Preliminary Geotechnical Investigation

313 Magpie Lane, Galambine NSW 2850

Prepared for: CAM Engineering and Constructions Pty Ltd
EP3229.001 23 February 2024

EP RISK

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313 Magpie Lane, Galambine NSW 2850

CAM Engineering and Constructions Pty Ltd
383 Freemans Drive,
Cooranbong NSW 2265

23 February 2024

Our Ref: EP3229.001

LIMITATIONS

This Preliminary Geotechnical Investigation was conducted on the behalf of CAM Engineering and Constructions Pty Ltd for the purpose/s stated in **Section 1**.

EP Risk has prepared this document in good faith, but is unable to provide certification outside of areas over which EP Risk had some control or were reasonably able to check. The report also relies upon information provided by third parties. EP Risk has undertaken all practical steps to confirm the reliability of the information provided by third parties and do not accept any liability for false or misleading information provided by these parties.

It is not possible in a Preliminary Geotechnical Investigation to present all data, which could be of interest to all readers of this report. Readers are referred to any referenced investigation reports for further data.

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QUALITY CONTROL

Version	Author	Date	Reviewer	Date	Quality Review	Date
v01	O. Pruteanu	20.08.2023	J. Young	20.08.2023	O. Pruteanu	22.08.2023
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DOCUMENT CONTROL

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v01	*22.08.2023*	*Preliminary Geotechnical Investigation*	*CAM Engineering and Constructions Pty Ltd*
v02	*23.02.2024*	*Layout Plans Update*	*ADW Johnson Pty Ltd*

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1 Introduction

EP Risk Management Pty Ltd (EP Risk) was engaged by CAM Engineering & Constructions Pty Ltd to undertake a preliminary geotechnical investigation at 313 Magpie Lane, Galambine NSW 2850. The site is located within lot 1 DP174385 and is approximately 72.41ha in area. It is understood that the Preliminary Geotechnical Investigation is required to submit the Development Application for the proposed development. Currently the site is proposed to be developed in two zones: - short term accommodation in the north-western part of the site and long-term accommodation on the rest of the site.

A revised plans of the proposed development provided following the investigation is included as **Appendix A – Proposed Development Layout**.

1.1 Objective

The objective of the investigation is to assess the substrata and identify the potential geotechnical constraints/conditions for future development and inform the geotechnical design for the on ground and underground infrastructure within the proposed development.

1.2 Scope of Works

EP Risk carried out the following scope of works for the preliminary geotechnical investigation:

- Desktop study – collection and review of available information related to the Site.
- Advanced thirty-five (35) test bores/pits within the proposed development to assess the subsurface conditions.
- Dynamic Cone Penetrometer (DCP) testing to assess the consistency of the strata.
- Collection of representative disturbed, undisturbed, and bulk soil samples for laboratory testing.

This Geotechnical Report has been prepared in accordance with our proposal (EP16772 dated 12 May 2023) and includes the findings of the investigation scope along with:

- Interpretation of the investigation results.
- Laboratory testing results.
- Identification of the relevant geological units on site.
- Preliminary pavement design.
- Pavement thickness for Magpie Lane and Guntawang Road.
- Preliminary site classification.
- Indication of rock strength in terms of ability to excavate.
- Detention basin guidelines.

2 Site Description and Location

The site is of triangular shape and fronts the Magpie Lane to the north, Guntawang Road to the west and farmland and vineyard to the east. At the time of the investigation the site was largely vacant apart from a shed and shipping container located on the eastern boundary, a partial constructed internal road and concrete annulus for a previous proposed roundabout. The land appears to be used for primary production purposes - grazing.

The site topography slopes gently from east towards west with elevations of approximately 450m Australian Height Datum (AHD) along the eastern boundary and approximately 420-430 m AHD along the western boundary on Guntawang Road. The site vegetation consists of short grass with scattered mature trees across the site. Several small dams associated with the primary production activities have been noted on site.

Recontouring of the hill slopes to reduce the scoring have been observed in the northern section of the site. Two ephemeral water courses run across the site following the contour lines from east to west. Photographs collected during site investigation are collated and included in **Appendix B – Photolog**.

An excerpt from Six Maps showing the site location is presented in Figure 1.

Figure 1. Site Location

3 Desktop Study

3.1 Published Data

3.1.1 Regional Geology

Based on geological data sourced from NSW Government website (www.minview.geoscience.nsw.gov.au), the Site is underlain by:

- Quaternary aged sediments (Qavt) comprising of fluvially deposited clay, silt, sand, and gravel.
- Permian aged sedimentary rock of Watermark Formation (Pmlw) comprising of siltstone, claystone, silty sandstone, thinly bedded siltstone, and sandstone.
- Ludlow aged sedimentary rock of Biraganbil Formation (Schb) comprising of quartz lithic, feldspar-lithic and quartz sandstone, siltstone, shale, and slate.

A faulted boundary crosses the site in an approximately north-south direction. An excerpt of the geological map is shown in Figure 2.

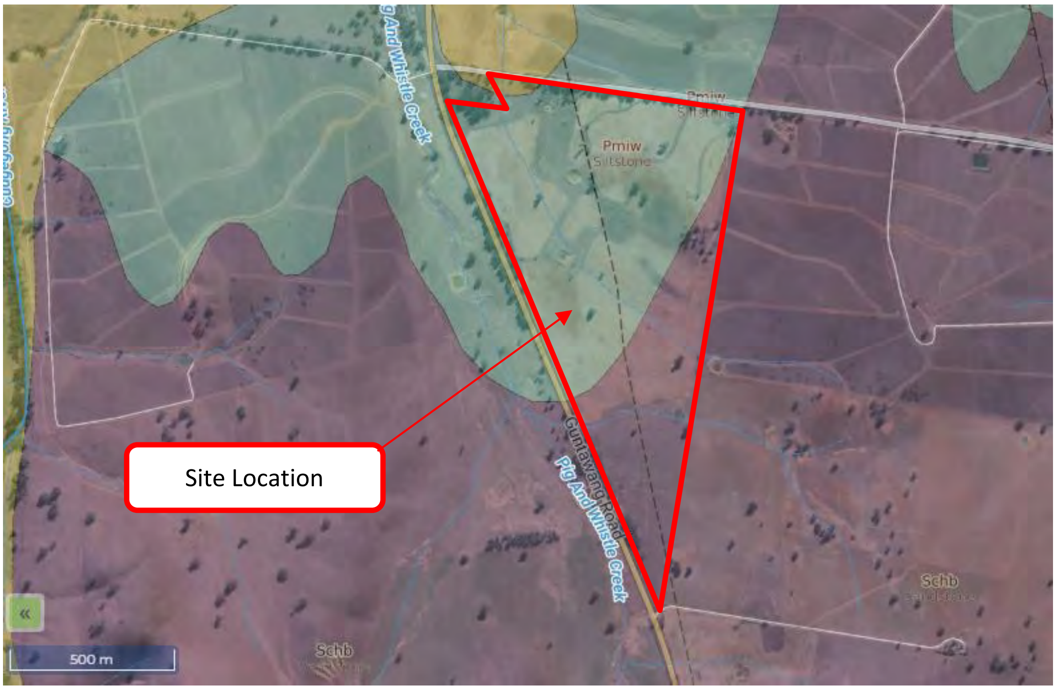

Figure 2. Geological Map Excerpt (Q_avt – yellow; Pmlw – green; Schb – purple)

3.2 Soil Landscape

With reference to the NSW Department of Industry, Resources and Energy (www.environment.nsw.gov.au), onsite soil landscapes have been identified to comprise of Mullion Creek (SI5504mu). The landscape is described as low undulating hills from 560 to 980m above sea level with slopes generally between 3-6% and sometimes up to 12%. Drainage channels are generally spaced from 200-500m, with some up to 150m apart. Some limitations of SI5504mu include low fertility, seasonal waterlogging, sodic subsoils on lower slopes, high erosion hazard, acidic surface soils, low permeability.

3.3 Mine Subsidence

With reference to the Mine Subsidence District Data Source the site is not located within a Mine Subsidence District. The closest Mine Subsidence District is located approximately 30km north-east of the site - Mudgee Mine Subsidence District.

4 Geotechnical Investigation

4.1 Investigation Methodology

The site subsurface investigation and adjacent roads (Magpie Lane and Guntawang Road) was undertaken between 10 to 12 July 2023 and included the following:

- Advanced six (6) test pits within the proposed short-term accommodation development in the northern section of the site for preliminary site classification and pavement design.
- Advanced twenty-four (24) test pits within the long-term accommodation development layout for preliminary site classification and pavement design.
- Advanced three (3) test bores on Guntawang Road and two (2) test bores on Magpie Lane to inform the pavement design.
- Dynamic Cone Penetration (DCP) was undertaken at each test pit location prior to excavation and in the subgrade at the location of test bores on Magpie Lane and Guntawang Road.

The field investigation was carried out by an experienced EP Risk Geotechnical Engineer who logged the subsurface profile in each test pit and obtained bulk, disturbed, and undisturbed soil samples for subsequent laboratory testing and soil/rock identification purposes. The test pits were excavated by a 13.5T Komatsu excavator fitted with a 450mm multipurpose bucket. The test bores for pavement were advanced using a 3.5T Bobcat excavator fitted with a 300mm auger.

All test locations were established based on the current development layout as per the plans provided by the client at the time of investigation. The locations of the investigations were identified on site using a handheld GPS unit. The locations of the geotechnical investigation tests are shown in **Appendix C – Geotechnical Investigation Locations**.

The subsurface conditions are summarised in Section 4.2 and detailed test pit/bore logs are included in **Appendix D – Test Pit/Bore Logs** together with the explanatory notes.

A summary of the geotechnical testing schedule is presented in Table 1.

Table 1. Summary of Geotechnical Testing Schedule

Media	Soil/Rock Tests
Soil	• (7B) California Bearing Ratio (CBR) • (3U) Shrink-Swell Index • (4D) Atterberg Limits • (4D) Particle Size Distribution (PSD) • (1B) Fall Head Permeability • (4D) Aggressivity
Rock	• (10) Point loads (rock samples)
B – bulk samples; D – disturbed samples, U – undisturbed samples	

4.2 Subsurface Profile

The identification of the test pits reflects their location within the site and its details are shown in Table 2.

Table 2. Test Pits Identification

ID	Identification Name
TPGRNB	Test Pit Guntawang Road North Bound
TPGRSB	Test Pit Guntawang Road South Bound
TPGRSB Shoulder	Test Pit Guntawang Road South Bound Shoulder
TPMLEB	Test Pit Magpie Lane East Bound
TPMLWB	Test Pit Magpie Lane West Bound
TPNW	Test Pit North-West – short term accommodation

A project geological classification has been developed based on the results of the investigation and a summary of the units and their distribution is presented in Table 3 and

Table 4.

The test pit logs, and accompanying explanatory notes are presented in **Appendix D – Test Pit Logs.**

Table 3. Observed Geotechnical Units

Unit #	Origin	Material	Description
Unit 1a	Topsoil	Sandy/Silty CLAY	Low to medium plasticity, brown, black, fine to medium grained sand
Unit 1b	Topsoil	Clayey SAND	Fine to medium grained, brown
Unit 2	Fill	Pavement	Road Seal Sandy GRAVEL, fine to coarse grained, sub-angular to angular, brown, fine to coarse grained sand Clayey SAND, fine to coarse grained, brown
Unit 3a	Residual Soil	Silty/Sandy CLAY	Low to high plasticity, pale brown, yellow, fine to medium grained sand
Unit 3b	Residual Soil	Clayey SAND/SAND	Fine to medium grained, grey

Unit #	Origin	Material	Description
Unit 4a	Extremely Weathered Material (XW)	SILTSTONE/SHALE	Clayey SILT, low to high plasticity, grey and brown, fine to coarse grained sand Silty/Sandy CLAY, medium to high plasticity, brown and grey, fine to coarse grained sand
Unit 4b	Extremely Weathered Material (XW)	SANDSTONE	Clayey SAND, fine to coarse grained, grey, pale brown, red, with pebbles and cobbles Sandy CLAY, medium to high plasticity, fie to coarse grained sand, yellow, red, grey, and brown

Table 4. Distribution of Subsurface Geological Unit Across the Investigated Locations

TP ID	Depth Below Gound Level (mBGL)						
	Topsoil		Fill (Pavement)	Residual Soil		Extremely Weathered Material (XW)	
	Unit 1a	Unit 1b	Unit 2	Unit 3a	Unit 3b	Unit 4a	Unit 4b
TP01-L	0.0-0.12	NE	NE	0.12-1.4	NE	NE	1.4-2.1*
TP02-L	NE	0.0-0.15	NE	0.15-0.6	NE	NE	0.6-1.7*
TP03-L	0.0-0.12	NE	NE	0.12-0.3	NE	0.3-0.9*	NE
TP04-L	0.0-0.22	NE	NE	0.22-0.8	NE	NE	0.8-1.8*
TP05-L	0.0-0.15	NE	NE	0.15-0.4	NE	0.4-0.73	NE
TP06-L	NE	0.0-0.4	NE	NE	NE	NE	0.4-1.4*
TP07-L	0.0-0.18	NE	NE	0.18-1.8	NE	1.8-2.9*	NE
TP08-L	NE	0.0-0.17	NE	0.17-0.6	NE	NE	0.6-1.3*
TP09-L	NE	0.0-0.13	NE	0.13-0.5	NE	NE	0.5-1.3*
TP01-P	0.0-0.19	NE	NE	0.19-1.3	NE	NE	1.3-1.9*
TP02-P	0.0-0.2	NE	NE	0.2-0.6	NE	NE	0.6-1.0*
TP03-P	0.0-0.13	NE	NE	0.13-0.46	NE	NE	0.46-0.9*
TP04-P	0.0-0.12	NE	NE	0.12-0.3	NE	0.3-0.92*	NE
TP05-P	0.0-0.09	NE	NE	0.09-0.4	NE	NE	0.4-1.0*
TP06-P	0.0-0.13	NE	NE	0.13-0.4	NE	0.4-1.0*	NE
TP07-P	NE	0.0-0.1	NE	0.1-2.0*	NE	NE	NE
TP08-P	0.0-0.24	NE	NE	0.24-2.7*	NE	NE	NE
TP09-P	NE	0.0-0.17	NE	0.17-1.4	NE	1.4-2.0*	NE
TP10-P	0.0-0.16	NE	NE	0.16-0.4	NE	NE	0.4-0.9*
TP11-P	0.0-0.13	NE	NE	0.13-2.1*	NE	NE	NE
TP12-P	0.0-0.12	NE	NE	0.12-0.6	NE	0.6-2.1*	NE
TP13-P	0.0-0.13	NE	NE	0.13-0.7	NE	NE	0.7-1.3*
TPNW01-L	0.0-0.18	NE	NE	0.18-0.7	NE	NE	0.7-1.1*
TPNW02-L	NE	0.0-0.17	NE	0.17-0.6	NE	NE	0.6-1.15*

TP ID	Depth Below Gound Level (mBGL)						
	Topsoil		Fill (Pavement)	Residual Soil		Extremely Weathered Material (XW)	
	Unit 1a	Unit 1b	Unit 2	Unit 3a	Unit 3b	Unit 4a	Unit 4b
TPNW03-L	NE	0.0-0.17	NE	0.17-0.5	NE	NE	0.5-0.9*
TPNW01-P	NE	0.0-0.12	NE	0.12-0.5	NE	0.5-1.1	1.1-1.6*
TPNW02-P	0.0-0.1	NE	NE	0.25-0.7	0.1-0.25	NE	0.7-1.9*
TPNW03-P	NE	0.0-0.7	NE	0.38-0.6	0.07-0.38	NE	0.6-2.1*
TP01-WS	NE	0.0-0.08	NE	0.08-1.6	NE	1.6-3.5*	NE
TP02-WS	NE	0.0-0.14	NE	0.14-0.6	NE	0.6-2.0*	NE
TPGRNB	NE	NE	0.0-0.5	NE	NE	NE	0.5-1.5*
TPGRSB	NE	NE	0.0-0.5	NE	NE	NE	0.5-1.5*
TPGRSB Shoulder	NE	NE	0.0-0.5	NE	NE	NE	0.5-1.5*
TPMLEB	NE	NE	0.0-1.2	1.2-1.5*	NE	NE	NE
TPMLWB	NE	NE	0.0-0.7	0.7-1.5*	NE	NE	NE
NE- not encountered *-limit of the investigation							

The fill/pavement layers encountered on Guntawang Road appears consistent over the three locations. The pavement thickness is about 500mm of sandy gravel with double seal on top. The subgrade on the testing area appeared to be competent sandstone.

The pavement on Magpie Lane varied between test locations. Bituminous flush seal and sandy gravel up to 0.5m BGL was encountered in one location (TPMLEB) with clayey sand subgrade (crushed sandstone). Sandy CLAY was encountered below the subgrade at 1.2m BGL. The second test pit identified pavement comprising of seal and sandy gravel to 0.3m BGL underlain by Sandy CLAY (crushed sandstone and siltstone). Sandy CLAY was encountered below the subgrade from 0.7m BGL to 1.5m BGL. The Mid-Western Regional Council classifies Magpie Lane as collector road.

4.3 Groundwater

No groundwater was observed in the test pits at the time of the investigation. It should be noted that the groundwater conditions will vary with seasonal and weather conditions along with construction related site conditions.

4.4 Laboratory Test Results

Geotechnical laboratory testing was carried out on selected bulk, disturbed and undisturbed samples collected during the site investigation. All testing was performed by Coffey Testing (Newcastle) and Eurofins - NATA accredited laboratories in accordance with the relevant Australian Standards and technical procedures. The detailed results of laboratory testing are presented in **Appendix E – Laboratory Test Results** and are summarised in the following sections.

4.4.1 California Bearing Ratio (%)

Four-day soaked California Bearing Ration (CBR) tests were undertaken on seven (7) soil samples to inform the design subgrade CBR for the proposed pavement areas. The results of the testing are summarised in Table 5.

Table 5. California Bearing Ratio Test Results

Test ID	Depth (m BGL)	Sample Description	W[1] (%)	SOMC[2] (%)	SMDD[3] (t/m^3)	Swell (%)	CBR (%)

TP05-P	0.4-1.0	XW - Clayey SAND	7.4	12.0	1.93	0.5	11[4]
TP07-P	0.5-1.0	Sandy CLAY	17.9	21.0	1.68	0.0	4.5[4]
TP09-P	0.5-1.0	Silty CLAY	14.8	15.0	1.84	0.0	4.5[5]
TP10-P	0.5-0.9	XW - Clayey SAND	11.0	19.0	1.72	0.5	5[4]
TP12-P	0.6-1.0	XW - Sandy CLAY	10.7	15.0	1.85	1.0	4.5[4]
TP13-P	0.2-0.7	Sandy CLAY	7.7	11.0	1.98	0.0	8[5]
TPNW03-P	0.6-1.0	XW - Sandy CLAY	12.5	12.5	1.92	0.5	8[5]

[1] Field Moisture Content

[2] Standard Optimum Moisture Content

[3] Standard Maximum Dry Density

[4] CBR at 2.5mm (%) - remoulded to a target of 100% relative density at SOMC, 4.5kg surcharge, four-day soak

[5] CBR at 5mm (%) - remoulded to a target of 100% relative density at SOMC, 4.5kg surcharge, four-day soak

4.4.2 Particle Size Distribution

Particle Size Distribution (PSD) test results undertaken on samples of subgrade containing Residual Soils and extremely weathered (XW) material are presented in **Error! Reference source not found.** and confirms the material description on the test pit logs.

Table 6. Particle Size Distribution Test Results

Test Pit ID	Depth (m BGL)	% passing 2.36 mm sieve	% passing 75 µm sieve	Sample Description
TP01-L	0.7-1.4	88	68	Silty CLAY with sand trace of gravel
TP04-L	0.3-0.5	96	62	Sandy CLAY
TPNW01-L	0.2-0.7	96	68	Silty CLAY with sand
TPNW02-L	0.2-0.6	91	69	Silty CLAY with sand

4.4.3 Shrink-Swell

Shrink-Swell testing was undertaken on three (3) soil samples and the results are summarised in Table 7.

Table 7. Shrink-Swell Index Test Results

Test Pit ID	Soil Type	Depth (m BGL)	Shrinkage		Swell			Shrink – Swell Index (Iss%)
			Shrinkage moisture content (%)	Shrink on drying (%)	Moisture content before (%)	Moisture content after (%)	Swell on saturation (%)	
TP04-L	Sandy CLAY	0.3-0.8	14.9	2.0	14.5	20.1	-1.1	1.1
TP07-L	Silty CLAY	0.5-1.0	19.9	4.1	19.3	22.6	-1.7	2.3
TPNW01-L	Silty CLAY	0.2-0.7	24.2	4.8	23.6	27.0	-0.2	2.7

4.4.4 Atterberg Limits

A summary of Atterberg Limits and Linear Shrinkage test results are presented in Table 8 and are plotted graphically in Figure 3. Testing indicates that clayey materials range from low to high plasticity.

Table 8. Atterberg Limits Test Results

Test Pit ID	Soil	Classification	Depth (m BGL)	Atterberg Limits			Linear Shrinkage (%)
				LL (%)	PL (%)	PI (%)	
TP01-L	Silty CLAY	CI-CH	0.7-1.4	59	22	37	18.0
TP04-L	Sandy CLAY	CI-CH	0.3-0.5	32	14	18	10.0
TPNW01-L	Silty CLAY	CI-CH	0.2-0.7	50	19	31	18.0
TPNW02-L	Silty CLAY	CL-CI	0.2-0.6	55	24	31	18.0

LL – Liquid Limit
PL – Plastic Limit
PI – Plasticity Index

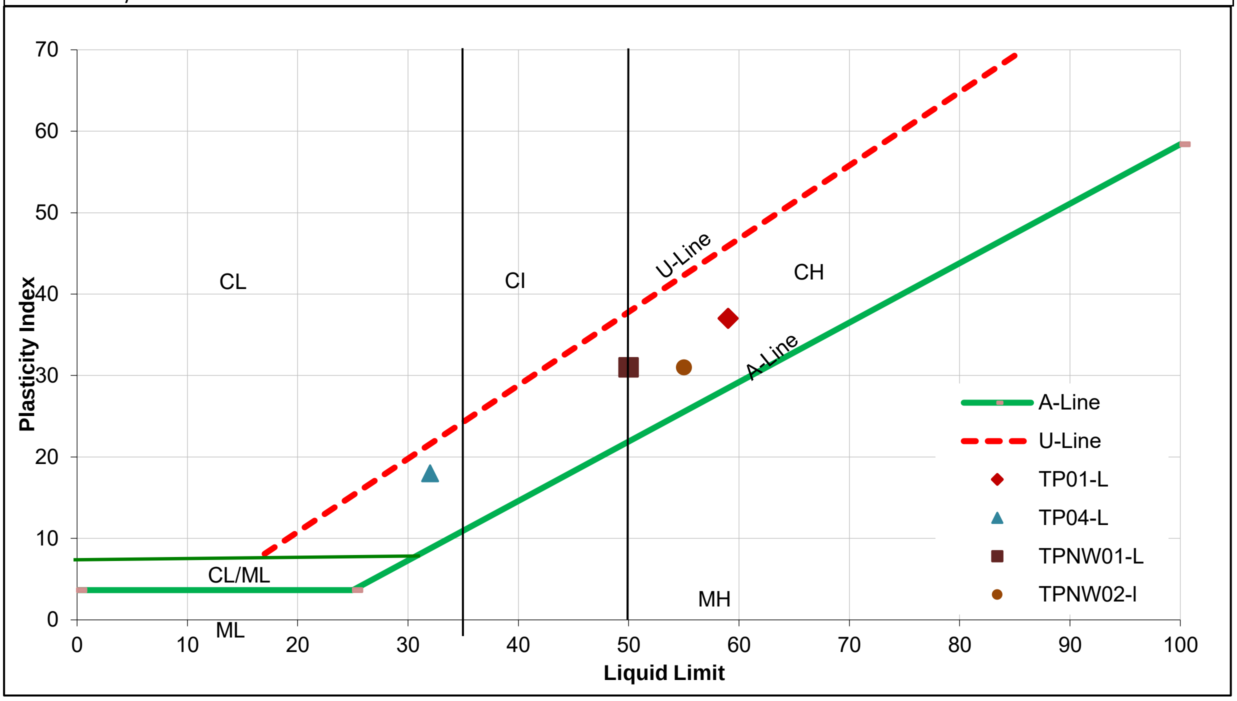

Figure 3. Atterberg Limits Plot

4.4.5 Point Load Testing

It is noted the rock samples collected from test pits are competent bedrock fragments as the lower strength bedrock was broken down into soil during excavation. All the rock samples were collected dry and were tested dry which could potentially contribute to a higher strength rock interpretation. Point load testing has been conducted on selected rock samples collected from test pits and the test results are shown in Table 9.

Table 9. Point Load Test Results

TP ID	Rock	Depth (m BGL)	Moisture condition	Peak Load (kN)	Is (50) MPa	Rock strength
TP02-P	Sandstone	0.6-1.0	Dry	3.74	3.2	Very High Strength
TP02-P	Sandstone	0.6-1.0	Dry	3.22	2.4	High Strength

TP ID	Rock	Depth (m BGL)	Moisture condition	Peak Load (kN)	Is (50) MPa	Rock strength
TP02-P	Sandstone	0.6-1.0	Dry	6.16	3.3	Very High Strength
TP02-P	Sandstone	0.6-1.0	Dry	3.87	2.0	High Strength
TP02-P	Sandstone	0.6-1.0	Dry	4.26	2.2	High Strength
TP02-P	Sandstone	0.6-1.0	Dry	2.86	2.0	High Strength
TP02-P	Sandstone	0.6-1.0	Dry	3.94	3.2	Very High Strength
TP02-P	Sandstone	0.6-1.0	Dry	5.65	3.6	Very High Strength
TP02-P	Sandstone	0.6-1.0	Dry	5.74	2.8	High Strength
TP02-P	Sandstone	0.6-1.0	Dry	4.98	3.4	Very High Strength

The point load testing summarised in Table 9 indicates that the rock encountered during investigation is generally of high and very high strength.

4.4.6 Aggressivity

The Australian Standard AS2159-2009 provides criteria for assessment of the level of exposure classification for steel and concrete to enable the designers to incorporate protective measures for each element into the design. The assessment criteria are based upon the pH, concentrations of Sulphate and Chloride in soil, the soil permeability, and the groundwater level.

Soil aggressivity testing was undertaken on four (4) samples recovered from test pits. An assessment of the exposure classification for each of the soil samples tested based on the above criteria is presented in Table 10.

Table 10. Aggressivity Test Results

Test Pit ID	Soil type	Sulphates (SO_4) in soil (mg/kg - ppm)	pH	Chlorides in groundwater (mg/kg- ppm)	Resistivity ohm.cm	Exposure classification	
						Aggressive to steel	Aggressive to concrete
TP01WS	Clayey SILT	27	7.6	67	14000	Non-Aggressive	Non-Aggressive
TP07-L	Clayey SILT	35	8.7	280	3800	Non-Aggressive	Non-Aggressive
TP09-L	Sandy CLAY	33	8.4	210	5100	Non-Aggressive	Non-Aggressive
TPNW02-L	Silty CLAY	<10	7.1	<10	110000	Non-Aggressive	Non-Aggressive

5 Preliminary Pavement Design

5.1 Design Traffic

Design traffic loadings and pavement thickness design calculation has been undertaken by EP Risk in general accordance with *Mid-Western Regional Council Development Engineering Guidelines* for the roads and in the proposed development for the expected traffic volumes and type. The design traffic data has been determined based on the following assumptions in Table 11**Error! Reference source not found.**.

Table 11. Recommended Road Type and Design ESA's

Road Type	Road Identification	Design ESA's
Collector	TBC	6.0 x 10^5
Local Access Road	TBC	2.0 x 10^5

Where traffic data varies from the above assumptions a review of pavement design may be required.

5.2 In-situ Testing

The DCP test can be used to provide a correlation with in-situ (field) CBR estimated in accordance with Austroads (2017). The field CBR versus laboratory CBR values are presented in Table 12 and the in-situ CBR values for substrata for the pavement boreholes are presented in the Figure 4.

Table 12. In-situ (field) CBR Values Versus Soaked CBR

TP	Material Classification	Depth (m BGL)		Average Field CBR (%) *	Laboratory CBR (%)
		Top	Bottom		
TP01-P	RESIDUAL SOIL: Sandy CLAY	0.2	0.8	17	**
TP02-P	RESIDUAL SOIL: Sandy CLAY	0.2	0.6	29	**
TP03-P	RESIDUAL SOIL: Silty CLAY	0.2	0.5	11	8
TP04-P	XW SHALE: Sandy CLAY	0.2	0.5	21	**
TP05-P	RESIDUAL SOIL: Silty CLAY	0.2	0.5	28	11
TP06-P	XW SHALE: Sandy CLAY	0.2	0.6	17	**
TP07-P	RESIDUAL SOIL: Sandy CLAY	0.2	0.8	8	4.5
TP08-P	RESIDUAL SOIL: Silty CLAY	0.2	0.8	11	**
TP09-P	RESIDUAL SOIL: Silty CLAY	0.2	0.8	12	4.5
TP10-P	RESIDUAL SOIL: Silty CLAY	0.2	0.5	23	5
TP11-P	RESIDUAL SOIL: Sandy CLAY	0.2	0.8	8	**
TP12-P	XW SANSTONE: Sandy CLAY	0.2	0.8	18	4.5
TP13-P	RESIDUAL SOIL: Sandy CLAY	0.2	0.8	10	8
TPNW01-P	XW SANSTONE: Sandy CLAY	0.2	0.6	25	**
TPNW02-P	XW SANSTONE: Sandy CLAY	0.2	0.8	23	**
TPNW03-P	XW SANSTONE: Sandy CLAY	0.2	0.7	22	**
*) in situ estimated CBR at anticipated design subgrade level (DSL) ** not tested					

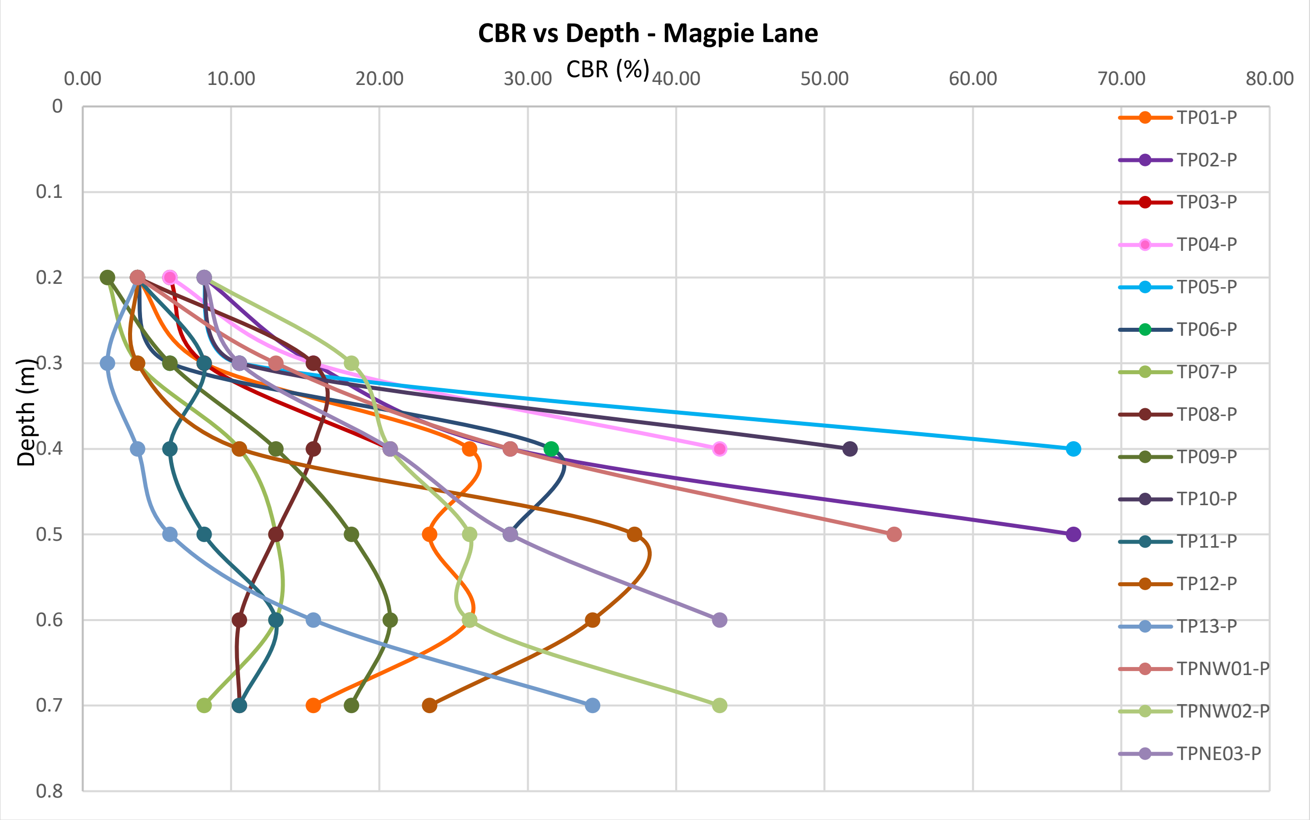

Figure 4. CBR (%) from DCP Tests Versus Depth

The CBR at the estimated subgrade level ranges between 2% to 67%. It is noted an unreliable correlation between the in-situ CBR and laboratory values. This could be attributed to the moisture content of the soil in situ being generally drier than the optimum moisture content and granular nature of materials and presence of XW Rock. Pavement Design Parameters

Pavement thickness design has been performed in accordance with Austroads, AGPT02-17 Guide to Pavement Technology, Part 2: Pavement Structural Design (Austroads AGPT02-17, 2017) based on the following parameters.

- Design subgrade CBR of 3% for Sandy/Silty CLAY subgrade and 6% for weathered rock subgrade.
- A Design for subgrade with CBR less than 4% using select layer is also provided and recommended if CBR swell ≥2.5% is encountered.

Final pavement outcomes will be determined by regrade activities in large portions of the Site. The design subgrade has been determined in accordance with Section 5 of Austroads (2017) based on results for both laboratory and field testing undertaken on this investigation and will require confirmation following completion of regrade.

A CBR of 6% for extremely weathered bedrock is considered as the material was not pre-treated prior to CBR testing and it is prone to breakdown.

5.3 Preliminary Pavement Thickness Design

The design for pavement construction utilising flexible unbound pavement materials is detailed in Table 13 and Table 14.

Table 13. Recommended Flexible Pavement Compositions

Pavement Layer	Road Type - Local	Road Type - Local	Road Type - Local
Wearing Course (mm)*	30 AC10with 7mm primer seal	30 AC10 with 7mm primer seal	30 AC10 with 7mm primer seal
Base Course (mm)	150	150	150
Subbase (mm)	220	120	120
Select (mm)*/**	-	300	-
Total Thickness (mm)	400	600	300
Subgrade CBR (%)	4%	4%	6%
Allowable DESA	2 x 10^5	2 x 10^5	2 x 10^5

*Where a 2-coat bituminous seal is utilised as a wearing course, the subbase should be increased by 30mm.
**Where reactive clay has a CBR swell ≥2.5% of a soaked CBR of ≤4% the pavement option using a select subgrade should be adopted.
***Subject to inspection and proof rolling of the subgrade by Council or the geotechnical engineer a select layer may be required

Table 14. Recommended Flexible Pavement Compositions

Pavement Layer	Road Type - Collector	Road Type - Collector	Road Tye - Collector
Wearing Course (mm)*	45 AC14 (AR45 Binder) with 7mm primer seal	45 AC14 (AR45 Binder) with 7mm primer seal	45 AC14 (AR45 Binder) with 7mm primer seal
Base Course (mm)	150	150	150
Subbase (mm)	225	125	150
Select (mm)**/* **	-	280	-
Total Thickness (mm)	420	600	345
Subgrade CBR (%)	4%	4%	6%
Allowable DESA	6 x 10^5	6 x 10^5	6 x 10^5

* Where a 2-coat bituminous seal is utilised as a wearing course, the subbase should be increased by 45mm
**Where reactive clay has a CBR swell ≥2.5% of a soaked CBR of ≤3% the pavement option using a select subgrade should be adopted.
***Subject to inspection and proof rolling of the subgrade by Council or the geotechnical engineer a select layer may be required

A minimum of fourteen days duration shall apply prior to application of subsequent asphalt layer(s). That period may be extended or shortened subject to approval by Council. Where acceptable to Council the subbase layer may be reduced to a 150mm layer, and the balance of subbase thickness made up of a select layer of minimum soaked CBR 30% material.

The determination of a weathered rock or sandy clay subgrade suitable to adopt a CBR 6% subgrade should be undertaken by a geotechnical consultant or suitably qualified council engineer. Low strength clay with a soaked CBR of <4% if encountered at DSL shall be removed and replaced with 0.6m of CBR >4% site won material.

Where weathered sandstone/siltstone/shale is encountered at design subgrade level (DSL) the pavement thickness design as indicated in Table 13 and Table 14 should be adopted. Where consistent sandstone bedrock is encountered at design subgrade level, adoption of the CBR 6% design is appropriate following ripping and re-compaction to a depth of 300mm below DSL.

As the extent of regrade is unknown at this stage, the design subgrade CBR will be dependent on the extent of regrade activities and final vertical and horizontal alignments. CBRs should be undertaken once final alignments are known during construction.

5.3.1 Preliminary Pavement Thickness Design – Roundabout

According to the Council's Engineering Guidelines the roundabouts are to be constructed using 320 Grade, full-depth asphalt. One test pit has been excavated at the location of each proposed roundabout. The CBR tests conducted on bulk selected samples from both test pits (TPNE03-P, TP13-P) indicated soaked CBR of 8%. A conservative approach for design of CBR 6% have been considered for the proposed roundabouts due to the potential breakdown of material. A select layer of 150mm thickness has been considered above the subgrade to facilitate the construction of the full asphalt pavement. Details about the thickness design calculations using CIRCLY software are presented in **Appendix F – Pavement Thickness Calculations**.

Table 15. Preliminary Pavement Thickness Design Roundabout

Pavement Layer	Road Type - Local	Road Type - Collector
Wearing Course (mm)	50 AC14 Dense Graded (HD C450 binder)	50 AC14 Dense Graded (HD C450 binder)
Intermediate Asphalt Layer (mm)	75 AC20 Dense Grade (HD C450 binder)	95 AC20 Dense Grade (HD C450 binder)
Select (mm)*/**	150	150
Total Thickness (mm)	275	295
Subgrade CBR (%)	6%	6%
Allowable DESA	2 x 10^5	6 x 10^5

*Where reactive clay has a CBR swell ≥2.5% of a soaked CBR of ≤4% the pavement option using a select subgrade should be adopted.
**Subject to inspection and proof rolling of the subgrade by Council or the geotechnical engineer a select layer may be required

A rigid pavement could be considered for the internal roundabouts as alternative to the full asphalt pavement. The proposed locations for the internal roundabouts are in an area with shallow extremely weathered sandstone hence a CBR of 6% is considered adequate for the pavement design. A 190mm of 5.5 MPa flexural strength Steel Fibre Reinforced Concrete Pavement (SFRC) with integrally cast shoulder over 150mm of bound subbase would be appropriate for a design subgrade of CBR 6% for a traffic 2 x 10^5 ESA. A 197mm of 5.5 MPa flexural strength Steel Fibre Reinforced Concrete Pavement (SFRC) with integrally cast shoulder over 150mm of bound subbase would be appropriate for a design subgrade of CBR 6% and a design traffic of 6 x 10^5 ESA.

Reinforcing and jointing detailing to be undertaken by an experienced structural engineer. The proposed pavement rigid design is detailed in Table 16 with concrete pavement design sheet provided in **Appendix F – Pavement Thickness Calculations.**

Table 16. Recommended rigid pavement roundabout (SFRC)

Layer	Material	Material
Base*	190 mm thick Pavement (SFRC) * Min Flexural Strength of 5.5 MPa (28 days)	197 mm thick Pavement (SFRC) * Min Flexural Strength of 5.5 MPa (28 days)
Curing/debonding	7 mm low cutter seal or other suitable interlayer debonding layer	7 mm low cutter seal or other suitable interlayer debonding layer
Subbase (mm)	150mm Bound Subbase	150mm Bound Subbase
Subgrade CBR (%)	min 6%	min 6%
Allowable DESA	2 x 10^5	6 x 10^5

5.4 Subgrade Preparation

Where construction of a new pavement is proposed, subgrade preparation should be in general accordance with the following procedures:

- Remove topsoil/fill to the design subgrade level (DSL).
- Excavation or residual soil/ weathered bedrock to design subgrade level.
- Ripping the insitu subgrade (including weathered bedrock) 300-350mm below DSL and recompact to a minimum 100% of SMDD. Moisture content should be within 70% to 90% of SOMC (generally -3% to -1% dry of SOMC) and care is required not to compact the subgrade at high levels of relative compaction at moisture significantly dry of SOMC as this will create swell potential, particularly in reactive/expansive clay subgrades.
- Static proof-rolling of the exposed subgrade using a heavy (minimum 10 tonne) roller under the direction of an experienced geotechnical consultant.
- Loose or yielding areas should be excavated and replaced with compacted select fill or suitable subgrade replacement comprising of material of similar consistency to the subgrade.
- Testing of the subgrade by soaked CBR testing to confirm the design parameters.

Where filling or subgrade replacement is required, the materials employed should be free of organics or other deleterious material. The material should also have a maximum particle size of 100mm or one third of the layer thickness, with a minimum soaked CBR of 4% or 6% depending on pavement option adopted. Select subgrade replacement should be utilised where CBR <4% subgrade is encountered. Following satisfactory preparation of the subgrade, the pavement should be placed in accordance with the designer’s recommendations.

Careful material management strategies will be required to obtain optimal pavement and Site Classification outcomes with more reactive lower strength material placed at lease 0.75m below design levels.

5.5 Materials

Pavement materials and compaction requirements for new pavement construction should be conform to Mid-Western Regional Council requests and the following conditions in Table 17.

Table 17. New Unbound Pavement Construction: Material Specification and Compaction Requirements

Pavement Course	Material Specification Recommendation	Compaction Requirements
Base Course High quality crushed rock (Class 2 for local roads)	Material complying with TfNSW QA Specifications 3051 Category D (local) CBR ≥80%, with 2% < PI < 6%	Min 98% Modified (AS 1289 5.2.1) or Min 102% Standard (AS 1289 5.1.1)
Subbase Subbase quality crushed rock	Material complying with TfNSW QA Specifications 3051 Category D and CBR ≥30% with PI < 10%	Min 95% Modified (AS 1289 5.2.1) or Min 100% Standard (AS 1289 5.1.1)
Select	CBR ≥30%	Min 100% Standard (AS 1289 5.1.1)
Subgrade or replacement	Minimum CBR≥4% or 6% depending on pavement option.	Min 100% Standard (AS 1289 5.1.1)

All granular pavement material quality should be in general accordance with TfNSW QA Specification 3051 for Traffic Category D "Light" for local roads. Where recycled base or subbase are proposed conformance with the Council specifications is required.

Minimum testing on all potential imported pavement materials should be in accordance with TfNSW 3051 Ed 7. Pre-treatment of material prior to testing would be advisable for materials subject to breakdown.

5.5.1 Wearing Course

Wearing courses should be in accordance with Mid-Western Regional Council specifications and with reference to Austroads AGPT04B-07 Guide to Pavement Technology, Part 4B: Asphalt.

The design and construction of wearing courses should be in in consultation with the preferred supplier considering traffic volume and type. All pavement surfaces should be primer sealed prior to the application of the asphaltic concrete ('AC') wearing course. A minimum delay of 14 days is required after the primer seal before placement of the AC wearing course. The delay period on application of the wearing course following primer seal may be altered following discussion with the supplier.

Council specify a minimum 40mm thickness Asphalt Concrete laid upon a sprayed bituminous prime coat for the new urban residential roads.

5.6 Pavement Interface and Tie-in

Where new pavement construction abuts an existing pavement, care should be exercised to either create a clean vertical construction joint or bench into the base course layer for a minimum of 0.5 m for the entire pavement width and match pavement compositions.

Adequate compaction of the subgrade and pavements in the joint/bench area is essential to maximise performance of the pavement. It is noted that where variable pavements are abutted, the potential for localised failure is generally greater. Consideration should be given to sealing any cracks that may develop between existing and new pavements. The use of strain alleviating membranes at the interface may also be appropriate.

It is recommended to install intra-pavement drainage at subgrade level at interfaces of variable existing and new pavements. Where pavements of various thickness abut, the thicker pavement should be tapered / transition over a minimum distance of 5m into the subgrade of the thinner pavement.

5.7 Drainage

The moisture regime associated with a pavement has a major influence on the performance considering the stiffness/strength of the pavement materials is dependent on the moisture content of the material used. Accordingly, to protect the pavement materials from wetting up and softening, particular care would be required to provide a waterproof seal for the pavement materials, together with adequate surface and sub-surface drainage of the pavement and adjacent areas.

Following investigation, observation of the proposed road alignments, and the subgrade conditions, it is recommended that subsoil drainage be installed at, or below subgrade level preferably along both sides of the road. Alternately open swale drains could be considered where designed and positioned below the design subgrade level.

The subgrade should be constructed with sufficient cross fall (in general 3%) to assist in reducing retention time for moisture entering the pavement. The subsoil drains should be located below or behind the kerb to intercept any moisture ingress from outside and within the road alignment. The drains will require flush-out points and regular maintenance to ensure their correct operation. The pavement thickness designs presented above assume drained pavement conditions. The selection, construction and maintenance of appropriate drainage mechanisms will be required for adequate performance.

5.8 Inspections and Testing

The subgrade will require inspection by an experienced geotechnical consultant after boxing out or filling to design subgrade level. The purpose of inspections is to confirm design parameters, assess the suitability of the subgrade to support the pavement, and delineate areas which may require subgrade replacement or remedial treatment prior to construction. This is particularly important where Sandy CLAY subgrade is encountered or where rock subgrade is encountered, and the contractor wishes to transition from the CBR 4% clay subgrade pavement design to the CBR 6% subgrade of weathered rock pavement design.

Soaked CBR testing will be required following the completion of bulk earthworks and site regrade activities to confirm the assumed design parameters and appropriate pavement thickness.

All works and materials used in construction should be constructed in accordance with Council Specifications and as specified in this report. Where discrepancies may occur, clarification should be sought from Council.

5.9 Additional Investigation

Additional investigation should be undertaken to confirm the subgrade design parameters used particularly in areas where the layout varies from the initial investigation. Additional soaked CBR testing is recommended for section of Road 1 Road 21 and the roundabout not previously investigated at the time of construction to confirm subgrade conditions and design CBR.

6 Preliminary Site Classification

AS2870-2011, 'Residential Slabs and Footings', sets out criteria for the classification of a site, the design and construction of a footing system for a single dwelling house, townhouse, or a similar structure. The standard can also be used for other forms of construction, including some light industrial, commercial, and institutional buildings if they are similar in size, loading and performance expectation to a typical domestic structure using engineering principles. Site classes as defined on Table 2.1 and 2.3 of AS 2870 are presented in Table 18.

Table 18. General Definition of Site Classes

Site Class	Foundation	Characteristic Surface Movement
A	Most sand and rock sites with little or no ground movement from moisture changes	
S	Slightly reactive clay sites, which may experience only slight ground movement from moisture changes	0 - 20mm
M	Moderately reactive clay or silt sites, which may experience moderate ground movement from moisture changes	20 - 40mm
H1	Highly reactive clay sites, which may experience high ground movement from moisture changes	40 - 60mm
H2	Highly reactive clay sites, which may experience very high ground movement from moisture changes	60 - 75mm
E	Extremely reactive sites, which may experience extreme ground movement from moisture changes	> 75mm
A to P	Filled sites (refer to clause 2.4.6 of AS 2870)	
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise.	

Reactive sites are sites consisting of cohesive soils that swell on wetting and shrink on drying, resulting in ground movements that can damage lightly loaded structures. The amount of ground movement is related to the physical properties of the clay and environmental factors such as climate, vegetation, and watering. A higher probability of damage can occur on reactive sites where abnormal moisture conditions occur, as defined in AS 2870, due to factors such as:

- Presence of trees on the building site or adjacent site, removal of trees prior to or after construction, and the growth of trees too close to a footing. The proximity of mature trees and their effect on foundations should be considered when determining building areas within each allotment (refer to AS 2870).
- Failure to provide adequate site drainage or lack of maintenance of site drainage, failure to repair plumbing leaks and excessive or irregular watering of gardens.
- Unusual moisture conditions caused by removal of structures, ground covers (such as pavements), drains, dams, swimming pools, tanks etc.

Regarding the performance of footings systems, AS 2870 states "footing systems designed and constructed in accordance with this Standard on a normal site (see Clause 1.3.2) that is:

(a) not subject to abnormal moisture conditions; and

(b) maintained such that the original site classification remains valid and abnormal moisture conditions do not develop.

are expected to usually experience no damage, a low incidence of damage category 1 and an occasional incidence of damage category 2.”

Damage categories are defined in Appendix C of AS 2870, which is reproduced in CSIRO Information Sheet BTF 18, **Appendix G - Foundation Maintenance and Footing Performance**.

The laboratory Shrink Swell test results summarised in Table 7 indicate that the tested Sandy CLAY soils returned I_{ss} values ranging from 1.1% (in TP04-L) to 2.7 % (in TPW01-L).

The classification of sites with controlled fill of depths greater than 0.4m (deep fill) comprising of material other than sand would be Class P. An alternative classification may however be given to sites with controlled fill where consideration is made to the potential for movement of the fill and underlying soil based on the moisture conditions at the time of construction and the long-term equilibrium moisture conditions.

Based on the subsurface profiles encountered during the Site inspection and in accordance with the AS 2870-2011; the Site in its existing condition and in the absence of abnormal moisture conditions would likely be classified as detailed in Table 19.

Table 19. Anticipated Site Classification

Myall Road, Garden Suburb, NSW	Site Classification
Founded in controlled fill or in stiff of better Sandy/Silty CLAY with rock<1.5m depth	**Class S, M-D, H2-D** – slightly to highly reactive
Founded in Controlled Fill >1.5 depth	**Class M-D, H2-D and E-D** medium to extremely reactive

A characteristic surface movement (y_s) in the range of 16mm to 64mm has been calculated for the site dependent on the soil profile, and the depth of design suction (Hs) change of 4m used as per Table 2.5 AS2876-2011 for Climatic Zone 6.

The above site classifications and footing recommendations are for the site conditions present at the time of fieldwork and consequently the site classification may need to be reviewed with consideration of any site works that may be undertaken after the investigation and this report.

Site works may include:

- Changes to the existing soil profile by cutting and filling.
- Reactivity of fill material utilised.
- Landscaping, including trees removed or planted in the general building area; and
- Drainage and watering systems.

Designs and design methods presented in AS 2870-2011 are based on the performance requirement that significant damage can be avoided if site conditions are properly maintained. Performance requirements and foundation maintenance are outlined in Appendix B of AS 2870. The above site classification assumes that the performance requirements as set out in Appendix B of AS 2870 are acceptable and that site foundation maintenance is undertaken to avoid extremes of wetting and drying.

Details on appropriate site and foundation maintenance practices are presented in Appendix B of AS 2870-2011 and in CSIRO Information Sheet BTF 18, Foundation Maintenance and Footing Performance: A Homeowner’s Guide. Adherence to the detailing requirement outlined in Section 5 of AS 2870-2011 is essential, Section 5.6. Additional requirements for Classes M-D, H1-D, H2_d and E-D sites, including architectural restrictions, plumbing and drainage requirements.

7 Construction Notes

7.1 Excavatability Assessment

Practical machine refusal for the 13-tonne excavator was encountered on bedrock in eighteen (18) test pits out of thirty-five (35) excavated test pits at depth ranging from 0.73m BGL to 2.9m BGL. The strength of bedrock encountered in test pits assessed by point load testing ranges from high to very high strength. To assess the excavatability of the bedrock the strength range is plotted on the graph in Figure 5 for excavatability as per suggested method by Pettifer and Fookes. The area of the chart covered indicates that very hard ripping by a D9 will be typically the excavation method for the type of rock encountered in the northern part of the site.

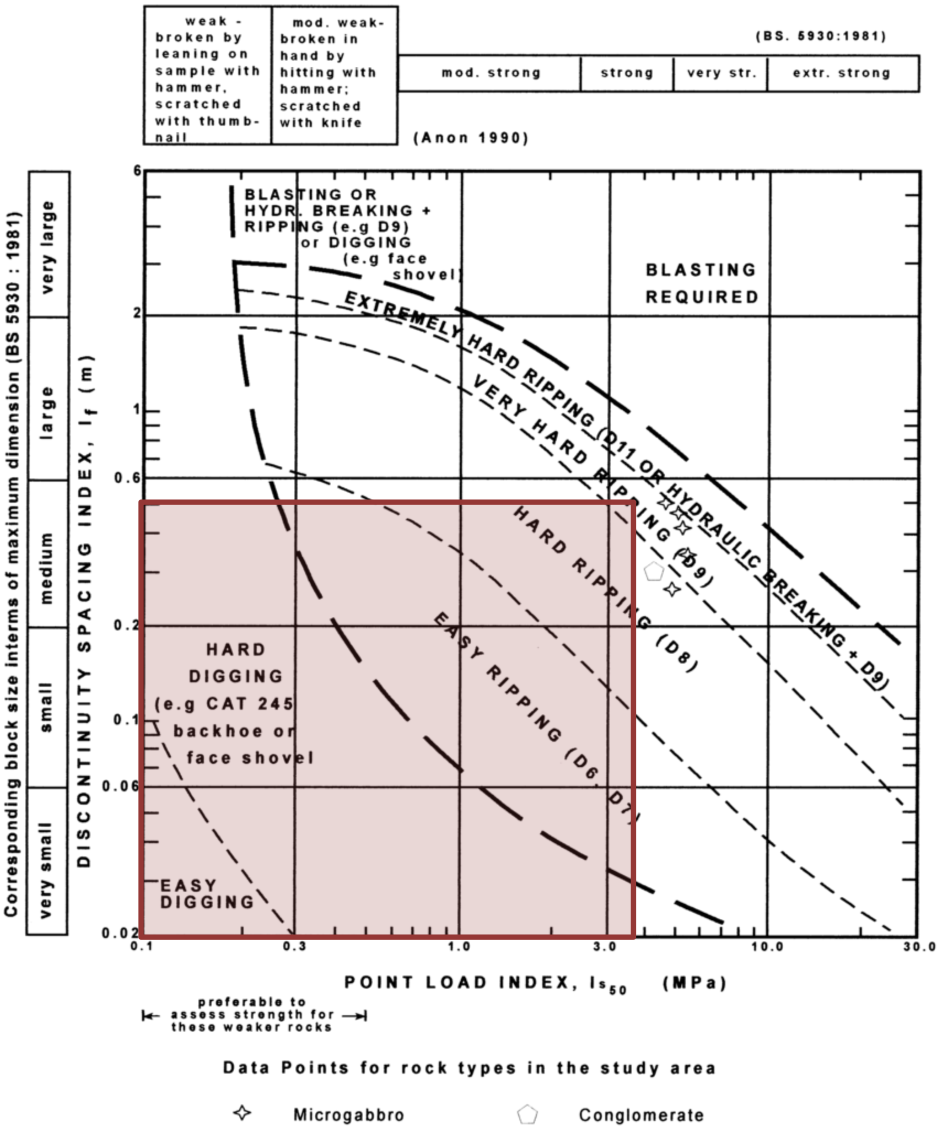

Figure 5. Excavatability Assessment after Pettifer and Fookes

Excavations to depths of 1.0m-1.5 m BGL in weathered bedrock are expected to be readily achievable using larger (>20T) conventional earthmoving equipment. Excavations below 2m deep (especially in confined space like trenches) in bedrock may require excavators fitted with tiger teeth buckets, single ripper attachment or rock hammer.

Excavatability conditions have not been assessed beyond the depths to which the test pits were excavated; however, the following general comments regarding rock mass excavatability conditions can be made:

- Rock strength as well as rock mass defect (joint) spacing could be expected to control rock mass excavatability. Rock strength is likely to be variable and layers of weaker rock can underlie stronger bedrock.
- Excavatability could be expected to be dependent on the plant used, the experience of the operator and the degree of confinement within the excavation.

Further investigation is recommended to assess rock strength / excavatability during detailed investigations.

It is recommended that long-term excavations are either battered at 2H:1V or flatter and protected against erosion or be supported by engineer designed and suitably constructed retaining walls. Excavations may be battered steeper than 2H:1V in rock materials, subject to specific geotechnical Investigation.

Excavations or trenches in the Sandy/Silty CLAY and extremely weathered material could be expected to stand close to vertical in the short-term. Granular soils were encountered within various site areas down to depths of up to 0.4m BGL, and unsupported short-term excavations or trenches may undergo some local slumping into the excavation particularly during or following high rainfall periods.

Where personnel are to enter excavations, options for short-term excavations stability include benching or battering back of the excavations to 1H:1V or the support of excavations within the residual soil and extremely weathered rock profile.

The excavation recommendations provided above should be considered with reference to the Safe Work Australia Code of Practice ‘Excavation Work’, dated January 2020.

7.2 Filling

Fill should be placed and compacted in accordance with AS 3798-2007. It is expected that construction of a suitable fill platform to support structural loads, such as pavements, ground slabs, footing and stiffened raft slabs, would include the following:

- Where wet material is encountered this will likely require treatment or moisture re-conditioning (drying and blending with dryer fill material) prior to placement and compaction.
- Proof rolling of the exposed subgrade to detect any weak or deforming areas of subgrade that should be excavated and replaced with compacted fill.
- Placement of fill in horizontal layers with compaction of each layer to a minimum dry density ratio of 95% Standard Relative Density (Australian Standard AS 1289 Clause 5.1.1) at moisture contents of 85-115% of SOMC. Fill within 0.5m of design subgrade in road alignments is to be compacted to 100% standard relative density at a 70-100% of SOMC. Reactive / Expansive clay materials (if encountered) should be placed as close to SOMC as practical as this will minimise their swell potential. All expansive soils should be placed in the lower layers of the deeper fill areas.

All fill materials should be supported by properly designed and constructed retaining walls or else battered at a slope of 2H:1V or flatter and protected against erosion by vegetation or similar and the provision of adequate drainage. Materials excavated on Site apart from topsoil and fill are considered suitable for re-use as engineering fill. Some materials will likely require treatment such as blending and moisture re-conditioning to produce suitable structural fill, subject to further assessment and weather conditions prior to and during construction. It is noted that clayey sands were encountered in areas of the Site. While these materials have suitable properties when dry they are prone to softening (loss or strength) when wet and can present trafficability and compaction issues when at elevated moisture contents. The sandy material may also prove difficult from an earthworks perspective and should be either stripped and replaced as surficial layers or blended with more cohesive materials. Material should be managed during regrade to allow use of higher CBR and lower reactivity material in the top 300mm of design subgrade and fill area to provide better pavement and classification outcomes.

Careful material management strategies will be required to obtain optimal pavement and Site Classification outcomes with more reactive lower strength material placed at lease 0.75m below design levels.

7.3 Water Storage Tanks

Two tanks for storage water are proposed to be placed along the eastern boundary of the site. A test pit was excavated in this area TP01-WS identifying loose sand and firm clay up to 0.3m BGL and stiff and very stiff clay up to 1.6m BGL. The shallow layers of firm clay and loose sand are considered inadequate to support the water tanks. The stiff and very stiff clay layers below 0.5m BGL are considered adequate to support loads of 100-125kPa (allowable).

8 Basin Construction

Several sediment control basins are planned to be constructed across the site. The substrata present at one of these locations have been tested and the results are outlined in the following section.

Testing of the subsurface soils in the areas of proposed basin construction indicates that the soils are suitable for the use in construction in selected zones of the proposed basin. The tests indicate the soils are likely to be appropriate for use in a homogeneous or zoned embankment. A zoned embankment may be preferred to allow the use of a lesser quality materials on downstream embankment construction and higher plasticity material used in the clay core.

8.1 Laboratory Testing Results

8.1.1 Fall Head Permeability

One Falling Head Permeability test was undertaken to confirm the design permeability of the basin foundations. Results of the testing are detailed in the laboratory reports attached in **Appendix E – Laboratory Test Results** and summarised in Table 20.

Table 20. Falling Head Permeability Test Results

Sample ID	Depth (m BGL)	Sample Description	W^1 (%)	$SOMC^2$ (%)	$SMDD^3$ (t/m^3)	Permeability (m/s)
TP02-WS	0.2-0.6	Sandy CLAY	13.4	13.2	1.84	8×10^{-9}

1) Field Moisture Content
2) Standard Optimum Moisture Content
3) Standard Maximum Dry Density

Permanent and temporary sediment and water detention basin should be designed and constructed in accordance with Mid-Western Regional Council specifications and the requirements from Table 21**.**

Table 21. Drainage Basin materials and compaction requirements

Zone	Material Specifications	Compaction Requirements
1- Clay Core / Clay Liner & Embankment Material	Liquid limit >50% 10% < Plasticity Index (PI) < 50%, Permeability <10^{-9}m/s **Emerson Class >4** Maximum Particle Size <50mm Percentage Clay Content >25	98% standard relative density AS1289 5.7.1 at a moisture content of -1 to +3% of standard optimum moisture
2 - Outer Embankment Material (lower standard)	10%< PI <50%, Permeability < 10^{-7}m/s **Emerson Class >2** Maximum Particle Size <75mm Percentage Clay Content >20 %	95% standard relative density AS1289 5.7.1 at a moisture content of -2 to +2% of standard optimum moisture
Topsoil	Suitable for sustaining planned vegetation plantings	Not applicable
Cut-Off Trench / Keyway	Minimum Stiff (CL-CH) Clay or better.	Minimum 2.4m wide and keyed into a minimum depth of 0.5 m into impervious material (compaction as per Zone 1)

Zone	Material Specifications	Compaction Requirements
Batter Slopes	1 Vertical: 6 Horizontal (Impoundment) 1 Vertical: 3 Horizontal (External)	
Spillway	Constructed in accordance with Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia (Geoscience Australia), 2019.	

Higher plasticity material should be used selectively in the construction of the basin, with the higher plasticity and lower permeability materials used in the construction of the key trench and clay core where a zone embankment is utilised.

8.2 Basin Batters Guidelines

Basins shall be designed and constructed in accordance with Council Engineering Guidelines and the following recommendations.

Embankments should be battered at a slope of 1V:3H or flatter for downstream batters or for batters above the permanent water level and 1V:6H for impoundment areas below the permanent water level or as otherwise agreed with Council or handrails installed to assist egress.

Earthworks and testing shall be undertaken in accordance with AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments. Table 21 above provides material requirements guidelines and compaction specifications for the construction of a zoned or non-zoned basin embankment. A zoned embankment can be considered where material of specified quality is limited. In this case attention will be required the location of the core and how it interfaces with the existing embankment.

8.2.1 Foundation Preparation for Embankments

Foundation preparation for new embankments could generally be expected to comprise the following:

- Removal of topsoil and slopewash and excavation of the cut-off trench into stiff or better impervious material and to a minimum depth of 0.5m.
- Inspection by an experienced geotechnical consultant to confirm the suitability of the foundation.
- Proof rolling of the exposed foundation area under the embankment with a heavy (minimum 10 tonne static) roller.
- Soft or weak areas detected during the proof rolling excavated and replaced with compacted fill / subgrade replacement comprising low permeability clay.
- Compaction of the various zones to achieve a minimum dry density ratio as detailed in Table 21.
- Protection of the prepared foundation to prevent excessive wetting or drying prior to placement of embankment fill material.
- Formation of the embankment in accordance with the above recommendations and specifications.

It is recommended that trafficking of the material exposed at foundation level be minimised during construction to prevent the permanent deformation of the subgrade or foundation.

Any abrupt changes between founding conditions, e.g., transition from rock to soil should be eliminated during foundation preparation. This could be expected to involve foundation preparation practices such as selective grading or mixing of material to provide a transition between material types and moisture / density control of subgrade compaction. This is particularly relevant where Clayey SAND bands/SANDSTONE/SHALE are observed as they will provide potential pathways for groundwater to enter the embankment.

Impoundment Area

The finished surface of the impoundment area should be treated as indicated below following excavation:

- Ripping of impoundment area excluding constructed embankments to a depth of 300mm and re-compaction as per Zone 1.
- If rock is exposed at the surface; subject to geotechnical inspection it will either require ripping and re-compaction or over excavation and lining with a minimum of 300mm of Zone 1 material, and
- Protection of subgrade to prevent drying cracking of the subgrade prior to filling of the basin.

8.2.2 Cut Off Trench / Keyway

A critical aspect is the construction of the cut-off trench. A cut-off trench or keyway should be a minimum of 2.4 m width or 1.5 times the height of the Basin at the bottom of the trench. The keyway is intended to minimise seepage under the embankment and increase the stability of the Basin embankment and should be designed and constructed accordingly. This includes extending the layer a minimum of 500 mm into stiff or better impervious clay or rock and backfilled with the appropriate quality clay that is thoroughly compacted to the specification requirements.

8.2.3 Vegetation

Topsoil should be spread over the exposed surfaces of the embankment to a depth of at least 150 mm and sown with pasture grass to establish a good cover as soon as possible. Never allow any vegetation larger than pasture grass to become established on or near the embankment. Tree roots, especially eucalyptus tree roots can cause the core to crack resulting in failure of the Basin. As a rule of thumb, trees and shrubs should be kept to a minimum distance of 1.5 times the height of the tree away from the embankment of the Basins. This especially applies to eucalypts.

8.2.4 Basin Construction References

All works and materials used in construction of the basins should be designed and constructed in accordance with Council's specific requirements detailed in their Engineering Design and Construction Guidelines or as specified within this report. Where discrepancies occur clarification should be sought from Council on their requirements.

Earthworks and testing should generally be undertaken in accordance with AS3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments".

9 References

- Austroads AGPT02-17, *Guide to Pavement Technology Part 2: Pavement Structural Design,* Austroads Ltd, 2017.
- Austroads AGPT04B-07 *Guide to Pavement Technology, Part 4B: Asphalt*
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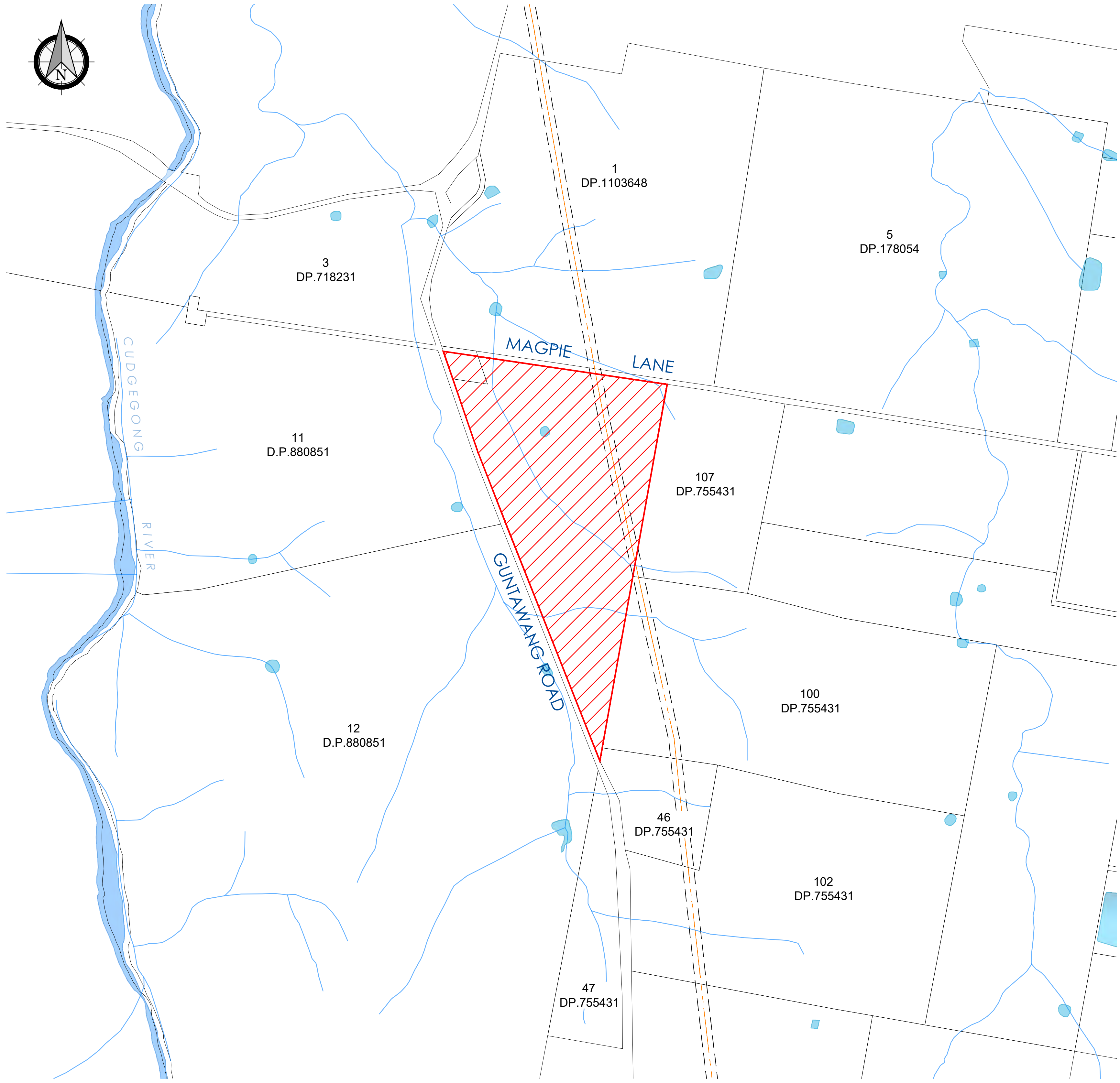
Appendix A

PROPOSED DEVELOPMENT LAYOUT PLANS

PROPOSED DEVELOPMENT OF LOT 1 D.P.174385 & LOT 1 D.P.1003242

313 MAGPIE LANE, GALAMBINE



INDEX OF DRAWINGS

drawing title:
LOCATION DIAGRAM
OF LOT 1 D.P.174385 &
LOT 1 D.P.1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-001-B

client: **CAM** Engineering & Construction Pty.Ltd.

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDINGS	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 250 500m SCALE: 1:10,000 (FULL)	SHEET 1 OF 17

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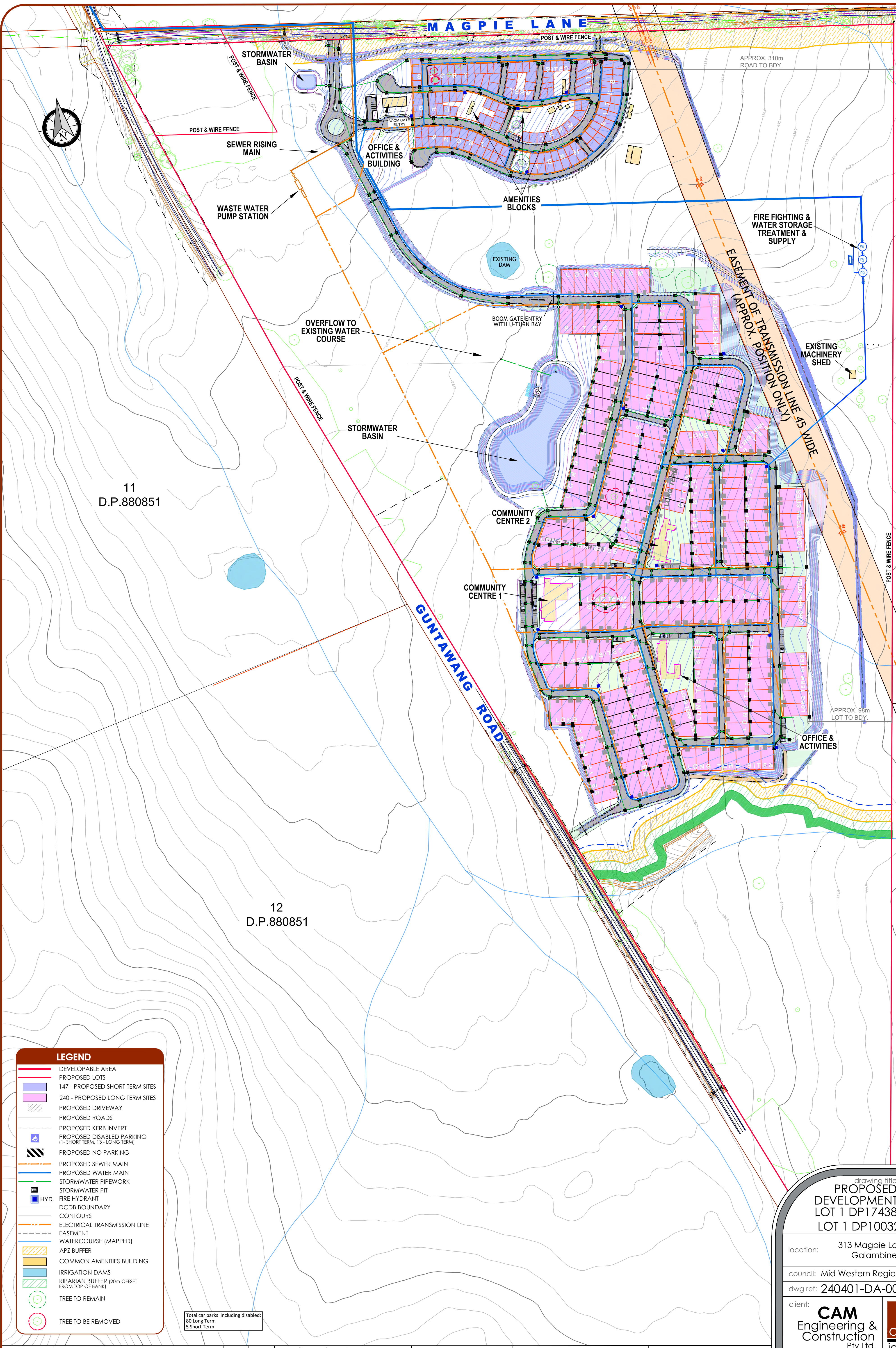

LEGEND

▬	DEVELOPABLE AREA
—	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
▨	PROPOSED DRIVEWAY
—	PROPOSED ROADS
– – –	PROPOSED KERB INVERT
♿	PROPOSED DISABLED PARKING (1- SHORT TERM, 13 - LONG TERM)
▨	PROPOSED NO PARKING
–·–	PROPOSED SEWER MAIN
—	PROPOSED WATER MAIN
– –	STORMWATER PIPEWORK
▤	STORMWATER PIT
■ HYD.	FIRE HYDRANT
—	DCDB BOUNDARY
—	CONTOURS
–··–	ELECTRICAL TRANSMISSION LINE
– – –	EASEMENT
—	WATERCOURSE (MAPPED)
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS
▨	RIPARIAN BUFFER (20m OFFSET FROM TOP OF BANK)
○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

ver.	date	comment	drawn	pm
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.

co-ordinate information: CO-ORDINATE SYSTEM: MGA 94

level information: DATUM: N/A CONTOUR INTERVAL: N/A

scale (A1 original size): 0 50 100m SCALE: 1:2000 (FULL)

notes

SHEET 2 OF 17

drawing title:
PROPOSED DEVELOPMENT OF LOT 1 DP174385 & LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client:
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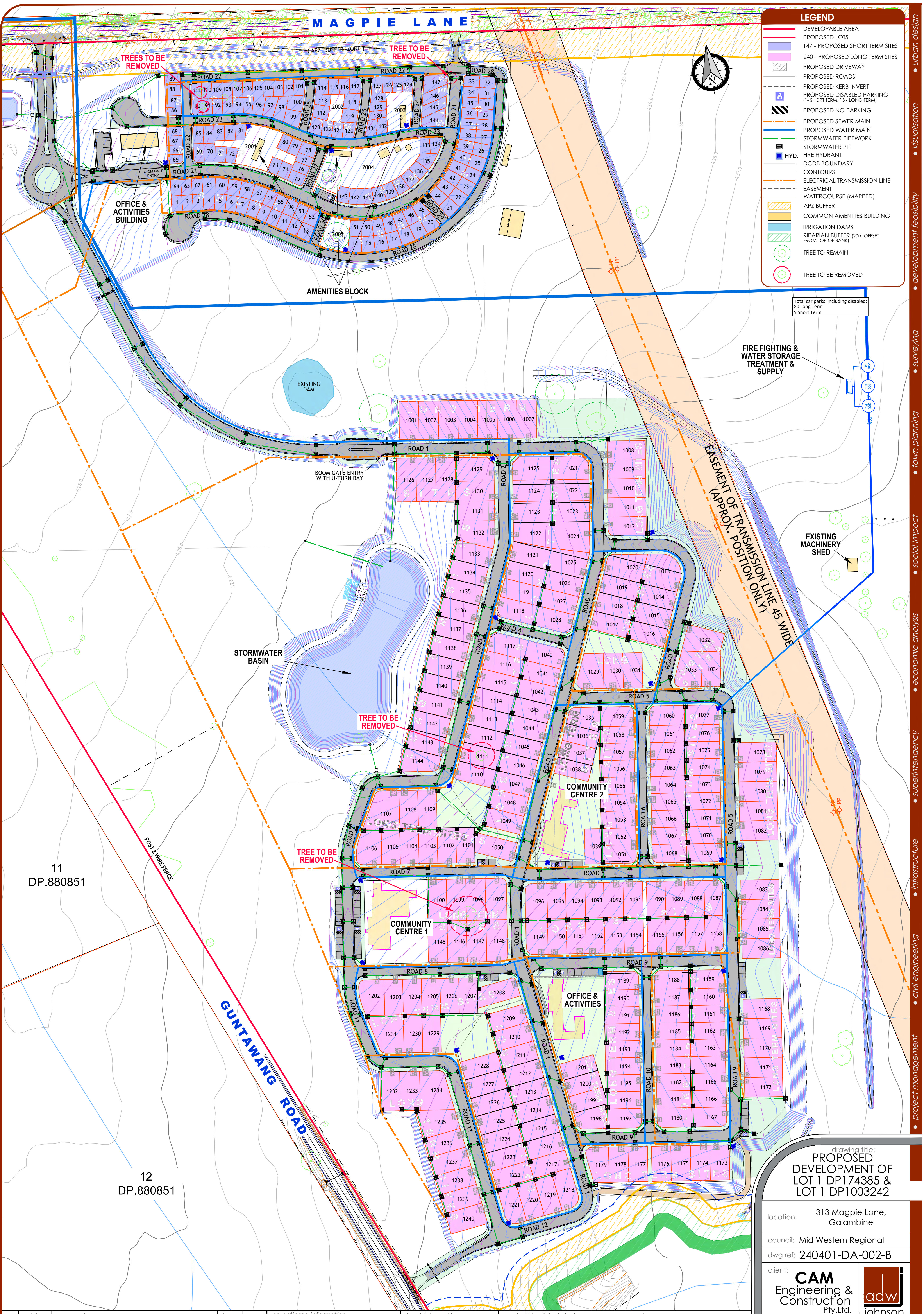

LEGEND

—	DEVELOPABLE AREA
—	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
▨	PROPOSED DRIVEWAY
—	PROPOSED ROADS
- - -	PROPOSED KERB INVERT
♿	PROPOSED DISABLED PARKING (1- SHORT TERM, 13 - LONG TERM)
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— · —	PROPOSED SEWER MAIN
—	PROPOSED WATER MAIN
— —	STORMWATER PIPEWORK
▤	STORMWATER PIT
■ HYD.	FIRE HYDRANT
—	DCDB BOUNDARY
—	CONTOURS
— · —	ELECTRICAL TRANSMISSION LINE
- - -	EASEMENT
—	WATERCOURSE (MAPPED)
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS
▨	RIPARIAN BUFFER (20m OFFSET FROM TOP OF BANK)
○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

drawing title:
PROPOSED
DEVELOPMENT OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client:
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Engineering &
Construction
Pty.Ltd.

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ver.	date	comment	drawn	pm
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.

co-ordinate information
CO-ORDINATE SYSTEM: MGA 94

level information
DATUM: N/A
CONTOUR INTERVAL: N/A

scale (A1 original size)
0 50 100m
SCALE: 1:2000 (FULL)

notes

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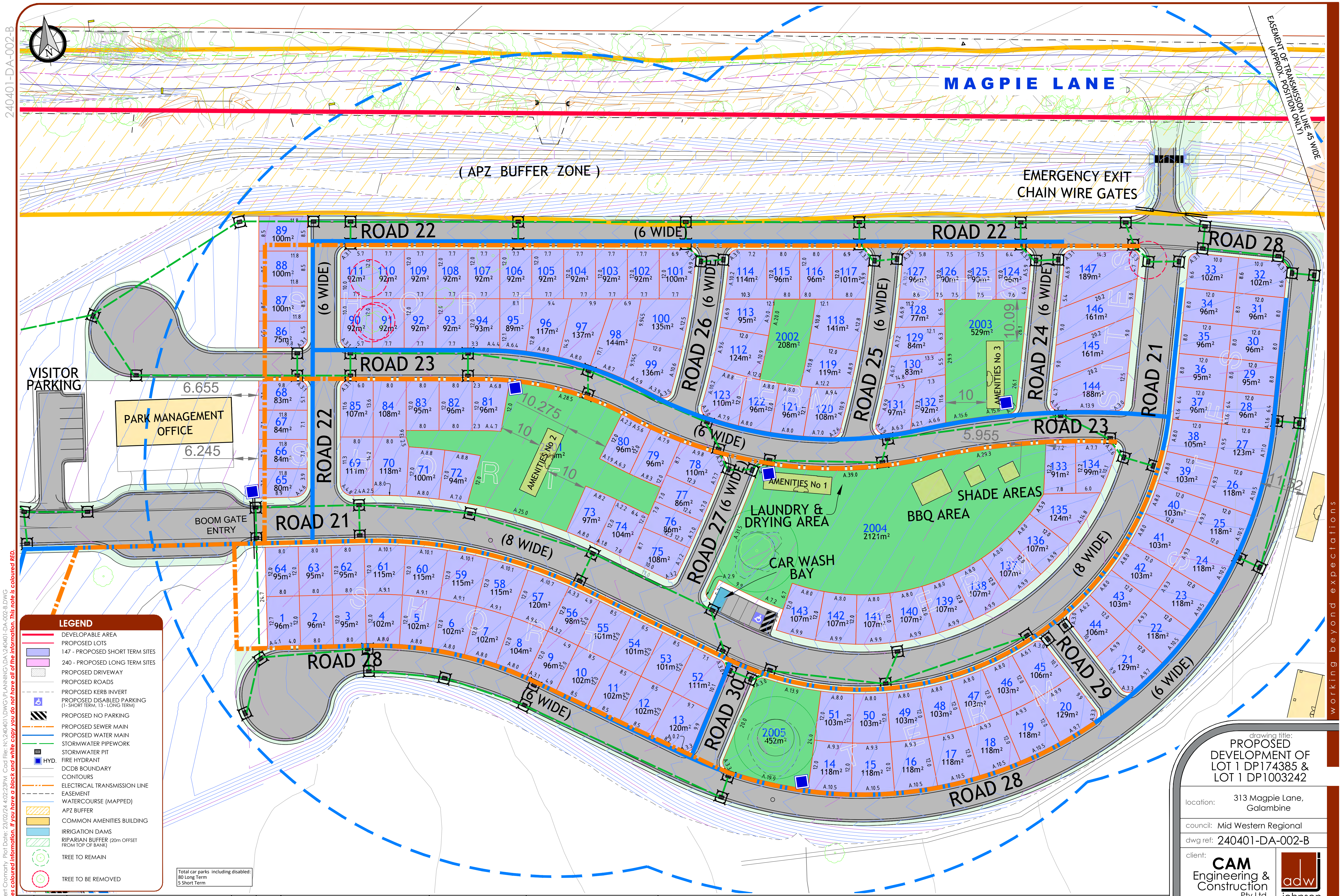

LEGEND

🟥	DEVELOPABLE AREA
🟥	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
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—	PROPOSED ROADS
- - -	PROPOSED KERB INVERT
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—	DCDB BOUNDARY
—	CONTOURS
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○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDINGS	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 10.0 20.0m SCALE: 1:400 (FULL)	

SHEET 4 OF 17

drawing title:
PROPOSED
DEVELOPMENT OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client:
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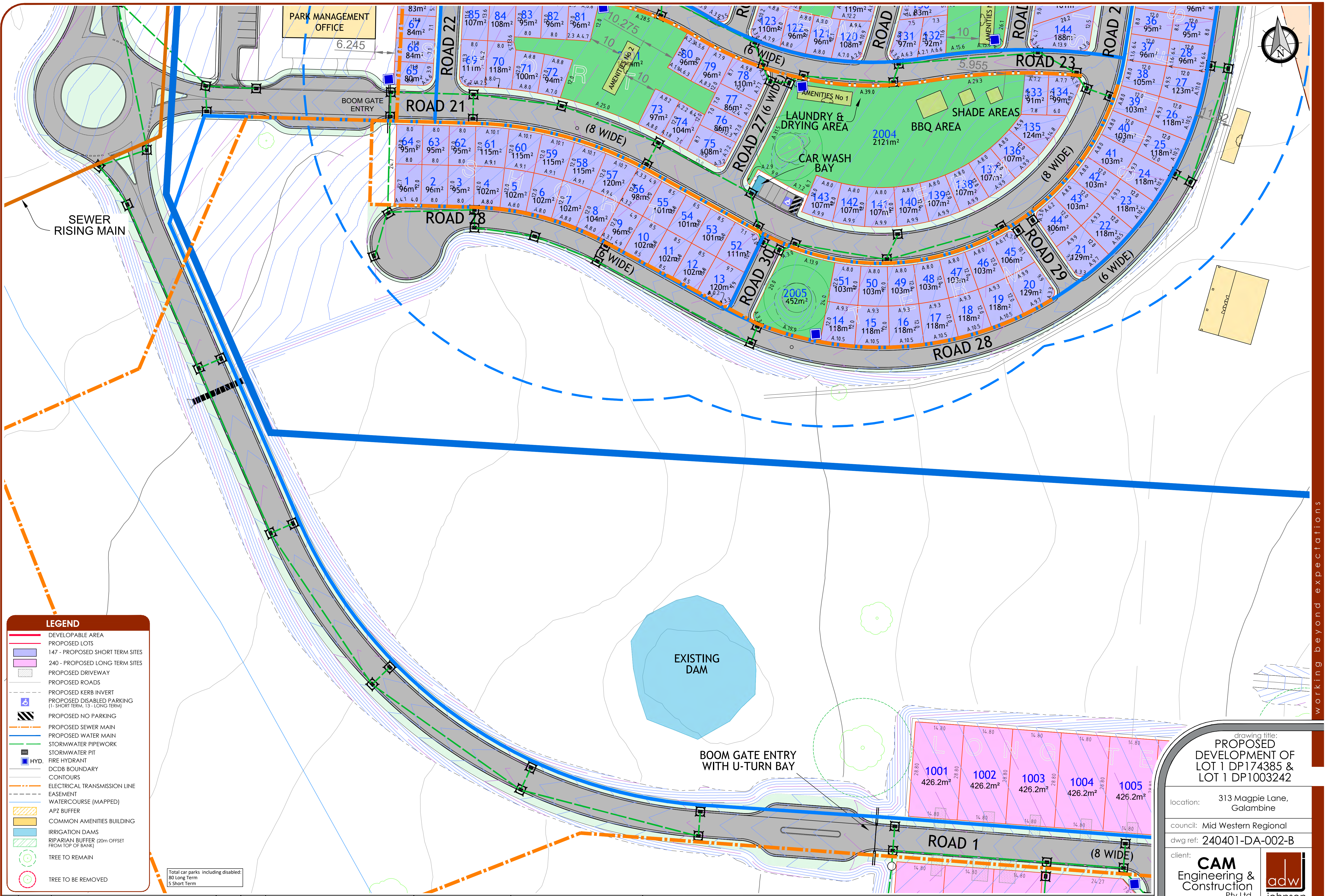

LEGEND

🟥	DEVELOPABLE AREA
🟥	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
▨	PROPOSED DRIVEWAY
	PROPOSED ROADS
	PROPOSED KERB INVERT
♿	PROPOSED DISABLED PARKING (1- SHORT TERM, 13 - LONG TERM)
▨	PROPOSED NO PARKING
	PROPOSED SEWER MAIN
	PROPOSED WATER MAIN
	STORMWATER PIPEWORK
▤	STORMWATER PIT
■ HYD.	FIRE HYDRANT
	DCDB BOUNDARY
	CONTOURS
	ELECTRICAL TRANSMISSION LINE
	EASEMENT
	WATERCOURSE (MAPPED)
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS
▨	RIPARIAN BUFFER (20m OFFSET FROM TOP OF BANK)
○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDINGS	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 12.5 25.0m SCALE: 1:500 (FULL)	

SHEET 5 OF 17

drawing title:
PROPOSED DEVELOPMENT OF LOT 1 DP174385 & LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client: **CAM** Engineering & Construction Pty.Ltd.

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LEGEND

🟥	DEVELOPABLE AREA
—	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
▨	PROPOSED DRIVEWAY
—	PROPOSED ROADS
- - -	PROPOSED KERB INVERT
♿	PROPOSED DISABLED PARKING (1- SHORT TERM, 13 - LONG TERM)
▨	PROPOSED NO PARKING
—·—	PROPOSED SEWER MAIN
—	PROPOSED WATER MAIN
— —	STORMWATER PIPEWORK
▣	STORMWATER PIT
■ HYD.	FIRE HYDRANT
—	DCDB BOUNDARY
—	CONTOURS
—·—	ELECTRICAL TRANSMISSION LINE
- - -	EASEMENT
—	WATERCOURSE (MAPPED)
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS
▨	RIPARIAN BUFFER (20m OFFSET FROM TOP OF BANK)
○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

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drawing title:
PROPOSED
DEVELOPMENT OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane,
Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client:
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B	23.02.2024	UPDATE AMENITIES BUILDINGS	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 12.5 25.0m SCALE: 1:500 (FULL)	

SHEET 6 OF 17

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LEGEND

🟥	DEVELOPABLE AREA
🟥	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
▨	PROPOSED DRIVEWAY
	PROPOSED ROADS
	PROPOSED KERB INVERT
♿	PROPOSED DISABLED PARKING (1- SHORT TERM, 13 - LONG TERM)
▨	PROPOSED NO PARKING
	PROPOSED SEWER MAIN
	PROPOSED WATER MAIN
	STORMWATER PIPEWORK
▤	STORMWATER PIT
■ HYD.	FIRE HYDRANT
	DCDB BOUNDARY
	CONTOURS
	ELECTRICAL TRANSMISSION LINE
	EASEMENT
	WATERCOURSE (MAPPED)
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS
▨	RIPARIAN BUFFER (20m OFFSET FROM TOP OF BANK)
○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDINGS	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 12.5 25.0m SCALE: 1:500 (FULL)	

SHEET 7 OF 17

drawing title:
PROPOSED
DEVELOPMENT OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client:
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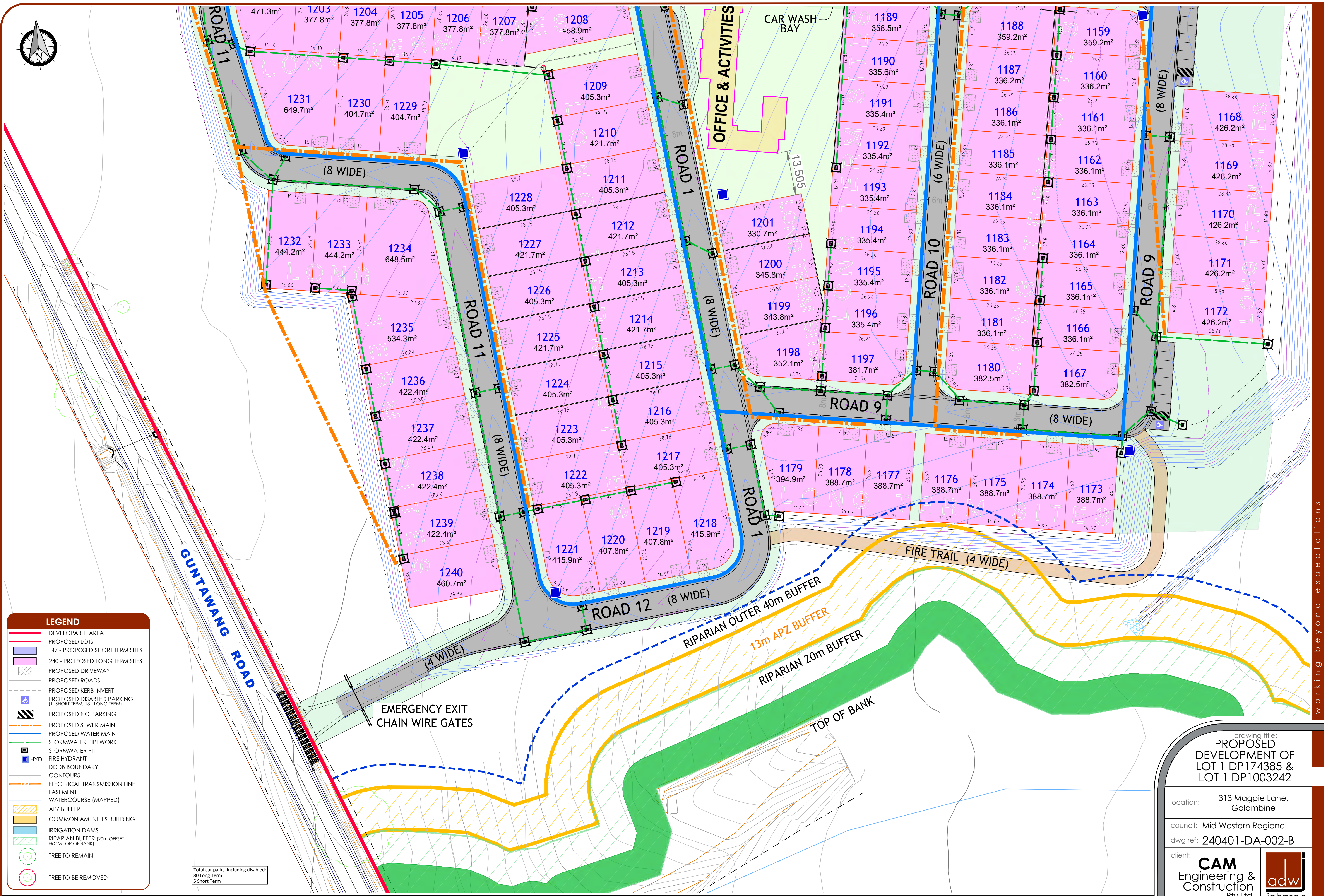

LEGEND

🟥	DEVELOPABLE AREA
🟥	PROPOSED LOTS
🟦	147 - PROPOSED SHORT TERM SITES
🟪	240 - PROPOSED LONG TERM SITES
▨	PROPOSED DRIVEWAY
—	PROPOSED ROADS
- - -	PROPOSED KERB INVERT
♿	PROPOSED DISABLED PARKING (1- SHORT TERM, 13 - LONG TERM)
▨	PROPOSED NO PARKING
-·-	PROPOSED SEWER MAIN
—	PROPOSED WATER MAIN
— —	STORMWATER PIPEWORK
▤	STORMWATER PIT
■ HYD.	FIRE HYDRANT
—	DCDB BOUNDARY
—	CONTOURS
-·-	ELECTRICAL TRANSMISSION LINE
- - -	EASEMENT
—	WATERCOURSE (MAPPED)
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS
▨	RIPARIAN BUFFER (20m OFFSET FROM TOP OF BANK)
○	TREE TO REMAIN
○	TREE TO BE REMOVED

Total car parks including disabled:
80 Long Term
5 Short Term

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDINGS	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 12.5 25.0m SCALE: 1:500 (FULL)	

SHEET 8 OF 17

drawing title:
PROPOSED
DEVELOPMENT OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane,
Galambine

council: Mid Western Regional

dwg ref: 240401-DA-002-B

client:
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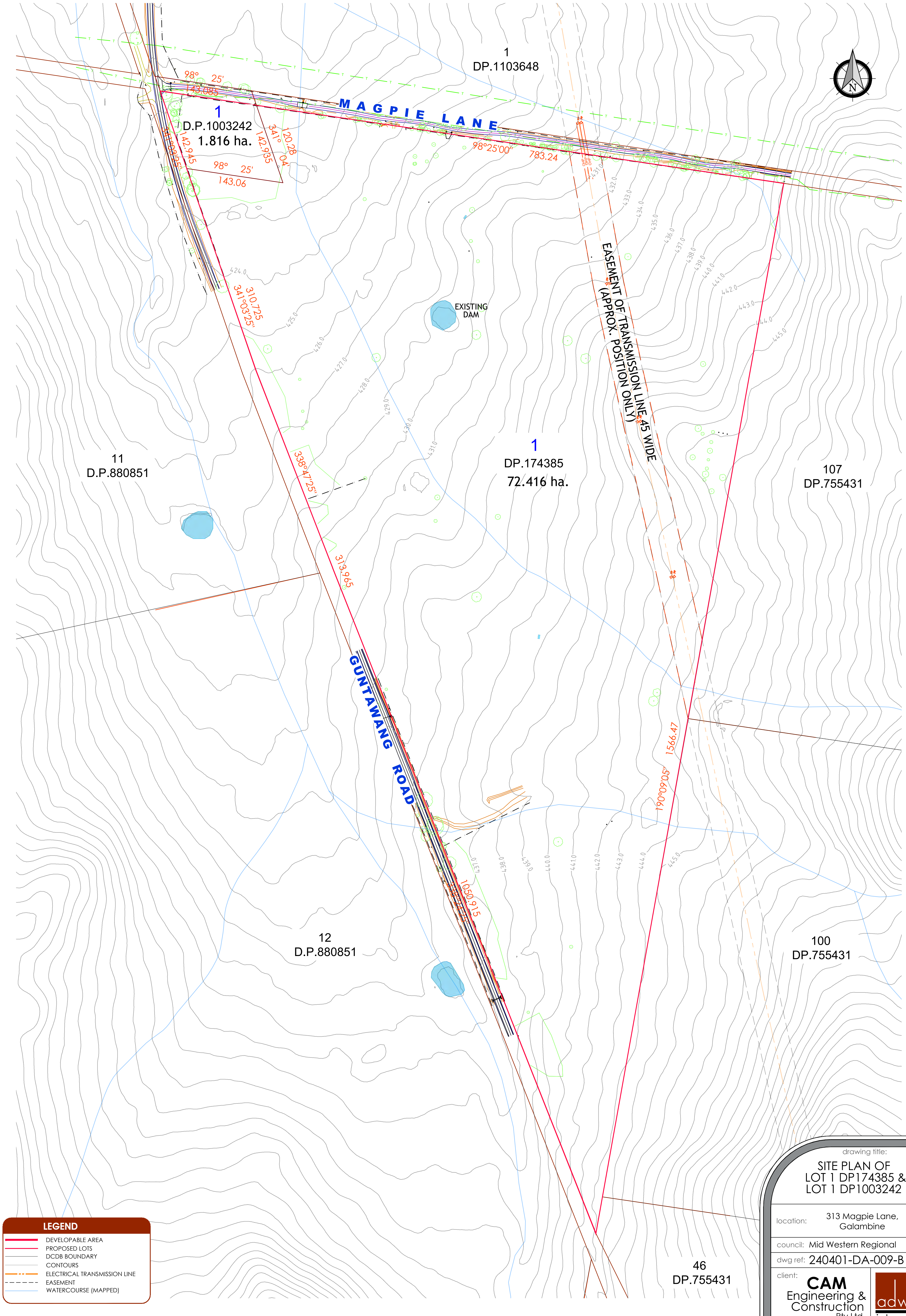

LEGEND

▬	DEVELOPABLE AREA
▬	PROPOSED LOTS
—	DCDB BOUNDARY
—	CONTOURS
-·-	ELECTRICAL TRANSMISSION LINE
- - -	EASEMENT
—	WATERCOURSE (MAPPED)

ver.	date	comment	drawn	pm
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.

co-ordinate information
CO-ORDINATE SYSTEM: MGA 94

level information
DATUM: N/A
CONTOUR INTERVAL: N/A

scale (A1 original size)
0 50 100 125m
SCALE: 1:2500 (FULL)

notes
SHEET 9 OF 17

drawing title:

SITE PLAN OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane,
Galambine

council: Mid Western Regional

dwg ref: 240401-DA-009-B

client:
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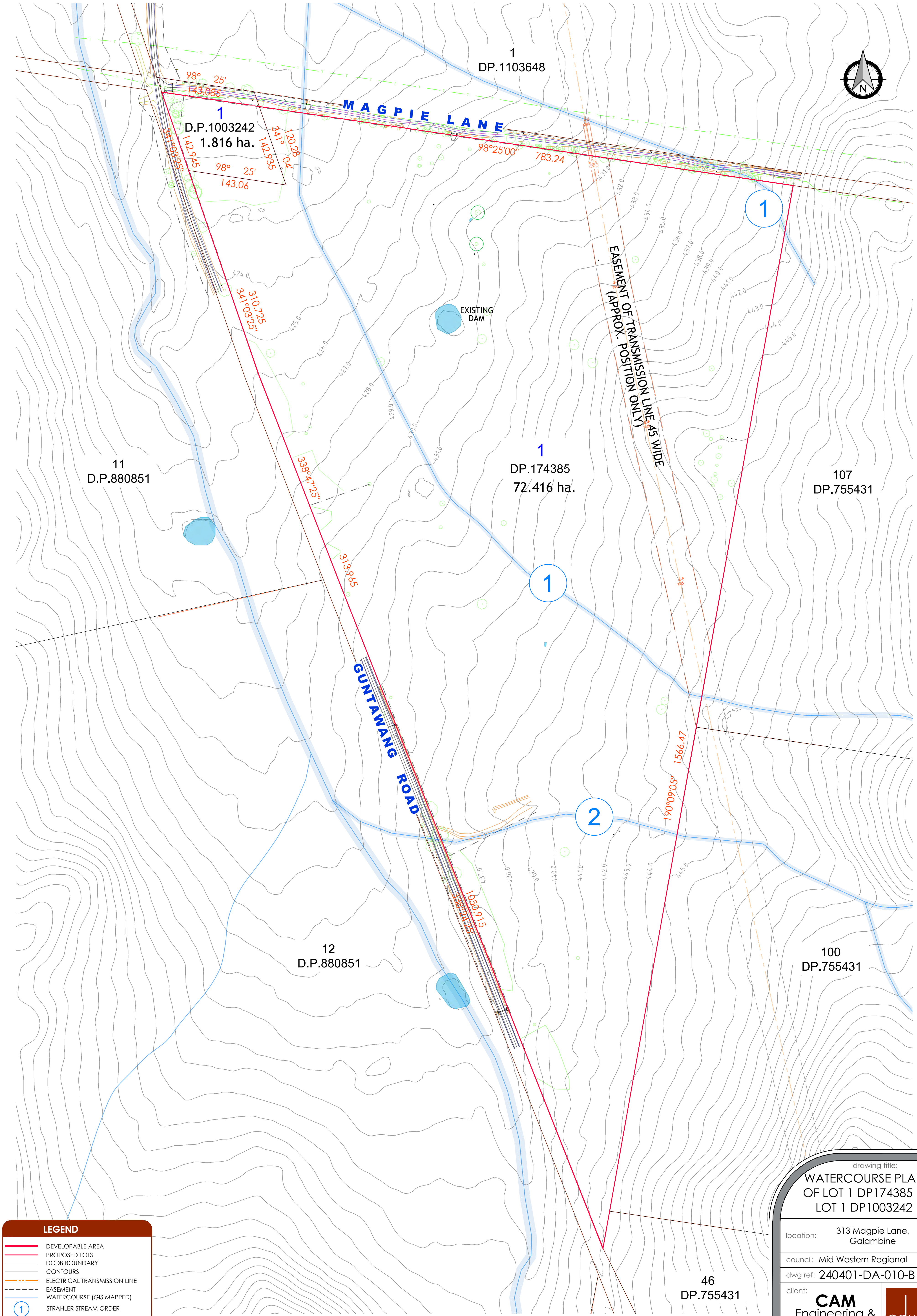

LEGEND

🟥	DEVELOPABLE AREA
―	PROPOSED LOTS
―	DCDB BOUNDARY
―	CONTOURS
–·–	ELECTRICAL TRANSMISSION LINE
– – –	EASEMENT
―	WATERCOURSE (GIS MAPPED)
①	STRAHLER STREAM ORDER

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.EL	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100 125m SCALE: 1:2500 (FULL)	SHEET 10 OF 17

working beyond expectations

drawing title:

WATERCOURSE PLAN OF LOT 1 DP174385 & LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-010-B

client: CAM Engineering & Construction Pty.Ltd.

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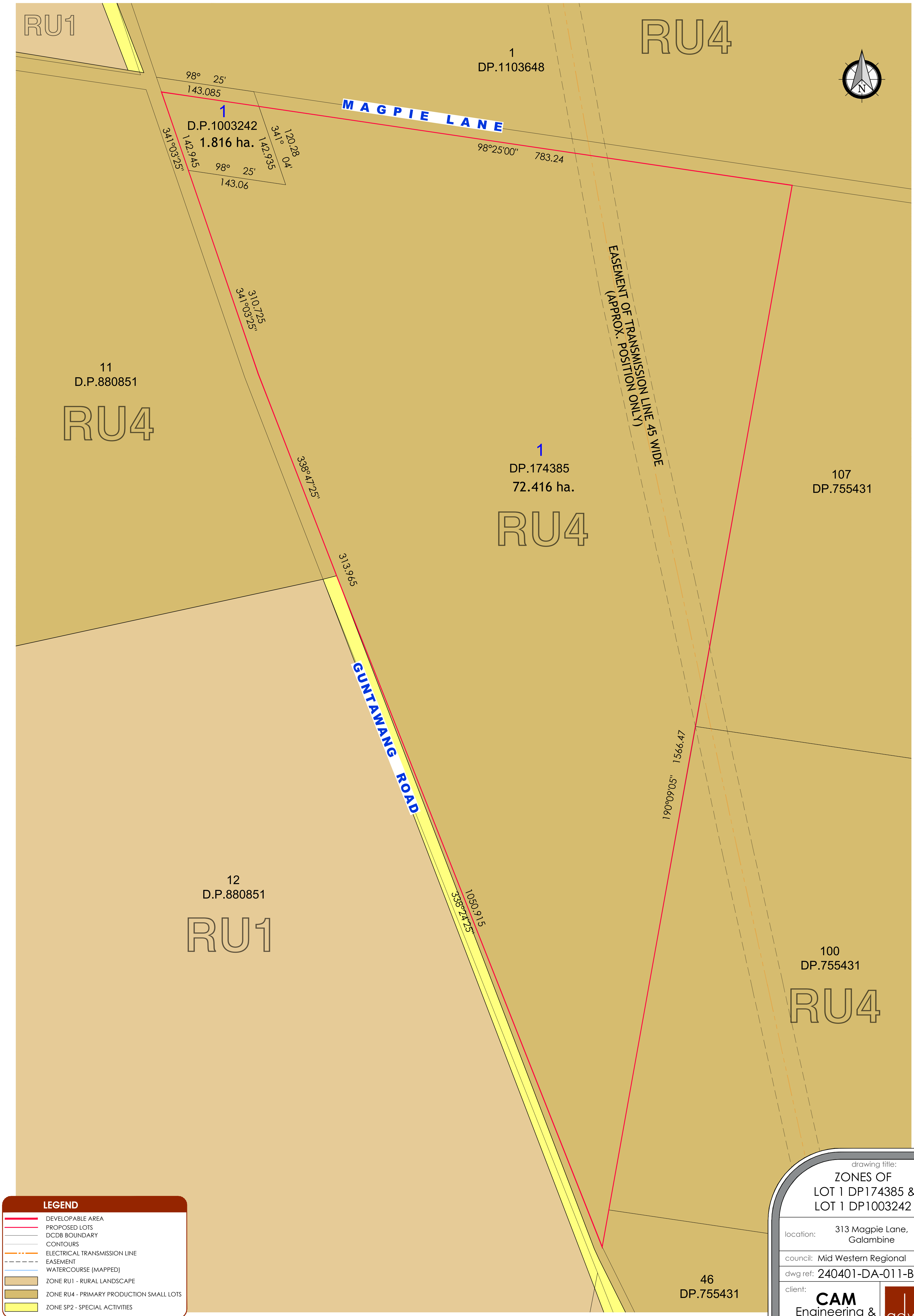

LEGEND

—	DEVELOPABLE AREA
—	PROPOSED LOTS
—	DCDB BOUNDARY
—	CONTOURS
—·—·—	ELECTRICAL TRANSMISSION LINE
- - - - - -	EASEMENT
—	WATERCOURSE (MAPPED)
▨	ZONE RU1 - RURAL LANDSCAPE
▨	ZONE RU4 - PRIMARY PRODUCTION SMALL LOTS
▨	ZONE SP2 - SPECIAL ACTIVITIES

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100 125m SCALE: 1:2500 (FULL)	SHEET 11 OF 17

drawing title:

ZONES OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane,
Galambine

council: Mid Western Regional

dwg ref: 240401-DA-011-B

client:
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240401-DA-011-B

Plotted By: Robert Cromarty Plot Date: 23/02/24 4:03:08PM Cad File: N:\240401\DWG\PLANNING\DA\240401-DA-011-B.DWG

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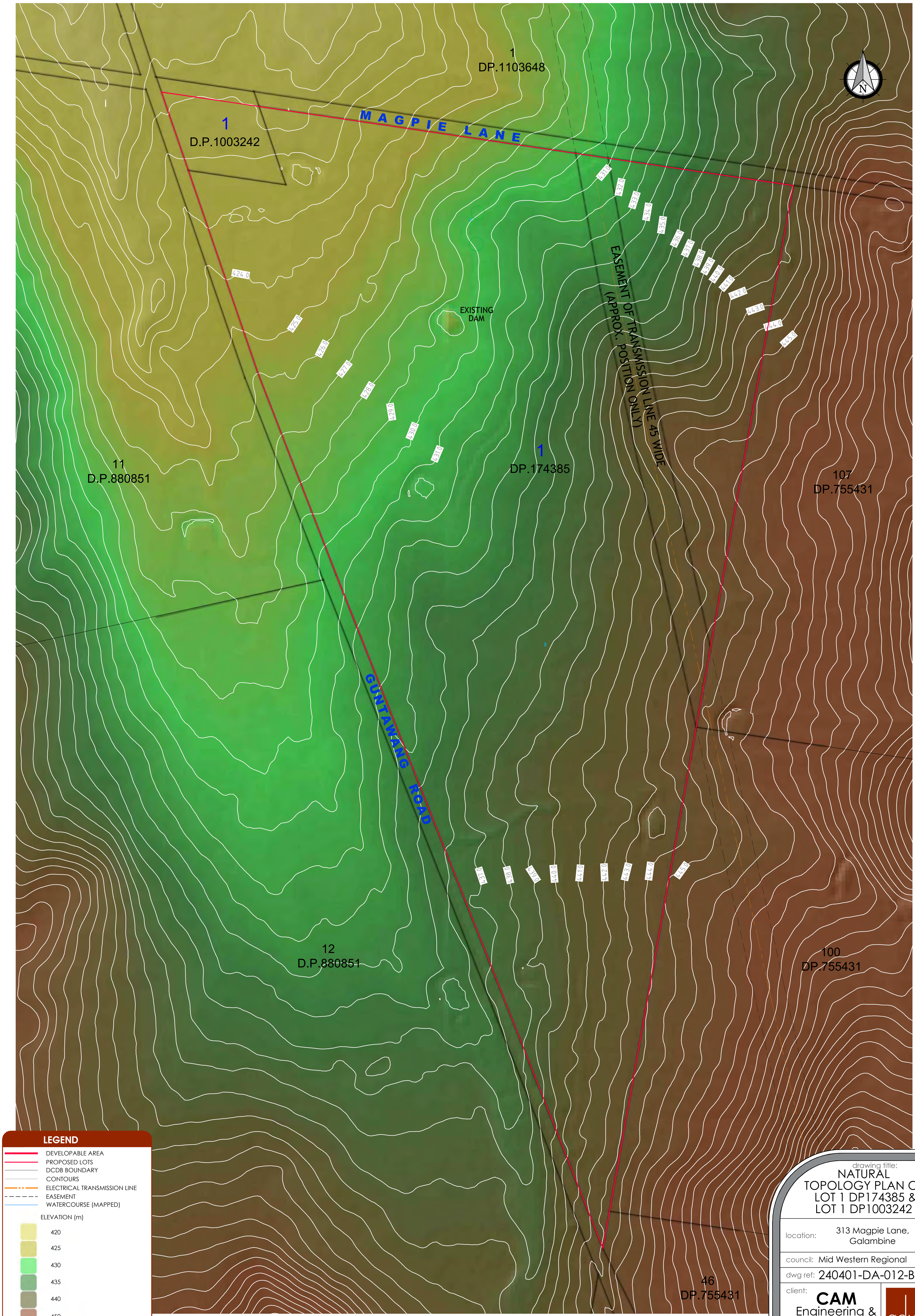
240401-DA-012-B



LEGEND

▬	DEVELOPABLE AREA
—	PROPOSED LOTS
—	DCDB BOUNDARY
—	CONTOURS
— · —	ELECTRICAL TRANSMISSION LINE
- - -	EASEMENT
—	WATERCOURSE (MAPPED)

ELEVATION (m)

🟨	420
🟨	425
🟩	430
🟩	435
▨	440
🟫	450

drawing title:
NATURAL TOPOLOGY PLAN OF LOT 1 DP174385 & LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-012-B

client: **CAM** Engineering & Construction Pty.Ltd.

adw johnson

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hunter office ph: (02) 4978 5100
sydney office ph: (02) 8046 7411

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ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100m SCALE: 1:2000 (FULL)	SHEET 12 OF 17

working beyond expectations

Plotted By: Robert Cromarty Plot Date: 23/02/24 4:03:17PM Cad File: N:\240401\DWG\PLANNING\DA\240401-DA-012-B.DWG

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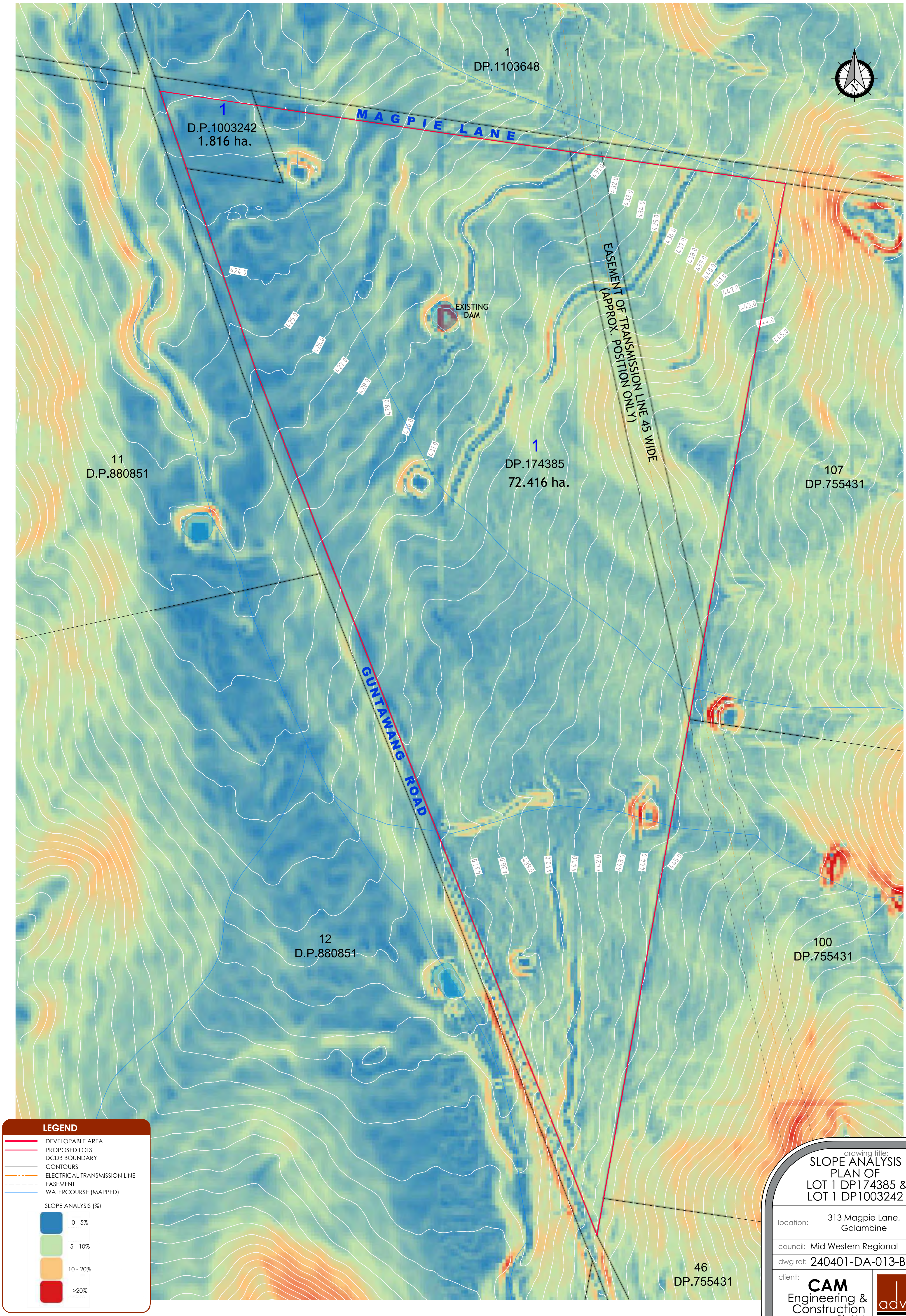

ver.	date	comment	drawn	pm
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.

co-ordinate information
CO-ORDINATE SYSTEM: MGA 94

level information
DATUM: N/A
CONTOUR INTERVAL: N/A

scale (A1 original size)
0 50 100 125m
SCALE: 1:2500 (FULL)

notes
SHEET 13 OF 17

drawing title:
SLOPE ANALYSIS
PLAN OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-013-B

client:
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Construction
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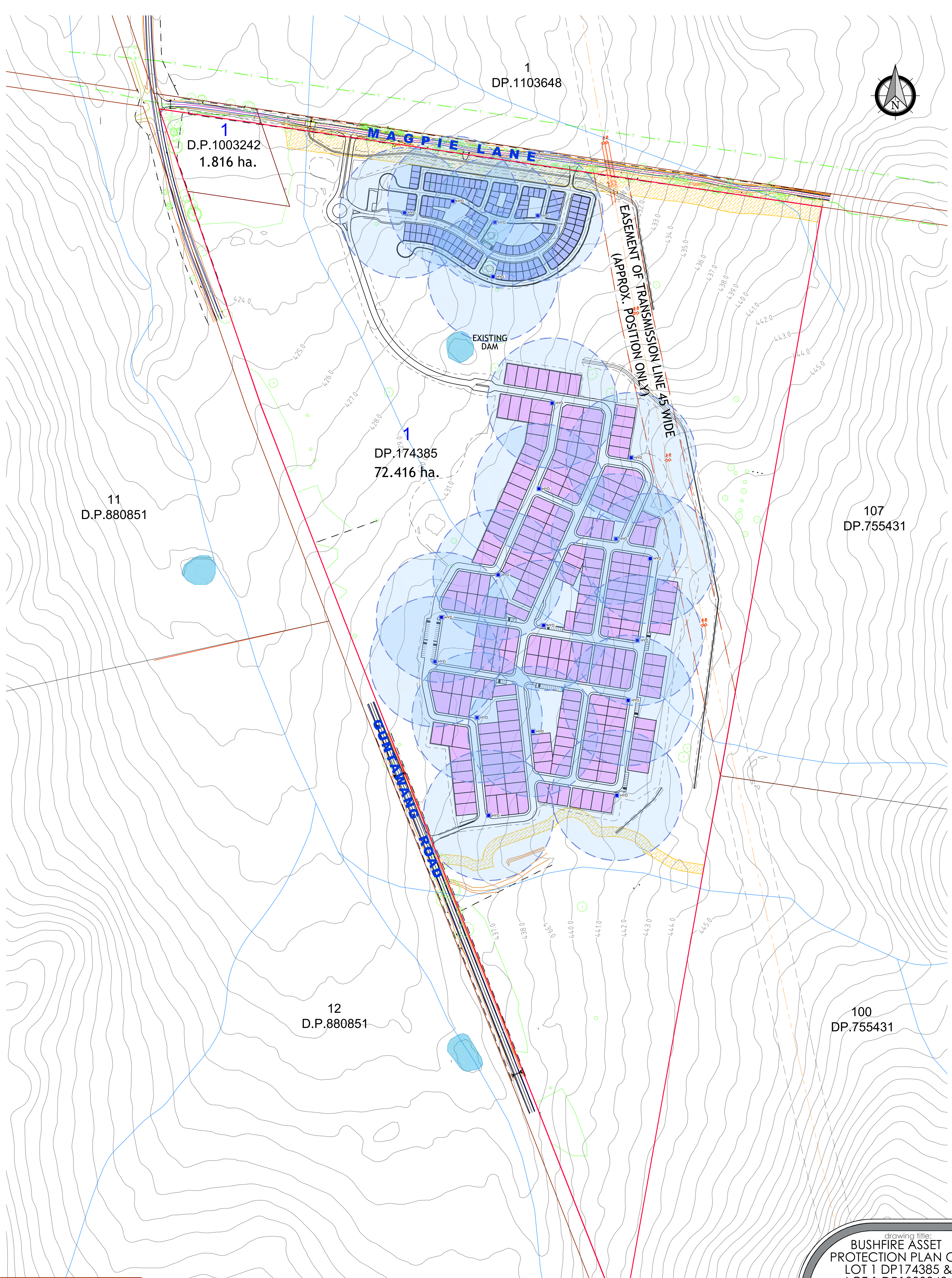

LEGEND

🟥	DEVELOPABLE AREA
🟥	PROPOSED LOTS
—	DCDB BOUNDARY
—	CONTOURS
–·–	ELECTRICAL TRANSMISSION LINE
– – –	EASEMENT
—	WATERCOURSE (MAPPED)
▨	BUSHFIRE ASSET PROTECTION ZONE
HYD.	FIRE HYDRANT & REACH

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDING	R.C.	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100 125m SCALE: 1:2500 (FULL)	SHEET 14 OF 17

drawing title:
BUSHFIRE ASSET
PROTECTION PLAN OF
LOT 1 DP174385 &
LOT 1 DP1003242

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-014-B

client:
CAM
Engineering &
Construction
Pty.Ltd.

adw
johnson

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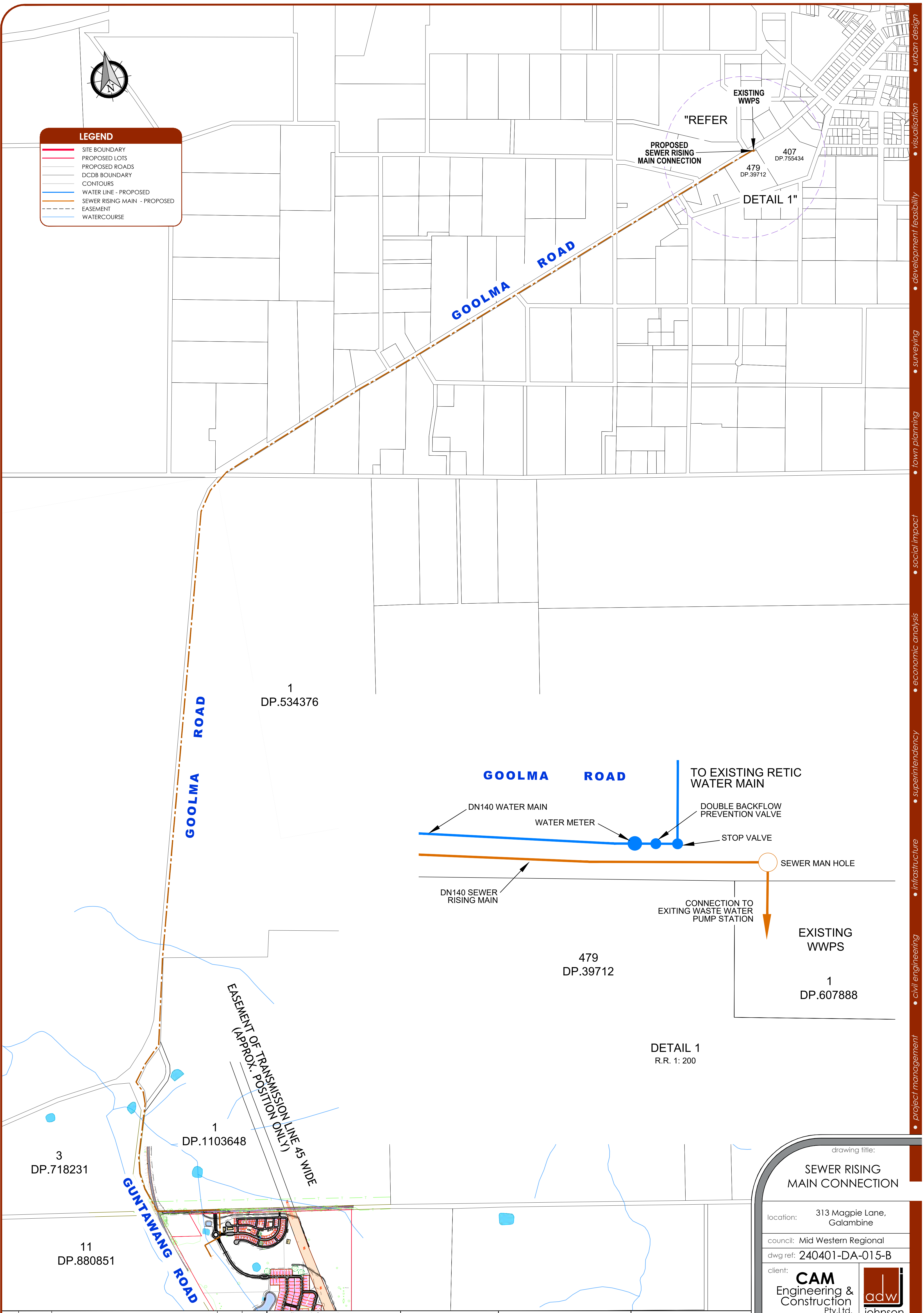

drawing title:

SEWER RISING MAIN CONNECTION

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-015-B

client: CAM Engineering & Construction Pty.Ltd.

adw johnson

ver.	date	comment	drawn	pm
B	23.02.2024	UPDATE AMENITIES BUILDING	RC	M.E.

co-ordinate information
CO-ORDINATE SYSTEM: MGA 94

level information
DATUM: N/A
CONTOUR INTERVAL: N/A

scale (A1 original size)
0 50 100m
SCALE: 1:2000 (FULL)

notes

SHEET 15 OF 17

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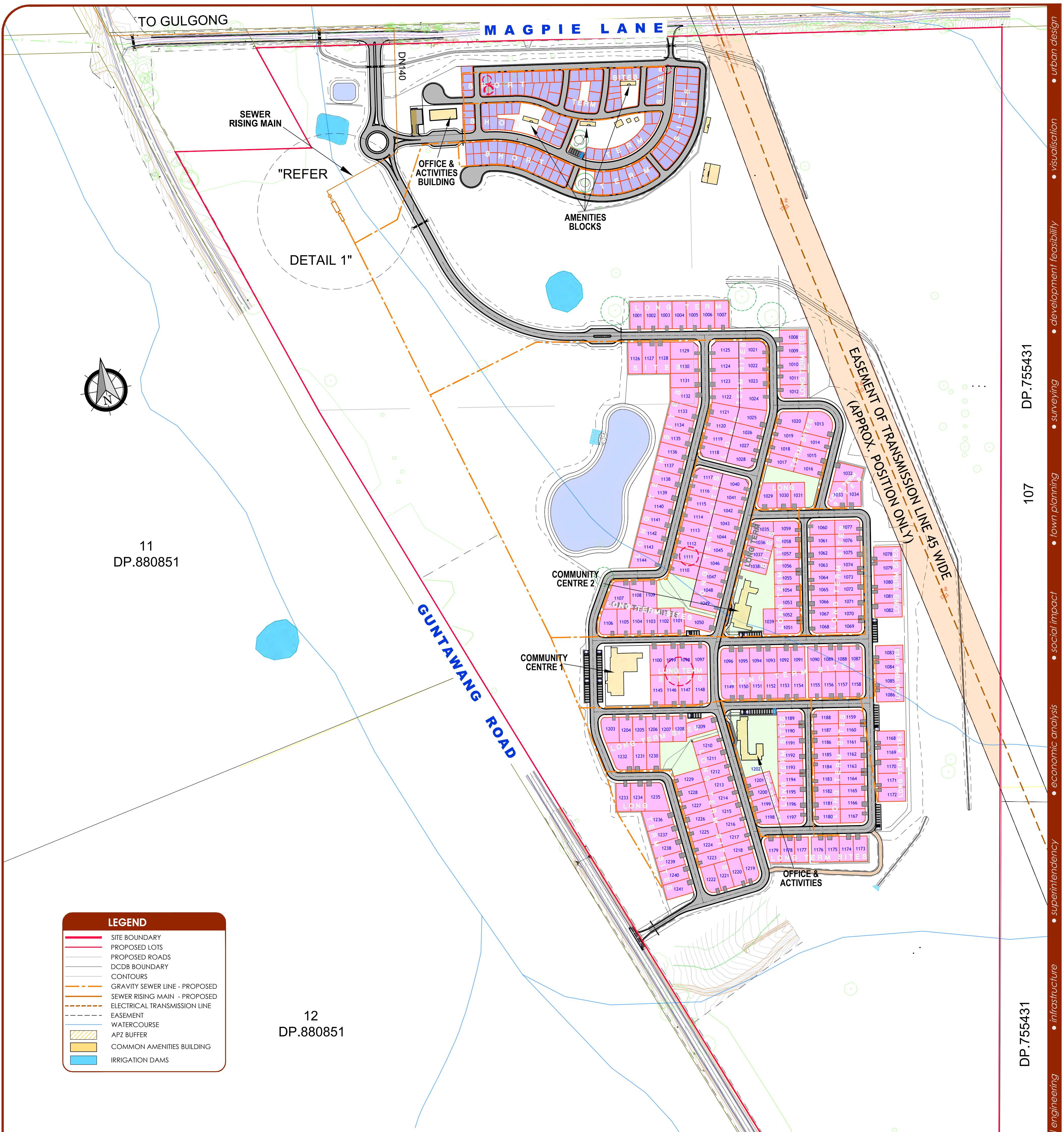
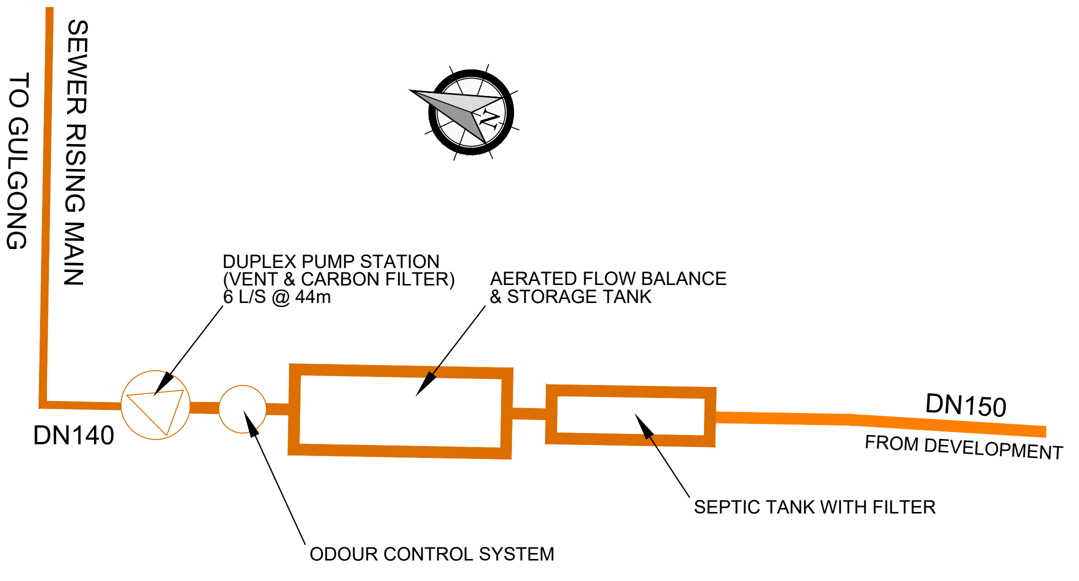


LEGEND

▬	SITE BOUNDARY
▬	PROPOSED LOTS
▬	PROPOSED ROADS
▬	DCDB BOUNDARY
▬	CONTOURS
-·-	GRAVITY SEWER LINE - PROPOSED
▬	SEWER RISING MAIN - PROPOSED
- -	ELECTRICAL TRANSMISSION LINE
- -	EASEMENT
▬	WATERCOURSE
▨	APZ BUFFER
🟨	COMMON AMENITIES BUILDING
🟦	IRRIGATION DAMS



DETAIL 1 - SEWER STORAGE
TREATMENT & DISCHARGE SYSTEM
R.R. 1: 200

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
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drawing title:
SEWER
DEVELOPMENT
DETAIL PLAN

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-015-B

client:
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Plotted By: Robert Cromarty Plot Date: 23/02/24 4:03:49PM Cad File: N:\240401\DWG\PLANNING\DA\240401-DA-015-B.DWG

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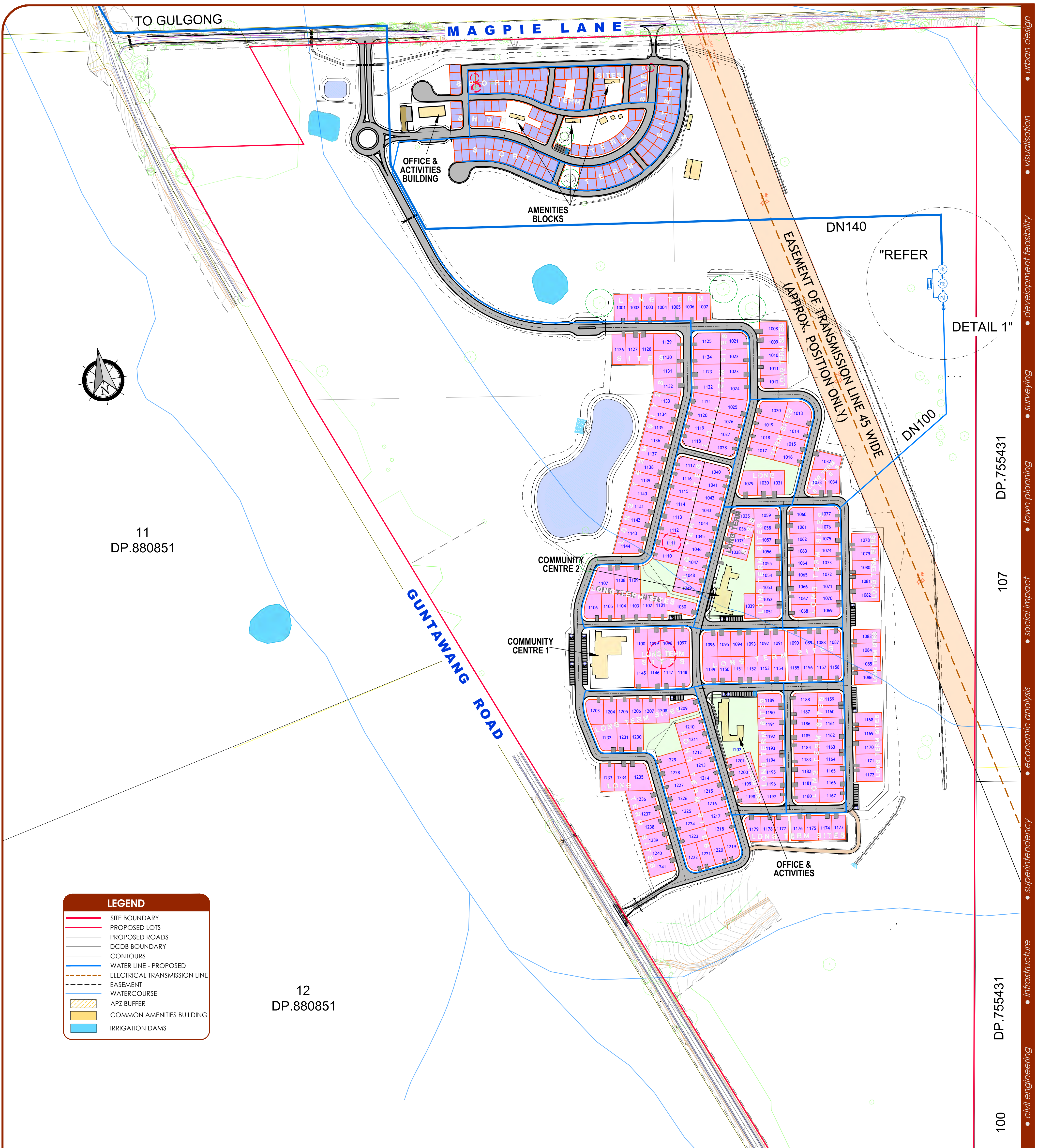

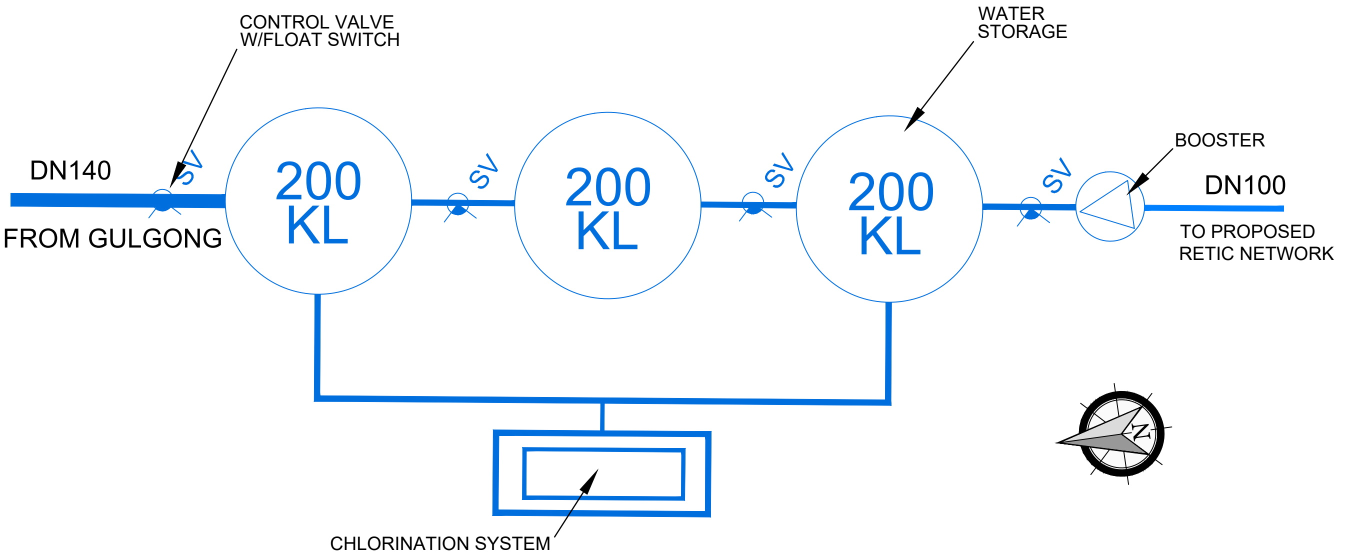

DETAIL 1 - WATER STORAGE, TREATMENT & SUPPLY SYSTEM

R.R. 1: 200

ver.	date	comment	drawn	pm	co-ordinate information	level information	scale (A1 original size)	notes
B	23.02.2024	UPDATE AMENITIES BUILDING	RC	M.E.	CO-ORDINATE SYSTEM: MGA 94	DATUM: N/A CONTOUR INTERVAL: N/A	0 50 100m SCALE: 1:2000 (FULL)	SHEET 17 OF 17

drawing title:
WATER
DEVELOPMENT
DETAIL PLAN

location: 313 Magpie Lane, Galambine

council: Mid Western Regional

dwg ref: 240401-DA-015-B

client:
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Plotted By: Robert Cromarty Plot Date: 23/02/24 4:03:53PM Cad File: N:\240401\DWG\PLANNING\DA\240401-DA-015-B.DWG

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Appendix B

PHOTOLOG

	**Plate 1** **Description: looking north towards Magpie Lane** **Date:10/07/2023**
	**Plate 2** **Description: Northern section of the site** **Date:10/07/2023**

	**Plate 3** **Description: looking east from the northern section of the site** **Date: 10/07/2023**
	**Plate 4** **Description: looking north-west from the northern section of the site** **Date: 10/07/2023**

	**Plate 5** **Description: Rock fragments in the northern section of the site** **Date: 10/07/2023**
	**Plate 6** **Description: General view of the site** **Date:10/07/2023**

	**Plate 7** **Description: Tree line along Guntawang Road** **Date: 10/07/2023**
	**Plate 8** **Description: Looking south-east** **Date:10/07/2023**

Plate 9

Description: Looking south

Date: 10/07/2023

Plate 10

Description: Ground Penetration radar used on Guntawang Road

Date: 11/07/2023

	**Plate 11** **Description: Traffic Control setup on Guntawang Road** **Date: 11/07/2023**
	**Plate 12** **Description: Setup for investigation on Guntawang Road** **Date: 11/07/2023**

	**Plate 13** **Description: Exclusion zone for investigation on Guntawang Road** **Date: 11/07/2023**
	**Plate 14** **Description: Rock subgrade on Guntawang Road** **Date: 11/07/2023**

Plate 15

Description: Magpie Lane view

Date: 11/07/2023

Plate 16

Description: Northern part of the site

Date: 12/07/2023

	**Plate 17** **Description: Roundabout view northern section** **Date: 12/07/2023**
	**Plate 18** **Description: monitoring well on site** **Date: 12/07/2023**

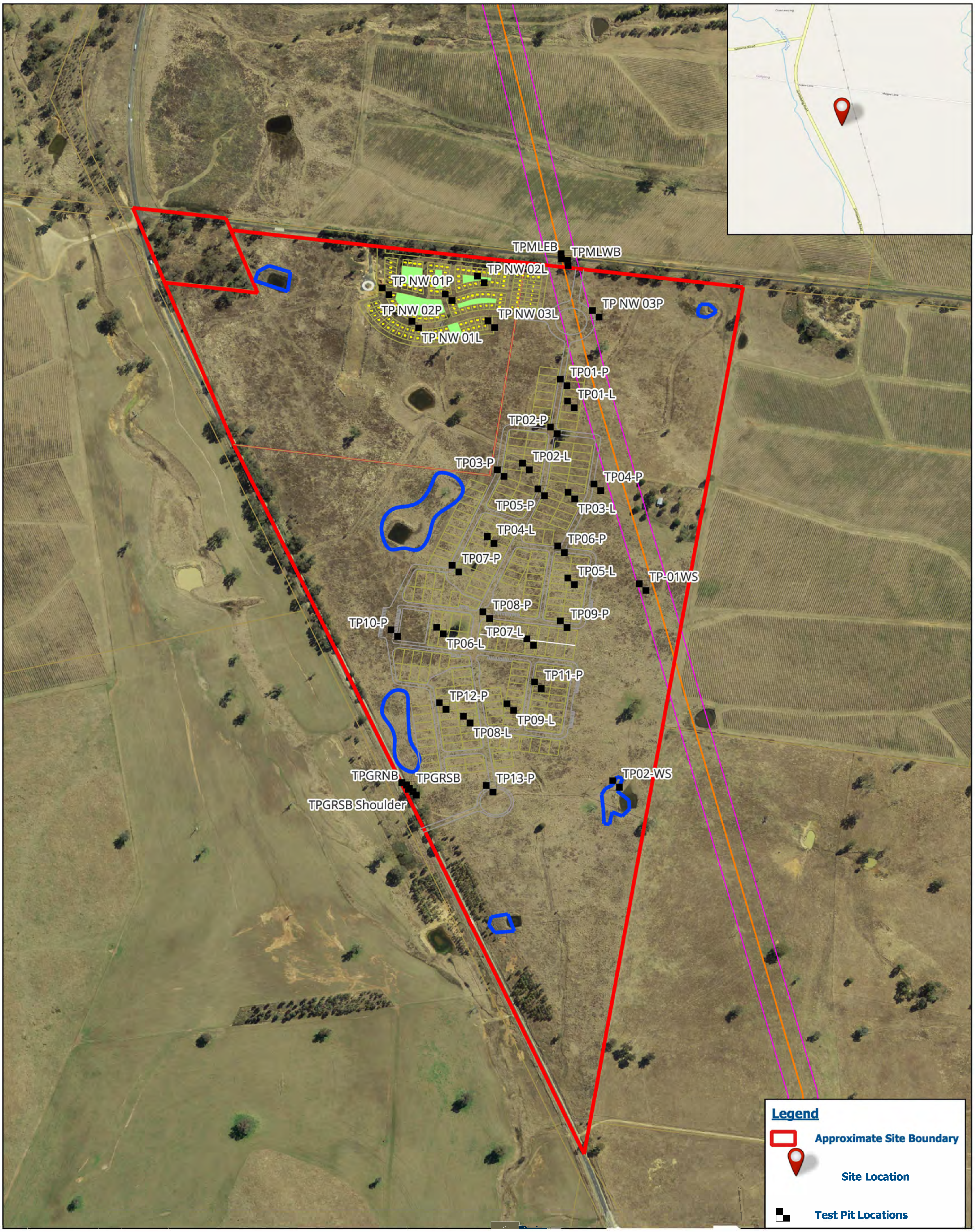
	**Plate 19** **Description: General view of the site** **Date: 12/07/2023**
	**Plate 20** **Description: Site dam in the northern section** **Date: 12/07/2023**

	**Plate 21** **Description: looking north towards intersection Guntawang Road and Magpie Lane** **Date: 12/07/2023**
	**Plate 22** **Description: Dam in the central area of the site** **Date: 12/07/2023**

	**Plate 23** **Description: Hill recontouring in the northern section of the site** **Date: 12/07/2023**
	**Plate 24** **Description: Shed and container on site** **Date: 12/07/2023**

Appendix C

GEOTECHNICAL INVESTIGATION LCOATIONS



EP RISK

www.eprisk.com.au

Preliminary Geotechnical Investigation
313 Magpie Lane, Galambine, NSW 2850

Appendix C - Geotechnical Investigation Locations

Job No: EP3229
Date: 15/8/23
Drawing Ref: Fig 1
Version No: v1

N

0 90 180 270 m

Approximate Scale Only

Coordinate System: WGS 84
Drawn by: MC Checked by: OP
~~**Scale of regional map not shown**~~
Source: Near Map / Six Maps

APPROVED COMPANY ISO 9001
APPROVED COMPANY ISO 45001
APPROVED COMPANY ISO 14001

QMS Certification Services

Appendix D

TEST PIT LOGS

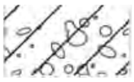
Soil Logging Symbols

CLAYS

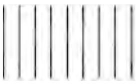

CLAY

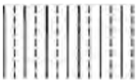

silty CLAY

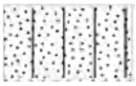

sandy CLAY


gravelly CLAY

SILTS

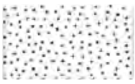

SILT


clayey SILT


sandy SILT


gravelly SILT

SANDS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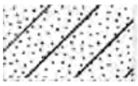
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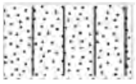
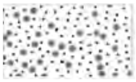
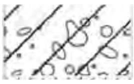

silty SAND

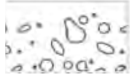

gravelly SAND

GRAVELS


GRAVEL


clayey GRAVEL


silty GRAVEL

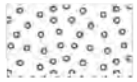

sandy GRAVEL

SEDIMENTARY ROCK


SANDSTONE

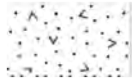

SILTSTONE


SHALE


CONGLOMERATE

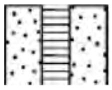
FILL

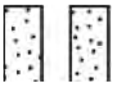

FILL

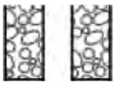

CONCRETE

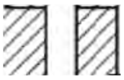

ASPHALT

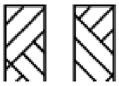
GROUNDWATER WELL SYMBOLS


WELL SCREEN


CASING – filter pack

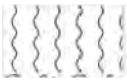

CASING – backfill


CASING – bentonite seal


CASING – grout seal


BACKFILL

OTHER


TOPSOIL – sandy SILT


TOPSOIL – highly organic

Rock Description Explanation Sheet (1 of 2)

Weathering Condition (Degree of Weathering):

The degree of weathering is a continuum from fresh rock to soil. Boundaries between weathering grades may be abrupt or gradational.

Rock Material Weathering Classification

Weathering Grade	**Symbol**	**Definition**
Residual Soil	RS	Soil-like material developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume, but the material has not been significantly transported.
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded in water, but substance fabric and rock structure still recognisable.
Highly Weathered Rock	HW	Strong discolouration is evident throughout the rock mass, often with significant change in the constituent minerals. The intact rock strength is generally much weaker than that of the fresh rock.
Moderately Weathered Rock	MW	Modest discolouration is evident throughout the rock fabric, often with some change in the constituent minerals. The intact rock strength is usually noticeably weaker than that of the fresh rock.
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh Rock	FR	Rock shows no sign of decomposition or staining.

Notes:

1. Minor variations within broader weathering grade zones will be noted on the engineering borehole logs.
2. Extremely weathered rock is described in terms of soil engineering properties.
3. Weathering may be pervasive throughout the rock mass or may penetrate inwards from discontinuities to some extent.
4. The 'Distinctly Weathered (DW)' class as defined in AS1726-2017 is divided to incorporate HW and MW in the above table. The symbol DW should not be used.

Strength Condition (Intact Rock Strength):

Strength of Rock Material

(Based on Point Load Strength Index, corrected to 50mm diameter – $I_{s(50)}$. Field guide used if no tests available. Refer to AS 4133.4.1-2007.

Term	**Symbol**	**Point Load Index (MPa) $I_{s(50)}$**		**Field Guide to Strength**
Very Low	VL	>0.03	≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3cm thick can be broken by finger pressure.
Low	L	>0.1	≤0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	>0.3	≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
High	H	>1	≤3	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	VH	>3	≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High	EH	>10		Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

Notes:

1. These terms refer to the strength of the rock material and not to the strength of the rock mass which may be considerably weaker due to the effect of rock defects.
2. Anisotropy of rock material samples may affect the field assessment of strength.
3. Extremely Low Strength ('EL') is now not considered a description of rock strength in line with the updated AS1726-2017 as by definition EL rock should be described in terms of soil properties.

Rock Description Explanation Sheet (2 of 2)

Discontinuity Description: Refer to AS1726-2017, Table A10.

Anisotropic Fabric	
BED	Bedding
FOL	Foliation
LIN	Mineral lineation
Defect Type	
LP	Lamination Parting
Pt	Bedding Parting
FP	Cleavage / Foliation Parting
Jt	Joint
SZ	Sheared Zone
CZ	Crushed Zone
BZ	Broken Zone
HFZ	Highly Fractured Zone
AZ	Alteration Zone
VN	Vein

Roughness (e.g. Planar, Smooth is abbreviated Pln / Sm)		**Class**
Stepped (Stp)	Rough or irregular (R or Irr)	I
	Smooth (Sm)	II
	Slickensided (Sl)	III
Undulating (Un)	Rough (R)	IV
	Smooth (Sm)	V
	Slickensided (Sl)	VI
Planar (Pln)	Rough (R)	VII
	Smooth (Sm)	VIII
	Slickensided (Sl)	IX

Aperture		**Infilling**		
Closed	CD	No visible coating or infill	Clean	Cn
Open	OP	Surfaces discoloured by mineral/s	Stain	St
Filled	FL	Visible mineral or soil infill <1mm	Veneer	Vr
Tight	TI	Visible mineral or soil infill >1mm	Coating	Ct

Other	
Clay	Clay
Fe	Iron
Co	Coal
Carb	Carbonaceous
Sinf	Soil Infill Zone
Qz	Quartz
Ca	Calcite
Chl	Chlorite
Py	Pyrite
Int	Intersecting
Inc	Incipient
DI	Drilling Induced
H	Horizontal
V	Vertical

Note: Describe 'Zones' and 'Coatings' in terms of composition and thickness (mm).

Discontinuity Spacing: On the geotechnical borehole log, a graphical representation of defect spacing vs depth is shown. This representation takes into account all the natural rock defects occurring within a given depth interval, excluding breaks induced by the drilling / handling of core. Refer to AS1726-2017, BS5930-1999.

Defect Spacing			**Bedding Thickness (Sedimentary Rock Stratification)**	
Spacing/Width (mm)	Descriptor	Symbol	Descriptor	Spacing/Width (mm)
			Thinly Laminated	< 6
<20	Extremely Close	EC	Thickly Laminated	6 – 20
20 – 60	Very Close	VC	Very Thinly Bedded	20 – 60
60 – 200	Close	C	Thinly Bedded	60 – 200
200 – 600	Medium	M	Medium Bedded	200 – 600
600 – 2000	Wide	W	Thickly Bedded	600 – 2000
2000 – 6000	Very Wide	VW	Very Thickly Bedded	> 2000
>6000	Extremely Wide	EW		

Defect Spacing in 3D	
Term	**Description**
Blocky	Equidimensional
Tabular	Thickness much less than length or width
Columnar	Height much greater than cross section

Defect Persistence (areal extent)
Trace length of defect given in metres

Symbols: The list below provides an explanation of terms and symbols used on the geotechnical borehole, test pit and penetrometer logs.

Test Results			
PI	Plasticity Index	c'	Effective Cohesion
LL	Liquid Limit	c_u	Undrained Cohesion
LI	Liquidity Index	c'_R	Residual Cohesion
DD	Dry Density	ϕ'	Effective Angle of Internal Friction
WD	Wet Density	ϕ_u	Undrained Angle of Internal Friction
LS	Linear Shrinkage	ϕ'_R	Residual Angle of Internal Friction
MC	Moisture Content	c_v	Coefficient of Consolidation
OC	Organic Content	m_v	Coefficient of Volume Compressibility
WPI	Weighted Plasticity Index	$c_{\alpha\varepsilon}$	Coefficient of Secondary Compression
WLS	Weighted Linear Shrinkage	e	Voids Ratio
DoS	Degree of Saturation	ϕ'_{cv}	Constant Volume Friction Angle
APD	Apparent Particle Density	q_t / q_c	Piezocone Tip Resistance (corrected / uncorrected)
s_u	Undrained Shear Strength	q_d	PANDA Cone Resistance
q_u	Unconfined Compressive Strength	$I_{s(50)}$	Point Load Strength Index
TCR	Total Core Recovery	*RQD*	Rock Quality Designation

Test Symbols	
DCP	Dynamic Cone Penetrometer
SPT	Standard Penetration Test
CPTu	Cone Penetrometer (Piezocone) Test
PANDA	Variable Energy DCP
PP	Pocket Penetrometer Test
U50	Undisturbed Sample 50 mm (nominal diameter)
U100	Undisturbed Sample 100mm (nominal diameter)
UCS	Uniaxial Compressive Strength
Pm	Pressuremeter
FSV	Field Shear Vane
DST	Direct Shear Test
PR	Penetration Rate
PLI	Point Load Index Test (axial)
D	Point Load Test (diametral)
L	Point Load Test (irregular lump)

▽	Groundwater level	▶	Water Inflow	◁	Water Outflow

Test Pit No: TP01-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6411134.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734232.00	Bearing	---	Ground Level	437 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered			▨	SC	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F	2		TOPSOIL
									3		
				▨	CI-CH	Silty CLAY: medium to high plasticity, pale brown, with fine to medium grained sand		St to VSt	3		RESIDUAL SOIL
									5		
									8		
								VSt to H	11		
									22		
						0.70m: with pebbles and cobbles and sandstone boulders (200mm-300mm)				B	
		436	1								
				▨	SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey and pale brown	D	D to VD			EXTREMELY WEATHERED ROCK
		435	2								
						Test Pit TP01-L Terminated at 2.10 m					Refusal on bedrock
		434	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP01-L

Test Pit No: TP02-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6411024.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734161.00	Bearing	---	Ground Level	436 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, brown	D	L	2 2		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, brown, with cobbles and pebbles	~PL	F VSt to H	8 11 15 15	B	RESIDUAL SOIL
		435	1		SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey, yellow and red	D	D to VD	19 14		EXTREMELY WEATHERED ROCK
		434 433	2 3			Test Pit TP02-L Terminated at 1.70 m					Refusal on bedrock

Remarks:

EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation

TP02-L

Test Pit No: TP03-L

Engineering Log - Test Pit

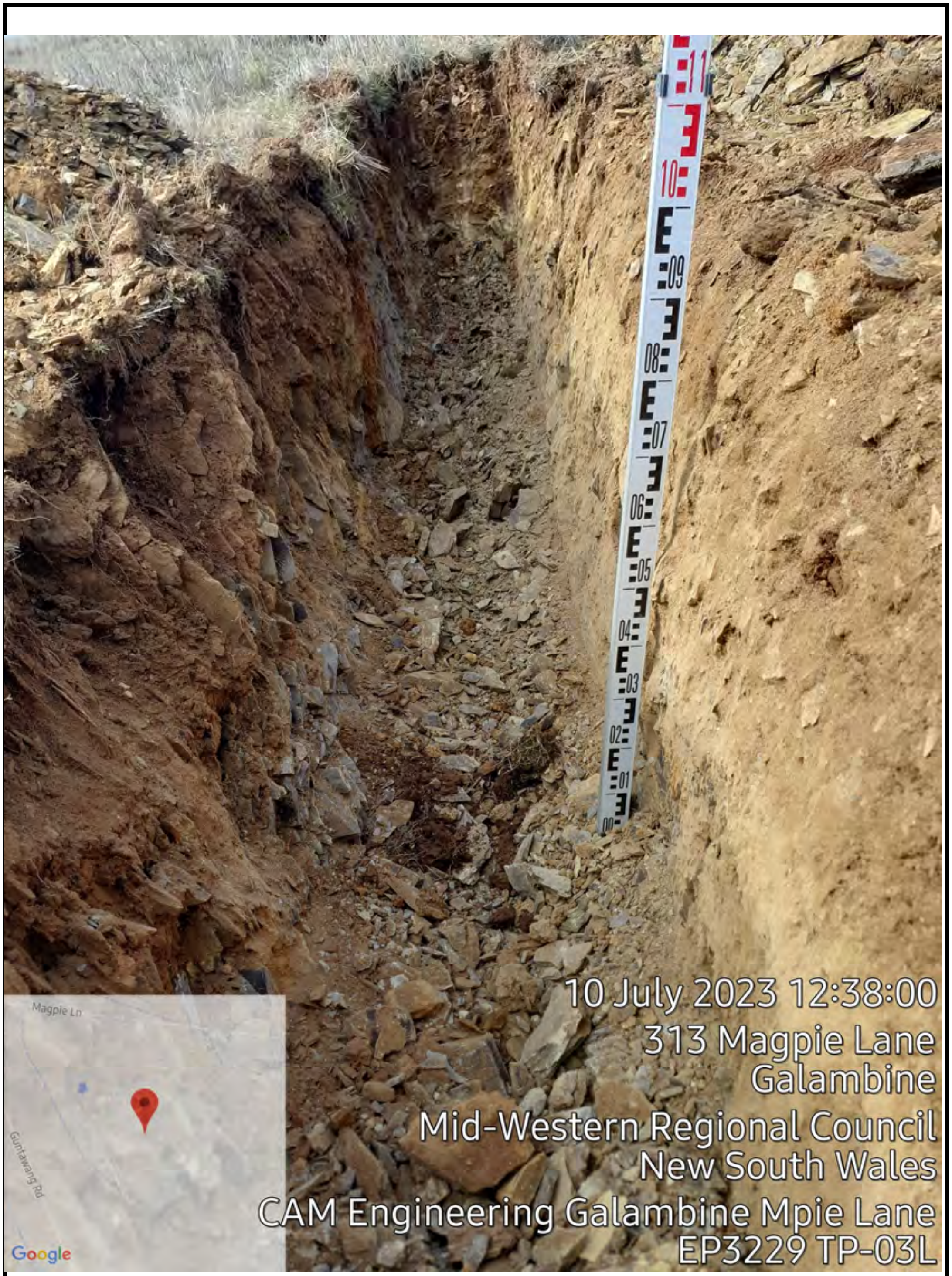
SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410970.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	1.7.23	Easting	734229.00	Bearing	---	Ground Level	438 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F	2		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, brown	~PL		1 2		RESIDUAL SOIL
					CI-CH	Extremely weathered Shale recovered as Sandy CLAY, medium to high plasticity, grey	<<PL	VSt to H	8 17 25	B	EXTREMELY WEATHERED ROCK
						Test Pit TP03-L Terminated at 0.90 m					Refusal on bedrock
		437	1								
		436	2								
		435	3								

Remarks:



10 July 2023 12:38:00
313 Magpie Lane
Galambine
Mid-Western Regional Council
New South Wales
CAM Engineering Galambine Mpie Lane
EP3229 TP-03L

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation	
	TP03-L	

Test Pit No: TP04-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client CAM Engineering and Construction Pty Ltd
Project Preliminary Geotechnical Investigation
Location Galambine NSW

Project No. EP3229
Logged By OP
Checked By OP

Started Excavation 10.7.23
Completed Excavation 10.7.23
Northing 6410893.00
Easting 734104.00
Slope 90°
Bearing ---
Equipment Komatsu 13T
Ground Level 435 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F to St	2 1		TOPSOIL
					CL-CI	Sandy CLAY: low to medium plasticity, pale brown, fine to coarse grained sand, with ferruginous cementations (50mm-100mm)		VSt to H	1 3 10 25	B U50	RESIDUAL SOIL
		434	1		SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey	D	D to VD			EXTREMELY WEATHERED ROCK
		433 432	2 3			Test Pit TP04-L Terminated at 1.80 m					Refusal on bedrock

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP04-L

Test Pit No: TP05-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410816.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734225.00	Bearing	---	Ground Level	437 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, black, fine to medium grained sand	<PL	F to St	2		TOPSOIL
					CL-CI	Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand			1 3 8		RESIDUAL SOIL
					CI-CH	Extremely weathered Shale recovered as Sandy CLAY, medium to high plasticity, grey and pale brown	<<PL	VSt to H	19		EXTREMELY WEATHERED ROCK
						Test Pit TP05-L Terminated at 0.73 m					Refusal on bedrock
		436	1								
		435	2								
		434	3								

Remarks:

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation	
	TP05-L	

Test Pit No: TP06-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6410732.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	734023.00	Bearing	---	Ground Level	433 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, grey	D	MD	2 2 3 3		TOPSOIL
		432	1		CL-CI	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, fine to coarse grained sand, yellow, grey and brown	<<PL	H	12 14 12 16	B	EXTREMELY WEATHERED ROCK
						Test Pit TP06-L Terminated at 1.40 m					Refusal on bedrock
		431	2								
		430	3								

Remarks:

EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation	
TP06-L	

Test Pit No: TP07-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410708.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734160.00	Bearing	---	Ground Level	438 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
					CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, grey, fine to medium grained sand	<PL		2		TOPSOIL
	Not Encountered								1		
					CL-CI	Silty CLAY: medium to high plasticity, grey and yellow			2		RESIDUAL SOIL
								F to St	3		
									3		
									2		
									3		
									6	U50	
									6		
									6		
		437	1				~PL		5		
								VSt	5		
									5	B	
									6		
E									7		
									8		
									10		
									15		DCP:-Hammer Bouncing
					ML	Extremely weathered Shale recovered as Clayey SILT, low plasticity, grey					EXTREMELY WEATHERED ROCK
		436	2								
								VSt to H			
							<PL				
										D	
						Test Pit TP07-L Terminated at 2.90 m					Refusal on bedrock
		435	3								

Remarks:

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation
TP07-L	

Test Pit No: TP08-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410571.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734060.00	Bearing	---	Ground Level	437 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, grey	D	L	2 1		TOPSOIL
					CL-CI	Sandy CLAY: low to medium plasticity, yellow and grey, fine to medium grained sand	<PL	F VSt to H	1 5 10 15		RESIDUAL SOIL DCP:-Hammer Bouncing
		436	1		SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, yellow and grey	D	D to VD			EXTREMELY WEATHERED ROCK
						Test Pit TP08-L Terminated at 1.30 m					Refusal on bedrock
		435	2								
		434	3								

Remarks:

EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation	
TP08-L	

Test Pit No: TP09-L

Engineering Log - Test Pit

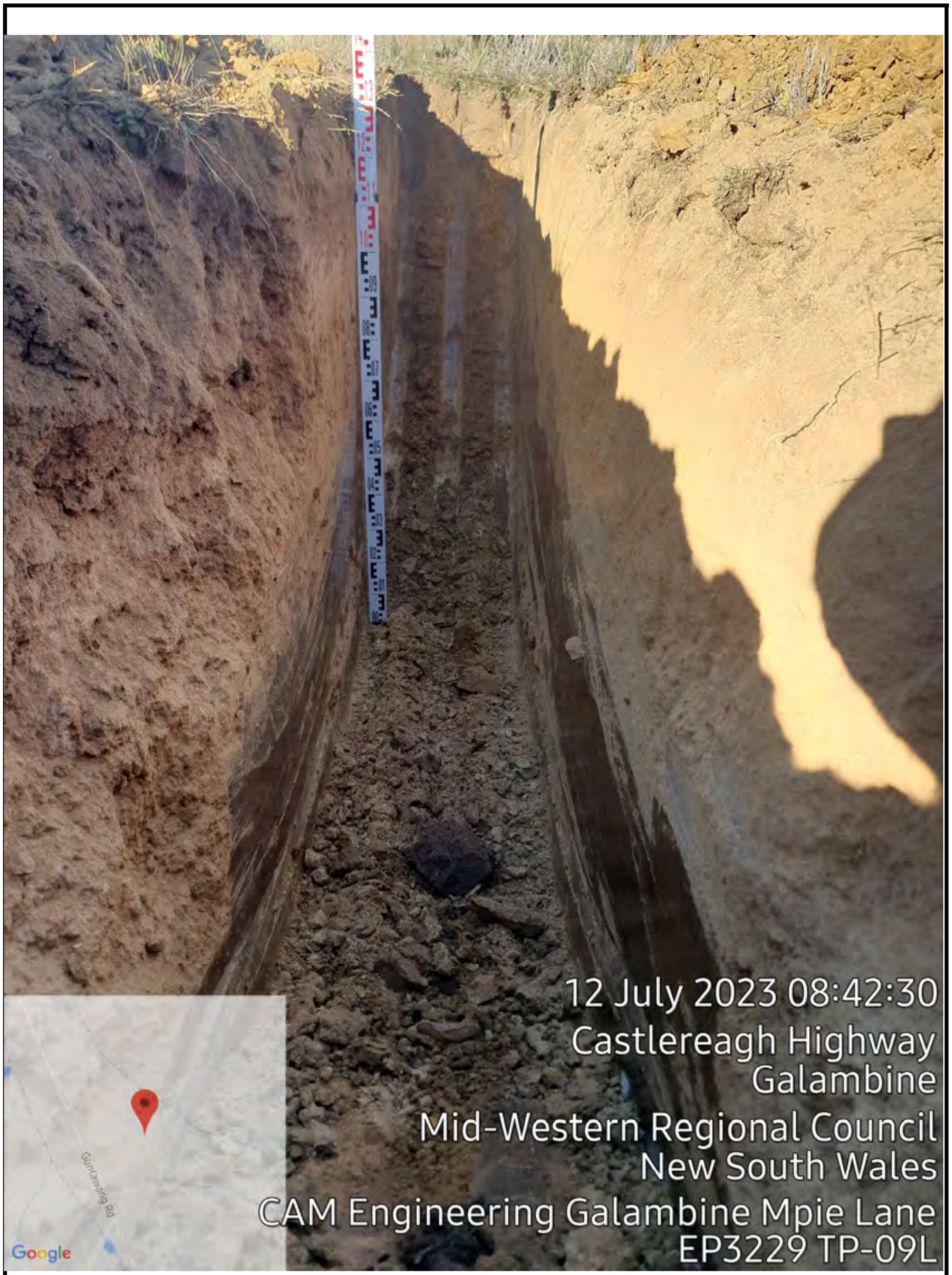
SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	12.7.23	Northing	6410592.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	12.7.23	Easting	734127.00	Bearing	---	Ground Level	439 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, grey	D	MD	2		TOPSOIL
					CI-CH	Sandy CLAY: medium to high plasticity, yellow, fine to medium grained sand	<PL	F VSt to H	2 2 7 11		RESIDUAL SOIL
		438	1		CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, yellow, fine to coarse grained sand	<<PL		13 14 15	D	EXTREMELY WEATHERED ROCK
						Test Pit TP09-L Terminated at 1.30 m					Refusal on bedrock
		437	2								
		436	3								

Remarks:



EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP09-L

Test Pit No: TP01-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6411174.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734222.00	Bearing	---	Ground Level	435 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, dark brown, fine to medium grained sand	<PL	F to St	2 2		TOPSOIL
					CL-CI	Sandy CLAY: low to medium plasticity, brown		VSt and H	2 4 11 10 11 7		RESIDUAL SOIL
		434	1		CI-CH	Silty CLAY: medium to high plasticity, pale brown and yellow	<<PL		8 8 7 12 12	B	
					SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey and brown with pebbles and cobbles	D	D to VD	5		EXTREMELY WEATHERED ROCK DCP:-5/5mm Hammer Bouncing
		433 432	2 3			Test Pit TP01-P Terminated at 1.90 m					Target depth

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP01-P

Test Pit No: TP02-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6411088.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734205.00	Bearing	---	Ground Level	437 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered			▨	CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand, with fragments of Sandstone (50mm-100mm)	<PL	St to VSt	3 3		TOPSOIL
				▨	CI-CH	Sandy CLAY: medium to high plasticity, pale brown, fine to medium grained sand		VSt to H	4 7 12 25		RESIDUAL SOIL
		436	1	▨	SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, pale brown and grey	D	D to VD		B	EXTREMELY WEATHERED ROCK
						Test Pit TP02-P Terminated at 1.00 m					Refusal on bedrock
		435	2								
		434	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP02-P

Test Pit No: TP03-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6411013.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734122.00	Bearing	---	Ground Level	434 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F to St	2		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, brown	~PL		2 3 4 9		RESIDUAL SOIL DCP:-9/5mm Hammer Bouncing
					SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey and brown	D	D to VD		B	EXTREMELY WEATHERED ROCK
						Test Pit TP03-P Terminated at 0.90 m					Refusal on bedrock
		433	1								
		432	2								
		431	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP03-P

Test Pit No: TP04-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410984.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734269.00	Bearing	---	Ground Level	440 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	St to VSt	4		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, brown	~PL		3 3		RESIDUAL SOIL
					CI-CH	Extremely weathered Shale recovered as Sandy CLAY, medium to high plasticity, brown and grey, fine to coarse grained sand	<<PL	H	7 17	B	EXTREMELY WEATHERED ROCK DCP:-17/80mm Hammer Bouncing
		439	1			Test Pit TP04-P Terminated at 0.92 m					Refusal on bedrock
		438	2								
		437	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP04-P

Test Pit No: TP05-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410977.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734183.00	Bearing	---	Ground Level	436 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	St to VSt	4		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, brown	~PL		3 4 5		RESIDUAL SOIL
					SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey and brown	D	D to VD	25	B	EXTREMELY WEATHERED ROCK DCP:-Hammer Bouncing
		435	1			Test Pit TP05-P Terminated at 1.00 m					Refusal on bedrock
		434	2								
		433	3								

Remarks:

10 July 2023 12:09:39
Castlereagh Highway
Gulgong
Mid-Western Regional Council
New South Wales
CAM Engineering Galambine Mpie Lane
EP3229 TP-05P

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP05-P

Test Pit No: TP06-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410874.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734211.00	Bearing	---	Ground Level	437 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F to St	1 2		TOPSOIL
				▨	CI-CH	Silty CLAY: medium to high plasticity, brown	~PL		2 3		RESIDUAL SOIL
				▨	CI-CH	Extremely weathered Shale recovered as Silty Sandy CLAY, medium to high plasticity, fine to coarse grained sand, grey and brown	<<PL	H	13 12	B	EXTREMELY WEATHERED ROCK DCP:-12/50mm Hammer Bouncing
		436	1			Test Pit TP06-P Terminated at 1.00 m					Refusal on bedrock
		435	2								
		434	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP06-P

Test Pit No: TP07-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6410843.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	734049.00	Bearing	---	Ground Level	433 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, grey	D	L	1		TOPSOIL
					CL-CI	Sandy CLAY: low to medium plasticity, grey, fine to coarse grained sand	<PL	F	1 1 2		RESIDUAL SOIL
					CI-CH	Sandy CLAY: medium to high plasticity, yellow, fine to coarse grained sand		St to VSt	5 6 6 4 5 5	B	
		432	1			0.90m: @0.9 becomes dark red, grey, brown and yellow			4 6 5 5 7 7 7 9		
		431	2			Test Pit TP07-P Terminated at 2.00 m					Target depth
		430	3								

Remarks:

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP07-P

Test Pit No: TP08-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410758.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734094.00	Bearing	---	Ground Level	434 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Silty CLAY: low to medium plasticity, grey	~PL	F	2 2 2		TOPSOIL
		433 432	1 2		CI-CH	Silty CLAY: medium to high plasticity, yellow 2.40m: @2.4m with fragments of Sandstone, brown and yellow (100mm-150mm)	<PL	St and VSt	7 7 6 5 5 5 4 3 4 4 5 6 6 6 7 7	B	RESIDUAL SOIL
		431	3			Test Pit TP08-P Terminated at 2.70 m					Target depth

Remarks:

10 July 2023 17:00:16
Goolma Road
Gulgong
Mid-Western Regional Council
New South Wales
CAM Engineering Galambine Mpie Lane
EP3229 TP-08P

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation
	TP08-P

Test Pit No: TP09-P

Engineering Log - Test Pit

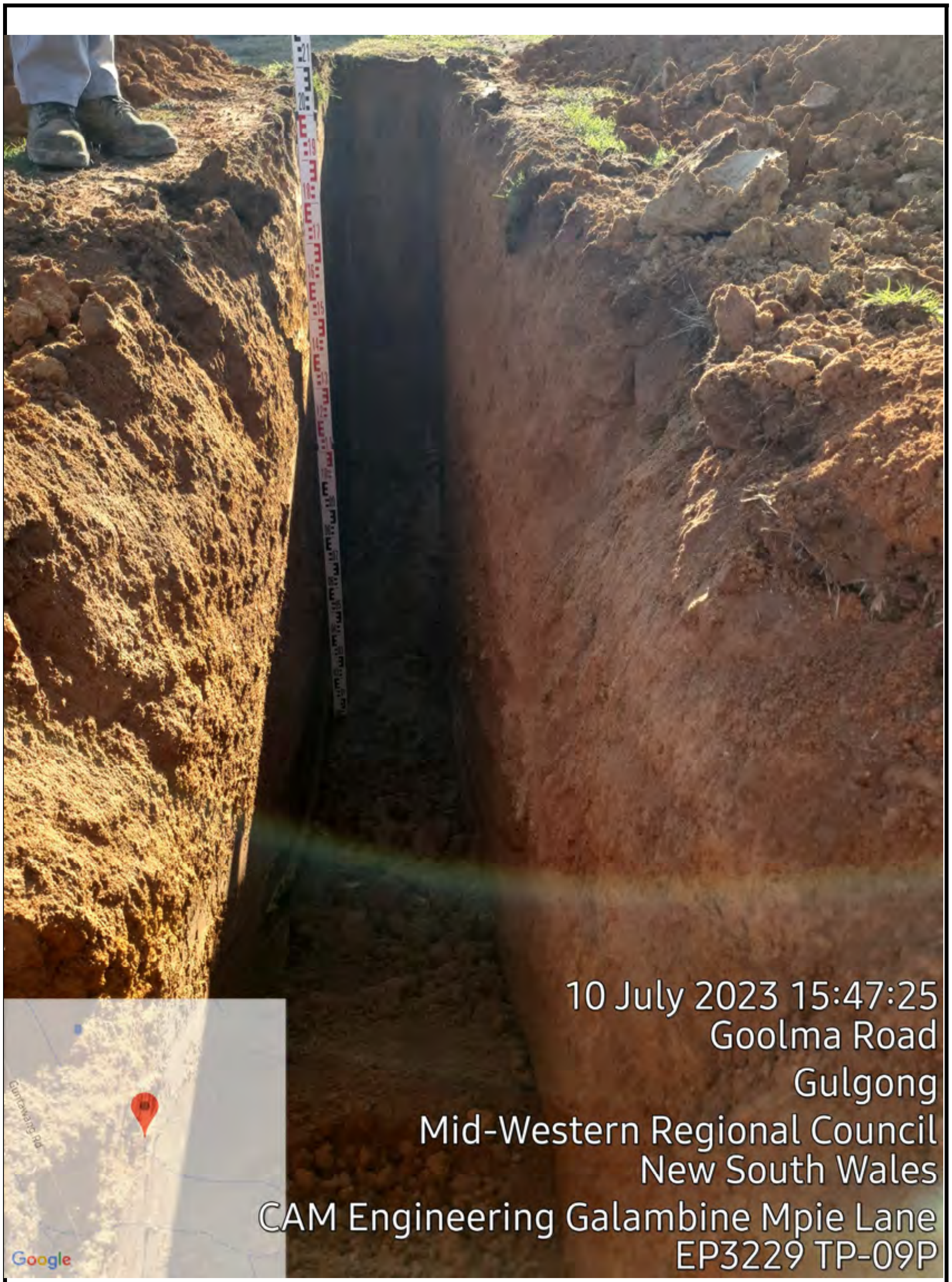
SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410739.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734212.00	Bearing	---	Ground Level	439 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, brown	M	L	1 1		TOPSOIL
		438	1		CI-CH	Silty CLAY: medium to high plasticity, yellow and red mottled	~PL	F to St St to VSt	1 3 6 8 9 8 8 10 9 9 8 10	B	RESIDUAL SOIL
		437	2		CI-CH	Extremely weathered Siltstone recovered as Silty CLAY, medium to high plasticity, grey	<PL	VSt to H	10 11 12		EXTREMELY WEATHERED ROCK
						Test Pit TP09-P Terminated at 2.00 m					Target depth
		436	3								

Remarks:



EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation

TP09-P

Test Pit No: TP10-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	12.7.23	Northing	6410729.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	12.7.23	Easting	733953.00	Bearing	---	Ground Level	433 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, dark brown, fine to medium grained sand	<PL	F to St	2 2		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, dark red, with fine to medium grained sand	~PL		4 5		RESIDUAL SOIL
					SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, yellow and red	D	VD	20	B	EXTREMELY WEATHERED ROCK DCP:-Hammer Bouncing
						Test Pit TP10-P Terminated at 0.90 m					Refusal on bedrock
		432	1								
		431	2								
		430	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP10-P

Test Pit No: TP11-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	12.7.23	Northing	6410630.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	12.7.23	Easting	734170.00	Bearing	---	Ground Level	439 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F	2		TOPSOIL
					CI-CH	Sandy CLAY: medium to high plasticity, yellow and red, fine to medium grained sand	~PL		1 2		RESIDUAL SOIL
								St to VSt	4 3 4 6 5 8 9		
		438	1						20		
					CI-CH	Sandy CLAY: medium to high plasticity, yellow and red, fine to coarse grained sand, with pebbles and ferruginous cementations (30mm-50mm)				B	
						1.50m: @1.5m becomes yellow		VSt to H			
		437	2								
						Test Pit TP11-P Terminated at 2.10 m					Target depth
		436	3								

Remarks:

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation
	TP11-P

Test Pit No: TP12-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	12.7.23	Northing	6410596.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	12.7.23	Easting	734024.00	Bearing	---	Ground Level	436 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, grey, fine to medium grained sand	<PL	F to St	2		TOPSOIL
					CI-CH	Sandy CLAY: medium to high plasticity, yellow, fine to medium grained sand			2 2 2 5 15		RESIDUAL SOIL
		435 434	1 2		CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, yellow with ferrugious cementations (30mm-50mm)	<<PL	H and VSt	14 10 8 4 5 5 6 5 6 6	B	EXTREMELY WEATHERED ROCK
		433	3			Test Pit TP12-P Terminated at 2.10 m					Target depth

Remarks:

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation	
	TP12-P	

Test Pit No: TP13-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	12.7.23	Northing	6410446.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	12.7.23	Easting	734092.00	Bearing	---	Ground Level	439 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, grey, fine to medium grained sand	<PL	F	1 1		TOPSOIL
					CI-CH	Sandy CLAY: medium to high plasticity, brown, fine to medium grained sand		F St to VSt	2 1 2 3 7	B	RESIDUAL SOIL
		438	1		CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, yellow and red, fine to coarse grained sand	<<PL	H	14 19		EXTREMELY WEATHERED ROCK DCP:-Hammer Bouncing
						Test Pit TP13-P Terminated at 1.30 m					Target depth
		437	2								
		436	3								

Remarks:

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TP13-P

Test Pit No: TPNW01-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client CAM Engineering and Construction Pty Ltd
Project Preliminary Geotechnical Investigation
Location Galambine NSW
Project No. EP3229
Logged By OP
Checked By OP

Started Excavation 11.7.23
Completed Excavation 11.7.23
Northing 6411283.00
Easting 733998.00
Slope 90°
Bearing ---
Equipment Komatsu 13T
Ground Level 427 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, black, fine to medium grained sand	<PL	F to St	2 2		TOPSOIL
					CI-CH	Silty CLAY: medium to high plasticity, yellow and red, with fine to medium grained sand	~PL	VSt	3 3 4 7 8	B U50	RESIDUAL SOIL
		426	1		CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, brown and grey, fine to coarse sand with pebbles	<<PL	VSt to H	10 16		EXTREMELY WEATHERED ROCK DCP:-Hammer Bouncing
		425 424	2 3			Test Pit TPNW01-L Terminated at 1.10 m					Target depth

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TPNW01-L

Test Pit No: TPNW02-L

Engineering Log - Test Pit

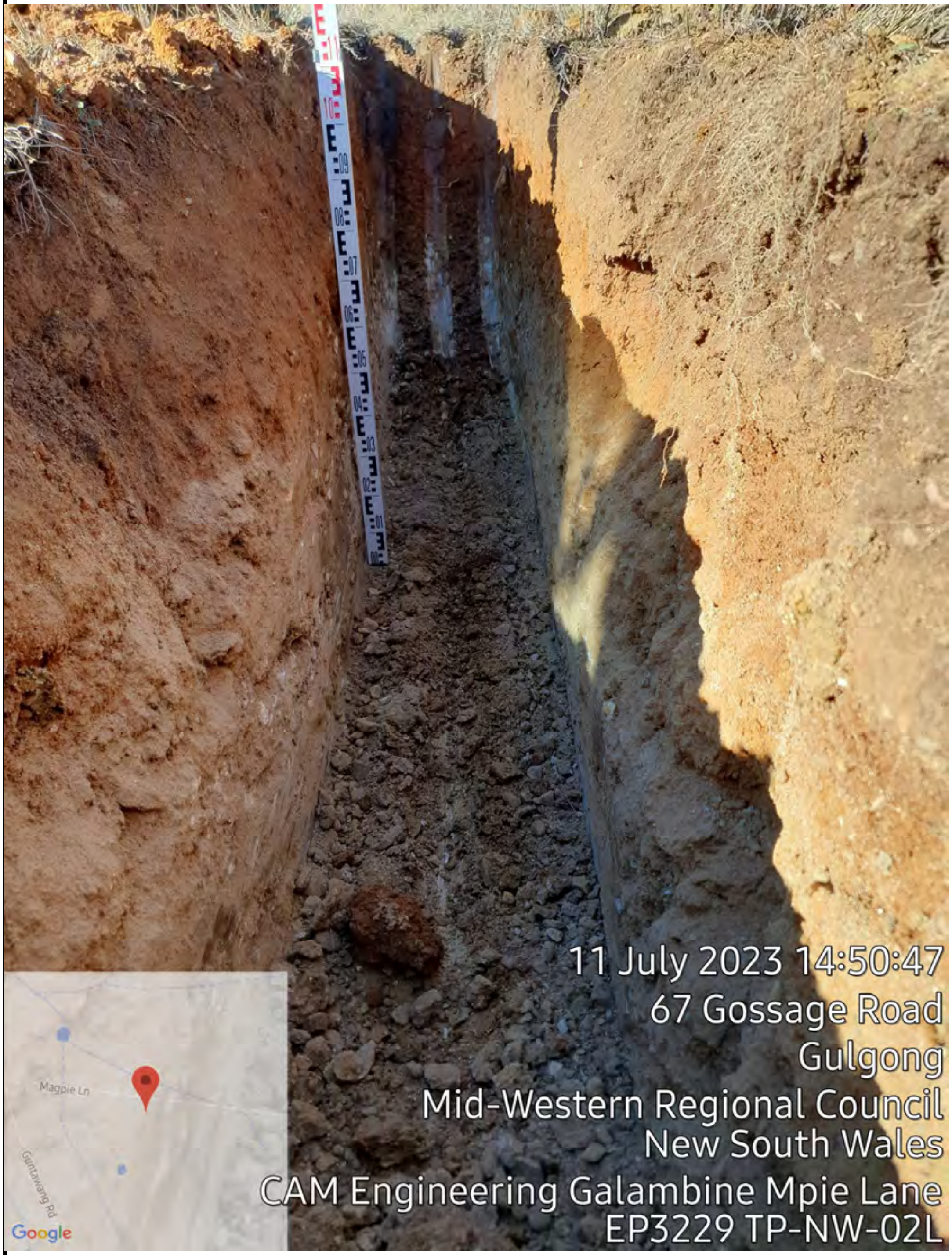
SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411362.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	734100.00	Bearing	---	Ground Level	430 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered			▨	SC	TOPSOIL: Clayey SAND: fine to medium grained, brown	D	L to MD	1 2		TOPSOIL
				▨	CI-CH	Silty CLAY: medium to high plasticity, brown and dark red, with fine to medium grained sand	~PL	F to St	2 3 4 10	B	RESIDUAL SOIL
		429	1	▨	CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, grey and brown, fine to coarse grained sand with pebbles	<PL	VSt to H	12 12		EXTREMELY WEATHERED ROCK
		428 427	2 3			Test Pit TPNW02-L Terminated at 1.15 m					Refusal on bedrock

Remarks:



EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TPNW02-L

Test Pit No: TPNW03-L

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411281.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	734114.00	Bearing	---	Ground Level	430 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to coarse grained, dark brown, with fine to medium grained, subangular gravel	D	L	2 1		TOPSOIL
					CI-CH	Sandy CLAY: medium to high plasticity, dark brown and red, fine to coarse grained sand	~PL	F	2 6 10		RESIDUAL SOIL
					CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, brown and grey, fine to coarse grained sand	<PL	VSt to H	12 20		EXTREMELY WEATHERED ROCK
						Test Pit TPNW03-L Terminated at 0.90 m					Target depth
		429	1								
		428	2								
		427	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TPNW03-L

Test Pit No: TPNW01-P

Engineering Log - Test Pit

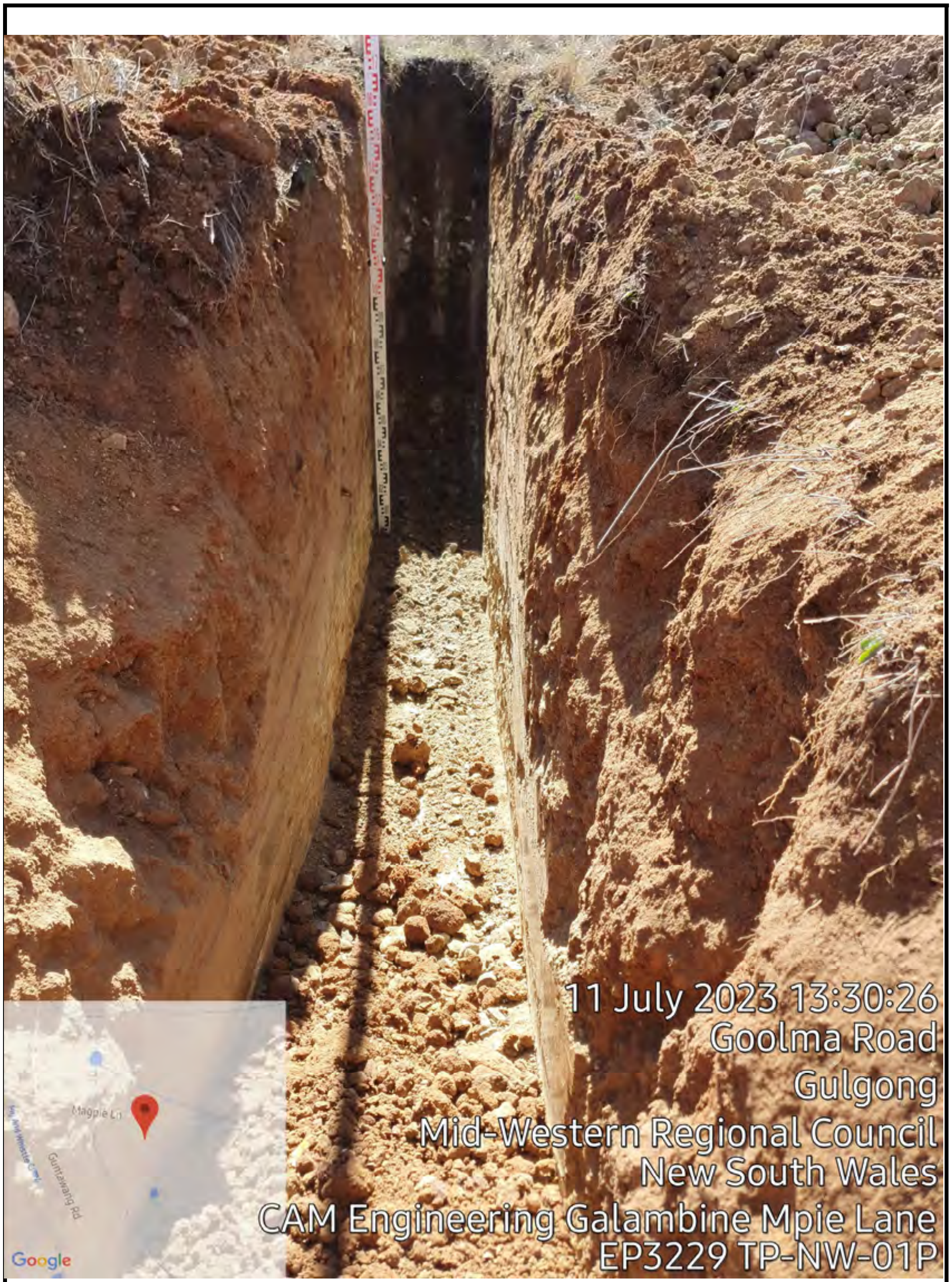
SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411344.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	733954.00	Bearing	---	Ground Level	427 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				SC	TOPSOIL: Clayey SAND: fine to medium grained, grey	M	L	1		TOPSOIL
					CL-CI	Sandy CLAY: low to medium plasticity, brown, fine to coarse grained sand	>PL ~PL	F	1 2 6 12		RESIDUAL SOIL
		426	1		ML	Extremely weathered Siltstone recovered as Clayey SILT, low plasticity, grey and brown with cobbles and pebbles	<PL	VSt to H	21	B	EXTREMELY WEATHERED ROCK
					SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey and brown	D	D to VD			
						Test Pit TPNW01-P Terminated at 1.60 m					Refusal on bedrock
		425	2								
		424	3								

Remarks:



EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TPNW01-P

Test Pit No: TPNW02-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411331.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	734050.00	Bearing	---	Ground Level	429 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, brown, fine to medium grained sand	<PL	F	2		TOPSOIL
					SC	Clayey SAND: fine to medium grained, grey	D	MD	2 4		RESIDUAL SOIL
					CI-CH	Sandy CLAY: medium to high plasticity, yellow, fine to coarse grained sand	<PL	St to VSt H	8 9 11 11	B	
					SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, grey and brown with cobbles and pebbles	D	D to VD	17		EXTREMELY WEATHERED ROCK
		428	1								
						Test Pit TPNW02-P Terminated at 1.90 m					Refusal on bedrock
		427	2								
		426	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TPNW02-P

Test Pit No: TPNW03-P

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411296.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	11.7.23	Easting	734274.00	Bearing	---	Ground Level	434 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered			≈	SC	TOPSOIL: Clayey SAND: fine to medium grained, dark brown	D	MD	3		TOPSOIL
				⁚	SP	SAND: fine to medium grained, grey, with clay			4 4 5		RESIDUAL SOIL
				▨	CL-CI	Sandy CLAY: low to medium plasticity, yellow and brown, fine to coarse grained sand	<PL	VSt to H	9 12		
		433 432	1 2	▨	CI-CH	Extremely weatherd Sandstone recovered as Sandy CLAY, medium to high plasticity, dark red and brown	<<PL		17	B	EXTREMELY WEATHERED ROCK
		431	3			Test Pit TPNW03-P Terminated at 2.10 m					Target depth

Remarks:

11 July 2023 15:30:18
67 Gossage Road
Gulgong
Mid-Western Regional Council
New South Wales
CAM Engineering Galambine Mpie Lane
EP3229 TP-NW-03P

EP3229 - CAM Engineering Galambine Magpie Lane
Geotechnical Investigation

TPNW03-P

Test Pit No: TP01-WS

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	10.7.23	Northing	6410803.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	10.7.23	Easting	734334.00	Bearing	---	Ground Level	443 AHD

EXCAVATION | MATERIAL DESCRIPTION | TESTING, SAMPLING & OTHER INFORMATION

Method	Water	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered	SC	TOPSOIL: Clayey SAND: fine to medium grained, dark brown	D to M	L		TOPSOIL
		CI-CH	Silty CLAY: medium to high plasticity, pale brown and yellow	<PL	F St and VSt		RESIDUAL SOIL
		ML	Extremely weathered Siltstone recovered as Clayey SILT, low plasticity, grey and brown	<<PL	VSt to H	D	EXTREMELY WEATHERED ROCK

RL (m) / Depth (m): 442 – 1; 441 – 2; 440 – 3

Tests DCP Results (blows/100mm)
2
1
2
6
5
6
4
4
4
5
6
5
5
6
6
6
10
10
10
11
10
10
12
12

Remarks: Test Pit TP01-WS Terminated at 3.50 m — Target depth

EP RISK	EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation
	TP01-WS

Test Pit No: TP02-WS

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	12.7.23	Northing	6410450.00	Slope	90°	Equipment	Komatsu 13T
Completed Excavation	12.7.23	Easting	734285.00	Bearing	---	Ground Level	443 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
E	Not Encountered				CL-CI	TOPSOIL: Sandy CLAY: low to medium plasticity, grey, fine to medium grained sand	<PL	F to St	1 2		TOPSOIL
					CI-CH	Sandy CLAY: medium to high plasticity, yellow, fine to medium grained sand			2 3	B	RESIDUAL SOIL
								VSt to H	6 13		
		442	1		CI-CH	Extremely weathered Sandstone recovered as Sandy CLAY, medium to high plasticity, yellow, fine to coarse grained sand	<<PL		25		EXTREMELY WEATHERED ROCK
					MH	Extremely weathered Siltstone recovered as Clayey Sandy SILT, high plasticity, grey, fine to coarse grained sand					
		441	2			Test Pit TP02-WS Terminated at 2.00 m					Target depth
		440	3								

Remarks:

EP RISK

EP3229 - CAM Engineering Galambine Magpie Lane Geotechnical Investigation

TP02-WS

Test Pit No: TPGRNB

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6410447.00	Slope	90°	Equipment	Bobcat 5T
Completed Excavation	11.7.23	Easting	733964.00	Bearing	---	Ground Level	435 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
AS	Not Encountered					Road Seal: fine to coarse grained, sub-angular to angular, black	D	D to VD			PAVEMENT
					GP	Sandy GRAVEL: fine to coarse grained, sub-angular to angular, pale brown, fine to coarse grained sand					
		434	1		SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, dark brown			5	B	EXTREMELY WEATHERED ROCK DCP:-5/5mm Hammer Bouncing
						Test Pit TPGRNB Terminated at 1.50 m					Target depth
		433	2								
		432	3								

Remarks:

Test Pit No: TPGRSB

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6410442.00	Slope	90°	Equipment	Bobcat 5T
Completed Excavation	11.7.23	Easting	733971.00	Bearing	---	Ground Level	435 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
AS	Not Encountered			■		Road Seal: fine to coarse grained, sub-angular to angular, black	D	D to VD			PAVEMENT
				▨	GP	Sandy GRAVEL: fine to coarse grained, sub-angular to angular, brown, fine to coarse grained sand					
		434	1	▨	SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, dark brown			2	B	EXTREMELY WEATHERED ROCK DCP:-2/5mm Hammer Bouncing
						Test Pit TPGRSB Terminated at 1.50 m					Target depth
		433	2								
		432	3								

Remarks:

Test Pit No: TPGRSB Shoulder

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6410440.00	Slope	90°	Equipment	Bobcat 5T
Completed Excavation	11.7.23	Easting	733975.00	Bearing	---	Ground Level	435 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
AS	Not Encountered			■		Road Seal: fine to coarse grained, sub-angular to angular, black	D				PAVEMENT
				▩	GP	Sandy GRAVEL: fine to coarse grained, sub-angular to angular, brown, fine to coarse grained sand					
		434	1	▨	SC	Extremely weathered Sandstone recovered as Clayey SAND, fine to coarse grained, dark brown		D to VD		B	EXTREMELY WEATHERED ROCK
		433 432	2 3			Test Pit TPGRSB Shoulder Terminated at 1.50 m					Target depth

Remarks:

Test Pit No: TPMLEB

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411400.00	Slope	90°	Equipment	Bobcat 5T
Completed Excavation	11.7.23	Easting	734232.00	Bearing	---	Ground Level	434 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
AS	Not Encountered			■		Road Seal: fine to coarse grained, sub-rounded to sub-angular, black	D	D to VD			PAVEMENT
				▨	GP	Sandy GRAVEL: fine to coarse grained, sub-angular to angular, yellow, fine to coarse grained sand			3 6 25		
		433	1	▨	SC	Clayey SAND: fine to coarse grained, dark brown, (crushed Sandstone)				B	
				▧	CI-CH	Sandy CLAY: medium to high plasticity, brown, fine to coarse grained sand	<PL	VSt to H			RESIDUAL SOIL
		432 431	2 3			Test Pit TPMLEB Terminated at 1.50 m					Target depth

Remarks:

Test Pit No: TPMLWB

Engineering Log - Test Pit

SHEET 1 OF 1

Client	CAM Engineering and Construction Pty Ltd	Project No.	EP3229
Project	Preliminary Geotechnical Investigation	Logged By	OP
Location	Galambine NSW	Checked By	OP

Started Excavation	11.7.23	Northing	6411395.00	Slope	90°	Equipment	Bobcat 5T
Completed Excavation	11.7.23	Easting	734231.00	Bearing	---	Ground Level	434 AHD

EXCAVATION				MATERIAL DESCRIPTION					TESTING, SAMPLING & OTHER INFORMATION		
Method	Water	RL (m)	Depth (m)	Graphic Log	Classification	Description of Soil (soil type: plasticity/grainsize, colour and other components)	Moisture Condition	Consistency	Tests DCP Results (blows/ 100mm)	Samples	Additional Comments (material origin, pocket penetrometer values, investigation observations)
AS	Not Encountered			■ ▨	 GP	Road Seal: fine to coarse grained, sub-angular to angular, black Sandy GRAVEL: fine to coarse grained, sub-angular to angular, brown, fine to coarse grained sand	D	D to VD			PAVEMENT
				▨	CL-CI	Sandy CLAY: low to medium plasticity, dark brown and red, fine to coarse grained sand, (with chips of Siltstone and Sandstone)	<PL	VSt to H	6 25		RESIDUAL SOIL
		433	1	▧	CL-CI	Sandy CLAY: medium to high plasticity, brown, fine to coarse grained sand				B	
						Test Pit TPMLWB Terminated at 1.50 m					Target depth
		432	2								
		431	3								

Remarks:

Appendix E

LABORATORY TEST RESULTS

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: SSI:NEWC23S-07816
Issue No: 1

Shrink Swell Index Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Greg Eveleigh
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 24/07/2023

Sample Details

Sample ID: NEWC23S-07816
Date Sampled: 10/07/2023
Date Submitted: 14/07/2023
Date Tested: 18/07/2023
Project Location: EP3229 Galambine, NSW.
Sample Location: TPNW01-L, @0.20 - 0.70, U50
Borehole Number: TPNW01-L
Borehole Depth (m): 0.20 - 0.70

Sampling Method: Submitted by client*
Material: Clay
Source: On-Site

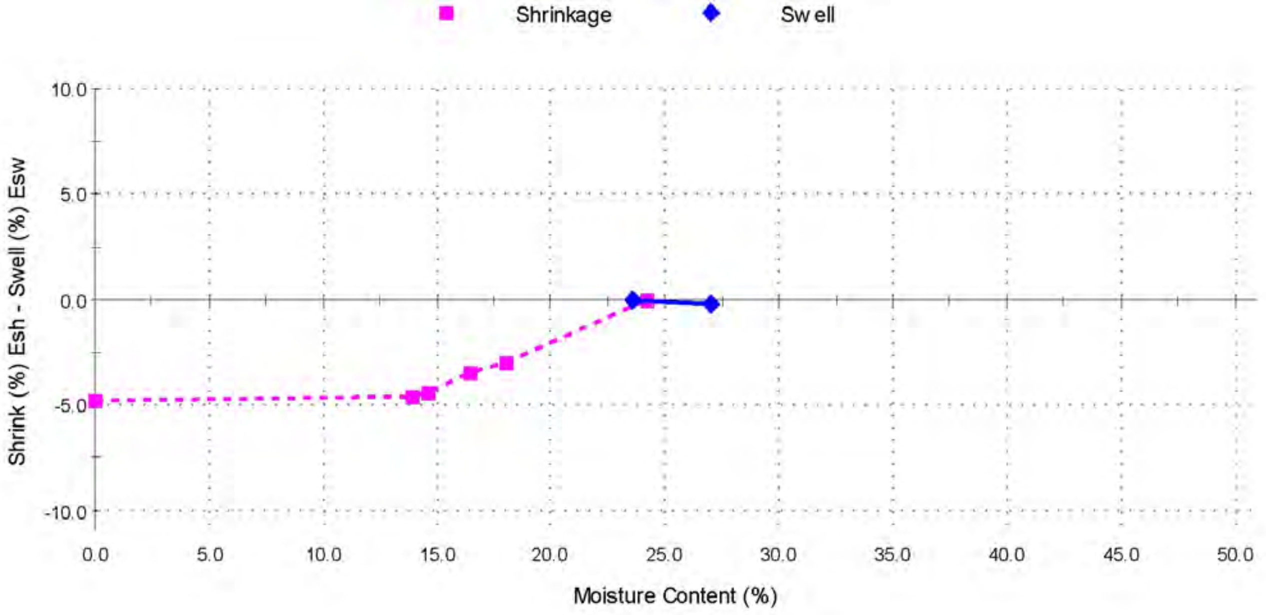
Swell Test AS 1289.7.1.1

Swell on Saturation (%): -0.2
Moisture Content before (%): 23.6
Moisture Content after (%): 27.0
Est. Unc. Comp. Strength before (kPa): +600
Est. Unc. Comp. Strength after (kPa): 350

Shrink Test AS 1289.7.1.1

Shrink on drying (%): 4.8
Shrinkage Moisture Content (%): 24.2
Est. inert material (%): 5-10
Crumbling during shrinkage: Nil
Cracking during shrinkage: Nil

Shrink Swell



Shrink Swell Index - Iss (%): 2.7

Comments

Clay, low to medium plasticity, brown. Trace of fine grained gravel.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: SSI:NEWC23S-07810
Issue No: 1

Shrink Swell Index Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Greg Eveleigh
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 24/07/2023

Sample Details

Sample ID:	NEWC23S-07810	**Sampling Method:**	Submitted by client*
Date Sampled:	10/07/2023	**Material:**	Clay
Date Submitted:	14/07/2023	**Source:**	On-Site
Date Tested:	18/07/2023		
Project Location:	EP3229 Galambine, NSW.		
Sample Location:	TP04-L, @0.30 - 0.80, U50		
Borehole Number:	TP04-L		
Borehole Depth (m):	0.30 - 0.80		

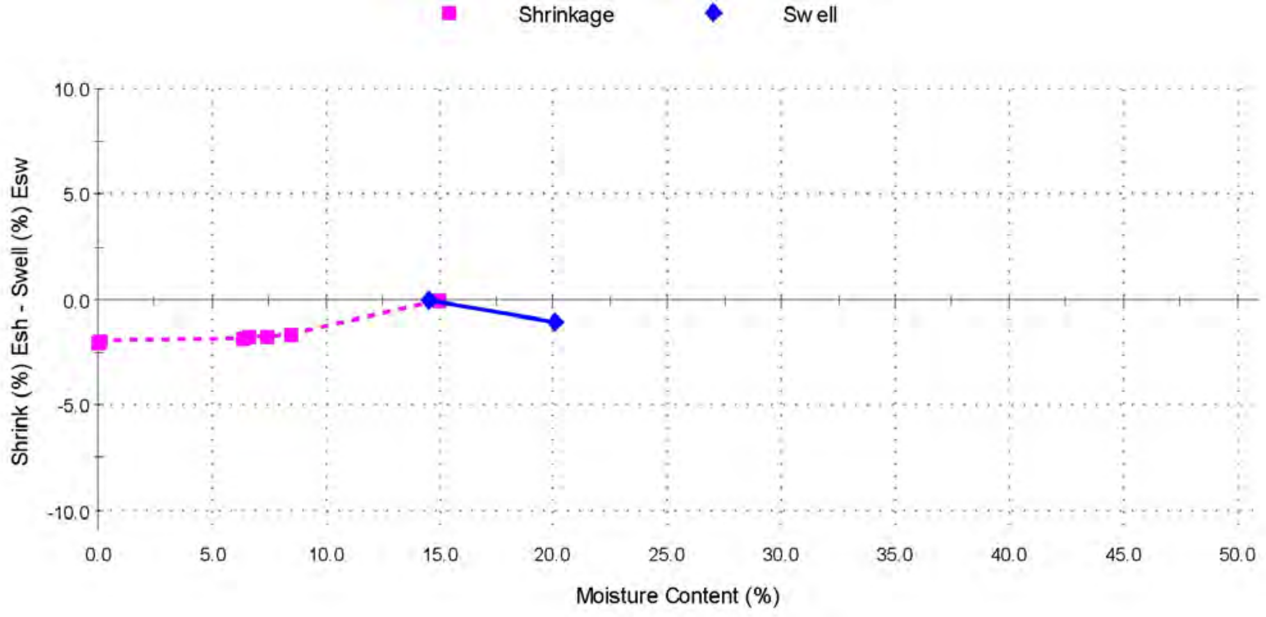
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-1.1
Moisture Content before (%):	14.5
Moisture Content after (%):	20.1
Est. Unc. Comp. Strength before (kPa):	130
Est. Unc. Comp. Strength after (kPa):	120

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	2.0
Shrinkage Moisture Content (%):	14.9
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 1.1

Comments

Silty Clay, low to medium plasticity, brown.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Shrink Swell Index Report

Report No: SSI:NEWC23S-07812
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Greg Eveleigh
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 24/07/2023

Sample Details

Sample ID:	NEWC23S-07812	**Sampling Method:**	Submitted by client*
Date Sampled:	10/07/2023	**Material:**	Clay
Date Submitted:	14/07/2023	**Source:**	On-Site
Date Tested:	18/07/2023		
Project Location:	EP3229 Galambine, NSW.		
Sample Location:	TP07-L, @0.50 - 1.00		
Borehole Number:	TP07-L		
Borehole Depth (m):	0.50 - 1.00		

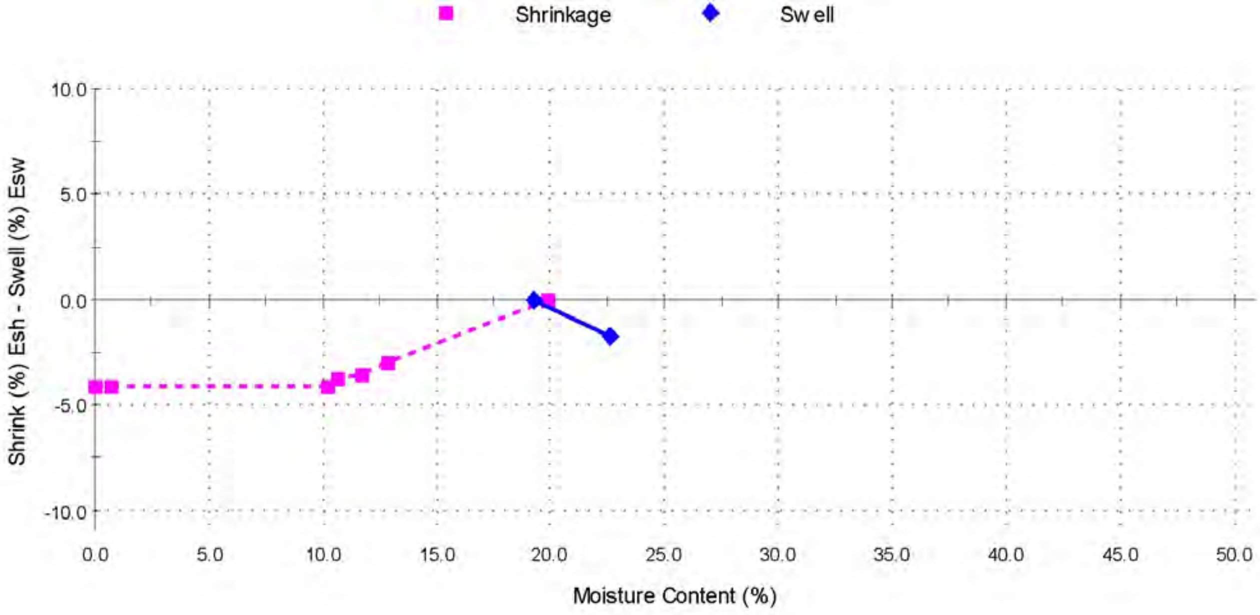
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	-1.7
Moisture Content before (%):	19.3
Moisture Content after (%):	22.6
Est. Unc. Comp. Strength before (kPa):	250
Est. Unc. Comp. Strength after (kPa):	220

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	4.1
Shrinkage Moisture Content (%):	19.9
Est. inert material (%):	0
Crumbling during shrinkage:	Nil
Cracking during shrinkage:	Nil

Shrink Swell



Shrink Swell Index - Iss (%): 2.3

Comments

Clay, low to medium plasticity, brown.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: RS:NEWC23S-07828
Issue No: 1

Rock Strength Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Greg Eveleigh
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 17/07/2023

Sample Details

Sample ID: NEWC23S-07828
Field ID: 00003
Date Sampled: 10/07/2023
Date Submitted: 14/07/2023
Date Tested: 14/07/2023
Project Location:
Sample Location: TP02-P, @0.60 - 1.00, Rock
Test Method: AS 4133.4.1

Sampling Method: Submitted by client*
Material: Rock
Source: On-Site
Specification: No Specification

General Details

Test Machine: 19595
Moisture Condition: D
Storage History: Unknown
Loading Rate: 30sec-3min

Irregular/Block					Orientation 1				Orientation 2				
Sample ID	Rock Type	Location	Sample Dimensions	Depth	P kN	Is MPa	Is(50) MPa	Failure Mode	P kN	Is MPa	Is(50) MPa	Failure Mode	Ia(50) MPa
1	Rock								3.74	4.0	3.2	valid	
2	Rock								3.22	2.9	2.4	valid	
3	Rock								6.16	3.6	3.3	valid	
4	Rock								3.87	2.1	2.0	valid	
5	Rock								4.26	2.3	2.2	valid	
6	Rock								2.86	2.4	2.0	valid	
7	Rock								3.94	3.9	3.2	valid	
8	Rock								5.65	4.2	3.6	valid	
9	Rock								5.74	2.9	2.8	valid	
10	Rock								4.98	4.0	3.4	valid	

Comments

Substance = Valid Break

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC23S-07820-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Tristram Johnson
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 25/07/2023

Sample Details

Sample ID: NEWC23S-07820
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: EP3229 Galambine, NSW.
Sample Location: TPNW03-P
@0.60 - 1.00

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	12.5	
Date Tested		14/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.92**	
Standard OMC (%)		**12.5**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		74	
LL Method		Visual / Tactile Assessment	
Date Tested		17/07/2023	
CBR at 5.0mm (%)	AS 1289.6.1.1	**8**	
Dry Density before Soaking (t/m³)		1.91	
Density Ratio before Soaking (%)		99.5	
Moisture Content before Soaking (%)		12.5	
Moisture Ratio before Soaking (%)		99.5	
Dry Density after Soaking (t/m³)		1.90	
Density Ratio after Soaking (%)		99.0	
Swell (%)		0.5	
Moisture Content of Top 30mm (%)		15.4	
Moisture Content of Remaining Depth (%)		13.2	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		150	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		24/07/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07831-1
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC01107AA
Project Name:	EP3229 CAM Engineering Galambine Magpie Lane
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID:	NEWC23S-07831
Date Sampled:	10/07/2023
Source:	On-Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	
Sample Location:	TP05-P @0.40 - 1.00

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	7.4	
Date Tested		25/07/2023	
Standard MDD (t/m^3)	AS 1289.5.1.1	**1.93**	
Standard OMC (%)		**12.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		8	
Curing Time (h)		259	
LL Method		Visual / Tactile Assessment	
Date Tested		25/07/2023	
CBR at 2.5mm (%)	AS 1289.6.1.1	**11**	
Dry Density before Soaking (t/m^3)		1.93	
Density Ratio before Soaking (%)		100.0	
Moisture Content before Soaking (%)		12.3	
Moisture Ratio before Soaking (%)		100.5	
Dry Density after Soaking (t/m^3)		1.92	
Density Ratio after Soaking (%)		99.5	
Swell (%)		0.5	
Moisture Content of Top 30mm (%)		14.6	
Moisture Content of Remaining Depth (%)		13.1	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		8	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		72	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		1/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07833-1
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC01107AA
Project Name:	EP3229 CAM Engineering Galambine Magpie Lane
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID:	NEWC23S-07833
Date Sampled:	10/07/2023
Source:	On-Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	
Sample Location:	TP07-P @0.50 - 1.00

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	17.9	
Date Tested		25/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.68**	
Standard OMC (%)		**21.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		287	
LL Method		Visual / Tactile Assessment	
Date Tested		26/07/2023	
CBR at 2.5mm (%)	AS 1289.6.1.1	**4.5**	
Dry Density before Soaking (t/m³)		1.66	
Density Ratio before Soaking (%)		99.0	
Moisture Content before Soaking (%)		20.6	
Moisture Ratio before Soaking (%)		99.0	
Dry Density after Soaking (t/m³)		1.66	
Density Ratio after Soaking (%)		99.0	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		24.1	
Moisture Content of Remaining Depth (%)		21.1	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		144	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		7/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07835-1
Issue No: 1

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID: NEWC23S-07835
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location:
Sample Location: TP09-P
@0.50 - 1.00

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.8	
Date Tested		25/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.84**	
Standard OMC (%)		**15.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		219	
LL Method		Visual / Tactile Assessment	
Date Tested		26/07/2023	
CBR at 5.0mm (%)	AS 1289.6.1.1	**4.5**	
Dry Density before Soaking (t/m³)		1.83	
Density Ratio before Soaking (%)		99.5	
Moisture Content before Soaking (%)		14.8	
Moisture Ratio before Soaking (%)		99.5	
Dry Density after Soaking (t/m³)		1.83	
Density Ratio after Soaking (%)		99.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		15.5	
Moisture Content of Remaining Depth (%)		14.2	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		212	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		7/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07835-1
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC01107AA
Project Name:	EP3229 CAM Engineering Galambine Magpie Lane
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID:	NEWC23S-07835
Date Sampled:	10/07/2023
Source:	On-Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	
Sample Location:	TP09-P @0.50 - 1.00

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	14.8	
Date Tested		25/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.84**	
Standard OMC (%)		**15.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		219	
LL Method		Visual / Tactile Assessment	
Date Tested		26/07/2023	
CBR at 5.0mm (%)	AS 1289.6.1.1	**4.5**	
Dry Density before Soaking (t/m³)		1.83	
Density Ratio before Soaking (%)		99.5	
Moisture Content before Soaking (%)		14.8	
Moisture Ratio before Soaking (%)		99.5	
Dry Density after Soaking (t/m³)		1.83	
Density Ratio after Soaking (%)		99.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		15.5	
Moisture Content of Remaining Depth (%)		14.2	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		212	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		7/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC23S-07836-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID: NEWC23S-07836
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location:
Sample Location: TP10-P
@0.50 - 0.90

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	11.0	
Date Tested		25/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.72**	
Standard OMC (%)		**19.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		261	
LL Method		Visual / Tactile Assessment	
Date Tested		25/07/2023	
CBR at 2.5mm (%)	AS 1289.6.1.1	**5**	
Dry Density before Soaking (t/m³)		1.72	
Density Ratio before Soaking (%)		100.0	
Moisture Content before Soaking (%)		18.7	
Moisture Ratio before Soaking (%)		100.0	
Dry Density after Soaking (t/m³)		1.72	
Density Ratio after Soaking (%)		99.5	
Swell (%)		0.5	
Moisture Content of Top 30mm (%)		20.6	
Moisture Content of Remaining Depth (%)		19.5	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		50	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		1/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC23S-07838-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID: NEWC23S-07838
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location:
Sample Location: TP12-P
@0.60 - 1.00

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	10.7	
Date Tested		25/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.85**	
Standard OMC (%)		**15.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		140	
LL Method		Visual / Tactile Assessment	
Date Tested		26/07/2023	
CBR at 2.5mm (%)	AS 1289.6.1.1	**4.5**	
Dry Density before Soaking (t/m³)		1.83	
Density Ratio before Soaking (%)		99.5	
Moisture Content before Soaking (%)		14.9	
Moisture Ratio before Soaking (%)		99.5	
Dry Density after Soaking (t/m³)		1.82	
Density Ratio after Soaking (%)		98.5	
Swell (%)		1.0	
Moisture Content of Top 30mm (%)		17.1	
Moisture Content of Remaining Depth (%)		16.0	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		96	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		1/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC23S-07839-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Jackson Antilla
(Senior Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 9/08/2023

Sample Details

Sample ID:	NEWC23S-07839
Date Sampled:	10/07/2023
Source:	On-Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	
Sample Location:	TP13-P @0.20 - 0.70

Test Results

Description	Method	Result	Limits
Moisture Content (%)	AS 1289.2.1.1	7.7	
Date Tested		25/07/2023	
Standard MDD (t/m³)	AS 1289.5.1.1	**1.98**	
Standard OMC (%)		**11.0**	
Retained Sieve (mm)		19	
Oversize Material (%)		0	
Curing Time (h)		121	
LL Method		Visual / Tactile Assessment	
Date Tested		25/07/2023	
CBR at 5.0mm (%)	AS 1289.6.1.1	**8**	
Dry Density before Soaking (t/m³)		1.98	
Density Ratio before Soaking (%)		100.5	
Moisture Content before Soaking (%)		11.2	
Moisture Ratio before Soaking (%)		100.0	
Dry Density after Soaking (t/m³)		1.98	
Density Ratio after Soaking (%)		100.5	
Swell (%)		0.0	
Moisture Content of Top 30mm (%)		14.2	
Moisture Content of Remaining Depth (%)		12.4	
Compaction Hammer Used		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Retained on 19 mm Sieve (%)		0	
CBR Moisture Content Method		AS 1289.2.1.1	
Sample Curing Time (h)		50	
Plasticity Method		Visual/Tactile Assessment	
Sample Moisture Content		AS 1289.2.1.1	
Date Tested		1/08/2023	

Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07815-1
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC01107AA
Project Name:	EP3229 CAM Engineering Galambine Magpie Lane
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Kerrina Christiansen
(Laboratory Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 28/07/2023

Sample Details

Sample ID:	NEWC23S-07815
Date Sampled:	10/07/2023
Source:	On-Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	EP3229 Galambine, NSW.
Sample Location:	TPNW01-L @0.20 - 0.70

Other Test Results

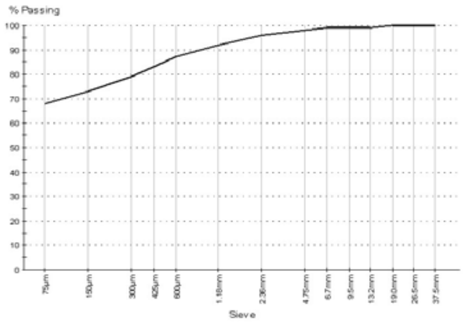
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	18.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	50	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	31	
Date Tested		20/07/2023	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying By:	Oven
Date Tested:	19/07/2023
Note:	Sample Washed

Sieve Size	% Passing	Limits
37.5mm	100	
26.5mm	100	
19.0mm	100	
13.2mm	99	
9.5mm	99	
6.7mm	99	
4.75mm	98	
2.36mm	96	
1.18mm	92	
600µm	87	
425µm	83	
300µm	79	
150µm	73	
75µm	68	

Chart



Comments

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Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Report No: NEWC23S-07815-1
Issue No: 1

Material Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Kerrina Christiansen
(Laboratory Manager)
NATA Accredited Laboratory Number:431
Date of Issue: 28/07/2023

Sample Details

Sample ID: NEWC23S-07815
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: EP3229 Galambine, NSW.
Sample Location: TPNW01-L
@0.20 - 0.70

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	18.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	50	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	31	
Date Tested		20/07/2023	

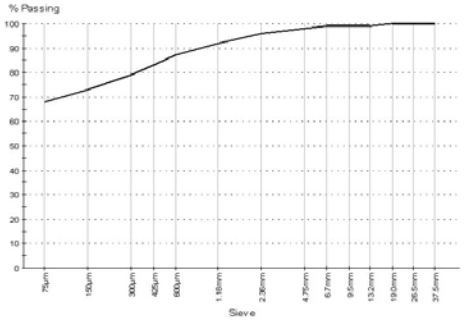
Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven
Date Tested: 19/07/2023

Note: Sample Washed

Sieve Size	% Passing	Limits
37.5mm	100	
26.5mm	100	
19.0mm	100	
13.2mm	99	
9.5mm	99	
6.7mm	99	
4.75mm	98	
2.36mm	96	
1.18mm	92	
600µm	87	
425µm	83	
300µm	79	
150µm	73	
75µm	68	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07806-1

Issue No: 2

This report replaces all previous issues of report no 'NEWC23S-07806-1'.

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Greg Eveleigh
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 24/07/2023

Sample Details

Sample ID: NEWC23S-07806
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: EP3229 Galambine, NSW.
Sample Location: TP01-L
@0.70 - 1.40

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	18.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	59	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	22	
Plasticity Index (%)	AS 1289.3.3.1	37	
Date Tested		19/07/2023	

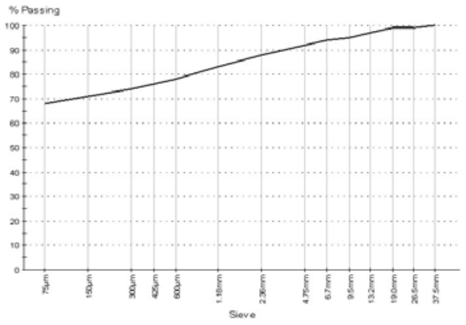
Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven
Date Tested: 20/07/2023

Note: Sample Washed

Sieve Size	% Passing	Limits
37.5mm	100	
26.5mm	99	
19.0mm	99	
13.2mm	97	
9.5mm	95	
6.7mm	94	
4.75mm	92	
2.36mm	88	
1.18mm	83	
600µm	78	
425µm	76	
300µm	74	
150µm	71	
75µm	68	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07817-1
Issue No: 1

Client:	EP Risk Management PO Box 57 Lochinvar NSW 2321
Principal:	
Project No.:	TESTNEWC01107AA
Project Name:	EP3229 CAM Engineering Galambine Magpie Lane
Lot No.:	**TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

R. Kirby Faust

Approved Signatory: Raphael Kirby Faust
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 20/07/2023

Sample Details

Sample ID:	NEWC23S-07817
Date Sampled:	10/07/2023
Source:	On-Site
Material:	Clay
Specification:	No Specification
Sampling Method:	Submitted by client*
Project Location:	
Sample Location:	TPNW02-L @0.20 - 0.60

Other Test Results

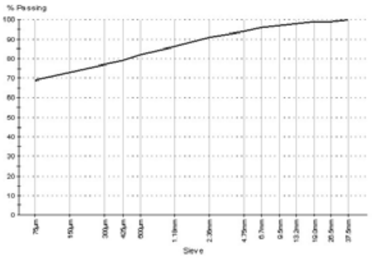
Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-Dried	
Preparation	AS 1289.1.1	Wet-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	18.0	
Mould Length (mm)		254	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	55	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	31	
Date Tested		19/07/2023	

Particle Size Distribution

Method:	AS 1289.3.6.1
Drying By:	Oven
Date Tested:	20/07/2023
Note:	Sample Washed

Sieve Size	% Passing	Limits
37.5mm	100	
26.5mm	99	
19.0mm	99	
13.2mm	98	
9.5mm	97	
6.7mm	96	
4.75mm	94	
2.36mm	91	
1.18mm	86	
600µm	82	
425µm	79	
300µm	77	
150µm	73	
75µm	69	

Chart



Comments

*Results relate only to the items tested or sampled.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304

Phone: +61 2 4016 2300

Material Test Report

Report No: NEWC23S-07809-1
Issue No: 2
This report replaces all previous issues of report no 'NEWC23S-07809-1'.

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

Accredited for compliance with ISO/IEC 17025 - Testing. NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates

Approved Signatory: Greg Eveleigh
(Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 24/07/2023

Sample Details

Sample ID: NEWC23S-07809
Date Sampled: 10/07/2023
Source: On-Site
Material: Clay
Specification: No Specification
Sampling Method: Submitted by client*
Project Location: EP3229 Galambine, NSW.
Sample Location: TP04-L
@0.30 - 0.50

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Air-Dried	
Preparation	AS 1289.1.1	Dry-Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	10.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	32	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	14	
Plasticity Index (%)	AS 1289.3.3.1	18	
Date Tested		19/07/2023	

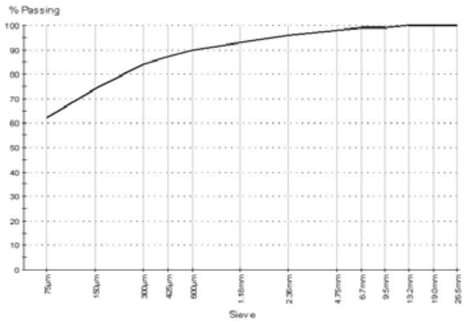
Particle Size Distribution

Method: AS 1289.3.6.1
Drying By: Oven
Date Tested: 19/07/2023

Note: Sample Washed

Sieve Size	% Passing	Limits
26.5mm	100	
19.0mm	100	
13.2mm	100	
9.5mm	99	
6.7mm	99	
4.75mm	98	
2.36mm	96	
1.18mm	93	
600µm	90	
425µm	87	
300µm	84	
150µm	74	
75µm	62	

Chart



Comments

*Results relate only to the items tested or sampled.
Issue raised to add location.

Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
16 Callistemon Close
Warabrook NSW 2304
Phone: +61 2 4016 2300

Report No: FPERM:NEWC23S-07841
Issue No:

Falling Head Permeability Test Report

Client: EP Risk Management
PO Box 57
Lochinvar NSW 2321

Principal:
Project No.: TESTNEWC01107AA
Project Name: EP3229 CAM Engineering Galambine Magpie Lane
Lot No.: **TRN:**

NATA Site Number: Newcastle Laboratory
Date of Issue:

Sample Details

Project Location:
Client Request ID:
Laboratory test Procedures: AS 1289.6.7.2
Sampling Method: Submitted by client*

Sample Data

Client Sample ID:
Date Sampled: 10/07/2023
Date Tested: 01/08/2023
Sample Location: TP02WS, @0.20 - 0.60
Material/Soil Description:

Test Conditions

Surcharge mass applied (kg)	6.0	**Target Maximum Dry Density (%)**	98
Surcharge pressure applied (kPa)	3	**Target Optimum Moisture Content (%)**	100
Material retained on 19.0mm sieve (%)		**Maximum Dry Density (t/m^3)**	1.88
Oversize material discarded	Yes	**Optimum Moisture Content (%)**	13.2
		MDD and OMC results from:	NEWC23S-07841

Test Results

Specimen Wet Density (t/m^3)	2.10	**Laboratory Density Ratio (%)**	97.8
Specimen Moisture Content (%)	13.4	**Laboratory Moisture Ratio (%)**	101.5
Specimen Dry Density (t/m^3)	1.84	**Compactive Effort**	Standard

Permeability Results

Coefficient of Permeability $k_{20°C}$ m/sec	**8×10^{-9}**
Coefficient of Permeability $k_{20°C}$ m/sec	**8×10^{-9}**

Comments:

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025 – Testing
NATA is a signatory to the ILAC Mutual Recognition Arrangement for the mutual recognition of the equivalence of testing, medical testing, calibration, inspection, proficiency testing scheme providers and reference materials producers reports and certificates.

EP Risk Management (NSW)
80 Mount Street,
North Sydney
NSW 2060

Attention:	**Ovidiu Pruteanu**
Report	**1008273-S**
Project name	GALAMBINE
Project ID	EP3229
Received Date	Jul 13, 2023

Client Sample ID			**TP01 WS**	**TP NW 02L**	**TP 07-L**	**TP 09-L**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**S23-JI0032490**	**S23-JI0032491**	**S23-JI0032492**	**S23-JI0032493**
Date Sampled			**Not Provided**[I12]	**Not Provided**[I12]	**Not Provided**[I12]	**Not Provided**[I12]
Test/Reference	LOR	Unit				
Chloride	10	mg/kg	67	< 10	280	210
Conductivity (1:5 aqueous extract at 25 °C as rec.)	10	uS/cm	74	< 10	270	200
pH (1:5 Aqueous extract at 25 °C as rec.)	0.1	pH Units	7.6	7.1	8.7	8.4
Resistivity*	0.5	ohm.m	140	1100	38	51
Sulphate (as SO4)	10	mg/kg	27	< 10	35	33
Sample Properties						
% Moisture	1	%	12	18	13	13

Sample Receipt Advice

Company name:	EP Risk Management (NSW)
Contact name:	Ovidiu Pruteanu
Project name:	GALAMBINE
Project ID:	EP3229
Turnaround time:	5 Day
Date/Time received	Jul 13, 2023 8:30 AM
Eurofins reference	1008273

Sample Information

✓	A detailed list of analytes logged into our LIMS, is included in the attached summary table.
✓	All samples have been received as described on the above COC.
✓	COC has been completed correctly.
✗	Attempt to chill was evident.
✓	Appropriately preserved sample containers have been used.
✓	All samples were received in good condition.
✗	Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.
✓	Appropriate sample containers have been used.
✓	Sample containers for volatile analysis received with zero headspace.
✗	Split sample sent to requested external lab.
✗	Some samples have been subcontracted.
N/A	Custody Seals intact (if used).

Notes

Contact

If you have any questions with respect to these samples, please contact your Analytical Services Manager:

Bonnie Pu on phone : or by email: BonniePu@eurofins.com

Results will be delivered electronically via email to Ovidiu Pruteanu - ovidiu.pruteanu@eprisk.com.au.

Note: A copy of these results will also be delivered to the general EP Risk Management (NSW) email address.

Global Leader - Results you can trust

eurofins

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

Eurofins Environment Testing Australia Pty Ltd
ABN: 50 005 085 521

Eurofins ARL Pty Ltd
ABN: 91 05 0159 898

Eurofins Environment Testing NZ Ltd
NZBN: 9429046024954

Melbourne	**Geelong**	**Sydney**	**Canberra**	**Brisbane**	**Newcastle**	**Perth**	**Auckland**	**Christchurch**
6 Monterey Road	19/8 Lewalan Street	179 Magowar Road	Unit 1,2 Dacre Street	1/21 Smallwood Place	1/2 Frost Drive	46-48 Banksia Road	35 O'Rorke Road	43 Detroit Drive
Dandenong South	Grovedale	Girraween	Mitchell	Murarrie	Mayfield West NSW 2304	Welshpool	Penrose,	Rolleston,
VIC 3175	VIC 3216	NSW 2145	ACT 2911	QLD 4172	Tel: +61 2 4968 8448	WA 6106	Auckland 1061	Christchurch 7675
Tel: +61 3 8564 5000	Tel: +61 3 8564 5000	Tel: +61 2 9900 8400	Tel: +61 2 6113 8091	Tel: +61 7 3902 4600	NATA# 1261	Tel: +61 8 6253 4444	Tel: +64 9 526 4551	Tel: +64 3 343 5201
NATA# 1261 Site# 1254	NATA# 1261 Site# 25403	NATA# 1261 Site# 18217	NATA# 1261 Site# 25466	NATA# 1261 Site# 20794	Site# 25079 & 25289	NATA# 2377 Site# 2370	IANZ# 1327	IANZ# 1290

Company Name: EP Risk Management (NSW)
Address: 80 Mount Street,
North Sydney
NSW 2060

Project Name: GALAMBINE
Project ID: EP3229

Order No.: EP3229
Report #: 1008273
Phone: 02 99225021
Fax:

Received: Jul 13, 2023 8:30 AM
Due: Jul 20, 2023
Priority: 5 Day
Contact Name: Ovidiu Pruteanu

Eurofins Analytical Services Manager : Bonnie Pu

Sample Detail						Aggressivity Soil Set	Moisture Set
Sydney Laboratory - NATA # 1261 Site # 18217						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TP01 WS	Not Provided		Soil	S23-Jl0032490	X	X
2	TP NW 02L	Not Provided		Soil	S23-Jl0032491	X	X
3	TP 07-L	Not Provided		Soil	S23-Jl0032492	X	X
4	TP 09-L	Not Provided		Soil	S23-Jl0032493	X	X
Test Counts						4	4

Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chloride	Sydney	Jul 19, 2023	28 Days
- Method: LTM-INO-4270 Anions by Ion Chromatography			
Conductivity (1:5 aqueous extract at 25 °C as rec.)	Sydney	Jul 19, 2023	7 Days
- Method: LTM-INO-4030 Conductivity			
pH (1:5 Aqueous extract at 25 °C as rec.)	Sydney	Jul 19, 2023	7 Days
- Method: LTM-GEN-7090 pH by ISE			
Sulphate (as SO4)	Sydney	Jul 19, 2023	28 Days
- Method: In-house method LTM-INO-4270 Sulphate by Ion Chromatograph			
% Moisture	Sydney	Jul 17, 2023	14 Days
- Method: LTM-GEN-7080 Moisture			

Company Name: EP Risk Management (NSW)
Address: 80 Mount Street,
North Sydney
NSW 2060

Project Name: GALAMBINE
Project ID: EP3229

Order No.: EP3229
Report #: 1008273
Phone: 02 99225021
Fax:

Received: Jul 13, 2023 8:30 AM
Due: Jul 20, 2023
Priority: 5 Day
Contact Name: Ovidiu Pruteanu

Eurofins Analytical Services Manager : Bonnie Pu

Sample Detail						Aggressivity Soil Set	Moisture Set
Sydney Laboratory - NATA # 1261 Site # 18217						X	X
External Laboratory							
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
1	TP01 WS	Not Provided		Soil	S23-Jl0032490	X	X
2	TP NW 02L	Not Provided		Soil	S23-Jl0032491	X	X
3	TP 07-L	Not Provided		Soil	S23-Jl0032492	X	X
4	TP 09-L	Not Provided		Soil	S23-Jl0032493	X	X
Test Counts						4	4

CHAIN OF CUSTODY RECORD

Eurofins | Environment Testing ABN 50 005 085 521

☐ **Sydney Laboratory**
179 Magowar Road, Girraween, NSW 2145
+61 2 9900 8400 EnviroSampleNSW@eurofins.com

☐ **Brisbane Laboratory**
Unit 1/21 Smallwood Place, Murarrie, QLD 4172
+61 7 3902 4600 EnviroSampleQLD@eurofins.com

☐ **Perth Laboratory**
46-48 Banksia Road, Welshpool, WA 6106
+61 8 6253 4444 EnviroSampleWA@eurofins.com

☐ **Melbourne Laboratory**
6 Monterey Road Dandenong South VIC 3175
+61 3 8564 5000 EnviroSampleVic@eurofins.com

Company	EP RisK
Address	19 BOLTON ST NEWCASTLE
Contact Name	OVIDIU PRUTEANU
Phone №	0497875336
Special Directions	
Purchase Order	EP 3229
Quote ID №	
Project №	EP 3229
Project Name	Galowhile
Project Manager	Ovidiu Pruteanu
EDD Format ESdat, EQuIS etc	
Sampler(s)	4
Handed over by	OP
Email for Invoice	ovidiu.pruteanu
Email for Results	@eprisk.com.au

Analyses
Where metals are requested, please specify "Total" or "Filtered". SUITE code must be used to attract SUITE pricing.

Containers
Change container type & size if necessary.

Required Turnaround Time (TAT)
Default will be 5 days if not ticked.
♦Surcharge will apply
☐ Overnight (reporting by 9am)♦
☐ Same day♦ ☐ 1 day♦
☐ 2 days♦ ☐ 3 days♦
☐ 5 days (Standard)
☐ Other( )

№	Client Sample ID	Sampled Date/Time dd/mm/yy hh:mm	Matrix Solid (S) Water (W)	Aggresivity															500mL Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL VOA vial	500mL PFAS Bottle	Jar (Glass or HDPE)	Other (Asbestos AS4964, WA Guidelines)	Sample Comments / Dangerous Goods Hazard Warning
1	TP01 WS			X																							
2	TP NW 02L			X																							
3	TP07-L			X																							
4	TP09-L			X																							
5																											
6																											
7																											
8																											
9																											
10																											
		Total Counts																									

Method of Shipment ☐ Courier (#) ☐ Hand Delivered ☐ Postal Name Signature Date Time

Laboratory Use Only	Received By	Jaidyn Slorgan	SYD | BNE | MEL | PER | ADL | [✓ NTL] | DRW	Signature		Date	13/7	Time	8:30	Temperature	19.5
	Received By		SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature		Date		Time		Report №	1008273

Eurofins Environment Testing Australia Pty Ltd EnviroSales@eurofins.com

Submission of samples to the laboratory will be deemed as acceptance of Eurofins | Environment Testing Standard Terms and Conditions unless agreed otherwise. A copy is available on request.

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**μg/L:** micrograms per litre
ppm: parts per million	**ppb:** parts per billion	**%:** Percentage
org/100 mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100 mL:** Most Probable Number of organisms per 100 millilitres
CFU: Colony forming unit		

Terms

APHA	American Public Health Association
COC	Chain of Custody
CP	Client Parent - QC was performed on samples pertaining to this report
CRM	Certified Reference Material (ISO17034) - reported as percent recovery.
Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
LOR	Limit of Reporting.
LCS	Laboratory Control Sample - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
SRA	Sample Receipt Advice
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
TBTO	Tributyltin oxide (*bis*-tributyltin oxide) - individual tributyltin compounds cannot be identified separately in the environment however free tributyltin was measured and its values were converted stoichiometrically into tributyltin oxide for comparison with regulatory limits.
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	Toxic Equivalency Quotient or Total Equivalence
QSM	US Department of Defense Quality Systems Manual Version 5.4
US EPA	United States Environmental Protection Agency
WA DWER	Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR: No Limit

Results between 10-20 times the LOR: RPD must lie between 0-50%

Results >20 times the LOR: RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% for Speciated Phenols & 50-150% for PFAS. SVOCs recoveries 20 – 150%

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
Chloride			mg/kg	< 10			10	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)			uS/cm	< 10			10	Pass	
Sulphate (as SO4)			mg/kg	< 10			10	Pass	
LCS - % Recovery									
Conductivity (1:5 aqueous extract at 25 °C as rec.)			%	94			70-130	Pass	
Resistivity*			%	94			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
				Result 1					
Chloride	S23-Jl0032491	CP	%	95			70-130	Pass	
Sulphate (as SO4)	S23-Jl0032491	CP	%	105			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Chloride	S23-Jl0032490	CP	mg/kg	67	67	<1	30%	Pass	
Conductivity (1:5 aqueous extract at 25 °C as rec.)	S23-Jl0026910	NCP	uS/cm	14	13	5.9	30%	Pass	
pH (1:5 Aqueous extract at 25 °C as rec.)	S23-Jl0025338	NCP	pH Units	7.6	7.5	<1	30%	Pass	
Resistivity*	S23-Jl0026910	NCP	ohm.m	710	760	5.9	30%	Pass	
Sulphate (as SO4)	S23-Jl0032490	CP	mg/kg	27	26	3.0	30%	Pass	
Duplicate									
Sample Properties				Result 1	Result 2	RPD			
% Moisture	S23-Jl0032490	CP	%	12	13	11	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	No
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	N/A
Some samples have been subcontracted	No

Authorised by:

Bonnie Pu	Analytical Services Manager
Dilani Samarakoon	Senior Analyst-Inorganic

Glenn Jackson
Managing Director

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Appendix F

PAVEMENT THICKNESS CALCULATIONS

```
CIRCLY  - Version 7.0 (7 November 2022)

   Layer no.  1 is INCLUDED in max. CDF calculation
   Layer no.  2 is INCLUDED in max. CDF calculation
   Layer no.  4 is INCLUDED in max. CDF calculation
Job Title: EP3229 CAM Engineering Galambine Magpie Lane

Design Method: Austroads 2017

NDT (cumulative heavy vehicle axle groups over design period): 2.00E+05

Traffic Load Distribution:

   ID: NSWPresumeUrban
   Name: NSW RMS Aug 2018 - Urban Presumptive (Table 17)
   ESA/HVAG: 1.037

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00
    2     SAST53                SAST53                Vertical Force    102.4    0.80         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1          -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1           165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1          1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1          1965.0        0.0   1.00E+00      0.00
    1         SAST53                 1             0.0        0.0   1.00E+00      0.00
    2         SAST53                 1          2130.0        0.0   1.00E+00      0.00

Details of Layered System:

   ID: Aust2017-1 Title: Austroads 2017 - Example 1 - Unbound Granular Pavement

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    AC14                   Iso.       2.20E+03   0.40
    2     rough    AC20                   Iso.       2.50E+03   0.40
    3     rough    Gran_300               Aniso.     3.00E+02   0.35      2.22E+02   1.50E+02   0.35
    4     rough    Sub_CBR6               Aniso.     6.00E+01   0.45      4.14E+01   3.00E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.   Shift
   No.             ID                                Constant   Exponent   Factor
    1     bottom   AC14                   ETH         0.004705    5.000      6.0
    2     bottom   AC20                   ETH         0.004342    5.000      6.0
    4     top      Sub_CBR6               EZZ         0.009150    7.000

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      6.00       Asphalt
    2      6.00       Asphalt
    4      1.00       Subgrade (Austroads 2017)

   Details of Layers to be sublayered:
   Layer no.  3:  Austroads (2004) sublayering

Automatic layer thickness design:
   Layer number to be designed:  2
   Minimum thickness:  0
   Maximum thickness:  5000

Strains:

   Layer  Thickness  Material               Axle      Unitless
   No.               ID                               Strain
    1       50.00    AC14
                                            SADT(80): 1.464E-05
                                            SAST(53): 5.640E-06 (Compressive)
    2       75.23    AC20
                                            SADT(80): 3.761E-04
                                            SAST(53): 3.644E-04
    4        0.00    Sub_CBR6
                                            SADT(80): 8.896E-04

Results:

   Layer  Thickness  Material               Axle      CDF
   No.               ID                     Group
    1       50.00    AC14                   Total:    3.135E-08
                                            SAST:     0.000E+00
                                            SADT:     5.017E-09
                                            TAST:     0.000E+00
                                            TADT:     1.881E-08
```

```
                                        TRDT:     7.473E-09
                                        QADT:     5.250E-11

2        75.23    AC20                  Total:    9.993E-01
                                        SAST:     4.414E-01
                                        SADT:     8.389E-02
                                        TAST:     3.358E-02
                                        TADT:     3.145E-01
                                        TRDT:     1.250E-01
                                        QADT:     8.779E-04

3       150.00    Gran_300                             n/a

4         0.00    Sub_CBR6              Total:    1.704E-02
```

```
CIRCLY  - Version 7.0 (7 November 2022)

   Layer no.  1 is INCLUDED in max. CDF calculation
   Layer no.  2 is INCLUDED in max. CDF calculation
   Layer no.  4 is INCLUDED in max. CDF calculation
Job Title: EP3229 CAM Engineering Galambine Magpie Lane

Design Method: Austroads 2017

NDT (cumulative heavy vehicle axle groups over design period): 6.00E+05

Traffic Load Distribution:

   ID: NSWPresumeUrban
   Name: NSW RMS Aug 2018 - Urban Presumptive (Table 17)
   ESA/HVAG: 1.037

Details of Load Groups:

   Load   Load                  Load                  Load            Radius    Pressure/    Exponent
   No.    ID                    Category              Type                      Ref. stress
    1     ESA750-Full           ESA750-Full           Vertical Force     92.1    0.75         0.00
    2     SAST53                SAST53                Vertical Force    102.4    0.80         0.00

   Load Locations:
   Location   Load                  Gear          X          Y      Scaling     Theta
   No.        ID                    No.                             Factor
    1         ESA750-Full            1         -165.0        0.0   1.00E+00      0.00
    2         ESA750-Full            1          165.0        0.0   1.00E+00      0.00
    3         ESA750-Full            1         1635.0        0.0   1.00E+00      0.00
    4         ESA750-Full            1         1965.0        0.0   1.00E+00      0.00
    1         SAST53                 1            0.0        0.0   1.00E+00      0.00
    2         SAST53                 1         2130.0        0.0   1.00E+00      0.00

Details of Layered System:

   ID: Aust2017-1 Title: Austroads 2017 - Example 1 - Unbound Granular Pavement

   Layer  Lower    Material               Isotropy   Modulus    P.Ratio
   No.    i/face   ID                                (or Ev)    (or vvh)  F          Eh         vh
    1     rough    AC14                   Iso.       2.20E+03   0.40
    2     rough    AC20                   Iso.       2.50E+03   0.40
    3     rough    Gran_300               Aniso.     3.00E+02   0.35      2.22E+02   1.50E+02   0.35
    4     rough    Sub_CBR6               Aniso.     6.00E+01   0.45      4.14E+01   3.00E+01   0.45

   Performance Relationships:
   Layer  Location Material               Component  Perform.   Perform.   Shift
   No.             ID                                Constant   Exponent   Factor
    1     bottom   AC14                   ETH         0.004705    5.000      6.0
    2     bottom   AC20                   ETH         0.004342    5.000      6.0
    4     top      Sub_CBR6               EZZ         0.009150    7.000

   Reliability Factors:
   Project Reliability: Austroads 95%
   Layer  Reliability  Material
    No.   Factor       Type
    1      6.00       Asphalt
    2      6.00       Asphalt
    4      1.00       Subgrade (Austroads 2017)

   Details of Layers to be sublayered:
   Layer no.  3:  Austroads (2004) sublayering

Automatic layer thickness design:
   Layer number to be designed:  2
   Minimum thickness:  0
   Maximum thickness:  5000

Strains:

   Layer  Thickness  Material               Axle      Unitless
   No.               ID                               Strain
    1       50.00    AC14
                                            SADT(80): 1.217E-05 (Compressive)
                                            SAST(53): 2.574E-05 (Compressive)
    2       94.45    AC20
                                            SADT(80): 3.065E-04
                                            SAST(53): 2.864E-04
    4        0.00    Sub_CBR6
                                            SADT(80): 7.541E-04

Results:

   Layer  Thickness  Material               Axle      CDF
   No.               ID                     Group
    1       50.00    AC14                             Compressive

    2       94.45    AC20                   Total:    9.929E-01
                                            SAST:     3.973E-01
                                            SADT:     9.048E-02
```

```
                                                  TAST:     3.022E-02
                                                  TADT:     3.392E-01
                                                  TRDT:     1.348E-01
                                                  QADT:     9.469E-04

3      150.00    Gran_300                                        n/a

4        0.00    Sub_CBR6                         Total:    1.607E-02
```

CONCRETE PAVEMENT DESIGN SHEET

Client:	CAM Engineering
Project Number:	EP3229
Project Name:	Magpie Lane Galambine
Road Section:	Concrete Roundabout
Location:	Galambine

Design Parameters	
Project design reliability	95%
Design period	40 years
Design Traffic (NDT)	2.00E+05
Traffic Load Distribution	AGPT02-12 (eg TLD)
Design subgrade	6.0%
Effective CBR	40%
Load safety factor (LSF)	1.50
Design Requirements	
Subbase	150mm bound
Concrete base type	Steel fibre reinforced concrete pavement
Transvers contraction joints	Undowelled joints
Shoulder support	Without shoulder support
Design flexural strength	5.5MPa (28-day)

Concrete Basecourse Thickness Design	
Minimum Base Thickness	**191mm SFCP**
Minimum flexural strength	5.5MPa (28-day)
Total percentage fatigue	97 %
Total percentage erosion	17 %

Calculated by:	O.P
Checked by:	J.Y
Date:	18/08/2023

CONCRETE PAVEMENT DESIGN SHEET

Client:	CAM Engineering
Project Number:	EP3229
Project Name:	Magpie Lane Galambine
Road Section:	Concrete Roundabout
Location:	Galambine

Design Parameters	
Project design reliability	95%
Design period	40 years
Design Traffic (NDT)	6.00E+05
Traffic Load Distribution	AGPT02-12 (eg TLD)
Design subgrade	6.0%
Effective CBR	40%
Load safety factor (LSF)	1.50
Design Requirements	
Subbase	150mm bound
Concrete base type	Steel fibre reinforced concrete pavement
Transvers contraction joints	Undowelled joints
Shoulder support	Without shoulder support
Design flexural strength	5.5MPa (28-day)

Concrete Basecourse Thickness Design	
Minimum Base Thickness	**197mm SFCP**
Minimum flexural strength	5.5MPa (28-day)
Total percentage fatigue	99 %
Total percentage erosion	41 %

Calculated by:	O.P
Checked by:	J.Y
Date:	18/08/2023

Appendix G

FOUNDATION MAINTENANCE AND FOOTING PERFORMANCE

Foundation Maintenance and Footing Performance:

A Homeowner's Guide

CSIRO

BTF 18
replaces
Information
Sheet 10/91

Buildings can and often do move. This movement can be up, down, lateral or rotational. The fundamental cause of movement in buildings can usually be related to one or more problems in the foundation soil. It is important for the homeowner to identify the soil type in order to ascertain the measures that should be put in place in order to ensure that problems in the foundation soil can be prevented, thus protecting against building movement.

This Building Technology File is designed to identify causes of soil-related building movement, and to suggest methods of prevention of resultant cracking in buildings.

Soil Types

The types of soils usually present under the topsoil in land zoned for residential buildings can be split into two approximate groups – granular and clay. Quite often, foundation soil is a mixture of both types. The general problems associated with soils having granular content are usually caused by erosion. Clay soils are subject to saturation and swell/shrink problems.

Classifications for a given area can generally be obtained by application to the local authority, but these are sometimes unreliable and if there is doubt, a geotechnical report should be commissioned. As most buildings suffering movement problems are founded on clay soils, there is an emphasis on classification of soils according to the amount of swell and shrinkage they experience with variations of water content. The table below is Table 2.1 from AS 2870, the Residential Slab and Footing Code.

Causes of Movement

Settlement due to construction

There are two types of settlement that occur as a result of construction:

- Immediate settlement occurs when a building is first placed on its foundation soil, as a result of compaction of the soil under the weight of the structure. The cohesive quality of clay soil mitigates against this, but granular (particularly sandy) soil is susceptible.
- Consolidation settlement is a feature of clay soil and may take place because of the expulsion of moisture from the soil or because of the soil's lack of resistance to local compressive or shear stresses. This will usually take place during the first few months after construction, but has been known to take many years in exceptional cases.

These problems are the province of the builder and should be taken into consideration as part of the preparation of the site for construction. Building Technology File 19 (BTF 19) deals with these problems.

Erosion

All soils are prone to erosion, but sandy soil is particularly susceptible to being washed away. Even clay with a sand component of say 10% or more can suffer from erosion.

Saturation

This is particularly a problem in clay soils. Saturation creates a bog-like suspension of the soil that causes it to lose virtually all of its bearing capacity. To a lesser degree, sand is affected by saturation because saturated sand may undergo a reduction in volume – particularly imported sand fill for bedding and blinding layers. However, this usually occurs as immediate settlement and should normally be the province of the builder.

Seasonal swelling and shrinkage of soil

All clays react to the presence of water by slowly absorbing it, making the soil increase in volume (see table below). The degree of increase varies considerably between different clays, as does the degree of decrease during the subsequent drying out caused by fair weather periods. Because of the low absorption and expulsion rate, this phenomenon will not usually be noticeable unless there are prolonged rainy or dry periods, usually of weeks or months, depending on the land and soil characteristics.

The swelling of soil creates an upward force on the footings of the building, and shrinkage creates subsidence that takes away the support needed by the footing to retain equilibrium.

Shear failure

This phenomenon occurs when the foundation soil does not have sufficient strength to support the weight of the footing. There are two major post-construction causes:

- Significant load increase.
- Reduction of lateral support of the soil under the footing due to erosion or excavation.
- In clay soil, shear failure can be caused by saturation of the soil adjacent to or under the footing.

GENERAL DEFINITIONS OF SITE CLASSES

Class	Foundation
A	Most sand and rock sites with little or no ground movement from moisture changes
S	Slightly reactive clay sites with only slight ground movement from moisture changes
M	Moderately reactive clay or silt sites, which can experience moderate ground movement from moisture changes
H	Highly reactive clay sites, which can experience high ground movement from moisture changes
E	Extremely reactive sites, which can experience extreme ground movement from moisture changes
A to P	Filled sites
P	Sites which include soft soils, such as soft clay or silt or loose sands; landslip; mine subsidence; collapsing soils; soils subject to erosion; reactive sites subject to abnormal moisture conditions or sites which cannot be classified otherwise

Tree root growth
Trees and shrubs that are allowed to grow in the vicinity of footings can cause foundation soil movement in two ways:

- Roots that grow under footings may increase in cross-sectional size, exerting upward pressure on footings.
- Roots in the vicinity of footings will absorb much of the moisture in the foundation soil, causing shrinkage or subsidence.

Unevenness of Movement

The types of ground movement described above usually occur unevenly throughout the building's foundation soil. Settlement due to construction tends to be uneven because of:

- Differing compaction of foundation soil prior to construction.
- Differing moisture content of foundation soil prior to construction.

Movement due to non-construction causes is usually more uneven still. Erosion can undermine a footing that traverses the flow or can create the conditions for shear failure by eroding soil adjacent to a footing that runs in the same direction as the flow.

Saturation of clay foundation soil may occur where subfloor walls create a dam that makes water pond. It can also occur wherever there is a source of water near footings in clay soil. This leads to a severe reduction in the strength of the soil which may create local shear failure.

Seasonal swelling and shrinkage of clay soil affects the perimeter of the building first, then gradually spreads to the interior. The swelling process will usually begin at the uphill extreme of the building, or on the weather side where the land is flat. Swelling gradually reaches the interior soil as absorption continues. Shrinkage usually begins where the sun's heat is greatest.

Effects of Uneven Soil Movement on Structures

Erosion and saturation
Erosion removes the support from under footings, tending to create subsidence of the part of the structure under which it occurs. Brickwork walls will resist the stress created by this removal of support by bridging the gap or cantilevering until the bricks or the mortar bedding fail. Older masonry has little resistance. Evidence of failure varies according to circumstances and symptoms may include:

- Step cracking in the mortar beds in the body of the wall or above/below openings such as doors or windows.
- Vertical cracking in the bricks (usually but not necessarily in line with the vertical beds or perpends).

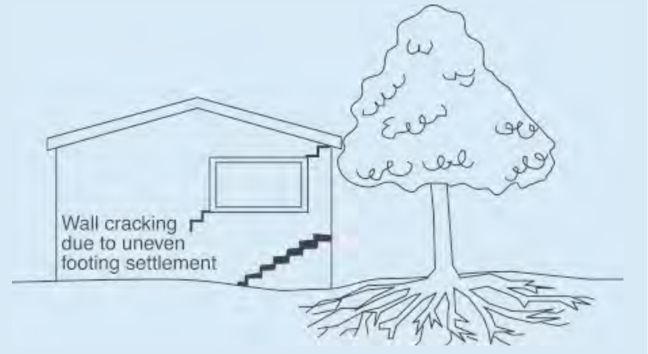
Isolated piers affected by erosion or saturation of foundations will eventually lose contact with the bearers they support and may tilt or fall over. The floors that have lost this support will become bouncy, sometimes rattling ornaments etc.

Seasonal swelling/shrinkage in clay
Swelling foundation soil due to rainy periods first lifts the most exposed extremities of the footing system, then the remainder of the perimeter footings while gradually permeating inside the building footprint to lift internal footings. This swelling first tends to create a dish effect, because the external footings are pushed higher than the internal ones.

The first noticeable symptom may be that the floor appears slightly dished. This is often accompanied by some doors binding on the floor or the door head, together with some cracking of cornice mitres. In buildings with timber flooring supported by bearers and joists, the floor can be bouncy. Externally there may be visible dishing of the hip or ridge lines.

As the moisture absorption process completes its journey to the innermost areas of the building, the internal footings will rise. If the spread of moisture is roughly even, it may be that the symptoms will temporarily disappear, but it is more likely that swelling will be uneven, creating a difference rather than a disappearance in symptoms. In buildings with timber flooring supported by bearers and joists, the isolated piers will rise more easily than the strip footings or piers under walls, creating noticeable doming of flooring.

Trees can cause shrinkage and damage



As the weather pattern changes and the soil begins to dry out, the external footings will be first affected, beginning with the locations where the sun's effect is strongest. This has the effect of lowering the external footings. The doming is accentuated and cracking reduces or disappears where it occurred because of dishing, but other cracks open up. The roof lines may become convex.

Doming and dishing are also affected by weather in other ways. In areas where warm, wet summers and cooler dry winters prevail, water migration tends to be toward the interior and doming will be accentuated, whereas where summers are dry and winters are cold and wet, migration tends to be toward the exterior and the underlying propensity is toward dishing.

Movement caused by tree roots
In general, growing roots will exert an upward pressure on footings, whereas soil subject to drying because of tree or shrub roots will tend to remove support from under footings by inducing shrinkage.

Complications caused by the structure itself
Most forces that the soil causes to be exerted on structures are vertical – i.e. either up or down. However, because these forces are seldom spread evenly around the footings, and because the building resists uneven movement because of its rigidity, forces are exerted from one part of the building to another. The net result of all these forces is usually rotational. This resultant force often complicates the diagnosis because the visible symptoms do not simply reflect the original cause. A common symptom is binding of doors on the vertical member of the frame.

Effects on full masonry structures
Brickwork will resist cracking where it can. It will attempt to span areas that lose support because of subsided foundations or raised points. It is therefore usual to see cracking at weak points, such as openings for windows or doors.

In the event of construction settlement, cracking will usually remain unchanged after the process of settlement has ceased.

With local shear or erosion, cracking will usually continue to develop until the original cause has been remedied, or until the subsidence has completely neutralised the affected portion of footing and the structure has stabilised on other footings that remain effective.

In the case of swell/shrink effects, the brickwork will in some cases return to its original position after completion of a cycle, however it is more likely that the rotational effect will not be exactly reversed, and it is also usual that brickwork will settle in its new position and will resist the forces trying to return it to its original position. This means that in a case where swelling takes place after construction and cracking occurs, the cracking is likely to at least partly remain after the shrink segment of the cycle is complete. Thus, each time the cycle is repeated, the likelihood is that the cracking will become wider until the sections of brickwork become virtually independent.

With repeated cycles, once the cracking is established, if there is no other complication, it is normal for the incidence of cracking to stabilise, as the building has the articulation it needs to cope with the problem. This is by no means always the case, however, and monitoring of cracks in walls and floors should always be treated seriously.

Upheaval caused by growth of tree roots under footings is not a simple vertical shear stress. There is a tendency for the root to also exert lateral forces that attempt to separate sections of brickwork after initial cracking has occurred.

The normal structural arrangement is that the inner leaf of brickwork in the external walls and at least some of the internal walls (depending on the roof type) comprise the load-bearing structure on which any upper floors, ceilings and the roof are supported. In these cases, it is internally visible cracking that should be the main focus of attention, however there are a few examples of dwellings whose external leaf of masonry plays some supporting role, so this should be checked if there is any doubt. In any case, externally visible cracking is important as a guide to stresses on the structure generally, and it should also be remembered that the external walls must be capable of supporting themselves.

Effects on framed structures
Timber or steel framed buildings are less likely to exhibit cracking due to swell/shrink than masonry buildings because of their flexibility. Also, the doming/dishing effects tend to be lower because of the lighter weight of walls. The main risks to framed buildings are encountered because of the isolated pier footings used under walls. Where erosion or saturation cause a footing to fall away, this can double the span which a wall must bridge. This additional stress can create cracking in wall linings, particularly where there is a weak point in the structure caused by a door or window opening. It is, however, unlikely that framed structures will be so stressed as to suffer serious damage without first exhibiting some or all of the above symptoms for a considerable period. The same warning period should apply in the case of upheaval. It should be noted, however, that where framed buildings are supported by strip footings there is only one leaf of brickwork and therefore the externally visible walls are the supporting structure for the building. In this case, the subfloor masonry walls can be expected to behave as full brickwork walls.

Effects on brick veneer structures
Because the load-bearing structure of a brick veneer building is the frame that makes up the interior leaf of the external walls plus perhaps the internal walls, depending on the type of roof, the building can be expected to behave as a framed structure, except that the external masonry will behave in a similar way to the external leaf of a full masonry structure.

Water Service and Drainage

Where a water service pipe, a sewer or stormwater drainage pipe is in the vicinity of a building, a water leak can cause erosion, swelling or saturation of susceptible soil. Even a minuscule leak can be enough to saturate a clay foundation. A leaking tap near a building can have the same effect. In addition, trenches containing pipes can become watercourses even though backfilled, particularly where broken rubble is used as fill. Water that runs along these trenches can be responsible for serious erosion, interstrata seepage into subfloor areas and saturation.

Pipe leakage and trench water flows also encourage tree and shrub roots to the source of water, complicating and exacerbating the problem.
Poor roof plumbing can result in large volumes of rainwater being concentrated in a small area of soil:

- Incorrect falls in roof guttering may result in overflows, as may gutters blocked with leaves etc.
- Corroded guttering or downpipes can spill water to ground.
- Downpipes not positively connected to a proper stormwater collection system will direct a concentration of water to soil that is directly adjacent to footings, sometimes causing large-scale problems such as erosion, saturation and migration of water under the building.

Seriousness of Cracking

In general, most cracking found in masonry walls is a cosmetic nuisance only and can be kept in repair or even ignored. The table below is a reproduction of Table C1 of AS 2870.

AS 2870 also publishes figures relating to cracking in concrete floors, however because wall cracking will usually reach the critical point significantly earlier than cracking in slabs, this table is not reproduced here.

Prevention/Cure

Plumbing
Where building movement is caused by water service, roof plumbing, sewer or stormwater failure, the remedy is to repair the problem. It is prudent, however, to consider also rerouting pipes away from the building where possible, and relocating taps to positions where any leakage will not direct water to the building vicinity. Even where gully traps are present, there is sometimes sufficient spill to create erosion or saturation, particularly in modern installations using smaller diameter PVC fixtures. Indeed, some gully traps are not situated directly under the taps that are installed to charge them, with the result that water from the tap may enter the backfilled trench that houses the sewer piping. If the trench has been poorly backfilled, the water will either pond or flow along the bottom of the trench. As these trenches usually run alongside the footings and can be at a similar depth, it is not hard to see how any water that is thus directed into a trench can easily affect the foundation's ability to support footings or even gain entry to the subfloor area.

Ground drainage
In all soils there is the capacity for water to travel on the surface and below it. Surface water flows can be established by inspection during and after heavy or prolonged rain. If necessary, a grated drain system connected to the stormwater collection system is usually an easy solution.

It is, however, sometimes necessary when attempting to prevent water migration that testing be carried out to establish watertable height and subsoil water flows. This subject is referred to in BTF 19 and may properly be regarded as an area for an expert consultant.

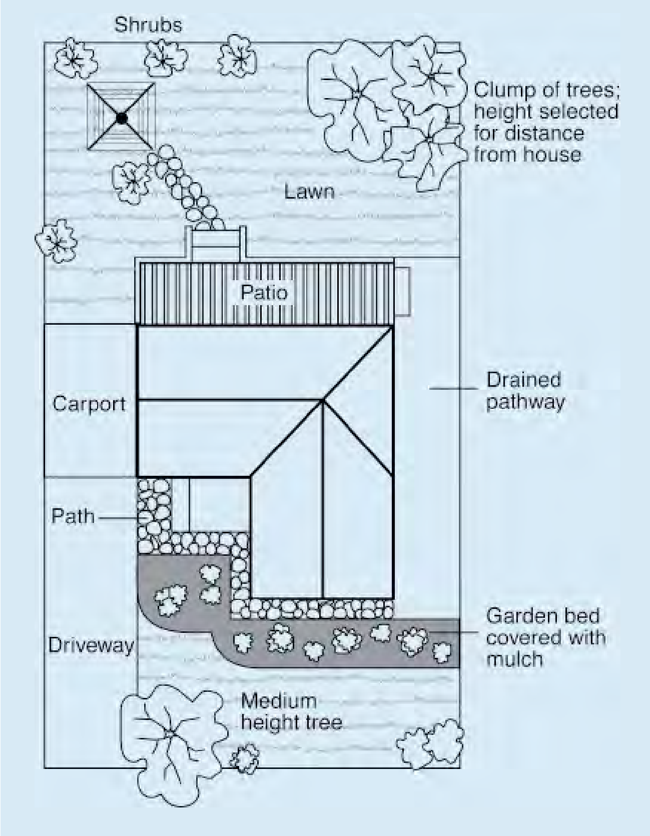
Protection of the building perimeter
It is essential to remember that the soil that affects footings extends well beyond the actual building line. Watering of garden plants, shrubs and trees causes some of the most serious water problems.

For this reason, particularly where problems exist or are likely to occur, it is recommended that an apron of paving be installed around as much of the building perimeter as necessary. This paving

CLASSIFICATION OF DAMAGE WITH REFERENCE TO WALLS

Description of typical damage and required repair	Approximate crack width limit (see Note 3)	Damage category
Hairline cracks	<0.1 mm	0
Fine cracks which do not need repair	<1 mm	1
Cracks noticeable but easily filled. Doors and windows stick slightly	<5 mm	2
Cracks can be repaired and possibly a small amount of wall will need to be replaced. Doors and windows stick. Service pipes can fracture. Weathertightness often impaired	5–15 mm (or a number of cracks 3 mm or more in one group)	3
Extensive repair work involving breaking-out and replacing sections of walls, especially over doors and windows. Window and door frames distort. Walls lean or bulge noticeably, some loss of bearing in beams. Service pipes disrupted	15–25 mm but also depend on number of cracks	4

Gardens for a reactive site



should extend outwards a minimum of 900 mm (more in highly reactive soil) and should have a minimum fall away from the building of 1:60. The finished paving should be no less than 100 mm below brick vent bases.

It is prudent to relocate drainage pipes away from this paving, if possible, to avoid complications from future leakage. If this is not practical, earthenware pipes should be replaced by PVC and backfilling should be of the same soil type as the surrounding soil and compacted to the same density.

Except in areas where freezing of water is an issue, it is wise to remove taps in the building area and relocate them well away from the building – preferably not uphill from it (see BTF 19).

It may be desirable to install a grated drain at the outside edge of the paving on the uphill side of the building. If subsoil drainage is needed this can be installed under the surface drain.

Condensation

In buildings with a subfloor void such as where bearers and joists support flooring, insufficient ventilation creates ideal conditions for condensation, particularly where there is little clearance between the floor and the ground. Condensation adds to the moisture already present in the subfloor and significantly slows the process of drying out. Installation of an adequate subfloor ventilation system, either natural or mechanical, is desirable.

Warning: Although this Building Technology File deals with cracking in buildings, it should be said that subfloor moisture can result in the development of other problems, notably:

- Water that is transmitted into masonry, metal or timber building elements causes damage and/or decay to those elements.
- High subfloor humidity and moisture content create an ideal environment for various pests, including termites and spiders.
- Where high moisture levels are transmitted to the flooring and walls, an increase in the dust mite count can ensue within the living areas. Dust mites, as well as dampness in general, can be a health hazard to inhabitants, particularly those who are abnormally susceptible to respiratory ailments.

The garden

The ideal vegetation layout is to have lawn or plants that require only light watering immediately adjacent to the drainage or paving edge, then more demanding plants, shrubs and trees spread out in that order.

Overwatering due to misuse of automatic watering systems is a common cause of saturation and water migration under footings. If it is necessary to use these systems, it is important to remove garden beds to a completely safe distance from buildings.

Existing trees

Where a tree is causing a problem of soil drying or there is the existence or threat of upheaval of footings, if the offending roots are subsidiary and their removal will not significantly damage the tree, they should be severed and a concrete or metal barrier placed vertically in the soil to prevent future root growth in the direction of the building. If it is not possible to remove the relevant roots without damage to the tree, an application to remove the tree should be made to the local authority. A prudent plan is to transplant likely offenders before they become a problem.

Information on trees, plants and shrubs

State departments overseeing agriculture can give information regarding root patterns, volume of water needed and safe distance from buildings of most species. Botanic gardens are also sources of information. For information on plant roots and drains, see Building Technology File 17.

Excavation

Excavation around footings must be properly engineered. Soil supporting footings can only be safely excavated at an angle that allows the soil under the footing to remain stable. This angle is called the angle of repose (or friction) and varies significantly between soil types and conditions. Removal of soil within the angle of repose will cause subsidence.

Remediation

Where erosion has occurred that has washed away soil adjacent to footings, soil of the same classification should be introduced and compacted to the same density. Where footings have been undermined, augmentation or other specialist work may be required. Remediation of footings and foundations is generally the realm of a specialist consultant.

Where isolated footings rise and fall because of swell/shrink effect, the homeowner may be tempted to alleviate floor bounce by filling the gap that has appeared between the bearer and the pier with blocking. The danger here is that when the next swell segment of the cycle occurs, the extra blocking will push the floor up into an accentuated dome and may also cause local shear failure in the soil. If it is necessary to use blocking, it should be by a pair of fine wedges and monitoring should be carried out fortnightly.

This BTF was prepared by John Lewer FAIB, MIAMA, Partner, Construction Diagnosis.

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Freecall 1800 645 051 Tel (03) 9662 7666 Fax (03) 9662 7555 www.publish.csiro.au
Email: publishing.sales@csiro.au