VIRTUS HERITAGE

CASTLEREAGH TOURISM DEVELOPMENT

39-65 Old Castlereagh Road, Castlereagh NSW

ABORIGINAL ARCHAEOLOGICAL DUE DILIGENCE ASSESSMENT

Final | September 2024

Prepared for Morson Group

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Acknowledgement of Country

Virtus Heritage acknowledges the Traditional Custodians of the land on which this project was undertaken and pays respect to Elders past, present and emerging.

Content Warning

Aboriginal and Torres Strait Islander people are warned that this publication may contain names and images of deceased people, descriptions of traumatic historic events and parts of Country that have been impacted by development.

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All queries related to the content, or to any use of this report must be addressed to Dr Mary-Jean Sutton.

Executive Summary

Virtus Heritage was engaged by the Morson Group to prepare an Aboriginal Archaeological Due Diligence Assessment for the Castlereagh Tourism Development in Castlereagh, NSW. The project area is located within the Penrith Local Government Area (LGA), within the Deerubbin Local Aboriginal Land Council's (DLALC) area.

The project area has previously been assessed for Aboriginal archaeological and cultural heritage values as part of the Penrith Lakes Development Scheme (Penrith Lakes Development Corporation (PLDC) 2011). Based on this assessment, AHIP C0001415 (AHIMS 3891) was issued to PLDC over the project area between 15 November 2018 and 15 November 2023 to allow harm to known and unknown Aboriginal objects without mitigation of harm during vegetation works and erosion and sediment control works as described in Controlled Activity Approval 10 ERM 2011/0057.

The proposed scope of works as provided by Morson Group Consultants includes a tourism development comprising of a 7-storey serviced apartment building with 65 dual key units, a 6 storey 4500sqm indoor recreation facility, 3 single-story fast-food outlets, a 5000sqm club, multiple shops, cafes and restaurants and a central community space. 1000 car parking spaces will be provided as multi-level above ground and on grade parking. The project design is still under development at the time of reporting but is being conducted with a Connecting with Country consultation process.

CONSULTATION FOR CULTURAL INPUTS AND VALUES

The project area lies within the boundaries of the DLALC. Steve Randall (DLALC) attended the site inspection to assist with identifying Aboriginal sites and objects and to provide cultural information about the project area. A copy of the draft report was provided to DLALC for review and comment prior to its finalisation.

UNDERSTANDING LANDFORM SENSITIVITY

The project area is located in the floodplains associated with the Nepean River, within the Penrith Unit of the Cranebrook Terrace formation. The soils of the project area are consistent with the Richmond soil landscape. Aboriginal objects are known to occur within this soil landscape and in the Penrith Unit to depths of 1-2m and generally in the top 0.9m of deposit. Archaeological models across the Cumberland Plain indicate that Aboriginal objects can be found in any landform, with stone artefacts tending to be found more frequently in proximity to key resources such as water and drainage lines, shelter and stone sources and decreasing in frequency as distance from those resources increases. The Nepean River is located a little over 650m from the project area. The historic path of Cranebrook Creek is mapped approximately 1.7km west of the project area. An unnamed tributary was located 500m north-east of the project area. A number of previous potential chain of ponds and paleochannels were also identified by Groundtruthing Consulting to the north of the project area (Mitchell 2010).

The project area's alluvium topsoils have been disturbed by vegetation clearance, previous farming activity and the construction of the residential housing and irrigation infrastructure but does not appear to have been subject to sand mining. This past land use has impacted the A-horizon soils to at least 0.6m in depth.

PREDICTING POTENTIAL FOR ABORIGINAL OBJECTS/PLACES

An AHIMS extensive search (Client Service ID 912988) was undertaken on 24 July 2024. No Aboriginal cultural heritage sites were registered in or in close proximity to the project area, however over eighty-five (85) Aboriginal cultural heritage sites were registered within a 4km radius of the project area. The majority of these sites were stone artefact scatters and Potential Archaeological Deposits.

Previous archaeological investigations in the local area indicate that Aboriginal objects are possible within the project area, either on the surface or in buried contexts. It is predicted that if Aboriginal objects were present, they would occur in low frequencies. It is anticipated that Aboriginal objects in the project area

may have been disturbed, removed or displaced as a result of past land use and disturbance to a depth of at least 0.6m.

SITE INSPECTION & RESULTS

A site inspection and meeting were undertaken on 25 June 2024 by Garth Thompson (Virtus Heritage), Anya Graubard (Virtus Heritage), Steve Randall (DLALC) and Peter Morson, Joshua West and Joyce Ting (Morson Group).

No Aboriginal objects or places were identified within the project area during the site inspection.

The site inspection confirmed that the project area had extensive ground disturbance associated with the previous and current agricultural land use to at least 0.6m. This includes the presence of housing and irrigation infrastructure visible within the yards. It was not clear whether any works associated with AHIP C0001415 (AHIMS 3891) had been undertaken.

Ground surface visibility (GSV) was limited over the entire project area (<1% in most areas). Small areas of exposure within the project area exposed a clayey-sand soil A-horizon. Steve Randall noted that nearby sites are predominantly associated with sandy lenses in close proximity to the Nepean River and that the project area had undergone extensive disturbance.

The findings of the site inspection supported the predictive statements made for the project area.

DUE DILIGENCE PROCESS AND REQUIREMENTS

Aboriginal objects are protected under the *National Parks and Wildlife Act 1974*. Where Aboriginal objects are considered likely within the project area or there is uncertainty as to whether Aboriginal objects may be present, the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (2010) and the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* state that further consultation and investigation are required.

The desktop assessment and site inspection did not identify Aboriginal objects within the project area but found a reasonable potential for Aboriginal objects to occur within the project area at low frequencies and with low archaeological integrity. The proposed activity therefore has the potential to harm Aboriginal objects.

The following recommendations have been made based on the information provided on project impacts, consultation to date, relevant archaeological and environmental background research, the requirements of the *National Parks and Wildlife Act 1974*, *National Parks and Wildlife Regulation 2019*, the *Heritage Act 1977* and the results of the site inspection:

1. Further consultation and investigation are warranted given the moderate potential for Aboriginal objects in low frequencies and with low archaeological integrity.

2. An Aboriginal Cultural Heritage Assessment (ACHA) must be undertaken in accordance with the Guide *to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* and *Aboriginal Cultural Heritage Consultation Requirements for Proponents.*

   The ACHA should consider the geomorphology of the project area and consider the need for test excavation in consultation with the Registered Aboriginal Parties and Heritage NSW.

3. Where harm to Aboriginal objects and areas likely to contain Aboriginal objects and cultural values cannot be avoided, an Aboriginal Heritage Impact Permit will be required prior to works commencing, supported by the ACHA.

4. Unexpected Find Procedure

It is recommended that an Unexpected Finds Procedure be implemented for the duration of the project. In the event that a suspected Aboriginal object/s is identified the procedure should include the following:

- Works are to stop immediately.
- The area of the suspected find/s is to be fenced off with an appropriate buffer and protected.
- A qualified archaeologist and representative of DLALC are to be contacted to inspect the area and the nature of the find.
- Representative of DLALC to determine the find's significance, in consultation with a qualified archaeologist or NSW Environment and Heritage, and the requirement for an Aboriginal Heritage Impact Permit (AHIP).
- Works are not to proceed until written advice is provided from the archaeologist or NSW Environment and Heritage on the appropriate management of the find.

5. Unexpected Human Remains Procedure

It is recommended that an Unexpected Human Remains procedure be implemented for the duration of the project. In the unlikely event that suspected Human Remains are identified the procedure should include the following:

- Works are to stop immediately.
- The area of the suspected Human Remains find is to be secured and cordoned off.
- NSW Police are to be notified. No further works can be undertaken until the NSW Police provide written advice.
- If these remains are deemed to require archaeological investigation by the NSW Police or NSW Coroner, then:
- NSW Environment and Heritage and the relevant Aboriginal parties must be notified; and
- a plan of management for the preservation of any identified Aboriginal human remains of for the salvage must be put in place or conducted under an AHIP methodology and variation developed in consultation with all relevant Aboriginal parties and the NSW Environment and Heritage.
- Works are not to proceed until written advice is provided from the archaeologist or NSW Environment and Heritage.

6. Induction

It is recommended that all site workers and personnel involved in site impact works should be inducted and briefed on the possible identification of Aboriginal sites and objects during construction and their responsibilities according to the provisions of the NPW Act 1974 and NPW Regulation 2019.

This induction package should be developed in consultation with DLALC, prior to works proceeding. The induction must include:

- The contact phone numbers of the NSW Environment and Heritage regional archaeologist, EnviroLine 131 555, and DLALC.
- The relevant contact phone number Environmental Officer responsible for this project in case unknown objects or items are uncovered during excavation.
- The penalty for moving Aboriginal objects need to be made clear and given due consideration.
- An outline types of unexpected heritage objects, items & relics, and their legal protection
- The Unexpected Finds and Human Remains Procedures, as outlined in Recommendation 1 and 2.

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Contents

Disclaimer and cultural restrictions 3
Executive Summary 4
Definitions 9
Glossary 10
1. INTRODUCTION 11
1.1 Requirements to the Code of Practice and Limitations 11
1.2 Project team and qualifications 12
1.3 Acknowledgements 12
2. CONSULTATION FOR CULTURAL INPUT & VALUES 14
3. UNDERSTANDING LANDFORM SENSITIVITY 15
3.1 Previous Land Use History 17
4. PREDICTING POTENTIAL FOR ABORIGINAL OBJECTS/PLACES 19
4.1 Heritage Register and Database Searches 19
4.2 Previous Archaeological Research 22
4.2.1. Significant Regional & Local Studies & Aboriginal Cultural Heritage Management Plans 22
4.3 Summary 26
4.4 Predictive Model 26
5. SITE INSPECTION & RESULTS 29
5.1 Site Inspection Results 29
6. DUE DILIGENCE PROCESS AND REQUIREMENTS 32
REFERENCES 35

Appendices

Appendix A. Legislation 37
Appendix B. Project Concept Plans 40
Appendix C. AHIMS Search Results 41
Appendix D. Summary and timeline of archaeological assessments 42
Appendix E. Borehole Data 48

Figures

Figure 1. Project Area and Locality 13
Figure 2. Historical Aerial Images 17

Figure 3. 1942 Royal Australian Survey Corps topographic map of Windsor including the project area and unnamed creek 18
Figure 4. Project area and heritage items. 21
Figure 5: Approximate distribution of Aboriginal objects recorded by Kohen prior to 2000 across the Penrith Lakes Scheme in both surface and subsurface contexts (ERM 2001: 2.15) 24
Figure 6. Cranebrook Terrace mapping from Nansen et al. 1987. 25
Figure 7. A cross section of the Cranebrook Terrace with date ranges from Williams et al. 2017. 25
Figure 8. Soil exposure within the project area. 30
Figure 9. Exotic trees within the project area (right) compared to native trees outside project area (left). 30
Figure 10. Buildings present and levelled landscape from north-west corner of project area. 30
Figure 11. Building present and levelled landscape from north-east corner of project area 30
Figure 12. Irrigation tap identified in western project area 30
Figure 13. View to roofed-water tank in central project area 30

Tables

Table 1. Code of Practice Requirements 11
Table 2. Summary of Consultation 14
Table 3. Predicting Potential for Aboriginal Objects/Places. 15
Table 4. Definitions of Archaeological Potential. 27
Table 5. Generic Due Diligence Process Applied to the Project Description. 32
Table 6: Timeline and summary of previous assessments 42

Definitions

AHD	Australian Heritage Database
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
Code of Practice	*Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010)
DPC	Department of Premier and Cabinet
EP&A Act	*Environmental Planning and Assessment Act 1979*
LEP	Local Environment Plan
LGA	Local Government Area
NNTT	National Native Title Tribunal
NPW Act	*National Parks and Wildlife Act 1974*
NTA	*Native Title Act 1993*
PAD	Potential Archaeological Deposit
SHI	State Heritage Inventory

Glossary

Aboriginal object - A term used in the NPW Act legislation, meaning: '… any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains' (s.5 NPW Act).

Registered Aboriginal party – An individual or party who registers for Aboriginal consultation as part of the consultation and notification process following Aboriginal cultural heritage consultation requirements for proponents 2010 (NSW DECCW 2010b).

AHIP – An Aboriginal Heritage Impact Permit which is a document provided by NSW Environment and Heritage which provides a defence to the applicant to certain activities which constitute 'harm' to Aboriginal objects or Aboriginal places under Part 6 of the NPW Act. A proponent must prepare an application for an AHIP and other relevant documentation (including an ACHA) to obtain an AHIP from NSW Environment and Heritage in the Department of Premier and Cabinet.

Declared Aboriginal place - A term used in the NPW Act legislation, meaning any place declared to be an Aboriginal place (under s.84 of the NPW Act) by the Minister administering the NPW Act, by order published in the NSW Government Gazette, because the Minister is of the opinion that the place is or was of special significance with respect to Aboriginal culture. It may or may not contain Aboriginal objects.

Due Diligence assessment – Due diligence is taking reasonable and practical steps to determine whether a person's actions will harm an Aboriginal object and, if so, what measures can be taken to avoid that harm. A due diligence assessment will assess the potential for harm and provide recommendations to mitigate harm, generally in the form of an Aboriginal Cultural Heritage Assessment (ACHA), if Aboriginal objects or places are likely to be harmed by proposed works.

Harm - A term used in the NPW Act Amendments meaning '… any act or omission that destroys, defaces, damages an object or place or, in relation to an object – moves the object from the land on **which it had been situated' (s.5 NPW Act).**

Project area - Area proposed to be impacted as part of a specified activity or development proposal. These activities include indirect impact.

Place - An area of cultural value to Aboriginal people in the area (whether or not it is an Aboriginal place declared under s.84 of the Act).

Proponent - A person proposing an activity that may harm Aboriginal objects or declared Aboriginal places and who may apply for an AHIP under the NPW Act.

1. INTRODUCTION

Virtus Heritage was engaged by Morson Group to prepare an Aboriginal Archaeological Due Diligence Assessment for the proposed Castlereagh Tourism Development. The project is located at 39-65 Old Castlereagh Road, Castlereagh, and within the City of Penrith local government area (LGA) (refer to Figure 1).

The project area has previously been assessed for Aboriginal archaeological and cultural heritage values as part of the Penrith Lakes Development Scheme (Penrith Lakes Development Corporation (PLDC) 2011). Based on this assessment, AHIP C0001415 (AHIMS 3891) was issued to PLDC over the project area between 15 November 2018 and 15 November 2023 to allow harm to known and unknown Aboriginal objects without mitigation of harm during vegetation works and erosion and sediment control works as described in Controlled Activity Approval 10 ERM 2011/0057. This AHIP has expired.

The proposed scope of works as provided by Morson Group Consultants include construction of a 7-storey serviced apartment building with 65 dual key units, a 6 storey 4,500sqm indoor recreation facility, 3 single-story fast-food outlets, a 5,000sqm club, multiple shops, cafes and restaurants and a central community space. 1,000 car parking spaces will be provided as multi-level above ground and on grade parking. It is anticipated that the proposed works will include earthworks.

The project design is still under development at the time of reporting but is being conducted with a Connecting with Country consultation process. Report

1.1 REQUIREMENTS TO THE CODE OF PRACTICE AND LIMITATIONS

This report was compiled with reference to the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in NSW (NSW)* (Due Diligence Code). The aim of this report is to advise on the archaeological (scientific) potential of the project area in order to assist the proponent in exercising due diligence in determining if their actions will harm Aboriginal objects.

This report follows the below steps, in line with the Due Diligence Code:

- identify whether or not Aboriginal objects are, or are likely to be, present in the area.
- if objects are present or likely to be present, determine whether the proposed development activities are likely to harm Aboriginal objects; and
- determine whether further assessment or an Aboriginal Heritage Impact Permit (AHIP) is required.

Table 1. Code of Practice Requirements

Due Diligence CoP Process	Section of Report
Step 1: Will the activity disturb the ground surface?	Refer to Section 1.2
Step 2a: AHIMS Search Are there any relevant confirmed site records or other associated landscape feature information on AHIMS?	Refer to Section 4
Step 2b: Are there any other sources of information of which a person is already aware? e.g. this may include other searches, knowledge from landholders, Aboriginal community, oral history, history or some other resource or knowledge holder.	Refer to Section 4.

Step 2c: Are there landscape features that are likely to indicate presence of Aboriginal objects? • within 200m of waters, or • located within a sand dune system, or • located on a ridge top, ridge line or headland, or • located within 200m below or above a cliff face, or • within 20m of or in a cave, rock shelter, or a cave mouth, or • is one land that is not disturbed land.	Yes, refer to Section 3, and Section 4.4.
Step 3. Can you avoid harm to the object or disturbance of the landscape feature?	No, refer to Section 6 for further information
Step 4: Does a desktop assessment and visual inspection confirm that there are Aboriginal objects or that they are likely?	Yes, refer to Section 6 for further information.

This report is limited to the assessment of project impacts described above and within the mapped project area in Figure 1. The site inspection undertaken was confined to areas of proposed works provided by Morson Group and illustrated in Figure 1

The areas of the project area that were accessible had limited ground surface visibility.

The assessment undertaken by Virtus Heritage provides the archaeological (scientific) potential of the project area, and the management strategies related to these. The cultural (social) and spiritual values can only be commented on by the Aboriginal community representatives for any project.

Virtus Heritage takes no responsibility for errors within NSW Environment and Heritage's Aboriginal Heritage Information Management Systems (AHIMS) data, and the NSW Environment and Heritage listings and has assumed information provided by NSW Environment and Heritage is accurate.

It was not possible to obtain a complete copy of Penrith Lakes Scheme Area Aboriginal Heritage Assessment Report (PLDC 2011) or Controlled Activity Approval 10 ERM 2011/0057 despite requests to Heritage NSW and Penrith Lakes Development Corporation for this assessment. This assessment has therefore not considered Volume 1: Sections 2 to 4, Volume 2, Volume 3 and Map 14 of the Penrith Lakes Scheme Area Aboriginal Heritage Assessment Report (PLDC 2011) or assessed impacts associated with AHIP C0001415 (AHIMS 3891), if any.

1.2 PROJECT TEAM AND QUALIFICATIONS

This report was compiled by Archaeologist, Garth Thompson (M.A. Archaeological and Evolutionary Science, Australian National University, B.A. Archaeology and Anthropology, University of Sydney) with assistance from Anya Graubard (B. Arts Hons, Anthropology, University of Nebraska). Quality review was undertaken by Principal Archaeologist Clare Anderson (BA, Hons Prehistoric and Historical Archaeology, University of Sydney). The site inspection was conducted by Garth Thompson. GIS Mapping was prepared by Shaun Sewell (GIS Analyst). Project information and description of works was provided by Peter Morson and Joshua West from the Morson Group.

1.3 ACKNOWLEDGEMENTS

We would like to acknowledge the assistance of the following individuals for the completion of this report:

- Steve Randall, Deerubbin Local Aboriginal Land Council
- Peter Morson, CEO, Morson Group
- Joshua West, Graduate Architect, Morson Group

537 Morson Group - Penrith Lakes Due Diligence
Castlereagh, NSW
Figure 1. Project Area and Locality

Author: Shaun Sewell
Date: 06/06/2024
Scale: 1:1500 @ A4
Datum: GDA2020 / MGA zone 56
Source: ©Department of Customer Service - Spatial Services 2024

Legend

- Project Area
- Roads
- Cities and Suburbs

N

0 8 16 24 32 40 m

2. CONSULTATION FOR CULTURAL INPUT & VALUES

Aboriginal people are the primary determinants of their culture and heritage, and cultural values can only be assessed and advised by the relevant Aboriginal parties for the locality. It should be noted that Aboriginal heritage refers both to Aboriginal archaeological sites and sites/places of cultural value to Aboriginal people, protected under the NPW Act as "Aboriginal Objects" and "Aboriginal Places". Sites and places of Aboriginal cultural significance can only be identified by the relevant local Aboriginal people and are likely in many cases (for example, song lines and story places) to not contain any archaeological evidence.

This assessment was conducted by archaeologists providing advice on the archaeological (scientific) values of the project area. Deerubbin LALC was invited to attend a site inspection and a copy of the draft report provided for comment. A summary of the consultation undertaken for this assessment is provided in Table 2.

Table 2. Summary of Consultation

Date	Comment	Method (Email, Phone)	Consultant Response
17 June 2024	Virtus Heritage contacted Deerubbin LALC to arrange DLALC representatives to attend the site inspection and to provide information on the proposed work.	Phone	Acknowledged receipt and confirmed attendance.
21 June 2024	DLALC contacted Virtus Heritage to confirm their attendance at the site inspection and to arrange a meeting point.	Phone, email	Virtus Heritage confirmed meeting place and time with WNAC.
25 June 2024	Site inspection	In Person	N/A
27 August 2024	Virtus Heritage provided a digital and hard copy of the draft Due Diligence assessment for DLALC's review and comment. Additional email and phonecall follow up was made 6-10 September 2024.	Email	No response received,

3. UNDERSTANDING LANDFORM SENSITIVITY

This section of the report details the existing geology, soils and topography, climate, fauna and flora, previous land use history and other environment factors to provide an environmental context to understanding the potential for Aboriginal occupation and evidence of material culture surviving within the project impact areas.

The environmental context assessment is based on a number of classifications that have been made at the national and regional level for Australia. The National Interim Biogeographic Regionalisation for Australia (IBRA) system classifies Australia's landscapes into 89 geographically distinct bioregions based on their common climate, geology, landform, native vegetation and species information (Department of Climate Change Energy the Environment and Water, 2021). This report also refers to the Mitchell Landscapes (Mitchel 2002b), which provides geomorphic and vegetation data for NSW and to the Australian Soil Classifications which describe and interpret soil profiles across Australia (Isbell 2016). Area refers to the inspected Areas as demonstrated in **Section 5**.

Table 3. Predicting Potential for Aboriginal Objects/Places.

Landscape Context	Notes
Topography	The project area is located on a modified, flat floodplain associated with the Quaternary terraces of the Nepean River.
Geology	The project area is within the Penrith Unit of the Cranebrook Terrace, a Quaternary alluvium geological landscape dominated by sand, silt and gravels derived from sandstone and shale. To the west of the project area, is the Richmond Unit of the Cranebrook Terrace (see **Section 3.2**). Sediment in the Richmond Unit to the west of Cranebrook Creek's historic path has been dated to a minimum of 15,000 years before present, while sediment east of Cranebrook Creek's historic path in the Penrith Unit dates to a minimum of 40,000 years before present (William et al 2017, see **Section 3.2**).
Soils	The project area is within the Richmond Soil Landscape. A geotechnical assessment was conducted for this project, within the project area (Morrow 2023). This report found the project area to contain a topsoil of silty sand/sandy silt to a depth of 0.6m, followed by alluvial clay sand/silty sand to depths between 3.3 and 6m, suggesting variation in the topography and land formation within the project area. Alluvial Cobbles are below this to a depth of 13.9m after which a shale bedrock was identified. The soil profile is consistent with those previously observed in the Cranebrook Terrace (see **Section 3.2**). Borehole data is provided in Appendix E.
Hydrology	The Nepean River is approximately 650m southeast of the project area. An unnamed man-made lake is approximately 25m north of the project area. The Sydney international Regatta Waterway is approximately 250m north of the project area and is also man-made. Prior to extensive modifications to the landscape from the Penrith Lakes Scheme, the primary channel of Cranebrook Creek is 1.7km west of the project area, an unnamed tributary to Cranebrook Creek was originally located approximately 500m north-east. Mitchell (2010) further mapped a number of potential paleochannels and chains-of-ponds to the north of the project area.

Vegetation

The native vegetation within the project area has been extensively cleared of open forest (refer to **Figure 2**). The vegetation of the area once included red cedar and paperbarks. Regrowth vegetation is dominated by Acacia species and Eucalypt species. During the site inspection no native vegetation was identified within the project area (**Section 5**).

During the 38-36 k cal. Yr BP period, the vegetation was likely an open sclerophyll forest with Eucalyptus viminalis and Leptospermum polygalifolium prominent. A 'spineless Asteraceae', thought to be Cassinia Ercuate was prominent in the understory. During the 27-16 k cal. Yr BP period, a shrubland of Cassinia Ercuate with some grasses was present. The lack of eucalypts during the height of the last glacial period suggests a cold, arid climate and agrees with less rainfall than today. In the period 6 k cal. Yr BP to present, a Eucalyptus tereticornis and Leptospermum juniperinum woodland with a grassey understorey occupied the site. When compared with other records in the Sydney Basin, the vegetation through the last glacial maximum at Penrith Lakes is the only one with a shrubland/grassland community (Chalson and Martin 2008)

The project area is within the sandy soils of a floodplain associated with the Nepean River. This is a sensitive landscape known to contain Aboriginal cultural heritage sites.

The project area is to the east of Cranebrook Creek, suggesting that the soils of the project area are in the Penrith Unit of the Cranebrook Terrace and were deposited at least 40,000 years before present and therefore, if Aboriginal objects were to occur in the project area, they would most likely be limited to the reworked topsoils. The project area is also over 500m from the unnamed tributaries of Cranebrook Creek and the Nepean River. Archaeological models for the Cumberland Plain indicate that the frequency and density of Aboriginal objects decreases with distance from water.

The level of disturbance from landscaping associated with the existing residential housing has likely impacted any Aboriginal objects or sites within these impacts.

3.1 PREVIOUS LAND USE HISTORY

Understanding previous land use history is critical to understanding if the sensitivity of a landform, soils, geology and hydrology for material evidence of Aboriginal occupation may be compromised or still extant over the passage of time.

The earliest record for European use of the Penrith Lakes region is a 90-acre land grant to George Fieldhouse in 1803, which included the project area (Biosis 2018). The area was used predominantly for farming due to the rich soils associated with the Nepean River's surrounds. This is evident in historical imagery, particularly the 1955 photographs, which show the project area as part of a larger context of fields (**Figure 2**). In the 1955 photographs one homestead is present within the project area, with two other residential houses appearing by 1978 (**Figure 2**). By 1998 only two housing developments would be present on the project area, which would be the two currently present residential buildings present at the time of reporting (**Figure 2**).

Sand quarrying took place in close proximity to the project area during the 1960s which would continue until the 1990s but does not appear to have impacted on the project area directly (**Figure 2**). The region would be further developed in the 1990s, with the Sydney International Regatta Centre being developed 250m north of the project area (**Figure 2**). This development would also remove a drainage channel with small dams visible northeast of the project area in the 1955-1978 aerial photographs (**Figure 2**). This is an unnamed channel that is a tributary of the historic path of Cranebrook Creek (**Figure 3**) Finally, the Nepean Business Park would be developed just south of the project area across Old Castlereagh Road (Eco Logical Australia 2021). Whilst extensive ground works have been undertaken surrounding the project area, the project area itself appears to have only been distubred by pastoral activities and the construction and of residential houses.

A drainage channel is evident northeast of the project area in the 1955-1978 aerial photographs that is removed by the construction of the Sydney International Regatta Centre in the 1990s (see **Figure 2**). This drainage channel is an unnamed tributary of Cranebrook Creek, as identified in a 1942 survey of Windsor (Royal Australian Survey Corps 1942, **Figure 3**).

Figure 2. Historical Aerial Images.

1955 Aerial Photograph.

1965 Aerial Photograph

1978 Aerial Photograph.

1998 Aerial Photograph.

Figure 3. 1942 Royal Australian Survey Corps topographic map of Windsor including the project area and unnamed creek

4. PREDICTING POTENTIAL FOR ABORIGINAL OBJECTS/PLACES

The archaeological context draws on existing heritage registers and database searches, previous archaeological research, and discussions of archaeological potential to understand and predict the potential for evidence of Aboriginal occupation in the project impact areas.

4.1 HERITAGE REGISTER AND DATABASE SEARCHES

This section of the report provides a summary of the results of relevant heritage register searches were undertaken as part of this Due Diligence assessment.

The following registers were searched:

- **Aboriginal Heritage Information Management System (AHIMS):** The AHIMS is a database of registered Aboriginal sites within NSW, administered by the NSW DEECCW. The limitation of the AHIMS cultural heritage database in that it contains information that has been registered and does not reflect all Aboriginal cultural sites that may have been identified. The AHIMS database is being continually updated and can contain errors. The AHIMS search was completed on 24 July 2024 for search area (GDA, Zone: 56, Eastings: 281848 - 289036, Northings: 6261482- 6270558, Appendix C)
  - A total of eighty-five Aboriginal cultural heritage sites were returned by the search. The nearest previously recorded Aboriginal cultural heritage site was "Andrews Road PAD 1" (AHIMS ID#45-5-5238), a PAD with stone artefacts associated. This site was destroyed in accordance with Aboriginal Heritage Impact Permit #4518 (Appendix B). This site is located approximately 1.1km southeast of the project area.
- **Aboriginal Heritage Impact Permit List:** Heritage NSW maintains a list of current and previous Aboriginal Heritage Impact Permits and is in the process of digitising this list. The Aboriginal Heritage Impact Permit Boundaries dataset (State Government of NSW and NSW Department of Climate Change, Energy, the Environment and Water 2023") was searched on 24 July 2024
  - AHIP C0001415 (AHIMS 3891) was mapped over the project area and was found to have expired.
- **Australian Heritage Database:** The Australian Heritage Database (AHD) is a Commonwealth administered heritage database that includes entries from the former Register for the National Estate and the current Commonwealth and National Heritage Lists and was searched on 5 June 2024:
  - **National Native Title Tribunal:** The search found no Native Title claims or agreements to be in place within or within close proximity to the project area.
  - **Indigenous Land Use Agreements (ILUAs):** There are no ILUAs within or within close proximity to the project area
  - **World Heritage List:** the search found no heritage items located within or within close proximity to the project area.
  - **National Heritage List:** the search found no heritage items located within or within close proximity to the project area.
  - **Commonwealth Heritage list:** the search found no heritage items located within or within close proximity to the project area.
  - **Register of the National Estate:** the search found no heritage items located within or within close proximity to the project area.
- **State Heritage Inventory and State Heritage Register:** The State Heritage Inventory (SHI) is a heritage database administered by the NSW Environment and Heritage (Department of Planning and Environment) and was searched 5 June 2024. This database includes heritage listings from local and regional planning instruments and heritage studies and State significant heritage items. Information and items listed in the State Heritage Inventory come from a number of sources. This means that there

may be several entries for the same heritage item in the database. Search results are divided into three sections.

- Section 1 – No Aboriginal Places were listed within the City of Penrith LGA.
- Section 2 – 29 items listed under the Heritage Act are located within the City of Penrith LGA. None of which are within the project area.
- Section 3 – 204 items were listed within the City of Penrith LGA. One heritage item, the Castlereagh Road Alignment, runs alongside the project area. The listing does not identify any Aboriginal history or cultural heritage values.

- **The Penrith LEP 2010**: The City of Penrith utilises the Penrith Local Environmental Plan (2010) to regulate land use and development within the City of Penrith LGA. Local Environmental Plans are planning instruments which contain provisions and listings of items of environmental heritage including heritage, conservation areas and archaeological sites within Schedule 5.
  - Ony heritage item, #261 Castlereagh Road Alignment, borders the project area to the south, but is not within the project area. No other heritage items, conservation areas or archaeological sites are within the project area.

Heritage items in close proximity to the project area are displayed in **Figure 4**

.

VIRTUS HERITAGE

537 Morson Group - Penrith Lakes Due Diligence
Castlereagh, NSW
Figure Project Area and

Author: Shaun Sewell
Date: 06/06/2024
Scale: 1:3000 @ A4
Datum: GDA2020 / MGA zone 56
Source: ©Department of Customer Service - Spatial Services 2024

Legend

- Project Area
- Local Heritage

N

0 20 40 60 80 m

4.2 PREVIOUS ARCHAEOLOGICAL RESEARCH

A review of the NSW Environment and Heritage AHIMS library and online searches were undertaken to obtain copies of previous Aboriginal heritage studies and archaeological investigations within the locality of the project area. Enquiries were also made with Heritage NSW and PLDC to obtain copies of reports not available on AHIMS. This section outlines the studies in the locality that can assist in understanding the potential archaeology of the region by building up a picture. This in turn can help predict the types of sites that may be expected to be present within the project area and will assist in building a predictive model for Aboriginal sites.

4.2.1. Significant Regional & Local Studies & Aboriginal Cultural Heritage Management Plans

A large number of heritage assessments have occurred in the local region, particularly in association with the Penrith Lakes Scheme. A timeline and annotated bibliography of relevant reports reviewed for this assessment is provided in Appendix D. Relevant information is summarised below.

The project area has previously been assessed for Aboriginal archaeological and cultural heritage values as part of the Penrith Lakes Development Scheme (Penrith Lakes Development Corporation (PLDC) 2011). This report consolidated previous archaeological assessments and survey coverage data up to 2011 and included consultation in accordance with the *Aboriginal community consultation requirements for proponents* (DECCW 2010). The assessment noted archaeological monitoring and excavation in both the Penrith Unit and Richmond Unit of the Cranebrook Terrace, but no archaeological monitoring or excavation in the project area. The project area was identified in the historic soil disturbance mapping as having agricultural disturbances with in-situ geomorphology (PLDC 2011). No sand mining appears to have occurred in the project area. The predictive model mapping from that assessment was unavailable for this report, was not available, the report identified the following statements (PLDC 2011):

> *Based on the archaeological background and suggested land use model of Aboriginal behaviour it is assumed that flaked stone artefacts will be present within the soil across the Scheme in a consistently low-density distribution.*
>
> *The Dharug speaking Aboriginal people who lived on the Cranebrook Terrace and associated landforms (such as the Smith Road conservation area ridge) hunted and gathered across the landscape with selection of elevated landforms as favoured camping locations.*
>
> *Kohen hypothesised that a continuous scatter of artefacts at varying densities probably occur along all creeks in the Cumberland Plain (Kohen 1988) with the Nepean River and adjacent flood plain acted as focus of activity (Kohen 1988). Kohen thought that the Eastern bank and terraces of Nepean River were likely to contain significant sites and possibly provided a focus of activity along bank of Cranebrook Creek (Kohen 1986). Fauna and vegetation associated with Cranebrook Creek and its tributary streams would have played a major part in the selection of prehistoric sites (Kohen 1986).*

Based on this assessment, AHIP C0001415 (AHIMS 3891) was issued to PLDC over the project area between 15 November 2018 and 15 November 2023 to allow harm to known and unknown Aboriginal objects without mitigation of harm during vegetation works and erosion and sediment control works as described in Controlled Activity Approval 10 ERM 2011/0057. It is not clear whether these works were undertaken in the project area.

The project area is part of a broader Aboriginal cultural landscape that extends from the Blue Mountains to the Cranebrook Escarpment, within the Dharug-speaking nations. It seems likely that the land fell within the territory of one of two clans – either the Boorooberongal to the north near Richmond or the Mulgoa clan to the south near Penrith (PLDC 2011). The mountains and river connect with shared songlines between Dharug, Darkinjung and Gundungurra Nations (PLDC 2011, Blue Mountains City Council 2017).

The Penrith Lakes area was a traditional meeting place for Aboriginal people. Its river and rich soils provided abundant natural vegetation and wildlife which supported Aboriginal people for many generations (New South Wales State Heritage Register. Department of Planning & Environment. H02009, 2024). Evidence of this history has been revealed through the many artefacts were collected during the 25 years of sand and gravel mining at Penrith Lakes, to the north, west and south of the project area (New South Wales State Heritage Register. Department of Planning & Environment. H02009, 2024). In addition to the eight-five Aboriginal cultural heritage sites registered within a 4km radius of the project area, there are additional Aboriginal cultural heritage sites were not recorded in AHIMS (ERM 2001, see Figure 5). To the north of the project area, near Hadley Park, the Nepean River was one of the many first contact places where local Aboriginal people were able to stay on their traditional lands by camping and working for the colonial settlers. It was a place of confrontation between Aboriginal people and colonial settlers before peaceful relationships were established (New South Wales State Heritage Register. Department of Planning & Environment. H02009, 2024). Substantial stone artefact workshops have been identified along the banks and terraces of Cranebrook Creek and the Nepean River, with many suitable stones for the manufacture of stone tools being sourced from the river and its creeks (Doelman et al 2015). Cranebrook Creek CC/1 (AHIMS 45-5-0281), listed as an artefact and Aboriginal Ceremony and Dreaming site, was located approximately 1.4km to the north-west of the project area.

A study of artefacts and the geological units associated with the Cranebrook Terrace in 1987 found natural sediment within the locality to have been deposited within three stages: a reworked overburden found between Cranebrook Creek and the Nepean River dating to 10-13,000 years BP, an original overburden dating to 40-45,000 years BP, and channel infill deposits dating to approximately 36,000 years BP (see **Figure 5**). The reworked overburden deposit was identified as being deposited within the known habitation of Aboriginal populations in the Sydney area, and also as having an increased potential for archaeological deposits to its maximum depth of approximately 4m. Within Nanson et al.'s mapping, the project area appears to be within 90m of the border between the reworked overburden deposit associated with higher archaeological potential, and the original overfill burden deposit (1987, **Figure 5**). This boundary was based on Walker's 1956 geological mapping at a 1-mile scale (Mitchell 2010). This model has subsequently been revised in Mitchell 2010 and Williams et al 2017.

The first major subsurface investigation of the overburden took place in 1997 with the mechanical excavation by Kohen of two very large trenches within the Penrith Unit soil. Each trench was 7m wide and 100m long dug by mechanical scraper and were mapped in PLDC 2011 to several kilometres north of the project area. One major trench was dug by Cranebrook Creek to a depth of 4.6m. A second trench was dug to a depth of 1.9m by the paleochannel feature - a depressed band of clayey soil swamps near the base of the escarpment in the northeastern area of the Scheme. Kohen reports that 99% of artefacts were recovered within the top 1.3m and European artefacts were recovered from the upper 90cm at Cranebrook Creek and upper 60cm at the paleochannel. The top 2m of the soil were heavily bioturbated. The results suggested that artefacts had been mixed through the soil by bioturbation. The results suggested a low density of artefacts, although the recovery via 10mm mechanical gravel screen would not have captured artefacts less than 10mm wide.

In 2000, Insite Heritage undertook archaeological test putting to the east of the project area near the boundary of the Penrith Unit and Londonderry Terrace for a proposed development between Cranebrook Road and Andrew Road. A total of 75 artefacts were identified. Artefacts located in the sand terrace averaged around 1-3 artefacts per m^3, with the majority located in the top 0.5m. The report recommended the proponent apply for a consent to destroy with monitoring.

In more recent times, Artefact (2016) conducted an Aboriginal Archaeological Survey Report as part of a Review of Environmental Factors for infostructure works on Jane Street and Mulgoa Road, Penrith, approximately 2.3km south of the project area. In their reporting, Artefact reviewed the archaeological and geotechnical investigations associated with the Cranebrook Terrace in the Penrith region. Artefact (2016) identified that artefact deposits have been found within the Cranebrook Terrace to a depth of 3.7m, or 20.55 AHD.

In 2017 Williams et al. conducted excavations on the banks of Peach Tree Creek and created the most recent dating model for the Cranebrook Terrace (see Figure 7). This modelling identifies that the sandy clay sediment in areas west of the historic pathway of Cranebrook Creek, within the Richmond Unit were deposited between 20-15,000 years ago to a depth of 3.5-3.9m or 20.73-21.13m AHD. This sedimentary layer is particularly sensitive for Aboriginal archaeological deposits, with flakes being identified by Williams et al. at the base of this layer. Sediment below this deposit are also sandy clays and date to approximately 50-40,000 years ago within the Richmond geological unit. Sediment east of the historic alignment of Cranebrook Creek dates to at least 50,000 years. Aboriginal objects are less likely to occur at depth to the east of Cranebrook Creek, with any Aboriginal objects most likely occurring in the reworked topsoils. Around 3km east of Cranebrook Creek is and channel infill dating to between 50-75,000 years ago.

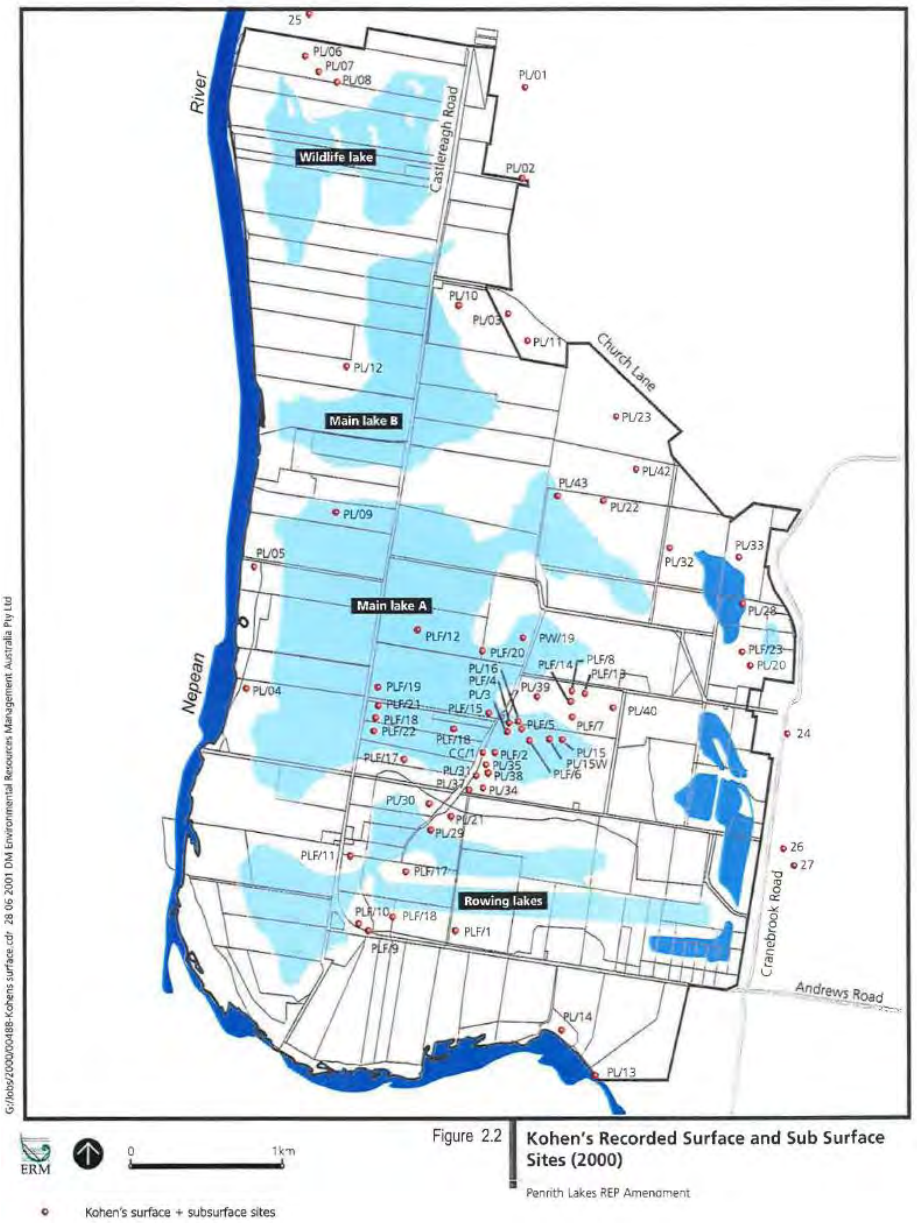

Figure 5: Approximate distribution of Aboriginal objects recorded by Kohen prior to 2000 across the Penrith Lakes Scheme in both surface and subsurface contexts (ERM 2001: 2.15)

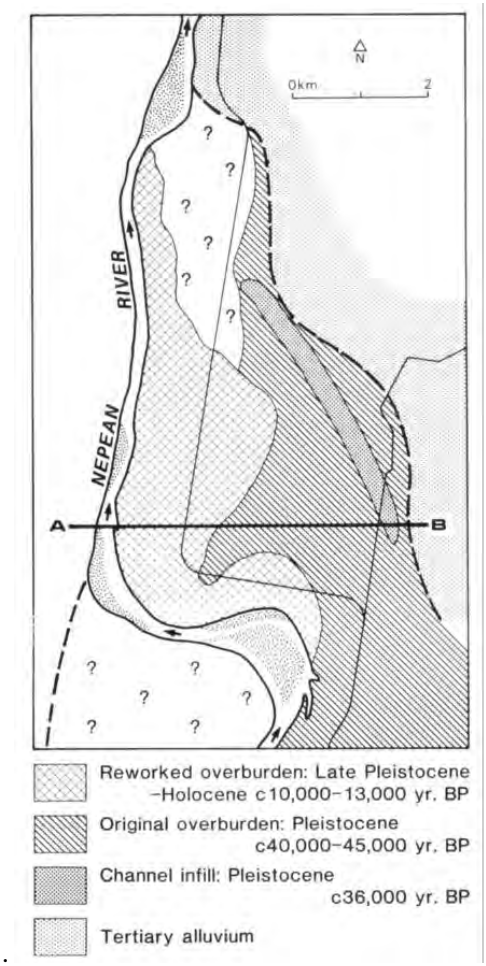

Figure 6. Cranebrook Terrace mapping from Nansen et al. 1987.

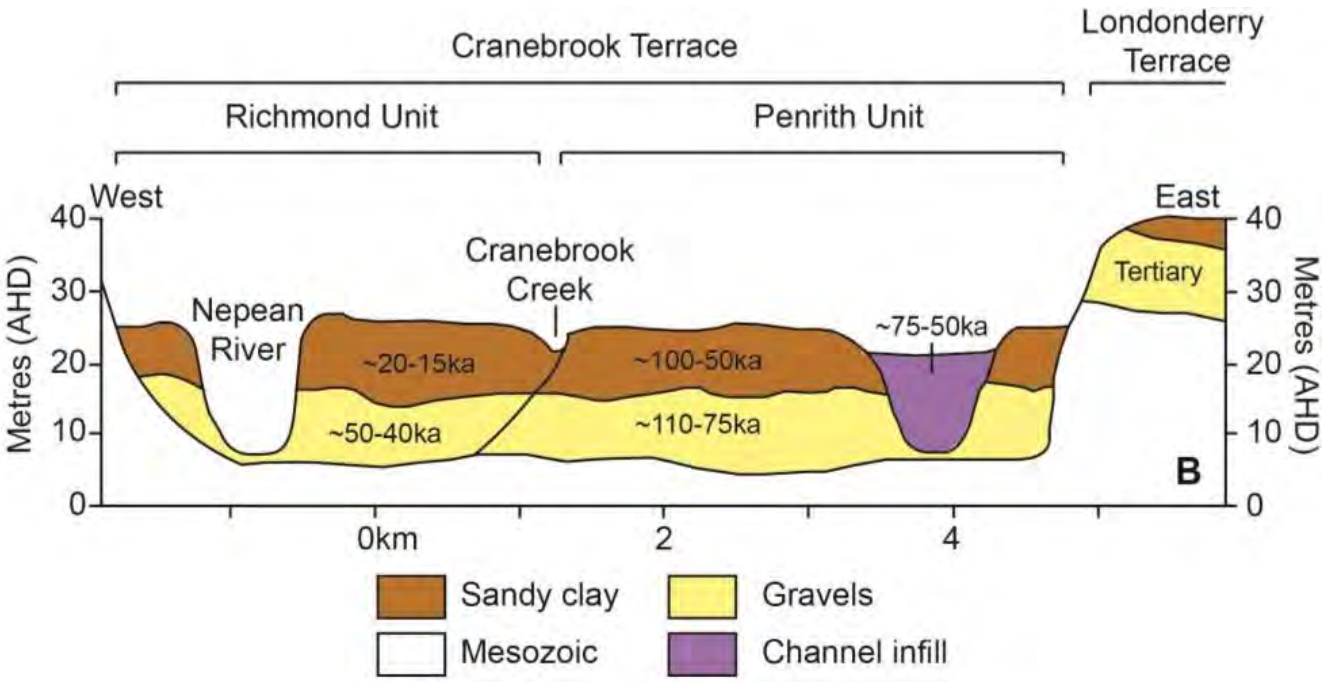

Figure 7. A cross section of the Cranebrook Terrace with date ranges from Williams et al. 2017.

4.3 SUMMARY

There does appear to be a trend towards area-wide AHIPs across the Penrith Lakes Scheme to manage the residual risk of Aboriginal objects across both the Richmond and Penrith units of the Cranebrook Terrace irrespective of the identification of sites, particularly in those areas not historically impacted by sand quarrying (Kohen 1986-2004, Insite Heritage 2000, AHIP C0001415, AHIP 1131345, Comber Consultants 2017, 2018, Ecological Australia 2020)

The project area is within the Cranebrook Terrace. Sediment in this geological unit is dominated by alluvial clayey sands that were deposited in successive periods. Clayey sand sediment in areas west of Cranebrook Creek but east of the Nepean River were deposited 15-20,000 years ago and are associated with archaeological deposits up to 3.9m below the ground surface Sediment in areas east of Cranebrook Creek's historic path were deposited 50-100,000 years ago. Aboriginal objects are less likely to occur at depth to the east of Cranebrook Creek, with any Aboriginal objects, should they be present, most likely occurring in the reworked topsoils, often associated with lenses of sandy soils. Williams et al 2017 notes variation in the extent of the original hypothesised Richmond and Penrith Units, while the original mapping undertaken by Nanson et al 1987 was based on borehole data and geological mapping undertaken by Walker in 1952 at a 1-mile scale. The project area falls within the predicted boundary of the Penrith Unit. which is associated with the preservation of Aboriginal objects up to depths of 1.3m (but often to 0.6-0.9m) based on archaeological excavations undertaken by Kohen (1997). Insite Heritage (2005) and Comber Consultants (2006, 2008).

The project area is located approximately 500m from the Nepean River, 1.7km east of the primary Cranebrook Creek channel and approximately 500m from previous drainage line and chains of ponds to the north-east of the project area. The frequency of Aboriginal objects occurring in the local area tends to decrease with distance to water.

Aboriginal objects, if present, in the project area may have been removed, truncated or reworked in the soil profile at least to a depth of 0.6m due to the past land uses and disturbance in the project area, particularly in association with the irrigation works.

4.4 PREDICTIVE MODEL

A predictive model for sites includes both analysis of the most likely site types to occur in a given area and predictions about where in the landscape sites might be likely to be located. The purpose of a predictive model is to "present a model, or series of testable statements, about the nature and distribution of evidence of Aboriginal land use within the project area" (DECCW 2010: 10).

The predictive model of Aboriginal site distribution considers the location of previously recorded sites, the results of assessments undertaken in the area, the availability of raw material and resources and is, by nature, broad in scope. The following summary provides an indication of the likely occurrence of various Aboriginal site types within the project area and surrounds.

When considering the potential for Aboriginal cultural sites in the project area, the Due Diligence Code states that 'Aboriginal objects are often associated with particular landscape features as a result of Aboriginal people's use of those features in their everyday lives and for traditional cultural activities'. Sensitive landscape features for Aboriginal sites include areas:

- within 200m of waters.
- located within a sand dune system.
- located on a ridge top, ridge line or headland.
- located within 200m below or above a cliff face.
- within 20m of or in a cave, rock shelter, or a cave mouth; or
- is on land that is not disturbed land.

With consideration to the Understanding Landform Sensitivity (**Section 3**), previous archaeological modelling and research undertaken in proximity to the project area (**Section 4.2 and Section 4.3**), the following archaeological (scientific) predictions can be made.

Isolated artefacts and **open campsites (artefact scatters)** are the locations of discarded stone artefacts, often material that has been discarded as part of making stone tools or over frequent episodes of occupation/visitation in an area. The objects are the most likely site type to be identified in the project area, with higher potential in undisturbed contexts. The past land use of the project area and geotechnical reporting indicates that the ground surface has likely been disturbed, and artefacts if present are likely to be disturbed, displaced or removed. It is predicted, based on the current mapping of the Penrith Unit within the Cranebrook Terrace and previous archaeological excavations in the Penrith Unit, that stone artefacts may be present infrequently to depths of 1.3m but most likely in the top 0.9m.

Scarred trees and **carved trees** contain evidence of scars and carved patterns which can be attributed as having Aboriginal cultural origin. Scarred trees are typically created by the removal of bark from the trunk of the tree (usually with a stone axe) to make shields, canoes, implements and other types of items which leave a wound on the tree trunk. Carved trees contain carved patterns on the tree trunk and are often found in association with ceremonial grounds, burials or cultural sites. Carved trees are a very rare site type, which are considered unlikely to be found in the project area based on its history of previous land use. Modified trees are unlikely to occur in the project area as there has been extensive vegetation clearing.

There are no known **burial sites, bora grounds** or **stone arrangements** within the project area based on Aboriginal consultation to date and preliminary previous archaeological and historical research for this assessment. Consultation for previous archaeological reports has noted a potential for burial sites to occur within the Penrith Lakes area. The project area has experienced past disturbance from agricultural activities, and it is rare for burials to occur.

Potential Archaeological Deposits refers to soil profiles within landforms which are predicted to contain buried evidence of Aboriginal occupation. This buried evidence is most often stone artefact scatters which survive most frequently in the archaeological record. The project area is considered to have moderate potential for infrequent subsurface stone artefacts.

How archaeological potential is defined and to be assessed in this report is provided in the table below.

Table 4. Definitions of Archaeological Potential.

Archaeological Potential	Definition
Low to Zero	Landforms that have been totally modified and have low to zero potential for any remaining original soil profile or intact archaeological deposits. This category includes existing roads, quarry areas or any area where the original soil profile (topsoil – A horizon) has been stripped and the landform completely modified. This landform may also include areas where there are no intact A horizon soils due to high levels of erosion.
Low	Landforms that may have been utilised by Aboriginal people in the past, but at a lower intensity relative to all surrounding landforms, resulting in a lower artefact density than all surrounding landforms. This category also includes landscape areas of low terrain integrity, where geomorphic processes or human action may have redistributed artefacts from their deposited locations, such as stripping of soil to create levees or excavation to create culverts, dams or bridges, resulting in site disturbance or destruction.
Moderate	Landforms that are predicted to have been utilised by Aboriginal people in the past, but not intensively or repeatedly. There is therefore potential for

Archaeological Potential	Definition
	artefactual deposition, but at a lower frequency and density than in areas of high archaeological potential. This category may also refer to landforms known to be sensitive for higher levels of Aboriginal occupation but where prior ground surface disturbances has decreased the archaeological integrity and potential of finding evidence of Aboriginal occupation (for example, creek confluences, alluvial terraces where stratigraphic integrity may have decreased due to previous land use).
High	Landscape areas predicted to have been intensively or repeatedly utilised by Aboriginal people in the past, such as creek confluences, Pleistocene terraces, floodplains or elevated landforms above major watercourses or floodplains. In these areas, site and artefact density are expected to be higher than the surrounding landscape, and sites in these areas may possibly be more complex. Terrain integrity in these areas may be variable although prior ground surface disturbance should be low or non-existent. An important characteristic of areas of high archaeological potential is the research potential or the capacity of sites to provide valuable information on past Aboriginal land use.

5. SITE INSPECTION & RESULTS

A pedestrian inspection of the project area was undertaken on 24 June 2024 by Steve Randall (DLALC), and Garth Thompson (Virtus Heritage), assisted by Anya Graubard (Virtus Heritage). The inspection aimed to identify and assess any potential Aboriginal archaeological sites and/or cultural heritage constraints within the project area The site inspection team were also met by Morsen Group representatives Peter Morson, Joshua West, Joyce Ting were on site to discuss the project design and impacts as part of this project's Connecting with Country consultation process.

Overall, the archaeological inspection aimed to:

- confirm the desktop environment context (e.g. soils, geology, and vegetation, see above).
- identify landscape features within the project area and record landscape elements that may have potential for cultural heritage.
- confirm the past land use and disturbance history within the project area.
- test the archaeological predictive model; and
- identify and record cultural heritage sites.

The following methodology was implemented:

- the inspection focussed on areas of proposed impacts.
- inspection focussed on ground surfaces with higher archaeological visibility.
- where possible the inspection looked for:
  - exposure and washout areas to try and understand soils and potential for artefacts.
  - mature trees for evidence of cultural modification (if any).
  - sandstone bedrock (if any) for evidence of grinding grooves; and
  - any stone outcrops for evidence of quarrying.
- recording the different types of surface exposures (e.g. vehicle tracks, ploughing, cattle), previous land use history and disturbance, natural features (e.g. presence of sandstone), soils, erosion, ground surface visibility, and geomorphic.
- mapping and recording all identified Aboriginal sites and/or PADs within the project area using a mapping software on a tablet device.

5.1 SITE INSPECTION RESULTS

No Aboriginal objects or places were identified within the project area during the site inspection. Soil exposures found around the proximity of the project area confirmed the soils to be a yellowish-brown clayey sand (see **Figure 8**). Ground surface visibility in the project area was extremely limited (<1%) due to the high level of non-native grass (see **Figures 9-10**). All mature trees within the project area were identified as non-native species (see **Figure 9**). The inspection confirmed that the project area had undergone extensive ground disturbance associated with the construction of the existing houses, and landscaping works that had levelled the project area in association with previous site developments (see **Figures 10-13**). Further impacts were identified in water piping associated with a protruding irrigation tap on the western lawn, and a water tank identified in the middle lawn (see **Figures 12-13**). These impacts also suggest underlying piping is present within the project area and impacts associated with their construction have previously taken place.

Figure 8. Soil exposure within the project area.

Figure 9. Exotic trees within the project area (right) compared to native trees outside project area (left).

Figure 10. Buildings present and levelled landscape from north-west corner of project area.

Figure 11. Building present and levelled landscape from north-east corner of project area.

Figure 12. Irrigation tap identified in western project area.

Figure 13. View to roofed-water tank in central project area.

During the site inspection Steve Randall commented that the project area had been extensively disturbed by previous activities evident during the site inspection. Steve also commented on sites being identified west, north and south of the project area, in association with sand lenses in close proximity to the Nepean River.

The impacts associated with the housing development, underlying infrastructure and landscaping works visible during the site inspection indicate a high level of disturbance has taken place within the A-horizon of sediment throughout the project area. Deeper sediment remains largely undisturbed. The likelihood of Aboriginal objects decreases with distance from water, with the nearest watercourses greater than 500m away.

The project area, located within the predicted boundary of the Penrith Unit of the Cranebrook Terrace, is considered to have moderate potential for infrequent occurrences of Aboriginal objects. These objects may be displaced due to the level of disturbance to the project area identified by the visual inspection.

6. DUE DILIGENCE PROCESS AND REQUIREMENTS

NSW Environment and Heritage (formerly DECCW) have set out the steps under the due diligence process where further impact assessment and an Aboriginal Heritage Impact Permit may be required.

Applying the generic due diligence process for this project, Table 5 provides the steps for further management advice based on the information provided on project impacts, consultation to date, relevant archaeological and environmental background research, and the results of the site inspection.

Table 5. Generic Due Diligence Process Applied to the Project Description.

Due Diligence CoP Process	Comment	Further steps following the due diligence process
Step 1: Will the activity disturb the ground surface?	Yes The proposed scope of works will disturb the ground surface. Refer to **Section 1.2** and **Appendix B.**	If Yes, Go to Step 2.
Step 2a: AHIMS Search	No. A search of the AHIMS database did not find any previously recorded sites within the search area (refer to **Section 4**).	
Step 2b: Are there any other sources of information of which a person is already aware?	Yes This assessment has considered the results of previous archaeological excavations and monitoring of the Penrith Unit of the Cranebrook Terrace and in the local region by Kohen 1997, Insite Heritage 2005 and Comber 2006, 2008, 2017, 2018 and geomorphic assessments undertaken by Nanson et al 1987, Mitchell 2010 and Williams et al 2017 where Aboriginal objects were identified in association with the Penrith Unit, as well as PLDC 2011 and AHIP C0001415 (AHIMS 3891).	If yes to any, Go to Step 3
Step 2c: Are there landscape features that are likely to indicate presence of Aboriginal objects?	The project area is located within the Cranebrook Terrace, a sensitive alluvium landform with known associations with Aboriginal objects. The project area's topsoils have been impacted by a continued history of agricultural use, vegetation clearance and levelling of the block for the installation of irrigation pipes. Previous assessments including PLDC 2011 and AHIP C0001415 (AHIMS 3891) note the potential for a low-density distribution of Aboriginal objects and in-situ geomorphology in the project area. Refer to **Section 4.3 and 4.4** for a Predictive Model.	If yes to any, Go to Step 3
Step 3. Can you avoid harm to the object or disturbance of the landscape feature?	No. The project area will be impacting on the landscape of the Nepean flood-plain and Cranebrook Terrace which cannot be avoided by project design.	If No, Go to Step 4
Step 4: Does a desktop assessment and visual inspection confirm that there are Aboriginal objects or	Yes. Whilst there were no Aboriginal objects or places identified within the project area during the visual inspection, the project area is within the predicted boundary of the Penrith Unit of the	Further investigation is required.

Due Diligence CoP Process	Comment	Further steps following the due diligence process
that they are likely?	Cranebrook Terrace. This geological unit is associated with Aboriginal artefacts to depths of 1.3m below the ground surface. The likelihood of Aboriginal objects decreases with distance from water, with the nearest watercourses greater than 500m away. The project area is considered to have moderate potential for infrequent occurrences of Aboriginal objects. These objects may be displaced due to the level of disturbance to the project area.	

Aboriginal objects are protected under the *National Parks and Wildlife Act 1974*. Where Aboriginal objects are considered likely within the project area or there is uncertainty as to whether Aboriginal objects may be present, the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (2010) and the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* state that further consultation and investigation are required.

Any further investigation and assessment are typically documented in an Aboriginal Cultural Heritage Assessment (ACHA) report. An ACHA is undertaken to understand the Aboriginal cultural values of the project area explore the harm of a proposed activity on Aboriginal objects and values and to clearly set out which impacts are avoidable, and which are not. An ACHA details the results of the assessment and recommendations for actions to be taken before, during and after an activity to manage and protect Aboriginal objects. The ACHA is a requirement to support an Aboriginal Heritage Impact Permit if harm to Aboriginal objects cannot be avoided.

The desktop assessment and site inspection did not identify Aboriginal objects within the project area but found a reasonable potential for Aboriginal objects to occur within the project area at low frequencies and with low archaeological integrity. The proposed activity therefore has the potential to harm Aboriginal objects.

The assessment noted that across the Cranebrook Terrace and Penrith Lakes Scheme there has been a management trend towards area-wide AHIPs across the Penrith Lakes Scheme to manage the residual risk of Aboriginal objects irrespective of the identification of sites, particularly in those areas not historically impacted by sand quarrying (Kohen 1986-2004, AHIP C0001415, AHIP 1131345, Comber 2017)

The following recommendations have been made based on the information provided on project impacts, consultation to date, relevant archaeological and environmental background research, the requirements of the *National Parks and Wildlife Act 1974*, *National Parks and Wildlife Regulation 2019*, the *Heritage Act 1977* and the results of the site inspection:

1. Further consultation and investigation are warranted given the moderate potential for Aboriginal objects in low frequencies and with low archaeological integrity.

2. An Aboriginal Cultural Heritage Assessment (ACHA) must be undertaken in accordance with the Guide *to investigating, assessing and reporting on Aboriginal cultural heritage in NSW, Code of Practice for Archaeological Investigation of Aboriginal objects in NSW* and *Aboriginal Cultural Heritage Consultation Requirements for Proponents.*

   The ACHA should consider the geomorphology of the project area and consider the need for test excavation in consultation with the Registered Aboriginal Parties and Heritage NSW.

3. Where harm to Aboriginal objects and areas likely to contain Aboriginal objects and cultural values cannot be avoided, an Aboriginal Heritage Impact Permit will be required prior to works commencing, supported by the ACHA.

4. Unexpected Find Procedure

It is recommended that an Unexpected Finds Procedure be implemented for the duration of the project. In the event that a suspected Aboriginal object/s is identified the procedure should include the following:

- Works are to stop immediately.
- The area of the suspected find/s is to be fenced off with an appropriate buffer and protected.
- A qualified archaeologist and representative of DLALC are to be contacted to inspect the area and the nature of the find.
- Representative of DLALC to determine the find's significance, in consultation with a qualified archaeologist or NSW Environment and Heritage, and the requirement for an Aboriginal Heritage Impact Permit (AHIP).
- Works are not to proceed until written advice is provided from the archaeologist or NSW Environment and Heritage on the appropriate management of the find.

5. Unexpected Human Remains Procedure

It is recommended that an Unexpected Human Remains procedure be implemented for the duration of the project. In the unlikely event that suspected Human Remains are identified the procedure should include the following:

- Works are to stop immediately.
- The area of the suspected Human Remains find is to be secured and cordoned off.
- NSW Police are to be notified. No further works can be undertaken until the NSW Police provide written advice.
- If these remains are deemed to require archaeological investigation by the NSW Police or NSW Coroner, then:
- NSW Environment and Heritage and the relevant Aboriginal parties must be notified; and
- a plan of management for the preservation of any identified Aboriginal human remains of for the salvage must be put in place or conducted under an AHIP methodology and variation developed in consultation with all relevant Aboriginal parties and the NSW Environment and Heritage.
- Works are not to proceed until written advice is provided from the archaeologist or NSW Environment and Heritage.

6. Induction

It is recommended that all site workers and personnel involved in site impact works should be inducted and briefed on the possible identification of Aboriginal sites and objects during construction and their responsibilities according to the provisions of the NPW Act 1974 and NPW Regulation 2019 in the unlikely event that unknown objects or items are uncovered during proposed works.

This induction package should be developed in consultation with DLALC, prior to works proceeding. The induction must include:

- The contact phone numbers of the NSW Environment and Heritage regional archaeologist, EnviroLine 131 555, and DLALC.
- The relevant contact phone number Environmental Officer responsible for this project in case unknown objects or items are uncovered during excavation.
- The penalty for moving Aboriginal objects need to be made clear and given due consideration.
- An outline types of unexpected heritage objects, items & relics, and their legal protection
    - The Unexpected Finds and Human Remains Procedures, as outlined in Recommendation 1 and 2.

REFERENCES

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Appendix A. Legislation

This section provides a summary of relevant legislation for the consideration of Aboriginal cultural heritage within the project area.

The *National Parks and Wildlife Act 1974* (NPW Act), the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Heritage Act 1977* are the relevant statutory controls protecting Aboriginal heritage within New South Wales. Details on these key pieces of legislation are provided below.

Environmental Planning and Assessment Act 1979 (EP&A Act)

The EP&A Act requires that environmental impacts are considered in land use planning and decision-making. The definition of 'environmental impacts' includes impacts on the cultural heritage of the project area. The Act sets out specific statutory assessment processes including:

- Part 4: Development that requires consent under consideration of environmental planning instruments.
- Part 5: An assessment process for activities undertaken by public authorities and for developments that do not require development consent but an approval under another mechanism.

The EP&A Act also gives statutory force to planning instruments. Environmental planning instruments (such as state environmental planning policies, regional environmental plans, and local environmental plans) are legal documents that regulate land use and development.

National Parks and Wildlife Act 1974 (NPW Act)

Under the provisions of the NPW Act, all Aboriginal objects are protected regardless of their significance or land tenure. Aboriginal objects are defined as *'any deposit, object, or material evidence (not being a handicraft made for sale) relating to Aboriginal habitation of the area that comprises NSW, being habitation before or concurrent with the occupation of that area by persons of non-Aboriginal extraction and includes Aboriginal remains'.*

Aboriginal objects are therefore limited to physical evidence and may also be referred to as 'Aboriginal sites', 'relics' or 'cultural material'. Aboriginal objects can include pre-contact features such as scarred trees, middens, and artefact scatters, as well as physical evidence of post-contact use of the area such as Aboriginal built fencing or stockyards and missions.

The NPW Act also protects Aboriginal Places, which are defined as *'a place that is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects'.* Aboriginal Places can only be declared by the Minister administering Part 6 of the NPW Act. The NPW Act protects Aboriginal objects and Aboriginal places in NSW. Under the *National Parks and Wildlife Act 1974* (NPW Act), and *National Parks and Wildlife Regulation 2019*, it is an offence to harm or desecrate an Aboriginal object:

- which the person knows is an Aboriginal object (a 'knowing offence'); and
- whether or not a person knows it is an Aboriginal object (a 'strict liability offence').

From 1 October 2010, the maximum penalty for a knowing offence is $550,000 (5000 penalty units) or imprisonment for 2 years or both for an individual or $1.1 million for a corporation. The maximum penalty for unknowingly harming offence is $110,000 (1000 penalty units) for an individual or $220,000 (2000 penalty units) for a corporation (DECCW 2010:5). A person or organisation who exercises due diligence in reasonably determining that their actions would not harm Aboriginal objects as a defence against prosecution for the s.86(2) offence if they later unknowingly harm an object without an AHIP (DECCW 2010:5). The due diligence defence (s.87(2)) is not available as a defence for any actions which harm or desecrate an Aboriginal place.

The Due Diligence Code of Practice sets out a procedure which, when followed, will satisfy the due diligence requirement. If a person or company can demonstrate that they exercised due diligence and determined that it was unlikely that Aboriginal objects would be harmed, then they have a defence to prosecution under Section 86(2) of the NPW Act (DECCW 2010:5).

Harm includes activities that destroy, deface, or damage an Aboriginal object or an Aboriginal Place, and in relation to an object, moving the object from the land on which it has been situated. Under s.89A (formerly Section 91) of the Act, the Chief Executive (*now the Secretary of Department of Planning and Environment (DPE). NSW Environment and Heritage in the DPE)* must be informed upon the identification of all Aboriginal Objects. Failure to do this within a reasonable time is an offence under the Act. Under Section 87 of the Act, it is a defence for a person to destroy, deface, damage, or desecrate an Aboriginal Object or Aboriginal Place with a valid Aboriginal Heritage Impact Permit (AHIP) issued under section 90 of the Act. Aboriginal Heritage Impact Permits are issued by NSW Environment and Heritage, DPE. Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to harm them. If harm to Aboriginal objects and places is anticipated an Aboriginal Heritage Impact Permit should be sought as a defence.

The NPW Act also provides for stop-work orders under Part 6A Division 1 if an action is likely to significantly affect an Aboriginal Object or Aboriginal Place. The order may require that an action is to cease or that no action is carried out in the vicinity of the Aboriginal Object or Aboriginal Place for a period of up to 40 days.

Heritage Act 1977

The Heritage Act, 1977 (as amended in 2009) protects and aims to conserve the environmental heritage of New South Wales. Environmental heritage is broadly defined under Section 4 of the Heritage Act as consisting of "those places, buildings, works, relics, moveable objects, and precincts, of State or local heritage significance" (Heritage Branch, DoP 2009:4). Aboriginal places or objects that are recognized as having high cultural value (potentially of local and State significance) can be listed on the State Heritage Register and protected under the provisions of the Heritage Act.

Amendments to the Heritage Act made in 2009 have changed the definition of an archaeological 'relic' under the Act, so that it is no longer based on age. A relic is now an archaeological deposit, resource or feature that has heritage significance at a local or State level. This significance-based approach to identifying 'relics' is consistent with the way other heritage items such as buildings, works, precincts or landscapes are identified and managed in NSW (Heritage Branch, DoP 2009:1). Section 4(1) of the Heritage Act (as amended 2009) defines 'relic' as follows:

> **Relic** *means any deposit, artefact, object, or material evidence that:*
> *a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
> *b) is of State or local heritage significance (Heritage Branch, DoP, 2009:6).*

Native Title Legislation

The Native Title Act 1993 (NTA) provides the legislative framework to:

- recognise and protect native title.
- establish ways in which future dealings affecting native title may proceed and to set standards for those dealings, including providing certain procedural rights for registered native title claimants and native title holders in relation to acts which affect native title.
- establish a mechanism for determining claims to native title.
- provide for, or permit, the validation of past acts invalidated because of the existence of native title.

The *NSW Native Title Act 1994* was introduced to make sure the laws of NSW are consistent with the Commonwealth's NTA on future dealings. It validates past and intermediate acts that may have been invalidated because of the existence of native title.

The National Native Title Tribunal has a number of functions under the NTA, including maintaining the Register of Native Title Claims, the National Native Title Register and the Register of Indigenous Land Use Agreements and mediating native title claims.

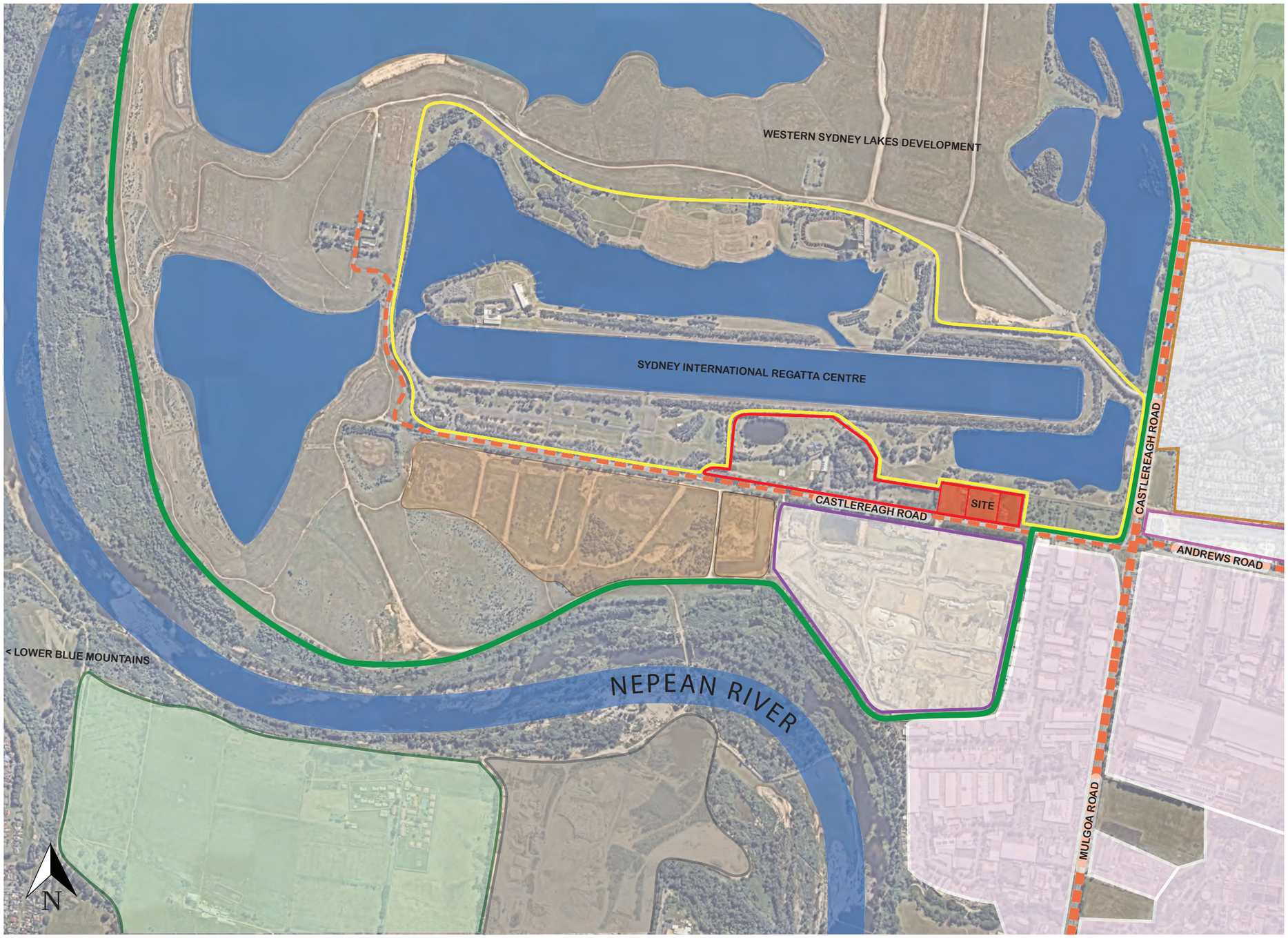
Other Acts

The Australian Government *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* may be relevant if any item of Aboriginal heritage significance to an Aboriginal community or historical heritage is under threat of injury or desecration and state-based processes are unable to protect it. The *Environment Protection and Biodiversity Conservation Act 1999* is relevant to projects where there are heritage values of national significance present.

Appendix B. Project Concept Plans

INTRODUCTION PAGE 1:1500

IMMEDIATE SITE CONTEXT DIAGRAM



RURAL AREA

QUARRY

INDUSTRIAL AREA

MOUNTAIN VIEW RESERVE

DEVELOPMENT SITE AREA

PENRITH LAKE SYSTEM

DETENTION BASIN & WETLANDS

PENRITH LAKES BOUNDARY

TOURISM SOUTH PRECINCT BOUNDARY

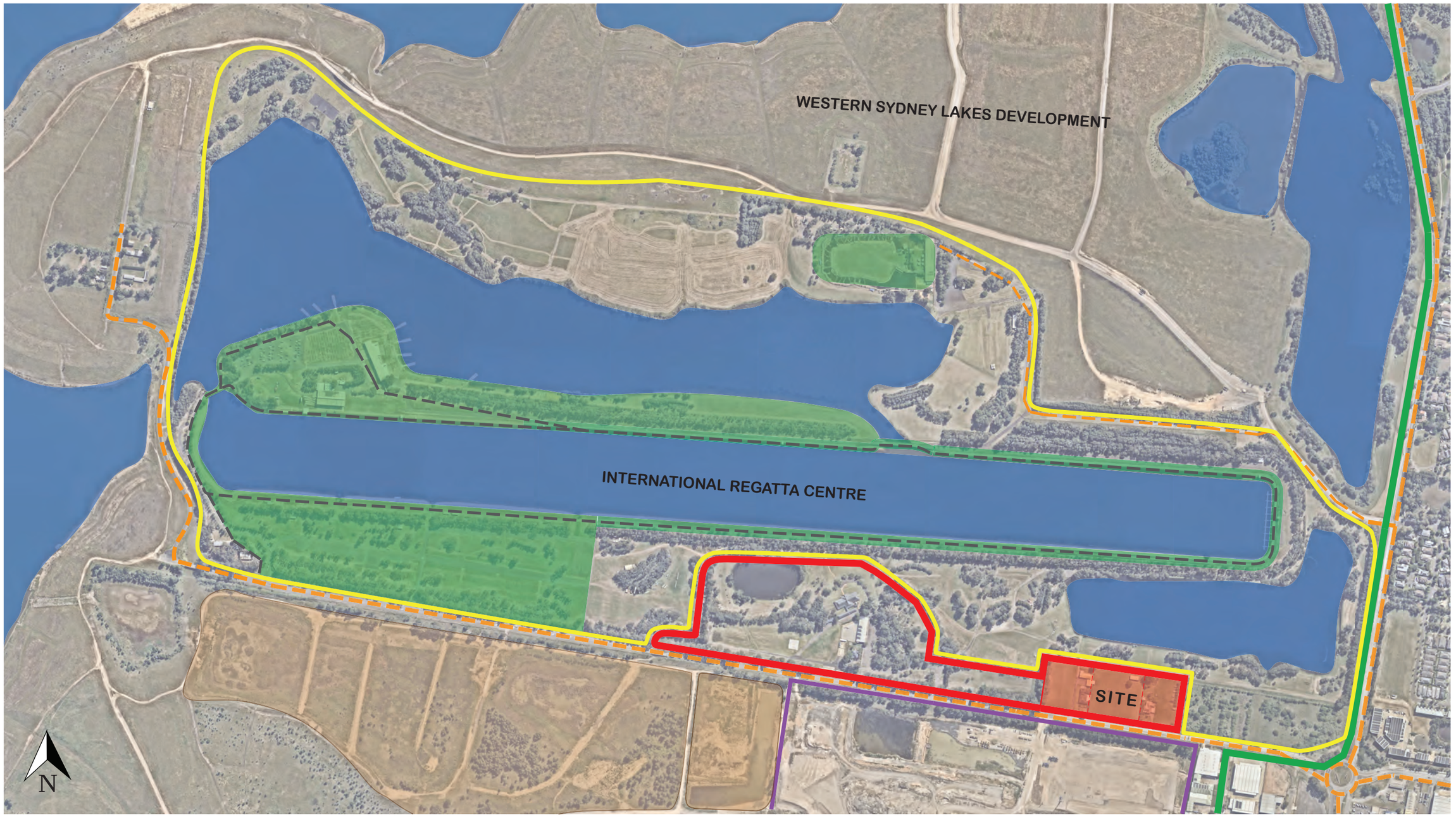
REGATTA CENTRE BOUNDARY

NEPEAN BUSINESS PARK BOUNDARY

RESIDENTIAL ZONING BOUNDARY

ROAD NETWORK

PENRITH LAKES TOURISM SOUTH PRECINCT 1:3000



REGATTA CENTRE PUBLIC OPEN SPACE / WHITE WATER RAFTING AND OLYMPIC ASSET

DEVELOPMENT SITE AREA

DETENTION BASIN & WETLANDS

PENRITH LAKE SYSTEM

ROAD NETWORK

TOURISM SOUTH PRECINCT BOUNDARY

REGATTA CENTRE BOUNDARY

NEPEAN BUSINESS PARK BOUNDARY

PENRITH LAKES BOUNDARY

REGATTA CENTRE WALKING / CYCLING PATH

BROAD SITE CONTEXT AND CONNECTIONS

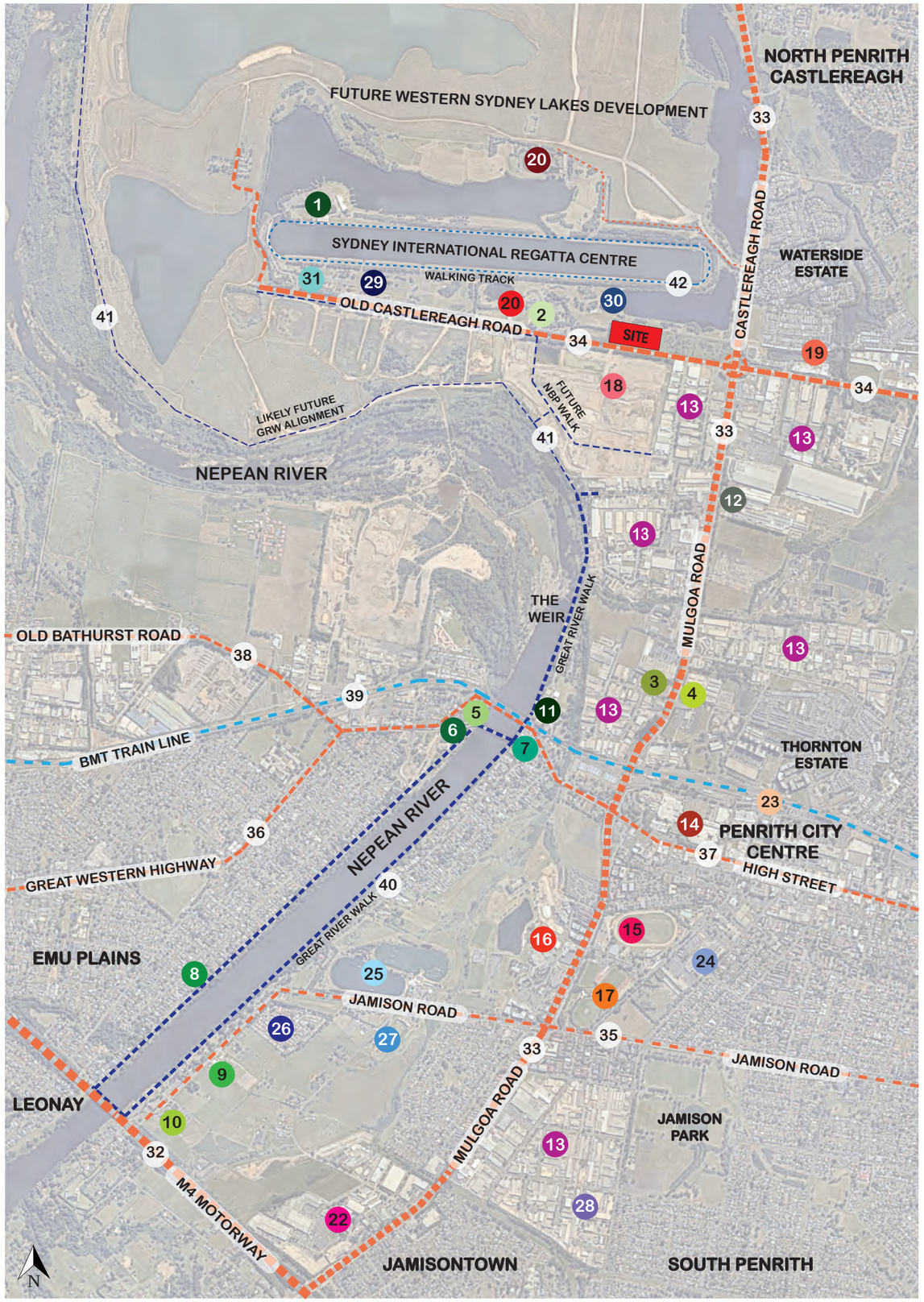
MAP LEGEND

RECREATION / ENTERTAINMENT

- NEPEAN SQUARE SHOPS 24
- WAKE PARK 25
- RETIREMENT VILLAGE 26
- DRIVING RANGE 27
- ENTERTAINMENT PRECINCT 28
- MODEL CARS RACING / STAY UPRIGHT MOTORBIKE TRAINING 29
- MODEL BOAT CLUB / JETPACK ADVENTURES SYDNEY 30
- PENRITH LAKES ENVIRONMENTAL EDUCATION CENTRE 31

SIGNIFICANT ROAD AND PATH NETWORK

- M4 MOTORWAY 32
- MULGOA ROAD / CASTLEREAGH ROAD 33
- ANDREWS / OLD CASTLEREAGH ROAD 34
- JAMISON ROAD 35
- GREAT WESTERN HIGHWAY 36
- HIGH STREET 37
- OLD BATHURST ROAD 38
- BMT TRAIN LINE 39
- GREAT RIVER WALK 40
- GREAT RIVER WALK POSSIBLE EXTENSION 41
- REGATTA CENTRE WALKING CIRCUIT 42



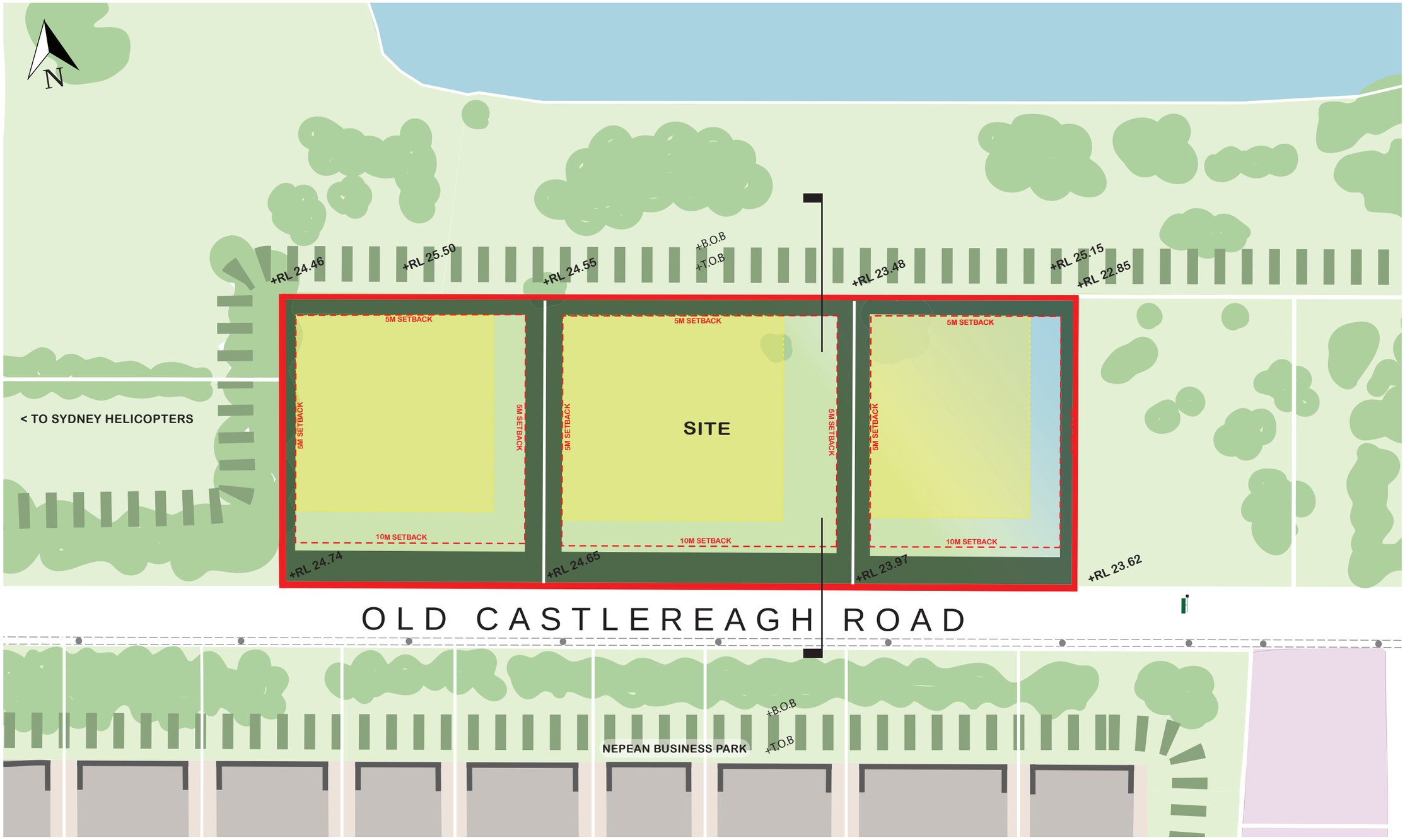
FOOD / ENTERTAINMENT

- 1 LAKESIDE RESTARAUNT
- 2 LONGS HOUSE CAFE
- 3 PEACHTREE RESTARAUNT
- 4 FAST FOOD OUTLETS
- 5 EMU HALL RESTAURANT
- 6 LAUGHING BOY CAFE
- 7 LOG CABIN RESTARAUNT / PUB
- 8 LEWERS GALLERY AND CAFE
- 9 THE ORCHARD RESTARAUNT
- 10 THE EASTBANK FOOD PRECINCT
- 11 THE ROWING CLUB / RESTAURANT
- 12 THE MANUFACTURER PRECINCT

SIGNIFICANT DEVELOPMENTS

- 13 INDUSTRIAL ZONES
- 14 PENRITH CITY CENTRE
- 15 PACEWAY ENTERTAINMENT PRECINCT
- 16 PANTHERS LEAGUES CLUB PRECINCT
- 17 PANTHERS STADIUM SPORTS PRECINCT
- 18 NEPEAN BUSINESS PARK
- 19 WATERSIDE BUSINESS PRECINCT
- 20 WHITE WATER RAFTING
- 21 SYDNEY HELICOPTERS
- 22 PENRITH HOMEMAKER CENTRE
- 23 PENRITH TRAIN STATION

PENRITH LAKES LEP/DCP PLANNING FRAMEWORK PLAN 1:1500



LAKE

TREES & TURFED AREAS

INDUSTRIAL AREA

30% LANDSCAPE AREA REQUIRED

50% SITE COVERAGE

1% AEP FLOOD AFFECTED AREA

SITE BOUNDARY

LOT BOUNDARIES & SETBACKS

EMBANKMENT

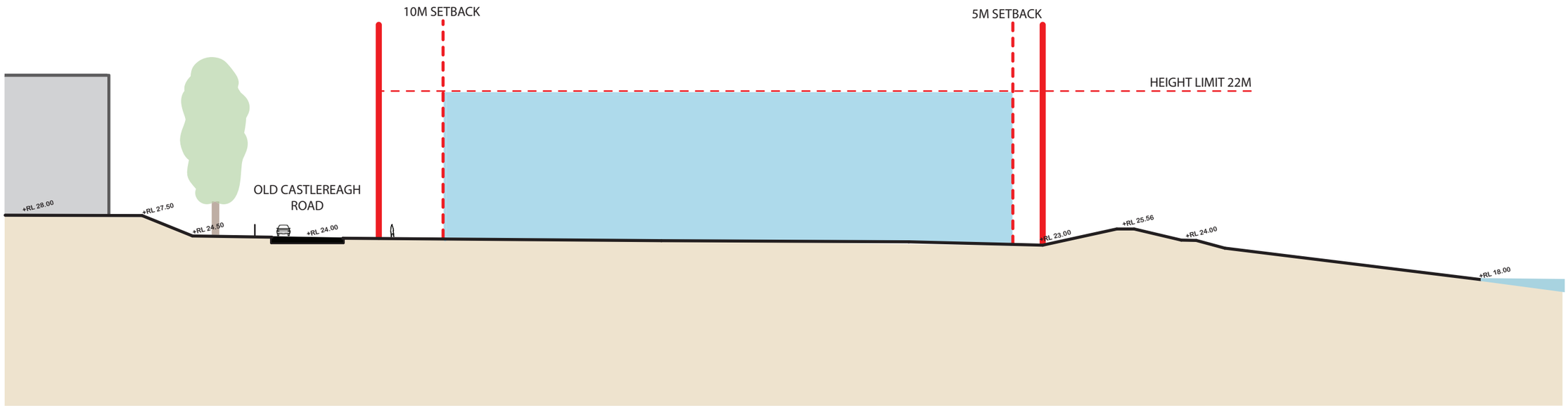
NBP BUILDING FOOTPRINTS

REAR OF NBP BUILDINGS DO NOT HAVE STREET CONNECTION OR ACTIVATION TO OLD CASTLEREAGH RAOD

EXISTING OVERHEAD POWER LINES

EXISTING ROAD DIRECTORY SIGN

PENRITH LAKES LEP/DCP PLANNING FRAMEWORK SECTION 1:750



ALLOWABLE BUILDING VOLUME

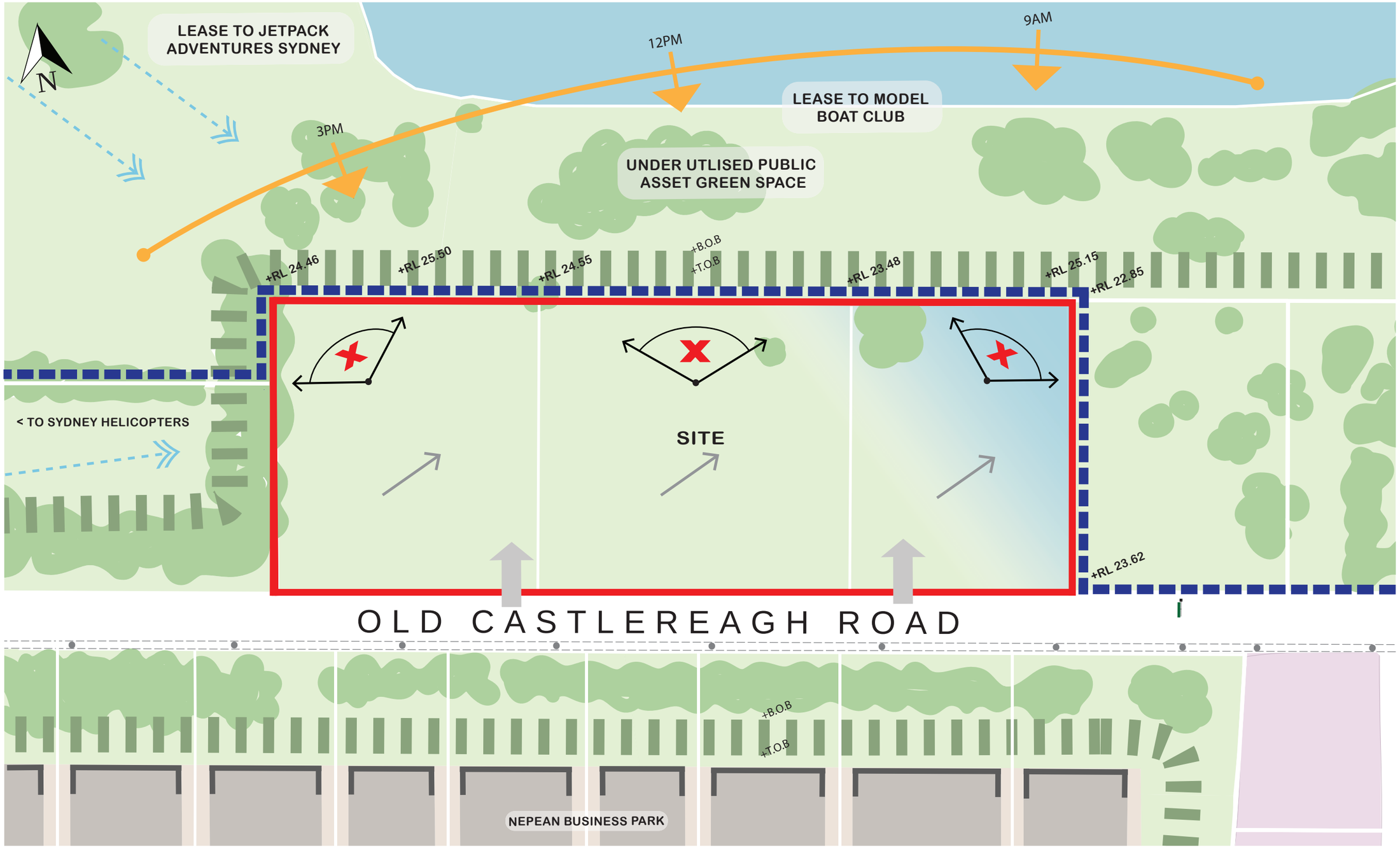
ASSUMED NBP BUILDING VOLUME

SITE BOUNDARY

SETBACK BOUNDARY

EXISTING SITE PHOTOS PANEL

SITE CHARACTERISTICS 1:500



UNDESIREABLE WINDS

FENCE TO INACCESIBLE LAND

EMBANKMENT

1% AEP FLOOD AFFECTED AREA (0.2-0.5M DEEP)

SITE BOUNDARY

LOT BOUNDARIES

NBP BUILDING FOOTPRINTS

REAR OF NBP BUILDINGS DO NOT HAVE STREET CONNECTION OR ACTIVATION TO OLD CASTLEREAGH RAOD

GENTLE SLOPE

VIEW BEYOND EMBANKMENT BLOCKED AT GROUND LEVEL

INDUSTRIAL AREA

TREES & TURFED AREAS

LAKE

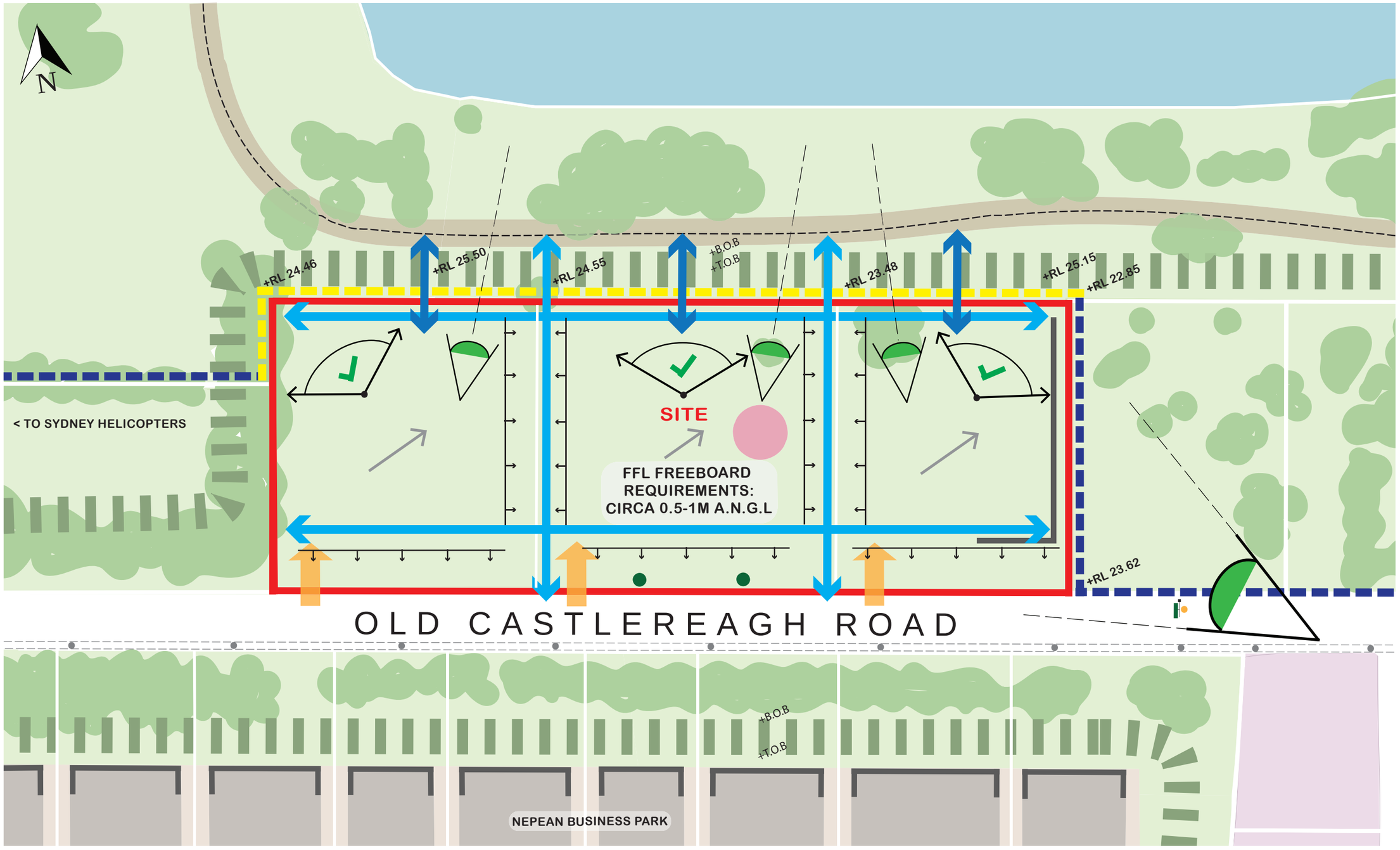
SOLAR ACCESS MID WINTER

EXISTING SITE ETNRY POINTS

EXISTING OVERHEAD POWER LINES

EXISTING ROAD DIRECTORY SIGN

SITE OPPORTUNITIES 1:500



UNDESIREABLE WINDS

GRANTED ACCES TO PUBLIC LAND. (SUBJECT TO DPHI APPROVAL)

EMBANKMENT

POSSIBLE SITE ENTRY POINTS

SITE BOUNDARY

LOT BOUNDARIES

NBP BUILDING FOOTPRINT

PUBLICALLY ACCESSIBLE CYCLING & WALKING TRACK

REAR OF NBP BUILDINGS DO NOT HAVE STREET CONNECTION OR ACTIVATION TO OLD CASTLEREAGH RAOD

GENTLE SLOPE

VIEW BEYOND EMBANKMENT ACCESIBLE FROM 4.5M HIGH

INDUSTRIAL AREA

LAKE

TREES & TURFED AREAS

PROMINANT DEVELOPMENT VISIBILITY

PROMINENT VISUAL FOCAL POINTS

WALKING ACCESSIBLE BEYOND 3M HIGH

SENSE OF ARRIVAL POSITION

ACTIVE EDGE

SIGNAGE OPPORTUNITIES

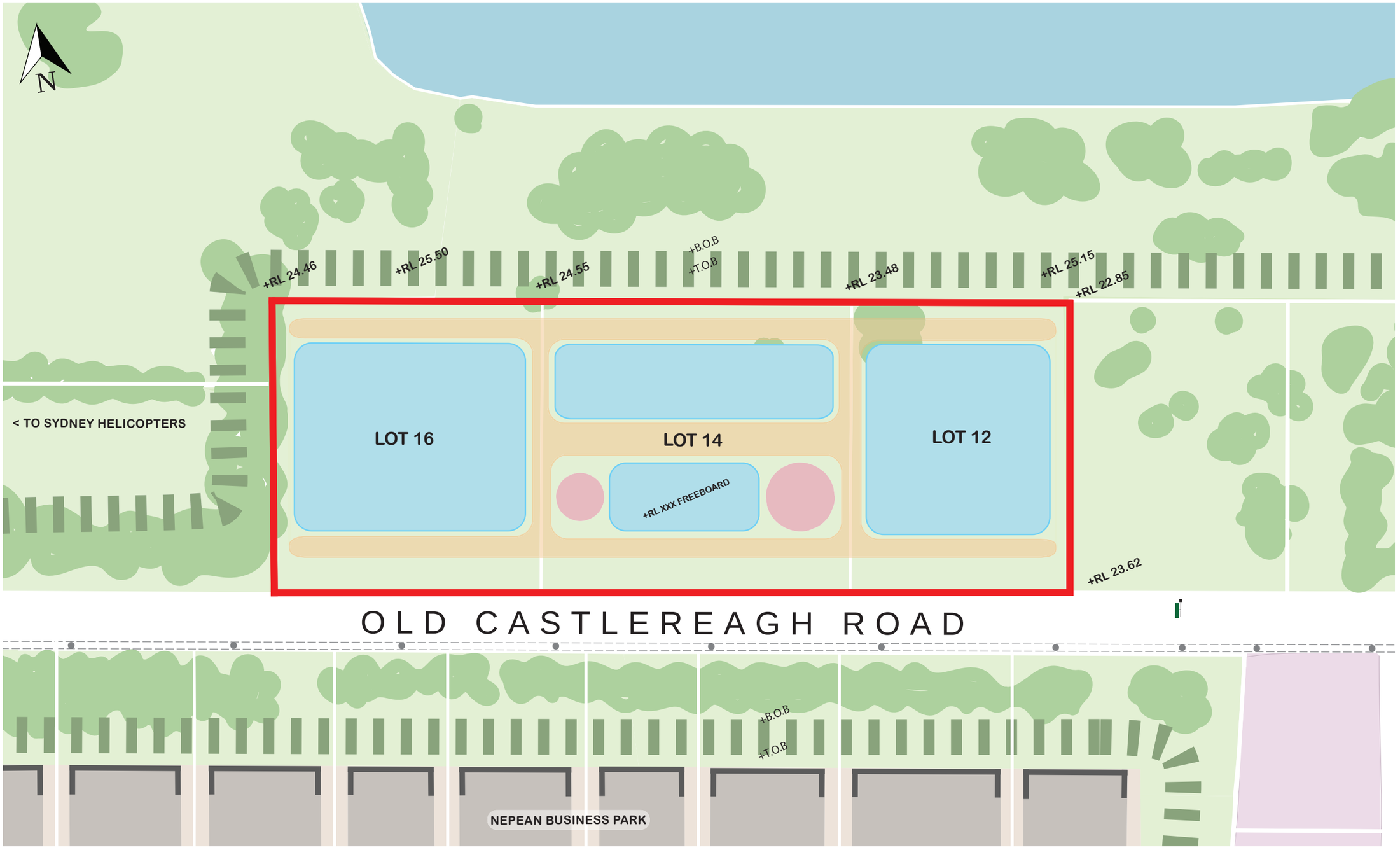
POSSIBLE THROUGH-SITE CONNECTIONS

EXISTING OVERHEAD POWER LINES

PROPOSED ROAD DIRECTORY SIGN

PROMINENT CORNER OF DEVELOPMENT

SITE POSSIBLE BUILDING FOOTPRINT 1:500



EMBANKMENT

SITE BOUNDARY

LOT BOUNDARIES

INDUSTRIAL AREA

LAKE

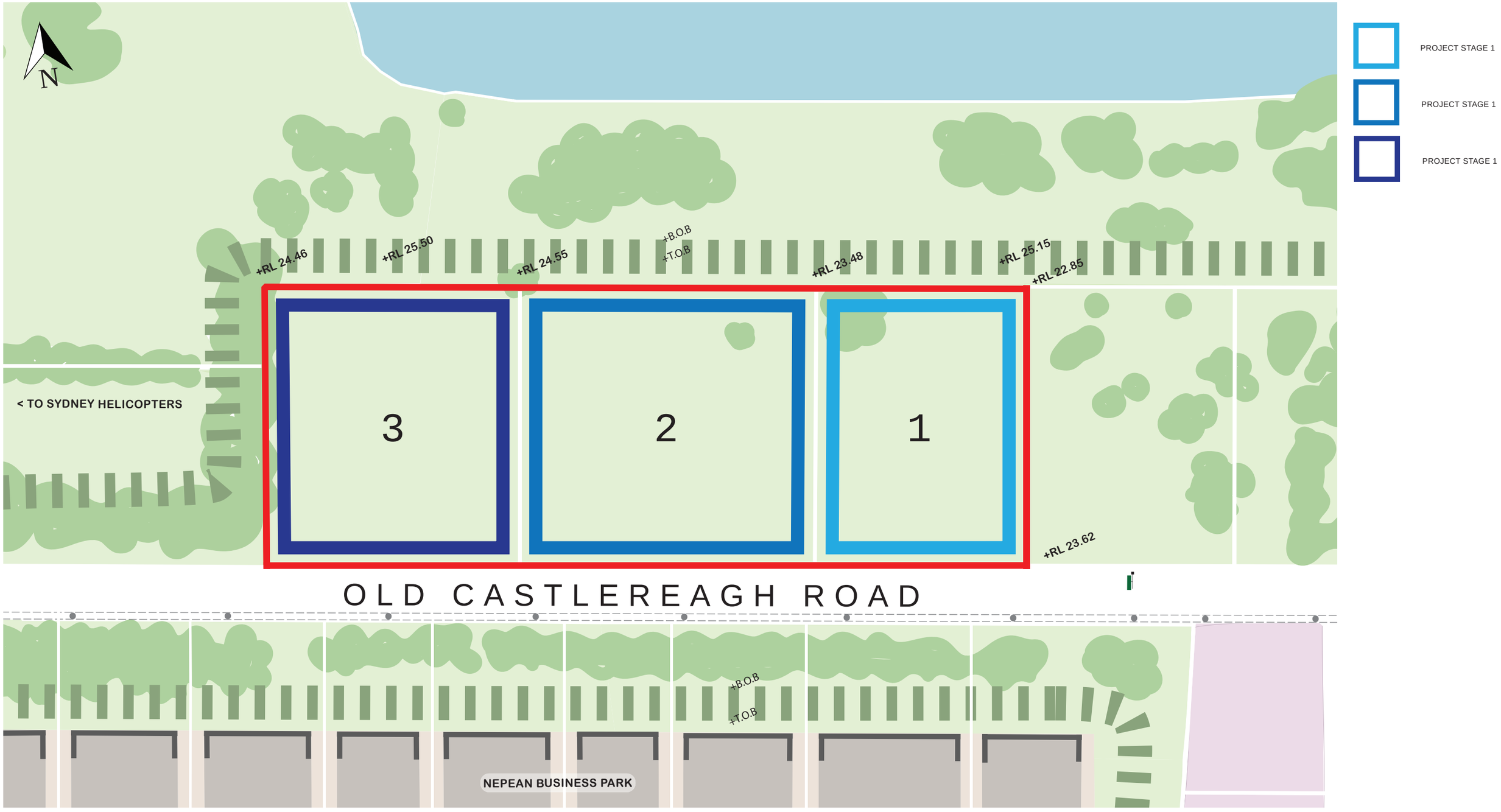
TREES & TURFED AREAS

POSSIBLE BUILDABLE AREA

POSSIBLE PEDESTRIAN CIRCULATION

SENSE OF ARRIVAL POSITION

SITE PHASING 1:500



Appendix C. AHIMS Search Results

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 537 Penrith

Client Service ID : 912988

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-5-0541	RP5 Penrith Leagues Club	AGD	56	285350	6262560	Open site	Valid	Artefact : -	Open Camp Site	102450,103155,103360
	Contact	**Recorders**	Elizabeth Rich					**Permits**		
45-5-0790	Jamison_and Blaikie Roads;	AGD	56	284750	6261800	Open site	Valid	Artefact : -	Open Camp Site	1633,103155,103360
	Contact	**Recorders**	Pam Dean-Jones					**Permits**		
45-5-0493	Emu Plains (EP/1 P/3)	AGD	56	281830	6262460	Open site	Valid	Artefact : -	Open Camp Site	1018
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0222	Jamisons Creek Emu Plains	AGD	56	282220	6262184	Open site	Valid	Artefact : -	Open Camp Site	822
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-5379	SMDS Basin I Area 06 PAD	GDA	56	288770	6265160	Open site	Valid	Artefact : -, Potential Archaeological Deposit (PAD) : -		
	Contact	**Recorders**	GML Heritage Pty Ltd - Surry Hills,Ms.Sophie Jennings					**Permits**		
45-5-0333	Penrith Lakes 23	AGD	56	285375	6269289	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018
	Contact	**Recorders**	Jim Kohen					**Permits**	872	
45-5-0070	Lapstone Creek (Emu Plains)	AGD	56	282116	6262822	Open site	Valid	Artefact : -	Open Camp Site	527
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-3598	ADI: FF/30 (Springwood)	GDA	56	288835	6265442	Open site	Valid	Artefact : 1		102155,102450
	Contact	**Recorders**	Jo McDonald Cultural Heritage Management see GML					**Permits**		
45-5-3599	ADI: FF/31 (Springwood)	GDA	56	288950	6265366	Open site	Valid	Artefact : 19		102450
	Contact	**Recorders**	Jo McDonald Cultural Heritage Management see GML					**Permits**		
45-5-5019	Union Street Penrith	GDA	56	285850	6262985	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		103872
	Contact	**Recorders**	Comber Consultants Pty Limited,Comber Consultants Pty Limited,Ms.Alandra Tasir					**Permits**	4477	
45-5-5191	Museum Drive Penrith AFT 1	GDA	56	285973	6263538	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Kelleher Nightingale Consulting Pty Ltd,Mr.Benjamin Anderson					**Permits**		
45-5-4568	Escarpment 01 AS	GDA	56	285284	6269516	Open site	Valid	Artefact : -, Potential Archaeological Deposit (PAD) : -		
	Contact	**Recorders**	GML Heritage Pty Ltd - Surry Hills,Doctor.Tim Owen					**Permits**		
45-5-0591	Penrith Lakes 30	AGD	56	284230	6266400	Open site	Valid	Artefact : -	Open Camp Site	1064,102450
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0522	Penrith P/1	AGD	56	285520	6263940	Open site	Valid	Artefact : -	Open Camp Site	1018,102450,103155,103360
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-3797	Cranebrook Escarpment 2 (CE2)	GDA	56	285400	6269650	Open site	Valid	Artefact : 100		101748
	Contact	**Recorders**	Comber Consultants Pty Limited					**Permits**		

Report generated by AHIMS Web Service on 24/07/2024 for Clare Anderson for the following area at Datum :GDA, Zone : 56, Eastings : 281848.0 - 289036.0, Northings : 6261482.0 - 6270558.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 85

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 537 Penrith

Client Service ID : 912988

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-5-5238	Andrews Road PAD 1	GDA	56	286905	6264763	Open site	Destroyed	Artefact : -		104180
	Contact	**Recorders**	Biosis Pty Ltd - Wollongong,Biosis Pty Ltd - Wollongong,Mrs.Samantha Keats,Mrs.S					**Permits**	4518	
45-5-2414	L1 (Penrith Lakeside Village)	GDA	56	286799	6266617	Open site	Valid	Artefact : -	Open Camp Site	102450,104180
	Contact	**Recorders**	Mary Dallas Consulting Archaeologists (MDCA),Biosis Pty Ltd - Wollongong,Mrs.Sa					**Permits**	939,1694,1803	
45-5-0317	Penrith Lakes 3	AGD	56	284461	6269271	Open site	Valid	Artefact : -	Open Camp Site	256,260,526,1018,105447
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0318	Penrith Lakes 4	GDA	56	283031	6267186	Open site	Valid	Artefact : -	Open Camp Site	256,260,526,1018,105447
	Contact	**Recorders**	Jim Kohen					**Permits**	3891	
45-5-3816	Emu Plains Rail Stabling Yards	GDA	56	284015	6263583	Open site	Destroyed	Artefact : 1		
	Contact	**Recorders**	Doctor.Alan Williams,Doctor.Alan Williams					**Permits**	3485,4823	
45-5-3817	Emu Plains Rail Stabling Yards1	GDA	56	284138	6263601	Open site	Destroyed	Artefact : 1		
	Contact	**Recorders**	Doctor.Alan Williams,Doctor.Alan Williams					**Permits**	3282,4823	
45-5-4302	TNR-3	GDA	56	288545	6265150	Open site	Valid	Artefact : 1		
	Contact	**Recorders**	Doctor.Jo McDonald					**Permits**	3619	
45-5-5730	Nepean River Trail 05	GDA	56	282938	6269016	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Michael Jackson,Jackson Ward Archaeology Pty Ltd					**Permits**		
45-5-5732	Nepean River Trail 07	GDA	56	282948	6269276	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Michael Jackson,Jackson Ward Archaeology Pty Ltd					**Permits**		
45-5-0052	Emu Plains F4-1	AGD	56	281800	6262200	Open site	Valid	Artefact : -	Open Camp Site	100450
	Contact	**Recorders**	Mary Dallas Consulting Archaeologists (MDCA),Elizabeth Rich					**Permits**		
45-5-0592	Penrith Lakes 33	AGD	56	286200	6268200	Open site	Valid	Artefact : -	Open Camp Site	1064
	Contact	**Recorders**	Jim Kohen					**Permits**	847,872,2174	
45-5-0593	Penrith Lakes 32	AGD	56	286250	6267700	Open site	Valid	Artefact : -	Open Camp Site	11,526,1063
	Contact	**Recorders**	Jim Kohen					**Permits**	1067	
45-5-1026	ADI-25;	AGD	56	288880	6264930	Open site	Valid	Artefact : -	Isolated Find	102155,102450,102573
	Contact	**Recorders**	Doctor.Jo McDonald					**Permits**		
45-5-0323	Penrith Lakes 10	AGD	56	284461	6269271	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,105447
	Contact	**Recorders**	Jim Kohen					**Permits**	872	
45-5-0324	Penrith Lakes 11	AGD	56	285357	6270203	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,105447
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0325	Penrith Lakes 12	AGD	56	283546	6269253	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,105447
	Contact	**Recorders**	Jim Kohen					**Permits**		

Report generated by AHIMS Web Service on 24/07/2024 for Clare Anderson for the following area at Datum :GDA, Zone : 56, Eastings : 281848.0 - 289036.0, Northings : 6261482.0 - 6270558.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 85

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 537 Penrith

Client Service ID : 912988

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-5-0328	Penrith Lakes 17	AGD	56	283617	6265596	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0330	Penrith Lakes 19	AGD	56	284496	6267442	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0334	Penrith Lakes 24	AGD	56	287257	6266581	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0336	Penrith Lakes 27	AGD	56	288189	6265685	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-1024	ADI-23	AGD	56	288700	6265510	Open site	Valid	Artefact : -	Isolated Find	102155,102450,102573
	Contact	**Recorders**	Doctor.Jo McDonald,Ms.Jenni Bate					**Permits**		
45-5-5020	Tench Reserve AFT 1	GDA	56	283626	6261646	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor					**Permits**		
45-5-5685	170 Russell Street	GDA	56	282934	6263991	Open site	Valid	Artefact : -		104390
	Contact	**Recorders**	Comber Consultants Pty Limited,Ms.Agata Calabrese					**Permits**		
45-5-5731	Nepean River Trail 06	GDA	56	282951	6269734	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Michael Jackson,Jackson Ward Archaeology Pty Ltd					**Permits**		
45-5-0540	RP4 Peach Tree Creek	AGD	56	284960	6262120	Open site	Valid	Artefact : -	Open Camp Site	103155,103360
	Contact	**Recorders**	Elizabeth Rich					**Permits**		
45-5-0287	Emu Plains (Jamisons Creek)	AGD	56	283052	6261743	Open site	Partially Destroyed	Artefact : -	Open Camp Site	260,1018,103155,103360
	Contact	**Recorders**	Jim Kohen					**Permits**	1423,1842	
45-5-0290	The Island	AGD	56	285661	6263989	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450,103155,103360
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-3796	Cranebrook Escarpment 1 (CE1)	GDA	56	285600	6269450	Open site	Valid	Artefact : 10		101748
	Contact	**Recorders**	Comber Consultants Pty Limited					**Permits**		
45-5-5389	SMDS Basin I AFT 16	GDA	56	288674	6265173	Open site	Valid	Artefact : -		
	Contact	**Recorders**	GML Heritage Pty Ltd - Surry Hills,Ms.Sophie Jennings					**Permits**		
45-5-0327	Penrith Lakes 16	AGD	56	285428	6266546	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450,105447
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0366	Emu Plains Emu Plains 4	AGD	56	285107	6264253	Open site	Valid	Artefact : -	Open Camp Site	1018,102450,103155,103360
	Contact	**Recorders**	Jim Kohen					**Permits**		

Report generated by AHIMS Web Service on 24/07/2024 for Clare Anderson for the following area at Datum :GDA, Zone : 56, Eastings : 281848.0 - 289036.0, Northings : 6261482.0 - 6270558.0 with a Buffer of 0 meters.. Number of Aboriginal sites and Aboriginal objects found is 85

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-5-3904	EPRSY 3(PAD)	GDA	56	284000	6263615	Open site	Destroyed	Artefact : -, Potential Archaeological Deposit (PAD) : -		103762
	Contact	**Recorders**	Doctor.Alan Williams,Doctor.Alan Williams,Ms.Georgia Burnett					**Permits**	3485,4823	
45-5-5021	Tench Reserve IF 1	GDA	56	283452	6261519	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Kelleher Nightingale Consulting Pty Ltd,Miss.Kristen Taylor					**Permits**	4528	
45-5-1025	ADI-24;	AGD	56	288540	6264980	Open site	Valid	Artefact : -	Isolated Find	102155,102450
	Contact	**Recorders**	Doctor.Jo McDonald					**Permits**		
45-5-5484	Emu Plains Railway AFT	GDA	56	284068	6263560	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Matthew Barber,NGH Heritage - Fyshwick					**Permits**		
45-5-5728	Nepean River Trail 03	GDA	56	282727	6267103	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Michael Jackson,Jackson Ward Archaeology Pty Ltd					**Permits**		
45-5-5390	SMDS Basin I AFT 15	GDA	56	288860	6265155	Open site	Valid	Artefact : -		
	Contact	**Recorders**	GML Heritage Pty Ltd - Surry Hills,Ms.Sophie Jennings					**Permits**		
45-5-0319	Penrith Lakes 5	GDA	56	283157	6268242	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,105447
	Contact	**Recorders**	Jim Kohen					**Permits**	3891	
45-5-0326	Penrith Lakes 15	AGD	56	285428	6266546	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450,105447
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0331	Penrith Lakes 20	AGD	56	286325	6267478	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**	28,1067	
45-5-5740	EPRSY 1	GDA	56	284199	6263600	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Corrine Quinlan					**Permits**		
45-5-2491	Coreeen Ave 1	GDA	56	287199	6263429	Open site	Valid	Artefact : -	Open Camp Site	98259,102450,103155,103360
	Contact	**Recorders**	Helen Brayshaw,Tony Kondek,Mr.Matthew Barber,NGH Heritage - Fyshwick					**Permits**	1367	
45-5-0281	Cranebrook Creek, CC/1	AGD	56	285150	6266723	Open site	Valid	Artefact : -, Aboriginal Ceremony and Dreaming : -		260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-3331	ADI/FF-30	AGD	56	288835	6265442	Open site	Valid	Artefact : 1		99635,102155,102450,102573,103618
	Contact T Russell	**Recorders**	Jo McDonald Cultural Heritage Management see GML					**Permits**	3057	
45-5-3318	Western Sydney 6	GDA	56	287710	6264801	Open site	Valid	Artefact : 5		100554,102450
	Contact Searle	**Recorders**	Navin Officer Heritage Consultants Pty Ltd					**Permits**		

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 537 Penrith

Client Service ID : 912988

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-5-0314	Penrith Lakes 28	AGD	56	286325	6267478	Open site	Valid	Artefact : -	Open Camp Site	256,260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0340	Penrith Regional Art Gallery	AGD	56	284048	6262220	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	260,1018,103155,103360
	Contact	**Recorders**	Charles.D Power					**Permits**		
45-1-0219	Penrith Lakes 39	AGD	56	284930	6267150	Open site	Valid	Artefact : -	Open Camp Site	2446,102450
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-3941	Hadley Park 1	GDA	56	283650	6269850	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Comber Consultants Pty Limited,Mr.Shaun Hooper					**Permits**		
45-5-5470	Andrews Road PAD 1 Reburial	GDA	56	287428	6264919	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Biosis Pty Ltd - Wollongong,Mrs.Samantha Keats					**Permits**		
45-5-0051	Emu Plains	AGD	56	281883	6265379	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	Contact	**Recorders**	Fred McCarthy					**Permits**		
45-5-0589	Penrith Lakes 29	AGD	56	284300	6266280	Open site	Valid	Artefact : -	Open Camp Site	1064
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0530	Upper Castlereagh, UC/1	GDA	56	283035	6267149	Open site	Valid	Artefact : -	Open Camp Site	1018
	Contact	**Recorders**	Jim Kohen					**Permits**	3891	
45-5-2850	Vincent Road 1	AGD	56	287550	6268250	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Doctor.Susan (left ahms) Mcintyre-Tamwoy					**Permits**	1599	
45-5-0329	Penrith Lakes 18	AGD	56	283617	6265596	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0332	Penrith Lakes 21	AGD	56	284514	6266528	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0288	Emu Plains	AGD	56	282030	6262546	Open site	Valid	Artefact : -	Open Camp Site	260,1018
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-5311	River Road AS1	GDA	56	284756	6263365	Open site	Valid	Artefact : -, Potential Archaeological Deposit (PAD) : -		
	Contact	**Recorders**	Biosis Pty Ltd - Wollongong,Eco Logical Australia Pty Ltd - Sydney - Individual user					**Permits**	4634,4731	
45-5-5729	Nepean River Trail 04	GDA	56	282884	6268421	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Michael Jackson,Jackson Ward Archaeology Pty Ltd					**Permits**		
45-5-0539	RP3 Peach Tree Creek	AGD	56	284920	6262050	Open site	Valid	Artefact : -	Open Camp Site	1018,103155,103360
	Contact	**Recorders**	Elizabeth Rich					**Permits**		
45-5-0282	Upper Castlereagh	GDA	56	282979	6267050	Open site	Valid	Artefact : -	Open Camp Site	260,1018
	Contact	**Recorders**	Jim Kohen					**Permits**	3891	

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref/PO Number : 537 Penrith

Client Service ID : 912988

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status **	SiteFeatures	SiteTypes	Reports
45-5-0590	Penrith Lakes 31	AGD	56	284610	6266550	Open site	Valid	Artefact : -	Open Camp Site	1064,102450
	Contact	**Recorders**	Jim Kohen					**Permits**	28	
45-5-0495	Jamisons Creek JC/2 Penrith	AGD	56	282890	6261700	Open site	Valid	Artefact : -	Open Camp Site	1018,103155,103360
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-3317	Western Sydney 5	GDA	56	287679	6264900	Open site	Valid	Artefact : 1		100554,102450
	Contact Searle	**Recorders**	Navin Officer Heritage Consultants Pty Ltd					**Permits**		
45-5-3319	Western Sydney 7 and PAD	GDA	56	287450	6264725	Open site	Valid	Artefact : 1, Potential Archaeological Deposit (PAD) : -		100554,102450
	Contact Searle	**Recorders**	Navin Officer Heritage Consultants Pty Ltd,Biosis Pty Ltd - Wollongong,Mrs.Samant					**Permits**		
45-5-4361	Peachtree Creek PAD	GDA	56	285590	6263560	Open site	Valid	Artefact : -, Potential Archaeological Deposit (PAD) : -		103360
	Contact	**Recorders**	Mr.Oliver Brown					**Permits**	3664,3688	
45-5-0316	Penrith Lakes 2	AGD	56	284443	6270186	Open site	Valid	Artefact : -	Open Camp Site	256,260,526,1018,103395,105447
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-0335	Penrith Lakes 26	AGD	56	287274	6265667	Open site	Valid	Artefact : -	Open Camp Site	260,526,1018,102450
	Contact	**Recorders**	Jim Kohen					**Permits**		
45-5-2416	L-1;Penrith Lakeside Village;	GDA	56	286799	6266617	Open site	Valid	Artefact : -	Open Camp Site	102450
	Contact	**Recorders**	Mary Dallas Consulting Archaeologists (MDCA),Biosis Pty Ltd - Wollongong,Mrs.Sa					**Permits**		
45-5-5727	Nepean River Trail 02	GDA	56	282748	6270469	Open site	Valid	Artefact : -		
	Contact	**Recorders**	Mr.Michael Jackson,Jackson Ward Archaeology Pty Ltd					**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

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Appendix D. Summary and timeline of archaeological assessments

Table 6: Timeline and summary of previous assessments

Author and Year	AHIMS report number	Report Title and Relevance to Project Area
Kohen 1981	526	**Archaeological survey of proposed Penrith Lakes scheme (Kohen 1981)** In 1981, Jim Kohen undertook archaeological survey of the Penrith Lakes Scheme to inform a Regional Environmental Study. According to the survey coverage figure in this report the project area was surveyed, however no specific detail regarding land access, sampling or visibility was provided for the project area. At this time, the project area does not appear to be part of the Penrith Lakes Scheme or any of the development applications. No Aboriginal objects were identified (Kohen 1981).
Kohen 1981	1154	**Supplementary report on archaeological survey of the proposed Penrith Lakes scheme** This provides additional information on the archaeological survey undertaken by Kohen in 1981 and suggests that as a private property outside the scheme, the project area was not assessed or surveyed.
Kohen 1986	1063	**An additional archaeological survey of the Penrith Lakes Scheme: The DA2 area, at Total Survey Cranebrook and Upper Castlereagh [report prepared for Penrith Lakes Development Corporation]** An archaeological survey of the DA 2 area that achieve 80-100% survey coverage. This did not include the project area and did not include assessment of the project area.
Kohen 1986	1064	**An archaeological survey of the Penrith Lakes scheme: The DA2 area, development area** Selective survey of the DA2 area. This assessment and survey did not include the project area
Nanson, Young and Stockton 1987	-	**Chronology and palaeoenvironment of the Cranebrook Terrace (near Sydney) containing artefacts more than 40,000 years old** A study of artefacts and the geological units associated with the Cranebrook Terrace in 1987 found natural sediment within the locality to have been deposited within three stages: a reworked overburden found between Cranebrook Creek and the Nepean River dating to 10-13,000 years BP, an original overburden dating to 40-45,000 years BP, and channel infill deposits dating to approximately 36,000 years BP (see **Figure 5**). The reworked overburden deposit was identified as being deposited within the known habitation of Aboriginal populations in the Sydney area, and also as having an increased potential for archaeological deposits to its maximum depth of approximately 4m. Within Nanson et al.'s mapping, the project area appears to be within close proximity to the border between the reworked overburden deposit associated with higher archaeological potential, and the original overfill burden deposit (1987, **Figure 5**). This model has subsequently been revised in Mitchell 2010 and Williams et al 2017.
Kohen 1988	-	**The Penrith Lakes scheme: Routine inspection of quarrying operation**

		The project area was not
Kohen 1988-2004	1433 4093	Inspections were initially conducted every six months and duly reported to PLDC. Monitoring of gravels within the quarrying continued until at least 1996 resulting in at least 13 reports without finding Aboriginal stone tools within the gravels. However the regular inspections of gravels resulted in observations of artefacts exposed in the overburden sections around Cranebrook Creek. Up to 1996 the then DLALC had been involved in the archaeological work, but around this time withdrew involvement. In order to maintain Aboriginal representation, the Darug Tribal Aboriginal Corporation were invited to participate, and the Aboriginal monitoring was expanded to stripping of overburden. Monitoring of overburden stripping continued to around 2004. Artefacts from the monitoring were listed in each monitoring report by Kohen and are mapped in Figure below. Based on the mapping provided in PLDC (2011), the project area was not part of this monitoring.
Koettig and Hughes 1995	-	Excavations at RS1 Regentville (Koettig and Hughes 1995) found occasional artefacts to depths of 0.8m, providing an indication of depth of stone artefacts in similar soil profiles to the project area.
Valerie Smith and Associates 1996	97515, 97527	**Review of the Geomorphology of the Penrith Lakes Scheme Area and Context for Aboriginal Literature Survey Occupation by Valerie Smith & Associates** This work was superseded by Mitchell 2010 and Williams et al 2017.
Kohen 1997	97700	**Archaeological investigations in the DA4 area, Penrith Lakes Scheme [report prepared for Investigation Penrith Lakes Development Corporation] by Dr James Kohen** Archaeological Assessments were completed by Kohen in 1997 for DA 4. This assessment did not include the project area. The first major subsurface investigation of the overburden took place in 1997 with the mechanical excavation by Kohen of two very large trenches within the Penrith Unit soil. Each trench was 7m wide and 100m long dug by mechanical scraper. One major trench was dug by Cranebrook Creek to a depth of 4.6m. A second trench was dug to a depth of 1.9m by the paleochannel feature - a depressed band of clayey soil swamps near the base of the escarpment in the northeastern area of the Scheme. Kohen reports that 99% of artefacts were recovered within the top 1.3m and European artefacts were recovered from the upper 90cm at Cranebrook Creek and upper 60cm at the paleochannel. The top 2m of the soil were heavily bioturbated. The results suggested that artefacts had been mixed through the soil by bioturbation. The results suggested a low density of artefacts, although the recovery via 10mm mechanical gravel screen would not have captured artefacts less than 10mm wide.
Insite Heritage 2000	-	In 2000, Insite Heritage undertook archaeological test putting to the east of the project area near the boundary of the Penrith unit and Londonderry Terrace for a proposed development between Cranebrook Road and Andrew Road, A total of 75 artefacts were identified. Artefacts located I the sand terrace averaged around 1-3 artefacts per m3, with the majority located in the top 0.5m. The report recommended the proponent apply for a consent to destroy with monitoring.
ERM 2001	-	ERM undertook a consolidation of information across the Penrith Lakes Scheme, including mapping the approximate distribution of Aboriginal objects recorded by Kohen prior to 2000 across the Penrith Lakes Scheme in both surface and subsurface contexts (ERM 2001: 2.15). The distribution of these sites notes the broader distribution of Aboriginal stone artefacts than indicated by the AHIMS data.
DECC 2004	-	Publication of the 2004 Interim Community Consultant Requirements. With the introduction of the 2004 Interim Community Consultation Requirements by the then Department ·of Environment and Conservation, PLDC followed the mandatory Aboriginal consultation procedure involving advertisement, notification and review phases as

		required under the Interim guideline. This process was documented in the 2005 Camenzuli assessment report by PLDC
Comber Consultant 2005, 2006	105447	In 2005 nine Aboriginal stone artefacts had been identified eroding from the edges of a farm dam on a parcel of land previously owned by Camenzuli, located in the north of the scheme., An archaeological assessment was conducted by Comber resulting in the recording of 17 stone artefacts. Comber recommended archaeological salvage and consequently excavated a total of sixteen trenches, each 2m by 3m in area to a depth of 60cm with all spoil dry sieved through 2.5mm aperture screen. One artefact was recovered from the excavation. Comber's 2007 excavation of the PL9 area, located 1km to the west of SB83, was conducted within the younger Richmond Unit and adopted total recovery wet-sieving approach. A series of 4m by 1m trenches were dug by backhoe along three slightly elevated levees. Some of the trenches were expanded and a small number of additional 1m x 1m test pits were dug by hand. A total of 5,078 artefacts (including shattered artefactual stone fragments) were recovered, with 52 backed artefacts extending to deeper spits within the undifferentiated alluvial deposits. These results indicate the presence of Holocene age technology bioturbated through a mixed alluvial deposit at least to the depth of excavation in many pits. In 2006, Comber prepared additional information This report recommends that the Sec 90 permit with salvage be issued to allow the quarrying of the Camenzuli Dam which contains the Camenzuli Site 1. It further recommends that a program of controlled excavation and research be undertaken and that a review of previous work undertaken at the Penrith Lakes Scheme be included in that research. The report recommends that the excavation and collection of artefacts be undertaken prior to the commencement of the quarrying; that monitoring of the quarrying occur and that the review of the previous work be undertaken in association with the results from the excavation. One artefact was identified as a result of this work.
Comber Consultants 2006	100211	**Archaeological and Cultural Heritage Assessment Aboriginal Cultural Heritage Region in the area surrounding PL 9 Penrith Lakes Scheme** This assessment did not include the project area.
Karskens 2007	-	
Comber Consultants 2008	101748	**Aboriginal Archaeological & Cultural Heritage Assessment: Cranebrook Escarpment. Report prepared for Penrith Lakes Development Corporation** This assessment did not include the project area and recommended further subsurface excavation to determine the nature and extent of two sites identified.
AHMS 2010	103762	**Emu Plains Rail Stabling Yards – Section 87 #118047 Excavation Report** This assessment identified stone artefacts within a levee landform adjacent a drainage line to the south of the Nepean River within the A Horizon soils, further demonstrating the potential for levee and terrace landforms to contain evidence of stone artefacts in proximity to water in the local area.
Mitchell 2010	-	**Geomorphology and soils in relation in relation to archaeological investigations on the Cranebrook Terrace, Penrith Lakes. Report prepared by Groundtruth Consulting for Comber Consultants** This report provides a summary of geomorphological investigations relevant to the project area, including additional interpretation on potential location of paleochannels and past drainage lines of Cranebrook Creek and its chains of ponds.
2010	-	The project area appears to have been incorporated into the Penrith Lakes Scheme
DECCW 2010	-	Subsequent PDLC reports followed the consultation guidelines
November 2011	-	An area wide Scheme AHIP was lodged with the then Office of Environment and Heritage on 7 November 2011.

EMGA 2011	-	***Aboriginal Heritage Assessment Report I Old Castlereagh Road and Quarantine Lake AHIP including results of test excavation of site PLSB83 (45-5-3991) under the Code of Practice for Archaeological Investigation of Aboriginal Object in NSW (DECCW 2010). Penrith Local Government Area. Prepared for Penrith Lakes Development Corporation*** The Scheme land holds areas of high cultural significance with scientific value as representative landform with Aboriginal sites. The areas protected from quarrying contain Aboriginal stone artefacts in surface exposures and deep deposits. The deposits have research potential capacity to address questions of past Aboriginal land-use, certainly within the last 10,000 years, and possibly the late Pleistocene. The areas have Aboriginal socio-cultural values relating to their capacity to demonstrate past and current Aboriginal connection to the land." Baker hypothesised that Based on the circumstances of initial discovery of PLSB83 and suggested land use model of Aboriginal behaviour it was initially assumed that flaked stone artefacts may be present within the upper 50 cm of soil in the AHIP area in an irregular very low-density distribution more than 300 m from Cranebrook Creek within the Penrith Unit soils. Within 300 m of Cranebrook Creek a higher concentration of Aboriginal flaked stone artefacts is anticipated. A very low-density artefact distribution may be present south of Cranebrook Creek within the Richmond Unit soils at an unknown depth. An archaeological test excavation of PLSB83 within the Penrith Lakes Scheme conducted in accordance with the Code of Practice for Archaeological Investigations and Aboriginal Objects in NSW (the Code - DECCW 2010) identified a low density of stone artefacts within the Richmond geomorphological unit, mainly on the eastern slightly higher ground close to the old Castlereagh Road. An AHIP was issued over part of the Penrith Lakes Scheme to support DA4, to the east of the project area with specific requirements to undertake salvage excavations across a number of geomorphic units including the Richmond Unit, the Penrith Unit and the boundaries of a tributary creek identified by Smith (1996). The applied for period was 2011-2018. DCAC noted a concern around the depth of excavation, and the lack of consideration of how the chains of ponds of Cranebrook Creek may have changed over 20,000 years.
EMGA 2011	105453	***Aboriginal Heritage Assessment Report I 5B83, 5B73, 5B66 including results of test excavation of site PLSB83 (45-5-3991) under the Code of Practice for Archaeological Investigation of Aboriginal Object in NSW (DECCW 2010). Penrith Local Government Area. Prepared for Penrith Lakes Development Corporation I 21 June 2011*** This report does not appear to contain any additional information to that presented in AHIMS
PDLC 2011	-	***Penrith Lakes Scheme Area of Aboriginal Assessment Report. November 2011 – Issue A*** Penrith Lakes Development Corporation (PLDC) conducted an ACHA to support an Aboriginal Heritage Impact Permit (AHIP) application to Heritage NSW for the post-extraction terraforming of the Penrith Lakes Scheme and associated infrastructure. This AHIP covered part of the Penrith Lakes area, but not the project area. The purpose of the AHIP was to attain consent to harm Aboriginal objects in areas within the Scheme footprint where unknown Aboriginal objects may exist but have not been previously identified and recorded. Volumes 1,2 and 3 and Map 14 were not available to review for this assessment. Morson Group has requested this information from Penrith Lakes Development Corporation

PDLC 2015	-	In July 2015, an application was made for an Aboriginal Heritage Impact Permit across part of the Penrith Lakes Scheme. This was subsequently amended in 2018 to include erosion works.
Artefact 2016		In more recent times, Artefact (2016) conducted an Aboriginal Archaeological Survey Report as part of a Review of Environmental Factors for infostructure works on Jane Street and Mulgoa Road, Penrith, approximately 2.3km south of the project area. In their reporting, Artefact reviewed the archaeological and geotechnical investigations associated with the Cranebrook Terrace in the Penrith region. The Cranebrook Terrace is a geological formation consisting of gravel, sand, silt and clay with increased archaeological potential within the Richmond Geological Unit. Artefact (2016) identified that artefact deposits have been found within the Cranebrook Terrace to a depth of 3.7m, or 20.55 AHD.
Williams et al 2017	-	In 2017 Williams et al. conducted excavations on the banks of Peach Tree Creek and created the most recent dating model for the Cranebrook Terrace (see **Figure 7**). This modelling identifies that the sandy clay sediment in areas west of the historic pathway of Cranebrook Creek, within the Richmond Unit were deposited between 20-15,000 years ago to a depth of 3.5-3.9m or 20.73-21.13m AHD. This sedimentary layer is particularly sensitive for Aboriginal archaeological deposits, with flakes being identified by Williams et al. at the base of this layer. Sediment below this deposit are also sandy clays and date to approximately 50-40,000 years ago within the Richmond geological unit. Sediment east of the historic alignment of Cranebrook Creek dates to at least 50,000 years. Aboriginal objects are less likely to occur at depth to the east of Cranebrook Creek, with any Aboriginal objects most likely occurring in the reworked topsoils. Around 3km east of Cranebrook Creek is and channel infill dating to between 50-75,000 years ago
Comber 2018	103872	***Toga Penrith Aboriginal Archaeological Assessment*** ***An assessment of land within the Penrith Unit recommended further investigation***
Biosis Research 2018	-	In 2018 Biosis conducted an Aboriginal Cultural Heritage Due Diligence Assessment for the construction of a new maintenance shed at the Penrith Regatta Centre. Biosis' assessment area was 153 Old Castlereagh Road, 1.7km west of the project area. The soils of Biosis' study area were within the same Richmond soil landscape as the project area, and with a similar flat topography. Biosis also identified the historic path of the Cranebrook Creek to be immediately west of their project area, which would also indicate the main path of the creek to be over 1.7km west of the project area for this assessment. However, there is no mention of the unnamed tributary previously of Cranebrook Creek located northeast of the project area. Biosis predicted stone artefacts to be the most likely site types, with PADs, shell middens and quarries also located within the broader locality. Biosis noted that a high level of disturbance from sand mining and landscaping had been undertaken within the locality, which has impacted the potential for sites to be identified. No artefacts were identified in Biosis' site inspection.
OEH and PDLC 2018	**AHIMS Permit ID 3891**	**AHIP C0001415 (AHIMS Permit I 3891)** AHIP C0001415 was issued on 15 November 2018 and expired in 2023. This permit was issued over the project area has part of an extension to an AHIP applied for in 2015 and was to allow for the remediation of the eastern riverbank of the Nepean River adjacent Wildlife Lake, Main Lakes A and B and Southern wetlands. Heritage NSW has been requested to provide the supporting Aboriginal Cultural Heritage Assessment, AHIP methodology for the project area

		and to date this information has not been provided. It is unclear as to why the project area was included and what works were undertaken in the project area, if any, as a result of this permit.
Heritage NSW and PDLC	**AHIP 1131345**	AHIP 1131345 does not include the project area.
Karskens et al 2019	-	**Traces in a Lost Landscape: Aboriginal archaeological sites, Dyarubbin/Nepean River and contiguous areas, NSW, Australia (Data Paper)** This dataset provides a compilation of sites and reports relevant to the Dyarubbin and Penrith Lakes Scheme. Individual report where relevant are considered in this table.
Eco Logical Australia 2020	-	**Nepean Business Park, Penrith, NSW Aboriginal Cultural Heritage Assessment Great River NSW Pty Ltd** Eco Logical Australia (2020) conducted and Aboriginal Cultural Heritage Assessment in 2020 for the construction of the Nepean Business Park located 20m south of the project area, on the other side of Old Castlereagh Road. This assessment identified stone artefacts to be the most common sites within the locality, though none were identified within their assessment area ERM (2001) indicates that Kohen possibly identified stone artefacts in or near this lot. Consultation with Aboriginal Parties in this report noted that burials had been identified in the broader Penrith Lakes region. However, the level of disturbance that has been undertaken in the locality due to sand mining indicated all Aboriginal objects to have a low potential within their assessment area. No Aboriginal artefacts or sites were identified in Eco Logical Australia's assessment.
Ecological Australia 2020	-	***Regatta Park and River Road Reserve Test Excavation.*** **Prepared for Penrith City Council** ELA was engaged by Penrith City Council to conduct a test excavation program and supporting Archaeological Technical Report (ATR) for the proposed upgrades in Regatta Park and River Road Reserve. In Regatta Park, there was low artefact density across the entirety of the site, with a majority of the artefacts found between 60 cm and 90 cm depth, 2.29 km south of the project area.

Appendix E. Borehole Data

Geotechnical Investigation Report

GEOTECHNICAL INVESTIGATION FOR TOURISM DEVELOPMENT

LOT 14, 47-65 OLD CASTLEREAGH ROAD, CASTLEREAGH NSW

Prepared for:

JACOB 4765 INVESTMENTS PTY LTD

Reference: P3023_01

4 October 2023

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1 PROJECT BACKGROUND

Morrow Geotechnics Pty Ltd has undertaken a Geotechnical Investigation to provide geotechnical advice and recommendations for the proposed development at Lot 14, 47-65 Old Castlereagh Road, Castlereagh NSW (the site).

This report has been prepared to provide geotechnical recommendations and address the following requirements of State Environmental Planning Policy (Precincts – Western Parkland City) 2021 Section 4.31 Development on land zoned Tourism, parts:

> (c) whether a stable foundation exists or can be developed for the development; and
>
> (e) whether the proposed development appropriately allows for potential differential settlement given the existing geotechnical conditions and the proposed foundation and for the geotechnical conditions present at the site to prevent excessive total and differential settlement.

1.1 Proposed Development

An architectural drawing for the proposed development titled Option 5 SK01 issue P1 has been prepared by Morson Group with project number 17011 dated 11 August 2023. The drawing provided proposes a six storey tourism development at or near existing grade.

1.2 Investigation Intent

The purpose of the investigation is to provide geotechnical advice and recommendations specific to the ground conditions observed at site for the proposed development. These recommendations include:

- Building foundation options, including design parameters.
- Lot classification in accordance with AS2870.
- Earthquake site classification in accordance with AS1170.4.
- Advice on groundwater level if encountered within the depth of investigation.
- Advice on geotechnical construction constraints.
- Pavement design parameters (subgrade CBR, MDD, OMC and modulus of subgrade reaction).

1.3 Published Geological Mapping

Information on regional sub-surface conditions, referenced from the Department of Mineral Resources Geological Map Penrith 1:100,000 Geological Series Sheet 9030 (DMR 1991), indicates that the site overlies the Cranebrook Formation of the Quaternary Period, which typically comprises gravel, sand, silt and clay.

1.4 Published Soil Landscapes

The Soil Conservation Service of NSW Penrith 1:100,000 Soil Landscapes Series Sheet 9030 (1st Edition) indicates that the alluvial landscape at the site likely comprises the Richmond Landscape. This landscape type typically includes Quaternary terraces of the Nepean and Georges Rivers, with slopes of < 1 %. It generally comprises poorly structured orange to red clay loams, clays and sands. These soils are noted to present localised seasonal waterlogging, localised flood hazard and localised water erosion hazard on terrace edges.

2 OBSERVATIONS

2.1 Investigation Methods

Fieldwork was undertaken by Morrow Geotechnics on 16 March 2023. Work carried out as part of this investigation includes:

- Review of publicly available information from previous reports in the project area, published geological and soil mapping and government agency websites;
- Site walkover inspection by a Geotechnical Engineer to assess topographical features, condition of surrounding structures and site conditions;
- Dial Before You Dig (DBYD) services search of proposed borehole locations;
- Drilling of one cored borehole (BH1) by a track mounted drill rig. The borehole was drilled using solid flight auger equipped with a tungsten-carbide bit (TC bit) then extended beyond TC bit refusal by NMLC coring techniques to 14.60 metres below ground level (mBGL). Rock core was boxed and photographed and point load tests were undertaken on selected core sample to assess rock strength;
- Drilling of five augered boreholes (BH2, BH3, BH4, BH5 & BH6) using a ute mounted drill rig. Boreholes were drilled using solid flight augers equipped with a tungsten-carbide bit (TC bit) to depths of 5.5, 4.2, 3.3, 3.8, and 3.8m below ground level (mBGL) respectively. Borehole locations are shown on **Figure 1** and borehole logs are presented in **Appendix A**;
- Standard Penetration Tests (SPT) were undertaken within BH1, and Dynamic Cone Penetrometer (DCP) tests were undertaken adjacent to BH2 to BH6. SPT and DCP test results were used to assess soil consistency/density.

2.2 Subsurface Conditions

The stratigraphy at the site is characterized by topsoil, alluvial sands and cobbles over shale bedrock. Observations taken during the investigation have been used to produce a stratigraphic model of the site. The observed stratigraphy has been divided into four geotechnical units.

A summary of the subsurface conditions across the site, interpreted from the investigation results, is presented in **Table 1 & 2**. More detailed descriptions of subsurface conditions at the test locations are available in the borehole logs presented in **Appendix A**.

TABLE 1 SUMMARY OF INFERRED SUBSURFACE CONDITIONS

Unit	Material	Comments
1	**Topsoil**	Silty SAND/Sandy SILT, generally loose to medium dense. Fine to medium grained with fine sized gravels.
2	**Medium Dense Sand**	Alluvial Clayey to Silty SAND, medium dense, low to medium plasticity, fine to medium grained gravels.
3	**Alluvial Cobbles**	COBBLES with coarse gravel, dense to very dense, some fine to medium grained sand, and trace clay.
4	**Shale Bedrock**	SHALE, fine grained, slightly weathered, medium strength.

TABLE 2 ENCOUNTERED GEOTECHNICAL CONDITIONS

Unit	Material	Approx. Depth Range of Unit [1] mBGL					
		BH1	BH2	BH3	BH4	BH5	BH6
1	Topsoil	0.0 to 0.5 (24.2 to 23.7)	0.0 to 0.6 (23.8 to 23.2)	0.0 to 0.6 (24.0 to 23.4)	0.0 to 0.3 (24.0 to 23.7)	0.0 to 0.6 (24.1 to 23.5)	0.0 to 0.3 (24.1 to 23.8)
2	Medium Dense Sand	0.5 to 6.0 (23.7 to 18.2)	0.6 to 5.5 (23.2 to 18.3)	0.6 to 4.2 (23.4 to 20.0)	0.3 to 3.3 (23.7 to 20.7)	0.6 to 3.8 (23.5 to 20.3)	0.3 to 3.8 (23.8 to 20.3)
3	Alluvial Cobbles	6.0 to 13.9 (18.2 to 10.3)	5.5 + (sub 18.3)	4.2 + (sub 19.8)	3.3 + (sub 20.7)	3.8 + (20.7 to 20.3)	3.8 + (sub 20.3)
4	Shale Bedrock	13.9 to 14.6 (10.3 to 9.6)	-	-	-	-	-

Notes:

1 Depths shown are based on material observed within test locations and will vary across the site.

2.3 Groundwater Observations

One standpipe piezometer was installed within BH1 as part of the present investigation. A groundwater monitoring event was carried out on 25 September 2023 to measure water levels within the piezometer. Measured groundwater levels are presented in **Table 3**. The monitoring well locations are shown on the attached plan.

TABLE 3 GROUNDWATER LEVELS

Borehole ID	Date of Monitoring	Water Depth Below Ground Level (m)	Water Level RL mAHD	Total Well Depth (m)
BH1	25 September 2023	5.55	18.65 mAHD	13.7

2.4 Laboratory Test Results

One soil sample was selected for laboratory pavement testing. A summary of test results is provided in **Table 4**.

TABLE 4 SUMMARY OF PAVEMENT DESIGN LABORATORY TEST RESULTS

Sample ID	BH2 0.3 to 0.9m	BH3 0.3 to 0.9m
Moisture content (% w/w)	11.1	14.5
Maximum Dry Density (t/m^3)	1.94	1.70
Optimum Moisture Content (%)	11.0	14.5
California Bearing Ratio (%)	3.5	2.5

3 RECOMMENDATIONS

3.1 Excavation Retention

Design of any required excavation retention systems will need to consider both the soil and groundwater conditions encountered within the investigation. For design of flexible shoring systems a triangular pressure distribution may be employed using the parameters provided in **Table 5**. For design of rigid anchored or braced walls, a trapezoidal earth pressure distribution should be used with a maximum pressure of 0.65.K_a.γ.H (kPa), where 'H' is the effective vertical height of the wall in metres.

TABLE 5 EARTH PRESSURE PARAMETERS

Material		Unit 1 Topsoil	Unit 2 Medium Dense Sand	Unit 3 Alluvial Cobbles	Unit 4 Shale Bedrock
Bulk Unit Weight (kN/m^3)		17	18	21	24
Saturated Unit Weight (kN/m3)		18.5	19.5	22	24
Earth Pressure Coefficients	At rest, K_o	0.58	0.47	0.38	0.36
	Passive, K_p	2.46	3.25	4.20	4.60
	Active, K_a	0.41	0.31	0.24	0.22
Drained Cohesion, c' (kPa)		3	2	1	300
Drained Friction Angle, ϕ' (°)		25	32	38	40
Elastic Modulus (MPa)		5	35	80	250
Poisson's Ratio		0.30	0.30	0.25	0.20

Notes:

1 Unit Weight is based on visual assessment only and may vary by ±10%.
2 Earth pressures are provided on the assumption that the ground behind the retaining wall is flat and drained.

In addition, design of retaining walls should consider the following:

- Appropriate surcharge loading from construction equipment, vehicular traffic and neighbouring structures at finished surface level should be taken into account in the retention design. Surcharge loads on retention structures may be calculated using a rectangular stress block with an earth pressure coefficient of 0.5 applied to surcharge loads at ground surface level.
- Anchor design should ignore the contribution of any bonded length within a wedge which extends upwards at 45^{o} from the base of the excavation to account for a failure wedge forming behind the shoring system.

3.2 Soil and Rock Excavatability

The expected ability of equipment to excavate the soil and rock encountered at the site is summarised in **Table 6**. This assessment is based on available site investigation data and guidance on the assessment of excavatability of rock by Pettifer and Fookes (1994). The presence of medium to high strength bands in lower strength rock and the discontinuity spacing may influence the excavatability of the rock mass.

TABLE 6 SOIL AND ROCK EXCAVATABILITY

Unit	Material	Excavatability
1	**Fill/Topsoil**	Easy digging by 20t Excavator
2	**Alluvial Soil**	
3	**Alluvial Gravel/Cobbles**	Hard ripping by 20t Excavator.
4	**Shale Bedrock**	Hydraulic hammering will be required where medium strength rock is encountered within Unit 4

The excavation methodology may also be affected by the following factors:

- Scale and geometry of the excavation;
- Availability of suitable construction equipment;
- Potential reuse of material on site; and
- Acceptable excavation methods, noise, ground vibration and other environmental criteria.

Where vibration intensive works such as hydraulic hammering of competent rock or driven piles are proposed contractors should make an assessment of the potential impact of their works on the basis of the borehole logs, core photographs and point load data. Monitoring of construction induced vibration should be undertaken at the commencement of such activities at the nearest vibration receptor in consultation with the project superintendent and geotechnical engineer. On the basis of trials at the commencement of works a construction methodology may be proposed to limit peak particle velocities (ppv) to acceptable levels. In the absence of ppv guidelines from affected asset owners, Morrow Geotechnics recommends the following limits be placed on vibrations:

- 20 mm/s for commercial or industrial structures;
- 10 mm/s for residential structures;

- 3 mm/s for structures which are particularly susceptible to vibration such as heritage buildings.

If vibration levels are found to be unacceptable during the trial, it may be necessary to adopt vibration mitigation measures such as:

- The use of smaller excavation plant and hydraulic hammers;
- Saw cutting of the perimeter of the excavation;
- Hammering at 50% capacity in short bursts to prevent the buildup of resonant frequencies;
- The use of low vibration techniques such as rotary grinders or chemical rock splitting.

3.3 Foundation Design

Due to the potential variability of fill material encountered at the site it is not recommended that any footings found within Unit 1. Footings and slabs on Unit 2 to 4 material should be designed in accordance with AS2870:2011 based on a Site Classification of 'S'.

The parameters given in **Table 7** may be used for the design of pad footings and bored piles. Morrow Geotechnics recommends that a Preliminary Geotechnical Strength Reduction Factor (GSRF) of 0.4 is used for the design of piles in accordance with AS 2159:2009 if no allowance is made for pile testing during construction. Should pile testing be nominated, the GSRF may be reviewed and a value of 0.55 to 0.6 may be expected.

Ultimate geotechnical strengths are provided for use in limit state design. Allowable or serviceability bearing pressures adopted in **Table 6** are intended to limit settlements to an acceptable level for conventional building structures, typically less than 1% of the minimum footing width. The values given in **Table 6** must be confirmed by geotechnical inspection to ensure ground conditions are consistent with material encountered within the DCPs.

TABLE 7 PAD FOOTING AND PILE DESIGN PARAMETERS

Material		Unit 1 Topsoil	Unit 2 Medium Dense Sand	Unit 3 Alluvial Cobbles	Unit 4 Shale Bedrock
Allowable Bearing Pressure (kPa)		N/A	150	750	3000
Ultimate Vertical End Bearing Pressure (kPa)		N/A	450	2250	9000
Elastic Modulus (MPa)		5	35	80	250
Ultimate Shaft Adhesion (kPa)	In Compression	0	20	40	500
	In Tension	0	10	20	250
Susceptibility to Liquefaction during an Earthquake		High	Medium	Low	Low

Notes:

1 Side adhesion values given assume there is intimate contact between the pile and foundation material. Design engineer to check both 'piston' pull-out and 'cone' pull-out mechanics in accordance with AS4678-2002 Earth Retaining Structures.

2 Susceptibility to liquefaction during an earthquake is based on the following definition:

Low	-	Medium to very dense sands, stiff to hard clays, and rock
Medium	-	Loose to medium dense sands, soft to firm clays, or uncontrolled fill below the water table
High	-	Very loose sands or very soft clays below the water table

3.4 AS1170 Earthquake Site Risk Classification

Assessment of the material encountered during the investigation in accordance with the guidelines provided in AS1170.4-2007 indicates an earthquake subsoil class of Class C_e – Shallow Soil for the site.

3.5 Design Subgrade CBR and Earthworks

The nominated samples for laboratory testing were chosen to be representative of the natural subgrade material which will be encountered beneath pavement areas. Based on the results of soaked CBR testing conducted on the subgrade samples, design CBR values of 2.5 % for alluvial sand material.

After stripping of topsoil and any loose, unsuitable material, the exposed subgrade should be lightly trimmed and compacted to the required degree of compaction as specified by the civil designer.

To confirm location and lateral extent of Weak Subgrade, in-situ testing should be carried out by both DCP testing and proof rolling. In-situ testing must confirm the strength of all exposed subgrade to a depth of least 1.5m below BEL.

The procedure to determine in-situ subgrade CBR strength should comprise DCP testing in accordance with AS1289 6.3.1. The relationship between DCP rate and in-situ CBR is published by Austroads 2017 "Guide to Pavement Technology" in Figure 5 3 and is replicated below. The formula is also provided which allows interpretation below CBR2%.

The chart is represented by the formula below:

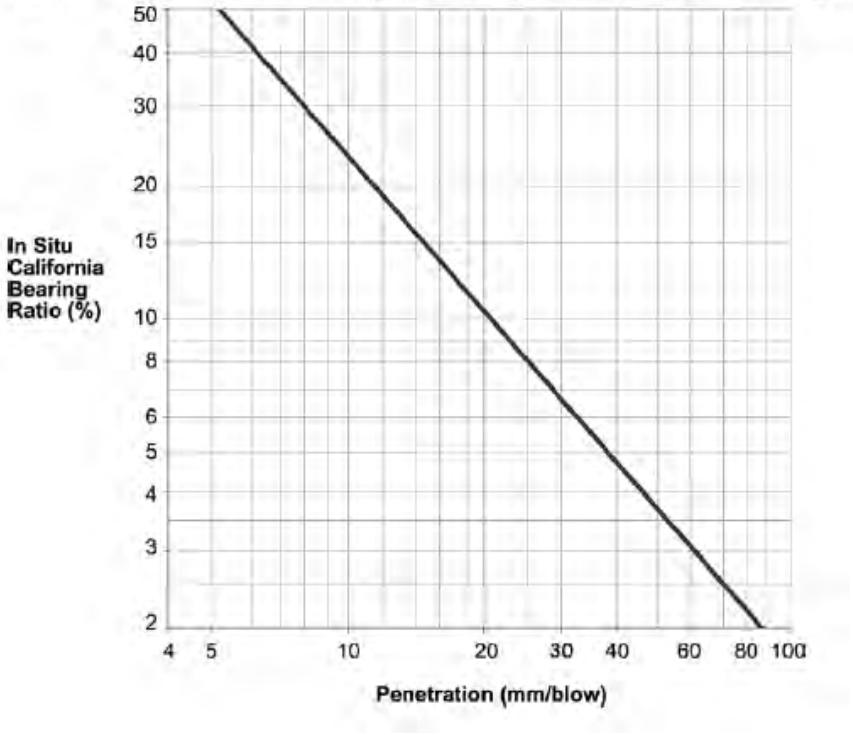
$$\log(CBR) = 2.465 - 1.12\log(DCPI)$$

Where DCPI = DCP Penetration in mm/blow.

After completion of light trimming and compaction of suitable subgrade light subgrade proof rolling shall be undertaken. Light proof rolling of the subgrade should be undertaken with a water tank loaded such that rear axle load does not exceed 4.5 tonnes with tyre inflation pressure of 550 kPa. A 10,000-litre water tanker is acceptable provided the tank has internal baffles to reduce water sloshing. Proof rolling test pattern must sufficiently overlap to ensure the entire subgrade is tested. During testing, the Geotechnical Testing Authority must observe for perceptible movement of the subgrade.

Where perceptible (generally > 2mm) surface deformation is observed, the GTA may require the Contractor to carry out additional testing, localised subgrade replacement or other additional subgrade treatment to ensure the earthworks formation complies with the project design requirements.

Figure 5.3: Correlation between dynamic cone penetration and CBR for fine-grained cohesive soils



4 RECOMMENDATIONS FOR FURTHER GEOTECHNICAL SERVICES

Further geotechnical inspections should be carried out during construction to confirm the geotechnical and hydrogeological model. These should include:

- All excavated material transported off site should be classified in accordance with NSW EPA 2014 - Waste Classification Guideline Part 1; Classifying Waste.
- Observation of the material within pile excavations should be undertaken at the start of piling works to confirm that material across the site is in accordance with the geotechnical model presented in this report.
- A suitably qualified geotechnical engineer is to assess the condition of exposed material at foundation or subgrade level to assess the ability of the prepared surface to act as a foundation or as a subgrade.

5 CONCLUSION

The findings of the geotechnical report are that the site is stable and suitable for the proposed development provided that the recommendations of this report are complied with in design and construction. Further, Morrow Geotechnics can confirm that the requirements of State Environmental Planning Policy (Precincts – Western Parkland City) 2021 Section 4.31 Development on land zoned Tourism, parts (c) and (e) have been achieved:

> (c) a stable foundation exists for the development as outlined in Section 3.3 of this report; and
>
> (e) the design of the proposed development can appropriately allow for potential differential settlement given the existing geotechnical conditions and the proposed foundation and for the geotechnical conditions present at the site to prevent excessive total and differential settlement as outlined in Section 3.3 of this report.

6 STATEMENT OF LIMITATIONS

The adopted investigation scope was limited by site access restrictions due to presence of structures at the site at the time of our investigation and by the investigation intent. Further geotechnical inspections should be carried out during construction to confirm both the geotechnical model and the design parameters provided in this report.

Your attention is drawn to the document "Important Information", which is included in **Appendix B** of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Morrow Geotechnics, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

7 REFERENCES

AS1726:1993, *Geotechnical Site Investigations*, Standards Australia.

AS2159:2009, *Piling – Design and Installation*, Standards Australia.

AS2870:2011, *Residential Slabs and Footings*, Standards Australia.

AS3798:2007, *Guidelines on Earthworks for Commercial and Residential Developments*, Standards Australia.

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Pells (2004) Substance and Mass Properties for the Design of Engineering Structures in the Hawkesbury Sandstone, Australian Geomechanics Journal, Vol 39 No 3

8 CLOSURE

Please do not hesitate to contact Morrow Geotechnics if you have any questions about the contents of this report.

For and on behalf of Morrow Geotechnics Pty Ltd,

Mark Peach
Engineering Geologist

Alan Morrow
Principal Geotechnical Engineer

morrow
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Map description	P3023 - Borehole Location Plan		
Site location	47-65 Old Castlereagh Road, Castlereagh NSW		
Client	Jacob 4765 Investments Pty Ltd		
Project name	Castlereagh		
Project No	P3023	**Scale**	Not to scale

Appendix A

BOREHOLE LOGS AND EXPLANATORY NOTES

Morrow Geotechnics
Bellambi, NSW
Phone: 0405 843 933

Boring No.: BH1

Easting	**: 285904.9**	**Drill Supplier**	**: GEOSENSE**	**Job Number**	**: P3023**	**Sheet**	**: 1 OF 4**
Northing	**: 6265525.5**	**Driller Company**	**: GEOSENSE**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 24.20(m)**	**Logged By**	**: Mahmoud Jangidaryan**	**Project**	**: Castlereagh**		
Total Depth	**: 14.6 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	Well Diagram	Testing: SPT	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture
ADT		Backfill		Topsoil		SM	0.5	24.2	Topsoil Sandy SILT (SM) : firm to stiff, low plasticity, brown, fine grained sand, trace fine sized gravel, trace low plasticity clay, inorganic, w < pl.	F-St	w < PL
		50mm PVC Solid	10, 17, 16, (N = 33)	Alluvial		SM	1	23.2	Alluvial Silty SAND (SM) : medium dense, brown, fine grained, trace fine sized gravel, trace low plasticity clay, moist to dry.	MD	M-D
		Bentonite	5, 8, 8.98, (N = 16)	Alluvial		SM	1.5		Alluvial Silty to gravelly SAND (SM) : medium dense, brown brown yellow, fine grained, fine to medium sized gravel, trace low plasticity clay, moist.		M
		50mm PVC Slotted		Alluvial		ML	2	22.2	Alluvial Clayey SILT (ML) : firm, low plasticity, brown red light grey, with fine grained sand, trace fine sized gravel, inorganic, w < pl.	F	w < PL
		5mm Graded Sand	5, 7, 8, (N = 15)	Alluvial		ML	3	21.2	Alluvial Clayey SILT (ML) : firm to stiff, low plasticity, brown red light grey, with fine grained sand, trace fine sized gravel, inorganic, w < pl.	F-St	
				Alluvial		SC	3.5		Alluvial Clayey SAND (SC) : medium dense, low plasticity clay, brown orange, fine to medium grained, trace fine sized gravel, moist, (low resistance).	MD	M

Morrow Geotechnics
Bellambi, NSW
Phone: 0405 843 933

Boring No.: BH1

Easting	**: 285904.9**	**Drill Supplier**	**: GEOSENSE**	**Job Number**	**: P3023**	**Sheet**	**: 2 OF 4**
Northing	**: 6265525.5**	**Driller Company**	**: GEOSENSE**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 24.20(m)**	**Logged By**	**: Mahmoud Jangidaryan**	**Project**	**: Castlereagh**		
Total Depth	**: 14.6 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	Well Diagram	Testing: SPT	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture
ADT				Alluvial		SC		20.2	Alluvial Clayey SAND (SC) : medium dense, low plasticity clay, brown orange, fine to medium grained, trace fine sized gravel, moist, (low resistance).	MD	M
							4.5				
			6, 9/90mm, (N = 30)	Alluvial		SP			Alluvial Gravelly SAND (SP) : dense, light grey brown, fine grained, medium to coarse sized gravel, with low plasticity clay, moist, (with cobbles of varying lithology).	D	
							5	19.2			
		5mm Graded Sand									
		50mm PVC Slotted					6	18.2			
			4, 6, 10, (N = 16)	Alluvial		GP			Alluvial Sandy GRAVEL sub-rounded (GP) : medium dense, light grey brown, coarse sized, fine to medium grained sand, trace low plasticity clay, wet, (with cobbles of varying lithology).	MD	W
150mm Washbore							7	17.2			

Morrow Geotechnics
Bellambi, NSW
Phone: 0405 843 933

Boring No.: BH1

Easting	**: 285904.9**	**Drill Supplier**	**: GEOSENSE**	**Job Number**	**: P3023**	**Sheet**	**: 3 OF 4**
Northing	**: 6265525.5**	**Driller Company**	**: GEOSENSE**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 24.20(m)**	**Logged By**	**: Mahmoud Jangidaryan**	**Project**	**: Castlereagh**		
Total Depth	**: 14.6 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	Well Diagram	Testing: SPT	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture
150mm Washbore		5mm Graded Sand 50mm PVC Slotted		Alluvial		GP	9 10 11	16.2 15.2 14.2 13.2	Alluvial Sandy GRAVEL sub-rounded (GP) : medium dense, light grey brown, coarse sized, fine to medium grained sand, trace low plasticity clay, wet, (with cobbles of varying lithology).	MD	W

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Boring No.: BH1

Easting	**: 285904.9**	**Drill Supplier**	**: GEOSENSE**	**Job Number**	**: P3023**	**Sheet**	**: 4 OF 4**
Northing	**: 6265525.5**	**Driller Company**	**: GEOSENSE**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 24.20(m)**	**Logged By**	**: Mahmoud Jangidaryan**	**Project**	**: Castlereagh**		
Total Depth	**: 14.6 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	Well Diagram	Testing: SPT	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture
150mm Washbore		5mm Graded Sand 50mm PVC Slotted		Alluvial		GP		12.2	Alluvial Sandy GRAVEL sub-rounded (GP) : medium dense, light grey brown, coarse sized, fine to medium grained sand, trace low plasticity clay, wet, (with cobbles of varying lithology).	MD	W
							13	11.2	**13m : Commenced NMLC Coring;**		
							14	10.2			
							15	9.2			

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Boring No.: BH1

Easting	: 285904.9	**Drill Supplier**	: GEOSENSE	**Job Number**	: P3023	**Sheet**	: 4 OF 4
Northing	: 6265525.5	**Driller Company**	: GEOSENSE	**Client**	: Jacob 4765 Investments Pty Ltd		
Elevation	: 24.20(m)	**Logged By**	: Mahmoud Jangidaryan	**Project**	: Castlereagh		
Total Depth	: 14.6 m	**Date**	: 15/09/2023	**Location**	: 47-65 Old Castlereagh Road, Castlereagh NSW		

Drilling Method	Water	Well Diagram	RQD% and TCR%	Testing Is(50)	Estimated Strength (VLS, LS, MS, HS, VHS, EHS)	Weathering	Depth (m)	Elevation (m)	Graphic Log	Classification Code	Material Description	Defect Spacing (mm) (30, 100, 300, 1000, 3000)	Defect Depth	Defect Description (type, inclination, planarity, roughness, coating, thickness)
		5mm Graded Sand 50mm PVC Slotted					12.2							
NMLC Coring							13	11.2		GW	alluvial Sandy GRAVEL rounded to sub-rounded (GW) : very dense, light orange brown grey, medium to coarse sized, fine grained sand, (cobbles of varying lithology).		13	
			RQD = 31% TCR = 100%	D:0.53 ; A:1.06		SW-F	13 14	10.2		SHA	rock SHALE: slightly to fresh weathered, medium to high strength, dark grey, fine grained, (sub-horizontal, thinly laminated).		14	14.09, P, 5°, SO, PL, CL, OP 14.11, P, 5°, RO, PL, CL, OP 14.18, P, 5°, RO, PL, CL, OP 14.21, P, SO, PL, CL, OP 14.29, P, 25°, RO, PL, CL, OP 14.52, P, 5°, RO, PL, CL, OP
				D:0.77 ; A:1.06							**BH1 Terminated at 14.6 m (Terminated in Fresh Shale)**			
							15	9.2					15	

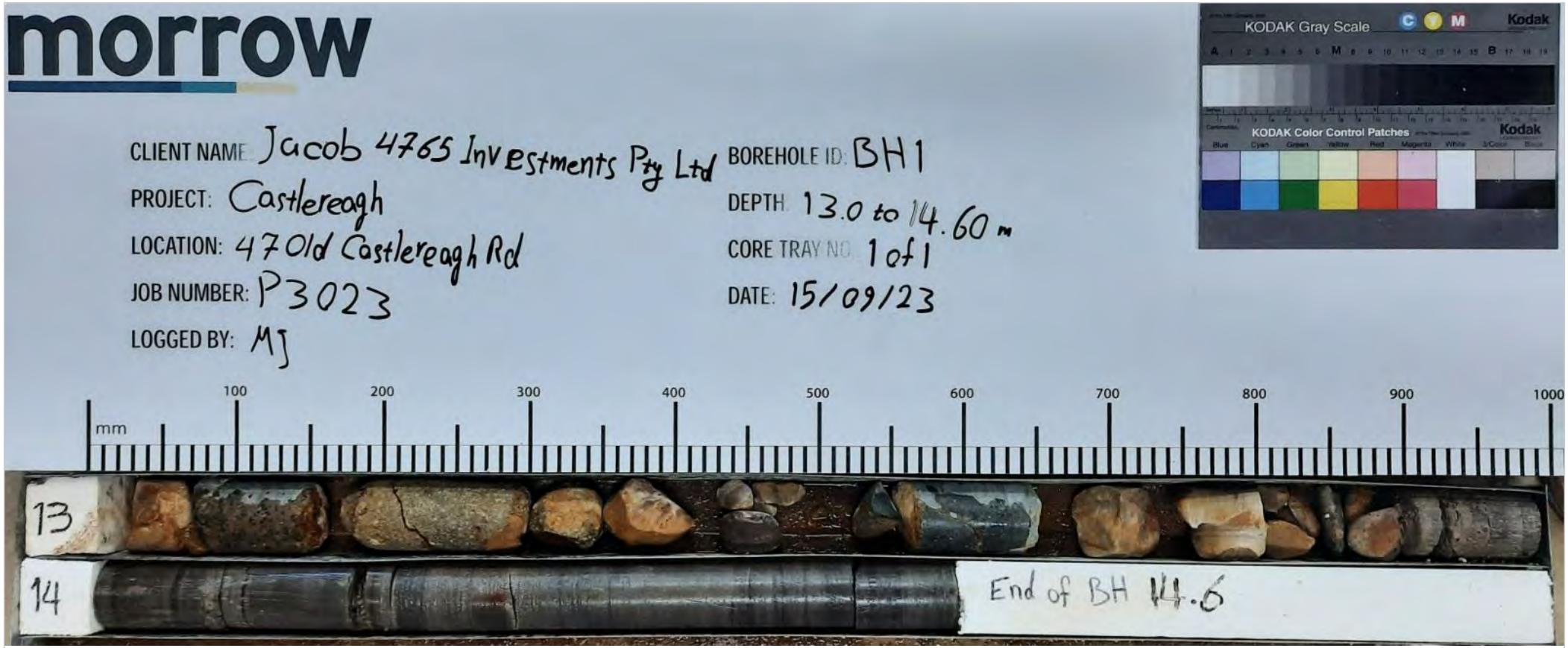

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Photo description	BH1 - Tray 1 of 1		
Client	Jacob 4765 Investments Pty Ltd		
Location	47-65 Old Castlereagh Road, Castlereagh NSW		
Project name	Castlereagh		
Project No	P3023	**Scale**	Not to Scale
BH No	BH1	**BH Depth**	13.0 to 14.6m

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Boring No.: BH2

Easting	: 285947.8	**Drill Supplier**	: HartGeo	**Job Number**	: P3023	**Sheet**	: 1 OF 2
Northing	: 6265500.1	**Driller Company**	: HartGeo	**Client**	: Jacob 4765 Investments Pty Ltd		
Elevation	: 23.8(m)	**Logged By**	: Mark Peach	**Project**	: Castlereagh		
Total Depth	: 5.5 m	**Date**	: 15/09/2023	**Location**	: 47-65 Old Castlereagh Road, Castlereagh NSW		

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
ADT		4 8 8 18 21 25+	Alluvial		SM	0.6	23.8	Alluvial Silty SAND (SM) : loose, brown grey, fine grained, moist to dry, (low resistance).	L	M-D	
			Alluvial		SC	1 1.3	22.8	Alluvial Clayey to silty SAND (SC) : inferred medium dense, low plasticity clay, brown grey orange, fine grained, moist, (low resistance).	D-VD	M	
			Alluvial		SC	2 2.8	21.8	As above, but medium dense, red grey.	MD		
			Alluvial		CL	3 3.3	20.8	Alluvial Sandy CLAY (CL) : stiff, low plasticity, red grey, fine to medium grained sand, with fine sized gravel, w ≈ pl, (low resistance).	St	w ≈ PL	
			Alluvial		Cl	3.6		Alluvial Sandy to gravelly CLAY (Cl) : stiff, medium plasticity, grey red, coarse sized gravel, fine to medium grained sand, w ≈ pl, (medium to high resistance, cobbles).			
			Alluvial		SC			Alluvial Clayey SAND (SC) : medium dense, low plasticity clay, medium plasticity, grey brown, coarse grained, trace fine sized gravel, moist, (low resistance, with some high plasticity clay bands).	MD	M	

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Boring No.: BH2

Easting	**: 285947.8**	**Drill Supplier**	**: HartGeo**	**Job Number**	**: P3023**	**Sheet**	**: 2 OF 2**
Northing	**: 6265500.1**	**Driller Company**	**: HartGeo**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 23.8(m)**	**Logged By**	**: Mark Peach**	**Project**	**: Castlereagh**		
Total Depth	**: 5.5 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
ADT			Alluvial		SC		19.8	Alluvial Clayey SAND (SC) : medium dense, low plasticity clay, medium plasticity, grey brown, coarse grained, trace fine sized gravel, moist, (low resistance, with some high plasticity clay bands).	MD	M	
			Alluvial		SC	4.3		Alluvial Clayey to gravelly SAND (SC) : medium dense, low plasticity clay, medium plasticity, grey brown, coarse grained, coarse sized gravel, moist, (high resistance, with cobbles).			
			Alluvial		SC	4.8		Alluvial Clayey SAND (SC) : medium dense, low plasticity clay, medium plasticity, grey brown, coarse grained, trace fine sized gravel, moist, (low resistance, with some high plasticity clay bands).			
						5	18.8				
						6	17.8	**BH2 Terminated at 5.5 m (Target Depth Reached)**			
						7	16.8				

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Boring No.: BH3

Easting	**: 285909.7**	**Drill Supplier**	**: HartGeo**	**Job Number**	**: P3023**	**Sheet**	**: 1 OF 2**
Northing	**: 6265478.7**	**Driller Company**	**: HartGeo**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 24(m)**	**Logged By**	**: Mark Peach**	**Project**	**: Castlereagh**		
Total Depth	**: 4.2 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
ADT		3 10 16 16 25+	Alluvial		SM	0.6	24	Alluvial Silty SAND (SM) : medium dense, brown grey, fine grained, moist to dry, (low resistance).	MD	M-D	
			Alluvial		SM	1 1.1	23	Alluvial Silty SAND (SM) : inferred medium dense, brown grey orange, fine grained, with low plasticity clay, moist, (low resistance).	D-VD	M	
			Alluvial		SC	2 3	22 21	As above, but Clayey (SC) : medium dense, low plasticity clay, low plasticity, red grey, medium grained, (low resistance, very sandy clay bands).	MD		

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Boring No.: BH3

Easting	: 285909.7	Drill Supplier	: HartGeo	Job Number	: P3023
Northing	: 6265478.7	Driller Company	: HartGeo	Client	: Jacob 4765 Investments Pty Ltd
Elevation	: 24(m)	Logged By	: Mark Peach	Project	: Castlereagh
Total Depth	: 4.2 m	Date	: 15/09/2023	Location	: 47-65 Old Castlereagh Road, Castlereagh NSW

Sheet : 2 OF 2

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
						4					
ADT			Alluvial		SC		20	As above, but grey red brown, coarse grained, with low plasticity clay, (high resistance, cobbles).			
								BH3 refusal at 4.2 m (Refusal on Cobbles)			
						5	19				
						6	18				
						7	17				

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Boring No.: BH4

Easting	**: 285872.1**	**Drill Supplier**	**: HartGeo**	**Job Number**	**: P3023**	**Sheet**	**: 1 OF 1**
Northing	**: 6265513.9**	**Driller Company**	**: HartGeo**	**Client**	**: Jacob 4765 Investments Pty Ltd**		
Elevation	**: 24.0(m)**	**Logged By**	**: Mark Peach**	**Project**	**: Castlereagh**		
Total Depth	**: 3.3 m**	**Date**	**: 15/09/2023**	**Location**	**: 47-65 Old Castlereagh Road, Castlereagh NSW**		

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
ADT		1 3 3	Topsoil		SC	0.3	24	Topsoil Clayey to silty SAND (SC) : loose, low plasticity clay, brown, fine to medium grained, moist to dry, (low resistance).	L	M-D	
		4 18 25+	Alluvial		SM	0.6		Alluvial Silty SAND (SM) : dense to very dense, brown grey, fine grained, moist to dry, (low resistance).	D-VD		
			Alluvial		SC	1 1.3	23	Alluvial Clayey to silty SAND (SC) : loose, low plasticity clay, orange grey brown, fine grained, moist, (low resistance).	L	M	
			Alluvial		SC	2	22	Alluvial Clayey SAND (SC) : loose to medium dense, low plasticity clay, red grey, medium grained, trace fine sized gravel, moist, (low resistance).	L-MD		
			Alluvial		SC	2.9 3	21	Alluvial Clayey to gravelly SAND (SC) : medium dense, low plasticity clay, red grey brown, medium to coarse grained, coarse sized gravel, moist, (medium to high resistance, cobbles).	MD		
								BH4 refusal at 3.3 m (Refusal on Cobbles)			

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Boring No.: BH5

Easting	: 285882.8	**Drill Supplier**	: HartGeo	**Job Number**	: P3023	**Sheet**	: 1 OF 1
Northing	: 6265556.4	**Driller Company**	: HartGeo	**Client**	: Jacob 4765 Investments Pty Ltd		
Elevation	: 24.1(m)	**Logged By**	: Mark Peach	**Project**	: Castlereagh		
Total Depth	: 3.8 m	**Date**	: 15/09/2023	**Location**	: 47-65 Old Castlereagh Road, Castlereagh NSW		

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
ADT		3 5 8 17 17 25+	Alluvial		SM	0.6	24.1	Alluvial Silty SAND (SM) : loose to medium dense, grey brown, fine grained, moist to dry, (low resistance).	L-MD	M-D	
			Alluvial		SC	1 1.3	23.1	Alluvial Clayey to silty SAND (SC) : medium dense, low plasticity clay, orange brown, fine grained, moist, (low resistance).	D-VD	M	
			Alluvial		SC	2 3	22.1 21.1	As above, but Clayey loose to medium dense, red grey, trace fine sized gravel.	L-MD		
			Alluvial		SC	3.4		As above, but medium dense, grey red brown, medium to coarse grained, (high resistance, cobbles).	MD		
								BH5 refusal at 3.8 m (Refusal in Cobbles)			

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Boring No.: BH6

Easting	: 285939.0	**Drill Supplier**	: HartGeo	**Job Number**	: P3023	**Sheet**	: 1 OF 1
Northing	: 6265537.1	**Driller Company**	: HartGeo	**Client**	: Jacob 4765 Investments Pty Ltd		
Elevation	: 24.1(m)	**Logged By**	: Mark Peach	**Project**	: Castlereagh		
Total Depth	: 3.8 m	**Date**	: 15/09/2023	**Location**	: 47-65 Old Castlereagh Road, Castlereagh NSW		

Drilling Method	Water	DCP graph	Soil Origin	Graphic Log	Classification Code	Depth (m)	Elevation (m)	Material Description	Consistency/Density	Moisture	Observations
		3 7 8	Alluvial		SM		24.	Alluvial Silty SAND (SM) : loose to medium dense, grey brown, fine grained, moist to dry, (low resistance).	L-MD	M-D	
		8 20 25+	Alluvial		SC	0.3		Alluvial Clayey to silty SAND (SC) : dense to very dense, low plasticity clay, orange, fine to medium grained, trace fine sized gravel, moist, (low resistance).	D-VD	M	
			Alluvial		SC	1 1.3	23.	As above, but loose to medium dense.	L-MD		
						2	22.				
						3	21.				
			Alluvial		SC	3.4		As above, but Clayey to gravelly medium dense, brown orange grey, medium to coarse grained, coarse sized gravel, (high resistance, cobbles).	MD		
								BH6 refusal at 3.8 m (Refusal on Cobbles)			

Soil and Rock Logging Explanatory Notes

GENERAL

Information obtained from site investigations is recorded on log sheets. The "Cored Drill Hole Log" presents data from an operation where a core barrel has been used to recover material - commonly rock. The "Non-Core Drill Hole - Geological Log" presents data from an operation where coring has not been used and information is based on a combination of regular sampling and insitu testing. The material penetrated in non-core drilling is commonly soil but may include rock. The "Excavation - Geological Log" presents data and drawings from exposures of soil and rock resulting from excavation of pits, trenches, etc.

The heading of the log sheets contains information on Project Identification, Hole or Pit Identification, Location and Elevation. The main section of the logs contains information on methods and conditions, material substance description and structure presented as a series of columns in relation to depth below the ground surface which is plotted on the left side of the log sheet. The common depth scale is 8m per drill log sheet and about 3-5m for excavation logs sheets.

As far as is practicable the data contained on the log sheets is factual. Some interpretation is inevitable in the identification of material boundaries in areas of partial sampling, the location of areas of core loss, description and classification of material, estimation of strength and identification of drilling induced fractures. Material description and classifications are based on SAA Site Investigation Code AS 1726 - 1993 with some modifications as defined below.

These notes contain an explanation of the terms and abbreviations commonly used on the log sheets.

DRILLING

Drilling & Casing

ADV	Auger Drilling with V-Bit
ADT	Auger Drilling with TC Bit
WB	Wash-bore drilling
RR	Rock Roller
NMLC	NMLC core barrel
NQ	NQ core barrel
HMLC	HMLC core barrel
HQ	HQ core barrel

Drilling Fluid/Water

The drilling fluid used is identified and loss of return to the surface estimated as a percentage.

Drilling Penetration/Drill Depth

Core lifts are identified by a line and depth with core loss per run as a percentage. Ease of penetration in non-core drilling is abbreviated as follows:

VE	Very Easy
E	Easy
M	Medium
H	High
VH	Very High

Groundwater Levels

Date of measurement is shown.

Standing water level measured in completed borehole

Level taken during or immediately after drilling

D	Disturbed
B	Bulk
U	Undisturbed
SPT	Standard Penetration Test
N	Result of SPT (sample taken)
PBT	Plate Bearing Test
PZ	Piezometer Installation
HP	Hand Penetrometer Test

EXCAVATION LOGS

Explanatory notes are provided at the bottom of drill log sheets. Information about the origin, geology and pedology may be entered in the "Structure and other Observations" column. The depth of the base of excavation (for the logged section) at the appropriate depth in the "Material Description" column. Refusal of excavation plant is noted should it occur. A sketch of the exposure may be added.

MATERIAL DESCRIPTION - SOIL

Classification Symbol - In accordance with the Unified Classification System (AS 1726-1993, Appendix A, Table A1)

Material Description - In accordance with AS 1726-1993, Appendix A2.3

Moisture Condition

D	Dry, looks and feels dry
M	Moist, No free water on remoulding
W	Wet, free water on remoulding

Consistency - In accordance with AS 1726-1993, Appendix A2.5

VS	Very Soft	< 12.5 kPa
S	Soft	12.5 – 25 kPa
F	Firm	25 – 50 kPa
St	Stiff	50 – 100 kPa
VSt	Very Stiff	100 – 200 kPa
H	Hard	> 200 kPa

Strength figures quoted are the approximate range of undrained shear strength for each class.

Density Index. (%) is estimated or is based on SPT results.

VL	Very Loose	< 15 %
L	Loose	15 – 35 %
MD	Medium Dense	35 – 65 %
D	Dense	65 – 85 %
VD	Very Dense	> 85 %

MATERIAL DESCRIPTION -ROCK

Material Description

Identification of rock type, composition and texture based on visual features in accordance with AS 1726-1993, Appendix A3.1-A3.3 and Tables A6a, A6b and A7.

Core Loss

Is shown at the bottom of the run unless otherwise indicated.

Bedding

Thinly Laminated	< 6 mm
Laminated	6 - 20
Very Thinly Bedded	20 - 60
Thinly Bedded	60 - 200
Medium Bedded	200 – 600
Thickly Bedded	600 – 2000
Very Thickly Bedded	> 2000

Weathering - No distinction is made between weathering and alteration. Weathering classification assists in identification but does not imply engineering properties.

Fresh (F)	Rock substance unaffected by weathering
Slightly Weathered (SW)	Rock substance partly stained or discoloured. Colour and texture of fresh rock recognisable.
Moderately Weathered (MW)	Staining or discolouration extends throughout rock substance. Fresh rock colour not recognisable.
Highly Weathered (HW)	Stained or discoloured throughout. Signs of chemical or physical alteration. Rock texture retained.
Extremely Weathered (EW)	Rock texture evident but material has soil properties and can be remoulded.

Strength - The following terms are used to described rock strength:

Rock Strength Class	Abbreviation	Point Load Strength Index, Is(50) (MPa)
Extremely Low	EL	< 0.03
Very Low	VL	0.03 to 0.1
Low	L	0.1 to 0.3
Medium	M	0.3 to 1
High	H	1 to 3
Very High	VH	3 to 10
Extremely High	EH	≥ 10

Strengths are estimated and where possible supported by Point Load Index Testing of representative samples. Test results are plotted on the graphical estimated strength by using:

° Diametral Point Load Test

Axial Point Load Test

Where the estimated strength log covers more than one range it indicates the rock strength varies between the limits shown.

MATERIALS STRUCTURE/FRACTURES

ROCK

Natural Fracture Spacing - A plot of average fracture spacing excluding defects known or suspected to be due to drilling, core boxing or testing. Closed or cemented joints, drilling breaks and handling breaks are not included in the Natural Fracture Spacing.

Visual Log - A diagrammatic plot of defects showing type, spacing and orientation in relation to core axis.

Defects	———	Defects open in-situu or clay sealed
	– – – – –	Defects closed in-situ
	.....	Breaks through rock substance

Additional Data - Description of individual defects by type, orientation, in-filling, shape and roughness in accordance with AS 1726-1993, Appendix A Table A10, notes and Figure A2.

Orientation - angle relative to the plane normal to the core axis.

Type	BP	Bedding Parting
	JT	Joint
	SM	Seam
	FZ	Fracture Zone
	SZ	Shear Zone
	VN	Vein
	FL	Foliation
	CL	Cleavage
	DL	Drill Lift
	HB	Handling Break
	DB	Drilling Break
Infilling	CN	Clean
	X	Carbonaceous
	Clay	Clay
	KT	Chlorite
	CA	Calcite
	Fe	Iron Oxide
	Qz	Quartz
	MS	Secondary Mineral
	MU	Unidentified Mineral
Shape	PR	Planar
	CU	Curved
	UN	Undulose
	ST	Stepped
	IR	Irregular
	DIS	Discontinuous
Rougness	POL	Polished
	SL	Slickensided
	S	Smooth
	RF	Rough
	VR	Very Rough

SOIL

Structures - Fissuring and other defects are described in accordance with AS 1726-1993, Appendix A2.6, using the terminology for rock defects.

Origin - Where practicable an assessment is provided of the probable origin of the soil, eg fill, topsoil, alluvium, colluvium, residual soil.

Appendix B

LABORATORY TEST CERTIFICATES

Material Test Report

Report Number: **P3023-1**
Issue Number: 1
Date Issued: 03/10/2023
Client: Morrow Geotechnical

Project Number: P3023
Project Name: Castlereagh
Work Request: 518
Sample Number: S-518A
Date Sampled: 19/09/2023
Dates Tested: 19/09/2023 - 03/10/2023

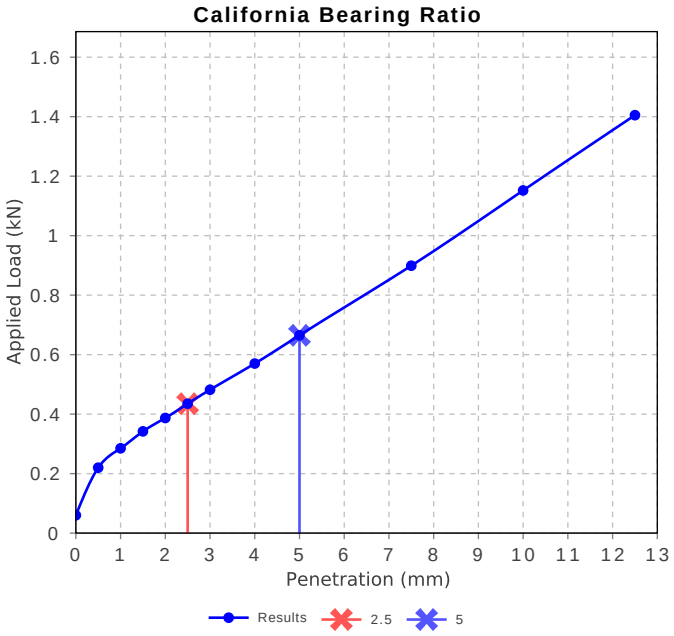
Atlas Geotechnical Services Pty Ltd
49/93-97 Newton Road Wetherill Park NSW 2164
Phone: 0426267115
Email: mh@atlasgeoservice.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Mahmudul Hossain
Director

NATA Accredited Laboratory Number: 20498

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**3.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	graph		
Method used to Determine Plasticity	visual		
Maximum Dry Density (t/m^3)	1.94		
Optimum Moisture Content (%)	11.0		
Laboratory Density Ratio (%)	97.5		
Laboratory Moisture Ratio (%)	101.0		
Moisture Content at Placement (%)	11.1		
Moisture Content Top 30mm (%)	16.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			
BH02			



Material Test Report

Report Number: **P3023-1**
Issue Number: 1
Date Issued: 03/10/2023
Client: Morrow Geotechnical

Project Number: P3023
Project Name: Castlereagh
Work Request: 518
Sample Number: S-518B
Date Sampled: 19/09/2023
Dates Tested: 19/09/2023 - 03/10/2023
Sampling Method: Sampled by Client
The results apply to the sample as received
Preparation Method: AS 1289.1.1 - Sampling and preparation of soils
Site Selection: Selected by Client

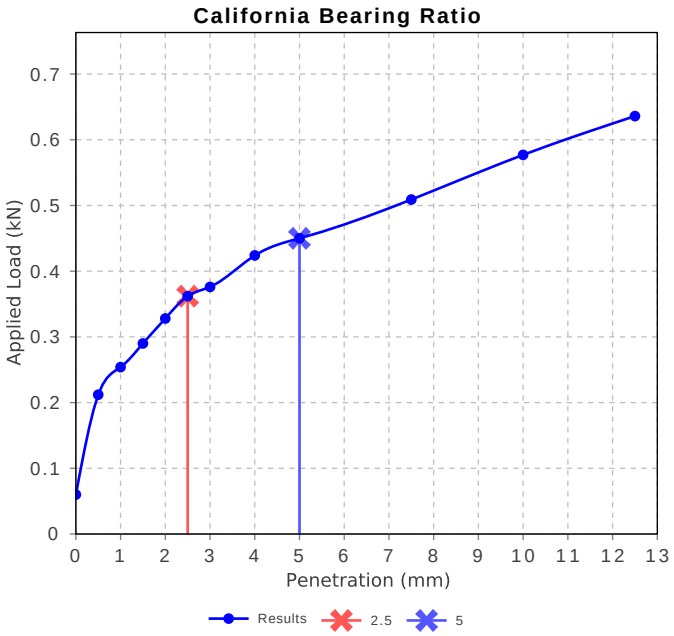
Atlas Geotechnical Services Pty Ltd
49/93-97 Newton Road Wetherill Park NSW 2164
Phone: 0426267115
Email: mh@atlasgeoservice.com.au

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Mahmudul Hossain
Director

NATA Accredited Laboratory Number: 20498

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**2.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	graph		
Method used to Determine Plasticity	visual		
Maximum Dry Density (t/m^3)	1.70		
Optimum Moisture Content (%)	14.5		
Laboratory Density Ratio (%)	98.0		
Laboratory Moisture Ratio (%)	100.5		
Moisture Content at Placement (%)	14.5		
Moisture Content Top 30mm (%)	15.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	72.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			
BH03			



Appendix C

IMPORTANT INFORMATION

Important Information

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