GROUNDWATER STUDY REPORT

GROUNDWATER DEPTH

Proposed Residential Development
45/49 Warriewood Road, Warriewood, NSW

Report To:

Mikara Developments Pty Ltd C/O

CPS

Report By:

NG Child & Associates

16 November 2021

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DOCUMENT CONTROL REGISTER

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TABLE OF CONTENTS

APPENDICES

LIST OF DIAGRAMS

LIST OF TABLES

1 INTRODUCTION

1.1 INTRODUCTION

Creative Planning Solutions (CPS), on behalf of its client Mikara Developments Pty Ltd, is coordinating the planning and prospective delivery of a residential development at 45 Warriewood Road, Warriewood, NSW.

The proposed development site is described in 1.2 to 1.5 below.

The proposed development is subject to the regulatory control of the Northern Beaches Council, and relevant NSW Government departments and agencies.

Northern Beaches Council is the consent authority for the development.

CPS has engaged NG Child & Associates to provide a revised version of a six-month study of groundwater depth and behaviour at the site completed in November 2020, including the final plans and drawings for the development.

Noel Child of NG Child & Associates is an appropriately qualified and experienced consultant to undertake the work required.

His experience and qualifications are summarised in Appendix B.

This revised report describes the installation of three groundwater monitoring wells at the site and presents the findings and recommendations of a six-month study of groundwater depths at the site, and associated rainfall influences.

1.2 SITE LOCATION

Satellite views and street maps showing the location of the proposed development are provided in Figures 1.1 and 1.2 respectively on the following page.

The direction of north is towards the top of both diagrams.

The site area is shown shaded in blue in both diagrams.

The proposed development site is bounded by Warriewood Road to the north; by prospective or existing residential developments to the east and west, and by Narrabeen Creek to the south and south-west.

The closest major road is Pittwater Road, some 50 metres to the east of the site.

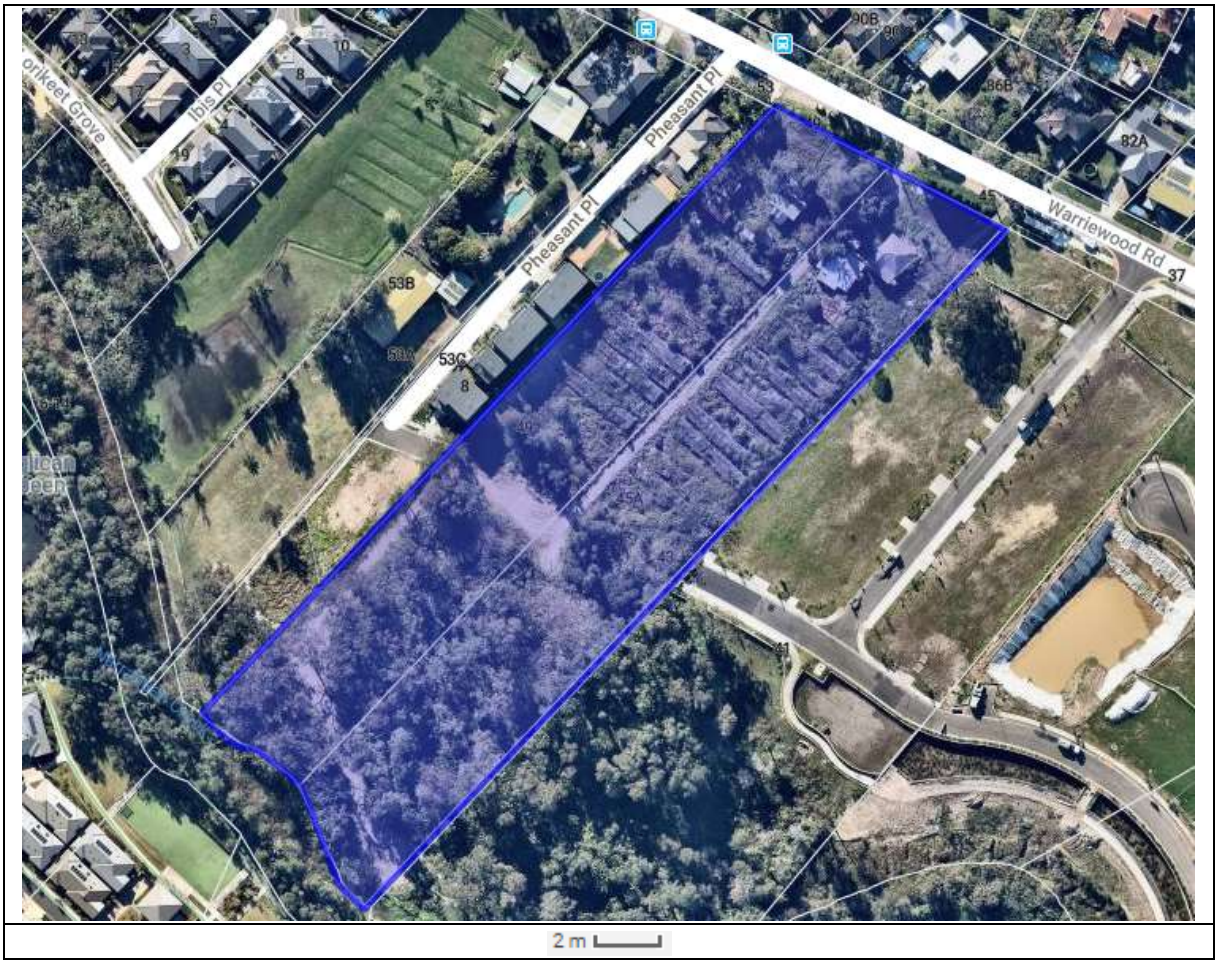


Figure 1.1 – Aerial View of the Proposed Development Site

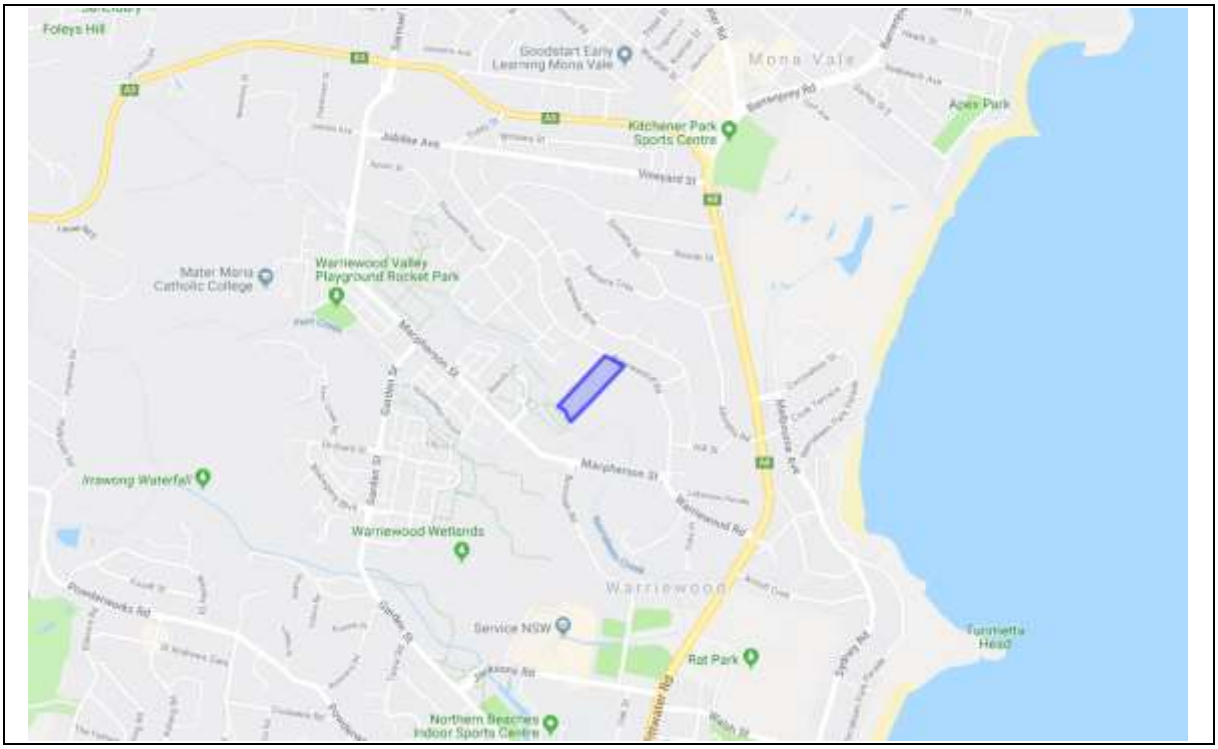


Figure 1.2 – Street Map Showing the Site Location

Views of structures at the site from Warriewood Road, are provided in Figures 1.3 to 1.6 below, and on the following page.

Figure 1.3 – Existing Buildings and Structures on 49 Warriewood Road (1)

Figure 1.4 – Existing Buildings and Structures on 45 Warriewood Road (2)

Figure 1.5 – Existing Buildings and Structures on 49 Warriewood Road (3)

Figure 1.6 – Existing Building on 45 Warriewood Road

Internal views of the site the site are provided in Figures 1.7 and 1.8 below.

Figure 1.7 – Typical Overgrown Former greenhouses in Centre Area of Site

Figure 1.8 – Internal Access Track from Warriewood Road to Rear Site Boundary

1.3 ZONING

The zoning of the proposed development site, and surrounding properties, is shown in Figure 1.9, below.

Figure 1.9 – Land Zoning Diagram

The diagram provided in Figure 1.9 is sourced from the current Northern Beaches Local Environment Plan. The site is shown at the approximate centre of Figure 1.9 and is zoned R3 Medium Density Residential.

Immediate surrounding land is also zoned R3 Medium Density Residential, with R2 low density residential land present on the opposite (northern) side of Warriewood Road, and a strip of public recreation land along the creek line bordering the site to the south.

1.4 PROPERTY DETAILS

Survey details of the site are provided for reference in Figures 1.5 and 1.6, on the following pages. The site formally comprises Lots 1 & 2 in Deposited Plan (DP) 349085 and Lot 2 in DP 972209, and is known as 43, 35 & 49 Warriewood Road, Warriewood.

The aggregate site has an approximate area of 21,500 square metres.

1.5 PROJECT DESCRIPTION & PLAN

This proposed development involves a residential subdivision and development.

Site survey details are as follows:

Figure 1.10 Site Survey (Sheet 1 of 2)

Figure 1.11 Site Survey (Sheet 2 of 2)

Figure 1.12 Site Analysis

Figure 1.13 Site Plan

Figure 1.14 Basement Plan

Figure 1.15 Ground Floor Plan

Figure 1.16 First Floor Plan

Figure 1.17 Second Floor Plan

Figure 1.18 Roof Plan

Figure 1.19 Elevations 01

Figure 1.20 Elevations 02

Figure 1.21 Elevations 03

Figure 1.22 Section AA

Figure 1.23 Section BB

Figure 1.24 Demolition Plan

Figure 1.25 3D Height Envelope

Figure 1.26 Views

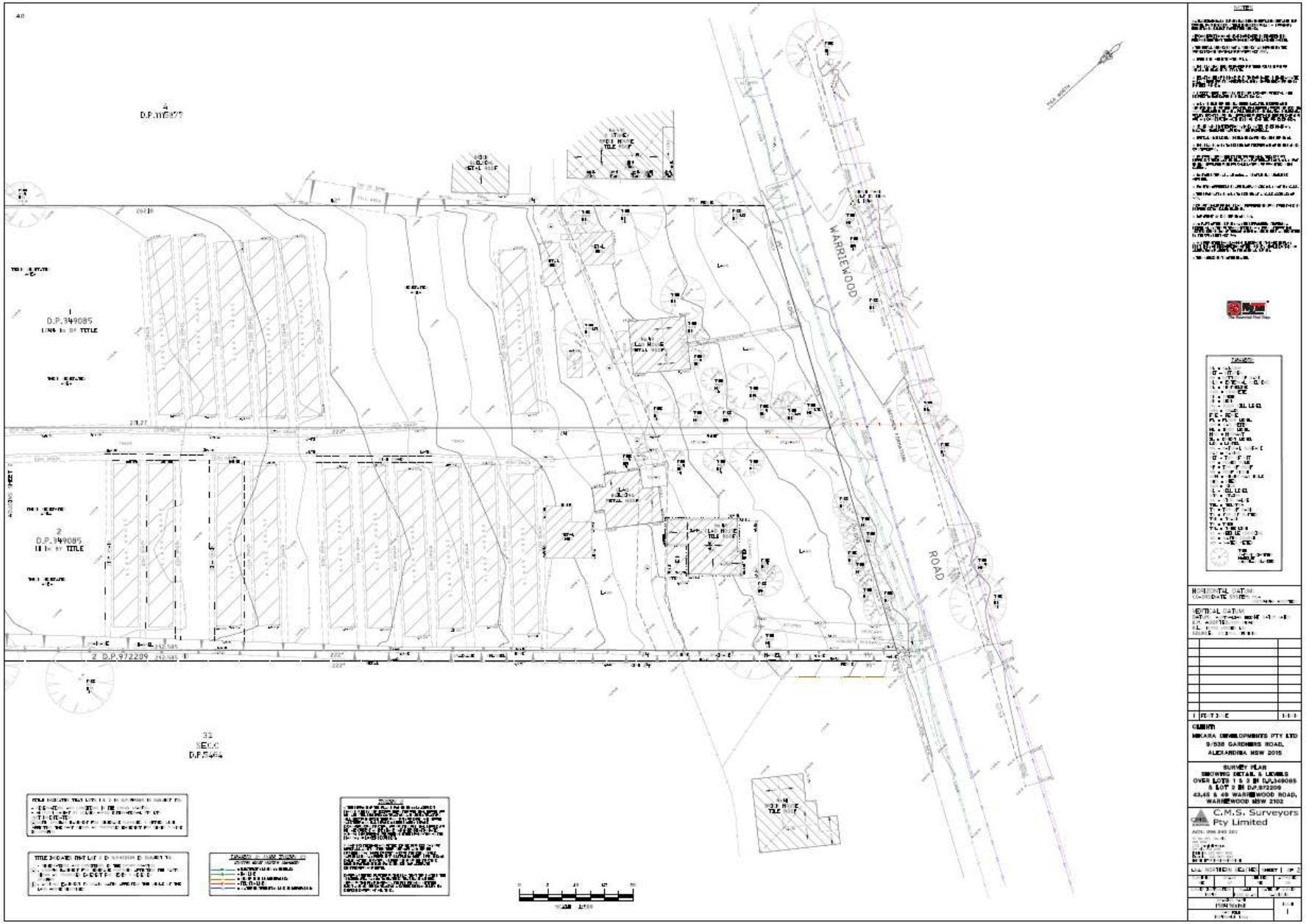


Figure 1.10 – Site Survey (Sheet 1 of 2)

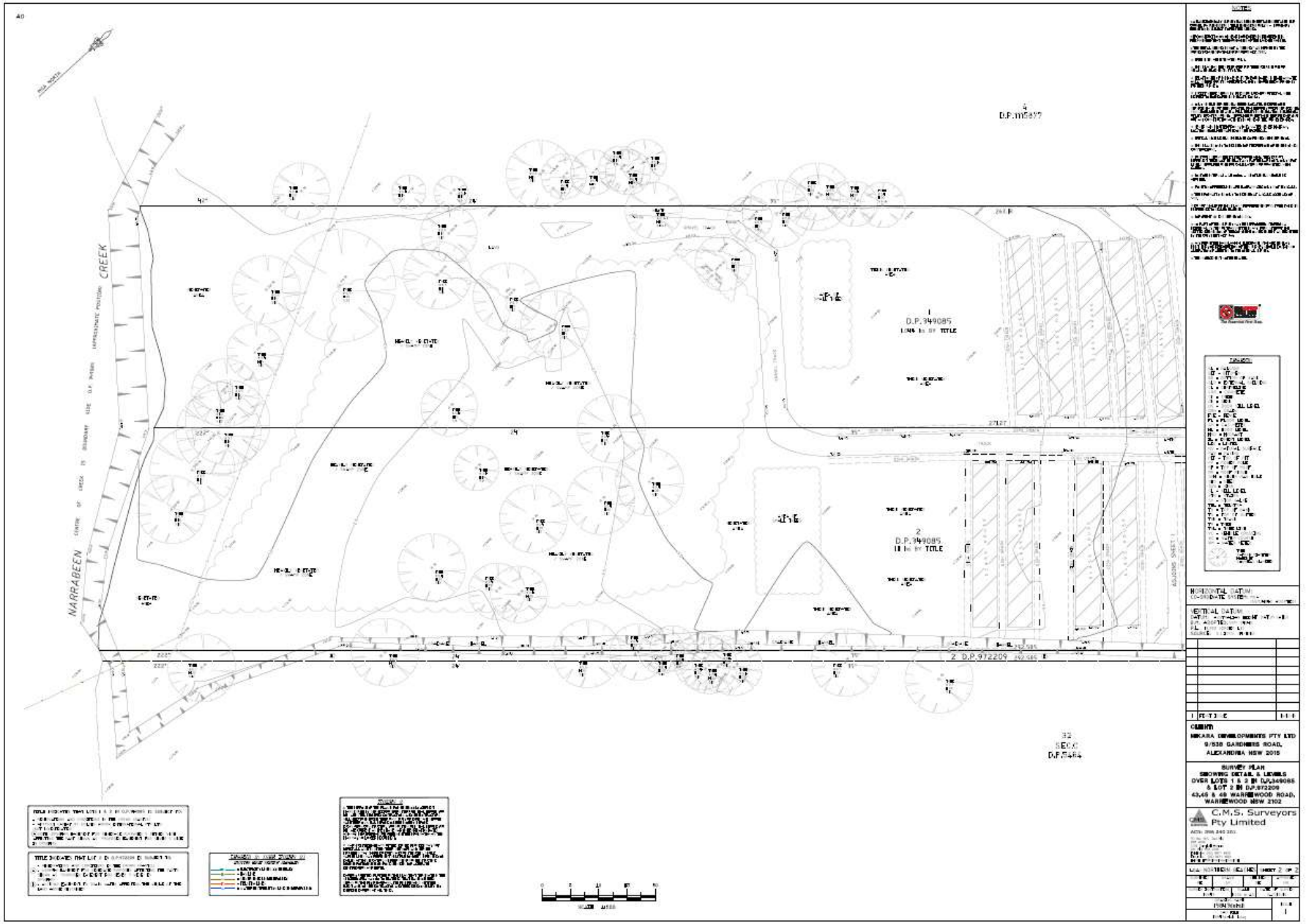


Figure 1.11 – Site Survey (Sheet 2 of 2)

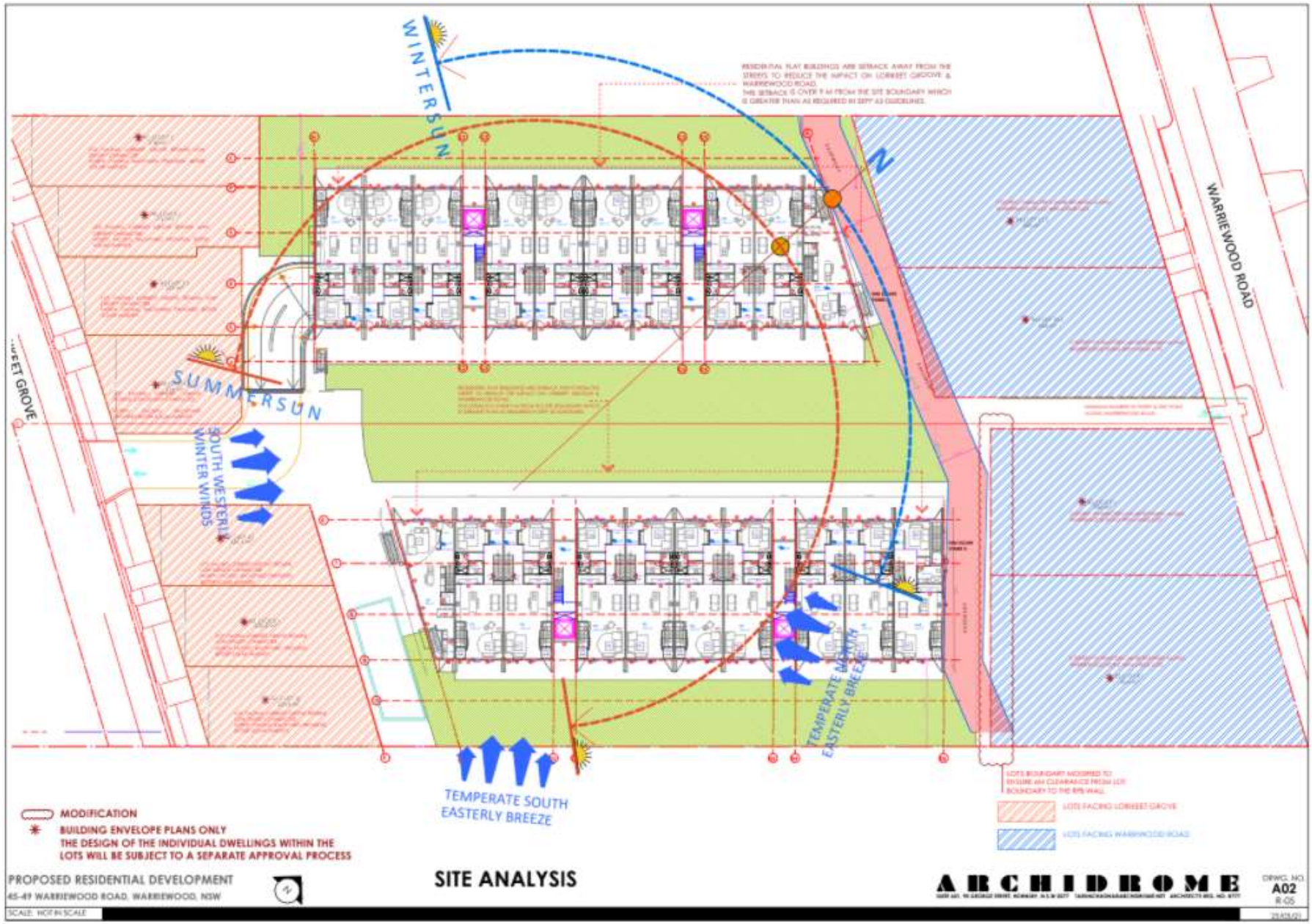


Figure 1.12 – Site Analysis

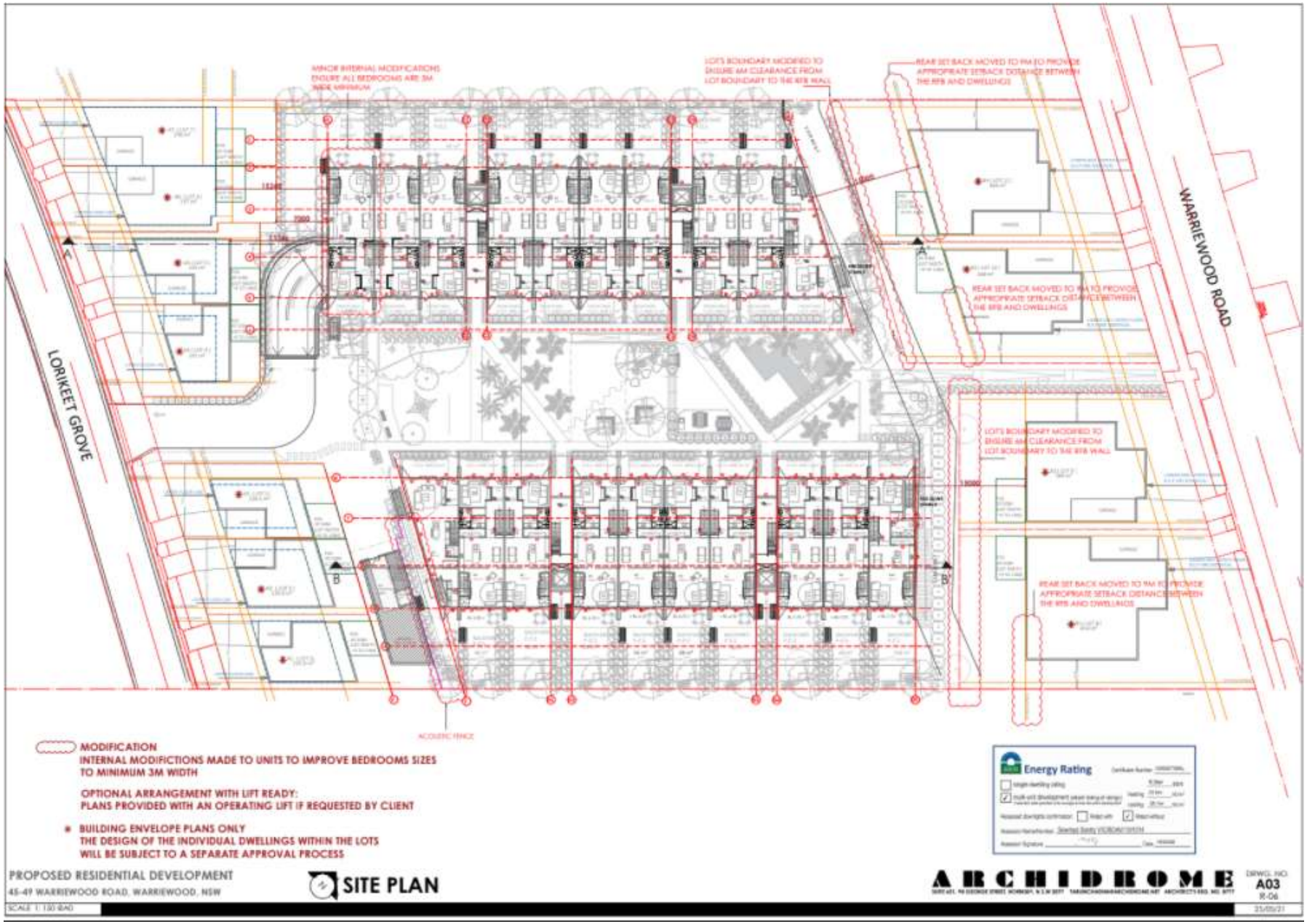


Figure 1.13 – Site Plan

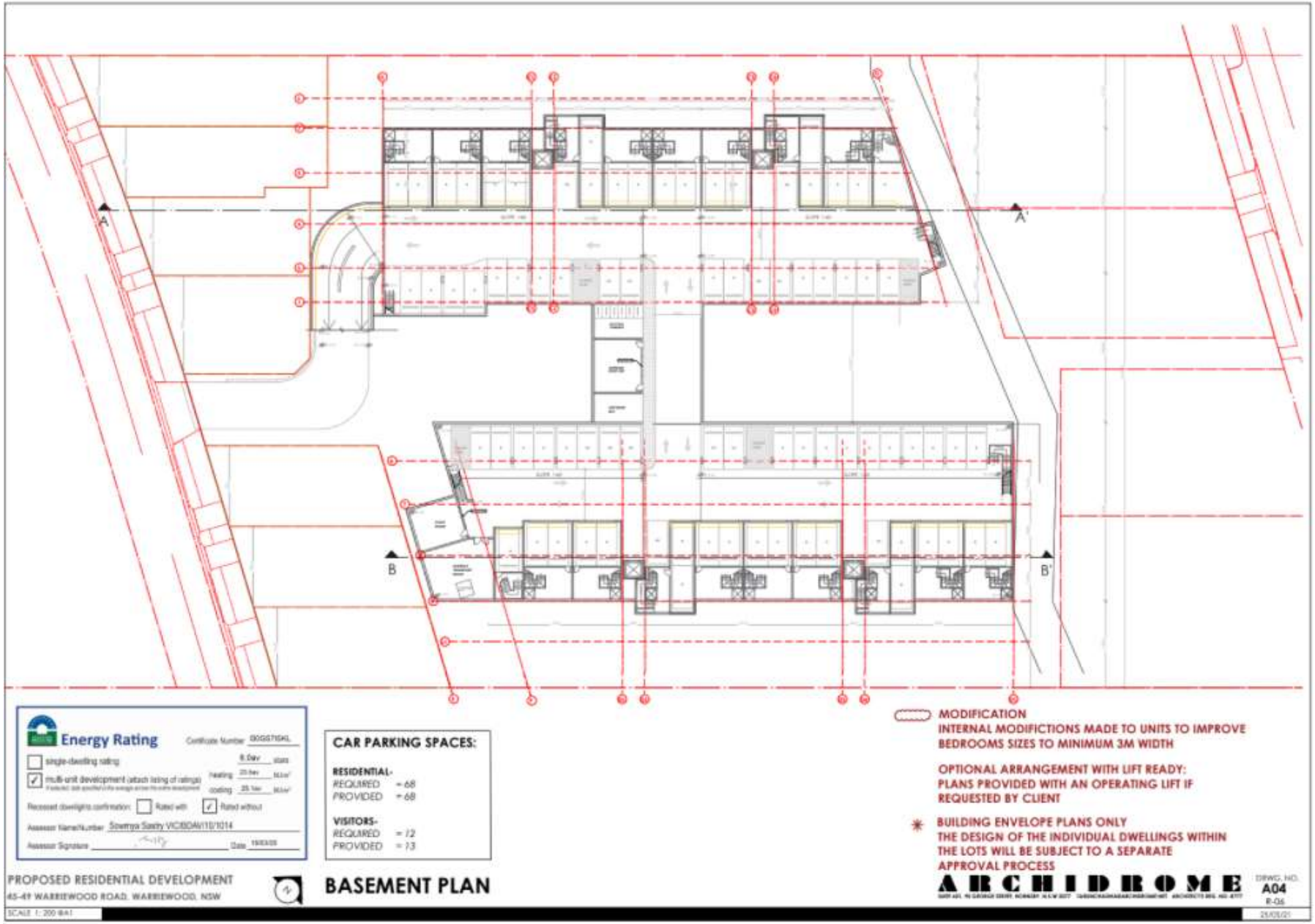


Figure 1.14 – Basement Plan

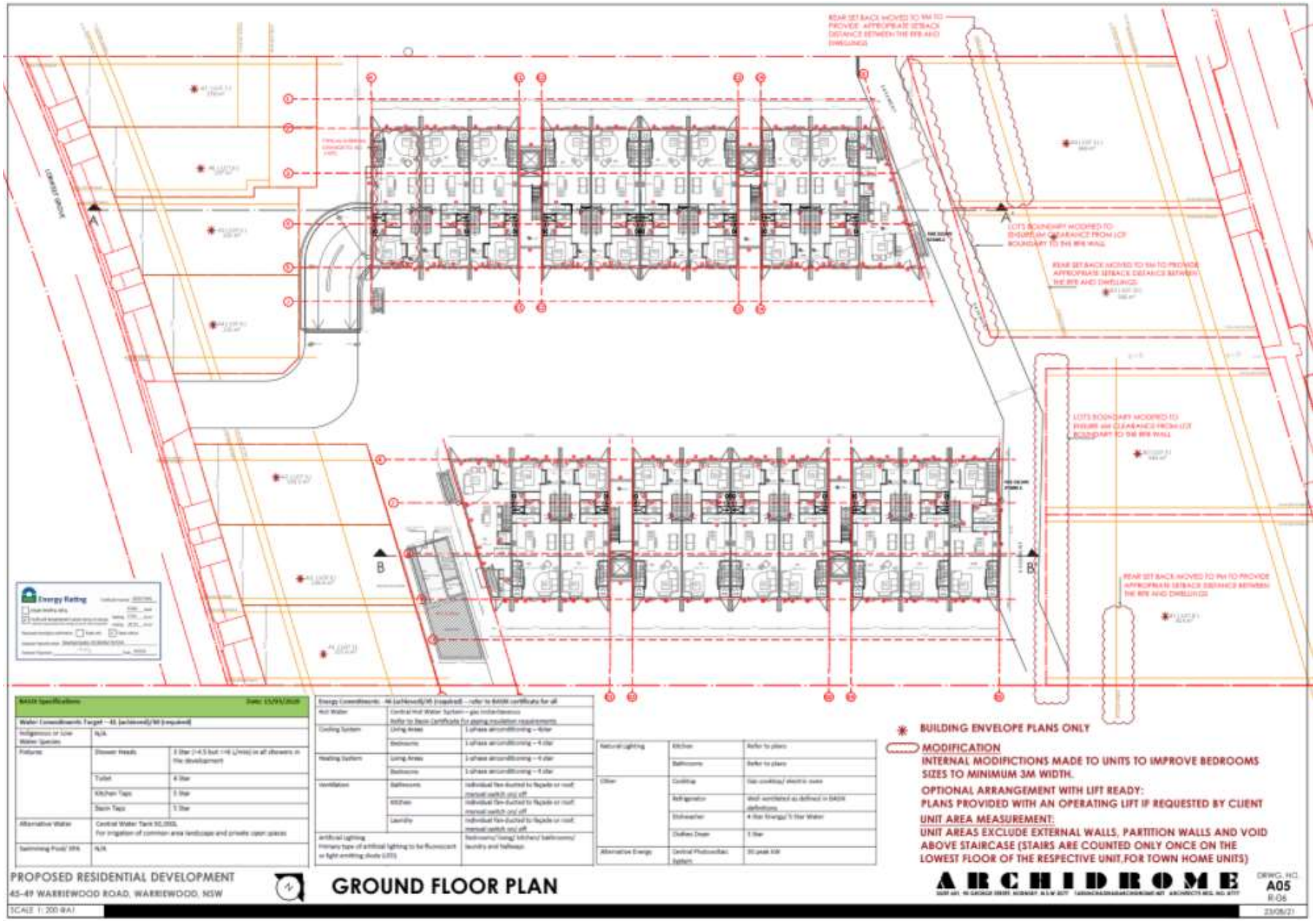


Figure 1.15 – Ground Floor Plan

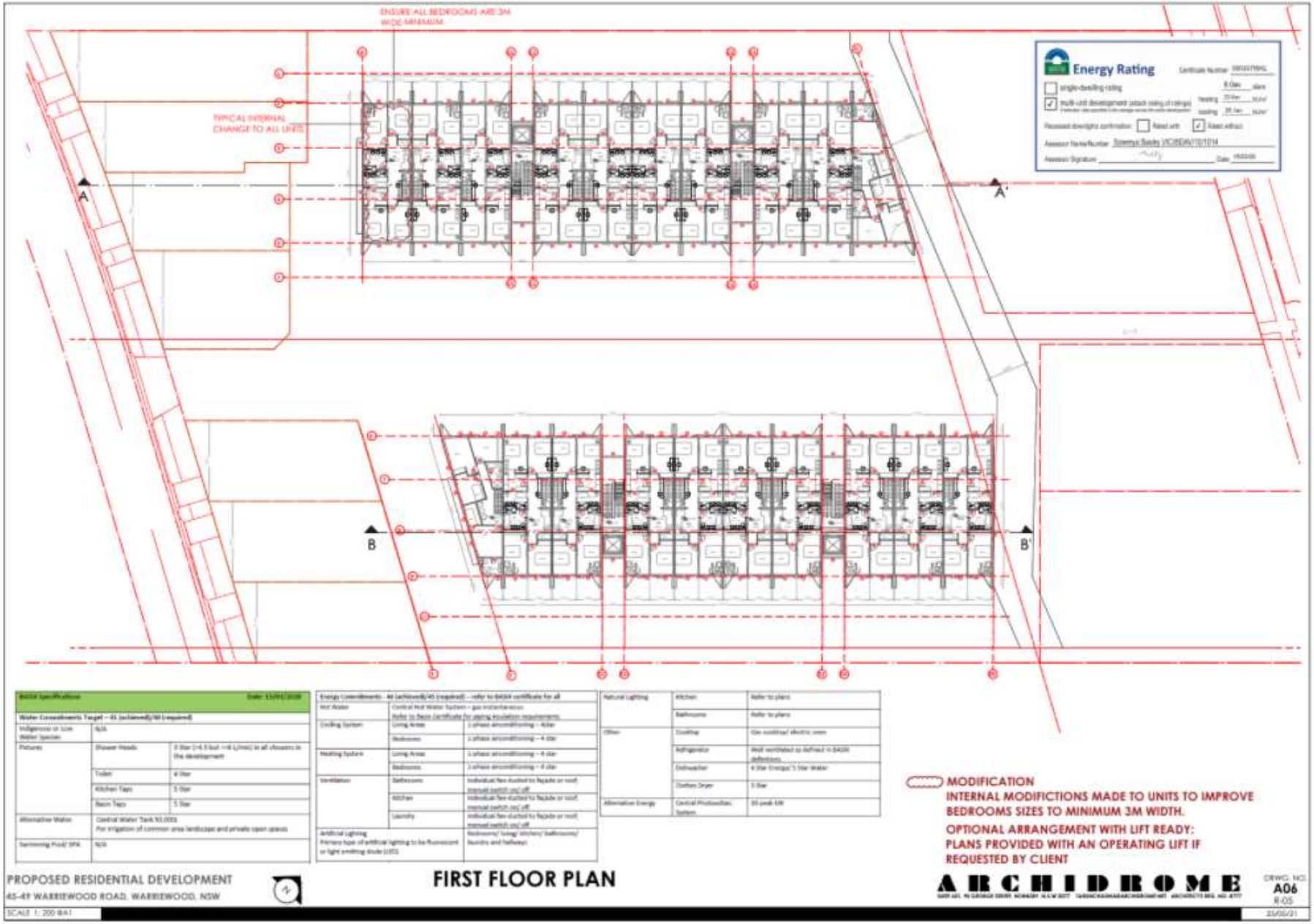


Figure 1.16 – First Floor Plan

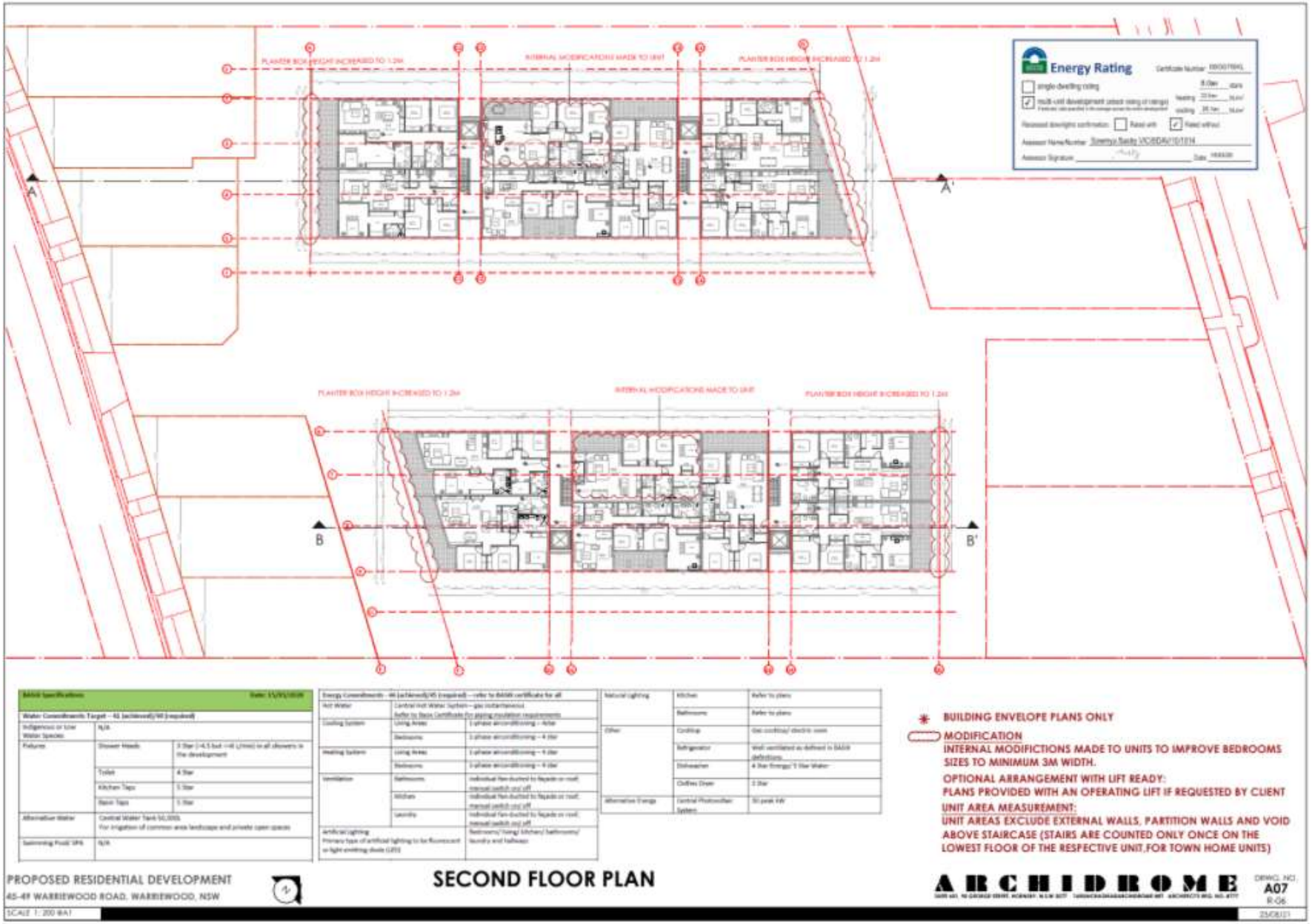


Figure 1.17 – Second Floor Plan

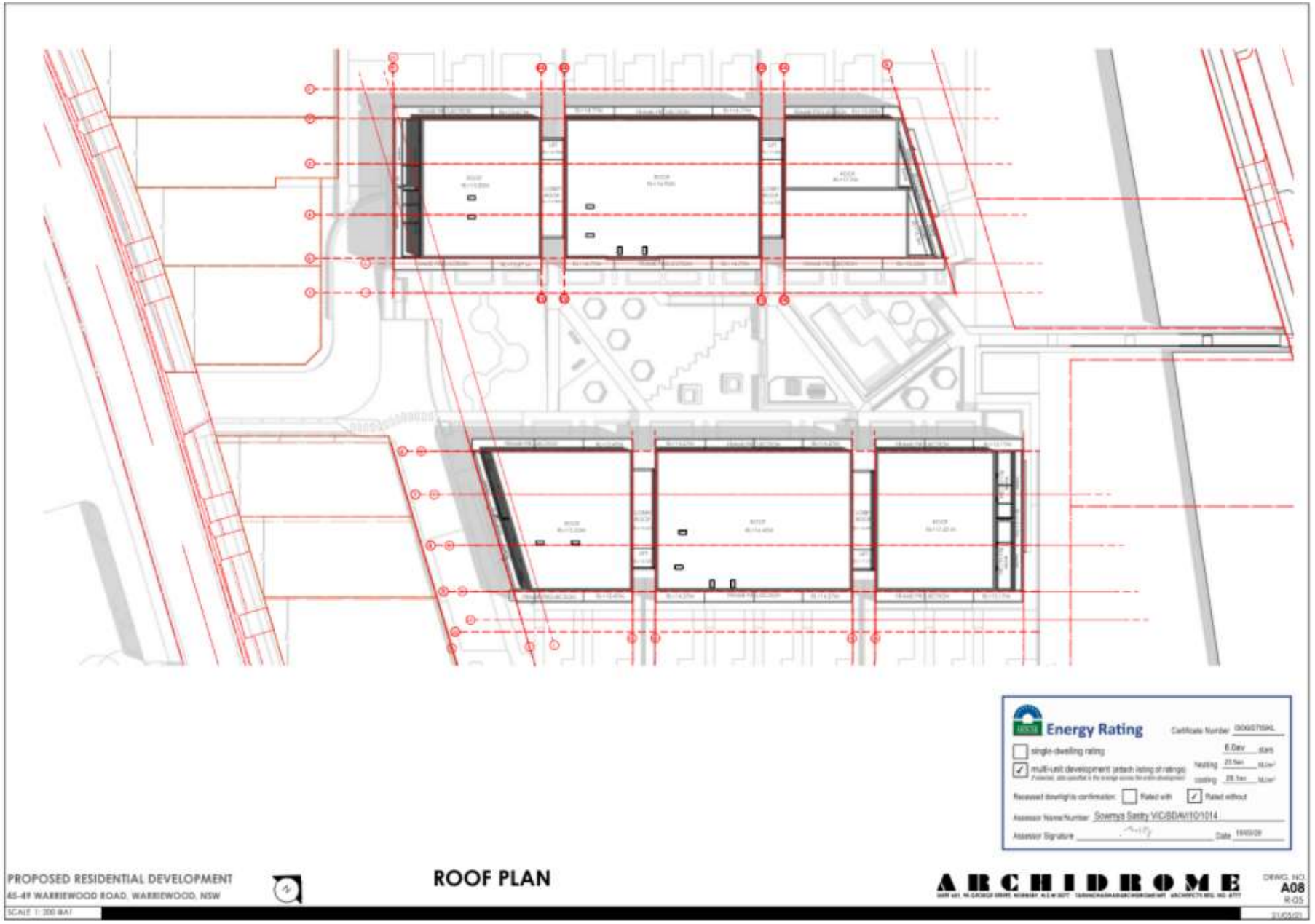


Figure 1.18 – Roof Plan

Figure 1.19 – Elevations 01

Figure 1.20 – Elevations 02

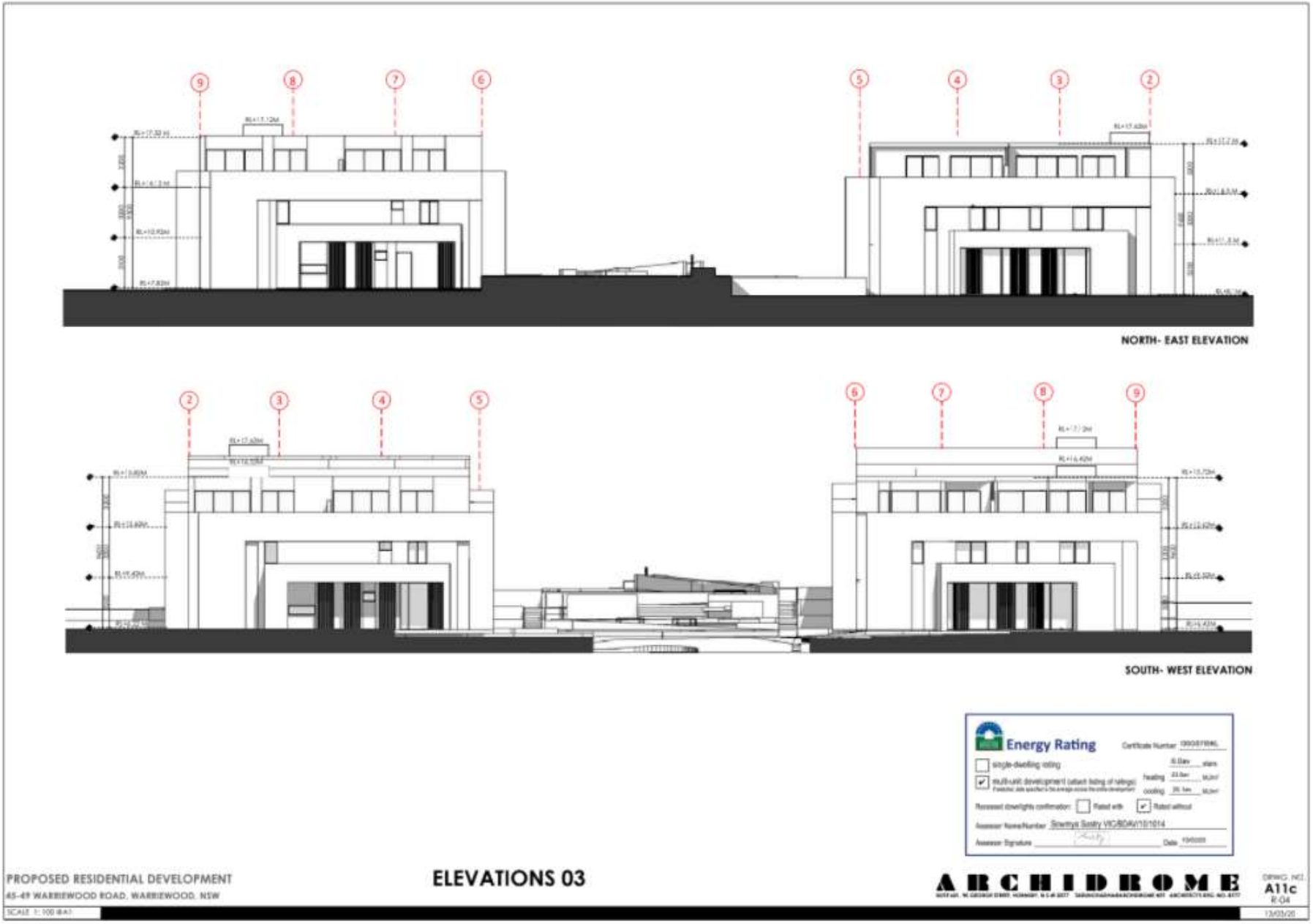


Figure 1.21 – Elevations 03

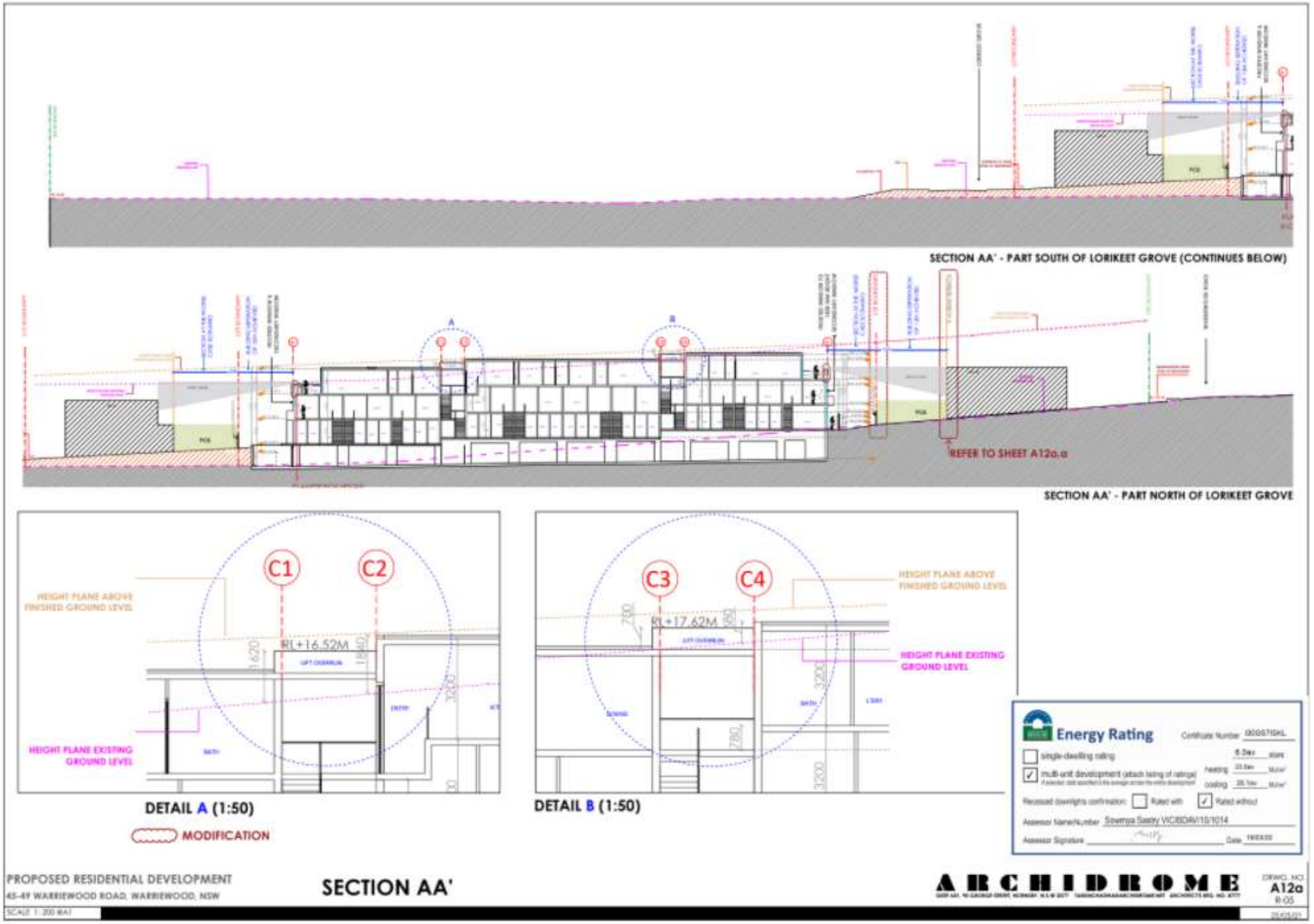


Figure 1.22 – Section AA

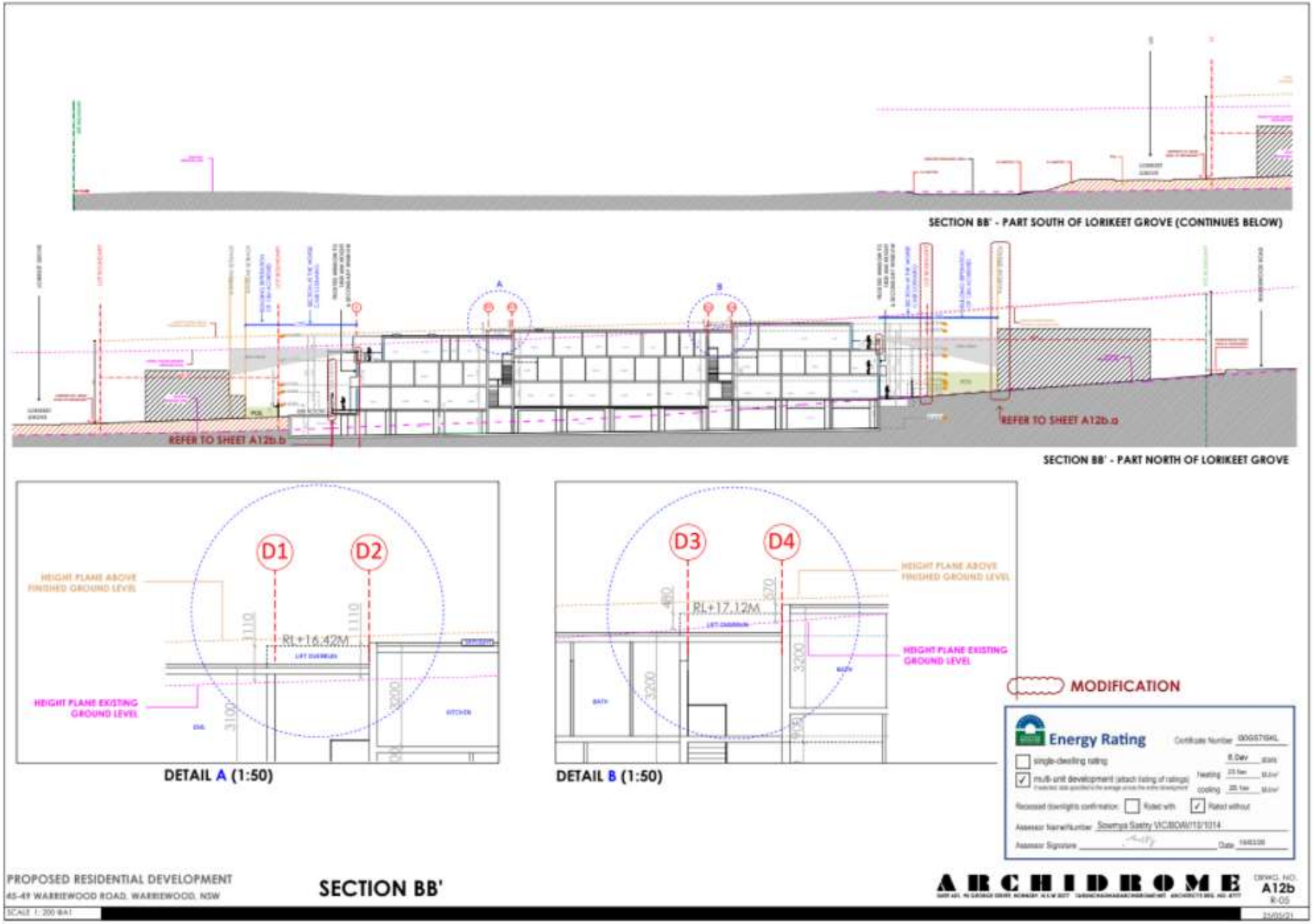


Figure 1.23 – Section BB

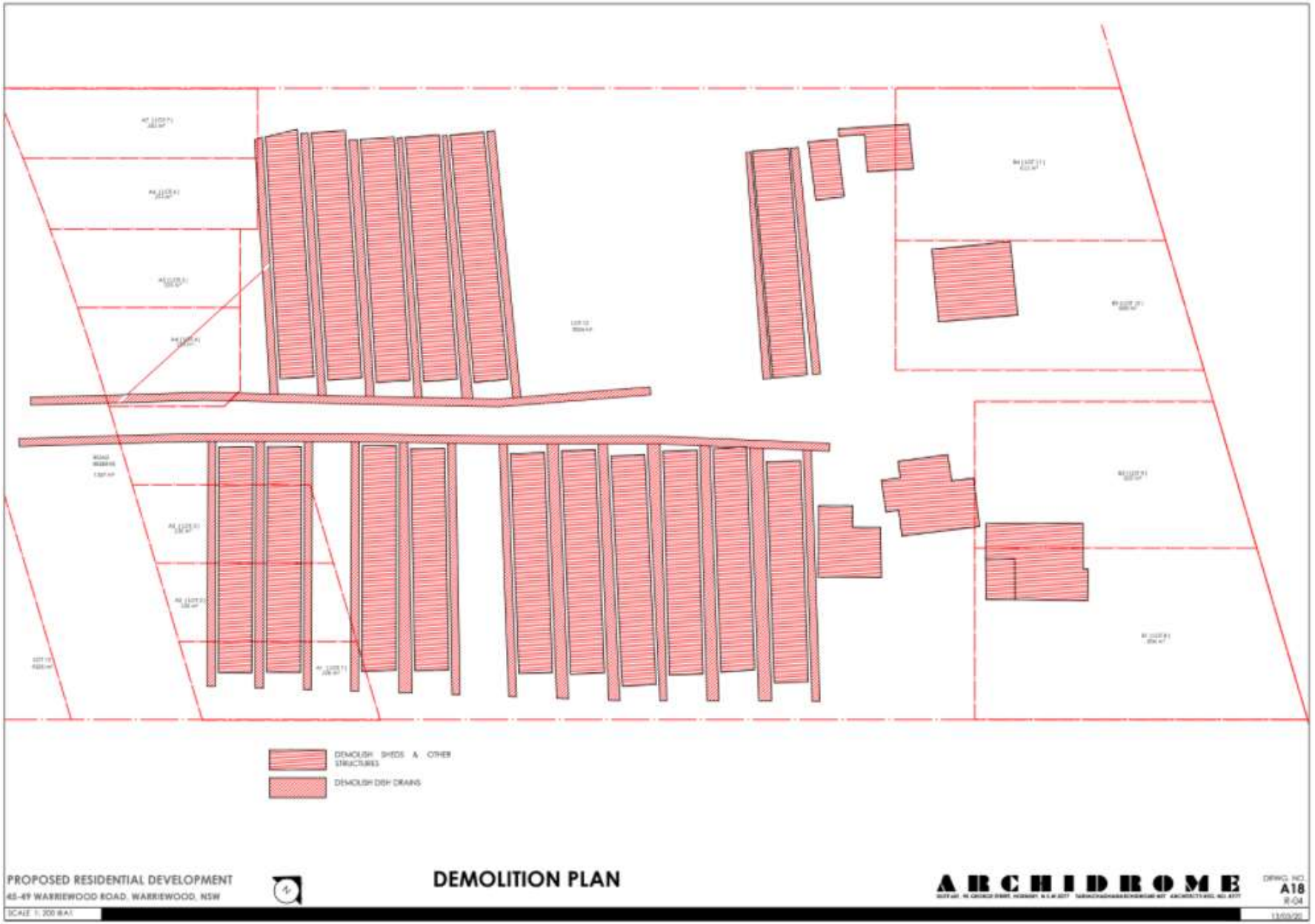


Figure 1.24 – Demolition Plan

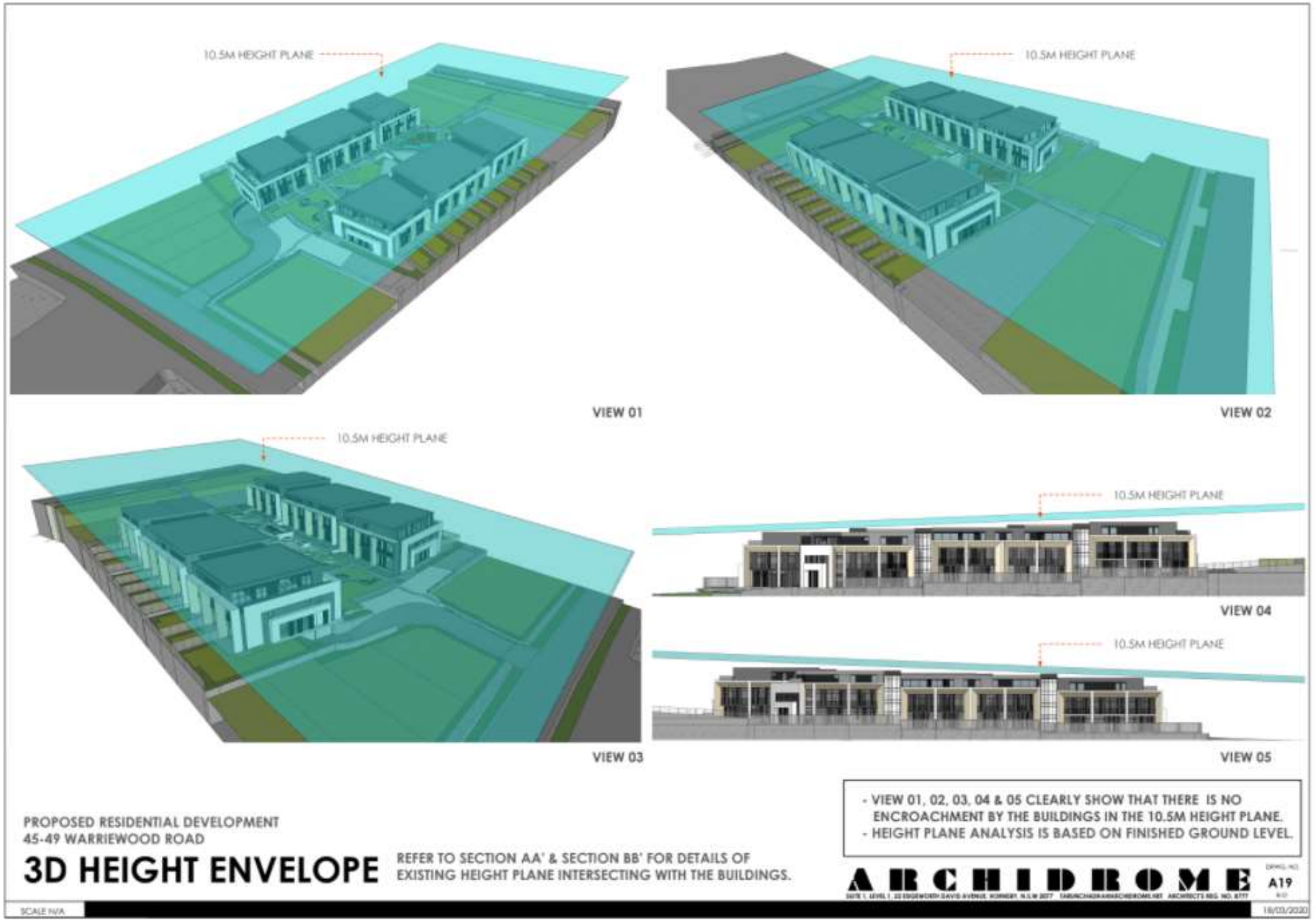


Figure 1.25 – 3D Height Envelope

Figure 1.26 – Views

2 ASSESSMENT REQUIREMENTS

2.1 INTRODUCTION

As part of the overall assessment of the 45/49 Warriewood Road site, an appropriate consideration of groundwater depth and behaviour is required.

2.2 NORTHERN BEACHES COUNCIL REQUIREMENTS

Northern Beaches Council has indicated that it requires two basic considerations of groundwater depth and behaviour at the site.

These are as follows:

2.2.1 Groundwater Level Investigation

Council requires a report on groundwater levels based on six months monitoring of water levels and other data from a minimum of three groundwater monitoring wells to be installed at the site.

Reference is made to Page 11 of the pre-DA meeting notes:

> "*Issues specific to this site Paragraph 2 "Please note: Water level monitoring should be undertaken on a regular basis for a period of six months from monitoring bores installed at the site upslope of the EEC (Endangered Ecological Community). Monitoring results should include a rainfall hyetograph to indicate the sensitivity of groundwater levels to periods of rainfall. A minimum of three bores should be installed to allow triangulation of water levels, determination of the hydraulic gradient and interpretation of flow direction"*

and to Page 17 of the pre-DA meeting notes

> *"Documentation to Accompany the Development Application "Water Table Report".*

2.2.2 Site Works Required

Work required to satisfy Council's requirements included the installation of three groundwater monitoring wells.

Installation of the groundwater monitoring wells involved the use a truck mounted mechanical augur, and construction of the groundwater monitoring wells using appropriate casings, screens and packing materials, as described in detail in Section 4 of this report.

Ground water level investigation to satisfy Council's requirement will require initial measurement of groundwater depths following the installation of the three wells, followed by monthly attendance at the site for a six-month period; measurement of groundwater levels in each well; reconciliation of groundwater levels with rainfall records; calculation of groundwater flow based on a triangulation of monitoring well data and surveyed ground levels at each well, and preparation of an appropriate report.

3 PREVIOUS REPORTS & FINDINGS

The most recent available groundwater depth information available in the vicinity of the 45/49 Warriewood Road site is provided in a report prepared by Morrrow Geotechnics Pty Ltd in 2018 for the adjacent development site at 53 Warriewood Road, as follows:

> *Geotechnical Investigation: Lot 10, 53C Warriewood Road, Warriewood NSW (Morrow; July 12th, 2018)*

53C Warriewood Road is the property to the immediate west of 45/49 Warriewood Road.

Data regarding depth to groundwater was included for three boreholes, as detailed in Table 3.1 and Figure 3.1 below, and on the following page.

The three boreholes indicated groundwater at depths of 3.7, 4.2 and 4.2 metres at points near Warriewood Road, and progressively towards the rear or southeastern site boundary.

These groundwater levels, which were measured during a period of relatively dry weather, indicated groundwater levels significantly below the lowest depth of the basement structure proposed for the 45/9 Warriewood Road development.

However, those indicative findings are subject to the six-month study of groundwater depths presented in this report.

While details are not provided in the July 2018 Morrow report, it is noted that a check of Bureau of Meteorology (BoM) records for the year 2018 indicates that:

> *Below average to average rainfall, with some days of localised heavy rainfall. Rainfall across the two-day period from 28 to 29 November resulted in many sites recording one of these days as their wettest day of the year across Greater Sydney Above average rainfall was recorded during June, October, November and December, with most other months recording average or below average rainfall. Total rainfall for the year was below average at most sites.*

This snapshot of background weather data suggests that the groundwater levels presented in the 2018 Morrow report reflected a period of below average rainfall.

Higher rainfall events reported later in the year would not have impacted on the groundwater levels recorded earlier in the year and reported in the July 2018 document.

Groundwater depths presented in the 2018 Morrow report are summarised in Table 3.1, below.

Table 3.1 – Groundwater Depths from the 2018 Morrow Report

Borehole ID	Date of Monitoring	Depth Below Ground Level (m)
BH1	5 July 2017	3.7 m
BH2	4 July 2027	4.2 m
BH3	4 July 2017	4.2 m

Location of the three monitoring wells is described in Figure 3.1, on the following page.

The Warriewood Road boundary is shown to the right of Figure 3.1.

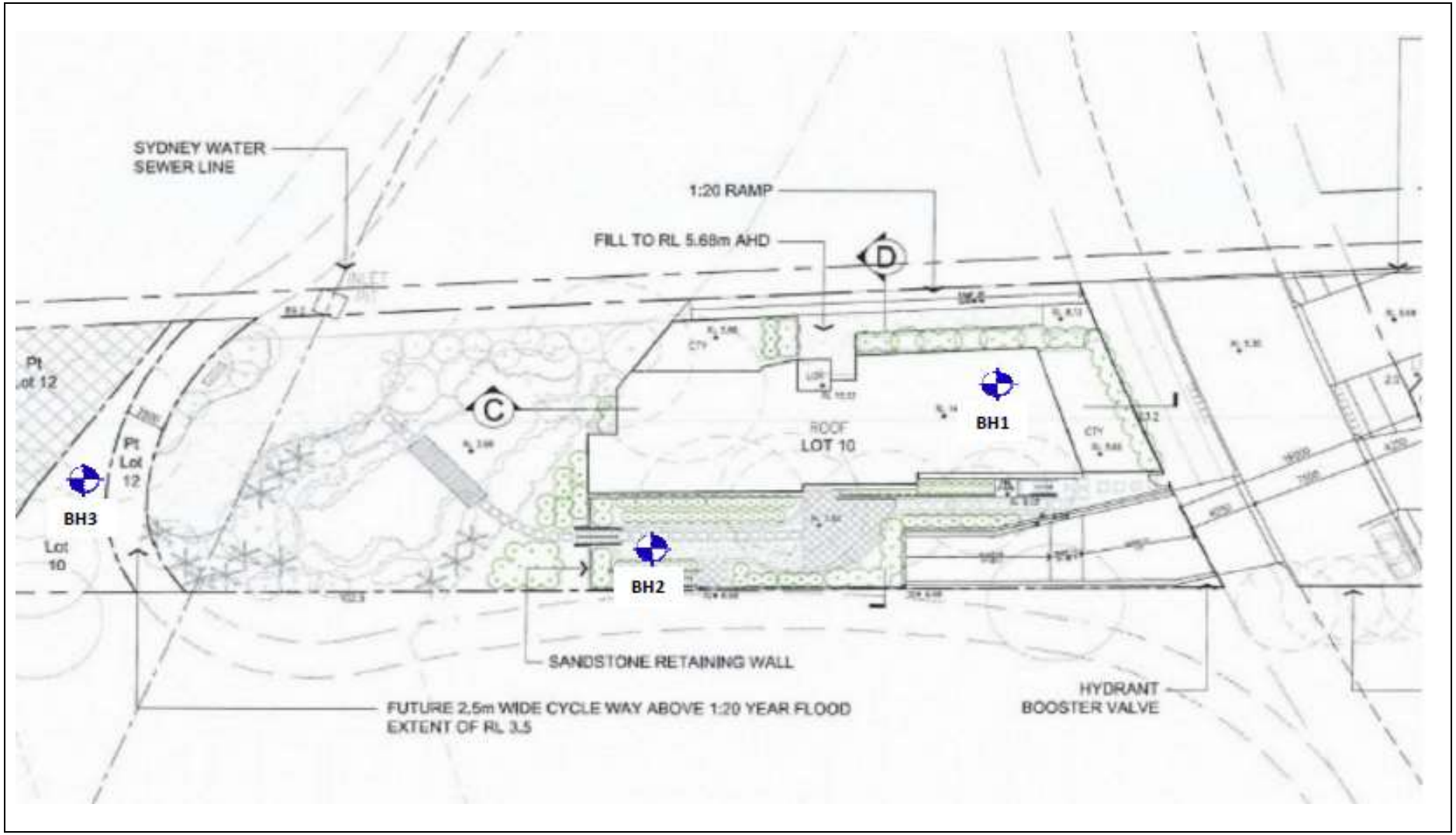


Figure 3.1 – Details of Monitoring Wells in the 2018 Morrow Report

4 GROUNDWATER MONITORING WELLS

4.1 LOCATION & NATURE OF WELLS

Three groundwater monitoring wells were installed at the site on Thursday April 9th, 2020.

The three wells were installed at the locations indicated in Figure 4.1 below, to reflect representative locations throughout the site area, and representative locations down the typical slope of the site from Warriewood Road towards Narrabeen Creek.

Figure 4.1 – Location of Groundwater Monitoring Wells

The wells were installed and constructed in accordance with accepted professional practice.

100 mm diameter soil bores were drilled to either refusal, or to depths sufficiently below the levels at which the intrusion of groundwater was indicated.

50 mm slotted PVC well screen pipes, capped at the base, were installed from the bottom of each well to approximately 500 mm above the depths at which groundwater instruction was noted.

50 mm solid wall PVC well casing pipes were installed from the top of the screen pipes to approximately 900 mm above finished ground level at the wells.

Coarse sand/fine quartz well screening material was placed around the well pipes from the bottom of the wells to approximately 300 mmm above the well screen pipes.

From the top of the screening sand/gravel layer, a xxx seal was installed to a depth of approximately 500 mm below finished ground level.

Quick set concrete was then used to provide a cap to the wells, and to fix and seal galvanized steel "monument" boxes to secure and protect the wells.

The monument boxes included hinged, lockable lids.

An indication of the typical monitoring well set-up is provided in Figure 4.2, below.

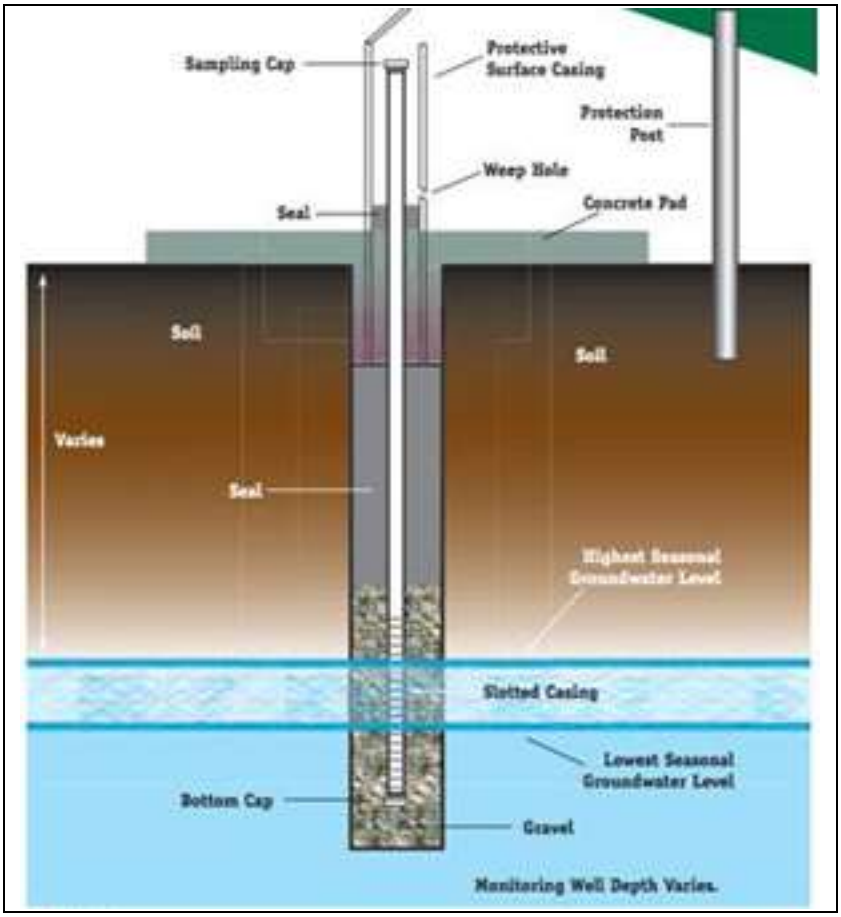


Figure 4.2 – Typical Monitoring Well Set-Up

Photographs illustrating the monitoring wells and their construction are provided in Figures 4.3 to 4.6 on subsequent pages, as follows:

Figure .4.3 Typical Orange Coloured Clay Turnings at Borehole MW1

Figure 4.4 Wet Light Grey Coloured Clay in Saturated Zone at MW2

Figure 4.5 Well Casing Pipe Installed at MW3

Figure 4.6 "Monument" Style Well Pipe Cover at MW1

4.2 SOIL BORE LOGS

Soil bore logs for each of the three groundwater monitoring wells have been included for reference at Appendix A

Figure 4.3 – Typical Orange Coloured Clay Turnings at Borehole MW1

Figure 4.4 – Wet Light Grey Coloured Clay in Saturated Zone at MW2

Figure 4.5 – Well Casing Pipe Installed at MW3

Figure 4.6 – "Monument" Style Well Pipe Cover at MW1

5 GROUNDWATER DEPTHS

5.1 MONITORING WELL MEASUREMENTS

Initial groundwater depths in each of the three monitoring wells installed at the site were measured on Thursday April 16th, 2020. These initial measurements were reported in the document *Groundwater Study Progress Report No: 1 Water Table Monitoring Program Proposed Residential Development 45/49 Warriewood Road, Warriewood, NSW (Version 1; April 17th, 2020)*.

These initial groundwater depths were reported in the April 17th, 2020, report, and are repeated in Table 5.1 below.

Table 5.1 – Groundwater Depths (April 16th, 2020)

Monitoring Well ID	Monitoring Date	Depth in Metres (Below FGL *)
MW1	16 April 2020	4.4
MW2	16 April 2020	2.2
MW3	16 April 2020	1.9

FGL = Finished Ground Level

As detailed in Section 2.2.1 Northern Beaches Council required that:

> "*Water level monitoring should be undertaken on a regular basis for a period of six months from monitoring bores installed at the site upslope of the EEC (Endangered Ecological Community). Monitoring results should include a rainfall hyetograph to indicate the sensitivity of groundwater levels to periods of rainfall. A minimum of three bores should be installed to allow triangulation of water levels, determination of the hydraulic gradient and interpretation of flow direction"*

To provide this information, the following further groundwater depth measurements were undertaken:

April 30th, 2020	Measurements after monitoring well stabilisation
May 12th, 2020	Month 1 groundwater depth measurement
June 16th, 2020	Month 2 groundwater depth measurement
July 20th, 2020	Month 3 groundwater depth measurement
August 18th, 2020	Month 4 groundwater depth measurement
September 16th, 2020	Month 5 groundwater depth measurement
October 31st, 2020	Month 6 groundwater depth measurement

The result of these groundwater depth measurements are summarised in Table 5.2, on the following page. As noted in the April 17th, 2020 report, further stabilisation of ground water depths was anticipated, and for this reason the April 30th, 2020 measurements have been adopted in this report as the starting point for the six month assessment of groundwater depths at the site.

Table 5.2 – Groundwater Depth Measurements April – October 2020

Date	Depth in Metres (below FGL *)		
	MW 1	MW 2	MW3
April 30th, 2020	3.5	1.5	1.1
May 12th, 2020	3.7	1.4	1.1
June 16th, 2020	3	0.8	0.5
July 20th, 2020	2.9	0.8	0.5
August 18th, 2020	2.5	0.7	0.4
September 16th, 2020	2.8	0.9	0.4
October 31st, 2020	2.7	0.8	0.3

FGL = Finished Ground Level

5.2 INDICATIVE FINDINGS RE GROUNDWATER DEPTHS

The following findings regarding groundwater depts at the Warriewood site are indicated:

- The groundwater table beneath the Warriewood site has generally risen during the six-month study period.
- As a consequence, depths to ground water at each of the three monitoring wells has decreased during the study period.
- Typical stabilised groundwater depths during the final four months of the study period were as follows:
    - Monitoring Well 1 2.7 – 2.9 metres
    - Monitoring Well 2 0.7 – 0.9 metres
    - Monitoring Well 2 0.3 – 0.5 metres

5.3 INDICATIVE DIRECTION OF GROUNDWATER FLOW

The indicative direction of groundwater flow beneath the site has been estimated based on groundwater depths at each monitoring well, and the elevation of finished ground level at each well based on data available from the original site survey (refer Figure 1.10).

The indicative direction of groundwater flow beneath the site is as indicated by the red arrow in Figure 5.1, below.

Figure 5.1 – Indicative Direction of Groundwater Flow

6 RAINFALL RECORDS

6.1 RAINFALL DATA

Groundwater depth is influenced by rainfall, and the effect of rainfall and associated drainage in the recharging of groundwater aquifers. Details of rainfall during the six-month study period were recorded to provide a basis for an analysis of the effect of rainfall on groundwater depths at the site, as required by Northern Beaches Council. The closest Bureau of Meteorology (BoM) rainfall measuring station to the Warriewood Road site is located some 1 kilometre away at Mona Vale Golf Club. Data from this rainfall measurement station has been adopted for this study. Rainfall data for the six month period in question is summarised in Table 6.1, below.

Table 6.1 – Rainfall Data Mona Vale Golf Club April – October 2020

	Apr	May	Jun	Jul	Aug	Sep
1st	0	14.4	0	0.2	0.4	0
2nd	0	0	2.8	0	0.4	0
3rd	3.6	0	0.2	0.2	0.4	0
4th	16	0	0	3.8	0	0
5th	0	2.2	0	0	0	16.2
6th	0	0.2	0	0	0	0
7th	2.6	0	0.4	0	0	0.2
8th	0.2	0	4.8	5	17.2	0
9th	10	0	2.6	0.4	0.8	0.4
10th	1.2	0	17.6	0.2	22	6
11th	1	0	4	5.8	0.6	0.6
12th	0	0	0	7.6	0.2	0.2
13th	0	0	3.6	3.4	2.8	0.2
14th	0.4	11.4	7.4	12.8	0.2	0
15th	0.4	22.4	0	8	3.8	0.2
16th	0	9.8	0	0	0	0.2
17th	0	0.8	0	0.2	0	0
18th	0	1	0.2	0.4	0.2	0
19th	0	0.4	0.4	0.4	0	6.8
20th	0.2	0.4	0.2	0	0	5.8
21st	0	0	3.2	0	0	11.4
22nd	0	17.2	1.8	0	0	0
23rd	0	1	3.8	0.2	0	0
24th	0	0	0	0.4	0	0
25th	0.2	0.6	0	0.4	0	0
26th	0	49.6	0	5.6	0	3
27th	2.4	5.4	2	63.2	0.2	0
28th	0	0.4	7.4	26	0	0
29th	1.8	0.6	9	1.4	0	0
30th	0.4	3.2	0.6	0	0.2	0
31st		0.4		0	0	
Highest Daily	16	49.6	17.6	63.2	22	16.2
Monthly Total	40.4	141.4	72	145.6	49.4	51.2
Monthly Average	1.34	4.6	2.4	4.7	1.6	1.7

Rainfall data for each of the seven months (including April 2020) relevant to the groundwater depth measurements at the Warriewood site are presented in graphical form in Figures 6.1 o 6.7 below, and on subsequent pages.

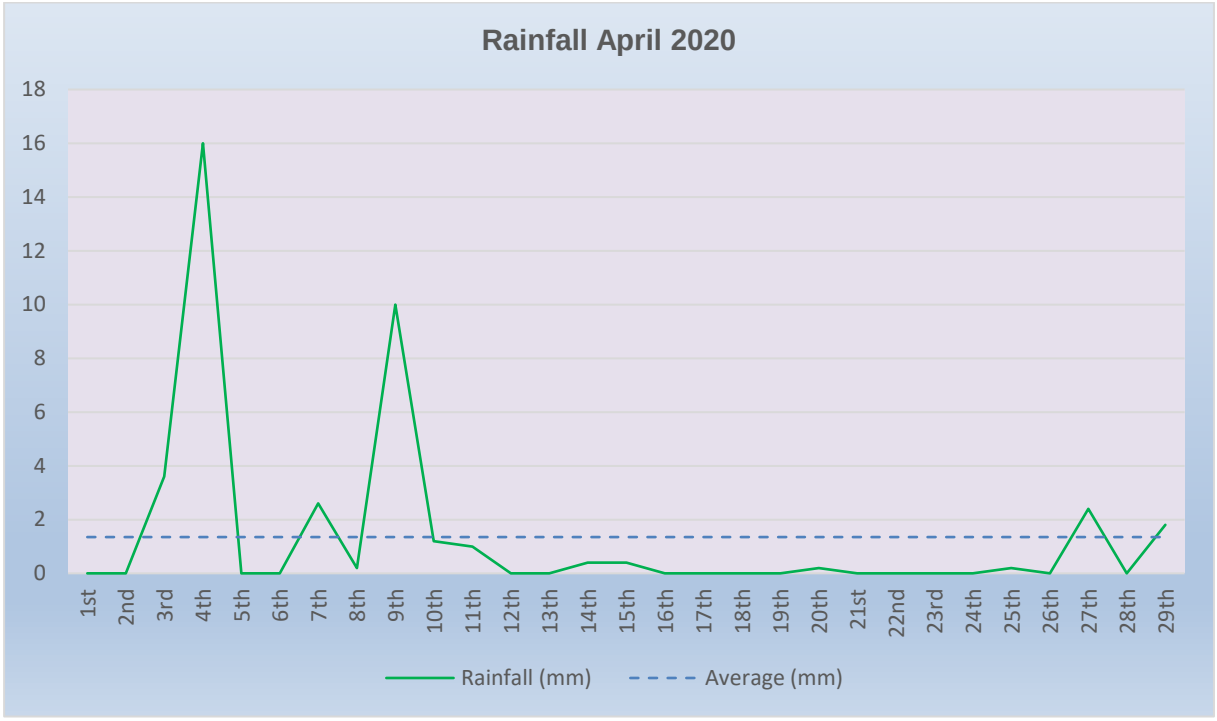


Figure 6.1 - April 2020 Rainfall Data (Mona Vale Golf Club)

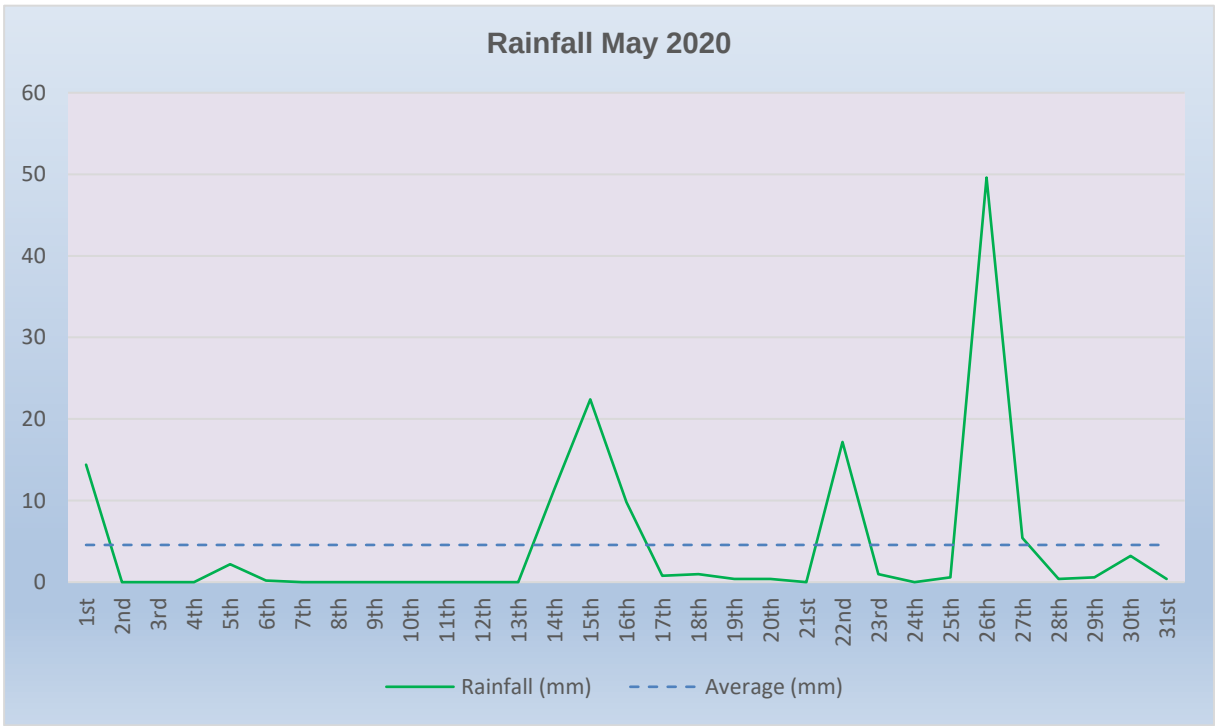


Figure 6.2 - May 2020 Rainfall Data (Mona Vale Golf Club)

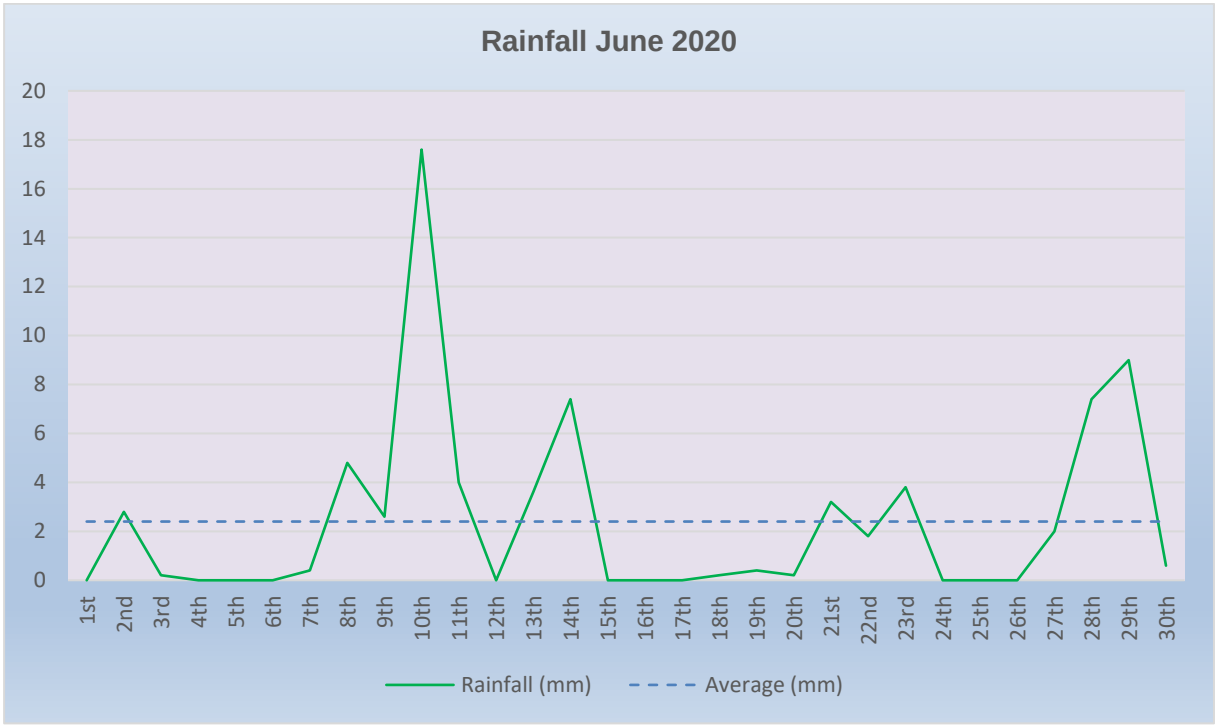


Figure 6.3 - June 2020 Rainfall Data (Mona Vale Golf Club)

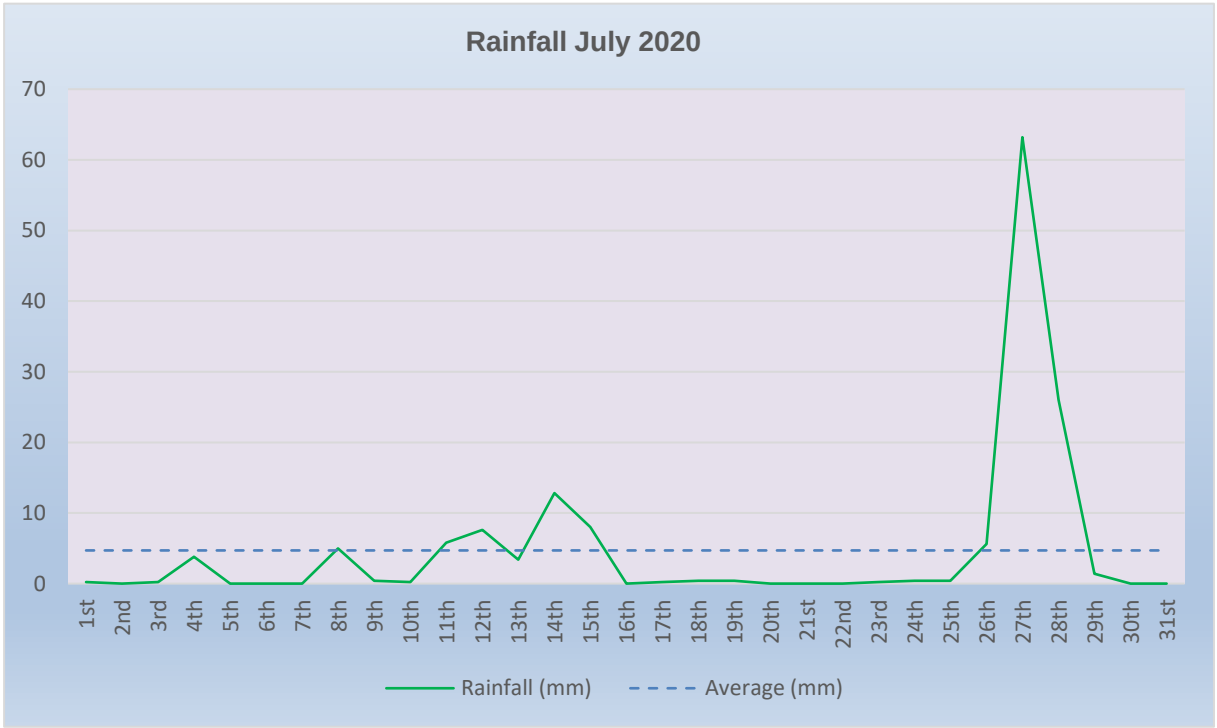


Figure 6.4 - July 2020 Rainfall Data (Mona Vale Golf Club)

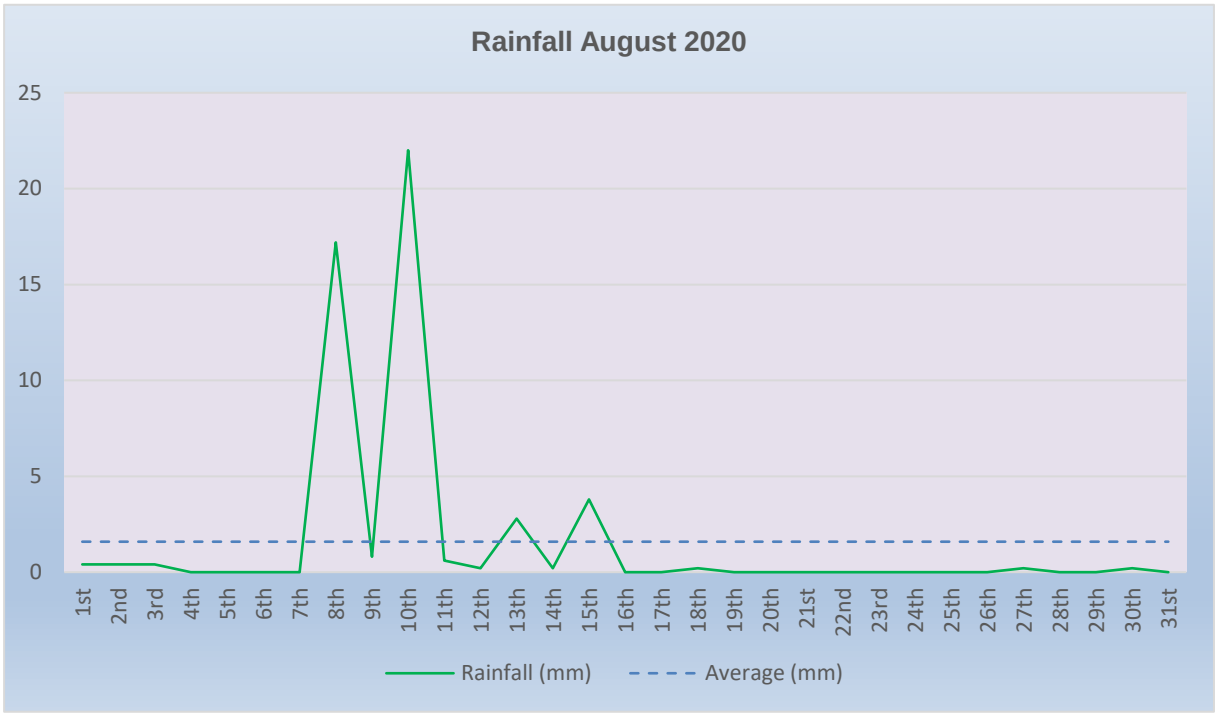


Figure 6.5 - August 2020 Rainfall Data (Mona Vale Golf Club)

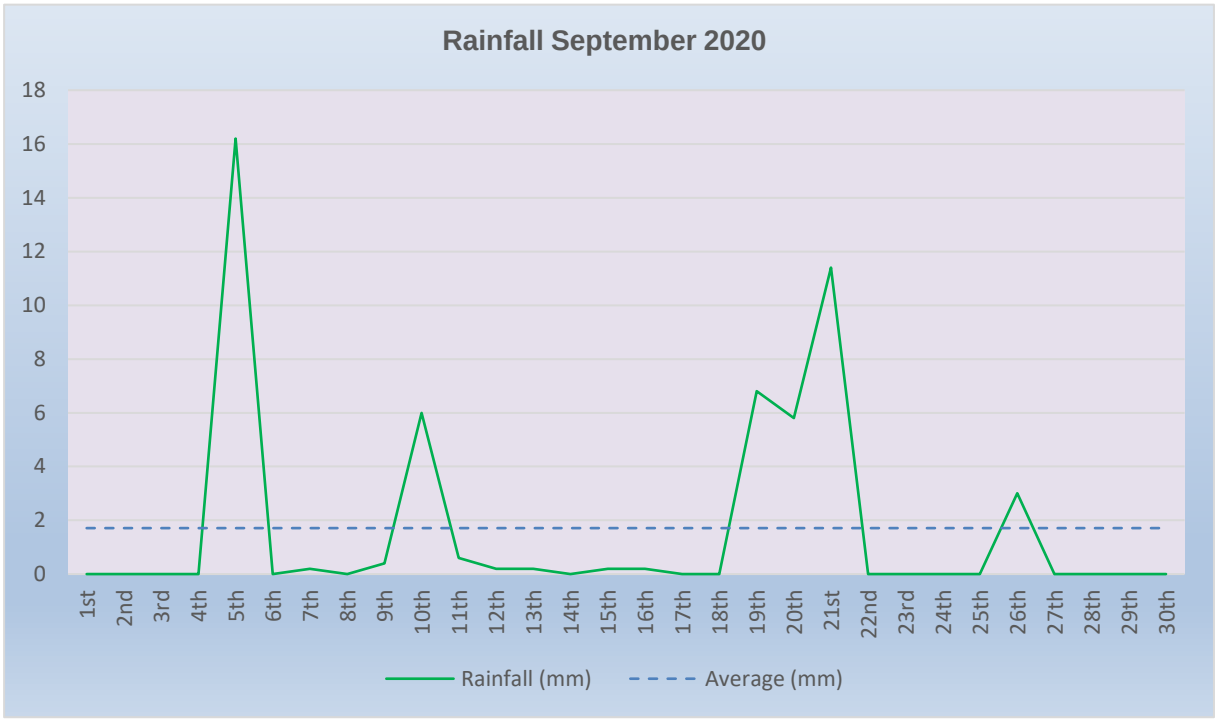


Figure 6.6 - September 2020 Rainfall Data (Mona Vale Golf Club)

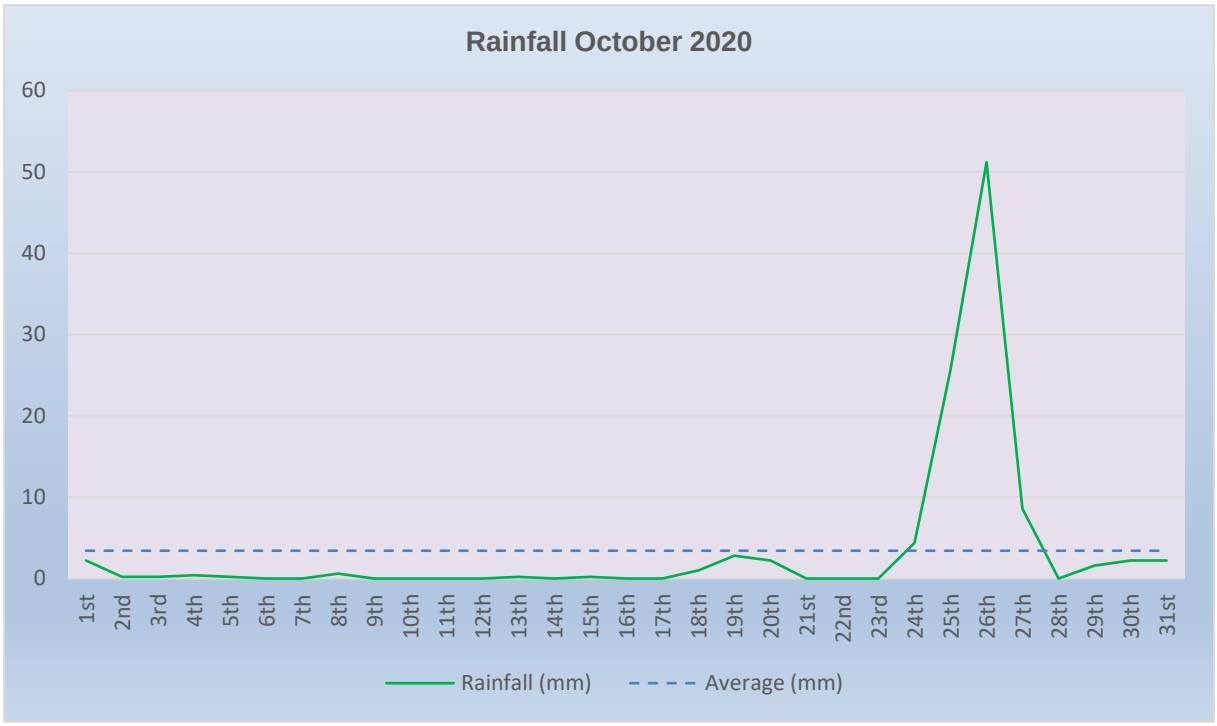


Figure 6.7 - October 2020 Rainfall Data (Mona Vale Golf Club)

6.2 RAINFALL DATA & GROUNDWATER DEPTH

The relationship between rainfall and groundwater depth at the Warriewood site is illustrated in Figure 6.8, below.

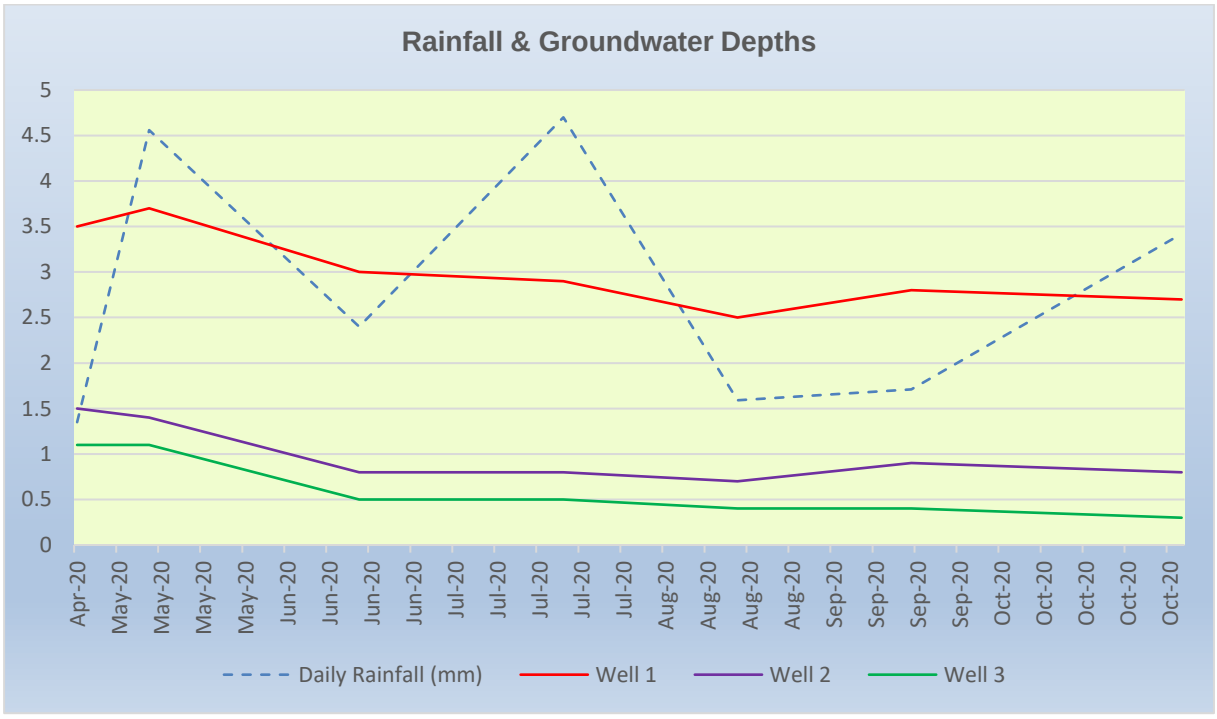


Figure 6.8 – Rainfall & Groundwater Depths at the Warriewood Site

Rainfall trends based on average monthly measurements from Table 6.1 is indicated by the broken blue line. Trends in groundwater depth at each of the three wells are shown by the red, purple and green lines.

6.3 INDICATIVE EFFECT OF RAINFALL ON GROUNDWATER DEPTHS

The indicative effects of rainfall on groundwater depths during the six-month study period at the Warriewood site are considered to be as follows:

- The study period followed an extensive period of dry weather on the east coast of Australia and in the Sydney metropolitan area, exemplified by reductions in dam levels, restrictions in water use, and the bushfires that occurred during the 2019/2020 spring and summer period.

- During the study period several significant rainfall events occurred in the Sydney metropolitan area, including the Warriewood area.

- The effect of the rainfall noted at the BoM measurement station closest to the site, and by direct inference at the site itself, has been to progressively re-charge the ground water aquifers flowing beneath the site, and as a consequence increase groundwater levels, and decrease the typical depth to groundwater.

7 OUTCOMES FINDINGS & RECOMMENDATIONS

7.1 OUTCOMES & FINDINGS

The key outcomes and findings of this six-month study of groundwater depth at the 45/49 Warriewood Road Warriewood site are as follows:

- **Three groundwater monitoring wells have been installed at the 45/49 Warriewood Road site;**
- **The three bores at located near the northern or Warriewood Road site boundary; at the approximate mid-point of the site, and near the rear or southern boundary of the site;**
- **Groundwater was encountered in all three wells;**
- **As a consequence of rainfall during the six-month study period, groundwater levels have increased at the site during this period;**
- **Typical stabilised groundwater depths during the final four months of the study period were as follows:**
  - **Monitoring Well 1 2.7 – 2.9 metres**
  - **Monitoring Well 2 0.7 – 0.9 metres**
  - **Monitoring Well 3 0.3 – 0.5 metres**
- **These groundwater depths indicate levels that may intersect the lowest proposed subsurface structural element (the basement car park) understood to be included in the proposed development;**
- **These groundwater depths confirm that excavations and drilling associated with construction at the site will be subject to groundwater intrusion, and that appropriate engineering practices will be required at the site;**
- **These groundwater depths confirm that any sub-surface structural elements associated with the site will require design and construction techniques consistent with the presence of groundwater; and**
- **The direction of groundwater flow is confirmed as typically from north-west to south-east beneath the site, as previously indicated. Groundwater flows from the Warriewood Road site boundary towards the Narrabeen Creek site boundary.**

7.2 RECOMMENDATIONS

Based on the findings of this six-month investigation of groundwater depths at the Warriewood site, it is recommended that:

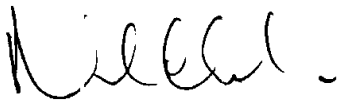
- **Design and construction of any sub-surface elements associated with the development take into account any likley intersection with groundwater based on the groundwater depths presented in this report; and**
- **That construction and in particular any excavation and piering work involved take into account the effects groundwater intrusion.**

The original version of this report was completed in November 2020. This updated version includes the final plans and drawings for the proposed development. The overall findings and recommendations of the original November 2020 report have been reviewed and remain valid and applicable at the date of this revised report.

8 LIMITATIONS & AUTHORISATION

This report presents the results of a six-month study of groundwater depths and associated rainfall effects at 45/49 Warriewood Road, Warriewood NSW.

The data presented in this report has been based on the methods and data sources described and is subject to any limitations associated with those methods and data sources.



Noel Child
Principal
NG Child & Associates
16 November 2021

APPENDIX A

Soil Bore Logs

Drilling Log — Borehole Reference: MW1

Project:	Groundwater depth Study – Progress Report No: 1				**Client:**	Archidrome	
Location:	45-49 Warriewood Road Warriewood NSW				**Project Ref:**	CA/20/126-2707	
Surface Elev:		**Hole Depth:**	4.3 m		**Diameter:**	100 mm	
Casing Type:	n/a	**Water Level:**	**Initial:**	4.7 m	**Static:**	4.5 m	
Screen:	**Diameter:**	50 mm	**Length:**	3.0 m	**Type/Size:**	n/a	
Casing:	**Diameter:**	50 mm	**Length:**	3.0 m	**Type/Size:**	n/a	
Fill Material:	n/a		**Rig/Core:**				
Drill Co:	NG Child & Associates		**Method:**	Truck Mounted Augur			
Driller:	Noel Child	**Logger:**	Noel Child	**Date:**	April 9 2000		
Comment:	Soil bore within 45-49 Warriewood Road Warriewood						
Bore reference “MW2”. Location refer Figure 4.1							

Depth (m)	Sample ID	Graphic Log	USCS Class	Description (Colour; Texture; Structure) Trace <10%; Little 10%-20%; Some 20%-35%; And 35%-50%
				Grass/soil at surface
0	WRD-1-SUR WRD-1-0300		SM	Fine grained dark brown loamy topsoil to approximately 500 mm
1.0	WRD-1-1000		CL	Dense grey clay mottled red/orange in places between approximately 500 mm and 4500 mm
2.0	WRD-1-1000			
3.0	WRD-1-3000			
4.0	WRD-1-4000			
5.0			SC	Indications of groundwater at 4500 mm. Grey/white wet clay
6.0				Refusal due to rock at approximately 6000 mm

Drilling Log — Borehole Reference: MW2

Project:	Groundwater depth Study – Progress Report No: 1				**Client:**	Archidrome	
Location:	45-49 Warriewood Road Warriewood NSW				**Project Ref:**	CA/20/126-2707	
Surface Elev:		**Hole Depth:**	6.0 m		**Diameter:**	100 mm	
Casing Type:	n/a	**Water Level:**	**Initial:**	2.6 m	**Static:**	2.5 m	
Screen:	**Diameter:**	50 mm	**Length:**	3.0 m	**Type/Size:**	n/a	
Casing:	**Diameter:**	50 mm	**Length:**	3.0 m	**Type/Size:**	n/a	
Fill Material:	n/a		**Rig/Core:**				
Drill Co:	NG Child & Associates		**Method:**	Truck Mounted Augur			
Driller:	Noel Child	**Logger:**	Noel Child	**Date:**	April 9 2000		
Comment:	Soil bore within 45-49 Warriewood Road Warriewood						
Bore reference “MW1”. Location refer Figure 4.1							

Depth (m)	Sample ID	Graphic Log	USCS Class	Description (Colour; Texture; Structure) Trace <10%; Little 10%-20%; Some 20%-35%; And 35%-50%
				Gravel at surface
0	WRD-1-SUR			Fill/reworked soil/gravel to 200/300 mm (driveway)
	WRD-2-0300		CL	Light brown sandy loam to approximately 900 mm
1.0	WRD-2-1000		CL	Medium grey plastic clay to approximately 2600 mmm
2.0	WRD-2-1000			
3.0	WRD-2-3000		SC	Indications of groundwater at 2600 mm. Grey/white wet clay
4.0	WRD-2-4000			Bore terminated at approximately 4300 mm
5.0				
6.0				

Drilling Log — Borehole Reference: MW3

Project:	Groundwater depth Study – Progress Report No: 1				**Client:**	Archidrome	
Location:	45-49 Warriewood Road Warriewood NSW				**Project Ref:**	CA/20/126-2707	
Surface Elev:		**Hole Depth:**	4.5 m		**Diameter:**	100 mm	
Casing Type:	n/a	**Water Level:**	**Initial:**	2.5 m	**Static:**	2.3 m	
Screen:	**Diameter:**	50 mm	**Length:**	3.0 m	**Type/Size:**	n/a	
Casing:	**Diameter:**	50 mm	**Length:**	3.0 m	**Type/Size:**	n/a	
Fill Material:	n/a		**Rig/Core:**				
Drill Co:	NG Child & Associates		**Method:**	Truck Mounted Augur			
Driller:	Noel Child	**Logger:**	Noel Child	**Date:**	April 9 2000		
Comment:	Soil bore within 45-49 Warriewood Road Warriewood						
Bore reference “MW3”. Location refer Figure 4.1							

Depth (m)	Sample ID	Graphic Log	USCS Class	Description (Colour; Texture; Structure) Trace <10%; Little 10%-20%; Some 20%-35%; And 35%-50%
				Grass/soil at surface
0	WRD-1-SUR WRD-2-0300			What appears to be clean fill/reworked material to approximately 700 mm
1.0	WRD-2-1000		SM	Dark brown/black loamy soil from approximately 700 mm to approximately 1600 mm
2.0	WRD-2-1000		CL	Medium grey plastic clay from approximately 1600 mm to approximately 2500 mm
3.0	WRD-2-3000		SC	Indications of groundwater at approximately 2500 mm. Grey/white wet clay
4.0	WRD--4000			Bore terminated at approximately 4500 mm
5.0				
6.0				

APPENDIX B

Noel Child CV

1 PERSONAL DETAILS

Full Name: Noel George CHILD
Profession: Consultant in Environmental Assessment and Management
Date of Birth: 6th December 1946
Nationality: Australian
Experience: > 30 Years
Address: 22 Britannia Road, Castle Hill, NSW, 2154
Contact: **Phone**: 61 2 9899 1968 **Fax**: 61 2 9899 1797 **Mobile:** 0409 393024

2 CAPABILITY AND EXPERIENCE - SHORT SUMMARY

Noel Child is a successful and experienced commercial and technical professional with over 30 years' experience in a variety of senior level appointments and assignments, within both the corporate and private sectors, with a particular focus on strategic, infrastructure and environmental applications.

Noel's experience includes senior management at both the State and National levels in the Australian petroleum industry, and a number of senior consultancies for both government and corporate clients. His record reflects the ability to develop and achieve positive commercial outcomes through effective planning and communication; critical and objective analysis; and quality task completion and delivery at both the personal and team level.

His management responsibilities have included transport, environmental, safety, and general operational activities at a national level, while his formal professional training includes strategic management, environmental, engineering and business disciplines. He has undertaken a number of senior corporate appointments with distinction and been successfully involved in the ownership and operation of a major petroleum distribution and marketing company in regional Australia. More recently, working through his own businesses Environment Australia and NG Child & Associates, he has applied his knowledge and experience in the areas of strategic management, infrastructure development, energy and the environment on a consultancy and contractual basis to a number of private and public-sector clients, both nationally and internationally.

Noel has had post-graduate training in several technical and commercial disciplines, and provides specialised teaching input, by invitation, to post graduate engineering and business management courses conducted by the Faculties of Business and Engineering at Sydney's University of Technology. He has strong affiliations with a number of international corporations and agencies and has worked closely with both the regulators and the regulated in a number of aspects of environmental management, assessment and performance. He has also been recognised as an independent expert on engineering, and environmental issues by the Land and Environment Court of NSW.

Noel has a detailed understanding of environmental engineering and associated processes and has specific experience and expertise in the fields of acoustics, air quality, electromagnetic field assessment, electrolysis and stray current assessment, contaminated site assessment, and liquid and solid waste management. He also provides post graduate teaching input on environmental engineering issues to post graduate courses at the University of Technology, Sydney, and La Trobe and Monash Universities in Melbourne.

3 EDUCATION, QUALIFICATIONS AND AFFILIATIONS

BE, PhD (Chemical Engineering), UNSW, Sydney
Master of Business Studies, University of New South Wales, Sydney
B.Sc. (Hons) Applied Chemistry (Environmental), University of Technology, Sydney
Graduate Diploma (Environmental Engineering and Management), UNSW, Sydney
Qualified Environmental Auditor, Standards Australia
Member, Royal Australian Chemical Institute, 1972/2020
Member, Institution of Engineers, Australia, 1972/2020
Member, Clean Air Society of Australia and New Zealand, 1992/2020
Member, Australian Natural Gas Vehicle Council, 1996/2004
Executive Director, Australasian Natural Gas Vehicles Council, 2003/2004
Visiting Fellow, Institute for Sustainable Futures, UTS, 1995/2002
Research Fellow, Faculty of Civil & Environmental Engineering, UTS, 1996/2020
Research Associate, New York Academy of Sciences, 2000/2020

4 RECENT ASSIGNMENTS & EXPERIENCE

Kaunitz Yeung Architecture (2016) – Electromagnetic field and air quality assessments of a childcare centre development project at 60 Dickson Avenue Artarmon NSW.

Australian Consulting Architects (Current) – Electromagnetic, stray current and electrolysis assessments of development projects a Field Place Telopea; Windsor Road Vineyard; Camden Valley way Horningsea Park and others.

Futurespace/Renascent (Current) – Environmental assessment of proposed childcare centre development at Waterloo Road Macquarie park and Cleveland Street Strawberry Hills, including general environmental, acoustic assessment, air quality and electromagnetic field assessment.

Thyssen Transrapid Australia (Current) – Adviser on technical and operational issues associated with the development and construction of a high-speed magnetic levitation train systems within the People's Republic of China, and elsewhere, including electrolysis, electromagnetic and stray field effects.

Trumen Corporation (Current) – Environmental assessment, including acoustic and contamination assessment and certification, of mixed use and childcare centre development projects at Waine Street Freshwater, Fitzroy Street Marrickville, and at Huntley Street Alexandria, NSW.

Commonwealth Bank (Current) – Environmental assessment, including general, acoustic, air quality, electromagnetic field and wind impact assessment, of a new childcare centre development to be located on Level 2 of Darling Park Power 2, Sussex Street, Sydney.

First Impressions Property – Environmental assessment of a proposed childcare centre at Ralph Street Alexandria NSW, including Preliminary (Stage 1) Site Contamination Assessment, and Electromagnetic Field Assessment.

LEDA Holdings – Environmental Assessment of a proposed childcare centre at 32 Cawarra Road Caringbah NSW, including general environmental, acoustic, air quality and electromagnetic field assessments.

Universal Property Group (Current) – Environmental assessment of a proposed multi building, multi-level residential development at Garfield Street, Wentworthville NSW, including general environmental, site and soil contamination and preliminary geotechnical assessments.

McCormack (Current) – Stage 2, 3 and 4 Environmental Site Assessment of 7,9 & 11 Bayard Street, Mortlake, NSW as part of the process of assessing the site for medium density residential development and obtaining a site audit statement confirming the suitability of the site for this purpose. Work inclusive of the assessment of all relevant environmental impacts.

Gundagai Meat Processors (Current) – Review and enhancement of solid and liquid waste processing and management systems at GMP's Gundagai abattoir, including the on-site treatment of waste streams from meat processing and other operations.

Campbelltown City Council (Current) – Peer review of acoustic assessments submitted to Campbelltown City Council regarding assessment of the acoustic impacts of proposed developments including a major truck maintenance facility and the expansion of Macarthur Square shopping centre, including the conduct of noise measurements.

Brenchley Architects (2009 - Current) – Acoustic assessments of proposed residential and commercial developments at Elizabeth Street Sydney; Spit Road Mosman, Botany Road Waterloo, Cranbrook Street, Botany and Bellevue Hill Road, Bellevue Hill NSW.

BJB Design (2009 - Current) – Acoustic, air quality and odour assessments of residential and commercial developments at Botany Road, Botany and Cranbrook Street Botany.

Bovis Lend Lease (Current) – Environmental assessment of a major development site at Darling Walk, Darling Harbour NSW, including a detailed review of air quality, electromagnetic field and acoustic issues for review by the NSW Department of Planning.

Penrith City Council (2012/13) – Preparation of the Penrith City Council response to the NSW Government Long Term Transport Plan, including consideration of transport and associated environmental issues affecting the Penrith Local Government Area.

Harry Azoulay & Michael Bell Architects (2012) – Assessment of the environmental impacts on and from a proposed childcare and early learning centre at Chatswood, NSW. Assessments lodged with and adopted by Willoughby City Council.

Wollondilly Shire Council (2012) – Preliminary environmental assessment and review of the proposed development of a second Sydney airport at Wilton, including a preliminary assessment of acoustic impacts.

White Horse Coffee (2011) – Air quality and odour assessment regarding a boutique coffee roasting and drying operation at 7/3-11 Flora Street, Kirrawee, and NSW.

Sydney Skips & Galaxy Waste (Current) – Environmental assessment of a proposed waste recycling facility to be located on a potentially contaminated site at Stephen Road, Botany, NSW, including a detailed review of all relevant engineering and environmental issues, and the preparation of relevant documentation including assessment reports for review by Botany City Council.

Michael Bell Architects & Clients (2004 to Current) – Assessment of the environmental impacts, including acoustic impacts, associated with various childcare centre applications in suburban Sydney, and the Sydney CBD, including the development of plans for the management and control of such impacts.

ABC Learning Centres Pty Ltd (2005 - Current) – Provision of professional services re the environmental assessment of prospective childcare centre developments, including issues relating to acoustics, air quality, odour, soil, and groundwater contamination.

NSW Roads & Traffic Authority (2004 to Current) – Review of international technologies, systems & applications in relation to the treatment of motor vehicle exhaust emissions and associated air pollution within and discharged from road tunnels, in accordance with the conditions of approval for the M5 East Motorway

Federal Airports Corporation (1995/1996) – Preliminary environmental and ground transport studies for the proposed Sydney West Airport, including consideration of all relevant environmental issues.

Isuzu-GM (2003 to Current) – Representations to Environment Australia and the Department of Transport and regional Services regarding the emission performance standards of Japanese sourced medium and heavy natural gas trucks, with the aim of having the current Japanese emission standard accepted within the Australian design Rule 80 series of vehicle emission standards.

City of Sydney (2005 - 2007) – Assessment of air quality and odour issues associated with a proposed redevelopment of craft studios and associated facilities at Fox Studios, Moore Park, Sydney, and review of air quality monitoring stations in the Sydney CBD area, in part as a basis for monitoring the air quality and potential health cost impacts of transport congestion and modes.

Warren Centre for Advanced Engineering, University of Sydney (2000 to 2003) – Contribution to the report "Sustainable Transport for Sustainable Cities", a major government and private enterprise funded study into the future sustainability of transport in Sydney and adjoining regions, including in particular a review of associated environmental issues. Study received the 2003 Bradfield Award for Engineering Excellence from the Australian Institute of Engineers.

United Kingdom Department of the Environment (1994) – Contribution to the development of revised environmental guidelines for air, soil and groundwater water quality.

United States Environmental Protection Agency (1994) - Contribution to an international team developing strategies for the control and management of air pollution in seven major US cities.

5 CORPORATE EXPERIENCE

NG Child & Associates

- **1992--Present**, Managing Principal - Responsible for all aspects of the conduct of a private engineering and environmental consultancy, including administration, marketing, team coordination and technical and professional delivery.

Western Fuel Distributions Pty Limited, Australia

- **1984-92** Managing Principal. - Responsible for all aspects of the management and development of one of the largest private petroleum distributorships then operating in Australia, with a peak annual sales volume of 70 million litres, turnover of $30 million per annum, a direct staff of thirty, and a network of some 40 retail and wholesale agency outlets. This position included direct personal accountability for all aspects of storage, distribution and environmental performance.

Caltex Oil Australia Limited

- **1982-84** General Manager, Marketing and Operations. Responsible for the management and operation of Caltex Australia's marketing, storage, warehousing, distribution, environmental and safety functions, including seaboard terminal and marine operations.
- **1980-82** National Consumer Marketing Manager. Responsible for Caltex Australia's national consumer, industrial and distributor marketing activities.

Golden Fleece Petroleum Limited

- **1977 - 1980** Manager Operations, NSW. Responsible for the overall management of the distribution, warehousing, seaboard terminal and lubricant production activities of Golden Fleece Petroleum in New South Wales, including environmental, occupational health and safety matters.

Esso Australia Limited

- **1976-77** SA Manager, Marketing and Operations. Responsible for all aspects of the management of Esso's petroleum, lubricant and LPG storage, distribution and marketing throughout South Australia.
- **1975-76** Refinery Manager. Responsible for all engineering, operational and environmental aspects of the joint Esso/Mobil refinery at Port Stanvac in South Australia.
- **1975** Manager, Process Operations, Port Dixon Refinery, Malaysia. Six-month special assignment at the Esso Petroleum Refinery, Port Dixon, Malaysia.
- **1971-75** Senior Analyst, Logistics and Corporate Strategy Departments, Esso Sydney Head office.

6 SOME REPORTS & PUBLICATIONS

- **High Speed Rail – Benefits for the Nation,** Keynote address at the UNSW Institute of Environmental and Urban Studies International High Speed Rail Seminar, August 2013.
- **High Speed Trains in Australia: Connecting Cities and Energising Regions**; with the Hon Peter Nixon AO, October 2010.
- **Sydney's High Residential Growth Areas: Averting the Risk of a Transportation Underclass**, World Transport & Environmental Forum, Reims France, June 2006.
- **The M5 East Road Tunnel: Implications for Ventilation, Air Quality and Emission Treatment Systems**, International Road Transport and Tunneling Forum, Graz Austria, May 2006.
- **Transport Fuels in Australia: The Folly of Australia's Increasing Reliance on Imported Crude Oil**, Submission to the Australian Senate Rural and Regional Affairs and Transport Committee Inquiry into Australia's Future Oil Supply and Alternative Transport Fuels, February 2006.
- **The Japan 2003 CNG Emission Standard & the Emission Performance of the Isuzu 4HF-1-CNG: The Case for Acceptance under ADR80**. Submission on behalf of Isuzu GM Australia to the Commonwealth Department of Transport and Regional Services, June 2004.
- **M5 East Freeway: A Review of Emission Treatment Technologies, Systems and Applications**, NSW RTA and NSW Department of Planning, April 2004.
- **Future Directions: Challenges & Opportunities in the Australian CNG Vehicle Industry**, ANGVC, December 2002
- **High Speed Rail in Australia: Beyond 2000** (with the Hon Peter Nixon), November 2000
- **Review of Options for the Treatment or "Filtration" of Tunnel Gases and Stack Emissions**, City of Sydney. January 2003
- **A Comparative Analysis of Energy and Greenhouse Performance: Austrans Ultras Light Rail System**, Bishop Austrans Limited, January 2003
- **Engineering and Environmental Aspects of Enclosing the Cahill Expressway Cutting**, City of Sydney, May 2001.
- **M5 East Motorway: Proposed Single Emission Stack at Turrella – Review of Air Quality Impacts and Consideration of Alternative Strategies**, Canterbury City Council, February 1999

7 PERSONAL & PROFESSIONAL REFERENCES

- The Hon Peter Nixon AO, Former Federal Transport Minister
- John Black, Professor Emeritus of Civil & Transport Engineering, University of NSW
- Mr Stephen Lye, Development Manager, Trumen Corporation, Sydney.
- Mr Peter Han, Project Director, Commonwealth Bank, Sydney
- Mr Michael Bell, Principal, Michael Bell Architects, Sydney.
- Mr Barry Babikian, Brenchley Architects
- Mr Luke Johnson, Assistant General Manager, Wollondilly Shire Council
- Mr Bernie Clark, Chief Executive, Thyssen Australia
- Mr Alan Ezzy, Former Chairperson, NSW Flood Mitigation Authority.
- Professor Vigid Vigneswaran, Faculty of Civil & Environmental Engineering, University of Technology, Sydney.
- Mr Merv Ismay, General Manager, Holroyd City Council, Sydney NSW
- Dr Jack Mundey, Past Chairman Historic Houses Trust, Environmentalist
- Alex Mitchell, Journalist

Noel G Child
16 November 2021

ATTACHMENT A
Client Reference List

Acre Woods Childcare Pty Ltd
Australian Commonwealth Environmental Protection Agency
Australian Consulting Architects
Australian Federal Airports Corporation
Australian Federal Department of Transport and Regional Development
Bovis Lend Lease
Brenchley Architects
Campbelltown City Council
Canterbury City Council, Sydney, NSW
Commonwealth Banking Corporation
Environment Protection Authority of NSW
Exxon Chemical
Fairfield City Council, Sydney, NSW
First Impressions Property
FreightCorp, Sydney, NSW
Futurespace
GM - Isuzu
Guangxi Environment Protection Bureau
Gundagai Meat Processors
Hong Kong Department of the Environment
Hornsby and Ku-ring-gai Councils, Sydney, NSW
John McCormack
Kaunitz Yeung Architecture
LEDA Holdings
Michael Bell Architects
Minter Ellison
Mobil Oil Australia, Associated
NSW Roads & Traffic Authority
Ove Arup & Partners
Qantas Airways
Queensland Ports Corporation
Renascent
Salibeau Pty Ltd
Shell Australia
Sinclair Knight Merz
Skouras and Mabrokardatos
Southern Sydney Regional Organisation of Councils (SSROC)
State Rail Authority of NSW
Stephen Davidson Property Investments
Sydney Skips & Galaxy Waste
The City of Sydney
The Western Sydney Alliance of Mayors
Thyssen Krup Transrapid Australia
Tom Howard QC
Trumen Corporation
UK Department of the Environment
United States Environment Protection Agency
University of Technology, Sydney
Warren Centre for Advanced Engineering, University of Sydney
Waverley Council, Sydney, NSW
Western Sydney Parklands Trust
Wollondilly Shire Council