N/A **See Flood Map D**

Probable Maximum Flood (PMF) – See Flood Map C

PMF Maximum Water Level [4]: 9.87 m AHD

PMF Maximum Depth from natural ground level: 5.24 m

PMF Maximum Velocity: 7.64 m/s

PMF Hydraulic Categorisation: N/A **See Flood Map E**

Flooding with Climate Change (See Flood Map F)

The following is for the 30% Rainfall intensity increase and 0.9m Sea Level Rise Scenario:

1% AEP Maximum Water Level with Climate change [3]: 8.85 m AHD

1% AEP Maximum Depth with Climate Change[3]: 3.03 m

1% AEP Maximum Velocity with Climate Change[3]: m/s

Flood Life Hazard Category – See Map G

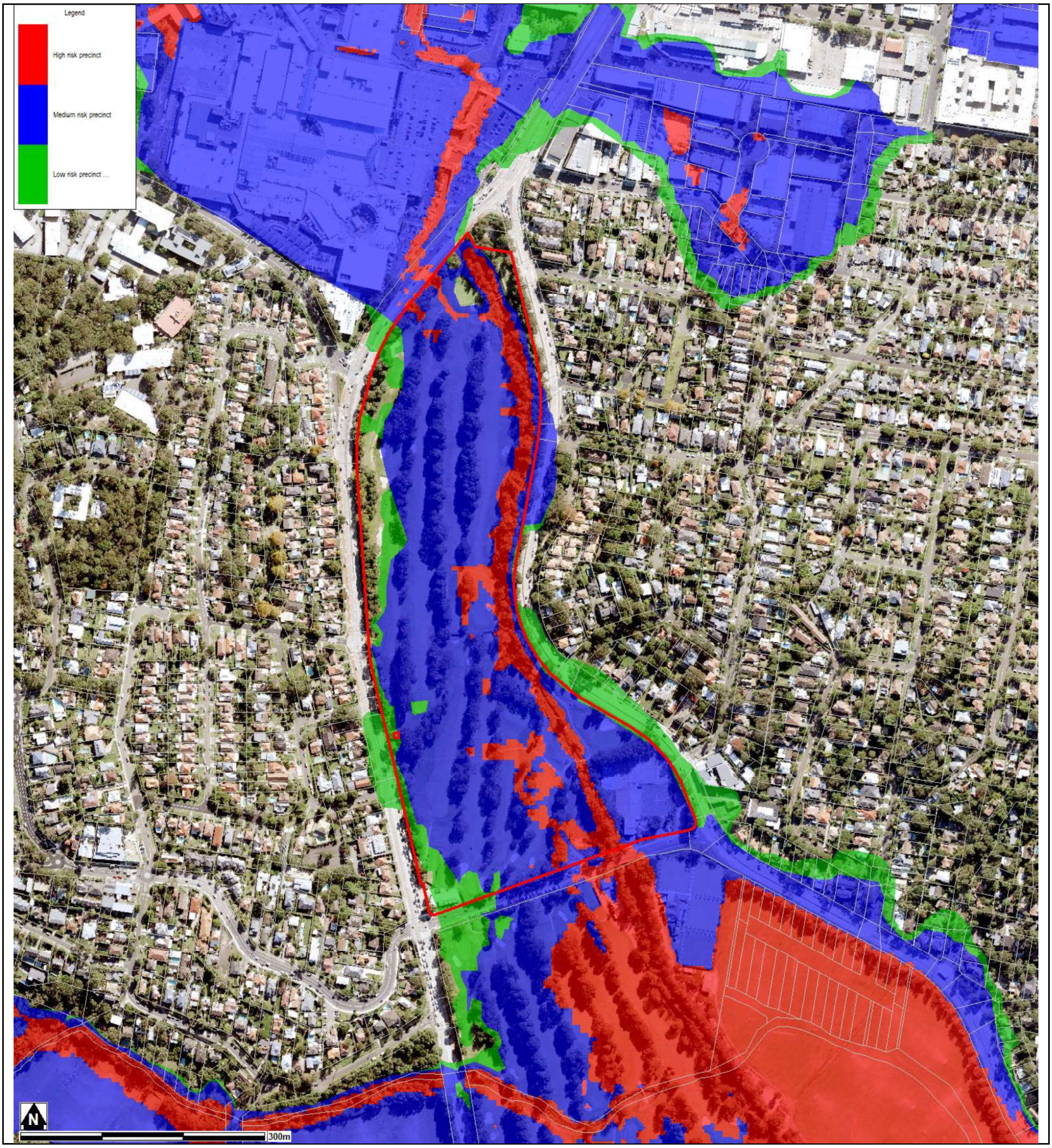
Indicative Ground Surface Spot Heights – See Map H

[1] The flood information does not take into account any local overland flow issues nor private stormwater drainage systems.
[2] Overland flow/mainstream water levels may vary across a sloping site, resulting in variable minimum floor/ flood planning levels across the site. The maximum Flood Planning Level may be in a different location to the maximum 1% AEP flood level.
[3] Intensification of development in the former Pittwater LGA requires the consideration of climate change impacts which may result in higher minimum floor levels.
[4] Vulnerable/critical developments require higher minimum floor levels using the higher of the PMF or FPL.

General Notes:

- All levels are based on Australian Height Datum (AHD) unless otherwise noted.
- This is currently the best available information on flooding; it may be subject to change in the future.
- Council recommends that you obtain a detailed survey of the above property and surrounds to AHD by a registered surveyor to determine any features that may influence the predicted extent or frequency of flooding. It is recommended you compare the flood level to the ground and floor levels to determine the level of risk the property may experience should flooding occur.
- Development approval is dependent on a range of issues, including compliance with all relevant provisions of Northern Beaches Council's Local Environmental Plans and Development Control Plans.
- Please note that the information contained within this letter is general advice only as a detail survey of the property as well as other information is not available. Council recommends that you engage a suitably experienced consultant to provide site specific flooding advice prior to making any decisions relating to the purchase or development of this property.
- The Flood Studies on which Council's flood information is based are available on Council's website.

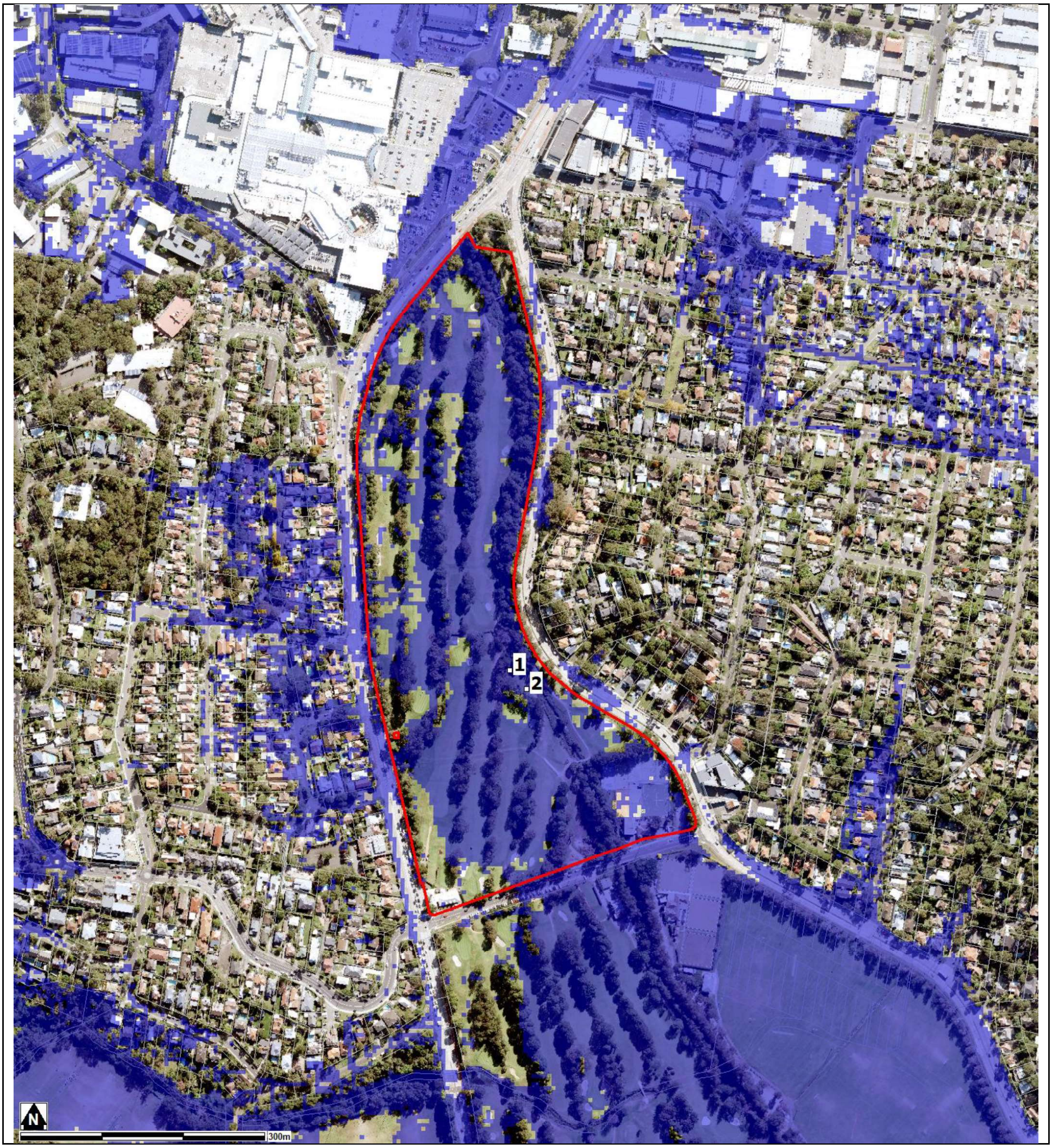
FLOOD MAP A: FLOOD RISK PRECINCT MAP



Notes:

- **Low Flood Risk precinct** means all flood prone land not identified within the High or Medium flood risk precincts.
- **Medium Flood Risk precinct** means all flood prone land that is (a) within the 1% AEP Flood Planning Area; and (b) is not within the high flood risk precinct.
- **High Flood Risk precinct** means all flood prone land (a) within the 1% AEP Flood Planning Area; and (b) is either subject to a high hydraulic hazard, within the floodway or subject to significant evacuation difficulties (H5 or H6 Life Hazard Classification).
- The **Flood Planning Area** extent is equivalent to the Medium Flood Risk Precinct extent, and includes the High Flood Risk Precinct within it. The mapped extent represents the 1% annual Exceedance Probability (AEP) flood event + freeboard.
- None of these mapped extents include climate change.

FLOOD LEVEL POINTS



Note: Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only.

Flood Levels

ID	5% AEP Max WL (m AHD)	5% AEP Max Depth (m)	1% AEP Max WL (m AHD)	1% AEP Max Depth (m)	1% AEP Max Velocity (m/s)	Flood Planning Level (m)	PMF Max WL (m AHD)	PMF Max Depth (m)	PMF Max Velocity (m/s)
1	3.55	0.29	3.69	0.43	1.21	4.19	5.69	2.43	1.91
2	3.33	0.23	3.47	0.37	1.24	3.97	5.69	2.59	2.17

WL – Water Level
PMF – Probable Maximum Flood
N/A = no peak water level/depth/velocity available in flood event

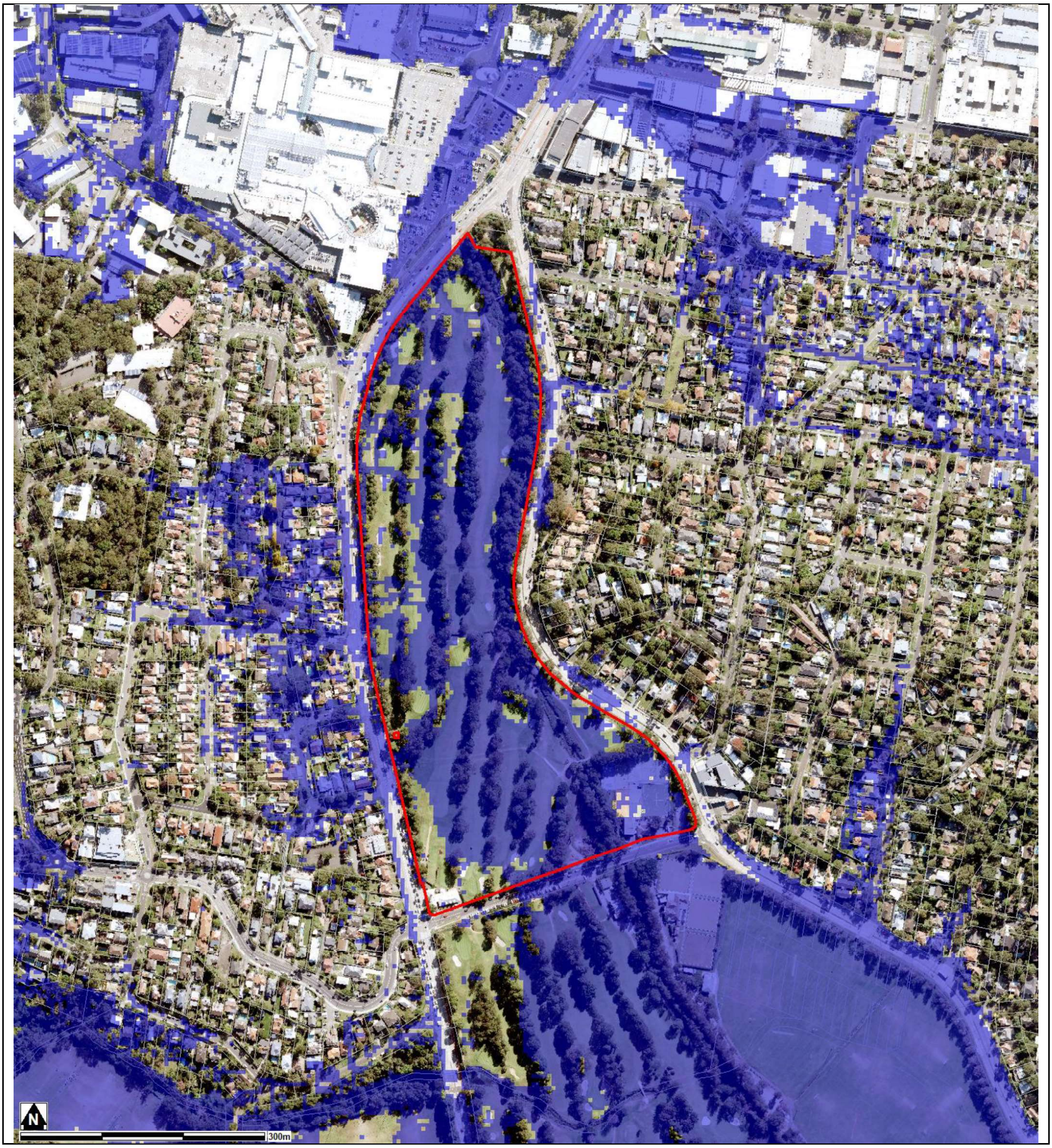
Climate Change Flood Levels (30% Rainfall intensity and 0.9m Sea Level Rise)

ID	CC 1% AEP Max WL (m AHD)	CC1 % AEP Max Depth (m)
1	3.70	0.44
2	3.54	0.45

WL – Water Level
PMF – Probable Maximum Flood
N/A = no peak water level/depth/velocity available in flood event.

A variable Flood Planning Level might apply. Freeboard is generally 0.5m above the maximum 1% AEP water level. However for overland flow with a depth less than 0.3m and a VelocityxDepth product less than 0.3m^2/s, a freeboard of 0.3m may be able to be justified.

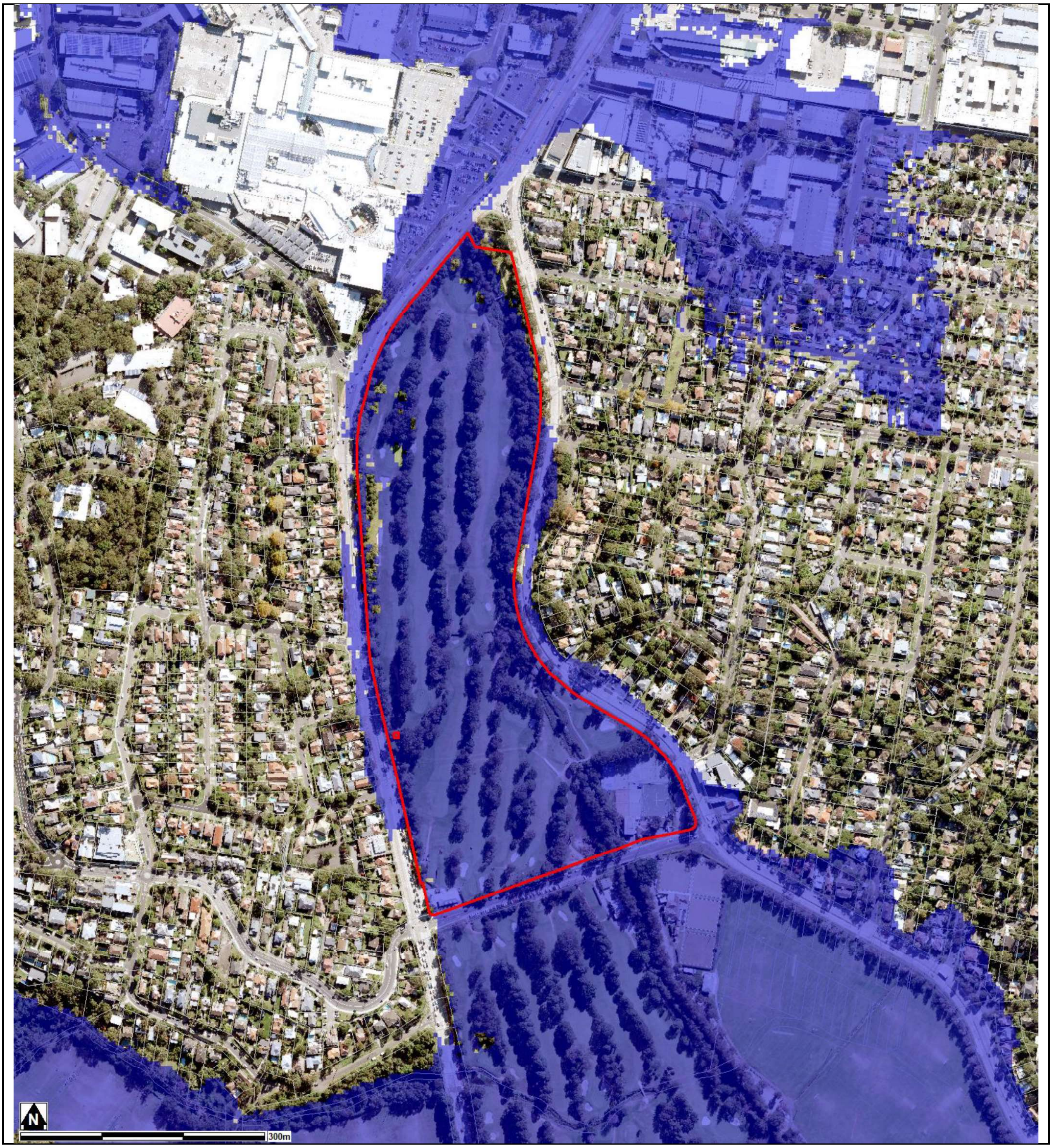
FLOOD MAP B: FLOODING - 1% AEP EXTENT



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event.
- Flood events exceeding the 1% AEP can occur on this site.
- Extent does not include climate change.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source Near Map 2014) are indicative only.

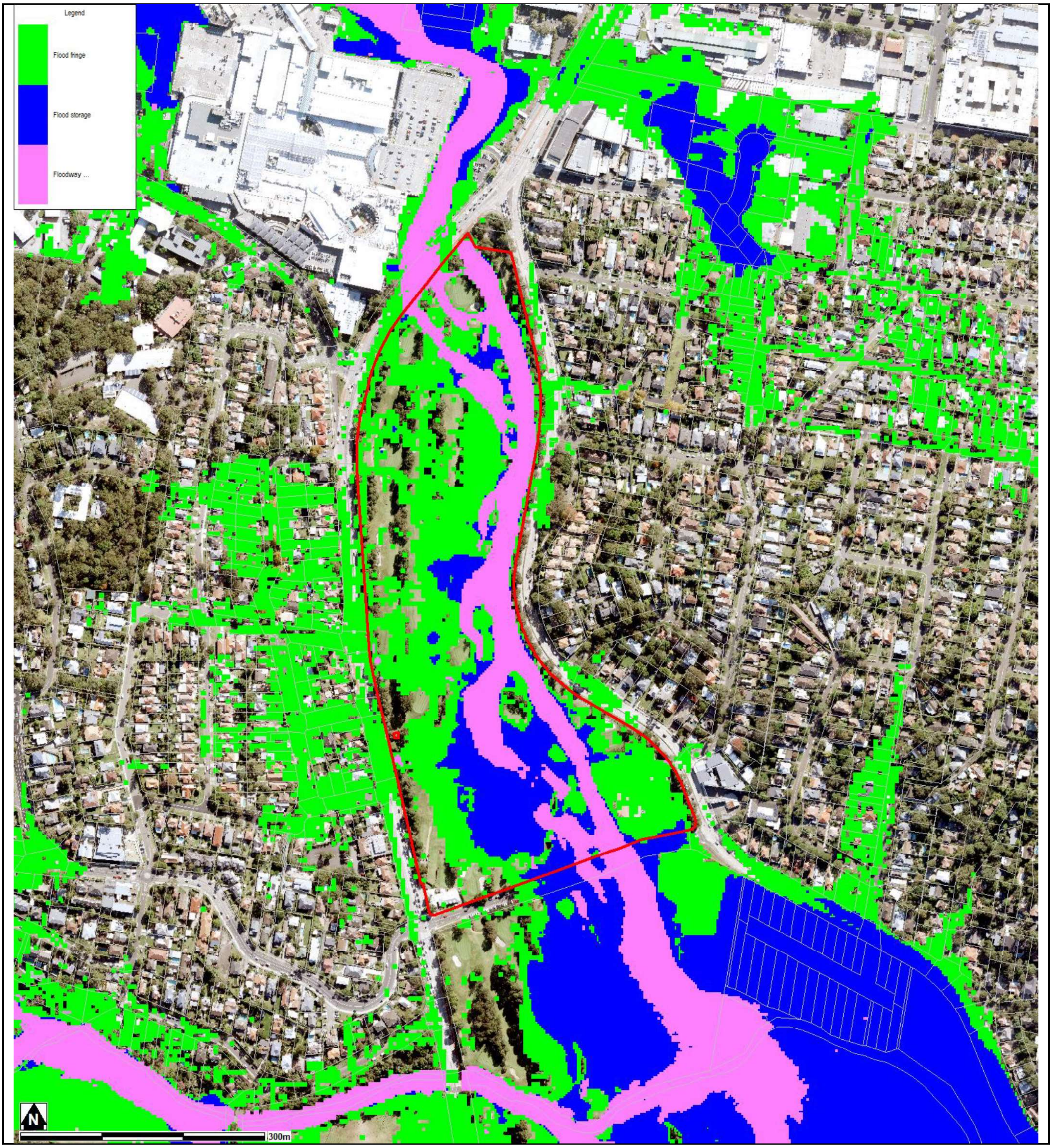
FLOOD MAP C: PMF EXTENT MAP



Notes:

- Extent represents the Probable Maximum Flood (PMF) flood event
- Extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only

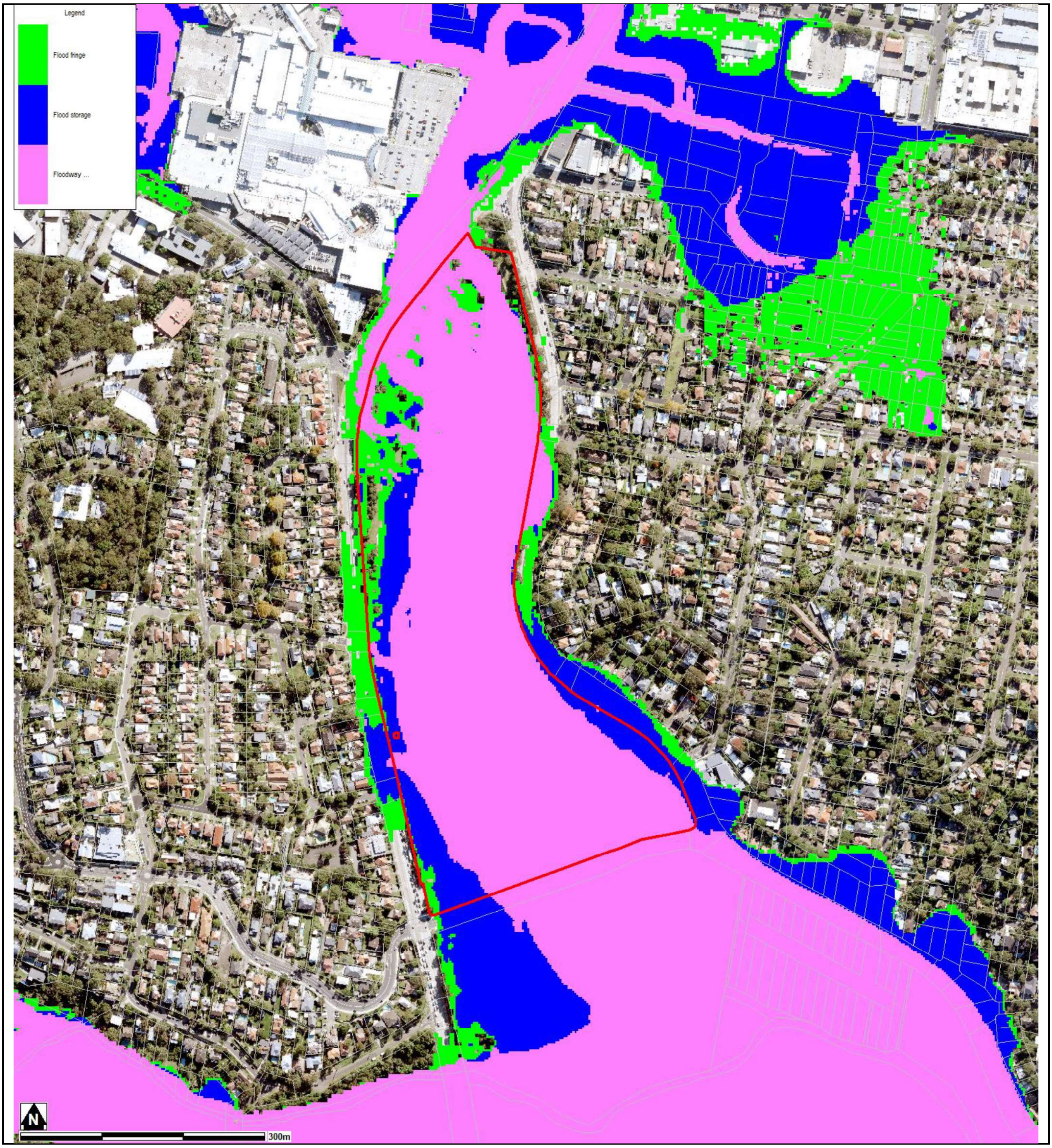
FLOOD MAP D: 1% AEP FLOOD HYDRAULIC CATEGORY EXTENT MAP



Notes:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event
- Extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only

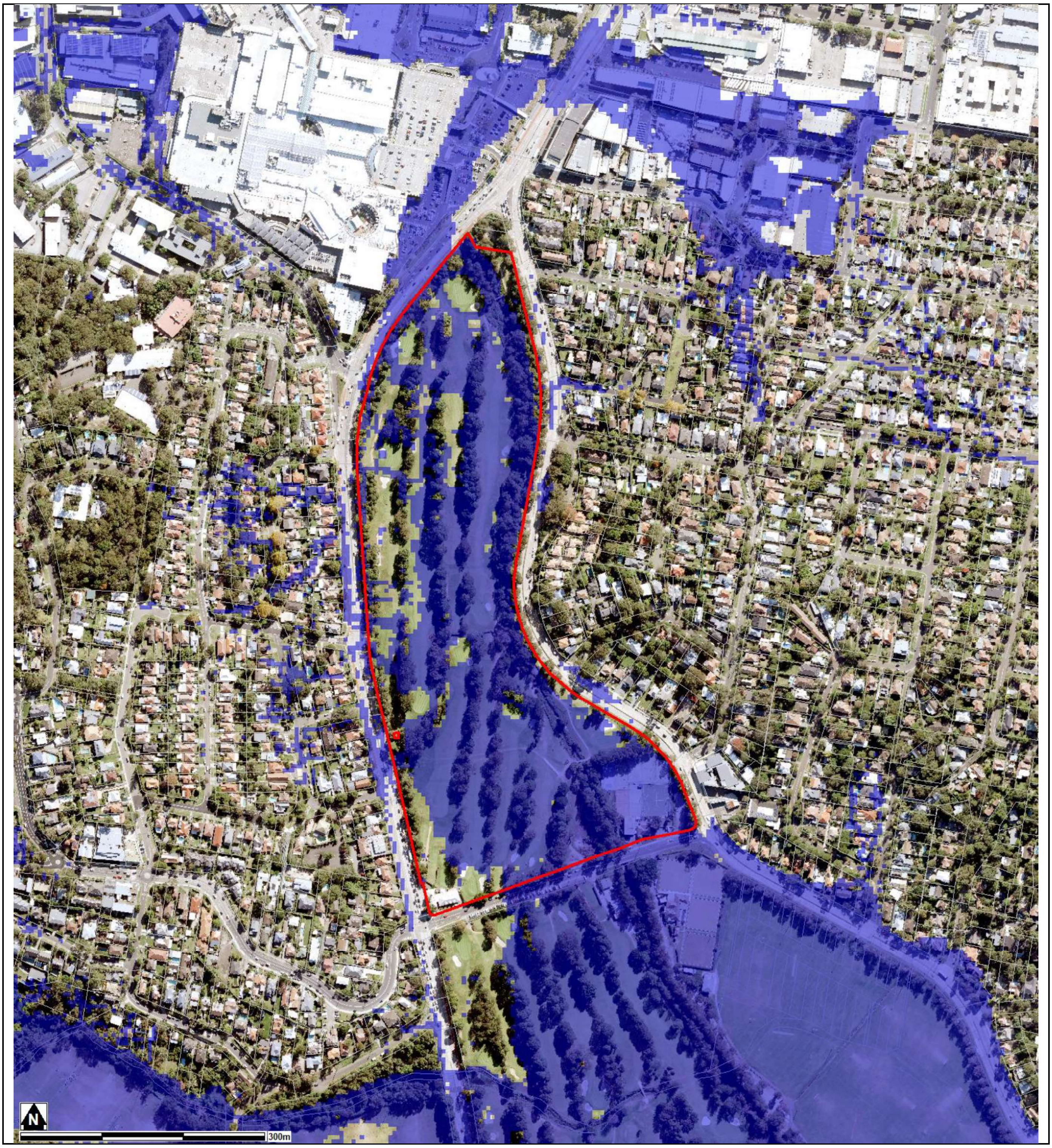
FLOOD MAP E: PMF FLOOD HYDRAULIC CATEGORY EXTENT MAP



Notes:

- Extent represents the Probable Maximum Flood (PMF) event
- Extent does not include climate change
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only

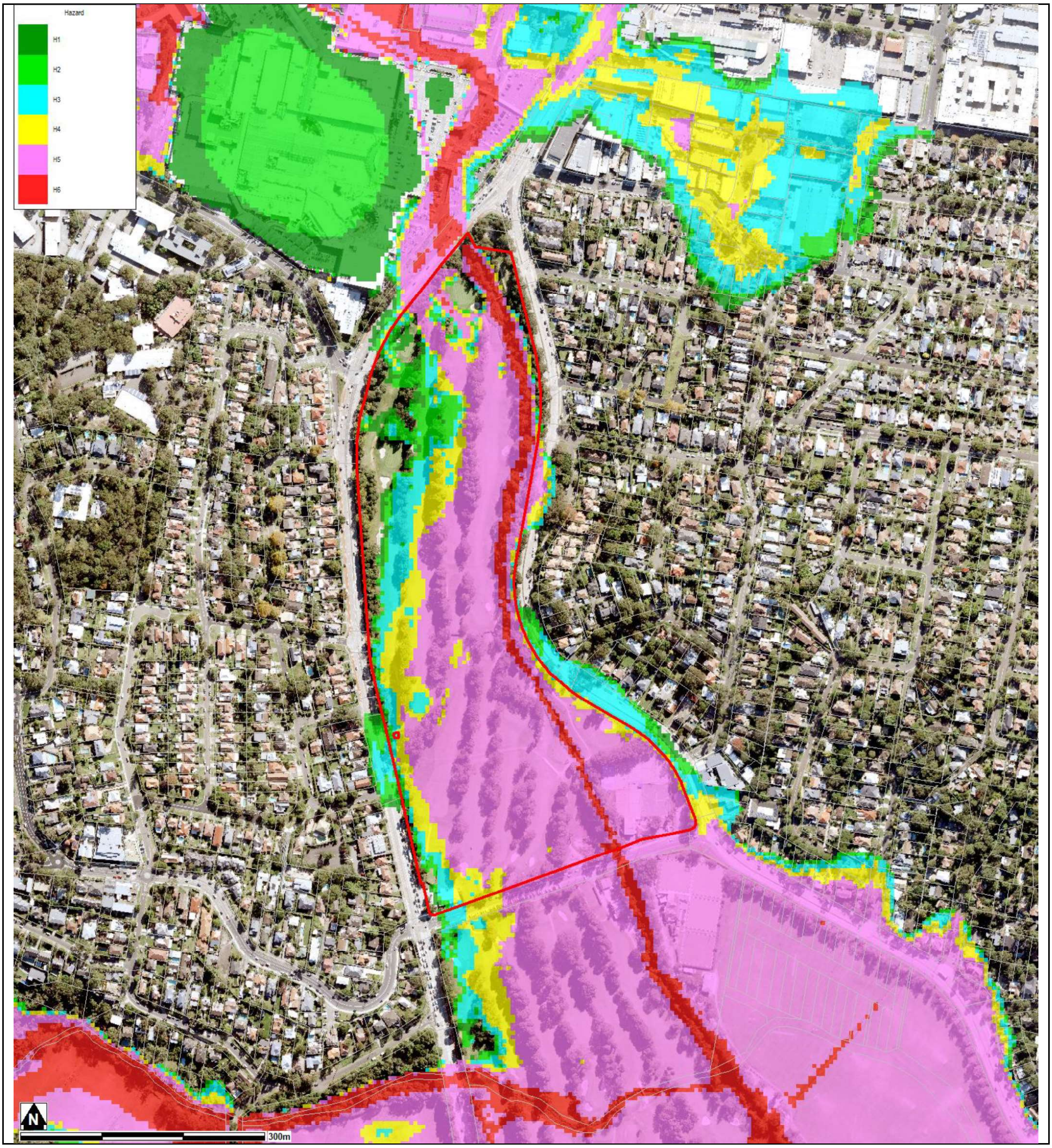
FLOOD MAP F: FLOODING – 1% AEP EXTENT PLUS CLIMATE CHANGE



Note:

- Extent represents the 1% annual Exceedance Probability (AEP) flood event including 30% rainfall intensity and 0.9m Sea Level Rise climate change scenario
- Flood events exceeding the 1% AEP can occur on this site.
- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source: NearMap 2014) are indicative only

FLOOD MAP G: FLOOD LIFE HAZARD CATEGORY

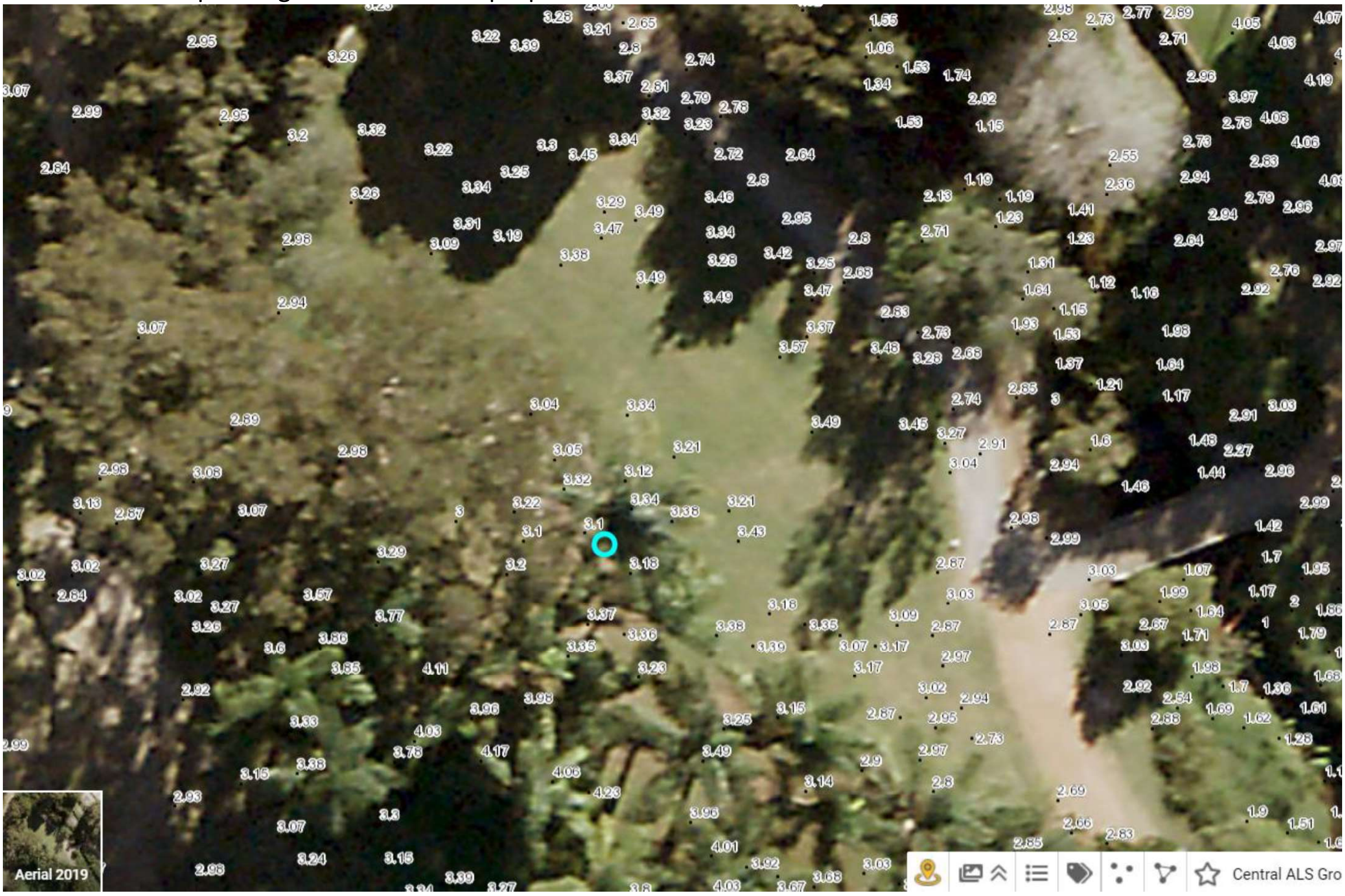


Notes:

- Cadastre Lines (Source: NSW Government Land and Property Information), flood levels/extents (Source: Manly Lagoon Flood Study 2013, BMT WBM) and aerial photography (Source Near Map 2014) are indicative only.

MAP H: INDICATIVE GROUND SURFACE SPOT HEIGHTS

Ground surface spot heights in location of proposed works



Notes:

- The surface spot heights shown on this map were derived from Airborne Laser Survey and are indicative only.
- Accuracy is generally within ± 0.2m vertically and ± 0.15m horizontally, and Northern Beaches Council does not warrant that the data does not contain errors.
- If accuracy is required, then survey should be undertaken by a registered surveyor.

Preparation of a Flood Management Report

Introduction

These guidelines are intended to provide advice to applicants on how to determine what rules apply on flood prone land, and how to prepare a Flood Management Report. The purpose of a Flood Management Report is to demonstrate how a proposed development will comply with flood related planning requirements.

Planning Requirements for Flood Prone Land

Development must comply with the requirements for developing flood prone land set out in the relevant Local Environment Plan (LEP) and Development Control Plan (DCP). There are separate LEPs and DCPs for each of the former Local Government Areas (LGAs), although preparation of a LGA-wide LEP and DCP is currently under way.

The clauses specific to flooding in the LEPs and DCPs are as follows:

LEP Clauses	DCP Clauses
Manly LEP (2013) – 6.3 Flood Planning	Manly DCP (2013) – 5.4.3 Flood Prone Land
Warringah LEP (2011) – 6.3 Flood Planning Warringah LEP (2000) – 47 Flood Affected Land *	Warringah DCP (2011) – E11 Flood Prone Land
Pittwater LEP (2014) – 7.3 Flood Planning Pittwater LEP (2014) – 7.4 Flood Risk Management	Pittwater 21 DCP (2014) – B3.11 Flood Prone Land Pittwater 21 DCP (2014) – B3.12 Climate Change

* The Warringah LEP (2000) is relevant only for the "deferred lands" which affects only a very small number of properties, mostly in the Oxford Falls area.

Development on flood prone land must also comply with Council's Water Management for Development Policy, and if it is in the Warriewood Release Area, with the Warriewood Valley Water Management Specification. Guidelines for Flood Emergency Response Planning are available for addressing emergency response requirements in the DCP. These documents can be found on Council's website on the Flooding page.

Note that if the property is affected by estuarine flooding or other coastal issues, these need to be addressed separately under the relevant DCP clauses.

When is a Flood Management Report required?

A Flood Management Report must be submitted with any Development Application on flood prone land (with exceptions noted below), for Council to consider the potential flood impacts and applicable controls. For Residential or Commercial development, it is required for development on land identified within the Medium or High Flood Risk Precinct. For Vulnerable or Critical development, it is required if it is within any Flood Risk Precinct.

There are some circumstances where a formal Flood Management Report undertaken by a professional engineer may not be required. However the relevant parts of the DCP and LEP would still need to be addressed, so as to demonstrate compliance. Examples where this may apply include:

- If all proposed works are located outside the relevant Flood Risk Precinct extent
- First floor addition only, where the floor level is above the Probable Maximum Flood level
- Internal works only, where habitable floor areas below the FPL are not being increased

Note that development on flood prone land will still be assessed for compliance with the relevant DCP and LEP, and may still be subject to flood related development controls.

What is the purpose of a Flood Management Report?

The purpose of a Flood Management Report is to demonstrate how a proposed development will comply with flood planning requirements, particularly the development controls outlined in the relevant LEP and DCP clauses. The report must detail the design, measures and controls needed to achieve compliance, following the steps outlined below.

A Flood Management Report should reflect the size, type and location of the development, proportionate to the scope of the works proposed, and considering its relationship to surrounding development. The report should also assess the flood risk to life and property.

Preparation of a Flood Management Report

The technical requirements for a Flood Management Report include (where relevant):

1. Description of development
    - Outline of the proposed development, with plans if necessary for clarity
    - Use of the building, hours of operation, proposed traffic usage or movement
    - Type of use, eg vulnerable, critical, residential, business, industrial, subdivision, etc

2. Flood analysis
    - 1% AEP flood level
    - Flood Planning Level (FPL)
    - Probable Maximum Flood (PMF) level
    - Flood Risk Precinct, ie High, Medium or Low
    - Flood Life Hazard Category
    - Mapping of relevant extents
    - Flood characteristics for the site, eg depth, velocity, hazard and hydraulic category, and the relevance to the proposed development

    If the property is affected by an Estuarine Planning Level (EPL) which is higher than the FPL, then the EPL should be used as the FPL. If the FPL is higher than the PMF level, then the FPL should still be used as the FPL, as it includes freeboard which the PMF does not.

3. Assessment of impacts
- Summary of compliance for each category of the DCP, as per the table below.

	Compliance		
	N/A	Yes	No
A) Flood effects caused by Development			
B) Building Components & Structural Soundness			
C) Floor Levels			
D) Car parking			
E) Emergency Response			
F) Fencing			
G) Storage of Goods			
H) Pools			

- Demonstration of how the development complies with any relevant flood planning requirements from the DCP, LEP, Water Management for Development Policy, and if it is in the Warriewood Valley Urban Land Release Area, with the Warriewood Valley Water Management Specification (2001)
- For any non-compliance, a justification for why the development should still be considered.
- Calculations of available flood storage if compensatory flood storage is proposed
- Plan of the proposed development site showing the predicted 1% AEP and PMF flood extents, as well as any high hazard or floodway affectation
- Development recommendations and construction methodologies
- Qualifications of author - Council requires that the Flood Management Report be prepared by a suitably qualified Engineer with experience in flood design / management who has, or is eligible for, membership to the Institution of Engineers Australia
- Any flood advice provided by Council
- Any other details which may be relevant

Further information and guidelines for development are available on Council's website at:

https://www.northernbeaches.nsw.gov.au/planning-and-development/building-and-renovations/development-applications/guidelines-development-flood-prone-land

Council's Flood Team may be contacted on 1300 434 434 or at floodplain@northernbeaches.nsw.gov.au .

Flora and Fauna Assessment Report and Waterway Impact Statement

Proposed Warringah Golf and Community Club

Report prepared by Narla Environmental

for Warringah Golf Club

September 2023

NARLA

environmental

Report:	Flora and Fauna Assessment Report and Waterway Impact Statement – Proposed Warringah Golf and Community Club
Prepared for:	Warringah Golf Club
Prepared by:	Narla Environmental Pty Ltd
Project no:	WGC1
Date:	September 2023
Version:	Final v2.0

Narla Environmental Pty Ltd

www.narla.com.au

Report Certification

Works for this report were undertaken by:

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Chris Moore *BBioCon*	Narla Environmental General Manager/ Senior Ecologist

Document Control

Revision	Document Name	Issue Date	Internal Document Review
Draft v1.0	Flora and Fauna Assessment Report and Waterway Impact Statement – Proposed Warringah Golf and Community Club	17/08/2023	Chris Moore
Final v1.0	Flora and Fauna Assessment Report and Waterway Impact Statement – Proposed Warringah Golf and Community Club	31/08/2023	Chris Moore
Final v2.0	Flora and Fauna Assessment Report and Waterway Impact Statement – Proposed Warringah Golf and Community Club	22/09/2023	Jonathan Coy

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Glossary

Acronym/ Term	Definition
BAM	Biodiversity Assessment Methodology
BC Act	New South Wales Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
DA	Development Application
DAFF	Department of Agriculture, Fisheries and Forestry
DCCEEW	Department of Climate Change, Energy, the Environment and Water
Development	The use of land, and the subdivision of land, and the carrying out of a work, and the demolition of a building or work, and the erection of a building, and any other act, matter or thing referred to in section 26 that is controlled by an environmental planning instrument but does not include any development of a class or description prescribed by the regulations for the purposes of this definition (Environmental Planning and Assessment Act 1979)
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment (Now DPE)
EP&A Act	Environmental Planning & Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FFA	Flora and Fauna Assessment
ha	Hectares
km	Kilometre
LGA	Local Government Area
Locality	The area within a 10 km radius of the Subject Property
m	metres
WDCP	Warringah Development Control Plan 2011
WLEP	Warringah Local Environmental Plan 2011
mm	millimetres
NSW	New South Wales
OEH	Office of Environment and Heritage (now known as the DPE)
SEPP	State Environmental Planning Policy
Subject Property	292 Condamine Street North Manly 2100 (Lot 2742/-/DP752038).
Subject Site	The footprint of the proposed development
Threatened species, populations and ecological communities	Species, populations and ecological communities specified in Schedules 1 and 2 of the BC Act 2016
TPZ	Tree Protection Zone

1. Introduction

1.1 Project Background

Narla Environmental (Narla) were engaged by Warringah Golf Club ('the proponent') to prepare a Flora and Fauna Assessment (FFA) and a Waterway Impact Statement (WIS), for the proposed development at 292 Condamine Street North Manly 2100 (Lot 2742/-/DP752038), hereafter referred to as the 'Subject Property' (**Figure 1**). The proposed development involves the building of a new clubhouse and will include ancillary works including the demolition of existing buildings and infrastructure, tree removal and the development of parking areas, a pedestrian bridge, landscaping, wastewater treatment system, a rainwater tank and new recreation facilities. All works associated with the proposed development will hereafter be referred to as the 'Subject Site' (**Figure 1**, **Appendix A**,).

Narla have produced this report in order to assess any potential impacts associated with the proposed development on terrestrial ecology, particularly threatened species, populations, and ecological communities listed under the Biodiversity Conservation Act 2016 (BC Act), and, the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). The report will also recommend appropriate measures to mitigate any potential impacts in line with all relevant State Environmental Planning Policies (SEPP) and local government plans, namely the Warringah Local Environmental Plan 2011 (WLEP 2011) the Warringah Development Control Plan 2011 (WDCP 2011), and the Warringah Council Waterways Impact Statement Guidelines.

1.2 Site Description and Location

The Subject Property is located within the locality of North Manly in the Northern Beaches Local Government Area (LGA). The site boundary was defined by cadastral boundaries provided on the NSW Government Land and Property Information Spatial Information Exchange map viewer (NSW SixMaps 2023). The Subject Property is currently utilised as a golf course and covers an area of approximately 17.3ha, bound by Pittwater Road to the east, Kentwell Road to the south and Condamine Street to the west. The surrounding area is a highly urbanised landscape.

The Subject Site covers an area of approximately 1.28ha and currently contains the Warringah Recreation Centre comprising of tennis courts, soccer fields, and squash courts located in the south-eastern portion of the Warringah Golf Course. Riparian vegetation is present on both sides of Brookvale Creek that intersects the Subject Site.

1.3 Topography, Geology and Soil

The Subject Site is located in a low-lying area with elevation ranging from approximately 3m above sea level (asl) to approximately 5m asl (Google 2023) and is situated on the Warriewood soil landscape as described in the Soil Landscapes of the Sydney 1:100,000 sheet (Chapman et al. 2009). This soil landscape is characterised by level to gently undulating plains with local relief <10 m and slope gradients <5% on in-filled coastal barrier dunes, lakes and lagoons as well as swale depressions in dunefields. Geology consists of Quaternary (Holocene) silty to peaty quartz sand and medium to fine marine sand with podzols. Dominant soil materials include dark grey loamy sand, massive sand, black sticky peat, brown soft iron pan and dark brown soft organic pan.

1.4 Hydrology

One (1) mapped 3rd order stream, Brookvale Creek, is located within the Subject Site. No other mapped or unmapped water features were identified within the Subject Site.

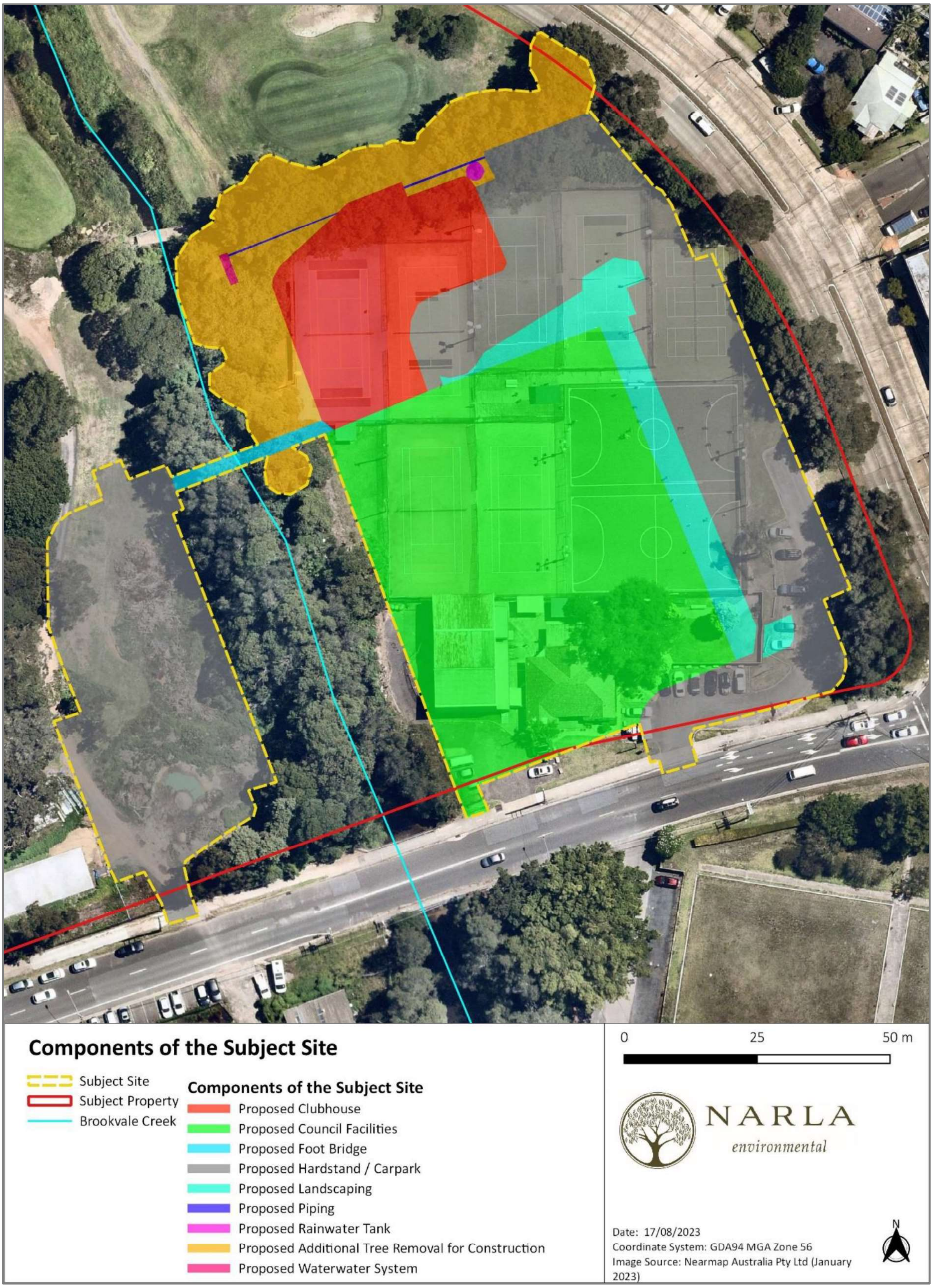

Figure 1. Components of the Subject Site.

1.5 Relevant Legislation and Policy

The legislation and policy that are addressed in this report are listed in **Table 1.**

Table 1. Relevant legislation and policy addressed

Legislation/Policy	Relevant Ecological Feature on Site	Triggered	Action Required
Environmental Planning and Assessment Act 1979 (EP&A Act)	All threatened species, populations, and ecological communities and their habitat that occur or are likely to occur on the Subject Property during a part of their lifecycle.	Yes	This Flora and Fauna Assessment and all subsequent recommendations relevant to the planning process under 'Part 4 Development assessment and consent'.
Biodiversity Conservation Act (BC Act) (New South Wales)	One (1) BC Act listed endangered ecological community occurs within the Subject Site: ▪ Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion. One (1) BC Act listed species, *Callistemon linearifolius* (Netted Bottle Brush), occurs within close proximity to the Subject Site, however it will not be directly impacted by the proposal. No other threatened species or populations listed under the BC Act were identified within the Subject Site at the time of the site assessment; however, suitable habitat for various threatened species listed under the BC Act was identified.	Yes	This FFA, particularly the likelihood tables for threatened fauna and flora species occurring or potentially occurring within the Subject Site, as well as severity of potential impacts. A test of significance (5 Part Test) was prepared for Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion (**Appendix D**).
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (Commonwealth)	One (1) EPBC Act listed Threatened Ecological Communities is present within the Subject Site: ▪ Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales. No threatened species, populations or endangered ecological communities listed under the EPBC Act were identified within the Subject Site at the time of the site assessment; however, suitable habitat for various threatened species listed under the EPBC Act was identified included.	Yes	This FFA, particularly the likelihood tables for threatened fauna and flora species occurring or potentially occurring within the Subject Site, as well as severity of potential impacts. An assessment of significant impact was prepared for Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales (**Appendix E**)
Biosecurity Act 2015 (Bio Act)	Four (4) Priority weeds for the Greater Sydney region were identified within the Subject Property: ▪ *Asparagus aethiopicus* (Ground Asparagus); ▪ *Rubus fruticosus spp. agg* (Blackberry);	Yes	The listed Priority weeds must be managed in accordance with the Biosecurity Act 2015.

Legislation/Policy	Relevant Ecological Feature on Site	Triggered	Action Required
	▪ *Lantana camara* (Lantana); and ▪ *Anredera cordifolia* (Madeira Vine).		
State Environmental Planning Policy (Resilience and Hazards) 2021 - Chapter 2 Coastal Management	The Subject Site does not contain areas mapped as 'Coastal Wetlands', 'Littoral Rainforest', or proximity to either, therefore, Chapter 2 of this SEPP does not apply.	No	None
State Environmental Planning Policy (Biodiversity and Conservation) 2021 – Chapter 4 Koala Habitat Protection 2021	The Subject Site occurs within an LGA listed in Schedule 2 of the SEPP and the Subject Property has an area of more than 1 ha. Therefore, chapter 4 of this SEPP applies	Yes	The requirements of this chapter have been discussed in **Section 1.9** and no further action should be required.
Water Management Act 2000	Brookvale Creek, a 3rd order stream, and its associated riparian corridor is mapped as occurring in the centre of the Subject Site.	Yes	Works occurring within 40 metres of the highest bank of the river, lake or estuary are considered controlled activities under the WM Act. Applicants may need to obtain a controlled activity approval from the NSW DPE – Water before commencing the controlled activity (**Section 1.10**)
Fisheries Management Act 1994	The Subject Site contains land mapped as Key Fish Habitat (KFH). Therefore, the Fisheries Management Act 1994 applies.	Yes	Any works that involve dredging or reclamation will require a Part 7 permit under the act (**Section 1.11**).

1.6 Biodiversity Assessment Pathway

The requirements of the BC Act 2016 and Biodiversity Conservation Regulation 2017 are mandatory for all Development Applications (DA) assessed pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) submitted in the Northern Beaches LGA.

The Biodiversity Values (BV) Map (DPE 2023a) identifies land with high biodiversity values that are particularly sensitive to impacts from development and clearing. The map forms part of the Biodiversity Offsets Scheme Entry Threshold which is one of the triggers for determining whether the Biodiversity Offset Scheme (BOS) applies to a clearing or development proposal. The map has been prepared by the Department of Planning and Environment (DPE) under Part 7 of the Biodiversity Conservation Act 2016 (BC Act). No areas identified as containing Biodiversity Values are located within the Subject Site or broader Subject Property.

The BC Act and its regulations also stipulate clearing 'area threshold' values (**Table 2**) that determine whether a development is required to be assessed in accordance with the BOS. Minimum entry thresholds for vegetation clearing depend on the minimum lot size (shown in the Lot Size Maps made under the relevant Local Environmental Plan [LEP]), or actual lot size (where there is no minimum lot size provided for the relevant land under the LEP).

As no minimum lot size is prescribed by the WLEP to the Subject Property, the actual lot size of 17.3ha determines the clearing threshold. To avoid triggering the BOS, the proponent must avoid the clearing/management of native vegetation in excess of 0.5ha. The proposed development will require approximately 0.19ha of native vegetation to be cleared within the Subject Site; therefore, the BOS is not triggered by the clearing threshold.

As such, the Biodiversity Offset Scheme is not triggered and a Biodiversity Development Assessment Report (BDAR) is not required. As such, a standard Flora and Fauna Assessment Report (this report) has been produced to assess the impact of the proposed DA.

Table 2. Biodiversity offset scheme entry thresholds. Bold indicates the threshold relevant to this report.

Minimum lot size associated with the property	Threshold for clearing, above which the BAM and offsets scheme apply
Less than 1ha	0.25ha or more
1ha to less than 40ha	**0.5 ha or more**
40ha to less than 1000ha	1ha or more
1000ha or more	2ha or more

1.7 Warringah Local Environmental Plan 2011 (WLEP)

1.7.1 Zoning

The Subject Property is zoned 'RE1: Public Recreation'. The WLEP requires that the development satisfies the zone objectives which are:

- To enable land to be used for public open space or recreational purposes.
- To provide a range of recreational settings and activities and compatible land uses.
- To protect and enhance the natural environment for recreational purposes.
- To protect, manage and restore public land that is of ecological, scientific, cultural or aesthetic value.
- To prevent development that could destroy, damage or otherwise have an adverse effect on those values.

The proposed development satisfies the objectives of this zone by providing public recreation activities.

1.8 Warringah Development Control Plan 2011 (WDCP)

1.8.1 Preservation of Trees or Bushland Vegetation

Part E1 of the WDCP applies to the land. The objectives of this clause are to:

- To protect and enhance the urban forest of the Northern Beaches;
- To effectively manage the risks that come with an established urban forest through professional management of trees;
- To minimise soil erosion and to improve air quality, water quality, carbon sequestration, storm water retention, energy conservation and noise reduction;
- To protect, enhance bushland that provides habitat for locally native plant and animal species, threatened species populations and endangered ecological communities;
- To promote the retention and planting of trees which will help enable plant and animal communities to survive in the long-term; and

- To protect and enhance the scenic value and character that trees and/or bushland vegetation provide.

Although the proposed development will require the removal of native bushland, revegetation is proposed to enhance the long-term survival of the community present and protect retained vegetation during and following construction.

1.8.2 Prescribed Vegetation

Part E2 of the WDCP applies to land identified within mapping as containing high conservation habitat, wildlife corridors or native vegetation The objectives of this clause are to:

- To preserve and enhance the area's amenity, whilst protecting human life and property;
- To improve air quality, prevent soil erosion, assist in improving water quality, carbon sequestration, storm water retention, energy conservation and noise reduction;
- To provide habitat for local wildlife, generate shade for residents and provide psychological & social benefits;
- To protect and promote the recovery of threatened species, populations and endangered ecological communities;
- To protect and enhance the habitat of plants, animals and vegetation communities with high conservation significance;
- To retain and enhance native vegetation communities and the ecological functions of wildlife corridors;
- To reconstruct habitat in non-vegetated areas of wildlife corridors that will sustain the ecological functions of a wildlife corridor and that, as far as possible, represents the combination of plant species and vegetation structure of the original 1750 community; and
- Promote the retention of native vegetation in parcels of a size, condition and configuration which will as far as possible enable plant and animal communities to survive in the long-term.

Development is to be situated and designed to minimise the impact on prescribed vegetation, including remnant canopy trees, understorey vegetation, and ground cover species. Although the proposed development will require the removal of native bushland, revegetation is proposed to enhance the long-term survival of the community present and protect retained vegetation during and following construction.

1.8.3 Threatened species, populations, ecological communities listed under State or Commonwealth legislation, or High Conservation Habitat

This control applies to land identified on WDCP Map as an Endangered Ecological Community (EEC) is present; therefore, this control applies. The objectives of this control are:

- To protect and promote the recovery of threatened species, populations and endangered ecological communities;
- To protect and enhance the habitat of plants, animals and vegetation communities with high conservation significance;
- To preserve and enhance the area's amenity, whilst protecting human life and property;
- To improve air quality, prevent soil erosion, assist in improving water quality, carbon sequestration, storm water retention, energy conservation and noise reduction; and
- To provide natural habitat for local wildlife, maintain natural shade profiles and provide psychological & social benefits.

Although the proposed development will require the removal of native bushland, revegetation is proposed to enhance the long-term survival of the community present and protect retained vegetation during and following construction. A VMP will be implemented for the continued enhancement and protection of the EEC within and adjacent to the Subject Site.

1.8.4 Wildlife Corridors

No areas mapped as 'Wildlife Corridors' on the WDCP Map are present within the Subject Property. No wildlife corridors will be affected by the proposed development. Therefore, this clause does not apply.

1.8.5 Native Vegetation

Although no areas mapped as 'Native Vegetation' on the WDCP Map are present within the Subject Property; native vegetation was observed during the site assessment, therefore, this clause applies. The objectives of this clause are:

- To preserve and enhance the area's amenity, whilst protecting human life and property;
- To improve air quality, prevent soil erosion, assist in improving water quality, carbon sequestration, storm water retention, energy conservation and noise reduction;
- To provide natural habitat for local wildlife, maintain natural shade profiles and provide psychological & social benefits;
- Promote the retention of native vegetation in parcels of a size, condition and configuration which will as far as possible enable local plant and animal communities to survive in the long term; and
- To maintain the amount, local occurrence and diversity of native vegetation in the area.

Although the proposed development will require the removal of native bushland, revegetation is proposed to enhance the long-term survival of the community present and protect retained vegetation during and following construction. A VMP will be implemented for the continued enhancement and protection of the EEC within and adjacent to the Subject Site.

1.8.6 Waterways and Riparian land

Part E8 of the WDCP applies to land identified as waterways and riparian lands. Objectives are:

- Protect, maintain and enhance the ecology and biodiversity of waterways and riparian land;
- Encourage development to be located outside waterways and riparian land;
- Avoid impacts that will result in an adverse change in watercourse or riparian land condition;
- Minimise risk to life and property from stream bank erosion and flooding by incorporating appropriate controls and mitigation measures;
- Maintain and improve access, amenity and scenic quality of waterways and riparian lands; and
- Development on waterways and riparian lands shall aim to return Group B and Group C creeks to a Group A standard (as described in Warringah Creek Management Study, 2004) through appropriate siting and development of development.

The proposed development is located adjacent to Brookvale Creek which is classed as a Group C creek. Catchments that are classed as Group C generally have a low to moderate ecological value with the catchment also containing a 15 to 20% connected impervious area (WDCP 2011). As a portion of the project development and activities are to occur within land mapped as Waterways and Riparian Land, the controls required by this part of the WDCP are to be implemented by (**Table 3**).

Table 3. Developmental controls required by the pursuant for Part E8 of the WDCP (2011)

Control requirement pursuant to Part E8	Response of the Proposal
1. Development is to be designed to address any distinctive environmental features of the site and on adjoining nearby land.	The proposal has been designed to minimise direct impacts on the creek. The proposed pedestrian bridge will be located above the creek to avoid instream works and impacts. Riparian vegetation which is associated with a Threatened Ecological Community (TEC) will be impacted by the proposal, however this impact is mainly associated within the proposed bridge

Control requirement pursuant to Part E8	Response of the Proposal
	and will be supplemented by a VMP. The threatened *Callistemon linearifolius* (Netted Bottle Brush) is located near the Subject Site, however is not anticipated to be impacted.
2. Development should respond to these features through location of structures, outlook, design and materials.	The proposed bridge has been designed to sit above the water level of the creek, at the same height as the creek banks, so that the proposed development does not impede on water flow. A Construction Management Plan (CMP) has been prepared to ensure any excess sediment and erosion will be controlled to avoid discharges into Brookvale Creek and minimise surface water flow velocity. Temporary stabilisation techniques such as strategically placed erosion matting, sediment screens, hay bale energy dissipaters, mulching and annual grass species establishment will be implemented on disturbed areas.
3. The applicant shall submit a Waterway Impact Statement.	Proposal complies through the preparation of this FFA and WIS.
4. Developments shall comply with the requirements of Council's Protection of Waterway and Riparian Land Policy and Water Management Policy.	Proposal complies as it satisfies all the objectives laid out in the WLEP 2011 and WDCP 2011.
5. Infrastructure such as roads, drainage, stormwater structures, services, etc. should be located outside land identified as Waterways and Riparian Land.	Owing to the location of the existing recreation centre, all of the proposed development could not be located outside of the Waterways and Riparian Land. However, mitigation methods have been outlined in this report and the CMP to limit impacts to this land and Brookvale Creek.
6. The Asset Protection Zone must not extend into land identified as Waterways and Riparian Land. Refer to NSW Rural Fire Service for site assessment methodology.	Not applicable.

1.9 State Environmental Planning Policy (Biodiversity and Conservation) 2021: Chapter 4 - Koala Habitat Protection 2021

This chapter applies to LGAs that are listed in Schedule 2 'Local government areas' of the SEPP. As the Northern Beaches LGA is included in Schedule 2, this SEPP applies to the Subject Site. As such, the following development control provisions apply to development applications relating to the land, as the land:

- Has an area of at least 1 hectare (including adjoining land within the same ownership); and
- Does not have an approved koala plan of management applying to the land.

Before a council may grant consent to a development application for consent to carry out development on the land, the council must assess whether the development is likely to have any impact on koalas or koala habitat. If the council is satisfied that the development is likely to have low or no impact on koalas or koala habitat, the council may grant consent to the development application.

A site assessment was undertaken to determine whether the land contained core koala habitat, which is defined by the SEPP as:

> a) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or
> b) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years.

The Subject Property did contain suitable habitat (where 15% or greater of the total number of trees are the regionally relevant species of those listed in Schedule 3 of the SEPP), however no signs of koalas or koala occupancy (scats, scratch marks) were observed at the time of the site assessment. Furthermore, there are only two (2) records of Koalas within 2.5km of the Subject Property in the last 18 years. Due to the urban nature of the Subject Site and low number of proximal records, it is considered unlikely to be core Koala habitat and no further assessment under the SEPP (i.e. Koala Assessment Report) should be required.

1.10 Water Management Act 2000

Controlled activities carried out in, on or under waterfront land are regulated by the Water Management Act 2000 (WM Act). The Natural Resources Access Regulator (NRAR) administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land. Water front land include the bed and bank of any river, lake or estuary and all land within 40 meters of the highest bank of the river, lake or estuary.

The proposed development involves a water crossing and riparian works, which are considered a controlled activity. Therefore, a controlled activity approval must be obtained from the NRAR before commencing the proposed development. Additionally, when a proposed controlled activity disturbs or substantially modifies the riparian corridor (e.g. through vegetation removal or excavation), its restoration and/or rehabilitation will be a requirement of the controlled activity approval. A Vegetation Management Plan (VMP) may be required that details how the restoration or rehabilitation will be carried out for crossing and riparian works.

1.11 Fisheries Management Act 1994

One of the objectives of the Fisheries Management Act 1994 is to 'conserve key fish habitats'. 'Key Fish Habitat' (KFH) was defined to include all marine and estuarine habitats up to highest astronomical tide level (that are reached by 'king' tides) and most permanent and semi-permanent freshwater habitats including rivers, creeks, lakes, lagoons, billabongs, weir pools and impoundments up to the top of the bank.

Brookvale Creek within the Subject Site is mapped as containing KFH (**Figure 2**). NSW DPI assesses development proposals with consideration to the water way class (**Table 4**) and habitat sensitivity type (**Table 5**), which factors in the importance, resilience and functionality of the waterway as fish habitat (DPI 2013). Brookvale Creek within the Subject Site meets the definition of 'Class 1 – Major key fish habitat' and 'Type 3 – Minimally sensitive key fish habitat'.

Any works that involve dredging or temporary obstruction of fish passage within KFH would require a Part 7 Fisheries Permit under section 201 and 219 of the FM Act.

Table 4. Classification of waterways for fish passage. Green shading = Class within the Subject Site (DPI 2013).

Water Way Classification	Characteristics of Waterway Class	Features present within the Subject Site
Class 1 – Major key fish habitat	Marine or estuarine waterway, or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'.	Brookvale Creek is a perennial (permanently flowing) waterway.
Class 2 – Moderate key fish habitat	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. Type 1 and 2 habitat present.	N/A
Class 3 – Minimal key fish habitat	Named or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or	N/A

Water Way Classification	Characteristics of Waterway Class	Features present within the Subject Site
	adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other Class 1-3 fish habitats	
Class 4 – Unlikely key fish habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free-standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present).	N/A

Table 5. Key fish habitat and associated sensitivity classification scheme. Green shading = Class within the Subject Site (DPI 2013).

Sensitivity Classification	Characteristics of Sensitivity Class	Features present within the Subject Site
Type 1 – Highly sensitive key fish habitat	▪ *Posidonia australis* (strapweed) ▪ *Zostera, Heterozostera*, *Halophila* and *Ruppia* species of seagrass beds >5m2 in area ▪ Coastal saltmarsh >5m2 in area ▪ Coral communities ▪ Coastal lakes and lagoons that have a natural opening and closing regime (i.e. are not permanently open or artificially opened or are subject to one off unauthorised openings) ▪ Marine Park, an aquatic reserve or intertidal protected area ▪ SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. Ramsar, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia ▪ Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 metres in length, or native aquatic plants ▪ Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act ▪ Mound springs	Not present
Type 2 – Moderately sensitive key fish habitat:	▪ *Zostera, Heterozostera, Halophila* and *Ruppia* species of seagrass beds <5m^2 in area ▪ Mangroves ▪ Coastal saltmarsh <5m^2 in area ▪ Marine macroalgae such as *Ecklonia* and *Sargassum* species ▪ Estuarine and marine rocky reefs ▪ Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g. managed in line with an entrance management plan) ▪ Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area ▪ Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna ▪ Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in Type 1 ▪ Weir pools and dams up to full supply	Not Present
Type 3 – Minimally sensitive key fish habitat may include	▪ Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches with minimal or no in-fauna ▪ Coastal and freshwater habitats not included in Type 1 or 2 ▪ Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation	Present. Brookvale Creek is a coastal habitat that does not have features listed in Type 1 or 2.

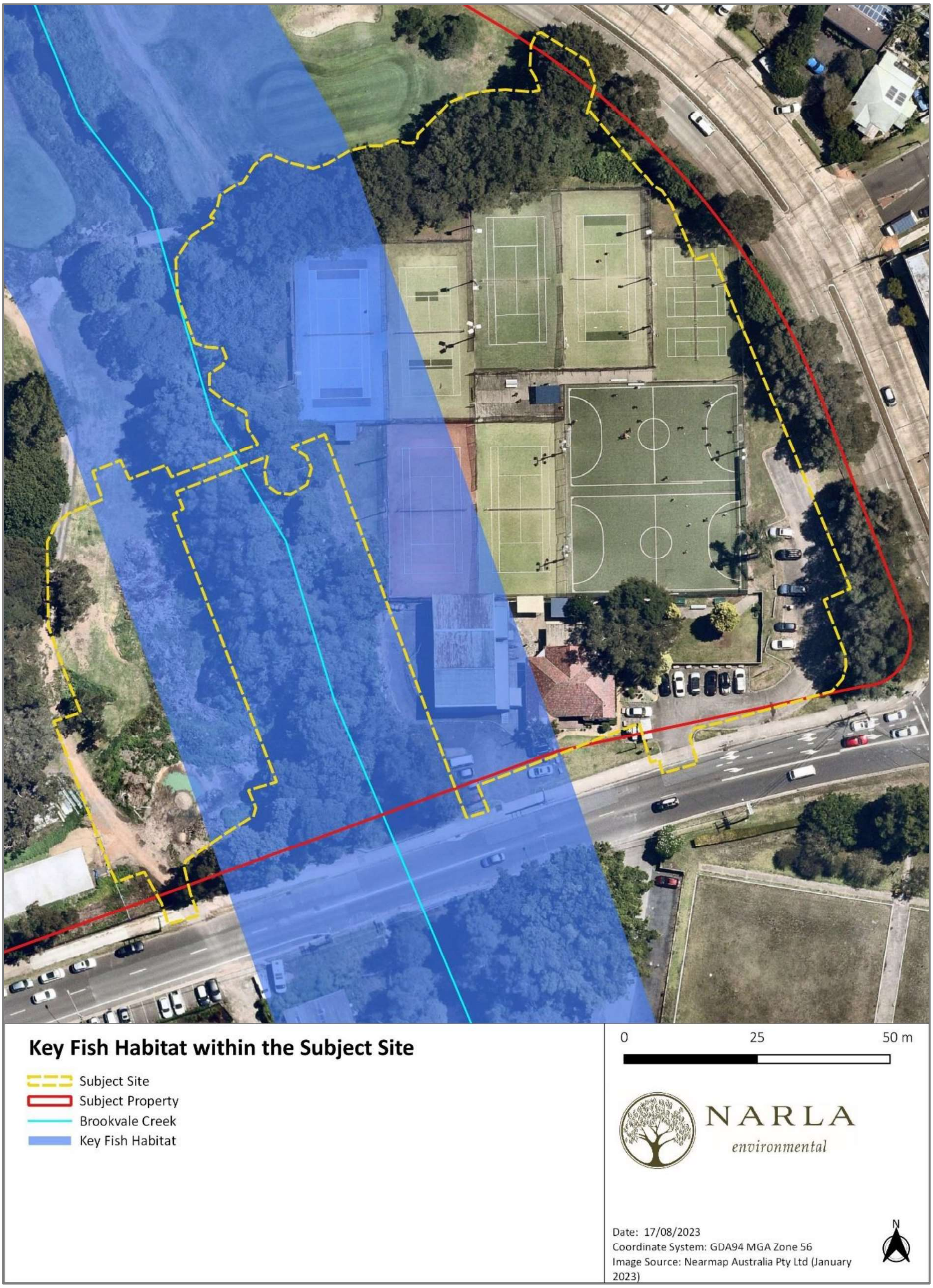

Figure 2. Key Fish Habitat within the Subject Site.

1.12 Scope of Assessment

1.12.1 Objectives of the Fauna and Flora Assessment

The objectives of this FFA were to:

- Establish the likelihood of occurrence of migratory species, threatened species, endangered populations, and threatened ecological communities as listed under the BC Act and/or the EPBC Act;
- Assess any potential impacts to species and/or communities listed under the BC Act and EPBC Act;
- Assess the ecological impacts of the proposed development on the waterway and riparian land that is within the Subject Site;
- Identify and map the distribution of vegetation communities within the Subject Property;
- Record presence and the extent of any known or potential fauna habitat features such as nests, dreys, caves, crevices, culverts, pools, soaks, flowering trees, fruiting trees, or hollow-bearing trees and provide recommendations for on-going management of these habitat features and any fauna present;
- Record presence and the extent of any priority weeds or weed infestations and provide recommendations for on-going management; and
- Recommend any controls or additional actions to be taken to protect or improve environmental outcomes of the proposed activity.

1.12.2 Objectives of the Water Impact Statement

The objectives of this WIS were to:

- Determine impacts upon water quality;
- Determine impacts on channel form, erosion rate and bank stability;
- Identify ecological impacts of the proposed development;
- Establish any landscaping impacts of the proposed development;
- Assess bank stability by demonstrating that the building and development is not at risk from erosion processes;
- Identify the extent of native vegetation proposed to be removed; and
- Determine any modifications to natural creek lines and overland flow.

1.13 Study Limitations

This study was not intended to provide a complete inventory of all flora and fauna species with potential to occur on the Subject Property. The species list provided for the Subject Property in this report was restricted to what was observed during the site assessment by the Narla Ecologist. The timing of the survey may not have coincided with emergence times of some species of flora and fauna, such as seasonally flowering herbs, seasonal migratory fauna, or nocturnal fauna. To account for those species that could not be identified during the field survey, detailed habitat assessments were combined with desktop research and local ecological knowledge to establish an accurate prediction of the potential for such species to occur on or adjacent the Subject Property.

2. Methodology

2.1 Desktop Assessment and Literature Review

A thorough literature review of local information relevant to the Northern Beaches Council area was undertaken. Searches using NSW Wildlife Atlas (BioNet; DPE 2023b) and the Commonwealth Protected Matters Search Tool (DCCEEW 2023) were conducted to identify all current threatened flora and fauna, as well as migratory fauna records within a 10km x 10km cell search area centred on the Subject Site. These data were used to assist in establishing the presence or likelihood of any ecological values as occurring on or adjacent the Subject Site, and helped inform the Ecologist on what to look for during the site assessment.

Soil landscape and geological mapping was examined to understanding of the environment on the Subject Site and assisted in determining whether any threatened flora or ecological communities may occur there (Chapman et al. 2009).

2.2 Ecological Site Assessment

2.2.1 Ecological Survey

A site assessment was undertaken by Narla Ecologists, Jonathan Coy and Jayden Maloney, on Wednesday 2nd of August 2023. During the site assessment, the following activities were undertaken:

- Identifying and recording the vegetation communities present within the Subject Site, with focus on identifying any threatened ecological communities (TEC);
- Recording a detailed list of flora species encountered within the Subject Site, with a focus on threatened species, species diagnostic of threatened ecological communities, and priority weeds;
- Recording opportunistic sightings of any fauna species seen or heard on or within the immediate surrounds of the Subject Site;
- Targeted surveys for threatened flora;
- Identifying and recording the locations of notable fauna habitat such as important nesting, roosting, or foraging microhabitats;
- Assessing the impact of the proposed development on the present waterway and riparian land;
- Assessing the connectivity and quality of the vegetation within the Subject Site and surrounding area; and
- Targeting the habitat of any threatened and regionally significant fauna including:
    - Tree hollows (habitat for threatened large forest owls, parrots, and arboreal mammals);
    - Caves and crevices (habitat for threatened reptiles, small mammals, and microbats);
    - Termite mounds (habitat for threatened reptiles);
    - Soaks (habitat for threatened frogs);
    - Wetlands (habitat for threatened fish, frogs, and water birds);
    - Drainage lines (habitat for threatened fish and frogs);
    - Fruiting trees (food for threatened frugivorous birds and mammals);
    - Flowering trees (food for threatened nectarivorous birds and mammals);
    - Trees and shrubs supporting nest structures (habitat for threatened birds and arboreal mammals); and
    - Any other habitat features that may support fauna (particularly threatened) species.

2.2.2 Weather Conditions

Weather conditions recorded at the nearest weather station (Terrey Hills AWS #066059) prior to and during the site assessment are provided in **Table 6** (BOM 2022). The data revealed mild to low temperatures and no rainfall in the lead up to the site assessment, these conditions may not have been conducive to the emergence of flowering plants.

Table 6. Weather conditions recorded at Terrey Hills AWS (station 066059) preceding and during the site assessment (site assessment date in bold)

Survey date	Day	Minimum Temp. (°C)	Maximum Temp. (°C)	Rainfall (mm)
27/07/2023	Thursday	7.9	19.5	0
28/07/2023	Friday	10.7	22.7	0
29/07/2023	Saturday	13.9	21.2	0
30/07/2023	Sunday	12.9	24	0
31/07/2023	Monday	11.5	21.8	0
01/08/2023	Tuesday	7.7	19.4	0
02/08/2023	**Wednesday**	**11.3**	**17.8**	**0**

2.2.3 Mapping and Analysis of Vegetation Communities

Narla examined local satellite imagery, geological mapping, soil landscape mapping, and topographic mapping, in addition to existing vegetation mapping the State Vegetation Type Map (DPE 2022) in order to stratify the Subject Site and guide the site assessment survey efforts. The following documents were also consulted during the site assessment to assist with the identification of vegetation communities present within the Subject Site:

- Chapman G.A., Murphy C.L., Tille P.J., Atkinson G. and Morse R.J. (2009) Soil Landscapes of the Sydney 1:100,000 Sheet map, Ed. 4, Department of Environment, Climate Change and Water, Sydney.
- Department of Planning and Environment (DPE) (2023d) eSPADE v2.2 https://www.environment.nsw.gov.au/eSpade2Webapp#
- Department of Planning and Environment (DPE) (2022) State Vegetation Type Map

2.2.4 Impact Assessment

An assessment of likely occurrence was carried out for locally occurring threatened species (**Table 11** and **Table 13**) and threatened migratory species. It was then determined if a further impact assessment (5-Part Test; test of significance) was required for any locally occurring threatened species or communities (**Appendix D**; **Appendix E**).

2.3 Waterways Impact Assessment

2.3.1 Waterways Impact Survey

A site assessment was undertaken by Narla Ecologist, Jonathan Coy and Jayden Maloney, on Wednesday 2nd of August 2023. During the site assessment, the following activities were undertaken:

- Observing water quality and turbidity;
- Recording the presence of litter, rubbish and pollutants;
- Identifying potential development-related impacts upon water quality;
- Determining potential impacts on channel form, erosion rate and bank stability;
- Identifying any potential fauna habitat;
- Establishing any potential landscaping impacts of the proposed development;

- Assessing the current state of bank stability; and
- Determining any potential modifications to natural creek lines and overland flow.

3. Native Vegetation

3.1 Historically Mapped Vegetation Communities

Historical vegetation mapping of the Subject Property utilizing the "State Vegetation Type Map" (DPE 2022) was conducted and identified the vegetation on site as non-classified. The nearest native vegetation mapped is Estuarine Swamp Oak Twig-rush Forest (**Figure 3**).

3.2 Field-validated Vegetation Communities

The field survey conducted by Narla identified the vegetation within the Subject Property as best conforming to two (2) vegetation community (**Figure 4**):

- Estuarine Swamp Oak Twig-rush Forest (**Table 7**);
- Exotic Dominated Vegetation (**Table 8**).

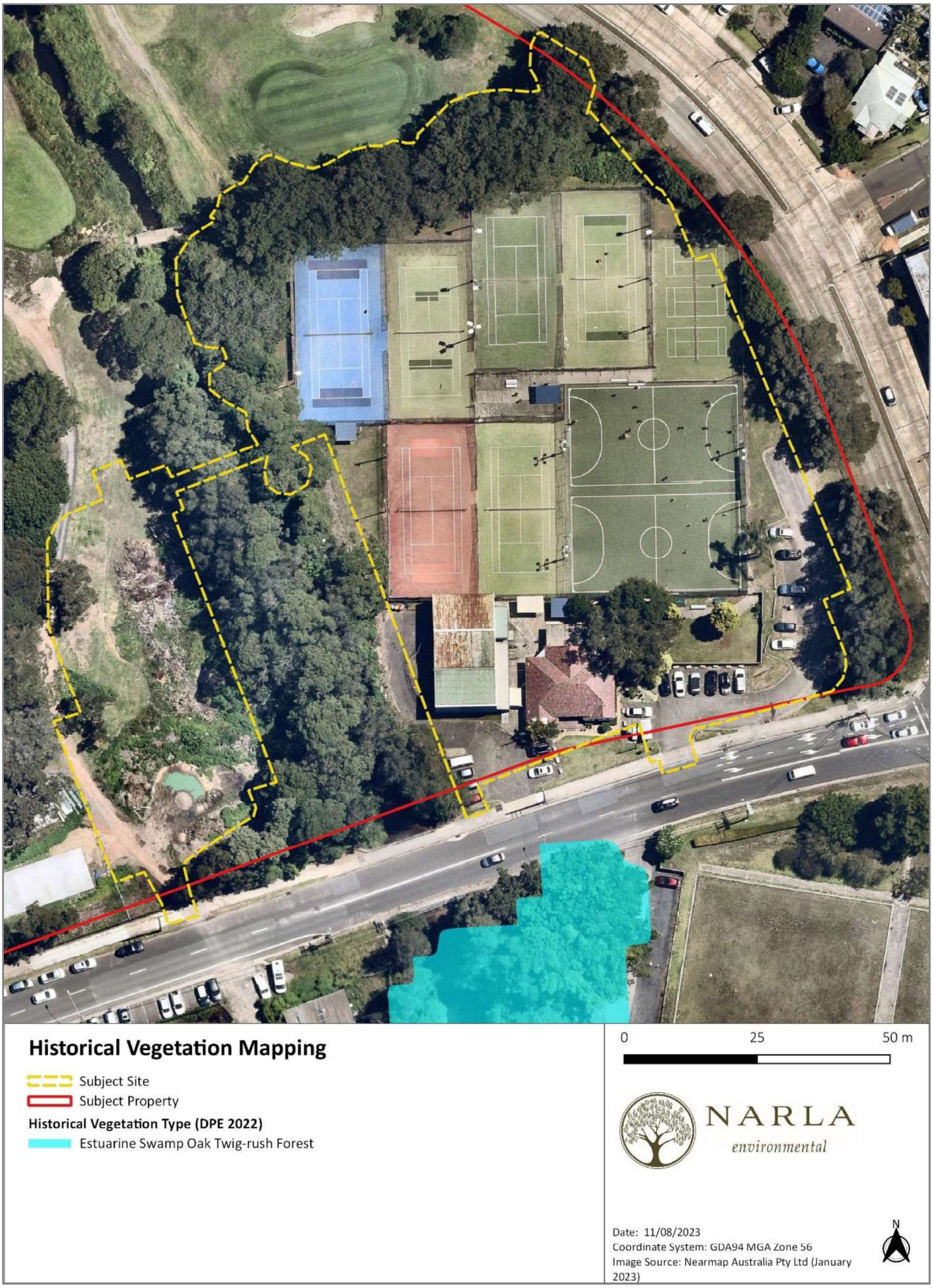

Figure 3. Historical Vegetation Mapping of the Subject Site.

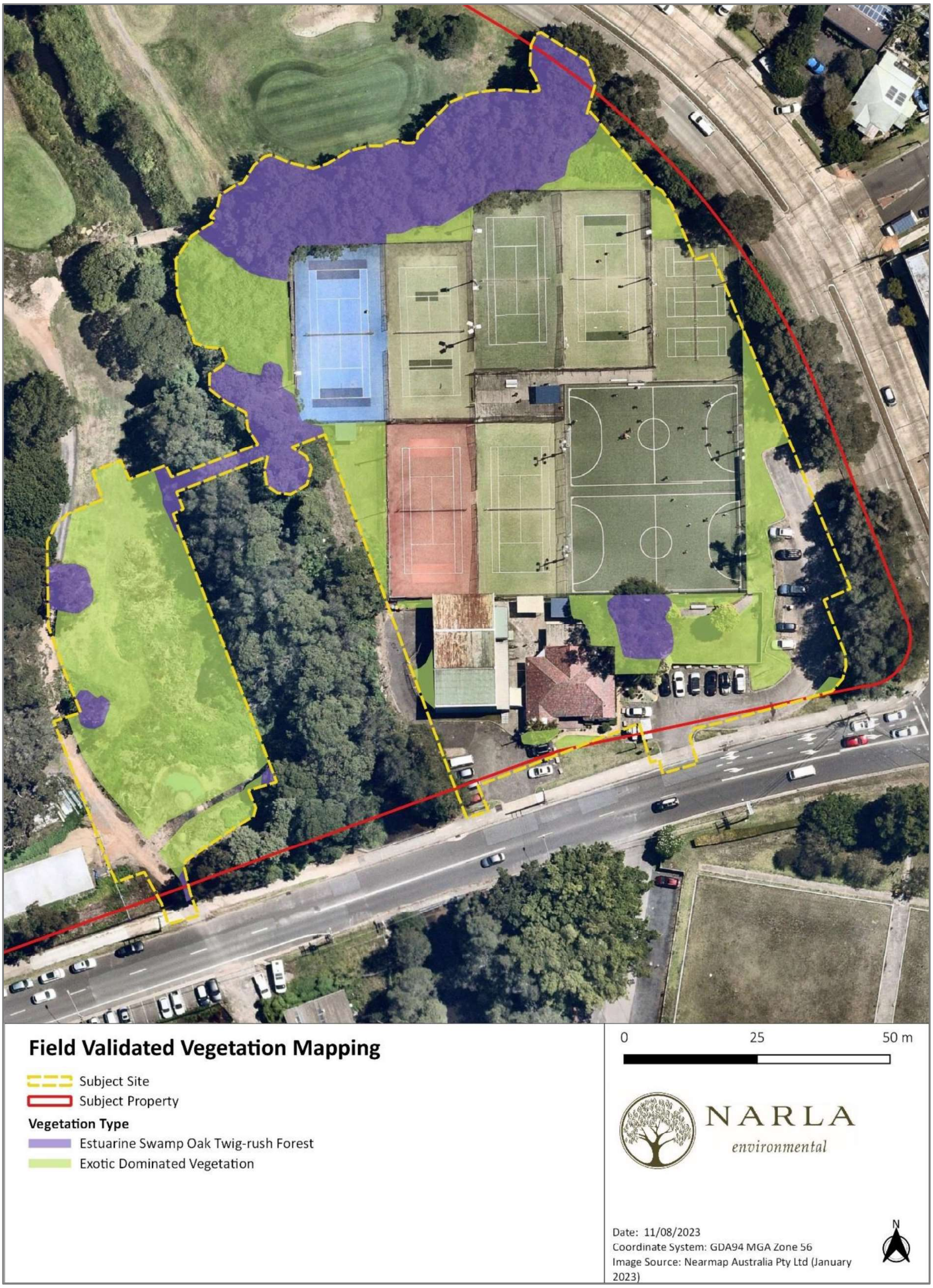

Figure 4. Field Validated Vegetation Mapping of the Subject Site.

Table 7 Description of Estuarine Swamp Oak Twig-rush Forest identified within the and surrounding the Subject Site.

Estuarine Swamp Oak Twig-rush Forest	
	
Extent within the Subject Site (approx.)	0.19ha
Description (DPE 2022)	
A tall to very tall open forest or woodland featuring *Casuarina glauca* and usually *Baumea juncea* and *Juncus kraussii* subsp. *australiensis*, occurring on the edges of tidal estuarine flats and tidal creek flats along the NSW coast, usually at elevations of below 10 metres asl. *Casuarina glauca* almost always forms a sparse to mid-dense tree layer, rarely accompanied by *Melaleuca quinquenervia*. A sparse or very sparse small tree or scrub layer of *Melaleuca ericifoli*a is occasionally present, while other *Melaleuca* species and other trees or shrubs only rarely occur. The mid-dense ground layer is primarily comprised of sedges, rushes, reeds and grasses that are tolerant of inundation, very frequently including *Baumea juncea* and *Juncus kraussii* subsp. *australiensis*, commonly with Phragmites australis. Other species occasionally occurring in the ground layer include *Samolus repens, Lobelia anceps* and *Gahnia clarkei*, while more rare species include *Sporobolus virginicus, Apium prostratum* and *Hemarthria uncinata*, the latter three with variable cover from site to site. This PCT has been recorded from Sawtell south to Tuross Head, however is likely to occur elsewhere along the NSW coast on the margins of brackish water bodies and watercourses. It is floristically related to PCT 4026 which occurs in similar environments, however PCT 4028 has a more consistent cover of *Casuarina glauca* and includes more species that are not tolerant of saline conditions. PCT 4028 occurs at slightly higher elevations than PCT 4026, or further upstream in areas with less frequent inundation. PCT 4028 overlaps spatially in the Hunter region with PCT 4038, with which it also weakly overlaps floristically, however PCT 4038 has thick *Melaleuca nodosa* which is only very rare and very sparse in PCT 4028.	

Estuarine Swamp Oak Twig-rush Forest	
Description of the Vegetation within and adjacent to the Subject Site	
This vegetation community was a tall open forest that was historically disturbed with a weed dominated understorey. The canopy layer was dominated by *Casuarina glauca* in conjunction with high quantities of *Melaleuca quinquenervia, Melaleuca linariifolia* and *Callistemon salignus,* with sporadic occurrences of *Eucalyptus robusta* and *Angophora costata*. Minor occurrences of the weeds *Cinnamomum camphora* and *Erythrina x sykesii* were also present within this stratum. The midstratum was generally sparse and dominated by *Homalanthus populifolius, Pittosporum undulatum* and *Acacia longifolia*. Exotic species in the midstratum included *Senna pendula, Lantana camara* and *Asparagus aethiopicus*. The ground layer was primarily exotic, however native species present included *Pteridium esculentum, Commelina cyanea, Lomandra longifolia, Cissus antarctica* and *Dichondra repens* Dominated exotic species includes *Ipomoea purpurea, Araujia sericifera, Ehrharta erecta, Ageratina adenophora, Parietaria Judaica, Cenchrus clandestinus, Anredera cordifolia* and *Eragrostis curvula.*	
Justification of Vegetation Assignment	This vegetation within the Subject Land is located on a tidal creek flat below 10m asl and contains diagnostic species in the canopy and midstratum, particularly *Casuarina glauca, Melaleuca quinquenervia* and *Melaleuca linariifolia.*
BC Act 2016 Status	The vegetation within the Subject Site conforms to the BC Act listed EEC Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions
EPBC Act 1999 Status	The vegetation within the Subject Site conforms to the EPBC Act listed EEC Coastal Swamp Oak Forest of South-east Queensland and New South Wales Community

Table 8 Description of Exotic Dominated Vegetation identified within the and surrounding the Subject Site.

Exotic Dominated Vegetation	
	
Extent within the Subject Site (approx.)	0.32ha
Description of the Vegetation within the Subject Property	
This vegetation community was dominated by common garden environmental exotics and noxious weeds, as well as areas of turf and planted gardens and trees. The canopy layer contained exotic species including *Phoenix canariensis* and *Harpephyllum caffrum.* The mid-storey was dominated by exotic species such as *Anethum graveolens, Lantana camara, Solanum nigrum, Ricinus communis* and *Strelitzia nicolai*. The ground layer was heavily dominated by exotic species, including *Ipomoea purpurea, Araujia sericifera, Ehrharta erecta, Ageratina adenophora, Parietaria Judaica, Cenchrus clandestinus, Anredera cordifolia* and *Eragrostis curvula*. The only native species within this zone was *Cynodon dactylon* which was located in areas of turf.	
Justification of Vegetation Assignment	This assemblage of species within the landscape of the Subject Property did not conform to any locally occurring community.
BC Act 2016 Status	Not Listed.
EPBC Act 1999 Status	Not Listed.

4. Threatened Entities

4.1 Threatened Ecological Communities

4.1.1 Listing under the BC Act: Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions, Endangered Ecological Community

Estuarine Swamp Oak Twig-rush Forest is associated with to Swamp Oak Floodplain Forest (SOFF) in the Sydney Basin Bioregion Endangered Ecological Community (EEC). Swamp Oak Floodplain Forest is associated with grey-black clay-loams and sandy loams, where the groundwater is saline or sub-saline, on waterlogged or periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains, generally below 20 m (NSW Scientific Committee 2011). The Subject Site occurs on such soils on a costal floodplain below 20m asl, and contains the following diagnostic species:

- *Callistemon salignus;*
- *Casuarina glauca;*
- *Commelina cyanea;*
- *Glochidion ferdinandi;*
- *Lomandra longifolia;* and
- *Melaleuca quinquenervia.*

Therefore, this community within the conforms to the EEC SOFF in the Sydney Basin Bioregion.

4.1.2 Listing under the EPBC Act: Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales

Estuarine Swamp Oak Twig-rush Forest is associated with Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales (CWOF) EEC. In order to be considered a Matter of National Significance, areas of the ecological community must meet both:

- the key diagnostic characteristics (**Table 9**); and
- at least the minimum condition thresholds for Category C (**Table 10**).

As Estuarine Swamp Oak Twig-rush Forest within the Subject Site meets the key diagnostic characteristics and minimum condition thresholds (Category C), this vegetation meets the definition of CWOF EEC.

Table 9. Key Diagnostic Characteristics of Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales.

Key Diagnostic Characteristic	Features Present within the Subject Site?
Occurs from south-east Queensland to southern NSW within the South Eastern Queensland, NSW North Coast, Sydney Basin, or South East Corner bioregions	Yes. The Subject Site is located within the Sydney Basin Bioregion.
Occurs in coastal catchments at elevations up to 50 m ASL, typically less than 20 m ASL, on coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated. There are also minor occurrences on coastal dune swales or flats, particularly deflated dunes and dune soaks.	Yes. The Subject Site occurs at <10m asl on a coastal floodplain.

Key Diagnostic Characteristic	Features Present within the Subject Site?
Occurs on soils derived from unconsolidated sediments (including alluvium), typically hydrosols (grey-black clay-loam and/or sandy loam soils) and sometimes organosols (peaty soils). It may occur in transitional soils (or catenas) where shallow unconsolidated sediments border lithic substrates.	Yes. The Subject Site is mapped as occurring on alluvial soils including loamy sand and peaty soils.
Has an open woodland, woodland, forest, or closed forest structure, with a tree canopy that has a total crown cover of at least 10 per cent.	Yes. Canopy cover is < 10%.
Has a canopy of trees dominated by *Casuarina glauca*	Yes. *Casuarina glauca* is the dominant species.

Table 10. Condition Thresholds for Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales (Green Box indicates condition class).

Vegetation Quality Class	**Large Patch** The patch ≥5 ha	**Medium Patch** The patch ≥2ha and <5 ha	**Small Contiguous Patch** The patch ≥0.5ha and <2ha, and is connected to a larger area of native vegetation of at least 5 ha	**Small Patch** The patch ≥0.5ha and <2ha
High Quality - Predominantly native understorey Non-native species comprise less than 20% of total understorey vegetation cover	Category A	Category B		Category C
Good Quality -Mostly native understorey Non-native species comprise less than 50% of total understorey vegetation cover and transformer species comprise less than 30% of total understorey vegetation cover*	Category B	Category C		N/A
Moderate Quality -Some native understorey Non-native species comprise less than 80% of total understorey vegetation cover and transformer species comprise less than 50% of total understorey vegetation cover	Category C		N/A	N/A
As non-native species comprise less than 80% of total understorey vegetation cover and transformer species comprise less than 50% of total understorey vegetation cover with a patch size >5ha, Estuarine Swamp Oak Twig-rush Forest within the Subject Site conforms to Condition Class C.				

4.1 Threatened Flora

Desktop analysis revealed a range of threatened flora as occurring or having the potential to occur on or within a 10km x 10km cell centred on the Subject Site. Thorough targeted surveys were undertaken throughout the Subject Site for potentially occurring threatened flora whose survey period coincided within the time of the site assessment (August 2023; **Figure 5**). No threatened flora whose survey period coincided with the time of the site assessment were identified at the time of the site assessment.

A comprehensive list of flora species identified during the site assessment is presented in **Appendix B .** The following locally occurring species were assessed for their potential to occur within the Subject Site (**Table 11**). Based on unsuitable habitat, geographic distribution and/or the small scale of the development, it was determined that the proposed works are unlikely to significantly impact upon these species. Therefore, no further assessment of impacts pursuant the BC Act (e.g. Biodiversity Development Assessment Report [BDAR]) and/or EPBC Act Referral to Commonwealth will be required.

Table 11. Assessment of likely occurrence of threatened flora species within the Subject Site. E = Endangered, CE = Critically Endangered, EP = Endangered Population, V = Vulnerable.

Species	BC Act	EPBC Act	Habitat Requirements (DPE 2023e)	Likelihood of occurrence within the Subject Site	Further Impact Assessment Required?
Acacia bynoeana (Bynoe's Wattle)	E	V	Occurs in heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches.	Absent. No heath or dry sclerophyll forest occurs within the Subject Site; however, a targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Acacia terminalis subsp. *terminalis* (Sunshine Wattle)	E	E	Coastal scrub and dry sclerophyll woodland on sandy soils. Habitat is generally sparse and scattered. Most areas of habitat or potential habitat are small and isolated. Most sites are highly modified or disturbed due to surrounding urban development. Flowers in autumn but may be through to early winter.	Low. Sandy soils were not present within the Subject Site; furthermore, the degraded and altered state of the Subject Site makes this species presence unlikely.	No
Allocasuarina portuensis (Nielsen Park She-oak)	E	E	The original known habitat of the Neilsen Park She-oak is at Nielsen Park, in Woollahra local government area. There are no plants left at the original site where it was discovered. However, propagation material has been planted successfully at a number of locations at Nielsen Park and other locations in the local area, e.g. Gap Bluff, Hermit Point and Vaucluse House. The Subject Site is outside this distribution.	Low. The original known habitat of the Neilsen Park She-oak is at Nielsen Park, in Woollahra local government area. There are no plants left at the original site where it was discovered. However, propagation material has been planted successfully at a number of locations at Nielsen Park and other locations in the local area, e.g. Gap Bluff, Hermit Point and Vaucluse House. The Subject Site is outside this distribution.	No
Caladenia tessellata (Thick Lip Spider Orchid)	E	V	Within NSW, *Caladenia tessellata* is currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Records in the Sydney area old from 1945 and it is likely extinct in these locations.	Low. As the Subject Site is outside of this current distribution it is unlikely to occur.	No
Callistemon linearifolius	V	-	Grows in dry sclerophyll forest on the coast and adjacent ranges.	**Present outside of the Subject Site.** This species was observed adjacent to Brookvale Creek outside of the	No

Species	BC Act	EPBC Act	Habitat Requirements (DPE 2023e)	Likelihood of occurrence within the Subject Site	Further Impact Assessment Required?
(Netted Bottle Brush)				Subject Site. Therefore, no impact is expected for this species.	
Chamaesyce psammogeton (Sand Spurge)	E	-	Grows on fore-dunes, pebbly strandlines and exposed headlands, often with Spinifex (*Spinifex sericeus*) and Prickly Couch (*Zoysia macrantha*).	Absent. No fore-shore dunes, pebbly strandlines, exposed headlands or the species associated with this species are located within the Subject Site. A targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Epacris purpurascens var. *purpurascens*	V	-	Found in a range of habitat types, most of which have a strong shale soil influence. Lifespan is recorded to be 5-20 years, requiring 2-4 years before seed is produced in the wild. Killed by fire and re-establishes from soil-stored seed.	Low. The Subject Site does not contain strongly shale influenced soils. Furthermore, the degraded state of the Subject Site makes this species presence unlikely.	No
Eucalyptus camfieldii (Camfield's Stringybark)	V	V	Occurs in poor coastal country in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges. Occurs mostly in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of *E. oblonga* Narrow-leaved Stringybark, *E. capitellata* Brown Stringybark and *E. haemastoma* Scribbly Gum.	Absent. While the Subject Site occurs on Hawkesbury sandstone, a targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Genoplesium baueri (Bauer's Midge Orchid)	E	E	Grows in dry sclerophyll forest and moss gardens over sandstone. Flowers February to March.	Low. The associated habitat for this species (dry sclerophyll forest) does not occur within the Subject Site. Furthermore, the highly disturbed nature of the Subject Site also makes the occurrence of this threatened plant highly unlikely.	No.

Species	BC Act	EPBC Act	Habitat Requirements (DPE 2023e)	Likelihood of occurrence within the Subject Site	Further Impact Assessment Required?
Grevillea caleyi (Caley's Grevillea)	CE	CE	All natural remnant sites occur within a habitat that is both characteristic and consistent between sites. All sites occur on the ridgetop between elevations of 170 to 240m asl, in association with laterite soils and a vegetation community of open forest, generally dominated by *Eucalyptus sieberi* and *E. gummifera*. Commonly found in the endangered Duffys Forest ecological community (EEC).	Absent. No ridgetops between elevations of 170-240 asl are present within the Subject Site, however, a targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Hibbertia superans	E	-	Flowering time is July to December. The species occurs on sandstone ridgetops often near the shale/sandstone boundary. Occurs in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides.	Absent. No ridgetops near the shale/sandstone boundary are present within the Subject Site. A targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Melaleuca biconvexa (Biconvex Paperbark)	V	V	Biconvex Paperbark generally grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects. Flowering occurs over just 3-4 weeks in September and October.	Absent. Although suitable habitat for this species is present within the Subject Site, a targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Microtis angusii (Angus's Onion Orchid)	E	E	It is not easy to define the preferred natural habitat of this orchid as the Ingleside location is highly disturbed. The dominant species occurring on the site are introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna*. The Ingleside population occurs on soils that have been modified but were originally those of the restricted ridgetop lateritic soils in the Duffys Forest - Terrey Hills - Ingleside and Belrose areas. These soils support a specific and distinct vegetation	Low. The Subject Site does not contain strongly shale influenced soils; furthermore, the degraded and altered state of the Subject Site makes this species presence unlikely.	No

Species	BC Act	EPBC Act	Habitat Requirements (DPE 2023e)	Likelihood of occurrence within the Subject Site	Further Impact Assessment Required?
			type, the Duffys Forest Vegetation Community and ranges from open forest to low open forest and rarely woodland.		
Persoonia hirsuta (Hairy Geebung)	E	E	The Hairy Geebung is found in clayey and sandy soils in dry sclerophyll open forest, woodland and heath, primarily on the Mittagong Formation and on the upper Hawkesbury Sandstone. It is usually present as isolated individuals or very small populations.	Absent. Sandy soil landscape is present within the Subject Site; however, a targeted survey was conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Pimelea curviflora var. *curviflora*	V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Also recorded in Illawarra Lowland Grassy Woodland habitat at Albion Park on the Illawarra coastal plain.	Low. Appropriate habitat requirements were not identified within the Subject Site, furthermore, the degraded and altered state of the Subject Site makes this species presence unlikely.	No
Prostanthera marifolia (Seaforth Mintbush)	CE	CE	Occurs in localised patches in or in close proximity to the endangered Duffys Forest ecological community. Located on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.	Absent. The endangered Duffys Forest ecological community is not in close proximity to the Subject Site. A targeted survey was still conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No
Rhodamnia rubescens (Scrub Turpentine)	CE	CE	Occurs in coastal districts north from Batemans Bay in New South Wales, approximately 280 km south of Sydney, to areas inland of Bundaberg in Queensland. Populations of *R. rubescen*s typically occur in coastal regions and occasionally extend inland onto escarpments up to 600 m asl. in areas with rainfall of 1,000-1,600 mm. Found in littoral, warm temperate and subtropical rainforest and wet sclerophyll forest usually on volcanic and sedimentary soils.	Absent. There was no presence of littoral, warm temperate and subtropical rainforest or wet sclerophyll forest usually on volcanic and sedimentary soils on the Subject Site. A targeted survey was still conducted during the approved survey period for this species (DPE 2023b) and no individuals were identified.	No.
Senecio spathulatus	E	-	Coast Groundsel occurs in Nadgee Nature Reserve (Cape Howe) and between Kurnell in Sydney and Myall Lakes	Absent. No frontal dunes were present within the Subject Site. A targeted survey was still conducted during the	No

Species	BC Act	EPBC Act	Habitat Requirements (DPE 2023e)	Likelihood of occurrence within the Subject Site	Further Impact Assessment Required?
(Coastal Groundsel)			National Park (with a possible occurrence at Cudmirrah). In Victoria there are scattered populations from Wilsons Promontory to the NSW border. Coast Groundsel grows on frontal dunes.	approved survey period for this species (DPE 2023b) and no individuals were identified.	
Syzygium paniculatum (Magenta Lilly Pilly)	E	V	On the south coast the Magenta Lilly Pilly occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low. Appropriate habitat requirements were not identified within the Subject Site, furthermore, the degraded and altered state of the Subject Site makes this species presence unlikely.	No
Tetratheca glandulosa	V	-	Associated with shale-sandstone transition habitat where shale-cappings occur over sandstone, with associated soil landscapes such as Lucas Heights, Gymea, Lambert and Faulconbridge. Topographically, the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches.	Low. Appropriate habitat requirements were not identified within the Subject Site, furthermore, the degraded and altered state of the Subject Site makes this species presence unlikely.	No

4.2 Threatened Fauna

Details of the fauna habitat recorded within the Subject Site are included in **Table 12** and displayed **Figure 5**. The likelihood of occurrence of threatened fauna species within the Subject Site is presented in **Table 13**.

Based on unsuitable habitat, geographic distribution and/or the small scale of the development, it was determined that the proposed works are unlikely to significantly impact upon a local viable population or occurrence of any of the threatened species. Therefore, no assessment under the '5-Part Test Assessment of Significance' was required and no BDAR or EPBC Act Referral to the Commonwealth is considered necessary for the proposed development.

Common avian fauna species were identified within and surrounding the Subject Site during the site assessment. All native fauna species encountered were listed as 'protected' under the BC Act. The list of fauna recorded during the site visit was produced opportunistically (**Appendix C**).

Table 12. Fauna habitat values within the Subject Site.

Habitat component	Site values
Coarse woody debris	Absent.
Rock outcrops and bush rock	Absent.
Caves, crevices and overhangs	Absent.
Culverts, bridges, mine shafts, or abandoned structures	Absent.
Nectar/lerp-bearing Trees	*Eucalyptus spp.* were present within the Subject Site. This species of tree may provide intermittent nectar sources for nomadic nectivores such as the Grey-headed Flying-fox.
Nectar-bearing shrubs	Present. *Melaleuca spp.* and *Callistemon spp.* were present within the Subject Site.
Koala use trees	Present.
Large stick nests	Absent.
Sap and gum sources	*Eucalyptus spp.* were present within the Subject Site. and can potentially be a sap and gum source.
She-oak fruit (Glossy Black Cockatoo feed)	Present in the form of *Casuarina glauca*
Seed-bearing trees and shrubs	Seed-bearing trees including *Angophora* species may provide foraging habitat for various bird species.
Soft-fruit-bearing trees	*Pittosporum undulatum* was identified within the Subject Site and may provide foraging habitat for fructivores such as the Grey-headed Flying-fox.
Dense shrubbery and leaf litter	Absent.
Tree hollows	Absent.
Decorticating bark	Absent.
Wetlands, soaks, and streams	Brookvale Creek is present within the Subject Site.
Open water bodies	Absent.
Estuarine, beach, mudflats, and rocky foreshores	Absent.
Smaller nests and possums dreys	Absent.

4.2.1 Migratory Fauna Species

Desktop analysis revealed the following EPBC Act listed migratory terrestrial fauna species were considered to have the potential to utilise habitat within the Subject Site (e.g. foraging or passage) during part of their lifecycles:

- *Cuculus optatus* (Oriental Cuckoo)
- *Hirundapus caudacutus* (White-throated Needletail);
- *Monarcha melanopsis* (Black Faced Monarch);
- *Motacilla flava* (Yellow Wagtail);
- *Myiagra cyanoleuca* (Satin Flycatcher);
- *Rhipidura rufifrons* (Rufous Fantail); and
- *Monarcha trivirgatus* (Spectacled Monarch).

It was determined that the proposed works are unlikely to have a significant impact on these species. Therefore, a Referral to Commonwealth pursuant to the EPBC Act is not required.

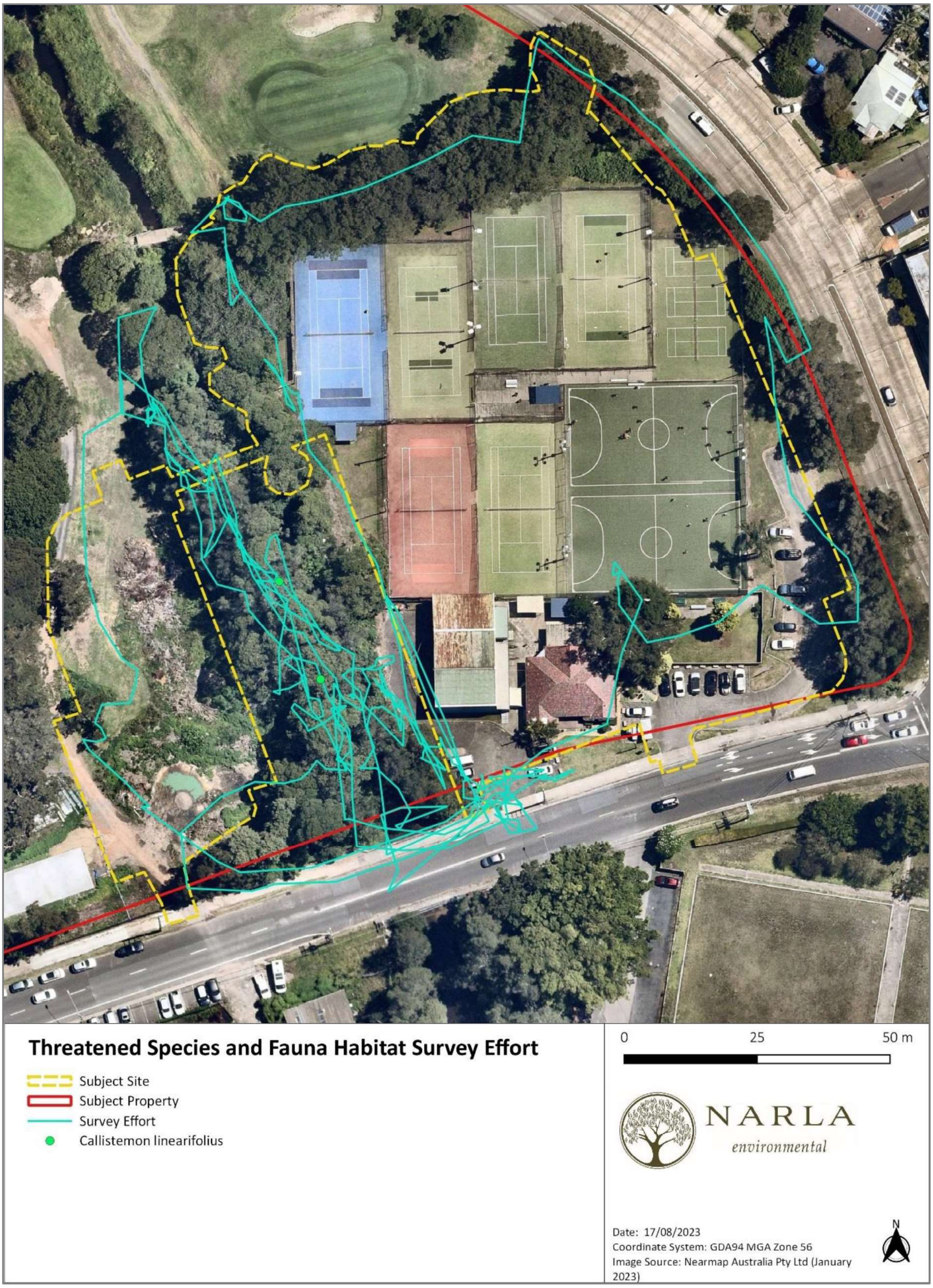

Figure 5. Threatened Species and Fauna Habitat Survey Effort.

Table 13. Assessment of likely occurrence of threatened fauna species within the Subject Site. E = Endangered, CE = Critically Endangered, EP = Endangered Population, V = Vulnerable.

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Anthochaera phrygia (Regent Honeyeater)	CE	CE	Low	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak These woodlands have significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Foraging habitat may be present within the Subject Site, however, due to its degraded nature it is sub-optimal in condition.	There are three known key breeding areas, two of them in NSW - Capertee Valley and Bundarra-Barraba regions. The species breeds between July and January in Box-Ironbark and other temperate woodlands and riparian gallery forest dominated by River Sheoak. Such habitat is not present within the Subject Site	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated loss of foraging or breeding habitat. Furthermore, the Subject Site is not located on the important areas map for this species.	No
Artamus cyanopterus (Dusky Wood swallow)	V	-	Low	Primarily inhabit dry, open eucalypt forests and woodlands, including mallee associations, with an open or sparse understorey of eucalypt saplings, acacias and other shrubs, and ground-cover of grasses or sedges and fallen woody debris. Foraging habitat may be present within the Subject Site, however, due to its degraded nature it is sub-optimal in condition.	Nest is an open, cup-shape, nest sites vary greatly, but generally occur in shrubs or low trees, living or dead, horizontal or upright forks in branches, spouts, hollow stumps or logs, behind loose bark or in a hollow in the top of a wooden fence post. Nest sites may be exposed or well concealed by foliage. No such nests were observed within the Subject Site. Due to highly urbanized and degraded nature of the Subject Site, the species is highly unlikely to use the Subject Site as breeding habitat.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated loss of foraging or breeding habitat.	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Botaurus poiciloptilus (Australasian Bittern)	E	E	Very Low	This species favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. No such habitat was identified within the Subject Site.	This species nests in densely vegetated wetlands. No such habitat was identified within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No
Burhinus grallarius (Bush Stone-curlew)	E	-	Low	This species inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. No such habitat was identified within the Subject Site.	This species nests on the ground in a scrape or small bare patch. No such nests were identified within the Subject Site. Due to highly urbanized and degraded nature of the Subject Site, the species is highly unlikely to use the Subject Site as breeding habitat.	Negligible. No anticipated loss of foraging or breeding habitat.	No
Calidris alba (Sanderling)	V	-	Low	This species is found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands. No suitable foraging habitat was found within the Subject Site.	N/A. Breeding occurs in the Northern Hemisphere.	Negligible. No anticipated loss of foraging or breeding habitat.	No.
Calidris canutus (Red Knot)	-	E	Low	This species mainly occurs in small numbers on intertidal mudflats, estuaries, bays, inlets, lagoons, harbours and sandflats and sandy beaches of sheltered coasts. No suitable foraging habitat was found within the Subject Site.	N/A. Breeding occurs in the Northern Hemisphere.	Negligible. No anticipated loss of foraging or breeding habitat.	No.

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Calidris ferruginea (Curlew Sandpiper)	E	CE	Low	The species generally occupies littoral and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats of sheltered coasts. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. No suitable foraging habitat was found within the Subject Site.	N/A. Breeding occurs in the Northern Hemisphere.	Negligible. No anticipated loss of foraging or breeding habitat.	No
Calidris tenuirostris (Great Knot)	V	CE	Low	This species occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons. Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms. No potential foraging habitat was found within the Subject Site.	N/A. Breeding occurs in the Northern Hemisphere.	Negligible. No anticipated loss of foraging or breeding habitat.	No
Calyptorhynchus lathami lathami (Southern Glossy Black-Cockatoo)	V	V	Low	This species feeds almost exclusively on the seeds of several species of she-oak (*Casuarina* and *Allocasuarina* species). Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of she-oak occur. Such habitat is present within the Subject Site.	Dependent on large hollow-bearing eucalypts for nest sites. No hollows were present within the Subject Site	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Cercartetus nanus	V	-	Low	This species is found in a broad range of habitats from rainforest through	Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-	Minimal impact to potential sub-optimal	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
(Eastern Pygmy-possum)				sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes, as well as insects. Such habitat is present within the Subject Site., although sub-optimal due to its degraded and urban nature.	nests, Ringtail Possum dreys or thickets of vegetation, although hollows are preferred. No such habitat was present within the Subject Site.	foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	
Chalinolobus dwyeri (Large-eared Pied Bat)	V	V	Low	This species forages for small, flying insects in well-timbered areas. Such habitat is present within the Subject Site., although sub-optimal due to its degraded and urban nature.	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*). No such habitat was identified within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Charadrius leschenaultii (Greater Sand-plover)	V	V	Low	Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks. Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders. No suitable foraging habitat was found within the Subject Site.	N/A. This species does not breed in Australia.	Negligible. No anticipated loss of foraging or breeding habitat.	No.

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Charadrius mongolus (Lesser Sand-plover)	V	E	Low	This species almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms. Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge. No suitable foraging habitat was found within the Subject Site.	N/A. This species does not breed in Australia.	Negligible. No anticipated loss of foraging or breeding habitat.	No.
Climacteris picumnus victoriae (Brown Treecreeper (eastern subspecies))	V	-	Low	Mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. Fallen timber is an important habitat component for foraging. No fallen timber was present within the Subject Site making it unsuitable for this species.	Hollows in standing dead or live trees and tree stumps are essential for nesting. No hollows were present within the Subject Site	Negligible. No anticipated loss of foraging or breeding habitat.	No.
Daphoenositta chrysoptera (Varied Sittella)	V	-	Low	Species feeds on arthropods from crevices in rough or decorticating bark. Such habitat is present within the Subject Site, although sub-optimal due to its degraded and urban nature.	This species nests in shrubs and low trees, creating an open cup shaped nest. No such nests were observed within the Subject Site. No such nests were observed within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Dasyurus maculatus (Spotted-tailed Quoll)	V	E	Low	Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits, reptiles and insects. Also eats carrion and takes domestic fowl. Potential prey items may exist within the Subject Site.	This species uses hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. No such habitat is present within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Esacus magnirostris (Beach Stone-curelw)	CE	-	Low	Beach Stone-curlews are found exclusively along the coast, on a wide range of beaches, islands, reefs and in estuaries, and may often be seen at the edges of or near mangroves. They forage in the intertidal zone of beaches and estuaries, on islands, flats, banks and spits of sand, mud, gravel or rock, and among mangroves. No suitable foraging habitat was present within the Subject Site.	Beach Stone-curlews breed above the littoral zone, at the backs of beaches, or on sandbanks and islands, among low vegetation of grass, scattered shrubs or low trees; also among open mangroves. There are no beaches within the Subject Site, thus no suitable breeding habitat is present.	Negligible. No anticipated loss of foraging or breeding habitat.	No
Eudyptula minor (Little Penguin in the Manly Point Area)	EP	-	Low	N/A. This species forages at sea.	This endangered population occurs from just north of Smedley's Point to Cannae Point, North Sydney Harbour, Manly. The Subject Site is not within this distribution.	Negligible. No anticipated loss of foraging or breeding habitat.	No
Glossopsitta pusilla (Little Lorikeet)	V	-	Low	This species forages primarily in the canopy of open Eucalyptus Forest and woodland, yet also finds food in *Angophora*, *Melaleuca,* and other tree species. Mostly feeds on nectar and pollen of flowers in the open canopy of woodland trees. Such habitat is present	Nests in proximity to feeding areas if possible, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. Entrance is small (3cm) and usually high above the ground (2–15m). No such habitat is present within Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
				within the Subject Site, although sub-optimal due to its degraded and urban nature.		anticipated net loss of breeding habitat.	
Haematopus fuliginosus (Sooty Oystercatcher)	V	-	Low	Forages on exposed rock or coral at low tide for foods such as limpets and mussels. No suitable foraging habitat was present within the Subject Site.	Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. No such habitat is present within Subject Site.	Negligible. No anticipated loss of foraging or breeding habitat.	No
Haematopus longirostris (Pied Oystercatcher)	E	-	Low	This species favours intertidal flats of inlets and bays, open beaches and sandbanks. Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. No suitable foraging habitat is present within the Subject Site.	This species nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. No suitable breeding habitat was found within the Subject Site.	Negligible. No anticipated loss of foraging or breeding habitat	No
Haliaeetus leucogaster (White-bellied Sea-Eagle)	V	-	Low	Habitats are characterised by the presence of large areas of open water including larger rivers, swamps, lakes, and the sea. Occurs at sites near the sea or sea-shore, such as around bays and inlets, beaches, reefs, lagoons, estuaries, and mangroves. Feed mainly on fish and freshwater turtles, but also waterbirds, reptiles, mammals and carrion. Such habitat is present within the Subject Site.	Breeding habitat consists of mature tall open forest, open forest, tall woodland, and swamp sclerophyll forest close to foraging habitat. Nests are large structures built from sticks and lined with leaves or grass. No nests or potential breeding sites were identified during the site assessment.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Heleioporus australiacus (Giant Burrowing Frog)	V	V	Low	Species occurs in heath, woodland and dry sclerophyll forest. It forages on invertebrates up to 300m from breeding site. No such habitat is present within or surrounding the Subject Site.	The species breeds in soaks and second order streams. As Brookvale Creek is a third order stream, such habitat is not present within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Hieraaetus morphnoides (Little Eagle)	V	-	Low	This species occupies open eucalypt forest, woodland or open woodland. Preys on birds, reptiles and mammals, occasionally adding large insects and carrion. Such habitat is present within the Subject Site, although sub-optimal due to its degraded and urban nature.	Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter. No suitably sized nests were identified during the site assessment.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Hirundapus caudacutus (White-throated Needletail)	-	V	Low	This species feeds on flying insects, such as termites, ants, beetles and flies. They catch the insects in flight in their wide gaping beaks. Birds usually feed in rising thermal currents associated with storm fronts and bushfires and they are commonly seen moving with wind fronts. Such habitat is present within the Subject Site, although sub-optimal due to its degraded and urban nature.	N/A. Does not breed in Australia.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Isoodon obesulus obesulus (Southern Brown Bandicoot [eastern])	E	E	Low	Typically found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous (underground-fruiting) fungi. The Subject Site may provide suboptimal foraging habitat for this species given the lack of heath or a heathy understorey, no distinctive scratching's were observed within the Subject Site.	Nest during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees *Xanthorrhoea* spp., blackberry bushes, and other shrubs, or in rabbit burrows. No such breeding habitat is present within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Ixobrychus flavicollis (Black Bittern)	V	-	Low	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. No such habitat was identified within the Subject Site.	Nests, built in spring, are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. No such nests were identified within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No
Lathamus discolor (Swift Parrot)	E	CE	Low	On the mainland, this species occurs in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (from sap-sucking bugs). Such habitat is present within the Subject Site, although sub-optimal due to its degraded and urban nature.	N/A. This species breeds in Tasmania.	Negligible, no anticipated net loss of foraging or breeding habitat. The Subject Site is not mapped on the Swift Parrot Important Areas Map (DPE 2023b).	No
Litoria aurea (Green and Gold Bell Frog)	E	V	Low	This species inhabits marshes, dams and stream-sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Brookvale Creek within the Subject Site lacks aquatic vegetation, making it sub-optimal for this species.	Breeding habitat in NSW includes water bodies that are still, shallow, ephemeral, unpolluted (but the frog can be found in polluted habitats), unshaded, with aquatic plants and free of Mosquito Fish (Gambusia holbrooki) and other predatory fish, with terrestrial habitats that consisted of grassy areas and vegetation no higher than woodlands, and a range of diurnal shelter site. Brookvale Creek within the Subject Site lacks aquatic vegetation, making it sub-optimal for this species.	Minimal impact to potential sub-optimal foraging and breeding habitat given the small area of removal and the degraded nature of the Subject Site.	No
Lophoictinia isura (Square-tailed Kite)	V	-	Low	Found in a variety of timbered habitats including dry woodlands and open forests. The species is a Is a specialist hunter of passerines, especially	Species nests along or near watercourses, in a fork or a larger horizontal limb. No nests were seen	Minimal, impact to potential foraging and breeding habitat given the small area	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
				honeyeaters, and most particularly nestlings, and insects in the tree canopy. Prey species may occur within the Subject Site.	within the Subject Site. Potential for nesting sites, however unlikely.	of removal and degraded nature of the Subject Site.	
Micronomus norfolkensis (Eastern Coastal Free-tailed Bat)	V	-	Low	Species insectivorous and occur in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Potential prey items may exist within the Subject Site.	Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges, and sometimes buildings during the day. A building, tree hollow and stormwater channel are present within the Subject Site. No such habitat is present within the Subject Site.	Minimal, impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site.	No
Miniopterus australis (Little Bent-winged Bat)	V	-	Low	Found in 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. At night, this species forages for small insects beneath the canopy of densely vegetated habitats. Such habitat is present within the Subject Site, although sub-optimal due to its degraded and urban nature.	Only five (5) nursery sites/maternity colonies are known in Australia. They require large colonies roosting together to provide the high temperatures needed to rear their young. No suitable breeding habitat was identified within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No
Miniopterus orianae oceanensis (Large Bent-winged Bat)	V	-	Low	Hunt in forested areas, catching moths and other flying insects above the tree tops. Such habitat is present within the Subject Site, although sub-optimal due to its degraded and urban nature.	This species only breeds in caves. No cave habitat was identified within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat.	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Myotis macropus (Southern Myotis)	V	-	Low	This species forages over streams and pools catching insects and small fish by raking their feet across the water surface. Foraging habitat may be present within the Subject Site, however, due to its degraded nature, it is sub-optimal in condition.	Generally, roost in groups of 10-15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges, and in dense foliage. No suitable breeding habitat was identified within the Subject Site.	Minimal impact to potential foraging habitat given the small area of removal and degraded nature of the Subject Site. Minimal impact to breeding habitat due to its degraded nature and sub-optimal condition.	No
Neophema pulchella (Turquoise Parrot)	V	-	Low	This species lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. It forges on seeds or grasses and herbaceous plants. Sub-optimal potential foraging habitat is present on the Subject Site.	This species nests in tree hollows, logs or posts. No suitable breeding habitat was identified within the Subject Site.	Minimal, impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site.	No
Ninox connivens (Barking Owl)	V	-	Low	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. 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. Potential	This species nests in large hollows. No large hollows were seen within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
				prey items may occur within the Subject Site.			
Ninox strenua (Powerful Owl)	V	-	Low	The species breeds and hunts in open or closed sclerophyll forest or woodlands and hunts small mammals. Foraging habitat may be present within the Subject Site, however, due to its degraded nature, it is sub-optimal in condition	This species favours hollows >20cm in diameter. No suitable breeding habitat was identified within the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat	No
Numenius madagascariensis (Eastern Curlew)	-	CE	Low	The species generally occupies coastal lakes, inlets, bays and estuarine habitats, and in New South Wales is mainly found in intertidal mudflats and sometimes saltmarsh of sheltered coasts. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. No such habitat is present within or surrounding the Subject Site.	N/A. This species does not breed in Australia	Negligible. No anticipated loss of foraging or breeding habitat	No
Pandion cristatus (Eastern Osprey)	V	-	Low	Favour coastal areas, especially the mouths of large rivers, lagoons, and lakes. Feed on fish over clear, open water. Suboptimal foraging habitat is present within the Subject Site.	Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea. No suitably sized nests were identified within the Subject Site.	Minimal, impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site.	No
Petroica boodang (Scarlet Robin)	V	-	Low	The species live in dry eucalypt forests and woodlands, habitat usually contains abundant logs and fallen	This species' nest is an open cup made of plant fibres and cobwebs and is built in the fork of tree usually more than 2	Minimal impact to potential sub-optimal foraging habitat given	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
				timber. Birds forage from low perches, fence-posts or on the ground, from where they pounce on small insects and other invertebrates which are taken from the ground. Foraging habitat may be present within the Subject Site, however, due to its degraded nature, it is sub-optimal in condition.	metres above the ground. No such nests were seen within the Subject Site.	the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat	
Phascolarctos cinereus (Koala)	E	E	Low	Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Foraging habitat may be present within the Subject Site, however, due to its degraded nature, it is sub-optimal in condition.	The urbanised and fragmented nature of the Subject Site makes the potential for Koala presence extremely low.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. No anticipated net loss of breeding habitat	No
Pseudomys novaehollandiae (New Holland Mouse)	-	V	Low	Species is known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. The Subject Site does not contain woodland and heathland understorey.	This species breeds in burrows. No burrows were identified within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No
Pseudophryne australis (Red-crowned Toadlet)	V	-	Low	Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones. Inhabits periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. No potential foraging habitat was seen within the Subject Site.	Breeding congregations occur in dense vegetation and debris beside ephemeral creeks and gutters. No potential breeding habitats were seen within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
Pteropus poliocephalus (Grey-headed Flying-fox)	V	V	Low	Feed on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca*, and *Banksia*, and fruits of rainforest trees and vines. Foraging habitat may be present within the Subject Site.	No breeding camps were identified within or surrounding the Subject Site.	Minimal impact to potential sub-optimal foraging habitat given the small area of removal and the degraded nature of the Subject Site. Negligible anticipated loss of breeding habitat.	No
Ptilinopus magnificus (Wompoo Fruit-Dove)	V	-	Low	Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit. Thought to be an effective medium to long-distance vector for seed dispersal. Feeds alone, or in loose flocks at any height in the canopy. Rainforest, low elevation moist eucalypt forest or brush box forests are not located in proximity to the Subject Site.	The nest is a typical pigeon nest - a flimsy platform of sticks on a thin branch or a palm frond, often over water, usually 3 - 10 m above the ground.	Negligible, no anticipated net loss of foraging or breeding habitat.	No
Ptilinopus regina (Rose-crowned Fruit-Dove)	V	-	Low	Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. Sub-tropical, dry rainforest, moist eucalypt forest or swamp forest do not occur within the Subject Site.	The species nest in rainforests with dense growth vines. The nest is a frail loosely woven cup of twigs and tendrils. No such nests were observed on site. No potential breeding habitat was seen within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No
Ptilinopus superbus	V	-	Low	Inhabits rainforest and similar closed forests where it forages high in the	The nest is a structure of fine interlocked forked twigs, giving a	Negligible, no anticipated net loss	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
(Superb Fruit-dove)				canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. The Subject Site does not contain rainforest or closed forests.	stronger structure than its flimsy appearance would suggest, and is usually 5-30m up in rainforest and rainforest edge tree and shrub species. No nests were observed within the Subject Site.	of foraging or breeding habitat.	
Saccolaimus flaviventris (Yellow-bellied Sheathtail-bat)	V	-	Low	This species forages for small, flying insects. The species flies high and fast over the forest canopy, but lower in more open country. Potential foraging habitat is present within the Subject Site	This species roosts in trees hollows and dilapidated buildings. No such habitat is present within the Subject Site.	Minimal impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site.	No
Scoteanax rueppellii (Greater Broad-nose bat)	V	-	Low	Species Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m. Foraging habitat may be present within the Subject Site, however, due to its degraded nature, it is sub-optimal in condition.	This species roosts in trees hollows and dilapidated buildings. No such habitat is present within the Subject Site.	Minimal impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site.	No
Thinornis cucullatus cucullatus (Eastern Hooded Dotterel)	CE	V	Low	Prefer sandy ocean beaches, especially those that are broad and flat, with a wide wave-wash zone for feeding, much beachcast seaweed, and backed by sparsely vegetated sand-dunes for shelter and nesting. No such habitat is present within the Subject Site.	Usually breed from August to March on sandy ocean beaches strewn with beachcast seaweed, in a narrow strip between the high-water mark and the base of the fore-dunes. No such habitat is present within the Subject Site.	Negligible, no anticipated net loss of foraging or breeding habitat.	No
Tyto novaehollandiae Masked Owl)	V	-	Low	Lives in dry eucalypt forests and woodlands from sea level to 1100m. The species often hunts along the edges of forests, including roadsides. Its diet consists of tree-dwelling and	This species nests in large hollows. No breeding habitat was present within the Subject Site.	Minimal impact to potential foraging and breeding habitat given the small area of removal and	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
				ground mammals, especially rats. Suboptimal foraging habitat was identified within the Subject Site.		degraded nature of the Subject Site. Negligible anticipated loss of breeding habitat.	
Tyto tenebricosa (Sooty Owl)	V	-	Low	Occurs in rainforest, including dry rainforest, subtropical and warm temperate rainforest, as well as moist eucalypt forests. Hunts by night for small ground mammals or tree-dwelling mammals such as the Common Ringtail Possum (*Pseudocheirus peregrinus*) or Sugar Glider (*Petaurus breviceps*). Suboptimal foraging habitat was identified within the Subject Site.	Nests in very large tree-hollows. No potential breeding habitat was present within the Subject Site.	Minimal impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site. Negligible anticipated loss of breeding habitat.	No
Varanus rosenbergi (Rosenburg's Goanna)	V	-	Low	Species is found in heath, open forest and woodland and associated with termites. The species feeds on carrion, birds, eggs, reptiles and small mammals. Sub-optimal foraging habitat was identified within the Subject Site.	The species lays up to 14 eggs in a termite mound; the hatchlings dig themselves out of the mounds. No termite mounds were identified within the Subject Site. No breeding habitat was present within the Subject Site.	Minimal impact to potential foraging and breeding habitat given the small area of removal and degraded nature of the Subject Site. Negligible anticipated loss of breeding habitat.	No
Vespadelus troughtoni (Eastern Cave Bat)	V	-	Low	Little is understood of its feeding or breeding requirements or behaviour. Therefore, foraging habitat may be present within the Subject Site.	A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs. No breeding habitat was present within the Subject Site.	Minimal impact to potential foraging and breeding habitat given the small area of removal and degraded nature of	No

Species	BC Act	EPBC Act	Likelihood of Occurrence	Foraging Habitat Present Within the Subject Site	Breeding Habitat Present Within the Subject Site	Anticipated Impact	Further Impact Assessment Required?
						the Subject Site. Negligible anticipated loss of breeding habitat.	

5. Impact Summary

5.1 Vegetation Impact

The proposed development will require the removal of the following vegetation within the Subject Site:

- 0.19ha of Estuarine Swamp Oak Twig-rush Forest which conforms to the BC Act listed Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions and EPBC listed Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales; and
- 0.32ha of Exotic Dominated Vegetation.

5.1.1 Threatened Ecological Communities: Swamp Oak Floodplain Forest Local Occurrence

Local occurrence is defined as the ecological community that occurs within the study area (OEH 2018). However, the local occurrence may include adjacent areas if the ecological community on the study area forms part of a larger contiguous area of that ecological community and the movement of individuals and exchange of genetic material across the boundary of the study area can be clearly demonstrated (OEH 2018).

Narla estimated that approximately 0.19ha of SOFF/CSOF occurs within the locality (the local occurrence) utilising the State Vegetation Type Map (DPE 2022) and field validated vegetation mapping of the Subject Site (**Figure 6**). The vegetation proposed for removal on the Subject Site therefore represents approximately 3.3% of the estimated local occurrence of SOFF.

5.2 Threatened Species

No threatened species are anticipated to be significantly impacted by the proposed works. One (1) threatened species, *Callistemon linearifolius* (Netted Bottle Brush), does occur in close proximity to the site, however it has been purposely avoided. Furthermore, a VMP will be prepared to guide the ongoing management and protection of the species within the vicinity of the works.

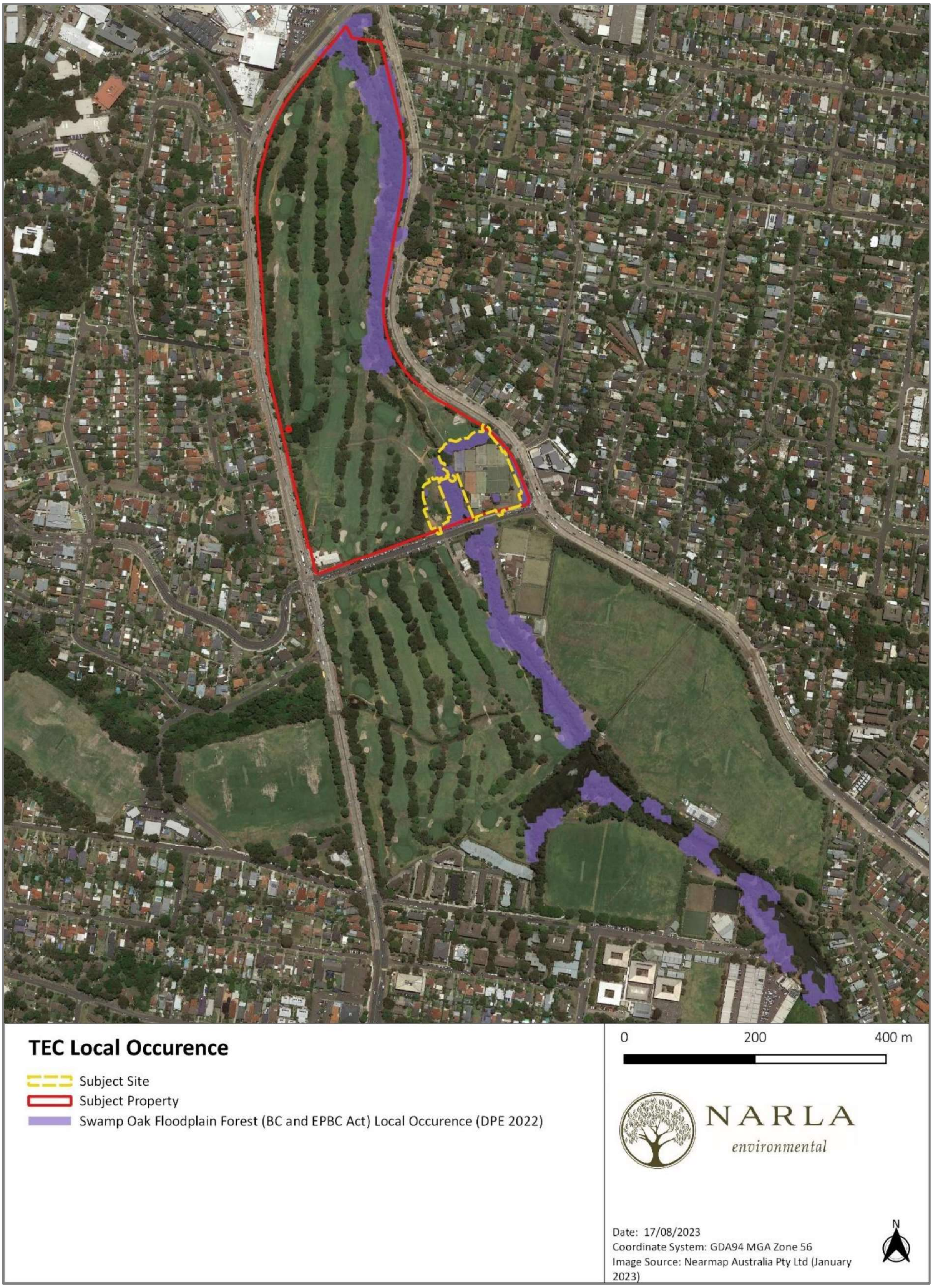

Figure 6. Local Occurrence of Swamp Oak Floodplain Forest (BC and EPBC Act)

5.3 Riparian Land and Waterway Impact

Potential impacts of construction and operation on the riparian land and waterway are to be controlled as per the CMP.

5.3.1 Impact Upon Water Quality

The existing waterway within the Subject Site is in a poor condition due to the continuous stormwater runoff it receives, with the water appearing murky and turbid. Although the health of the waterway on site is already degraded, water quality may be further impacted by pollutants during construction through the increase of stormwater and erosion during construction. A stormwater overflow outlet will be constructed to flow into Brookvale Creek, however it is not expected that this would impact water quality as it would only occur during overflow events.

In order to minimise impacts to water quality and the waterway on site, a CMP will be implemented during construction, which will apply the following principles:

- Sediment and erosion control measures will be constructed in accordance with "Managing Urban Stormwater: Soils and Construction (Landcom 2004)" The Blue Book
- All stormwater and erosion control structures will be in place before the commencement of construction and continue to operate after completion of the construction until the land is stabilised.
- Uncontaminated runoff from outside the construction site will be diverted around the site.
- No untreated construction site runoff will be discharged into receiving waters such including Brookvale Creek and Kentwell Road stormwater drains.
- Drainage through and from areas of construction will be designed to minimise surface flow velocities.
- All silt fences, silt traps and sedimentation basins will be cleaned out once 30% of their capacity has been filled.
- Bare areas will be stabilised within 20 days of the completion of construction activities or 14 days in areas where erosion is more likely to occur.
- Temporary stabilisation techniques such as strategically placed erosion matting, sediment screens, hay bale energy dissipaters, mulching and annual grass species establishment will be implemented on disturbed areas.

If the mitigation measures recommended in the CMP are undertaken, water quality within the waterway on site (which is already in a poor health) will not be adversely impacted by the proposed development.

5.3.2 Impacts On Channel Form, Erosion Rate and Bank Stability

There was no evidence of erosion or sedimentation issues identified during the site visit with the banks consisting primarily of sandstone blocks. Although minor impacts to the banks stability and erosion may occur during construction of the pedestrian bridge, it is not expected the impact the channel form. A stormwater overflow outlet will be constructed to flow into Brookvale Creek; however, it is not expected that this would impact bank stability as it will be supported by rock headwall via a lined swale to flow into the creek. Bank stability and erosion will be managed by an CMP during construction, and a VMP will be prepared to guide to management of the vegetation on the banks and riparian area post-construction.

5.3.3 Riparian Ecological Impacts of the Development

The vegetation surrounding the degraded waterway was exotic dominated, particularly in the groundlayer. Overall, 0.19ha of native riparian vegetation and 0.32ha of exotic riparian vegetation will be removed as part of the proposal, which may impact up bank stability and general ecological health. However, a VMP will be prepared to mitigate against the impacts to riparian vegetation through requirements of revegetation following construction and the ongoing management of the remnant riparian vegetation.

The proposal has the potential to impose indirect impacts on vegetation and within the stormwater channel that are on site, as well to those that occur downstream. Alteration to the amount and quality of runoff from the development areas has the potential to alter sensitive downstream environments, through the introduction of hard surfaces (roofs, driveways, access roads, hard landscaping) and the reduction of vegetation cover. Furthermore, it is possible to the proposed development will introduce weeds to vegetation directly adjacent the Subject Site. Such impacts will be managed through the implementation of the CMP and VMP.

5.3.4 Landscape Impacts of the Development

The natural landscape of the Subject Site will remain largely intact. No alterations to the naturally occurring waterway will occur, with only minor impacts to the banks associated with the proposed pedestrian bridge. The proposal has been designed to minimise impacts to the natural waterway and potential overland flows across the site, which will be managed through the implementation of CMP. No other modification to the landscape of the waterway is expected as part of the proposal.

6. Recommendations

6.1 Impact Mitigation and Minimisation Recommendations

This section of the report details recommended efforts to avoid and minimise impacts on biodiversity values associated with the proposed development. Measures to be implemented before, during, and post construction are detailed in **Table 14.**

Table 14. Measures to be implemented before, during and after construction to avoid and minimise the impacts of the proposed development

Action	Outcome	Timing	Responsibility
Project Location, Design and Planning	The development proposal is concentrated in the areas of existing infrastructure and disturbance with aims to avoid remnant riparian vegetation, where possible. One (1) threatened species, *Callistemon linearifolius* (Netted Bottle Brush), does occur in close proximity to the site, however it has been purposely avoided by the proposal.	Pre-construction phase	Proponent
Assigning a Project Ecologist	Prior to the implementation of the development, the proponent should commission the services of a qualified and experienced Ecologist with a minimum tertiary degree in Science, Conservation, Biology, Ecology, Natural Resource Management, Environmental Science or Environmental Management. The Ecologist must be licensed with a current Department of Primary Industries Animal Research Authority permit and New South Wales Scientific License issued under the BC Act. The Ecologist will be commissioned to: ▪ Undertake an extensive pre-clearing survey; delineating habitat-bearing trees and shrubs to be retained/removed; and ▪ Supervise the clearance of trees and shrubs (native and exotic) in order to capture, treat and/or relocate any displaced fauna particularly	Pre-construction phase	Proponent
Vegetation Management Plan (VMP)	A Vegetation Management Plan (VMP) is to be prepared by a suitably qualified Ecologist to guide the revegetation of the riparian corridor following construction. All revegetation should use species that conform to Estuarine Swamp Oak Twig-rush Forest and be undertaken in accordance with '*Controlled activities – Guidelines for vegetation management plans on waterfront land*' (DPE 2022). The VMP should also guide the management of retained riparian vegetation adjacent to the Subject Site within the Subject Property, particularly the management and enhancement of Swamp Oak Floodplain forest EEC and *Callistemon linearifolius* (Netted Bottle Brush) through the reduction of weeds.	Pre-construction phase	Proponent Project Ecologist

Action	Outcome	Timing	Responsibility
Tree Protections	Australian Standard 4970 (2009) Protection of Trees on Development Sites (AS-4970) outlines that a Tree Protection Zone (TPZ) is the principal means of protecting trees on construction sites. It is an area isolated from construction disturbance so that the tree remains viable. Ideally, works should be avoided within the TPZ. A Minor Encroachment is less than 10% of the TPZ and is outside the SRZ. A Minor Encroachment is considered acceptable by AS-4970 when it is compensated for elsewhere and contiguous within the TPZ. A Major Encroachment is greater than 10% of the TPZ or inside the SRZ. Major Encroachments generally require root investigations undertaken by non-destructive methods or the use of tree sensitive construction methods. Trees proposed for retention should be delineated by temporary fencing by the Project Arborist. Temporary fencing should be erected at a minimum distance of the structural root zone of each tree proposed for retention.	Pre-construction phase	Proponent Arborist
Removal of Priority Weeds	The four (4) Priority weeds identified within the Subject Site should be removed in accordance with the Biosecurity Act 2015 and NSW Weedwise, these weed species include: ▪ *Asparagus aethiopicus* (Ground Asparagus); ▪ *Rubus fruticosus spp. agg* (Blackberry); ▪ *Lantana camara* (Lantana); and ▪ *Anredera cordifolia* (Madeira Vine).	Construction Phase	Proponent Ecologist
Erosion, Sedimentation and Stormwater.	A CMP has been prepared to guide the management of Erison, Sediment and Stormwater during construction. The following principles will be applies to ensure effects of Brookvale Creek and minimised: ▪ Sediment and erosion control measures will be constructed in accordance with "Managing Urban Stormwater: Soils and Construction (Landcom 2004)" – The Blue Book; ▪ All stormwater and erosion control structures will be in place before the commencement of construction and continue to operate after completion of the construction until the land is stabilised; ▪ Uncontaminated runoff from outside the construction site will be diverted around the site; ▪ No untreated construction site runoff will be discharged into receiving waters such including Brookvale Creek and Kentwell Road stormwater drains; ▪ Drainage through and from areas of construction will be designed to minimise surface flow velocities;	Construction phase	Proponent Construction Contractor

Action	Outcome	Timing	Responsibility
	▪ All silt fences, silt traps and sedimentation basins will be cleaned out once 30% of their capacity has been filled; ▪ Bare areas will be stabilised within 20 days of the completion of construction activities or 14 days in areas where erosion is more likely to occur; and ▪ Temporary stabilisation techniques such as strategically placed erosion matting, sediment screens, hay bale energy dissipaters, mulching and annual grass species establishment will be implemented on disturbed areas.		
Landscaping	Landscaping within the Subject Property should incorporate species representative of the local community being Estuarine Swamp Oak Twig-rush Forest.	Post-construction	Proponent Landscape Architect
Storage and Stockpiling (Soil and Materials)	Allocate all storage, stockpile, and laydown sites away from any vegetation that is planned to be retained. Avoid importing any soil from outside the site as this can introduce weeds and pathogens to the site in order to avoid the potential of incurring indirect impacts on biodiversity values.	Construction phase	Construction Contractors
Riparian Lands and Waterways	Impact mitigation and minimisation measures are to be implemented and followed before, during and after construction works as described within the project CMP. This plan outlines measures to be followed in regards to impacts on vegetation, riparian ecology, bank stability, erosion and sedimentation, water quality and landscaping. Specific outcomes of these mitigation and minimisation measures include: ▪ Protecting native species and communities; ▪ Preventing loss of natural diversity through protecting waterway and riparian vegetation (including non-native vegetation); ▪ Minimising damage to public and private property by waterway processes through maintaining the relative stability of the beds and banks; and ▪ Preserving natural ecological processes.	All phases	Proponent Construction Architect

7. Conclusion

This assessment indicates that the relevant biodiversity conservation provisions of the Environmental Planning and Assessment Act 1979 and the relevant provisions of the WLEP 2011 and the WDCP 2011 have been fulfilled. The proposed development will require the removal of the following vegetation within the Subject Site:

- 0.19ha of Estuarine Swamp Oak Twig-rush Forest which conforms to the BC Act listed Swamp Oak Floodplain Forest in the NSW North Coast, Sydney Basin and South East Corner Bioregions and EPBC listed Coastal Swamp Oak (*Casuarina glauca*) Forest of South-east Queensland and New South Wales; and
- 0.32ha of Exotic Dominated Vegetation.

No threatened species are expected to be significantly impacts by the proposed development. One (1) threatened species, *Callistemon linearifolius* (Netted Bottle Brush), does occur in close proximity to the site, however it has been purposely avoided.

In addition, the proposed development is considered unlikely to result in adverse impacts on the waterway. Brookvale Creek is already heavily disturbed with turbid water and weed dominated riparian vegetation. The overall impact to the creek is minimal, with no instream works proposed.

If the appropriate recommendations in this report are followed, the proposed DA will have minimal ecological impacts. This includes the preparation of a VMP and the implementation of the site CMP.

8. References

Australian Standard 4970 (2009) Protection of Trees on Development Sites (AS-4970)

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Department of Primary Industries (DPI) (2023) NSW WeedWise: Priority weeds for the Greater Sydney https://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=3

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Landcom (2004) Managing Urban Stormwater: Soils and Construction 'The Blue Book', Volume 1, Fourth Edition, New South Wales Government, ISBN 0-9752030-3-7

Group Architects (2023) Overall Site Plan

Northern Beaches Council (2011a) Warringah Development Control Plan (WDCP)

Northern Beaches Council (2011b) Warringah Environmental Plan (WLEP)

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PlantNET (2023) The NSW Plant Information Network System, Royal Botanic Gardens and Domain Trust, Sydney. http://plantnet.rbgsyd.nsw.gov.au

9. Appendices

Appendix A. Site Plan (Group Architects 2023)

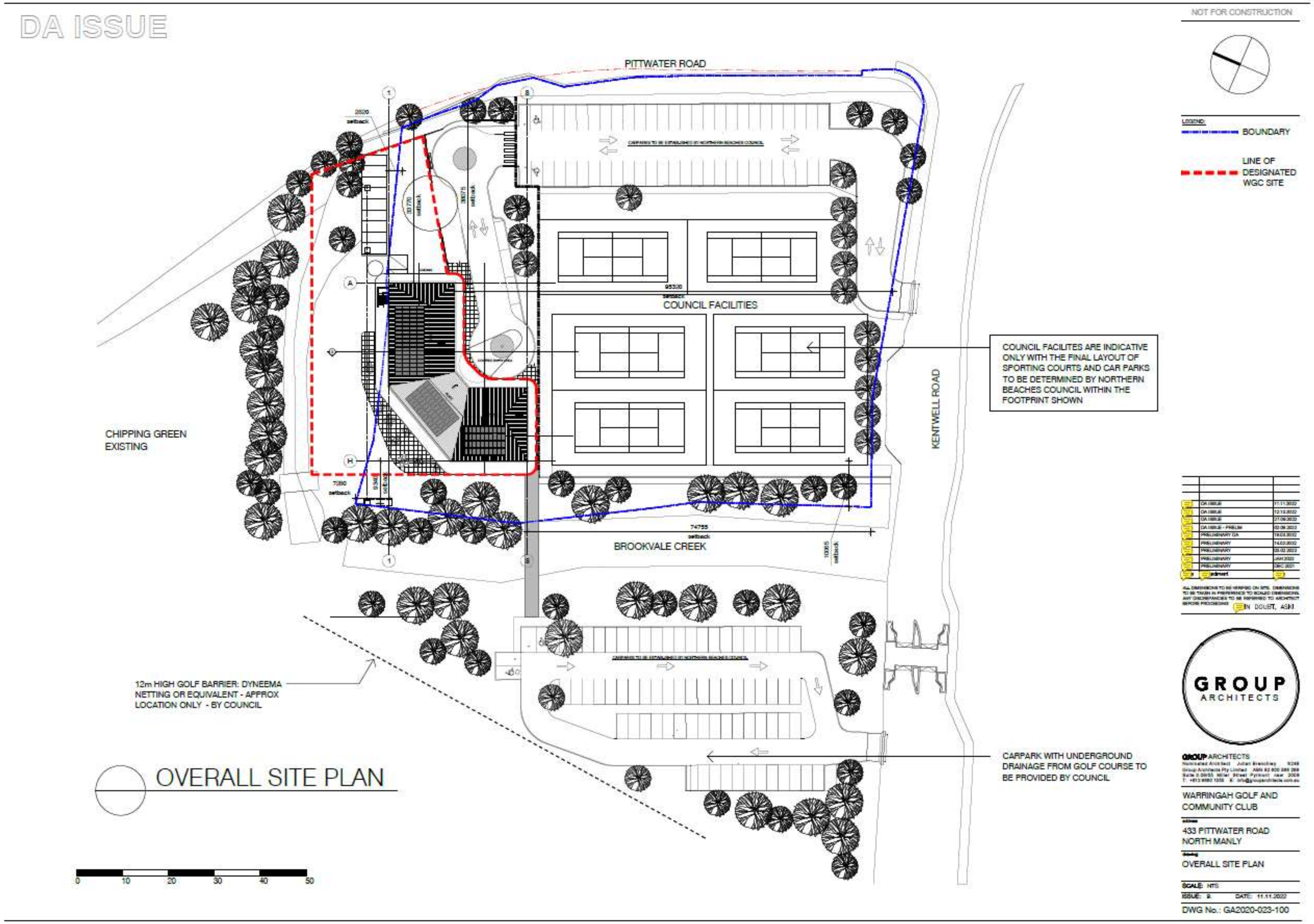
Appendix B. Flora species identified within the Subject .

Appendix C. Fauna species identified within and surrounding the Subject Property.

Appendix D. Biodiversity Conservation Act 2016 - Test of Significance for Swamp Oak Floodplain Forest.

Appendix E. EPBC Act Assessment of Significant Impact for Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland

Appendix A. Site Plan (Group Architects 2023)



Appendix B. Flora species identified within the Subject Site and immediate surrounds.

Scientific Name	Canopy	Mid-Story	Ground
Acacia longifolia		x	
*Acetosa sagittata**			x
*Ageratina adenophora**			x
*Anethum graveolens**		x	
Angophora costata	x		
*Anredera cordifolia***			x
*Araujia sericifera**			x
*Asparagus aethiopicus***		x	
*Bidens pilosa**			x
Brachychiton acerifolius	x		
*Bromus catharticus**			x
Callistemon linearifolius (Vulnerable)		x	
Callistemon salignus	x		
Callistemon viminalis		x	
Casuarina glauca	x		
*Cenchrus clandestinus**			x
*Cinnamomum camphora**	x		
Cissus antarctica			x
*Colocasia spp. **			x
Commelina cyanea			x
*Conyza bonariensis**			x
Cupaniopsis anacardioides		x	
Cyathea australis		x	
Cynodon dactylon			x
*Cyperus eragrostis**			x
Dichondra repens			x
*Ehrharta erecta**			x
*Eragrostis curvula**			x
*Erythrina x sykesii**	x		
Eucalyptus robusta	x		
Ficus rubiginosa		x	
*Fumaria officinalis**			x
Glochidion ferdinandi		x	
*Harpephyllum caffrum**		x	
Homalanthus populifolius		x	
*Hydrocotyle bonariensis**			x
*Ipomoea purpurea**			x
*Lantana camara***		x	
Livistona australis	x		
Lomandra longifolia			x
Melaleuca linariifolia	x		
Melaleuca quinquenervia	x		
*Modiola caroliniana**			x

Scientific Name	Canopy	Mid-Story	Ground
*Nephrolepis cordifolia**			x
*Parietaria judaica**			x
*Phoenix canariensis**	x		
Phragmites australis			x
Pittosporum undulatum		x	
*Poa annua**			x
Pteridium esculentum			x
*Ricinus communis**			x
*Rubus fruticosus spp. agg.***		x	
*Senna pendula**		x	
*Sifa rhombifolia**			x
*Solanum nigrum**		x	
*Soliva sessilis**			x
*Sonchus oleraceus**			x
*Stellaria media**			x
*Strelitzia nicolai**			x
*Thunbergia alata**			x
*Tradescantia fluminensis**			x
*Vicia sativa**			x

* Denotes exotic species, ** Denotes Priority Weed

Appendix C. Fauna species identified within and surrounding the Subject Property.

Class	Scientific Name	Common Name	Status
Aves	*Chenonetta jubata*	Australian Wood Duck	Protected
	Cracticus torquatus	Grey Butcherbird	
	Manorina melanocephala	Noisy Miner	
	Porphyrio porphyrio	Purple Swamphen	
	Vanellus miles	Masked Lapwing	
	Manorina melanocephala	Noisy Miner	
Reptilia	*Cracticus torquatus*	Grey Butcherbird	

Appendix D. Biodiversity Conservation Act 2016 - Test of Significance for Swamp Oak Floodplain Forest.

<table>
<tr><th colspan="3">Biodiversity Conservation Act 2016 – Test of Significance (5-part Test)
for
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF)</th></tr>
<tr><th colspan="3">BC Act Status: Endangered Ecological Community</th></tr>
<tr><td>(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,</td><td colspan="2">Not applicable – Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF) is not a species</td></tr>
<tr><td rowspan="2">(b) in the case of an endangered ecological community or critically endangered ecological community, whether the proposed development or activity:</td><td>(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or</td><td>The proposed activity is not 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.
In total, 0.19ha of this community will be impacted which accounts for less than 3.3% of the local occurrence of this community. Large areas of this community will continue to exist in the adjoining landscape.</td></tr>
<tr><td>(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,</td><td>The proposed activity is not likely to substantially and adversely modify the composition of SOFF such that its local occurrence is likely to be placed at risk of extinction.
In total, 0.19ha of the local occurrence of the EEC is proposed to be impacted. The vegetation to be cleared is in poor condition with a predominately exotic groundlayer with common canopy and mid-storey species present, making it unlikely the composition of the community within the locality would be reduced.</td></tr>
<tr><td rowspan="2">(c) in relation to the habitat of a threatened species or ecological community:</td><td>(i) the extent to which habitat is likely to be removed or modified as a result of the proposed development or activity, and</td><td>Approximately 0.19ha will be removed to accommodate the proposed activity.</td></tr>
<tr><td>(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of</td><td>The 0.19ha SOFF to be impacted located on the edge of an existing patch adjacent to a road. The removal of this small amount of vegetation is</td></tr>
</table>

Biodiversity Conservation Act 2016 – Test of Significance (5-part Test) for Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (SOFF)		
BC Act Status: Endangered Ecological Community		
	habitat as a result of the proposed development or activity, and	not expected to lead to any further fragmentation.
	(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,	All areas that support viable patches of SOFF are important. However, impacts to the patch in question will not cause significant fragmentation or isolation of the EEC as representative vegetation will continue to occur throughout the locality. Impacts to 0.19ha of the EEC is highly unlikely to decrease the long-term survival of the community.
(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),	The proposed activity is not likely to have an adverse effect on any declared area of outstanding biodiversity value, 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.	The following Key Threatening Processes (KTPs) listed under Schedule 4 of the BC Act are relevant to the protection of potential habitat in the scope of the proposed activity within the Subject Site for this EEC: Clearing of native vegetation; ▪ Invasion of native plant communities by exotic perennial grasses; and ▪ Invasion, establishment and spread of Lantana (*Lantana camara*).	

References

NSW Department of Planning and Environment (DPE) (2021) Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions – profile.

NSW Government (2021) NSW Legislation: Biodiversity Conservation act 2016 No 63, Schedule 4: Key Threatening Processes https://www.legislation.nsw.gov.au/acts/2016-63.pdf

Appendix E. EPBC Act Assessment of Significant Impact for Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland

Commonwealth Environment Protection and Biodiversity Conservation Act 1999 Assessment of Significant Impact Criteria for Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland (CSOF)	
EPBC Act Status: Endangered	
Significant impact criteria An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:	
• reduce the extent of an ecological community	The proposed development is not likely to reduce the extent of the ecological community. The proposed subdivision will result in the removal of approximately 0.19ha of CSOF which makes up approximately 3.3% of the community within the Subject Property. The extent of CSOF to be removed is in poor condition and is expected to persist in the broader Subject Property and locality
• fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines	It is not likely that CSOF within the Subject Site will become fragmented. Vegetation consisting of CSOF will persist directly adjacent to the Subject Site to the north and the south. A small pedestrian bridge will be built within the patch however connectivity is expected to remain either side of the bridge.
• adversely affect habitat critical to the survival of an ecological community	The proposed development will not adversely affect habitat critical to the survival of CSOF. The extent of CSOF to be removed is in poor condition due to the invasion of weeds. It is not expected the removal of 0.19ha will significantly impact the long-term survival of the ecological community in the locality.
• modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns	The proposed development will not modify or destroy abiotic factors necessary for the survival of CSOF. The proposed activities will result in the removal/management of approximately 0.19ha of CSOF. The removal of this small amount of vegetation is not likely to have any impact on groundwater or surface water drainage patterns, particularly through the implementation of the CMP during the construction until revegetation works are complete.
• cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting	The proposed development will result in the removal of approximately 0.19ha of CSOF. The vegetation to be cleared is in poor condition with a predominately exotic groundlayer with common canopy and mid-storey species present, making it unlikely the composition of the community within the locality would be reduced within the locality.
• cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to: – assisting invasive species, that are harmful to the listed ecological community, to become established, or	The proposed development will not cause a substantial reduction in the quality or integrity of CSOF. The extent of CSOF to be removed is 3.3% of the local occurrence and consists of a predominately exotic groundlayer.

Commonwealth Environment Protection and Biodiversity Conservation Act 1999 Assessment of Significant Impact Criteria for Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland (CSOF)	
EPBC Act Status: Endangered	
– causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or	
• interfere with the recovery of an ecological community	It is not expected that the removal of 0.19ha of CSOF will interfere with the recovery of this community given the implementation of the impact mitigation measures as outlined in this report.
References: Department of the Environment and Energy (2018). Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community. Canberra: Department of the Environment and Energy.	

NARLA

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Our Ref: 64551
25 July 2023

Attention: Graeme McMullan

RE: Preliminary Slope Stability Assessment at 292 Condamine Road, North Manly

1 INTRODUCTION

Ideal Geotech has prepared this report to discuss the results of the preliminary geotechnical assessment undertaken for the proposed development at 292 Condamine Road, North Manly. Ideal Geotech was engaged to provide a preliminary landslip risk assessment.

The site is located within **Area A** on the Landslip Risk Map- Sheet LSR_008 which does not normally require a preliminary Geotechnical Assessment, but council has requested a report to determine if further investigation is required.

2 PROPOSED DEVELOPMENT

With reference to the supplied drawings prepared by Group Architects, drawing no. GA2020-023-00X and dated 24 January 2023, it is understood that the proposed development comprises the construction of a new clubhouse at the Warringah Golf and Community Club. Up to approximately 0.7m of cut and 0.6m of fill will be undertaken for the construction of the clubhouse with some possible further excavation undertaken for the footings.

4 GEOLOGY

The Sydney 1:100,000 scale Geological Series Map indicates that the subject site is underlain by Quaternary deposits consisting of silty to peaty quartz sand, silt and clay with some shell layers.

5 SITE DESCRIPTION

The site is irregular in shape with a total area of approximately 1,239m^2. The site is bound by Pittwater Road to the north and east, Kentwell Road to the south and the golf course to the west. The site is located on relatively flat terrain.

During the course of the inspection no slip scarps or tension cracks were documented nor was there any visible hummocking of the land. This leads to the assumption that no significant slope failures have occurred.

Existing development comprises an existing club house.

6 RECOMMENDATIONS

During the course of the inspection, no slip scarps or tension cracks were documented nor was there any visible hummocking of the land. This leads to the assumption that no significant slope failures or subsidence has occurred.

The stability of a site is generally governed by site factors such as slope angles, depth of in-situ soils, and strength of sub-surface material and concentrations of water. The Australian Geomechanics Society recommends that the landslide risk of a site is assessed on the basis of the likelihood of a landslide event and the consequences of that event.

A Risk Assessment related to shallow soil slips, near surface slumping and deep-seated landslides, subject to adherence to our recommendations, has been provided in Table 1 below.

Table 1: Summary of Risk to Property and Life

HAZARD	SOIL CREEP	NEAR SURFACE SLUMPING	ACTIVE OR DEEP SEATED LAND SLIDE	ROCK FALL (ABOVE DWELLING LOCATION)
Likelihood	Rare	Rare	Rare	Barely credible
Consequence to Property	Minor	Medium	Major	Major
Risk to Proposed Development	Very Low	Low	Low	Very low
Risk to Life	1 x 10^{-6}/annum	1 x 10^{-5}/annum	1 x 10^{-5}/annum	1 x 10^{-6}/annum
Remarks	None observed	None observed	None observed	None observed

The site is currently in a stable condition, based on a "Very Low to Low" Risk Level of instability relating to shallow soil slips and active or deep-seated land slide. With reference to the supplied drawings prepared by Group Architects, it is our assessment that the site is suitable for the proposed development and will not be subject to subsidence, slip, slope failure or erosion, provided all construction is carried out in accordance with good engineering and hill slope practices.

The soil profile consists of high permeability silty sands and stormwater discharge will not cause significant detrimental impacts as it is understood absorption trenches are to be installed in conjunction with the high permeability soils. Due to the soil profile consisting of sand and minimal excavation is proposed, subsurface flow conditions will not be impacted.

7 GENERAL

The scope of Ideal Geotech services are described in the report and are subject to restrictions and limitations. Ideal Geotech did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Site conditions may also change subsequent to the investigations and assessment due to ongoing use.

Where data has been supplied by the client or a third party, it is assumed that the information is correct unless otherwise stated. No responsibility is accepted by Ideal Geotech for incomplete or inaccurate data supplied by others.

Assessment was undertaken on 18 July 2023.

For and on behalf of

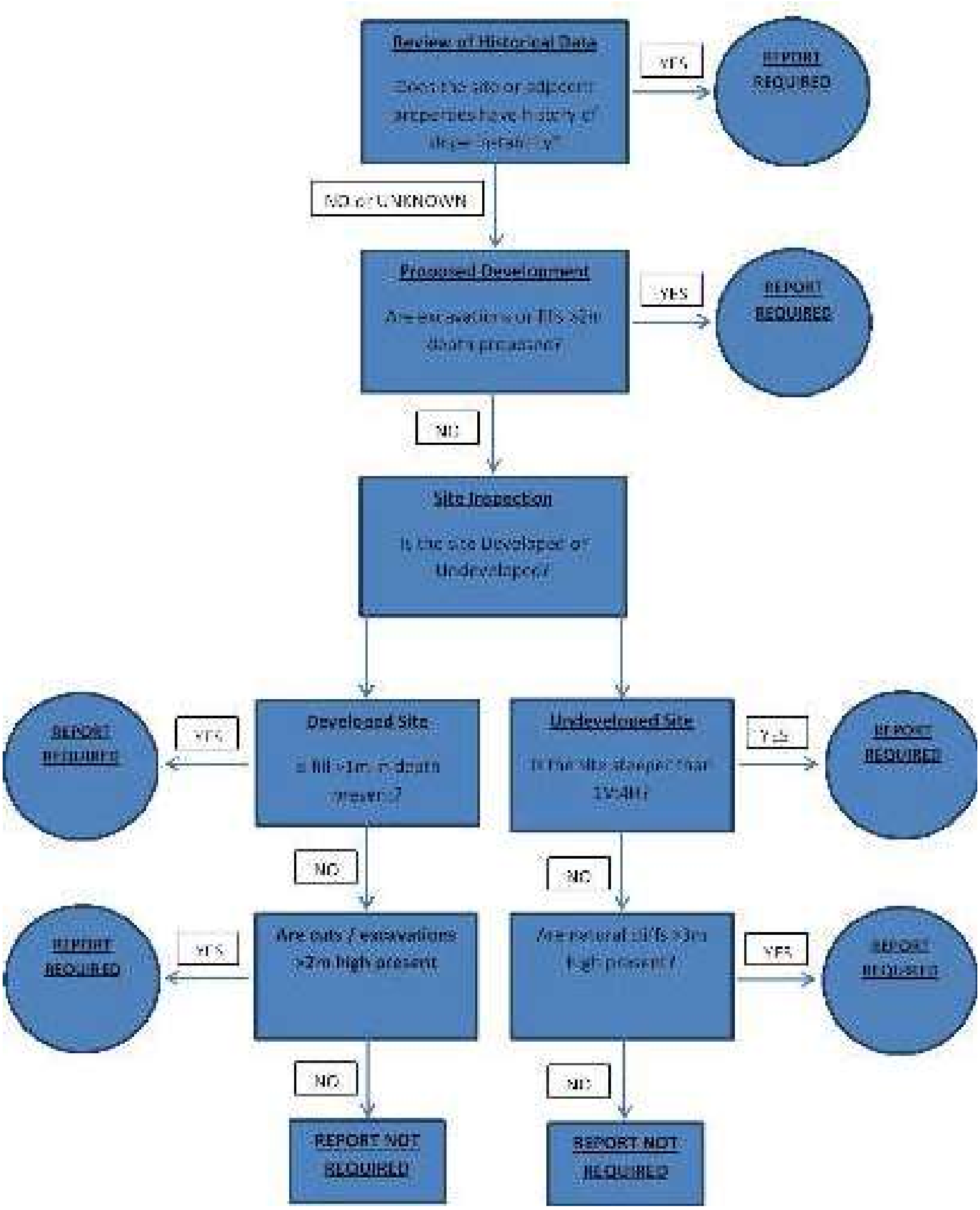
Ideal Geotech

D. Dwyer

Dane Dwyer
Geotechnical Engineer

Attachments - *Preliminary Assessment Flow Chart*

PRELIMINARY ASSESSMENT FLOW CHART



In-Situ Permeability

Prepared For:

Warringah Golf Club

Site Address:

(WGC Pro Shop) 292 Condamine Street, North Manly

Ref No:

64338-IDF

Date:

July 2023

Accredited for compliance With ISO/IEC 17025 NATA Accreditation No. 19226

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idealgeotech

PERMEABILITY TEST REPORT

Client :	**Warringah Golf Club**	Ideal Job Number :	**64338-IDF**
Project :	**Soil Permeability**	Test Date :	**12-Jul-23**
Location :	**292 Condamine Street, North Manly**	Tested By :	**I.Mackenzie Hunter**

Job ref / borehole ref: BH1 **test location:** Refer to plan

Test Method : AS /NZS 1547:2000 **(refer to sketch)**

Appendix 4.1F Soil Permeability measurement - constant head method

The borehole was soaked with potable water for 10 minutes prior to commencing the test.

Applies where S > $2H_c$

Test Fluid : Potable water

Hole Radius, R : 0.05 m

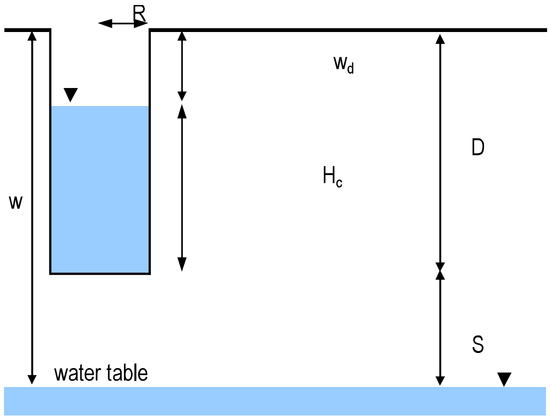
Hole Depth, D : 1.00 m

Depth to Water, w_d: 0.10 m

Constant Head, H_c : 0.90 m

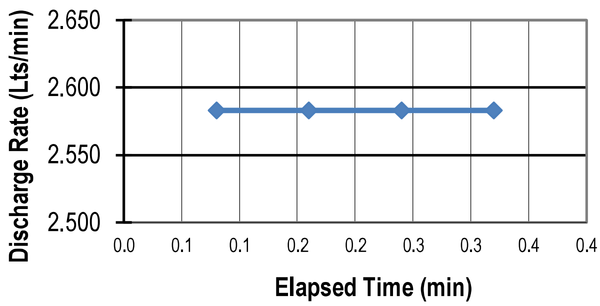
Depth to Water Table, w (if known) : NA m

- date & time : 12/07/23 1:30pm



Reading No.	Elapsed Time t (mins)	Time Interval dt (mins)	Water Added per dt (litres)	Discharge Rate (litres/min)
1	1:30:00	0.00	0.000	0.00000
2	1:30:05	0.08	0.207	2.58320
3	1:30:10	0.08	0.207	2.58320
4	1:30:15	0.08	0.207	2.58320
5	1:30:20	0.08	0.207	2.58320
6			0.000	
7			0.000	
8			0.000	
9			0.000	
10			0.000	
11			0.000	
12			0.000	

Discharge Rate versus Time



Site conditions

soil moisture condition :	moist
vegetaion cover at test site:	grass cover, trees and shrubs
slope:	1° towards west
surface cracks:	none observed
water logging:	no

Discharge Rate Q = **2.5832** litres/min

Hydraulic Conductivity, K = $\dfrac{Q\{\sinh^{-1}(H_c/R) - 1\}}{2\pi H_c^{2}}$

=	**2.2E-05**	**m/sec**
=	**1.8888**	**m/day**
=	**78.70**	**mm/hr**
=	**0.517**	**L/m2/sec**

Notes : 1) Material Description: Silty Gravelly SAND overlying; Silty SAND

PERMEABILITY TEST REPORT

Client :	**Warringah Golf Club**	Ideal Job Number :	**64338-IDF**
Project :	**Soil Permeability**	Test Date :	**12-Jul-23**
Location :	**292 Condamine Street, North Manly**	Tested By :	**I.Mackenzie Hunter**

Job ref / borehole ref: BH2 **test location:** Refer to plan

Test Method : AS /NZS 1547:2000 **(refer to sketch)**

Appendix 4.1F Soil Permeability measurement - constant head method

The borehole was soaked with potable water for 10 minutes prior to commencing the test.

Applies where S > $2H_c$

Test Fluid : Potable water

Hole Radius, R : 0.05 m

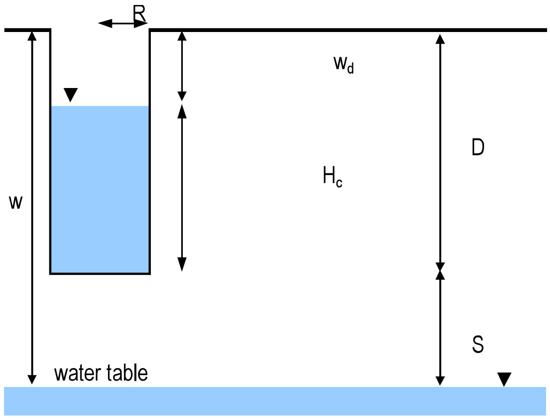
Hole Depth, D : 1.00 m

Depth to Water, w_d: 0.10 m

Constant Head, H_c : 0.90 m

Depth to Water Table, w (if known) : NA m

- date & time : 12/07/23 1:30pm



Reading No.	Elapsed Time t (mins)	Time Interval dt (mins)	Water Added per dt (litres)	Discharge Rate (litres/min)
1	1:30:00	0.00	0.000	0.00000
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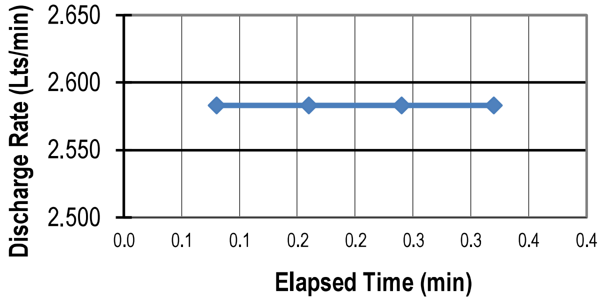
3	1:30:10	0.08	0.207	2.58320
4	1:30:15	0.08	0.207	2.58320
5	1:30:20	0.08	0.207	2.58320
6			0.000	
7			0.000	
8			0.000	
9			0.000	
10			0.000	
11			0.000	
12			0.000	



Site conditions

soil moisture condition :	moist
vegetaion cover at test site:	grass cover, trees and shrubs
slope:	1˚ towards west
surface cracks:	none observed
water logging:	no

Discharge Rate Q = **2.5832** litres/min

Hydraulic Conductivity, K = $\dfrac{Q\{\sinh^{-1}(H_c/R) - 1\}}{2\pi H_c^2}$

=	**2.2E-05**	**m/sec**
=	**1.8888**	**m/day**
=	**78.70**	**mm/hr**
=	**0.517**	**L/m2/sec**

Notes : 1) Material Description: Silty Gravelly SAND overlying; Silty SAND

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Title	Borehole Location Plan	**Council**	Northern Beaches Council	**Drawn By**	Ben
Project	In-Situ Permeability	**Job Number**	64338-IDF	**Checked By**	Dane
Site Address	292 Condamine Street, North Manly	**Figure Number**	Figure 1	**Date**	Jul-23

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5.1 FIELD LOG

Date: 13/07/2023
Customer Job: -
Ideal Job: 64338
Site Address: (WGC Pro Shop) 292 Condamine Street NORTH MANLY, NSW, 2100

Borehole: BH1
Surface RL:
Easting:
Northing:

Water		Samples	Depth	Material Origin	FILL Depth	Classification Code	Material Description	Moisture	Density / Consistency
No water observed				FILL		SM	Silty Gravelly SAND Dark Brown	Slightly Moist	
			0.5	NATURAL		SM	Silty SAND Brown	Slightly Moist	
			1.0				End Bore (Hand Auger) 0.8m		
			1.5						
			2.0						
			2.5						
			3.0						

Water Table **UTP** - Unable to penetrate **DCP** - 9kg Dynamic Cone Penetrometer **PP** - Pocket Penetrometer

SAND – Density Index vs Approx. Penetrometer results				**SILTS & CLAY** – Cu vs Approx. Penetrometer results				**MOISTURE**	
DENSITY		**Density Index**	**DCP Blow Count** (blows/100mm)	**CONSISTENCY**		**Undrained Shear Strength** (kPa)	**DCP Blow Count** (blows/100mm)		
VL	Very Loose	< 15 %	< 1	VS	Very Soft	0 – 12	< 1	D	Dry
L	Loose	15 – 35 %	1 – 3	S	Soft	12 – 25	1 – 2	M	Moist
MD	Medium Dense	35 – 65 %	3 – 9	F	Firm	25 – 50	2 – 3	W	Wet
D	Dense	65 – 85 %	9 – 15	St	Stiff	50 – 100	3 – 5	W_P	Plastic Limit
VD	Very Dense	> 85 %	> 15	VSt	Very Stiff	100 – 200	5 – 8	W_L	Liquid Limit
				H	Hard	> 200	> 8	m	Moisture

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5.2 FIELD LOG

Date: 13/07/2023
Customer Job: -
Ideal Job: 64338
Site Address: (WGC Pro Shop) 292 Condamine Street NORTH MANLY, NSW, 2100

Borehole: BH2
Surface RL:
Easting:
Northing:

Water		Samples	Depth	Material Origin	FILL Depth	Classification Code	Material Description	Moisture	Density / Consistency
No water observed				FILL		SM	Silty Gravelly SAND Dark Brown	Slightly Moist	
			0.5	NATURAL		SM	Silty SAND Brown	Slightly Moist	
			1.0						
							End Bore (Hand Auger) 1m		
			1.5						
			2.0						
			2.5						
			3.0						

Water Table **UTP** - Unable to penetrate **DCP** - 9kg Dynamic Cone Penetrometer **PP** - Pocket Penetrometer

SAND – Density Index vs Approx. Penetrometer results				**SILTS & CLAY** – Cu vs Approx. Penetrometer results				**MOISTURE**	
DENSITY		**Density Index**	**DCP Blow Count** (blows/100mm)	**CONSISTENCY**		**Undrained Shear Strength** (kPa)	**DCP Blow Count** (blows/100mm)		
VL	Very Loose	< 15 %	< 1	VS	Very Soft	0 – 12	< 1	D	Dry
L	Loose	15 – 35 %	1 – 3	S	Soft	12 – 25	1 – 2	M	Moist
MD	Medium Dense	35 – 65 %	3 – 9	F	Firm	25 – 50	2 – 3	W	Wet
D	Dense	65 – 85 %	9 – 15	St	Stiff	50 – 100	3 – 5	W_P	Plastic Limit
VD	Very Dense	> 85 %	> 15	VSt	Very Stiff	100 – 200	5 – 8	W_L	Liquid Limit
				H	Hard	> 200	> 8	m	Moisture

NEO
CONSULTING

PRELIMINARY SITE INVESTIGATION

N6898

Warringah Golf Club Limited

PROPOSED DEVELOPMENT AT:

292 Condamine Street

North Manly NSW 2100

Wednesday, 1st February 2023

NEO CONSULTING

Report Distribution

Preliminary Site Investigation

Address: 292 Condamine Street, North Manly, NSW 2100

Report No: N6898

Date: Wednesday, 1st February 2023

Copies	Recipient/Custodian
1 Soft Copy (PDF) – Secured and issued by email	Warringah Golf Club Limited
1 Original – Saved to NEO Consulting Archives	Secured and Saved by NEO Consulting on Register.

Version	Prepared by	Reviewed by	Date issue
Draft	Sarah Houlahan Environmental Consultant	Nick Caltabiano Project Manager	31st January 2023
FINAL	Sarah Houlahan Environmental Consultant	Nick Caltabiano Project Manager	1st February 2023

Report Revision	*Details*	*Report No.*	*Date*	*Amended By*
0	***FINAL Report***	***N6898***		-
Issued By:			***Nick Caltabiano***	

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Table of Contents

Appendices

Executive Summary

NEO Consulting was appointed by Warringah Golf Club Limited (the client) to undertake a Preliminary Site Investigation (PSI) on a property located at 292 Condamine Street, North Manly, NSW, 2100 (Lot 2742 DP752038) with a focus on the proposed development of a new golf club house on near the corner of Kentwell Road and Pittwater Road and is currently zoned as REI- Public Recreation.

The following scope of works were undertaken:

- A site inspection to identify potential sources of contamination on site;
- Historical investigations relating to the site (if any);
- Review of current and historical Certificates of Title;
- Local Council records and planning certificates;
- Review of NSW EPA Contaminated Land Records, POEO Register and PFAS Investigation Program map;
- Review of local geological and hydrogeological information, including an evaluation of the NSW Groundwater registered groundwater bore database;
- Review of Acid Sulphate Soil data maps;
- Development of a Conceptual Site Model (CSM) to identify the connections between potential sources of contamination and exposure pathways, human and/or ecological receptors; and
- Recommendations for additional investigations (if any), based on the identified data gaps and findings of this report.

A site investigation was undertaken on 20th January 2023 by NEO environmental consultants. During the site inspection, a soil investigation program was undertaken with a judgemental approach in accessing locations across proposed development area to identify areas of contamination. Historical investigations confirm the targeted area appears to have tennis courts in the same location onsite since at least 1943 which would likely mean the continuous use of the land as recreational and the low potential impact of any contamination.

Three (3) soil samples were obtained from three (3) borehole locations, each sample was obtained from the current topsoil/fill layer. The samples were submitted to a National Association of Testing Authorities, Australia (NATA) accredited laboratory for analysis of Chemicals of Potential Concern (CoPC) that may have impacted the site during historical or present activities.

Analytical results indicate no exceedance of the NEPM Health and Ecological Assessment Criteria for Commercial/Industrial (D) sites. The consent authority may be satisfied that the required considerations of Cl 4.6 of State Environmental Planning Policy (Resilience and Hazards) 2021are satisfied for the following reasons:

1) Site observations did not indicate significant visible indications of contamination or contaminating sources;
2) Analytical results for all analytes were below the NEPM Health and Ecological Assessment Criteria for Commercial/Industrial (D) sites.

NEO Consulting considers that the potential for significant contamination of soil to be low and find that the site can be made suitable for the proposed development and land use, provided the recommendations within **Section 13** are undertaken.

1. Introduction

1.1 Background

NEO Consulting was appointed by Warringah Golf Club Limited (the client) to undertake a Preliminary Site Investigation (PSI) for the property located at 292 Condamine Street, North Manly, NSW, 2100 (Lot 2742 DP 752038) with a focus on the proposed development of a new golf club house on near the corner of Kentwell Road and Pittwater Road and is currently zoned as REI- Public Recreation.

A site inspection was undertaken on 20th January 2023 by qualified environmental consultants. Reporting, photographs and sampling were conducted on this day and with reference to the relevant regulatory criterial **(2. Scope of Work**). Further information of the inspection is described in **4. Site Condition**.

1.2 Objectives

This report provides a preliminary assessment of current and/or historical potentially contaminating activities that may have impacted the soils and will determine if the site is suitable for the proposed development.

1.3 Regulatory Framework

This PSI has been prepared in general accordance with the following regulatory framework:

- State Environmental Planning Policy (Resilience and Hazard) 2021;
- National Environment Protection Measures (NEPM), 2013;
- NSW Environmental Protection Authority, *Guidelines on the Duty to Report Contamination under Contaminated Land Management Act*, 1997;
- NSW Environmental Protection Authority, *Consultants Reporting on Contaminated Land: Contaminated Land Guidelines,* 2020;
- Protection of the Environment and Operation Act 1997; and
- Protection of the Environment Operations (Waste) Regulations, 2005.

2. Scope of Work

To meet the requirements in Section 1.3 of this report, the following scope of works were included:

- A site inspection to identify potential sources of contamination on site;
- Historical investigations relating to the site (if any);
- Review of current and historical Certificates of Title;
- Local Council records and planning certificates;
- Review of NSW EPA Contaminated Land Records, POEO Register and PFAS Investigation Program map;
- Review of local geological and hydrogeological information, including an evaluation of the NSW Groundwater registered groundwater bore database;
- Review of Acid Sulphate Soil data maps;
- Development of a Conceptual Site Model (CSM) to identify the connections between potential sources of contamination and exposure pathways, human and/or ecological receptors; and
- Recommendations for additional investigations (if any), based on the identified data gaps and findings of this report.

3. Site Details

Table 1. Site Details

Address	292 Condamine Street, North Manly, NSW, 2100
Deposited plan	Lot 2742/DP752038
Zoning	RE1- Public Recreation
Locality map	Figure 1, Appendix A
Site Boundary	Figure 2, Appendix A
Area	Area of proposed development approx. 1,239.5m^2

Table 2. Surrounding land-use(from the targeted area)

Direction from site	**Land-use**
North	Pittwater Road, followed by houses
East	Pittwater Road, followed by houses
South	Kentwell Road
West	Golf Course

4. Site Condition

A site inspection was undertaken on 20th January 2023 by NEO Consulting. During the site inspection, the following observations were noted (photographs in **Appendix A**):

- The targeted area for proposed development is currently made up of tennis courts, there are courts which appear to have a cover of astro turf, concrete or a firm synthetic material
- There is spectator seating in the form of park benches and seats surrounding the courts ;
- The site had healthy vegetation growth in the form of grass where there were no concrete coverings and bushes beyond normal access areas
- No evidence of contamination was identified;
- No indications of underground storage of petroleum products were identified;

5. Site History

5.1 History of Site

A summary of historical aerial imagery is contained below, and the images referenced can be seen in **Appendix A**.

Table 3. Historical aerial images of the site and surrounding area.

Year	**Description**
1943	The targeted area appears to have the tennis court layout which is similar to the current tennis courts currently located today. This confirms the continuous use of the land as recreational use since 1943, confirming the low likely hood of potential contamination.
2000	The next available aerial image shows the current configuration of the courts.
2022	The courts have likely have additional layers added to the surface which is evident in the change in colour over the years, however the same footprint confirms the same land use over time.

5.2 Section 10.7 (2) Planning Certificate

A Section 10.7 Planning Certificate describes how a property may be used and the restrictions on development. The Planning Certificate is issued under Section 149 of the Environmental Planning and Assessment Act 1979. At the time of reporting, the Planning Certificate was not available.

5.3 NSW EPA Contaminated Land Register

A search within the NSW EPA contaminated land register was undertaken for the site. No results were found for the site or within 200m of the site.

5.4 Protection of the Environment Operation Act (POEO) Public Register

A search on the POEO public register of licensed and delicensed premises (DECC) was undertaken for the site. No results were found for the site or within 200m of the site.

5.5 SafeWork NSW Hazardous Goods

A search was not undertaken with SafeWork NSW for historical dangerous goods stored onsite.

5.6 Product Spill and Loss History

The visual site inspection did not identify evidence of contamination within the site (e.g. chemical staining, unhealthy vegetation).

5.7 PFAS Investigation Program

The NSW Government PFAS Investigation Program map indicates the site is not currently listed for PFAS contamination investigation and management programs, nor is any site within a 1km radius.

6. Environmental Setting

6.1 Hydrology

A groundwater bore search was conducted on 1st February 2023 and three (3) borehole was present within a 500m radius of the site, GW102334, GW107816 and GW020813.

Table 4. GW102334 drillers log

From (mbgl)	To (mbgl)	Thickness (m)	Drillers Description	Geological Material
0.00	0.50	0.50	Topsoil	Topsoil
0.50	3.00	2.50	SAND YELLOW	Sand
3.00	7.00	4.00	MARINE DARK GREY/CLAY-VERY GREASY	Clay
7.00	11.00	4.00	MARINE WITH 15%SHELL FRAGMENTS, QUARTZ	Quartz
11.00	17.00	6.00	MARINE NO QUARTZ	Quartz
17.00	23.00	6.00	MARINE/5%SHELL FRAGMENT	Sand
23.00	26.00	3.00	MARINE/10%SHELL FRAGMENT	Sand
26.00	28.00	2.00	MARINE/15%SHELL FRAGMENT	Sand
28.00	30.00	2.00	SANDSTONE/BROWN/ GRAIN	Sandstone
30.00	31.00	1.00	SANDSTONE/BROWN/R. QUARTZ	Sandstone
31.00	35.00	4.00	SANDSTONE/GREY/F/G/MINOR CLAY MATRIX	Sandstone
35.00	40.00	5.00	CLAY STONE GREY	Claystone
40.00	60.00	20.00	SANDSTONE/WHITE MINOR QUARTZ	Sandstone

6.2 Geology

Data obtained from the Geological Survey of NSW and the Geoscience Australia Stratigraphic Units Database indicate the site is located within the Hawkesbury Sandstone. This formation is regionally characterized by medium to coarse-grained quartz sandstone, secondary quartz cement, with minor shale and laminate lenses.

6.3. Acid Sulphate Soil

Acid Sulphate Soils (ASS) naturally occur under waterlogged condition and contain iron sulphide minerals. If these soils remain undisturbed, they are considered harmless. However, if disturbed and subsequently oxidised, this reaction can cause damage to the environment and built structures that overlie the ASS. The potential for ASS has been divided into five (5) classes, with Class 1 the highest at risk of ASS. A search of the

DPIE eSpade map viewer was undertaken and indicate that site is located within an area with no known occurrence of ASS.

7. Areas of Environmental Concern

Based on the above information, the potential Areas of Environmental Concern (AEC) and their associated Contaminants of Potential Concern (CoPC) for the site were identified and summarised.

Table 5. Potential Areas and Contaminants of Concern

AEC	Potentially Contaminating / Hazardous Activity	CoPC	Likelihood of Site Impact	Comments
Entire site	Importation of fill material. Historical on site operations.	Metals, TRH, BTEX, PAH, OCP, OPP, ACM	Low	The presence of imported fill is possible. Historical on site operations may have given rise to contamination events.
Onsite structures	Hazardous material within onsite residential dwellings and sheds.	ACM, SMF, ODS, Lead (paint and/or dust), PCBs	Low	Considering the age of onsite structures presence of these CoPCs are likely. An HMS should be undertaken in order to confirm the presence or absence of COPCs.

ABBREVIATIONS: ASBESTOS CONTAINING MATERIALS (ACM), BENZENE, TOLUENE, ETHYLBENZENE AND XYLENE (BTEX), POLYCYCLIC AROMATIC HYDROCARBON (PAH), ORGANOPHOSPHATE PESTICIDES (OPP), ORGANOCHLORINE PESTICIDES (OCP), TOTAL RECOVERABLE HYDROCARBONS (TRH).

8. Conceptual Site Model

A Conceptual Site Model (CSM) was developed to provide an indication of potential risks associated with contamination source and contamination migration pathways, receptors and exposure mechanisms. The CSM provides a framework for the review of the reliability and useability of the data collected and to identify data gaps in the existing site characterisation. Here, we consider the connections between the following elements:

- Potential contamination sources and their associated CoPC;
- Potential human receptors that may be impacted by the site contamination are current and future site users including occupants to the dwelling/infrastructures onsite, site workers and the general public within the immediate vicinity of the site;
- Potential environmental receptors to the site including but not limited to: groundwater and surface water bodies, residual soils at and/or nearby the site;
- Potential exposure pathways; and
- Whether source-pathway-receptor connections are complete based on current and future site conditions.

Table 6. Conceptual Site Model

Potential Sources	Potential Receptor	Potential Exposure Pathway	Complete connection	Risk	Justification/ Control Measures
Contaminated soil from importation of uncontrolled fill across the site. Historical on site operations. On site structures. On site car parking.	Future site occupant, construction workers, general public, surrounding sensitive receptors	Dermal contact, inhalation/ ingestion of particulates, vapour intrusion.	Complete (current)	Low	The historical land use of the site does not indicate any concerns of significant contamination.
			Complete (Future)	Low	If present, impacted soils are to be disposed of off-site in accordance with an unexpected finds protocol.
	Natural soils	Migration of contamination from fill layer.	Complete (current)	Low	If contamination is present in the fill layer, migration to the natural layer is possible. If present, impacted soils are to be disposed of off-site.
			Complete (Future)	Low	
	Manly Creek located 260m S		Complete (current)	Low	If contamination is present on site, migration to this surface water receptor is possible. If present, impacted soils are to be disposed of off-site.
			Complete (future)	Low	
	Underlying aquifer	Leaching and migration of contaminants through groundwater infiltration.	Complete (current)	Low	Due to existing sealed surfaces, leachability of contaminants is unlikely. If present, contaminated soil and/or groundwater is likely to be remediated.
			Complete (future)	Low	

9. Data Gaps

Hazardous materials within on site structures, considering the proposed demolition.

10. Assessment Criteria

The following assessment criteria were adopted for the investigation.

10.1 NEPM Health Investigation Level D (HIL-D) – Commercial/Industrial

HILs are scientific, risk-based guidance levels to be used as in the primary stage of assessing soil contamination to evaluate the potential risks to human health from chronic exposure to contaminants. HILs are applicable to a broad range of metals and organic substances, and generally apply to depths up to

3m below the surface for residential use. Tier 1 HILs are divided into sub-criteria. The sub-criteria appropriate to the site is HIL-D, Commercial/Industrial sites.

Table 7. HIL-D

Assessment Criteria	Commercial/Industrial Soil HIL-D, mg/kg
HCB	80
Heptachlor	50
Chlordane	530
Aldrin & Dieldrin	45
Endrin	100
DDD+DDE+DDT	3600
Endosulfan	2000
Methoxychlor	2500
Mirex	100
Arsenic, As	3000
Cadmium, Cd	900
Chromium, Cr	3600
Copper, Cu	240 000
Lead, Pb	1500
Nickel, Ni	6000
Zinc, Zn	400 000
Mercury, Hg	730
Carcinogenic PAHs (as BaP TEQ)	40
Total PAH (18)	4000

10.2 NEPM Health Screening Level D (HSL-D) – Commercial/Industrial

HSLs have been developed for selected petroleum compounds and fractions and are used for the assessment of potential risks to human health from chronic inhalation and direct contact pathways of petroleum vapour emanating off petroleum contaminated soils (Vapour Risk). HSLs are guided by land-use scenarios, specific soil physicochemical properties and generally apply to depths below surface to >4m. Tier 1 HSLs are divided into sub-criteria. The sub-criteria appropriate to the site is HSL-D, Commercial/Industrial sites. NL = Not Limiting.

Table 8. HSL-D

Assessment Criteria	Commercial/Industrial Soil HSL-D for Vapour Intrusion, 0-<1m depth, Clay, mg/kg	Commercial/Industrial Soil HSL-D for Vapour Intrusion, 1-<2m depth, Clay, mg/kg
Benzene	4	6
Toluene	NL	NL
Ethylbenzene	NL	NL
Xylenes	NL	NL
Naphthalene	NL	NL
TRH C_6-C_{10} - BTEX (F1)	50	280
TRH >C_{10}-C_{16} - N (F2)	90	NL

10.3 NEPM Ecological Investigation Level (EIL) – Commercial/Industrial

Ecological investigation levels (EILs) have been developed to assess the risk for the presence of metals and organic substance in a terrestrial ecosystem. EILs are guided by land-use scenarios, specific soil physicochemical properties and generally apply to the top 2m of soil. EILs can be applied for arsenic (As), copper (Cu), chromium III (Cr(III)), dichlorodiphenyltrichloroethane (DDT), naphthalene, nickel (Ni), lead (Pb) and zinc (Zn). The NEPM Soil Quality Guidelines (SQG) for EILs are calculated using the Added Contamination Limit (ACL) to determine the amount of contamination that had to be added to the soil to cause toxicity, including ambient background concentration (ABC).

Table 9. Generic EIL

Assessment Criteria	Soil Generic EIL for Commercial/Industrial, mg/kg
Arsenic, As	160
DDT	640
Naphthalene	370

10.4 NEPM Ecological Screening Level (ESL) – Commercial/Industrial

ESLs have been developed for selected petroleum hydrocarbons (BTEX, benzo(a)pyrene, TRH F1 and F2) in soil, based on fresh contamination. These parameters are applicable to coarse and fine-grained soil and apply from the surface of the soil to 2m below ground level, which corresponds with the root and habitat zone for many species.

Table 10. ESL

Assessment Criteria	Soil ESL for Commercial/Industrial, fine-grained soil, mg/kg
Benzene	95
Toluene	135
Ethylbenzene	185
Xylenes	95
BaPyr (BaP)	0.7
TRH C_6-C_{10}	215
TRH >C_{10}-C_{16}	170
TRH >C_{16}-C_{34} (F3)	2500
TRH >C_{34}-C_{40} (F4)	6600

10.5 NEPM Management Limits – Commercial/Industrial

Management Limits for petroleum have been developed for prevention of explosive vapour accumulation, prevention of the formation of observable Light Non-Aqueous Phase Liquids (LNAPL) and protection against effects on buried infrastructure. Residential, Parkland and Public Open Space limits have been adopted based on the proposed land use.

Table 11. Management Limits

Assessment Criteria	Management Limits for Commercial/Industrial, fine-grained soil, mg/kg
TRH C_6-C_{10}	800
TRH >C_{10}-C_{16}	1000
TRH >C_{16}-C_{34} (F3)	3500
TRH >C_{34}-C_{40} (F4)	10000

10.6 NEPM Health Screening Level D (HSL-D) – Commercial/Industrial for Asbestos

The assessed soil must not contain Asbestos Containing Materials (ACM) in the excess of 0.05%w/w and surface soil within the site must be free of visible ACM, Asbestos Fines (AF) and Fibrous Asbestos (FA).

Table 12. Management Limits

Assessment Criteria	Health Screening Level (HSL-D) (%w/w)
ACM	0.05%
FA and AF (friable asbestos)	0.001%
All forms of asbestos	No visible asbestos for surface soils

11. Analytical Results

The analytical results indicate no exceedances above the NEPM Health and Ecological Assessment Criteria for Commercial/Industrial (D) sites.

12. Conclusion

Based on the site investigation and analytical results, NEO Consulting considers that the potential for significant contamination of soil to be low. Historical investigations confirm the targeted area appears to have tennis courts in the same location onsite since at least 1943 which would likely mean the continuous use of the land as recreational and the low potential impact of any contamination. We find that the site is suitable for the proposed development and land use, provided the Recommendations within **Section 13** are undertaken.

13. Recommendations

Based on the information collected and available during this investigation, the following recommendations have been made:

- The demolition of structures and excavation activity on site be undertaken in accordance with relevant Australian Standards, SafeWork NSW codes of practice and any other applicable requirements;
- Any soils requiring excavation, onsite reuse and/or removal must be classified in accordance with "Waste Classification Guidelines Part 1: Classifying Waste" NSW EPA (2014); and
- A site specific 'Unexpected Finds Protocol' is to be made available for reference for all occupants and/or site workers in the event unanticipated contamination is discovered.

Limitations

The findings of this report are based on the Scope of Work outlined in Section 2. NEO Consulting performed the services in a manner consistent with the normal level of care and expertise exercised by members of the environmental consulting profession. No warranties, express or implied are made.

The results of this assessment are based upon the information documented and presented in this report. All conclusions and recommendations regarding the site are the professional opinions of NEO Consulting personnel involved with the project, subject to the qualifications made above. While normal assessments of data reliability have been made, NEO Consulting assumes no responsibility or liability for errors in any data obtained from regulatory agencies, statements from sources outside of NEO Consulting, or developments resulting from situations outside the scope of this project.

The results of this assessment are based on the site conditions identified at the time of the site inspection and validation sampling. NEO Consulting will not be liable to revise the report to account for any changes in site characteristics, regulatory requirements, assessment criteria or the availability of additional information, subsequent to the issue date of this report.

NEO Consulting is not engaged in environmental consulting and reporting for the purpose of advertising sales promoting, or endorsement of any client interests, including raising investment capital, recommending investment decisions, or other publicity purposes.

NEO CONSULTING

Prepared by:	Reviewed by:
Sarah Houlahan	Nick Caltabiano
Environmental Consultant	Project Manager

APPENDIX A

Figures and Photographic Log

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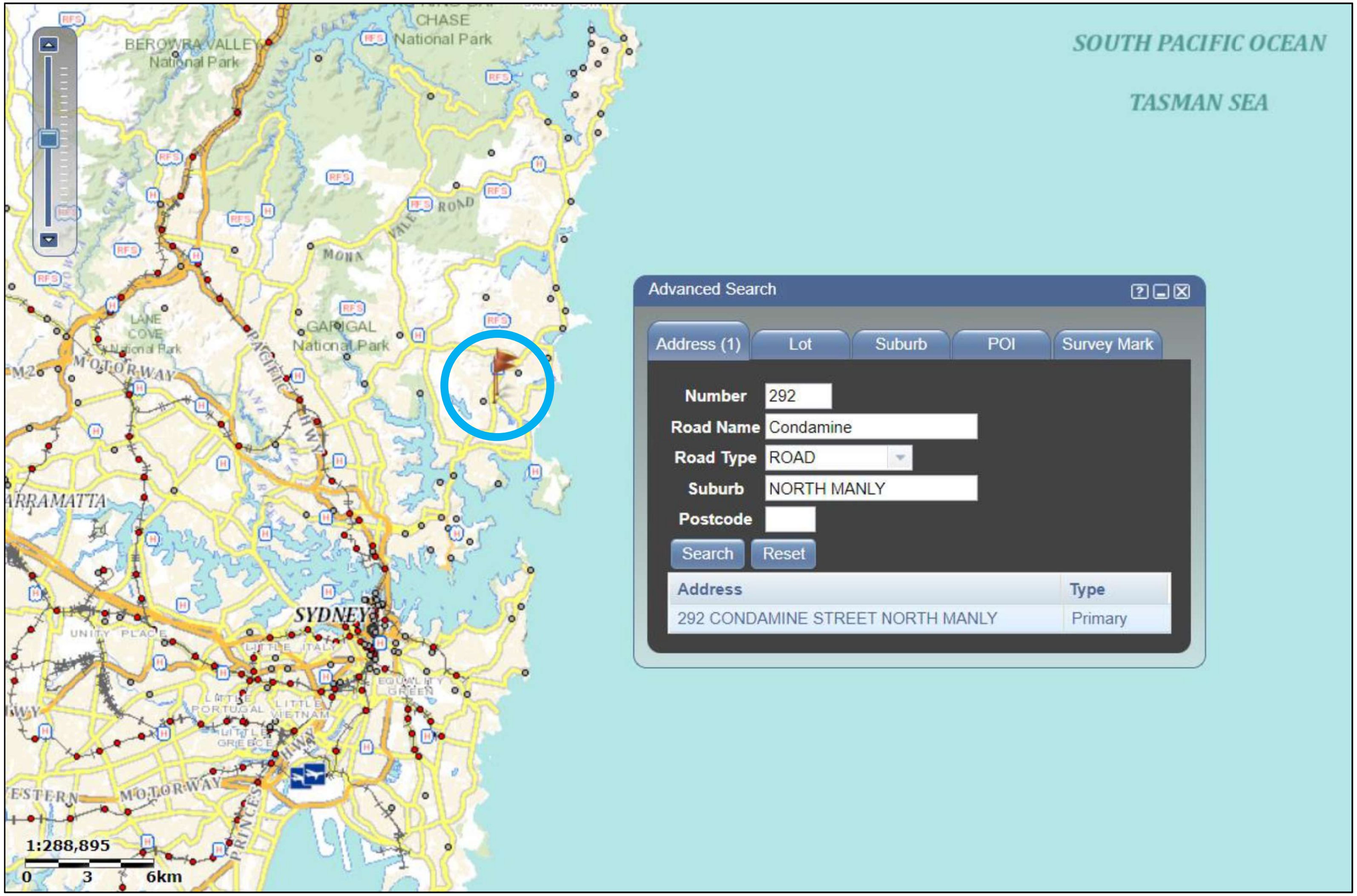
Figure 1. The site is located approximately 11.5km North East of Sydney CBD.



Site location

Source: Six Maps 2023

Figure 1	Locality Map
Project	292 Condamine Road, North Manly, NSW, 2100

Figure 2. 3 targeted primary soil samples were obtained from the site. Site layout from January 2023, showing the surfaces of the courts have obviously been changed overtime, however the footprints of the courts appear to have remained relatively unchanged.

⊗ Sample Locations

Source: Nearmap 2023

Figure 2	Site Area
Project	292 Condamine Road, North Manly, NSW, 2100

Figure 3. Aerial image of the site and surrounding area 1943. The targeted area shows the same layout of tennis courts as in todays current layout.

Source: NSW Historical Imagery 2023

Figure 3	Aerial Image 1943
Project	292 Condamine Road, North Manly, NSW, 2100

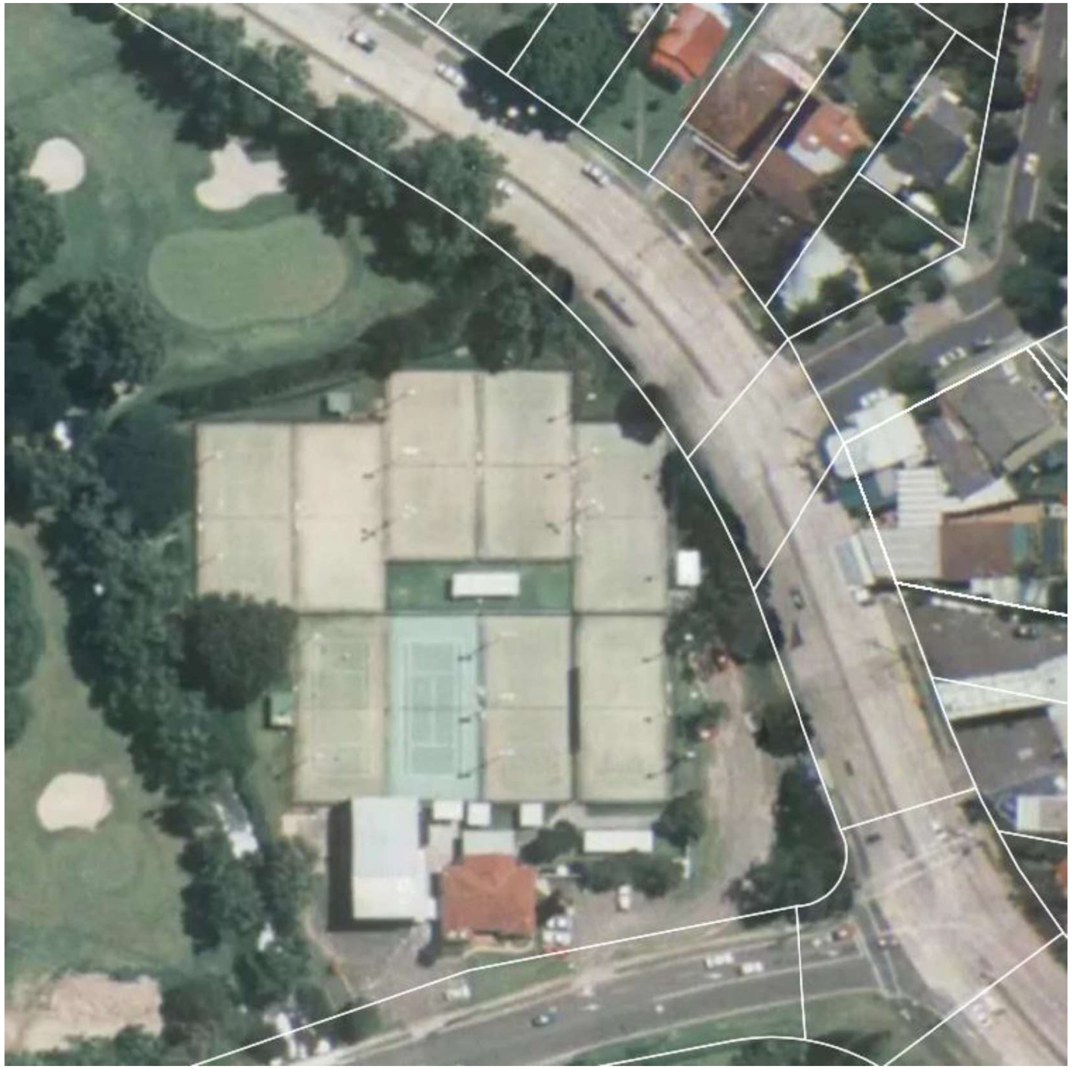


Figure 4. Aerial image of the site from the year 2000 shows a similar layout to todays configuration.

Source: MetroMaps

Figure 4	Aerial Image 2000
Project	292 Condamine Road, North Manly, NSW, 2100

Figure 5. Collection of samples S1, sandy fertile top soil.

Figure 6. Healthy grass in the foreground and tennis courts in the back ground.

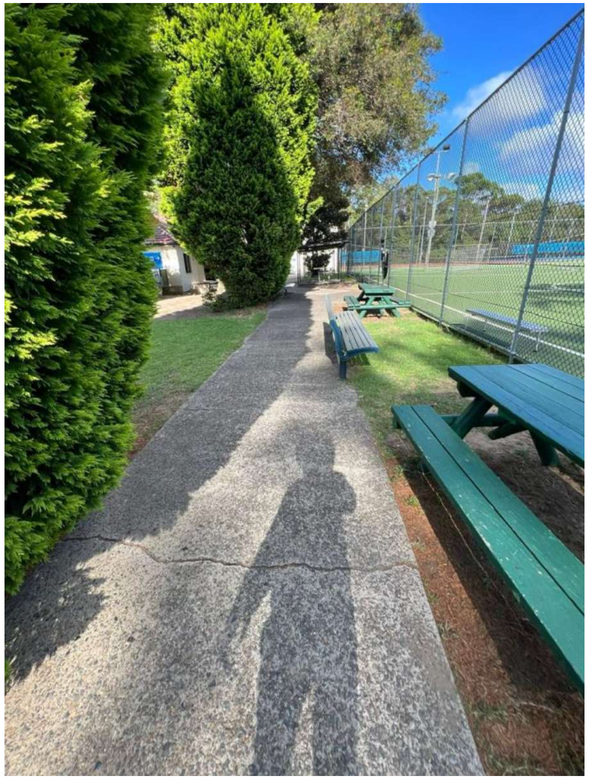


Figure 7. Showing the areas around the courts

Figure 8. Showing the multiple courts onsite.

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APPENDIX B

Analytical Results and Laboratory Reports

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Table 13. Total Recoverable Hydrocarbon (TRH) analytical results. Values are presented as mg/kg. NL = Not Limiting. F1 = subtract the sum of BTEX concentrations from the C_6-C_{10} aliphatic hydrocarbon fraction. F2 = subtract Naphthalene from the> C_{10}-C_{16} aliphatic hydrocarbon fraction.

Assessment Criteria		TRH C_6-C_{10}	TRH C_6-C_{10} - BTEX (F1)	TRH >C_{10}-C_{16}	TRH >C_{10}-C_{16} - N (F2)	TRH >C_{16}-C_{34} (F3)	TRH >C_{34}-C_{40} (F4)
NEPM 2013 Commercial/Industrial Soil HSL-D for Vapour Intrusion, 0-<1m depth, Clay, mg/kg			50		280		
NEPM 2013 Soil Generic ESL for Commercial/Industrial, fine-grained soil, mg/kg		215		170		2500	6600
NEPM 2013 Management Limits for Commercial/Industrial, fine-grained soil, mg/kg		800		1000		3500	10 000
Sample	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
S1	0.15	<25	<25	<25	<25	<90	<120
S2	0.15	<25	<25	<25	<25	<90	<120
S3	0.15	<25	<25	<25	<25	<90	<120

Table 14. Benzene, Toluene, Ethylbenzene and Xylene (BTEX) analytical results. Values are presented as mg/kg. NL = Not Limiting.

Assessment Criteria		Benzene	Toluene	Ethylbenzene	Xylenes
NEPM 2013 Commercial/Industrial Soil HSL-D for Vapour Intrusion, 0-<1m depth, Clay, mg/kg		4	NL	NL	NL
NEPM 2013 Soil ESL for Commercial/Industrial, fine-grained soil, mg/kg		95	135	185	95
Sample	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg
S1	0.15	<0.1	<0.1	<0.1	<0.3
S2	0.15	<0.1	<0.1	<0.1	<0.3
S3	0.15	<0.1	<0.1	<0.1	<0.3

Table 15. Polycyclic Aromatic Hydrocarbon (PAH) analytical results. The carcinogenic PAH (Benzo(a)anthracene (BaAnt); Benzo(a)pyrene (BaPyr or BaP); Benzo(b+j) fluoranthene (BbjFl); Benzo(k)fluoranthene (BkFl); Benzo(g,h,i)perylene (BghiPer); Chrysene (Chr); and Dibenz(a,h)anthracene (DBahAnt)) potency is calculated relative to Benzo(a)pyrene to produce a Toxicity Equivalent Factor (TEF). The Toxicity Equivalent Quotient (TEQ) is calculated by multiplying the concentration of each carcinogenic PAH in the sample by its Benzo(a)pyrene (B(a)P) TEF. Total PAH includes Naphthalene (N), 2-methylnaphthalene (2-MN), 1-methylnaphthalene (1-MN), Acenaphthylene (Acy), Acenaphthene (Ace), Fluorene (F), Phenanthrene (P), Anthracene (Ant), Fluoranthene (Fl), Pyrene (Pyr) and the carcinogenic PAHs. Values are presented as mg/kg. NL = Not Limiting.

Assessment Criteria		Naphthalene	Benzo(a)pyrene	Carcinogenic PAH (as BaP TEQ)	Total PAH (18)
NEPM 2013 Commercial/Industrial Soil HSL-D for Vapour Intrusion, 0-<1m depth, Clay, mg/kg		NL			
NEPM 2013 Soil Generic EIL for Commercial/Industrial, mg/kg		370			
Soil ESL for Commercial/Industrial, fine-grained soil, mg/kg			0.7		
NEPM 2013 Commercial/Industrial Soil HIL-D, mg/kg			1.00 TEF	40	4000
Sample	Depth (m)	mg/kg	mg/kg	TEQ (mg/kg)	mg/kg
S1	0.15	<0.1	<0.1	<0.3	<0.8
S2	0.15	<0.1	<0.1	<0.3	<0.8
S3	0.15	<0.1	<0.1	<0.3	<0.8

Table 16. Heavy Metal analytical results. Values are presented as mg/kg.

Assessment Criteria		Arsenic, As	Cadmium, Cd	Chromium, Cr	Copper, Cu	Lead, Pb	Nickel, Ni	Zinc, Zn	Mercury, Hg
NEPM 2013 Commercial/Industrial Soil HIL-D, mg/kg		3000	900	3600	240 000	1500	6000	400 000	730
NEPM 2013 Soil Generic EIL for Commercial/Industrial, mg/kg		160				1800			
Sample	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
S1	0.15	**3**	<0.3	**7.4**	**11**	**33**	**2.8**	**54**	**0.10**
S2	0.15	**2**	<0.3	**6.7**	**10**	**44**	**2.0**	**80**	**0.17**
S3	0.15	**1**	<0.3	**4.2**	**1.9**	**9**	<0.5	**9.8**	<0.05

Table 17. Pesticides analytical results. Values are presented as mg/kg.

Assessment Criteria		HCB	Heptachlor	Chlordane	Aldrin & Dieldrin	Endrin	DDT	DDD+DDE +DDT	Endosulfan	Methoxychlor	Mirex
NEPM 2013 Commercial/Industrial Soil HIL-D, mg/kg		80	50	530	45	100		3600	2000	2500	100
NEPM 2013 Soil Generic EIL for Commercial/Industrial, mg/kg							640				
Sample	Depth (m)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
S1	0.15	<0.1	<0.2	<0.2	<0.3	<0.2	<0.2	<0.6	<0.5	<0.1	<0.1
S2	0.15	<0.1	<0.2	<0.2	<0.3	<0.2	<0.2	<0.6	<0.5	<0.1	<0.1
S3	0.15	<0.1	<0.2	<0.2	<0.3	<0.2	<0.2	<0.6	<0.5	<0.1	<0.1

Table 18. Asbestos analytical results. Values are presented as %w/w.

Assessment Criteria		Asbestos		
NEPM 2013 Soil HSL-D, mg/kg		Detected	Bonded ACM	FA and AF
			0.01%w/w	0.001%w/w
Sample	Depth (m)	Y/N	%w/w	%w/w
S1	0.15	N	<0.01	-
S2	0.15	N	<0.01	-
S3	0.15	N	<0.01	-

CHAIN OF CUSTODY & ANALYSIS REQUEST

SGS
SGS Environmental Services Sydney
Unit 16, 33 Maddox Street
Alexandria NSW 2015
Telephone No: (02) 85940400
Facsimile No: (02) 85940499
Email: au.samplereceipt.sydney@sgs.com

Lab ID Number: *(please quote on correspondence)*

Company Name:	Neo Consulting Pty Ltd	Project Name/No:	N6898
Address:	186 Riverstone Parade	Purchase Order No:	QUOTE NUMER: 322722
	Riverstone NSW 2765	Results Required Date:	Normal
		Telephone:	0416680375 Fax:
Contact Name:	Nick Caltabiano	Email Results and invoices to :	nick@neoconsulting, admin@neoconsulting, oskar@neoconsulting, sarah@neoconsulting, eshan@neoconsulting
Quotation No:			

SGS ID	Client Sample ID	Sampling Date/ Time	Matrix (Tick as appropriate): Soil Sample	Water Sample	Other____	NO. OF CONTAINERS	ANALYSIS REQUESTED: NEO 1	NEO 2	NEO 3	NEO 4	Asbestos ID	Heavy Metals 8	BTEX						Notes/Guidelines/LOR/ Special instructions
1	S1		X					X			X								
2	S2		X					X			X								
3	S3		X					X			X								

Additional Report Formats

- ☐ NEPM
- ☐ CSV
- ☐ ESDAT
- ☐ DQO
- ☐ GO, Guidelines ---------
- ☐ Others ___________

SGS EHS Sydney COC
SE242054

Relinquished By:	Date/Time:	Received By:	Date/Time: 20.1.23 7.15
Relinquished By:	Date/Time:	Received By:	Date/Time:
Samples Intact: Yes / No	Temperature: 8.8 °C	Sample Security Sealed: Yes / No	Hazards: *e.g. may contain Asbestos*
Comments / Subcontracting details:			

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS

Contact	Admin
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Email	admin@neoconsulting.com.au
Project	**N6898**
Order Number	**N6898**
Samples	3

LABORATORY DETAILS

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Laboratory	SGS Alexandria Environmental
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Email	au.environmental.sydney@sgs.com
SGS Reference	**SE242054 R0**
Date Received	20/1/2023
Date Reported	30/1/2023

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

No respirable fibres detected in all soil samples using trace analysis technique.
A portion of the sample supplied has been sub-sampled for asbestos analysis in soil according to SGS In-house procedures. We therefore cannot guarantee that the sub-sample is representative of the entire sample supplied. SGS Industries and Environment recommends supplying approximately 50-100g of sample in a separate container.
Asbestos analysed by Approved Identifier Ravee Sivasubramaniam.

SIGNATORIES

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Ly Kim HA
Organic Section Head

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Hygiene Team Leader

Shane MCDERMOTT
Inorganic/Metals Chemist

Teresa NGUYEN
Organic Chemist

VOC's in Soil [AN433] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Benzene	mg/kg	0.1	<0.1	<0.1	<0.1
Toluene	mg/kg	0.1	<0.1	<0.1	<0.1
Ethylbenzene	mg/kg	0.1	<0.1	<0.1	<0.1
m/p-xylene	mg/kg	0.2	<0.2	<0.2	<0.2
o-xylene	mg/kg	0.1	<0.1	<0.1	<0.1
Total Xylenes*	mg/kg	0.3	<0.3	<0.3	<0.3
Total BTEX*	mg/kg	0.6	<0.6	<0.6	<0.6
Naphthalene (VOC)*	mg/kg	0.1	<0.1	<0.1	<0.1

Volatile Petroleum Hydrocarbons in Soil [AN433] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
TRH C6-C9	mg/kg	20	<20	<20	<20
Benzene (F0)	mg/kg	0.1	<0.1	<0.1	<0.1
TRH C6-C10	mg/kg	25	<25	<25	<25
TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	<25

TRH (Total Recoverable Hydrocarbons) in Soil [AN403] Tested: 24/1/2023

			S1	S2	S3
			SOIL	SOIL	SOIL
			-	-	-
			19/1/2023	19/1/2023	19/1/2023
PARAMETER	UOM	LOR	SE242054.001	SE242054.002	SE242054.003
TRH C10-C14	mg/kg	20	<20	<20	<20
TRH C15-C28	mg/kg	45	<45	<45	<45
TRH C29-C36	mg/kg	45	<45	<45	**47**
TRH C37-C40	mg/kg	100	<100	<100	<100
TRH >C10-C16	mg/kg	25	<25	<25	<25
TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	<25
TRH >C16-C34 (F3)	mg/kg	90	<90	<90	<90
TRH >C34-C40 (F4)	mg/kg	120	<120	<120	<120
TRH C10-C36 Total	mg/kg	110	<110	<110	<110
TRH >C10-C40 Total (F bands)	mg/kg	210	<210	<210	<210

PAH (Polynuclear Aromatic Hydrocarbons) in Soil [AN420] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Naphthalene	mg/kg	0.1	<0.1	<0.1	<0.1
2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1
1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	<0.1
Acenaphthylene	mg/kg	0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	0.1	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.1	<0.1	<0.1	<0.1
Anthracene	mg/kg	0.1	<0.1	<0.1	<0.1
Fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1
Pyrene	mg/kg	0.1	<0.1	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1
Chrysene	mg/kg	0.1	<0.1	<0.1	<0.1
Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	<0.1
Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	<0.1
Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	<0.1
Carcinogenic PAHs, BaP TEQ <LOR=0*	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2
Carcinogenic PAHs, BaP TEQ <LOR=LOR*	TEQ (mg/kg)	0.3	<0.3	<0.3	<0.3
Carcinogenic PAHs, BaP TEQ <LOR=LOR/2*	TEQ (mg/kg)	0.2	<0.2	<0.2	<0.2
Total PAH (18)	mg/kg	0.8	<0.8	<0.8	<0.8
Total PAH (NEPM/WHO 16)	mg/kg	0.8	<0.8	<0.8	<0.8

OC Pesticides in Soil [AN420] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1	<0.1	<0.1
Alpha BHC	mg/kg	0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	mg/kg	0.1	<0.1	<0.1	<0.1
Heptachlor	mg/kg	0.1	<0.1	<0.1	<0.1
Aldrin	mg/kg	0.1	<0.1	<0.1	<0.1
Beta BHC	mg/kg	0.1	<0.1	<0.1	<0.1
Delta BHC	mg/kg	0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	mg/kg	0.1	<0.1	<0.1	<0.1
o,p'-DDE*	mg/kg	0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	mg/kg	0.2	<0.2	<0.2	<0.2
Gamma Chlordane	mg/kg	0.1	<0.1	<0.1	<0.1
Alpha Chlordane	mg/kg	0.1	<0.1	<0.1	<0.1
trans-Nonachlor	mg/kg	0.1	<0.1	<0.1	<0.1
p,p'-DDE	mg/kg	0.1	<0.1	<0.1	<0.1
Dieldrin	mg/kg	0.2	<0.2	<0.2	<0.2
Endrin	mg/kg	0.2	<0.2	<0.2	<0.2
o,p'-DDD*	mg/kg	0.1	<0.1	<0.1	<0.1
o,p'-DDT*	mg/kg	0.1	<0.1	<0.1	<0.1
Beta Endosulfan	mg/kg	0.2	<0.2	<0.2	<0.2
p,p'-DDD	mg/kg	0.1	<0.1	<0.1	<0.1
p,p'-DDT	mg/kg	0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	mg/kg	0.1	<0.1	<0.1	<0.1
Endrin aldehyde	mg/kg	0.1	<0.1	<0.1	<0.1
Methoxychlor	mg/kg	0.1	<0.1	<0.1	<0.1
Endrin ketone	mg/kg	0.1	<0.1	<0.1	<0.1
Isodrin	mg/kg	0.1	<0.1	<0.1	<0.1
Mirex	mg/kg	0.1	<0.1	<0.1	<0.1
Total CLP OC Pesticides	mg/kg	1	<1	<1	<1
Total OC VIC EPA	mg/kg	1	<1	<1	<1

OP Pesticides in Soil [AN420] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Dichlorvos	mg/kg	0.5	<0.5	<0.5	<0.5
Dimethoate	mg/kg	0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	mg/kg	0.5	<0.5	<0.5	<0.5
Fenitrothion	mg/kg	0.2	<0.2	<0.2	<0.2
Malathion	mg/kg	0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	mg/kg	0.2	<0.2	<0.2	<0.2
Methidathion	mg/kg	0.5	<0.5	<0.5	<0.5
Ethion	mg/kg	0.2	<0.2	<0.2	<0.2
Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2	<0.2	<0.2
Total OP Pesticides*	mg/kg	1.7	<1.7	<1.7	<1.7

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES [AN040/AN320] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Arsenic, As	mg/kg	1	**3**	**2**	**1**
Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	<0.3
Chromium, Cr	mg/kg	0.5	**7.4**	**6.7**	**4.2**
Copper, Cu	mg/kg	0.5	**11**	**10**	**1.9**
Lead, Pb	mg/kg	1	**33**	**44**	**9**
Nickel, Ni	mg/kg	0.5	**2.8**	**2.0**	<0.5
Zinc, Zn	mg/kg	2	**54**	**80**	**9.8**

Mercury in Soil [AN312] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Mercury	mg/kg	0.05	**0.10**	**0.17**	<0.05

Moisture Content [AN002] Tested: 24/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
% Moisture	%w/w	1	14.9	9.3	7.5

Fibre Identification in soil [AS4964/AN602] Tested: 27/1/2023

PARAMETER	UOM	LOR	S1 SOIL - 19/1/2023 SE242054.001	S2 SOIL - 19/1/2023 SE242054.002	S3 SOIL - 19/1/2023 SE242054.003
Asbestos Detected	No unit	-	No	No	No
Estimated Fibres*	%w/w	0.01	<0.01	<0.01	<0.01

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN040/AN320	A portion of sample is digested with nitric acid to decompose organic matter and hydrochloric acid to complete the digestion of metals. The digest is then analysed by ICP OES with metals results reported on the dried sample basis. Based on USEPA method 200.8 and 6010C.
AN040	A portion of sample is digested with Nitric acid to decompose organic matter and Hydrochloric acid to complete the digestion of metals and then filtered for analysis by ASS or ICP as per USEPA Method 200.8.
AN312	Mercury by Cold Vapour AAS in Soils: After digestion with nitric acid, hydrogen peroxide and hydrochloric acid, mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). F2 is reported directly and also corrected by subtracting Naphthalene (from VOC method AN433) where available.
AN403	Additionally, the volatile C6-C9 fraction may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoverable Hydrocarbons - Silica (TRH-Si) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	(SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols (etc) in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D). Total PAH calculated from individual analyte detections at or above the limit of reporting.
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC`s are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.
AN602	Qualitative identification of chrysotile, amosite and crocidolite in bulk samples by polarised light microscopy (PLM) in conjunction with dispersion staining (DS). AS4964 provides the basis for this document. Unequivocal identification of the asbestos minerals present is made by obtaining sufficient diagnostic `clues`, which provide a reasonable degree of certainty, dispersion staining is a mandatory `clue` for positive identification. If sufficient `clues` are absent, then positive identification of asbestos is not possible. This procedure requires removal of suspect fibres/bundles from the sample which cannot be returned.
AN602	Fibres/material that cannot be unequivocably identified as one of the three asbestos forms, will be reported as unknown mineral fibres (umf) The fibres detected may or may not be asbestos fibres.
AN602	AS4964.2004 Method for the Qualitative Identification of Asbestos in Bulk Samples, Section 8.4, Trace Analysis Criteria, Note 4 states:"Depending upon sample condition and fibre type, the detection/reporting limit (RL) of this technique has been found to lie generally in the range of 1 in 1,000 to 1 in 10,000 parts by weight, equivalent to 1 to 0.1 g/kg."

AN602	The sample can be reported "no asbestos found at the reporting limit (RL) of 0.1 g/kg" (<0.01%w/w) where AN602 section 4.5 of this method has been followed, and if- (a) no trace asbestos fibres have been detected (i.e. no 'respirable' fibres): (b) the estimated weight of non-respirable asbestos fibre bundles and/or the estimated weight of asbestos in asbestos-containing materials are found to be less than 0.1g/kg: and (c) these non-respirable asbestos fibre bundles and/or the asbestos containing materials are only visible under stereo-microscope viewing conditions.

FOOTNOTES

*	NATA accreditation does not cover the performance of this service.	-	Not analysed.	UOM	Unit of Measure.
**	Indicative data, theoretical holding time exceeded.	NVL	Not validated.	LOR	Limit of Reporting.
***	Indicates that both * and ** apply.	IS	Insufficient sample for analysis.	↑↓	Raised/lowered Limit of Reporting.
		LNR	Sample listed, but not received.		

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Admin	Manager	Huong Crawford
Client	NEO CONSULTING PTY LTD	Laboratory	SGS Alexandria Environmental
Address	PO BOX 279 RIVERSTONE NSW 2765	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	0416 680 375	Telephone	+61 2 8594 0400
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	admin@neoconsulting.com.au	Email	au.environmental.sydney@sgs.com
Project	**N6898**	SGS Reference	**SE242054 R0**
Order Number	**N6898**	Date Received	20 Jan 2023
Samples	3	Date Reported	30 Jan 2023

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

No respirable fibres detected in all soil samples using trace analysis technique.
A portion of the sample supplied has been sub-sampled for asbestos analysis in soil according to SGS In-house procedures. We therefore cannot guarantee that the sub-sample is representative of the entire sample supplied. SGS Industries and Environment recommends supplying approximately 50-100g of sample in a separate container.
Asbestos analysed by Approved Identifier Ravee Sivasubramaniam.

SIGNATORIES

S. Raveendran.

Ravee SIVASUBRAMANIAM
Hygiene Team Leader

RESULTS

Fibre Identification in soil — Method AN602

Laboratory Reference	Client Reference	Matrix	Sample Description	Date Sampled	Fibre Identification	Est.%w/w*
SE242054.001	S1	Soil	65g Clay,Sand,Rocks	19 Jan 2023	No Asbestos Found at RL of 0.1g/kg Organic Fibres Detected	<0.01
SE242054.002	S2	Soil	92g Clay,Sand,Rocks,Plant Matter	19 Jan 2023	No Asbestos Found at RL of 0.1g/kg Organic Fibres Detected	<0.01
SE242054.003	S3	Soil	103g Sand,Soil,Rocks,Plant Matter	19 Jan 2023	No Asbestos Found at RL of 0.1g/kg Organic Fibres Detected	<0.01

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN602	Qualitative identification of chrysotile, amosite and crocidolite in bulk samples by polarised light microscopy (PLM) in conjunction with dispersion staining (DS). AS4964 provides the basis for this document. Unequivocal identification of the asbestos minerals present is made by obtaining sufficient diagnostic `clues`, which provide a reasonable degree of certainty, dispersion staining is a mandatory `clue` for positive identification. If sufficient `clues` are absent, then positive identification of asbestos is not possible. This procedure requires removal of suspect fibres/bundles from the sample which cannot be returned.
AN602	Fibres/material that cannot be unequivocably identified as one of the three asbestos forms, will be reported as unknown mineral fibres (umf) The fibres detected may or may not be asbestos fibres.
AN602	AS4964.2004 Method for the Qualitative Identification of Asbestos in Bulk Samples, Section 8.4, Trace Analysis Criteria, Note 4 states:"Depending upon sample condition and fibre type, the detection/reporting limit (RL) of this technique has been found to lie generally in the range of 1 in 1,000 to 1 in 10,000 parts by weight, equivalent to 1 to 0.1 g/kg."
AN602	The sample can be reported “no asbestos found at the reporting limit (RL) of 0.1 g/kg” (<0.01%w/w) where AN602 section 4.5 of this method has been followed, and if- (a) no trace asbestos fibres have been detected (i.e. no ‘respirable’ fibres): (b) the estimated weight of non-respirable asbestos fibre bundles and/or the estimated weight of asbestos in asbestos-containing materials are found to be less than 0.1g/kg: and (c) these non-respirable asbestos fibre bundles and/or the asbestos containing materials are only visible under stereo-microscope viewing conditions.

FOOTNOTES

Amosite	-	Brown Asbestos	NA	-	Not Analysed
Chrysotile	-	White Asbestos	LNR	-	Listed, Not Required
Crocidolite	-	Blue Asbestos	*	-	NATA accreditation does not cover the performance of this service.
Amphiboles	-	Amosite and/or Crocidolite	**	-	Indicative data, theoretical holding time exceeded.
			***	-	Indicates that both * and ** apply.

(In reference to soil samples only) This report does not comply with the analytical reporting recommendations in the Western Australian Department of Health Guidelines for the Assessment and Remediation and Management of Asbestos Contaminated sites in Western Australia - May 2009.

Unless it is reported that sampling has been performed by SGS, the samples have been analysed as received.

Where reported: 'Asbestos Detected': Asbestos detected by polarised light microscopy, including dispersion staining.
Where reported: 'No Asbestos Found': No Asbestos Found by polarised light microscopy, including dispersion staining.
Where reported: 'UMF Detected': Mineral fibres of unknown type detected by polarised light microscopy, including dispersion staining. Confirmation by another independent analytical technique may be necessary.

Even after disintegration it can be very difficult, or impossible, to detect the presence of asbestos in some asbestos-containing bulk materials using polarised light microscopy. This is due to the low grade or small length or diameter of asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/en-gb/environment-health-and-safety.

STATEMENT OF QA/QC PERFORMANCE

SE242054 R0

CLIENT DETAILS

Contact	Admin	Manager	Huong Crawford
Client	NEO CONSULTING PTY LTD	Laboratory	SGS Alexandria Environmental
Address	PO BOX 279 RIVERSTONE NSW 2765	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	0416 680 375	Telephone	+61 2 8594 0400
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	admin@neoconsulting.com.au	Email	au.environmental.sydney@sgs.com
Project	**N6898**	SGS Reference	**SE242054 R0**
Order Number	**N6898**	Date Received	20 Jan 2023
Samples	3	Date Reported	30 Jan 2023

COMMENTS

All the laboratory data for each environmental matrix was compared to SGS' stated Data Quality Objectives (DQO). Comments arising from the comparison were made and are reported below.

The data relating to sampling was taken from the Chain of Custody document.
This QA/QC Statement must be read in conjunction with the referenced Analytical Report.
The Statement and the Analytical Report must not be reproduced except in full.

All Data Quality Objectives were met (within the SGS Alexandria Environmental laboratory).

SAMPLE SUMMARY

Sample counts by matrix	3 Soil	Type of documentation received	COC
Date documentation received	20/1/2023	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	8.8°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes		

SGS holding time criteria are drawn from current regulations and are highly dependent on sample container preservation as specified in the SGS "Field Sampling Guide for Containers and Holding Time" (ref: GU-(AU)-ENV.001). Soil samples guidelines are derived from NEPM "Schedule B(3) Guideline on Laboratory Analysis of Potentially Contaminated Soils". Water sample guidelines are derived from "AS/NZS 5667.1 : 1998 Water Quality - sampling part 1" and APHA "Standard Methods for the Examination of Water and Wastewater" 21st edition 2005.

Extraction and analysis holding time due dates listed are calculated from the date sampled, although holding times may be extended after laboratory extraction for some analytes. The due dates are the suggested dates that samples may be held before extraction or analysis and still be considered valid.

Extraction and analysis dates are shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria. If the

Fibre Identification in soil — Method: ME-(AU)-[ENV]AS4964/AN602

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269796	19 Jan 2023	20 Jan 2023	19 Jan 2024	27 Jan 2023	19 Jan 2024	30 Jan 2023
S2	SE242054.002	LB269796	19 Jan 2023	20 Jan 2023	19 Jan 2024	27 Jan 2023	19 Jan 2024	30 Jan 2023
S3	SE242054.003	LB269796	19 Jan 2023	20 Jan 2023	19 Jan 2024	27 Jan 2023	19 Jan 2024	30 Jan 2023

Mercury in Soil — Method: ME-(AU)-[ENV]AN312

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269607	19 Jan 2023	20 Jan 2023	16 Feb 2023	24 Jan 2023	16 Feb 2023	30 Jan 2023
S2	SE242054.002	LB269607	19 Jan 2023	20 Jan 2023	16 Feb 2023	24 Jan 2023	16 Feb 2023	30 Jan 2023
S3	SE242054.003	LB269607	19 Jan 2023	20 Jan 2023	16 Feb 2023	24 Jan 2023	16 Feb 2023	30 Jan 2023

Moisture Content — Method: ME-(AU)-[ENV]AN002

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269600	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	29 Jan 2023	27 Jan 2023
S2	SE242054.002	LB269600	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	29 Jan 2023	27 Jan 2023
S3	SE242054.003	LB269600	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	29 Jan 2023	27 Jan 2023

OC Pesticides in Soil — Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S2	SE242054.002	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S3	SE242054.003	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023

OP Pesticides in Soil — Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S2	SE242054.002	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S3	SE242054.003	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023

PAH (Polynuclear Aromatic Hydrocarbons) in Soil — Method: ME-(AU)-[ENV]AN420

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S2	SE242054.002	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S3	SE242054.003	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES — Method: ME-(AU)-[ENV]AN040/AN320

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269604	19 Jan 2023	20 Jan 2023	18 Jul 2023	24 Jan 2023	18 Jul 2023	30 Jan 2023
S2	SE242054.002	LB269604	19 Jan 2023	20 Jan 2023	18 Jul 2023	24 Jan 2023	18 Jul 2023	30 Jan 2023
S3	SE242054.003	LB269604	19 Jan 2023	20 Jan 2023	18 Jul 2023	24 Jan 2023	18 Jul 2023	30 Jan 2023

TRH (Total Recoverable Hydrocarbons) in Soil — Method: ME-(AU)-[ENV]AN403

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S2	SE242054.002	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023
S3	SE242054.003	LB269598	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	05 Mar 2023	27 Jan 2023

VOC's in Soil — Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269599	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	02 Feb 2023	30 Jan 2023
S2	SE242054.002	LB269599	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	02 Feb 2023	30 Jan 2023
S3	SE242054.003	LB269599	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	02 Feb 2023	30 Jan 2023

Volatile Petroleum Hydrocarbons in Soil — Method: ME-(AU)-[ENV]AN433

Sample Name	Sample No.	QC Ref	Sampled	Received	Extraction Due	Extracted	Analysis Due	Analysed
S1	SE242054.001	LB269599	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	02 Feb 2023	30 Jan 2023
S2	SE242054.002	LB269599	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	02 Feb 2023	30 Jan 2023
S3	SE242054.003	LB269599	19 Jan 2023	20 Jan 2023	02 Feb 2023	24 Jan 2023	02 Feb 2023	30 Jan 2023

Surrogate results are evaluated against upper and lower limit criteria established in the SGS QA/QC plan (Ref: MP-(AU)-[ENV]QU-022). At least two of three routine level soil sample surrogate spike recoveries for BTEX/VOC are to be within 70-130% where control charts have not been developed and within the established control limits for charted surrogates. Matrix effects may void this as an acceptance criterion. Water sample surrogate spike recoveries are to be within 40-130%. The presence of emulsions, surfactants and particulates may void this as an acceptance criterion.

Result is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Tetrachloro-m-xylene (TCMX) (Surrogate)	S1	SE242054.001	%	60 - 130%	98
	S2	SE242054.002	%	60 - 130%	98
	S3	SE242054.003	%	60 - 130%	95

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	S1	SE242054.001	%	60 - 130%	85
	S2	SE242054.002	%	60 - 130%	81
	S3	SE242054.003	%	60 - 130%	84
d14-p-terphenyl (Surrogate)	S1	SE242054.001	%	60 - 130%	93
	S2	SE242054.002	%	60 - 130%	91
	S3	SE242054.003	%	60 - 130%	93

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
2-fluorobiphenyl (Surrogate)	S1	SE242054.001	%	70 - 130%	85
	S2	SE242054.002	%	70 - 130%	81
	S3	SE242054.003	%	70 - 130%	84
d14-p-terphenyl (Surrogate)	S1	SE242054.001	%	70 - 130%	93
	S2	SE242054.002	%	70 - 130%	91
	S3	SE242054.003	%	70 - 130%	93
d5-nitrobenzene (Surrogate)	S1	SE242054.001	%	70 - 130%	86
	S2	SE242054.002	%	70 - 130%	86
	S3	SE242054.003	%	70 - 130%	88

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	S1	SE242054.001	%	60 - 130%	101
	S2	SE242054.002	%	60 - 130%	103
	S3	SE242054.003	%	60 - 130%	95
d4-1,2-dichloroethane (Surrogate)	S1	SE242054.001	%	60 - 130%	126
	S2	SE242054.002	%	60 - 130%	118
	S3	SE242054.003	%	60 - 130%	124
d8-toluene (Surrogate)	S1	SE242054.001	%	60 - 130%	88
	S2	SE242054.002	%	60 - 130%	96
	S3	SE242054.003	%	60 - 130%	91

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Parameter	Sample Name	Sample Number	Units	Criteria	Recovery %
Bromofluorobenzene (Surrogate)	S1	SE242054.001	%	60 - 130%	101
	S2	SE242054.002	%	60 - 130%	103
	S3	SE242054.003	%	60 - 130%	95
d4-1,2-dichloroethane (Surrogate)	S1	SE242054.001	%	60 - 130%	126
	S2	SE242054.002	%	60 - 130%	118
	S3	SE242054.003	%	60 - 130%	124
d8-toluene (Surrogate)	S1	SE242054.001	%	60 - 130%	88
	S2	SE242054.002	%	60 - 130%	96
	S3	SE242054.003	%	60 - 130%	91

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Number		Parameter	Units	LOR	Result
LB269607.001		Mercury	mg/kg	0.05	<0.05

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB269598.001		Alpha BHC	mg/kg	0.1	<0.1
		Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1
		Beta BHC	mg/kg	0.1	<0.1
		Lindane (gamma BHC)	mg/kg	0.1	<0.1
		Delta BHC	mg/kg	0.1	<0.1
		Heptachlor	mg/kg	0.1	<0.1
		Aldrin	mg/kg	0.1	<0.1
		Isodrin	mg/kg	0.1	<0.1
		Heptachlor epoxide	mg/kg	0.1	<0.1
		Gamma Chlordane	mg/kg	0.1	<0.1
		Alpha Chlordane	mg/kg	0.1	<0.1
		Alpha Endosulfan	mg/kg	0.2	<0.2
		p,p'-DDE	mg/kg	0.1	<0.1
		Dieldrin	mg/kg	0.2	<0.2
		Endrin	mg/kg	0.2	<0.2
		Beta Endosulfan	mg/kg	0.2	<0.2
		p,p'-DDD	mg/kg	0.1	<0.1
		Endrin aldehyde	mg/kg	0.1	<0.1
		Endosulfan sulphate	mg/kg	0.1	<0.1
		p,p'-DDT	mg/kg	0.1	<0.1
		Endrin ketone	mg/kg	0.1	<0.1
		Methoxychlor	mg/kg	0.1	<0.1
		Mirex	mg/kg	0.1	<0.1
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	98

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB269598.001		Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2
		Bromophos Ethyl	mg/kg	0.2	<0.2
		Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2
		Diazinon (Dimpylate)	mg/kg	0.5	<0.5
		Dichlorvos	mg/kg	0.5	<0.5
		Dimethoate	mg/kg	0.5	<0.5
		Ethion	mg/kg	0.2	<0.2
		Fenitrothion	mg/kg	0.2	<0.2
		Malathion	mg/kg	0.2	<0.2
		Methidathion	mg/kg	0.5	<0.5
		Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2
	Surrogates	2-fluorobiphenyl (Surrogate)	%	-	83
		d14-p-terphenyl (Surrogate)	%	-	92

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB269598.001		Naphthalene	mg/kg	0.1	<0.1
		2-methylnaphthalene	mg/kg	0.1	<0.1
		1-methylnaphthalene	mg/kg	0.1	<0.1
		Acenaphthylene	mg/kg	0.1	<0.1
		Acenaphthene	mg/kg	0.1	<0.1
		Fluorene	mg/kg	0.1	<0.1
		Phenanthrene	mg/kg	0.1	<0.1
		Anthracene	mg/kg	0.1	<0.1
		Fluoranthene	mg/kg	0.1	<0.1
		Pyrene	mg/kg	0.1	<0.1
		Benzo(a)anthracene	mg/kg	0.1	<0.1
		Chrysene	mg/kg	0.1	<0.1
		Benzo(a)pyrene	mg/kg	0.1	<0.1

METHOD BLANKS

Blank results are evaluated against the limit of reporting (LOR), for the chosen method and its associated instrumentation, typically 2.5 times the statistically determined method detection limit (MDL).

Result is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

PAH (Polynuclear Aromatic Hydrocarbons) in Soil (continued)

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result
LB269598.001		Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1
		Dibenzo(ah)anthracene	mg/kg	0.1	<0.1
		Benzo(ghi)perylene	mg/kg	0.1	<0.1
		Total PAH (18)	mg/kg	0.8	<0.1
	Surrogates	d5-nitrobenzene (Surrogate)	%	-	86
		2-fluorobiphenyl (Surrogate)	%	-	83
		d14-p-terphenyl (Surrogate)	%	-	92

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Sample Number		Parameter	Units	LOR	Result
LB269604.001		Arsenic, As	mg/kg	1	<1
		Cadmium, Cd	mg/kg	0.3	<0.3
		Chromium, Cr	mg/kg	0.5	<0.5
		Copper, Cu	mg/kg	0.5	<0.5
		Nickel, Ni	mg/kg	0.5	<0.5
		Lead, Pb	mg/kg	1	<1
		Zinc, Zn	mg/kg	2	<2.0

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result
LB269598.001		TRH C10-C14	mg/kg	20	<20
		TRH C15-C28	mg/kg	45	<45
		TRH C29-C36	mg/kg	45	<45
		TRH C37-C40	mg/kg	100	<100
		TRH C10-C36 Total	mg/kg	110	<110

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB269599.001	Monocyclic Aromatic Hydrocarbons	Benzene	mg/kg	0.1	<0.1
		Toluene	mg/kg	0.1	<0.1
		Ethylbenzene	mg/kg	0.1	<0.1
		m/p-xylene	mg/kg	0.2	<0.2
		o-xylene	mg/kg	0.1	<0.1
	Polycyclic VOCs	Naphthalene (VOC)*	mg/kg	0.1	<0.1
	Surrogates	d4-1,2-dichloroethane (Surrogate)	%	-	128
		d8-toluene (Surrogate)	%	-	104
		Bromofluorobenzene (Surrogate)	%	-	115
	Totals	Total BTEX*	mg/kg	0.6	<0.6

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result
LB269599.001		TRH C6-C9	mg/kg	20	<20
	Surrogates	d4-1,2-dichloroethane (Surrogate)	%	-	128

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242058.006	LB269607.014		Mercury	mg/kg	0.05	<0.05	<0.05	200	0
SE242177.002	LB269607.021		Mercury	mg/kg	0.05	<0.05	<0.05	200	0

Moisture Content

Method: ME-(AU)-[ENV]AN002

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242058.006	LB269600.011		% Moisture	%w/w	1	24.7	25.3	34	2
SE242177.002	LB269600.022		% Moisture	%w/w	1	15.9	15.7	36	1

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242177.002	LB269598.025		Alpha BHC	mg/kg	0.1	<0.1	<0.1	200	0
			Hexachlorobenzene (HCB)	mg/kg	0.1	<0.1	<0.1	200	0
			Beta BHC	mg/kg	0.1	<0.1	<0.1	200	0
			Lindane (gamma BHC)	mg/kg	0.1	<0.1	<0.1	200	0
			Delta BHC	mg/kg	0.1	<0.1	<0.1	200	0
			Heptachlor	mg/kg	0.1	<0.1	<0.1	200	0
			Aldrin	mg/kg	0.1	<0.1	<0.1	200	0
			Isodrin	mg/kg	0.1	<0.1	<0.1	200	0
			Heptachlor epoxide	mg/kg	0.1	<0.1	<0.1	200	0
			Gamma Chlordane	mg/kg	0.1	<0.1	<0.1	200	0
			Alpha Chlordane	mg/kg	0.1	<0.1	<0.1	200	0
			Alpha Endosulfan	mg/kg	0.2	<0.2	<0.2	200	0
			o,p'-DDE*	mg/kg	0.1	<0.1	<0.1	200	0
			p,p'-DDE	mg/kg	0.1	<0.1	<0.1	200	0
			Dieldrin	mg/kg	0.2	<0.2	<0.2	200	0
			Endrin	mg/kg	0.2	<0.2	<0.2	200	0
			Beta Endosulfan	mg/kg	0.2	<0.2	<0.2	200	0
			o,p'-DDD*	mg/kg	0.1	<0.1	<0.1	200	0
			p,p'-DDD	mg/kg	0.1	<0.1	<0.1	200	0
			Endrin aldehyde	mg/kg	0.1	<0.1	<0.1	200	0
			Endosulfan sulphate	mg/kg	0.1	<0.1	<0.1	200	0
			o,p'-DDT*	mg/kg	0.1	<0.1	<0.1	200	0
			p,p'-DDT	mg/kg	0.1	<0.1	<0.1	200	0
			Endrin ketone	mg/kg	0.1	<0.1	<0.1	200	0
			Methoxychlor	mg/kg	0.1	<0.1	<0.1	200	0
			Mirex	mg/kg	0.1	<0.1	<0.1	200	0
			trans-Nonachlor	mg/kg	0.1	<0.1	<0.1	200	0
			Total CLP OC Pesticides	mg/kg	1	<1	<1	200	0
			Total OC VIC EPA	mg/kg	1	<1	<1	200	0
		Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	mg/kg	-	0.15	0.14	30	1

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242054.003	LB269598.027		Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2	0.0028649884	200	0
			Bromophos Ethyl	mg/kg	0.2	<0.2	0	200	0
			Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	<0.2	0.0008293871	200	0
			Diazinon (Dimpylate)	mg/kg	0.5	<0.5	0.0023440000	200	0
			Dichlorvos	mg/kg	0.5	<0.5	0.0429316602	200	0
			Dimethoate	mg/kg	0.5	<0.5	0.0037720265	200	0
			Ethion	mg/kg	0.2	<0.2	0.0006905828	200	0
			Fenitrothion	mg/kg	0.2	<0.2	0	200	0
			Malathion	mg/kg	0.2	<0.2	0.0009308029	200	0
			Methidathion	mg/kg	0.5	<0.5	0.0030634190	200	0
			Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2	0	200	0
			Total OP Pesticides*	mg/kg	1.7	<1.7	0	200	0
		Surrogates	2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.4221044314	30	0
			d14-p-terphenyl (Surrogate)	mg/kg	-	0.5	0.4656917262	30	1

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Original	Duplicate		Parameter	Units	LOR

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may

PAH (Polynuclear Aromatic Hydrocarbons) in Soil (continued)

Method: ME-(AU)-[ENV]AN420

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242054.003	LB269598.027		Naphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthylene	mg/kg	0.1	<0.1	<0.1	200	0
			Acenaphthene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluorene	mg/kg	0.1	<0.1	<0.1	200	0
			Phenanthrene	mg/kg	0.1	<0.1	<0.1	200	0
			Anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Chrysene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(a)pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	200	0
			Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	200	0
			Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	200	0
			Carcinogenic PAHs, BaP TEQ <LOR=0*	mg/kg	0.2	<0.2	<0.2	200	0
			Carcinogenic PAHs, BaP TEQ <LOR=LOR/2*	mg/kg	0.2	<0.2	<0.2	175	0
			Carcinogenic PAHs, BaP TEQ <LOR=LOR*	mg/kg	0.3	<0.3	<0.3	134	0
			Total PAH (18)	mg/kg	0.8	<0.8	<0.1	200	0
		Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	-	0.4	0.4	30	0
			2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.4	30	0
			d14-p-terphenyl (Surrogate)	mg/kg	-	0.5	0.5	30	1

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242058.006	LB269604.014		Arsenic, As	mg/kg	1	5	4	51	9
			Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	200	0
			Chromium, Cr	mg/kg	0.5	34	36	31	4
			Copper, Cu	mg/kg	0.5	<0.5	<0.5	200	0
			Nickel, Ni	mg/kg	0.5	1.3	0.8	78	42
			Lead, Pb	mg/kg	1	15	16	36	2
			Zinc, Zn	mg/kg	2	6.4	5.3	64	19
SE242177.002	LB269604.021		Arsenic, As	mg/kg	1	4	4	56	3
			Cadmium, Cd	mg/kg	0.3	<0.3	<0.3	200	0
			Chromium, Cr	mg/kg	0.5	33	29	32	11
			Copper, Cu	mg/kg	0.5	<0.5	<0.5	200	0
			Nickel, Ni	mg/kg	0.5	1.3	1.7	63	24
			Lead, Pb	mg/kg	1	15	13	37	12
			Zinc, Zn	mg/kg	2	4.3	3.7	80	14

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242054.003	LB269598.027		TRH C10-C14	mg/kg	20	<20	<20	200	0
			TRH C15-C28	mg/kg	45	<45	<45	157	0
			TRH C29-C36	mg/kg	45	47	59	115	22
			TRH C37-C40	mg/kg	100	<100	<100	200	0
			TRH C10-C36 Total	mg/kg	110	<110	<110	200	0
			TRH >C10-C40 Total (F bands)	mg/kg	210	<210	<210	200	0
		TRH F Bands	TRH >C10-C16	mg/kg	25	<25	<25	200	0
			TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	200	0
			TRH >C16-C34 (F3)	mg/kg	90	<90	<90	148	0
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	200	0
SE242177.002	LB269598.025		TRH C10-C14	mg/kg	20	<20	<20	200	0
			TRH C15-C28	mg/kg	45	<45	<45	200	0
			TRH C29-C36	mg/kg	45	<45	<45	200	0
			TRH C37-C40	mg/kg	100	<100	<100	200	0
			TRH C10-C36 Total	mg/kg	110	<110	<110	200	0
			TRH >C10-C40 Total (F bands)	mg/kg	210	<210	<210	200	0
		TRH F Bands	TRH >C10-C16	mg/kg	25	<25	<25	200	0

Duplicates are calculated as Relative Percentage Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

NOTE: The RPD reported is calculated from the unrounded data for the original and replicate result. Manual calculation of the RPD from the rounded data reported may

TRH (Total Recoverable Hydrocarbons) in Soil (continued)

Method: ME-(AU)-[ENV]AN403

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242177.002	LB269598.025	TRH F Bands	TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	<25	<25	200	0
			TRH >C16-C34 (F3)	mg/kg	90	<90	<90	200	0
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	200	0

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242058.006	LB269599.014	Monocyclic Aromatic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
			Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0
			m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
			o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene (VOC)*	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	11.7	12.0	50	3
			d8-toluene (Surrogate)	mg/kg	-	8.4	8.2	50	2
			Bromofluorobenzene (Surrogate)	mg/kg	-	8.9	9.1	50	2
		Totals	Total BTEX*	mg/kg	0.6	<0.6	<0.6	200	0
			Total Xylenes*	mg/kg	0.3	<0.3	<0.3	200	0
SE242177.002	LB269599.022	Monocyclic Aromatic	Benzene	mg/kg	0.1	<0.1	<0.1	200	0
			Toluene	mg/kg	0.1	<0.1	<0.1	200	0
			Ethylbenzene	mg/kg	0.1	<0.1	<0.1	200	0
			m/p-xylene	mg/kg	0.2	<0.2	<0.2	200	0
			o-xylene	mg/kg	0.1	<0.1	<0.1	200	0
		Polycyclic	Naphthalene (VOC)*	mg/kg	0.1	<0.1	<0.1	200	0
		Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	12.7	12.3	50	3
			d8-toluene (Surrogate)	mg/kg	-	8.9	8.6	50	4
			Bromofluorobenzene (Surrogate)	mg/kg	-	9.7	9.3	50	3
		Totals	Total BTEX*	mg/kg	0.6	<0.6	<0.6	200	0
			Total Xylenes*	mg/kg	0.3	<0.3	<0.3	200	0

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Original	Duplicate		Parameter	Units	LOR	Original	Duplicate	Criteria %	RPD %
SE242058.006	LB269599.014		TRH C6-C10	mg/kg	25	<25	<25	200	0
			TRH C6-C9	mg/kg	20	<20	<20	200	0
		Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	11.7	12.0	30	3
			d8-toluene (Surrogate)	mg/kg	-	8.4	8.2	30	2
			Bromofluorobenzene (Surrogate)	mg/kg	-	8.9	9.1	30	2
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	200	0
SE242177.002	LB269599.022		TRH C6-C10	mg/kg	25	<25	<25	200	0
			TRH C6-C9	mg/kg	20	<20	<20	200	0
		Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	12.7	12.3	30	3
			d8-toluene (Surrogate)	mg/kg	-	8.9	8.6	30	4
			Bromofluorobenzene (Surrogate)	mg/kg	-	9.7	9.3	30	3
		VPH F Bands	Benzene (F0)	mg/kg	0.1	<0.1	<0.1	200	0
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	<25	<25	200	0

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269607.002		Mercury	mg/kg	0.05	0.23	0.2	70 - 130	114

OC Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269598.002		Delta BHC	mg/kg	0.1	0.2	0.2	60 - 140	89
		Heptachlor	mg/kg	0.1	0.2	0.2	60 - 140	92
		Aldrin	mg/kg	0.1	0.2	0.2	60 - 140	87
		Dieldrin	mg/kg	0.2	<0.2	0.2	60 - 140	86
		Endrin	mg/kg	0.2	<0.2	0.2	60 - 140	93
		p,p'-DDT	mg/kg	0.1	0.2	0.2	60 - 140	76
	Surrogates	Tetrachloro-m-xylene (TCMX) (Surrogate)	mg/kg	-	0.15	0.15	40 - 130	98

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269598.002		Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	1.6	2	60 - 140	81
		Diazinon (Dimpylate)	mg/kg	0.5	1.6	2	60 - 140	81
		Dichlorvos	mg/kg	0.5	1.4	2	60 - 140	70
		Ethion	mg/kg	0.2	1.4	2	60 - 140	69
	Surrogates	2-fluorobiphenyl (Surrogate)	mg/kg	-	0.5	0.5	40 - 130	90
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.5	0.5	40 - 130	92

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269598.002		Naphthalene	mg/kg	0.1	4.1	4	60 - 140	102
		Acenaphthylene	mg/kg	0.1	3.9	4	60 - 140	97
		Acenaphthene	mg/kg	0.1	4.0	4	60 - 140	100
		Phenanthrene	mg/kg	0.1	3.8	4	60 - 140	96
		Anthracene	mg/kg	0.1	4.0	4	60 - 140	100
		Fluoranthene	mg/kg	0.1	4.1	4	60 - 140	103
		Pyrene	mg/kg	0.1	4.0	4	60 - 140	99
		Benzo(a)pyrene	mg/kg	0.1	4.5	4	60 - 140	114
	Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	-	0.4	0.5	40 - 130	88
		2-fluorobiphenyl (Surrogate)	mg/kg	-	0.5	0.5	40 - 130	90
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.5	0.5	40 - 130	92

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269604.002		Arsenic, As	mg/kg	1	340	318.22	80 - 120	108
		Cadmium, Cd	mg/kg	0.3	4.1	4.81	70 - 130	86
		Chromium, Cr	mg/kg	0.5	40	38.31	80 - 120	104
		Copper, Cu	mg/kg	0.5	310	290	80 - 120	107
		Nickel, Ni	mg/kg	0.5	190	187	80 - 120	101
		Lead, Pb	mg/kg	1	93	89.9	80 - 120	103
		Zinc, Zn	mg/kg	2	270	273	80 - 120	97

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269598.002		TRH C10-C14	mg/kg	20	43	40	60 - 140	106
		TRH C15-C28	mg/kg	45	<45	40	60 - 140	107
		TRH C29-C36	mg/kg	45	<45	40	60 - 140	80
	TRH F Bands	TRH >C10-C16	mg/kg	25	43	40	60 - 140	107
		TRH >C16-C34 (F3)	mg/kg	90	<90	40	60 - 140	102
		TRH >C34-C40 (F4)	mg/kg	120	<120	20	60 - 140	74

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269599.002	Monocyclic Aromatic	Benzene	mg/kg	0.1	4.8	5	60 - 140	97
		Toluene	mg/kg	0.1	5.1	5	60 - 140	102
		Ethylbenzene	mg/kg	0.1	4.8	5	60 - 140	97
		m/p-xylene	mg/kg	0.2	9.7	10	60 - 140	97
		o-xylene	mg/kg	0.1	5.0	5	60 - 140	100
	Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	11.5	10	70 - 130	115

Laboratory Control Standard (LCS) results are evaluated against an expected result, typically the concentration of analyte spiked into the control during the sample preparation stage, producing a percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA /QC plan (Ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended dagger symbol (†) when outside suggested criteria.

VOC's in Soil (continued)

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269599.002	Surrogates	d8-toluene (Surrogate)	mg/kg	-	9.9	10	70 - 130	99
		Bromofluorobenzene (Surrogate)	mg/kg	-	10.1	10	70 - 130	101

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

Sample Number		Parameter	Units	LOR	Result	Expected	Criteria %	Recovery %
LB269599.002		TRH C6-C10	mg/kg	25	73	92.5	60 - 140	79
		TRH C6-C9	mg/kg	20	57	80	60 - 140	71
	Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	11.5	10	70 - 130	115
		Bromofluorobenzene (Surrogate)	mg/kg	-	10.1	10	70 - 130	101
	VPH F Bands	TRH C6-C10 minus BTEX (F1)	mg/kg	25	43	62.5	60 - 140	69

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

Mercury in Soil

Method: ME-(AU)-[ENV]AN312

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269607.004	Mercury	mg/kg	0.05	0.33	0.10	0.2	117

OP Pesticides in Soil

Method: ME-(AU)-[ENV]AN420

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269598.004	Azinphos-methyl (Guthion)	mg/kg	0.2	<0.2	<0.2	-	-
		Bromophos Ethyl	mg/kg	0.2	<0.2	<0.2	-	-
		Chlorpyrifos (Chlorpyrifos Ethyl)	mg/kg	0.2	1.6	<0.2	2	77
		Diazinon (Dimpylate)	mg/kg	0.5	1.6	<0.5	2	79
		Dichlorvos	mg/kg	0.5	1.4	<0.5	2	66
		Dimethoate	mg/kg	0.5	<0.5	<0.5	-	-
		Ethion	mg/kg	0.2	1.5	<0.2	2	74
		Fenitrothion	mg/kg	0.2	<0.2	<0.2	-	-
		Malathion	mg/kg	0.2	<0.2	<0.2	-	-
		Methidathion	mg/kg	0.5	<0.5	<0.5	-	-
		Parathion-ethyl (Parathion)	mg/kg	0.2	<0.2	<0.2	-	-
		Total OP Pesticides*	mg/kg	1.7	6.0	<1.7	-	-
	Surrogates	2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.4	-	87
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.4	0.5	-	86

PAH (Polynuclear Aromatic Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN420

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269598.004	Naphthalene	mg/kg	0.1	3.9	<0.1	4	96
		2-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	-	-
		1-methylnaphthalene	mg/kg	0.1	<0.1	<0.1	-	-
		Acenaphthylene	mg/kg	0.1	3.7	<0.1	4	92
		Acenaphthene	mg/kg	0.1	3.7	<0.1	4	93
		Fluorene	mg/kg	0.1	<0.1	<0.1	-	-
		Phenanthrene	mg/kg	0.1	3.6	<0.1	4	89
		Anthracene	mg/kg	0.1	3.7	<0.1	4	92
		Fluoranthene	mg/kg	0.1	3.9	<0.1	4	96
		Pyrene	mg/kg	0.1	3.7	<0.1	4	91
		Benzo(a)anthracene	mg/kg	0.1	<0.1	<0.1	-	-
		Chrysene	mg/kg	0.1	<0.1	<0.1	-	-
		Benzo(b&j)fluoranthene	mg/kg	0.1	<0.1	<0.1	-	-
		Benzo(k)fluoranthene	mg/kg	0.1	<0.1	<0.1	-	-
		Benzo(a)pyrene	mg/kg	0.1	4.3	<0.1	4	107
		Indeno(1,2,3-cd)pyrene	mg/kg	0.1	<0.1	<0.1	-	-
		Dibenzo(ah)anthracene	mg/kg	0.1	<0.1	<0.1	-	-
		Benzo(ghi)perylene	mg/kg	0.1	<0.1	<0.1	-	-
		Carcinogenic PAHs, BaP TEQ <LOR=0*	TEQ (mg/kg)	0.2	4.3	<0.2	-	-
		Carcinogenic PAHs, BaP TEQ <LOR=LOR/2*	TEQ (mg/kg)	0.2	4.4	<0.2	-	-
		Carcinogenic PAHs, BaP TEQ <LOR=LOR*	TEQ (mg/kg)	0.3	4.4	<0.3	-	-
		Total PAH (18)	mg/kg	0.8	30	<0.8	-	-
	Surrogates	d5-nitrobenzene (Surrogate)	mg/kg	-	0.4	0.4	-	84
		2-fluorobiphenyl (Surrogate)	mg/kg	-	0.4	0.4	-	87
		d14-p-terphenyl (Surrogate)	mg/kg	-	0.4	0.5	-	86

Total Recoverable Elements in Soil/Waste Solids/Materials by ICPOES

Method: ME-(AU)-[ENV]AN040/AN320

QC Sample	Sample Number	Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269604.004	Arsenic, As	mg/kg	1	54	3	50	102
		Cadmium, Cd	mg/kg	0.3	49	<0.3	50	98
		Chromium, Cr	mg/kg	0.5	57	7.4	50	100
		Copper, Cu	mg/kg	0.5	63	11	50	103
		Nickel, Ni	mg/kg	0.5	53	2.8	50	100
		Lead, Pb	mg/kg	1	80	33	50	94
		Zinc, Zn	mg/kg	2	100	54	50	97

TRH (Total Recoverable Hydrocarbons) in Soil

Method: ME-(AU)-[ENV]AN403

QC Sample	Sample Number	Parameter	Units	LOR

Matrix Spike (MS) results are evaluated as the percentage recovery of an expected result, typically the concentration of analyte spiked into a field sub -sample during the sample preparation stage. The original sample's result is subtracted from the sub-sample result before determining the percentage recovery. The criteria applied to the percentage recovery is established in the SGS QA/QC plan (ref: MP-(AU)-[ENV]QU-022). For more information refer to the footnotes in the concluding page of this report.

Recovery is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the end of this report for failure reasons.

TRH (Total Recoverable Hydrocarbons) in Soil (continued)

Method: ME-(AU)-[ENV]AN403

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269598.004		TRH C10-C14	mg/kg	20	45	<20	40	100
			TRH C15-C28	mg/kg	45	61	<45	40	102
			TRH C29-C36	mg/kg	45	52	<45	40	76
			TRH C37-C40	mg/kg	100	<100	<100	-	-
			TRH C10-C36 Total	mg/kg	110	160	<110	-	-
			TRH >C10-C40 Total (F bands)	mg/kg	210	<210	<210	-	-
		TRH F Bands	TRH >C10-C16	mg/kg	25	45	<25	40	100
			TRH >C10-C16 - Naphthalene (F2)	mg/kg	25	45	<25	-	-
			TRH >C16-C34 (F3)	mg/kg	90	<90	<90	40	93
			TRH >C34-C40 (F4)	mg/kg	120	<120	<120	-	-

VOC's in Soil

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269599.004	Monocyclic Aromatic	Benzene	mg/kg	0.1	4.9	<0.1	5	98
			Toluene	mg/kg	0.1	5.4	<0.1	5	107
			Ethylbenzene	mg/kg	0.1	5.1	<0.1	5	102
			m/p-xylene	mg/kg	0.2	10	<0.2	10	104
			o-xylene	mg/kg	0.1	5.4	<0.1	5	108
		Polycyclic	Naphthalene (VOC)*	mg/kg	0.1	<0.1	<0.1	-	-
		Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	10.8	12.6	10	108
			d8-toluene (Surrogate)	mg/kg	-	8.9	8.8	10	89
			Bromofluorobenzene (Surrogate)	mg/kg	-	9.3	10.1	10	93
		Totals	Total BTEX*	mg/kg	0.6	31	<0.6	-	-
			Total Xylenes*	mg/kg	0.3	16	<0.3	-	-

Volatile Petroleum Hydrocarbons in Soil

Method: ME-(AU)-[ENV]AN433

QC Sample	Sample Number		Parameter	Units	LOR	Result	Original	Spike	Recovery%
SE242054.001	LB269599.004		TRH C6-C10	mg/kg	25	82	<25	92.5	89
			TRH C6-C9	mg/kg	20	55	<20	80	68
		Surrogates	d4-1,2-dichloroethane (Surrogate)	mg/kg	-	10.8	12.6	10	108
			d8-toluene (Surrogate)	mg/kg	-	8.9	8.8	10	89
			Bromofluorobenzene (Surrogate)	mg/kg	-	9.3	10.1	-	93
		VPH F Bands	Benzene (F0)	mg/kg	0.1	4.9	<0.1	-	-
			TRH C6-C10 minus BTEX (F1)	mg/kg	25	51	<25	62.5	81

Matrix spike duplicates are calculated as Relative Percent Difference (RPD) using the formula: RPD = | OriginalResult - ReplicateResult | x 100 / Mean

The original result is the analyte concentration of the matrix spike. The Duplicate result is the analyte concentration of the matrix spike duplicate.

The RPD is evaluated against the Maximum Allowable Difference (MAD) criteria and can be graphically represented by a curve calculated from the Statistical Detection Limit (SDL) and Limiting Repeatability (LR) using the formula: MAD = 100 x SDL / Mean + LR

Where the Maximum Allowable Difference evaluates to a number larger than 200 it is displayed as 200.

RPD is shown in **Green** when within suggested criteria or **Red** with an appended reason identifer when outside suggested criteria. Refer to the footnotes section at the

No matrix spike duplicates were required for this job.

Samples analysed as received.

Solid samples expressed on a dry weight basis.

QC criteria are subject to internal review according to the SGS QA/QC plan and may be provided on request or alternatively can be found here: https://www.sgs.com.au/~/media/Local/Australia/Documents/Technical Documents/MP-AU-ENV-QU-022 QA QC Plan.pdf

*	NATA accreditation does not cover the performance of this service.
**	Indicative data, theoretical holding time exceeded.
***	Indicates that both * and ** apply.
-	Sample not analysed for this analyte.
IS	Insufficient sample for analysis.
LNR	Sample listed, but not received.
LOR	Limit of reporting.
QFH	QC result is above the upper tolerance.
QFL	QC result is below the lower tolerance.
①	At least 2 of 3 surrogates are within acceptance criteria.
②	RPD failed acceptance criteria due to sample heterogeneity.
③	Results less than 5 times LOR preclude acceptance criteria for RPD.
④	Recovery failed acceptance criteria due to matrix interference.
⑤	Recovery failed acceptance criteria due to the presence of significant concentration of analyte (i.e. the concentration of analyte exceeds the spike level).
⑥	LOR was raised due to sample matrix interference.
⑦	LOR was raised due to dilution of significantly high concentration of analyte in sample.
⑧	Reanalysis of sample in duplicate confirmed sample heterogeneity and inconsistency of results.
⑨	Recovery failed acceptance criteria due to sample heterogeneity.
⑩	LOR was raised due to high conductivity of the sample (required dilution).
†	Refer to relevant report comments for further information.

SAMPLE RECEIPT ADVICE

SE242054

CLIENT DETAILS

Contact	Admin
Client	NEO CONSULTING PTY LTD
Address	PO BOX 279 RIVERSTONE NSW 2765
Telephone	0416 680 375
Facsimile	(Not specified)
Email	admin@neoconsulting.com.au
Project	**N6898**
Order Number	**N6898**
Samples	3

LABORATORY DETAILS

Manager	Huong Crawford
Laboratory	SGS Alexandria Environmental
Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	+61 2 8594 0400
Facsimile	+61 2 8594 0499
Email	au.environmental.sydney@sgs.com
Samples Received	Fri 20/1/2023
Report Due	Mon 30/1/2023
SGS Reference	**SE242054**

SUBMISSION DETAILS

This is to confirm that 3 samples were received on Friday 20/1/2023. Results are expected to be ready by COB Monday 30/1/2023. Please quote SGS reference SE242054 when making enquiries. Refer below for details relating to sample integrity upon receipt.

Sample counts by matrix	3 Soil	Type of documentation received	COC
Date documentation received	20/1/2023	Samples received in good order	Yes
Samples received without headspace	Yes	Sample temperature upon receipt	8.8°C
Sample container provider	SGS	Turnaround time requested	Standard
Samples received in correct containers	Yes	Sufficient sample for analysis	Yes
Sample cooling method	Ice Bricks	Samples clearly labelled	Yes
Complete documentation received	Yes		

Unless otherwise instructed, water and bulk samples will be held for one month from date of report, and soil samples will be held for two months.

COMMENTS

A separate portion was not supplied for Asbestos analysis . A sub-sample will be used from the jar provided.

SAMPLE RECEIPT ADVICE

CLIENT DETAILS

Client NEO CONSULTING PTY LTD

Project N6898

SUMMARY OF ANALYSIS

No.	Sample ID	OC Pesticides in Soil	OP Pesticides in Soil	PAH (Polynuclear Aromatic Hydrocarbons) in Soil	Total Recoverable Elements in Soil/Waste	TRH (Total Recoverable Hydrocarbons) in Soil	VOC's in Soil	Volatile Petroleum Hydrocarbons in Soil
001	S1	30	14	26	7	10	11	7
002	S2	30	14	26	7	10	11	7
003	S3	30	14	26	7	10	11	7

CONTINUED OVERLEAF

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

SAMPLE RECEIPT ADVICE

SE242054

CLIENT DETAILS

Client NEO CONSULTING PTY LTD

Project N6898

SUMMARY OF ANALYSIS

No.	Sample ID	Fibre Identification in soil	Mercury in Soil	Moisture Content
001	S1	2	1	1
002	S2	2	1	1
003	S3	2	1	1

The above table represents SGS' interpretation of the client-supplied Chain Of Custody document.
The numbers shown in the table indicate the number of results requested in each package.
Please indicate as soon as possible should your request differ from these details .
Testing as per this table shall commence immediately unless the client intervenes with a correction .

APPENDIX C

Property Report and Relevant Site Data

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION

DRAWING SCHEDULE

000	COVER SHEET
001	3D IMAGES
002	DRAWING SCHEDULE
003	LOCATION PLAN
100	OVERALL SITE PLAN
101	MASTER PLAN
102	GROUND FLOOR PLAN
103	FIRST FLOOR PLAN
104	ROOF PLAN
200	SOUTH AND EAST ELEVATIONS
201	NORTH, WEST, SOUTH-WEST ELEVATIONS
202	SITE ELEVATIONS
300	SECTIONS 1,2,3
400	GFA/FSR CALCULATION

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
1.	PRELIMINARY	DEC 2021

ALL DIMENSIONS TO BE VERIFIED ON SITE. DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED DIMENSIONS. ANY DISCREPANCIES TO BE REFERRED TO ARCHITECT BEFORE PROCEEDING IF IN DOUBT, ASK!

GROUP ARCHITECTS

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Group Architects Pty Limited ABN 82 600 366 069
Suite 3.09/55 Miller Street Pyrmont nsw 2009
T: +612 9660 1055 E: info@grouparchitects.com.au

WARRINGAH GOLF CLUB

address
KENTWELL RD
NORTH MANLY

drawing
DRAWING SCHEDULE

SCALE:
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-002

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION

LOCATION PLAN

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
1.	PRELIMINARY	DEC 2021

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WARRINGAH GOLF CLUB

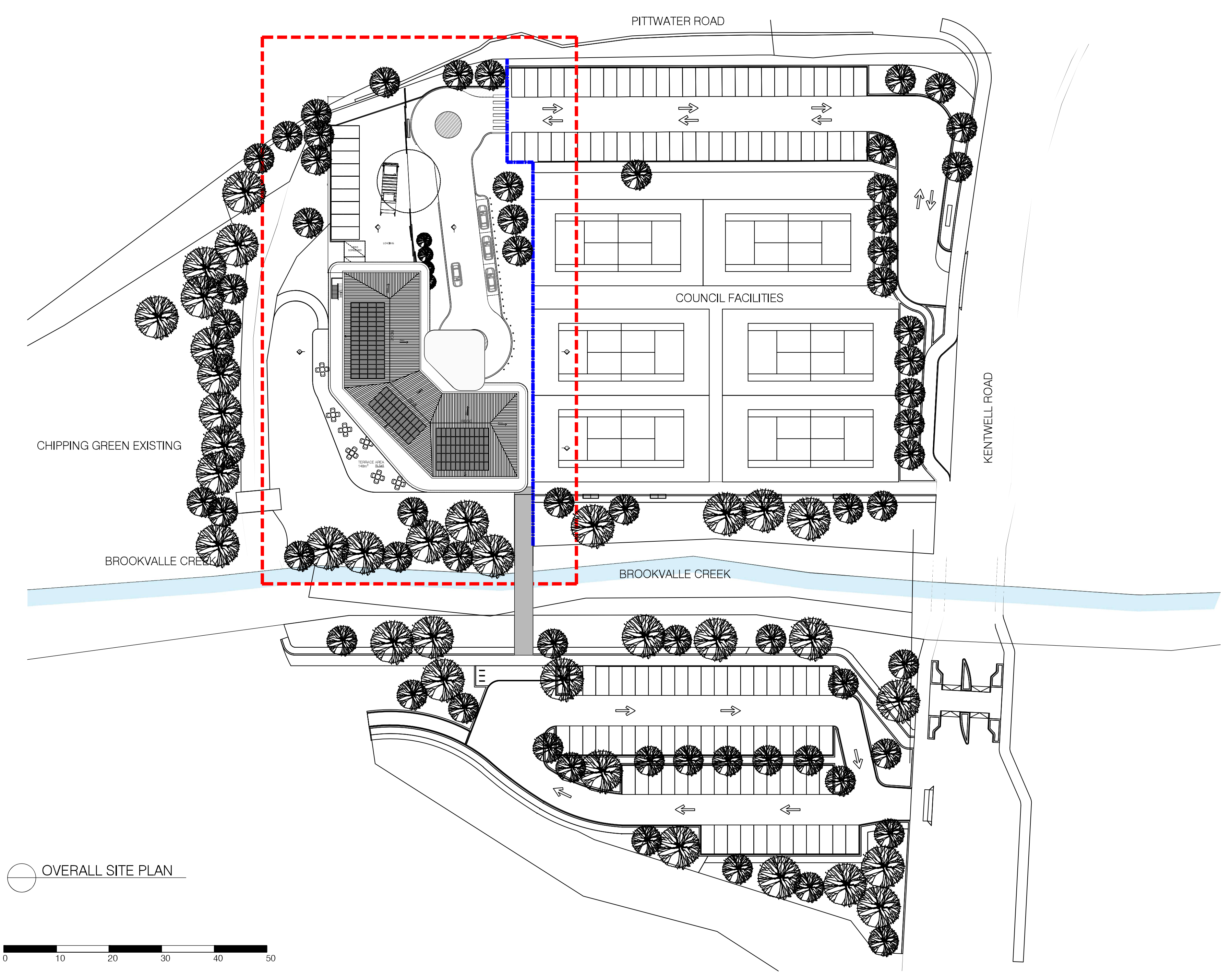
address
KENTWELL RD
NORTH MANLY

drawing
LOCATION PLAN

SCALE:
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-003

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION



OVERALL SITE PLAN

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
1.	PRELIMINARY	DEC 2021

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WARRINGAH GOLF CLUB

address
KENTWELL RD
NORTH MANLY

drawing
OVERALL SITE PLAN

SCALE:
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-100

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION

MASTER PLAN
1:500@A1

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
1.	PRELIMINARY	DEC 2021

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WARRINGAH GOLF CLUB

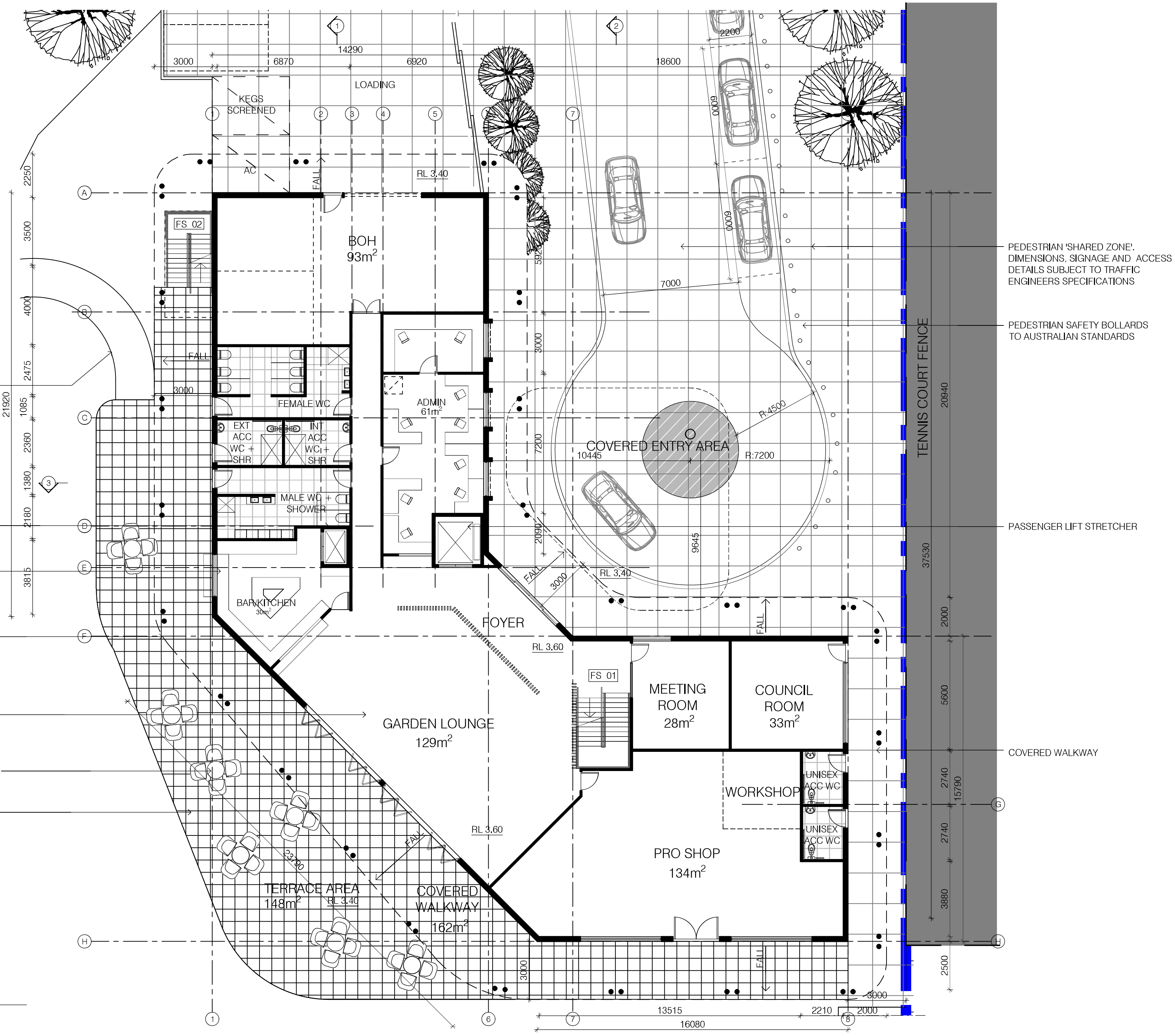
address
KENTWELL RD
NORTH MANLY

drawing
MASTER PLAN

SCALE: 1:500 @ A1
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-101

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION



1 GROUND FLOOR PLAN
1:200@A3

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
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WARRINGAH GOLF CLUB

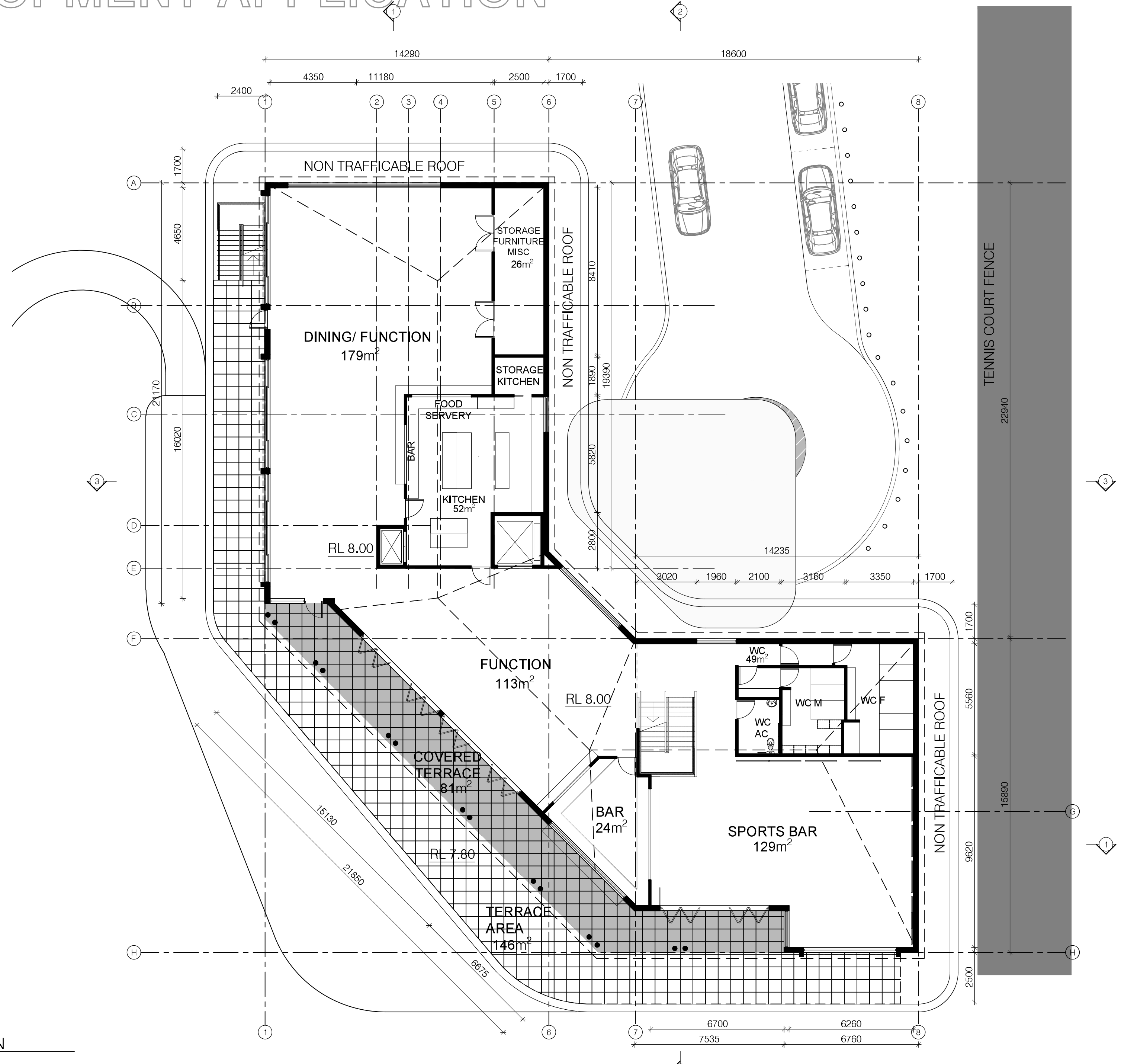
address
KENTWELL RD
NORTH MANLY

drawing
GROUND FLOOR PLAN

SCALE: 1:100 @ A1
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-102

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION



2 FIRST FLOOR PLAN
1:200@A3

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
1.	PRELIMINARY	DEC 2021

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WARRINGAH GOLF CLUB

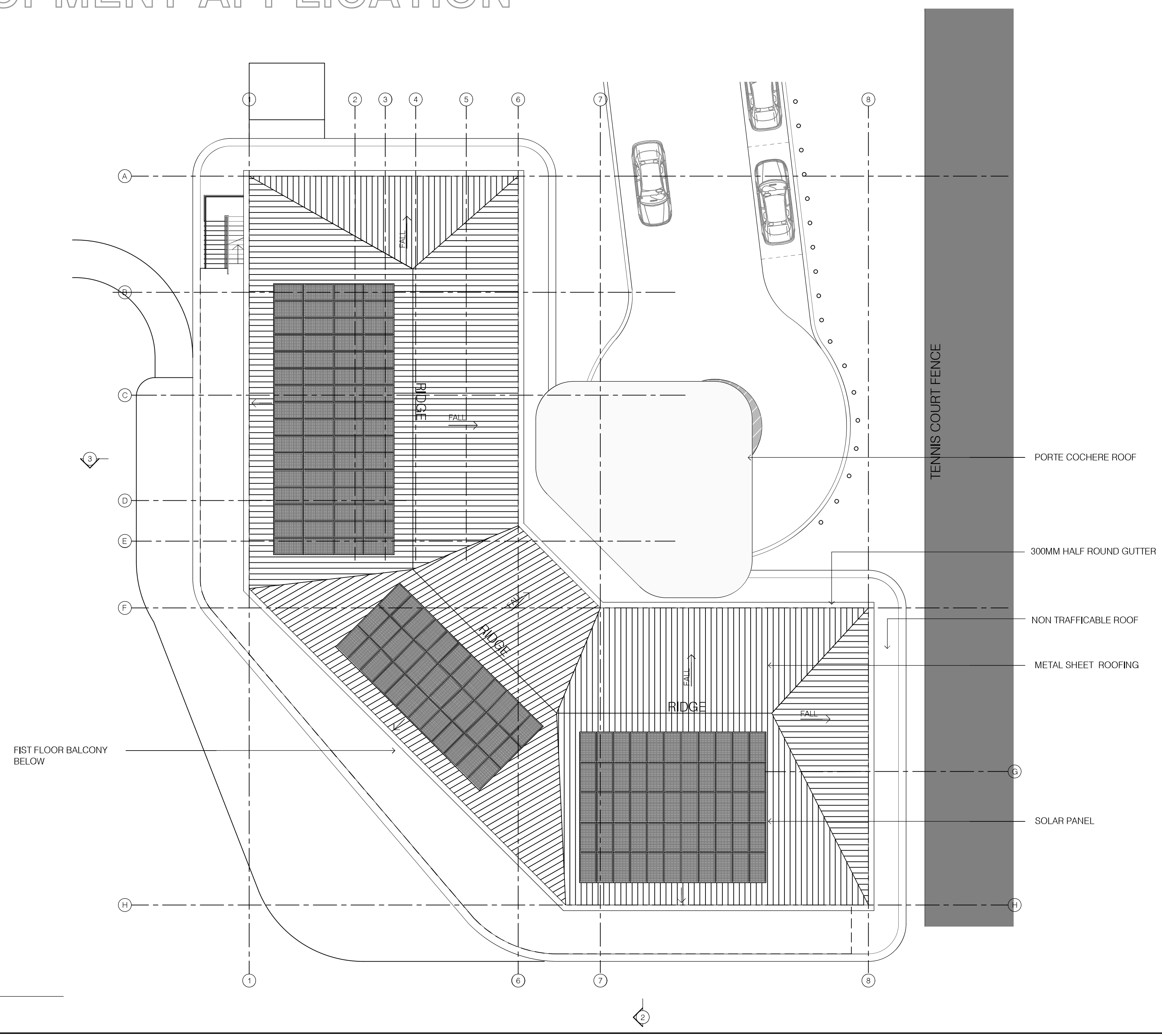
address
KENTWELL RD
NORTH MANLY

drawing
FIRST FLOOR PLAN

SCALE: 1:100 @ A1
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-103

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION



3 ROOF PLAN
1:200@A3

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
2.	PRELIMINARY	JAN 2022
1.	PRELIMINARY	DEC 2021

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WARRINGAH GOLF CLUB

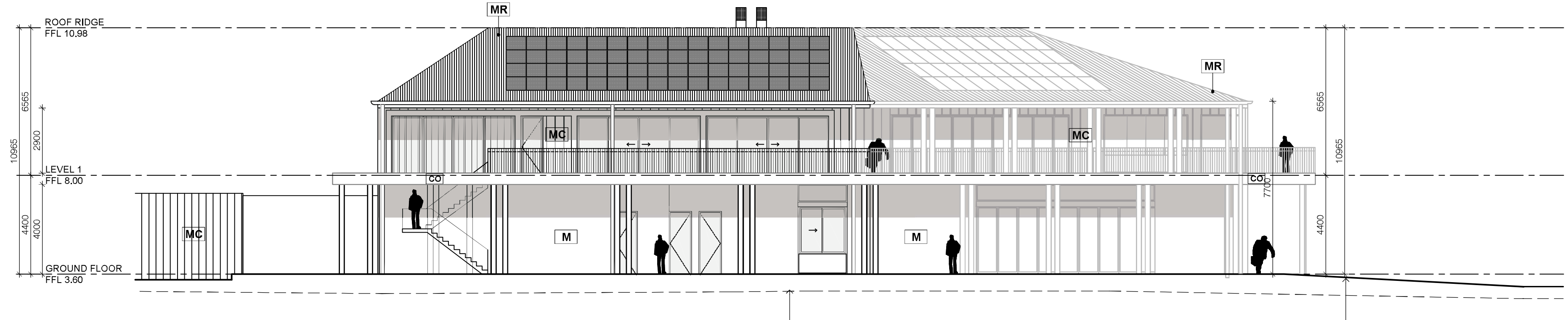
address
KENTWELL RD
NORTH MANLY

drawing
ROOF PLAN

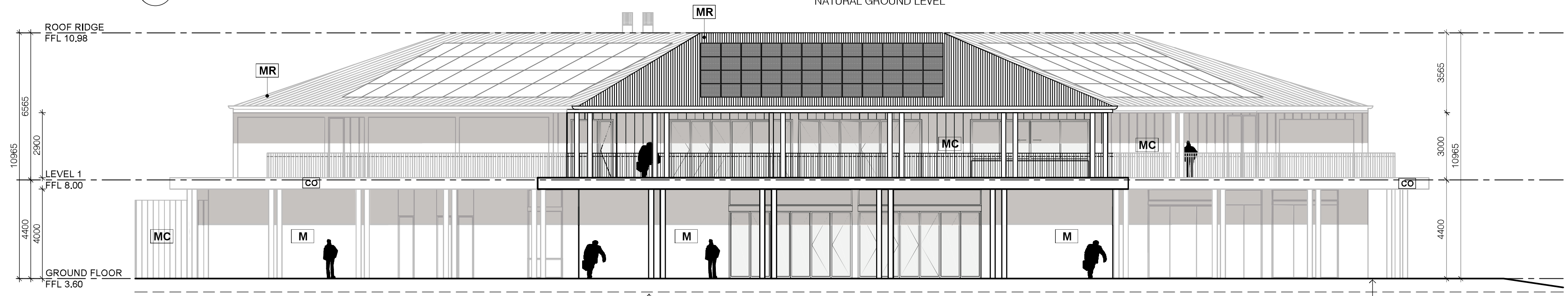
SCALE: 1:100 @ A1
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-104

DEVELOPMENT APPLICATION

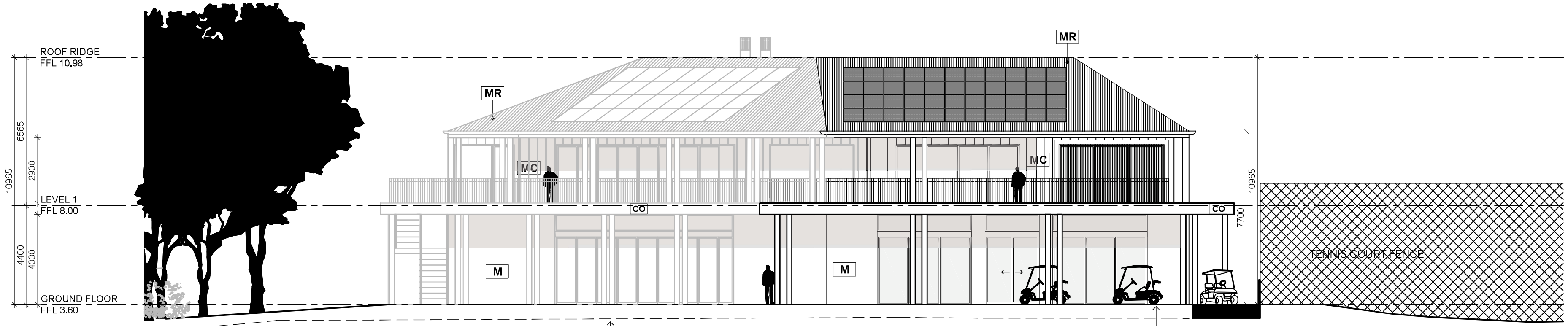
NOT FOR CONSTRUCTION



3 NORTH ELEVATION
1:200@A3



4 WEST ELEVATION
1:200@A3



5 SOUTH WEST ELEVATION
1:200@A3

CO	CONCRETE
BP	BRICK PAVEMENT
M	MASONRY
MR	METAL ROOFING
MC	METAL CLADDING
CG	CLEAR GLASS
CG	COMPACTED GRAVEL
S	SAND
PE	PEBBLE

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
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2.	PRELIMINARY	JAN 2022
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WARRINGAH GOLF CLUB

address
KENTWELL RD
NORTH MANLY

drawing
NORTH, WEST, SOUTH-WEST ELEVATIONS

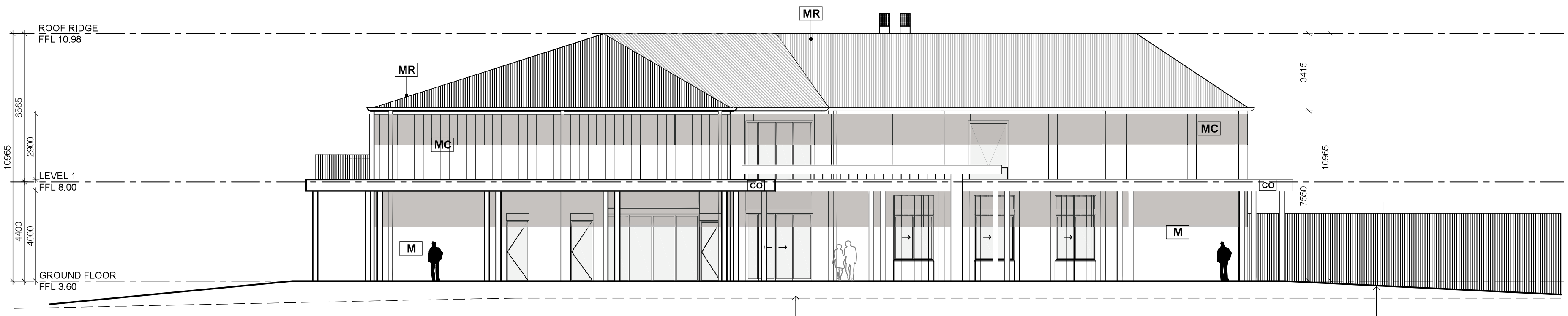
SCALE:

ISSUE: 5. DATE: 18.03.2022

DWG No.: GA2020-023-201

DEVELOPMENT APPLICATION

NOT FOR CONSTRUCTION



1 SOUTH ELEVATION
1:200@A3

2 EAST ELEVATION
1:200@A3

CO	CONCRETE
BP	BRICK PAVEMENT
M	MASONRY
MR	METAL ROOFING
MC	METAL CLADDING
CG	CLEAR GLASS
CG	COMPACTED GRAVEL
S	SAND
PE	PEBBLE

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
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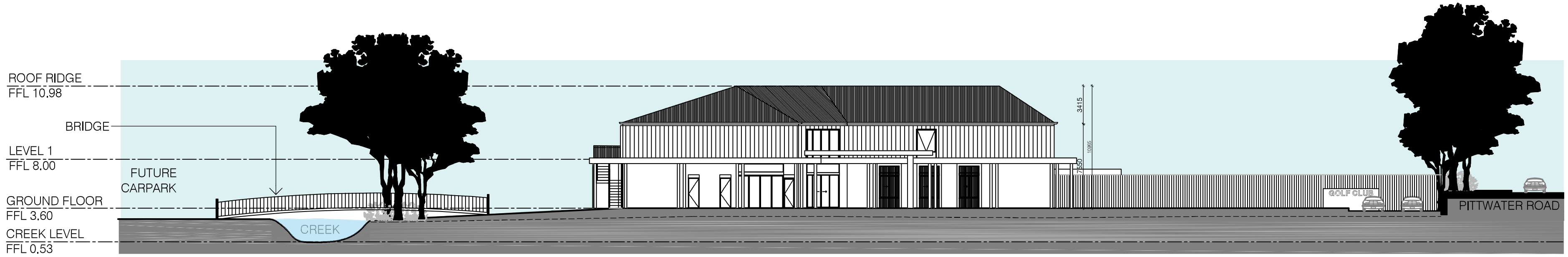
WARRINGAH GOLF CLUB

address
KENTWELL RD
NORTH MANLY

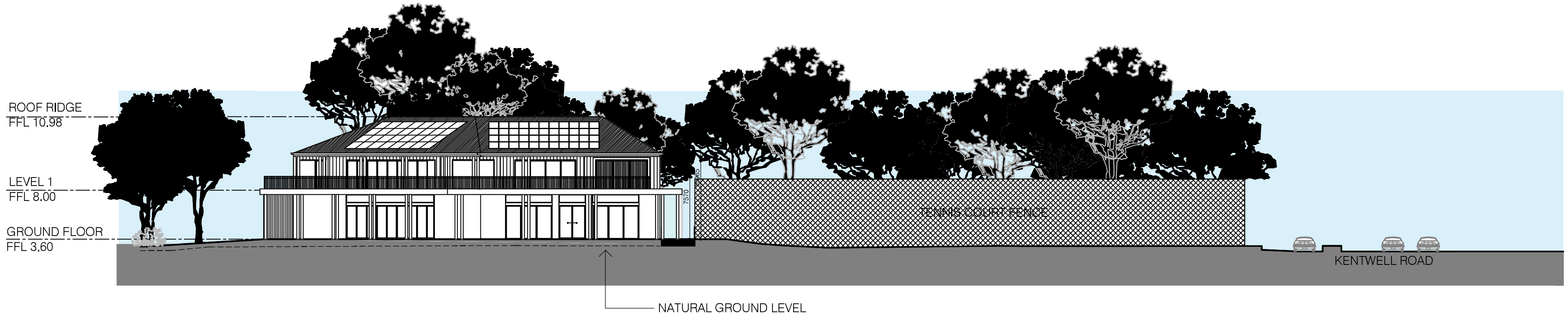
drawing
SOUTH AND EAST
ELEVATIONS

SCALE:
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-006-200

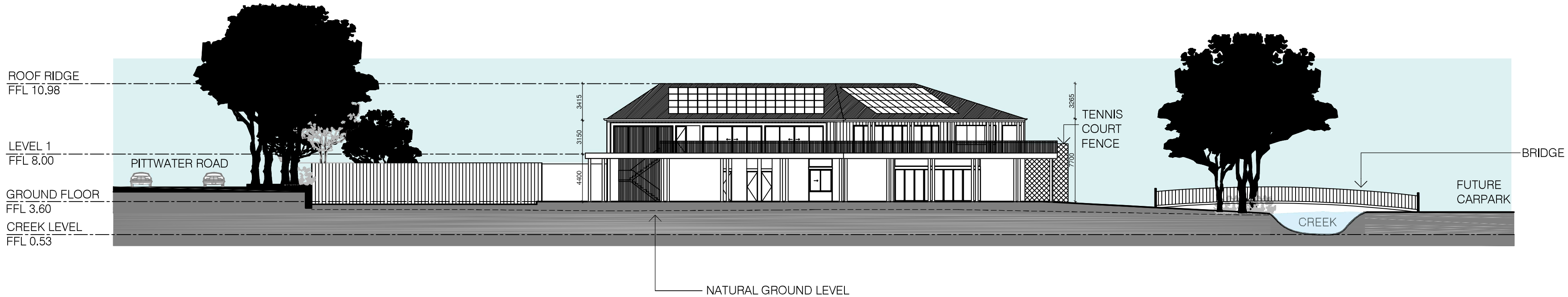
DEVELOPMENT APPLICATION



6 SOUTH SITE ELEVATION
1:200@A3



7 SOUTH WEST SITE ELEVATION
1:200@A3



8 NORTH SITE ELEVATION
1:200@A3

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
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2.	PRELIMINARY	JAN 2022
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WARRINGAH GOLF CLUB

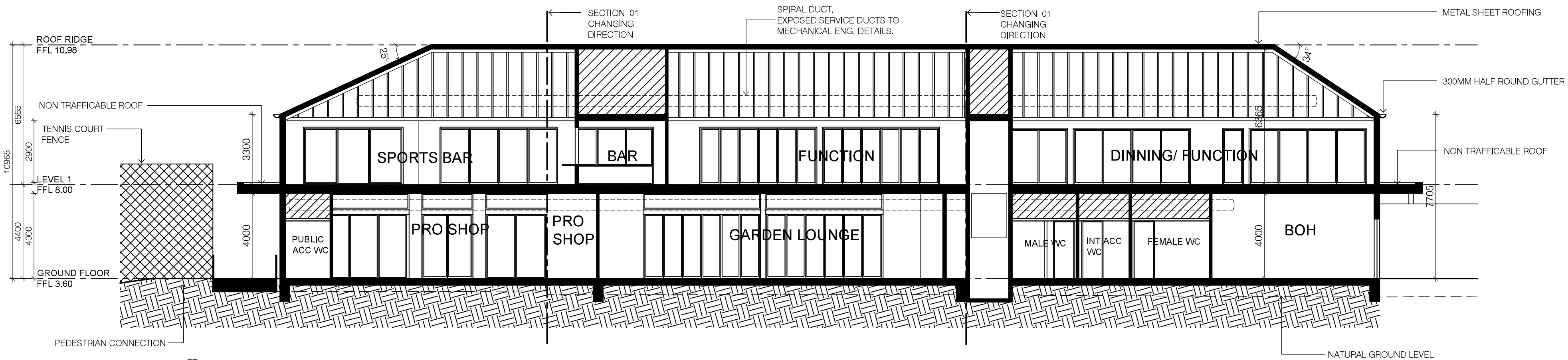
address
KENTWELL RD
NORTH MANLY

drawing
SITE ELEVATIONS

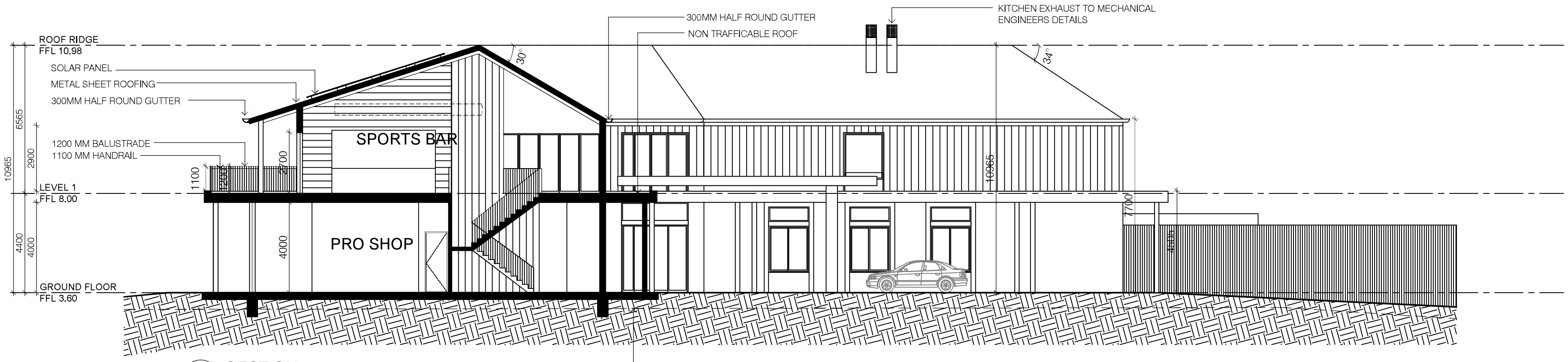
SCALE: 1:200 @ A1
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-202

DEVELOPMENT APPLICATION

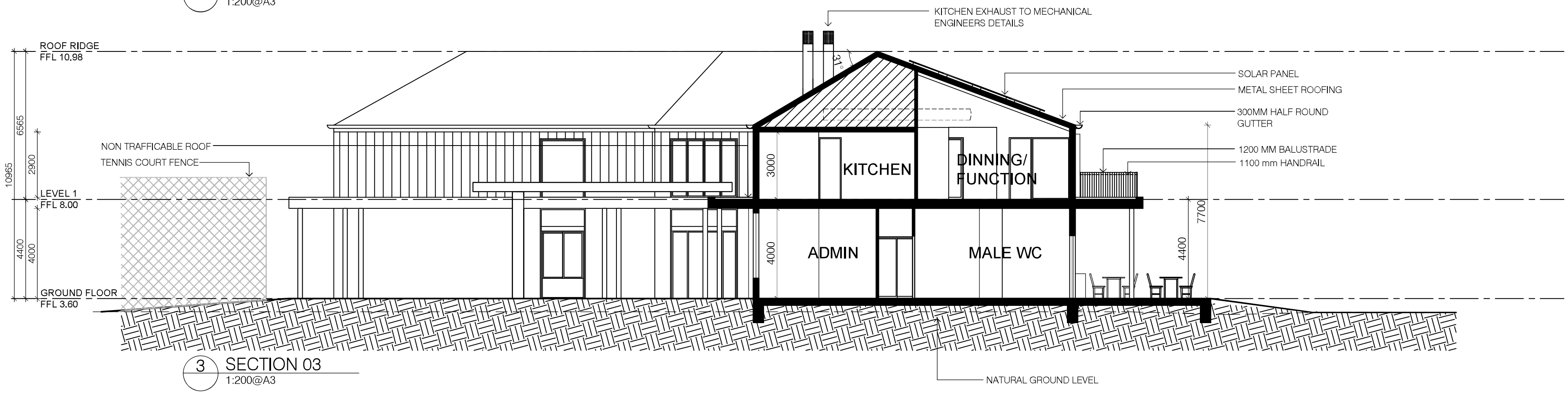
NOT FOR CONSTRUCTION



1 SECTION 01
1:200@A3



2 SECTION 02
1:200@A3



3 SECTION 03
1:200@A3

Issue	Amendment	Date
5.	PRELIMINARY DA	18.03.2022
4.	PRELIMINARY	14.02.2022
3.	PRELIMINARY	03.02.2022
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WARRINGAH GOLF CLUB

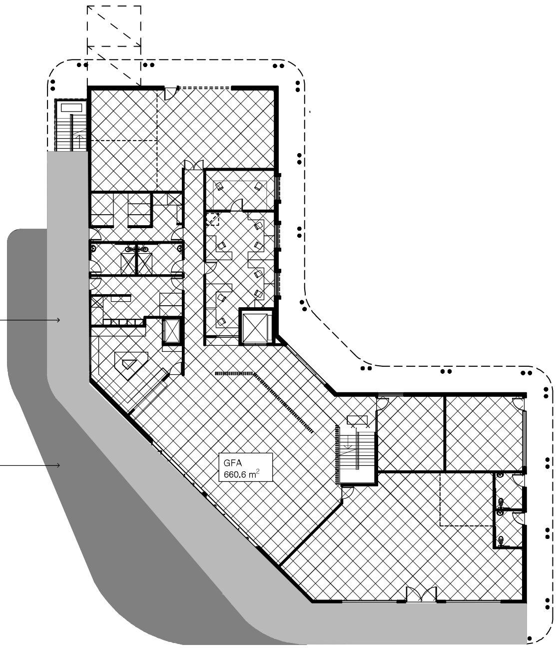
address
KENTWELL RD
NORTH MANLY

drawing
SECTIONS 1,2,3

SCALE:
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-006-300

DEVELOPMENT APPLICATION

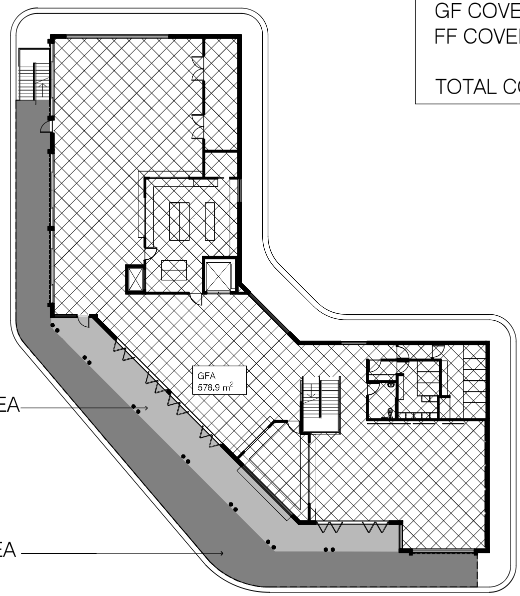
NOT FOR CONSTRUCTION



VERED AREA
2m^2

RRACE AREA
3m^2

1 GROUND FLOOR GFA
NTS



COVERED AREA
81.54m^2

TERRACE AREA
163.46m^2

2 FIRST FLOOR GFA
NTS

GROSS FLOOR AREA

GFA

GROUND FLOOR:	660.6 m^2
FIRST FLOOR:	578.9 m^2
TOTAL GFA:	1.239.5 m^2

EXTERNAL AREA

GF TERRACE:	148 m^2
FF TERRACE:	163.46 m^2
TOTAL TERRACE AREA:	311.46 m^2
GF COVERED AREA:	162 m^2
FF COVERED AREA:	81.54 m^2
TOTAL COVERED AREA:	243.54 m^2

Issue	Amendment	Date
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WARRINGAH GOLF CLUB

address
KENTWELL RD
NORTH MANLY

drawing
SITE ELEVATIONS

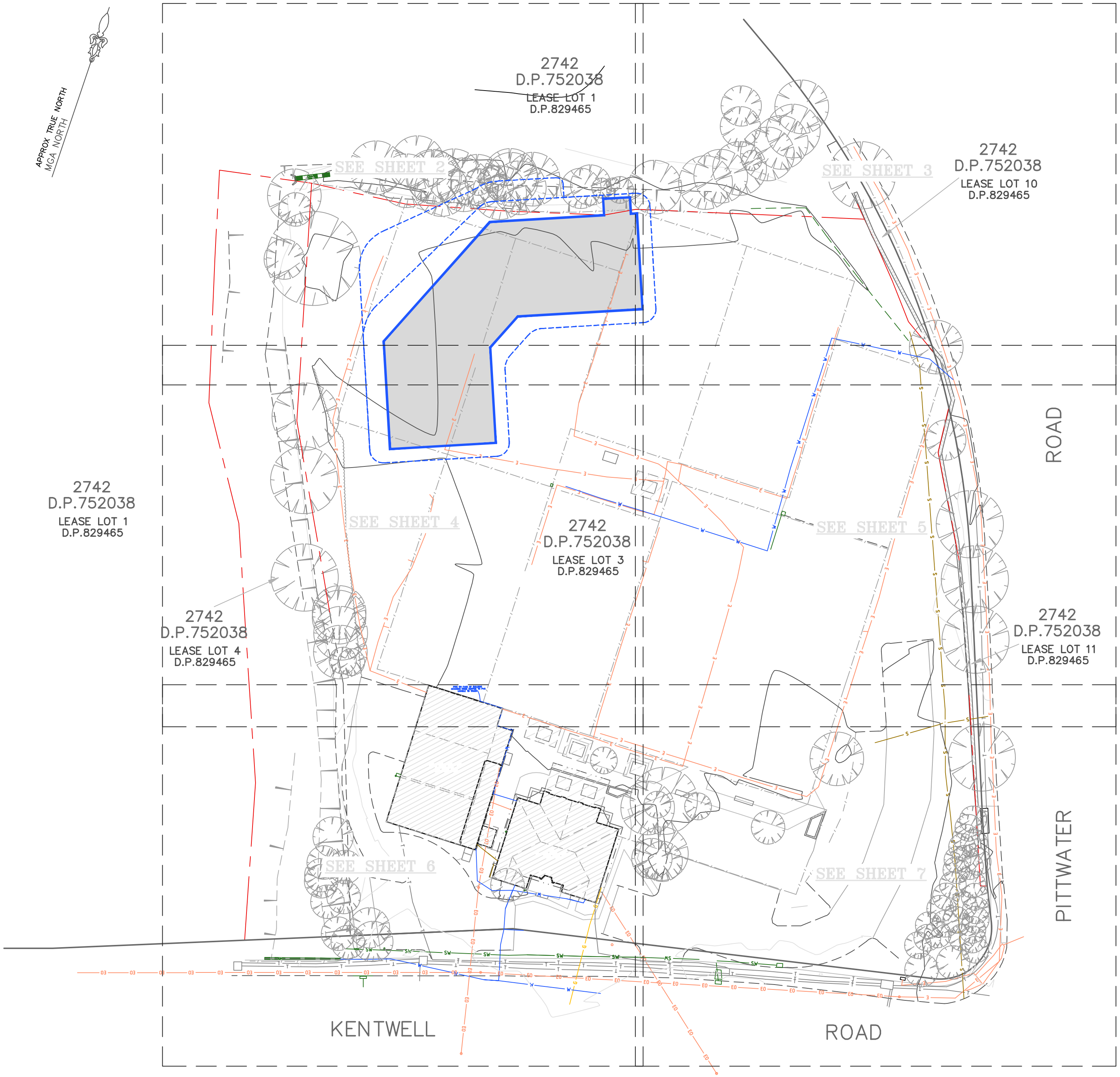
SCALE: 1:200 @ A1
ISSUE: 5. DATE: 18.03.2022
DWG No.: GA2020-023-400

WARRINGAH GOLF CLUB
MARCH 2022

GROUP ARCHITECTS

WARRINGAH GOLF CLUB
MARCH 2022

GROUP ARCHITECTS



TITLE INDICATES THAT AUTO CONSOL 13394–147 IS SUBJECT TO:

– LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN – SEE CROWN GRANT(S)
– AS TO BOUNDARIES TO RIVERS/LAKES – SEE SECTION 172 CROWN LANDS ACT 1989 AFFECTING LOTS 2743, 2744, 2748 & 2762 IN DP752038
– EASEMENT FOR ELECTRICITY TRANSMISSION LINE CREATED BY NOTIFICATION IN GOVERNMENT GAZETTE 9–1–1931 AFFECTING THE PART OF LOT 2743 IN DP752038 SHOWN IN THE TITLE DIAGRAM
– EASEMENT FOR SEWERAGE CREATED BY NOTIFICATION IN GOVERNMENT GAZETTE 1–12–1961 AFFECTING THE PART OF LOTS 2742 & 2743 IN DP752038 SHOWN IN DP829465
– S351395 EASEMENT FOR WATERMAIN AFFECTING THE PART OF LOT 2742 IN DP752038 SHOWN IN DP590932
– I64061 RESTRICTION(S) ON THE USE OF LAND
– DP1082167 DRAINAGE EASEMENT 1 METRE(S) WIDE AFFECTING THE PART(S) OF LOT 2743 IN DP752038 SHOWN SO BURDENED IN DP1082167
– AJ177736 LEASE TO G8 EDUCATION LIMITED OF PART BEING LOT 1 IN DP810097. EXPIRES: 6/10/2019. OPTION OF RENEWAL: 5 YEARS.
AP933672 VARIATION OF LEASE AJ177736 EXPIRY DATE NOW 6/10/2024. OPTION OF RENEWAL: RELINQUISHED.
– AP819753 LEASE TO MANLY VALE CALABRIA BOWLING SPORTS AND SOCIAL CLUB LIMITED OF PART BEING LOT 1 IN DP866678. EXPIRES: 31/3/2027.

CODE		DEPTH	PIPE DIAMETER	
106.78	SSL	B	1.31	0.10	EOT
RL.		LOCATION QUALITY			NOTE

SUBSURFACE UTILITY INFORMATION

QL-D
IS THE LOWEST OF THE FOUR QUALITY LEVELS STIPULATED IN AS5488. IT IS AN INDICATIVE POSITION COMPILED FROM EXISTING RECORDS, CURSORY SITE INSPECTION, ANECDOTAL EVIDENCE.
QL-C
IS THE NEXT LEVEL UP FROM QL-D. AS5488 STATES THAT QL-C IS A SURFACE FEATURE CORRELATION OR AN INTERPRETATION OF THE APPROXIMATE LOCATIONS AND ATTRIBUTES OF A SURFACE FEATURE USING A COMBINATION OF EXISTING RECORDS (ANECDOTAL EVIDENCE) SONIC BOOM TECHNIQUES AND A SITE SURVEY OF VISIBLE EVIDENCE.
QL-B
ELECTRONICALLY TRACED AS PER AS5488 (DIRECT CONNECTION, INDUCTION, FLEXITRACE/SONDE, FLEXIROD/SONDE) WITH AN ESTIMATED POSITIONAL TOLERANCE OF +/-300MM IN PLAN, +/-500MM IN DEPTH (HIGH CONFIDENCE LEVEL).
QL-A
IS THE HIGHEST QUALITY LEVEL AS PER AS5488 AND CONSISTS OF THE POSITIVE IDENTIFICATION OF THE ATTRIBUTE AND LOCATION OF A SUBSURFACE UTILITY AT A POINT TO AN ABSOLUTE SPATIAL POSITION IN THREE DIMENSIONS. THIS CAN BE ACHIEVED AT OPENED PITS AND IN THE POTHOLES WHERE THE UTILITY IS EXPOSED. HORIZONTAL AND VERTICAL
TOLERANCE: -/+ 50MM.

LEGEND: (SEE NOTES 1)

- —E— = ELECTRICITY LINE (UNDERGROUND)
- —G— = GAS LINE (UNDERGROUND)
- —S— = SEWER LINE (UNDERGROUND)
- —SW— = STORMWATER LINE (UNDERGROUND)
- —T— = TELSTRA LINES (UNDERGROUND)
- —W— = WATER LINE (UNDERGROUND)

NOTES 1

· THE PURPOSE OF THIS PLAN IS FOR DESIGN ONLY. CURRENT PLANS ISSUED BY SERVICE PROVIDERS THROUGH "DIAL BEFORE YOU DIG" ARE STILL REQUIRED. CONTRACTORS AND SUBCONTRACTORS WILL NEED TO EXERCISE THEIR OWN "DUTY OF CARE" AND SHOULD MAKE THEIR OWN DIAL BEFORE YOU DIG ENQUIRY BEFORE EXCAVATION/CONSTRUCTION. YOU MUST ENSURE "DIAL BEFORE YOU DIG" ARE CURRENT AS THEY HAVE VARYING EXPIRATION DATES, AND MAY REQUIRE RE-ISSUE OTHERWISE THE INFORMATION ON THIS PLAN MAY NO LONGER BE CURRENT.

· WARNING: UNKNOWN SERVICES MAY EXIST THAT COULD NOT BE ELECTRONICALLY DETECTED. THE DIAGRAMS OF THE SERVICE PROVIDER MAY NOT DEPICT ALL ASSETS WITHIN THEIR NETWORK AND SERVICE PROVIDERS MAY SHARE CONDUITS AND /OR TRENCHES AT THIS LOCATION.

· WARNING: SINGLE MARKED LINES MAY REPRESENT MULTIPLE CONDUITS, PIPES END/OR CABLES AT THIS LOCATION. THE RECORDING OF DEPTHS AND POSITION OF UTILITIES CANNOT BE GUARANTEED AS CORRECT. WE RECOMMEND NON DESTRUCTIVE DIGGING/POTHOLING TO EXPOSE SERVICES FOR ACCURATE IDENTIFICATION AND DEPTH.

CAUTION: SURESEARCH HAVE SURVEYED AND MARKED OUT EXISTING SERVICES IN THE AREA SPECIFIED BY THE CLIENT. THESE SERVICE LINES HAVE BEEN LOCATED BY ABOVE GROUND SERVICE TRACING METHODS AND HAVE NOT BEEN SIGHTED. CMS SURVEYORS HAVE THEN LOCATED THE LINE MARKED BY SURESEARCH. THE LOCATION OF THESE MARKED SERVICES ARE APPROXIMATE ONLY. THE POSITION OF THE MARKED SERVICE LINES HAS BEEN MADE WITH REFERENCE TO THE RELEVANT SERVICE AUTHORITY DIAGRAMS. ALL SERVICES MAY NOT HAVE BEEN SHOWN AND UTILITY DESCRIPTIONS HAVE BEEN TAKEN FROM UTILITY PROVIDED DIAGRAMS WHERE AVAILABLE. WE RECOMMEND NON DESTRUCTIVE DIGGING/POTHOLING TO EXPOSE MARKED SERVICES TO IDENTIFY AND SHOW EXACT DEPTH AND LOCATION OF SERVICE LINES PRIOR TO EARTHWORKS COMMENCING. UTILITIES PLOTTED ON THE PLAN THAT TERMINATE IN THE SPECIFIED AREA MAY GO TO FEATURES THAT HAVE NOT BEEN SHOWN ON THE BACKGROUND DETAIL SURVEY PROVIDED BY CLIENT. THE RISK REMAINS WITH THE CLIENT AND/OR SUB CONTRACTOR AND THEIR RESPONSIBILITY TO EXERCISE CAUTION AT ALL TIMES.

0 5 10 15 20 25 30

SCALE 1:300@A1
SCALE 1:600@A3

NOTES

· A BOUNDARY SURVEY HAS BEEN UNDERTAKEN.

· IF CONSTRUCTION IS INTENDED TO BE UNDERTAKEN ON OR ADJACENT TO PROPERTY BOUNDARIES THE BOUNDARIES OF THE LAND MUST BE MARKED OR THE BUILDING SETOUT.
WALL THICKNESS CAN BE CONFIRMED BY INTERNAL SURVEY.

· THIS SURVEY IS FOR DESIGN PURPOSES OF THE SUBJECT LAND ONLY THIS PLAN MUST NOT BE USED FOR ANY OTHER MATTER, PURPOSE OR CONSTRUCTION SETOUT.

· TREE SIZES ARE ESTIMATES ONLY.

· THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF NORTHERN BEACHES COUNCIL.

· RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.

· EXCEPT WHERE SHOWN BY DIMENSION LOCATION OF DETAIL WITH RESPECT TO BOUNDARIES IS INDICATIVE ONLY.

· ONLY VISIBLE SERVICES HAVE BEEN LOCATED, UNDERGROUND SERVICES HAVE NOT BEEN LOCATED. DIAL BEFORE YOU DIG SERVICES (ph 1100) SHOULD BE USED AND A FULL UTILITY INVESTIGATION, INCLUDING A UTILITY LOCATION SURVEY, SHOULD BE UNDERTAKEN BEFORE CARRYING OUT ANY CONSTRUCTION ACTIVITY IN OR NEAR THE SURVEYED AREA.

· SEWER MAIN PLOTTED FROM SYDNEY WATER SEWER DIAGRAM. LOCATION SHOULD BE MARKED ON SITE IF CRITICAL.

· CRITICAL SPOT LEVELS SHOULD BE CONFIRMED WITH SURVEYOR.

· CONTOURS SHOWN DEPICT THE TOPOGRAPHY. THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.

· CONTOUR INTERVAL - 0.5 metre. - SPOT LEVELS SHOULD BE ADOPTED.

· POSITION OF RIDGE LINES ARE DIAGRAMMATIC ONLY (NOT TO SCALE).

· THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:100.

· DO NOT SCALE OFF THIS PLAN / FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED READINGS.

AREA OF LOT 2742 IN DP752038
17.43 Ha BY TITLE

STEPHEN EMERY
REGISTERED SURVEYOR BOSSI NUMBER 1605

HORIZONTAL DATUM:
CO-ORDINATE SYSTEM:MGA (GDA 2020)
MARKS ADOPTED:PM 740 & D.P.1206258

VERTICAL DATUM:
DATUM: AUSTRALIAN HEIGHT DATUM (AHD)
B.M. ADOPTED:PM 740
R.L. 5.297 (CLASS LB)
SOURCE: S.C.I.M.S. (15/10/2020)

1	FIRST ISSUE	25/11/20

CLIENT:
NORTHERN BEACHES COUNCIL
CIVIC CENTRE, 725 PITTWATER ROAD
DEE WHY, NSW, 2099

SURVEY PLAN
SHOWING DETAIL & LEVELS WITH
UNDERGROUND SERVICE LOCATING
OVER PART LOT 2742 IN DP75203
433 PITTWATER ROAD
NORTH MANLY, NSW, 2100

C.M.S. Surveyors Pty Limited
ACN: 096 240 201
PO Box 463 Dee Why
NSW 2099
2/99A South Creek Road,
Dee Why NSW 2099
Telephone: (02) 9971 4802
Facsimile: (02) 9971 4822
E-mail: info@cmssurveyors.com.au

LGA: NORTHERN BEACHES		SHEET 1 OF	
SURVEYED PB	DRAWN GP	CHECKED PB	APPROVED AF
SURVEY INSTRUCTION 19741	SCALE 1:300 @ A1 1:600 @ A3	DATE OF SURVEY 06/11/2020	
DRAWING NAME 19741detail		ISSUE 1	
CAD FILE 19741detail 1 WITH CLUB OUTLINE.dwg			

15 December 2022

Warringah Golf Club Limited
397 Condamine Street
ALLAMBIE HEIGHTS NSW 2100

Dear Sir/Madam,

Application No. **DA2022/2081 - PAN-287528**
Address: **Lot 2742/9999 Condamine Street MANLY VALE and WARRINGAH GOLF COURSE (DISTRICT PARK)Condamine Street NORTH MANLY and , Warringah Golf Course Pro shop 292Condamine Street NORTH MANLY and & Warringah Golf Course Pro shop 292 Condamine Street NORTH MANLY and District Park Tennis and Squash Centre - Clubhouse & District Park Tennis and Squash Centre - Clubhouse Kentwell Road NORTH MANLY**

Request for Additional Information

Council has conducted a review of your application in accordance with Council's *Development Application and Modification Lodgement Requirements (21/22)* and additional information is required in order to assess the proposed development.

Accordingly, you are requested to address the matter(s) listed below by submitting the additional information via the NSW Planning Portal:

1. **Lot, Strata Plan (SP) and Deposited Plan (DP)**
   The details of the property included on the application form do not match Council's records. Please provide corrected address and formal particulars of the property on title, including Lot and DP/SP No. for the land on which the development is to be carried out. In this regard, our records show the property is described as Lot 2742/9999 Condamine Street, Manly Vale.

2. **Access Report**
   An Access Report addressing the relevant provisions of the WDCP 2011 and any other relevant legislation and Australian Standards.

3. **Building Code of Australia (BCA) Report**
   A Building Code of Australia (BCA) Report.

4. **Contaminated Land Report**
   A Preliminary Site Contaminated Land Report as the history of contamination is unknown for the site. The report is to be prepared by, or reviewed and approved, by a certified consultant as defined under NSW EPA Contaminated Land Consultant Certification Policy. The investigation is to be in accordance with relevant industry guidelines including SEPP (Resilience and Hazards) and NSW EPA guidelines.

5. **DWG No: GA2020-023-101c**
   Site Plan zones suggests work outside the site boundary please clarify.

Council has adopted this review and checking procedure in the interests of streamlining the processing of applications, ensuring all applications are *Assessment Ready* and so applications can be processed within a reasonable timeframe.

Should you need to better understand the reason(s) why this information is being requested, you are referred to the *Development Application and Modification Lodgement Requirements (21/22*), which can be found on Council's forms page. Please visit Council's "*Lodge your Application"* page for more information or to access Planning Portal user guides.

You are provided 7 days to submit the additional information via the Planning Portal to avoid the application being returned to you.

Should your application be returned to you, the Planning Portal now provides the option to *Create a new Copy of your DA* allowing applicants to relodge a new application (including the additional documentation) with ease.

Should you wish to speak to an officer to obtain clarification on the above matter(s) prior to submitting the information, please do not hesitate to contact Council's Planning Officer on 1300 434 434 during our business hours of 8.30am to 5.00pm, Monday to Friday.

Your co-operation in this matter is appreciated.

Yours Faithfully

Development Advisory Service Team