PRELIMINARY
GEOTECHNICAL ASSESSMENT REPORT

1455 & 1475 BURRAGORANG ROAD & 1838 BARKERS LODGE ROAD
OAKDALE NSW

PREPARED FOR
COLLIERS INTERNATIONAL ENGINEERING & DESIGN
REPORT ID: E23010OAK-R02F (REV 1)

Date: 3rd March 2024
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Client:
Colliers International Engineering & Design
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1 PROJECT INFORMATION

1.1 INTRODUCTION AND OBJECTIVES

Geo-Environmental Engineering Pty Ltd (GEE), was commissioned by Colliers International Engineering & Design (CED) to complete a geotechnical assessment of 1455 & 1475 St Burragorang Road & 1838 Barkers Lodge Road, Oakdale NSW 2570 (herein referred to as the 'site' – **Figure 1**). The site covers an area of approximately 22.7 hectares and is legally described as Lot 6, Lot 2 and Lot 1 of DP 734561.

A plan showing the extent of each of the above allotments and addresses is shown on **Figure 2** along with a recent aerial photograph taken in August 2022.

The assessment was requested to support a rezoning and subdivision submission to Wollondilly Shire Council which would enable urban development for new homes, while also protecting the existing forest. No development is proposed under the planning submission.

The report presents factual information about the site based on a review of readily available information and a site inspection. This preliminary assessment is in lieu of a thorough geotechnical investigation to be undertaken to support a future development.

1.2 PROPOSED DEVELOPMENT

As mentioned above, no specific development is currently proposed. However, this report was prepared to support a rezoning and subdivision submission to Wollondilly Shire Council which would enable urban development for new homes, while also protecting the existing forest. A plan of potential rezoning and future development is provided in **Appendix A**.

In summary the proposal would result in 208 low-density residential lots, 3 super lots for Environmental Conservation & Environmental Management purposes and 1 lot containing the Stormwater basin.

1.3 PREVIOUS INVESTIGATIONS

GEE is not aware of a geotechnical investigation having been completed at the site.

1.4 SCOPE OF WORK

The scope of work undertaken by GEE to satisfy the above objective was as follows:

◊ A review of regional geological and soil maps,

◊ Site Inspection, and

◊ Engineering assessment and reporting.

As previously, mentioned, this assessment was considered sufficient to be confident about the expected ground conditions and to provide Council with assurances about the geotechnical feasibility of the proposed development. Notwithstanding this, GEE notes that a thorough geotechnical investigation will be required to be undertaken to support any future development.

2 SITE INFORMATION

2.1 SITE DESCRIPTION

As previously mentioned, the site is currently an amalgamation of three predominantly vacant, semi-rural properties / allotments. Each of the lots contains a dwelling and various outbuilding and a more detailed description each of these properties/allotments is provided in the following sub-sections.

2.1.1 1838 BARKERS LODGE ROAD (LOT 6 DP734561)

This parcel of land is at the southern end of the site and occupied by a one- and two-level fibro clad dwelling with a metal roof that is located approximately midway along the southern boundary. There was also detached metal garage/shed with a concrete floor just to the east of the dwelling, and both the dwelling and garage/shed were within a fenced compound. Between the two structures were several vehicles of which some appeared to be derelict. Access inside the fenced compound was not possible at the request of the tenant and because of a guard dog.

Immediately to the east and south-east of this compound were some metal shipping containers, a timber framed and metal clad animal shelter and some more derelict plant and equipment, including a large excavator. In the centre and western end of the property were two farm dams which appeared to have been constructed through local cut and fill earthworks. This is supported by our observations of the exposed banks which revealed a mixture clay and shale, which is local to this part of Sydney, and no visible foreign matter.

Elsewhere, most of the property is predominately covered by grass with some sporadic trees and appeared to be used for horse agistment. The exception was in the north-eastern corner of the property, and immediately east of Willis Park, where there is a Shale Sandstone Transition Forest and other vegetation.

During our site walkover inspection there was no evidence of significant earthworks. However, there was an area of disturbed ground and a separate stockpile of soil centrally on the site. The stockpile contained anthropogenic inclusions such as concrete and fragments of fibrous cement sheeting suspected of containing asbestos. There was also Elsewhere there was some sporadic waste debris observed within the forest area.

A site plan showing the existing site features is provided as **Figure 3**, while photographs taken by GEE on the 30th May 2023 are provided for reference as Plates 1 to 14 below.

Plate 1: View towards the south showing the dwelling and garage/shed on Lot 6.

Plate 2: Some of the derelict vehicles to the east of the garage/shed. The timber framed and metal clad animal shelter is in the background.

Plate 3: View to the north showing some of the metal shipping containers on Lot 6.

Plate 4: View to the east showing entrance to Lot 6.

Plate 5: View to the west showing the stockpile on Lot 6 containing potential ACM.

Plate 6: Example of potential ACM on the stockpile on Lot 6.

Plate 7: Timber frames and metal clad shelter along the southern boundary of Lot 6.

Plate 8: Farm dam at the eastern end of Lot 6.

Plate 9: Farm dam in the centre of Lot 6.

Plate 10: View to the south along the eastern property boundary. Forest is to the right.

Plate 11: Example of car Tyres and plastic within the forest.

Plate 12: Example of car Tyres within the forest.

Plate 13: View south within the Forest.

Plate 14: View to the west across the western part of Lot 6.

2.1.2 1455 Burragorang Road (Lot 2 DP734561)

This parcel of land is in the north-eastern corner of the site and development on the site includes a one storey, brick dwelling with a tiled roof which is located at the end of a gravel driveway, approximately midway along the eastern boundary. There is also a detached metal garage/shed with a concrete floor located centrally to the property. Internal access to the was not possible during our site inspection but the owner advised that it was used for general storage and household items and gardening tools.

In the north-western corner of this allotment was a farm dam which appeared to have been constructed through local cut and fill earthworks. This is supported by our observations of the exposed banks which revealed a mixture clay and shale, which is local to this part of Sydney, and no visible foreign matter. Elsewhere, most of the property is predominately covered by grass with some sporadic trees.

During our site walkover inspection there was no evidence of significant earthworks and no visible presence of Asbestos Containing Materials (ACM) on the surface of the site.

A site plan showing the existing site features is provided as **Figure 4**, while photographs taken by GEE on the 30th May 2023 are provided for reference as Plates 15 to 20 below.

Plate 15: View towards the south from the front, north-western corner of Lot 2.

Plate 16: View to the north showing the farm dam on Lot 2.

Plate 17: View to the south-east showing the dwelling on Lot 2.

Plate 18: View to the south-west showing the metal clad garage/shed on Lot 2.

Plate 19: View to the north between the garage/shed and the dwelling on Lot 2.

Plate 20: View to the north from the southern boundary of Lot 2

2.1.3 1475 Burragorang Road (Lot 1 DP734561)

This parcel of land is in the north-western corner of the site and development on the site includes a one storey, brick dwelling with a tiled roof which is located centrally to the property. There is also a detached metal garage/shed with a concrete floor located to the east of the dwelling. Internal access to the shed was not possible during our site inspection, however, the Lessor did advise that it was used for general storage of garden and plumbing tools associated with their plumbing business.

Surrounding the garage/shed was some piles of plumbing equipment, some old water heaters and other general waste debris. There was also a metal skip bin containing scrap metal. Amongst a cluster of trees in the south-eastern part of the property were two concrete water tanks and a metal clad, and timber framed, animal shelter. Adjacent to these trees and at the rear of the property were several piles of timber fence palings with one pile having been burnt, leaving some timber remnants and ash.

Elsewhere, most of the property was predominately covered by grass with some sporadic trees. Importantly there was no evidence of significant earthworks and no visible presence of ACM on the surface of the site.

A site plan showing the existing site features is provided as **Figure 4**, while photographs taken by GEE on the 30th May 2023 are provided for reference as Plates 21 to 32 below.

Plate 21: View towards the north-west showing the rear of the dwelling and the detached garage/shed.

Plate 22: View to the west along the northern side of the garage/shed on Lot 1.

Plate 23: View to the south showing the garage/shed and scattered debris on Lot 1.

Plate 24: Example of scattered debris adjacent to the garage/shed on Lot 1.

Plate 25: Example of scattered debris adjacent to the garage/shed on Lot 1.

Plate 26: Timber framed and metal clad animal shelter amongst the trees on Lot 1.

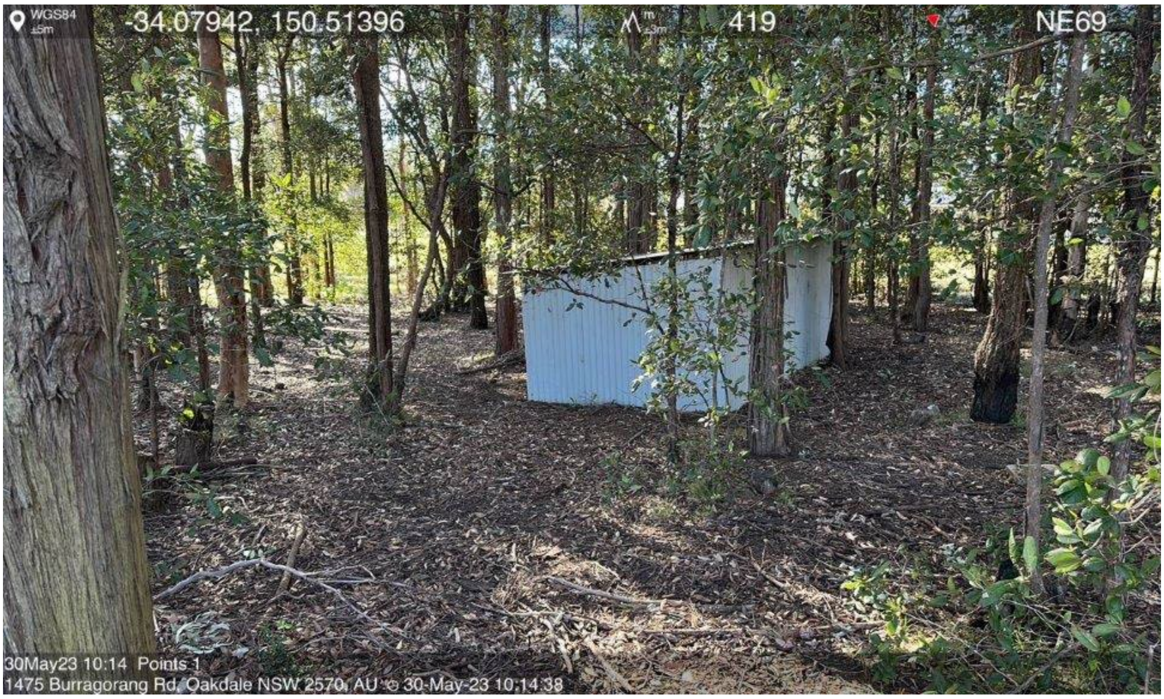

Plate 27: Timber framed and metal clad animal shelter amongst the trees on Lot 1.

Plate 28: Concrete water tanks amongst the trees on Lot 1.

Plate 29: Scattered piles of timber fence palings at the rear of Lot 1.

Plate 30: Burnt pile of timber at the rear of Lot 1.

Plate 31: View to the west along the rear of Lot 1.

Plate 32: View to the north from the southern boundary of Lot 1.

2.2 TOPOGRAPHY

Lots 1 & 2 gently fall towards Burragorang Road, while Lot 6 falls gently from Barkers Lodge Road to the east and drains to Back Creek via a first-order stream located centrally over the lot. According to the regional topographical map (reference 1) which provides contours at 10m intervals, the surface elevation is between 430m and 410m above Australian Height Datum (AHD).

2.3 GEOLOGY AND SOILS

2.3.1 REGIONAL

A review of the regional 1:100,000 geological map (reference 2) indicates that the northern and south-western portions of the site are underlain by the Late Triassic aged Bringelly Shale formation of the Wianamatta Group which typically consists of shale, carbonaceous claystone, laminite and coal in parts. The remainder (and majority) of the site is underlain by the Hawkesbury Sandstone Formation which typically comprises "*…Medium to coarse-grained quartz sandstone, very minor shale and laminite lenses*".

A review of the regional soils map (reference 3) indicates that the site is underlain by the Blacktown Soil Landscape Group (9029bt). This soil group is associated with gently undulating rises on the underlying shale formation. Local reliefs are up to 30m and slopes are usually less than 5% in gradient. Soils of the Blacktown Group typically comprise heavy clays that have been derived from the weathering process of shale bedrock, have low fertility and are often strongly acidic.

2.3.2 LOCAL

Based on the geological and soil mapping information, GEE predicts that the subsurface conditions across the site will comprise surface topsoil over natural silty clay and sandy clay soil which will then transitioned into weathered sandstone or shale bedrock. The depth to bedrock is inferred to be between approximately 1.0m and 3.0m.

2.4 GROUNDWATER / HYDROGEOLOGY

Based on local knowledge and the regional geological information, it is expected that the groundwater in the vicinity of the site is likely to be confined, or partly confined, within discrete water-bearing zones within the bedrock formation. However, intermittent 'perched' water seepage is possible at the soil-bedrock interface following heavy and prolonged rainfall events.

An online search of registered groundwater bores within proximity to the site was completed revealed that there are 2 registered bores within 500m of the site. The closest bore is 179m to the north of the site and is used for irrigation purposes. The second bore is 340m to the south and is listed as a water supply bore. A review of the bore information does not provide any useful information about specific groundwater levels beneath the site.

3 GENERAL RECOMMENDATIONS FOR FUTURE DEVELOPMENT

3.1 SITE PREPARATION

Following demolition of the existing structures and any bulk earthworks, all root-affected surface soils will need to be stripped and stockpiled for re-use as landscape material or removed from site. This also applies to any remaining portion of the pure silt soil in the topsoil layer, which has poor engineering properties, especially with respect to compaction as engineered fill. Based on the limited intrusive investigations conducted across the site the topsoil had sufficient clay content to enable the non-root-affected topsoil to be blended in with the underlying silty clay soil for use as part of the bulk earthworks program.

Material removed from site will need to be managed in accordance with the provisions of current legislation and may include segregation by material type classification in accordance with NSW EPA (2014) *Waste Classification Guidelines* (reference 5) and disposal at facilities appropriately licensed to receive the particular materials. GEE notes that the natural soil and bedrock may be classified as Virgin Excavated Natural Material (VENM) and re-used on other sites rather than disposed at a landfill, although it must be proven to be free of contamination.

Finally, the clay soil across the site is likely to be susceptible to changes in moisture and when wet and could result in significant loss in strength. In this regard, stripping of the root affected topsoil should be undertaken during a period of dry weather and once stripped it will be important to provide adequate drainage to ensure stormwater run-off while the clay subgrade is exposed. Additionally, it may be necessary to construct a working platform above the prepared sub-grade in areas of high construction vehicle traffic, comprising a minimum of 150 mm of gravel or recycled concrete.

3.2 EARTHWORKS

GEE envisages that earthworks will be necessary for the proposed development and will comprise some level of excavation and filling with the aim to balance the excavation and fill to minimize off-site disposal or importation of soil. The following preliminary advice is for future earthworks across the site.

3.2.1 EXCAVATION

Based on the regional geological and soil mapping, and local knowledge, any excavation work is expected to encounter silty clay and sandy clay soil and depending on the depth of the excavation, shale and/or sandstone bedrock may also be encountered. The natural soil and bedrock is considered suitable for re-use as fill elsewhere across the site, however, any unsuitable material, as defined by Section 4.3 of AS3798-2007 (reference 6) will need to be removed or managed. This includes tree roots and any oversize fragments such as rock (typically greater than 37.5mm).

Most of the excavation will likely be achievable using standard excavation equipment such as excavators, although the use of an impact hammer may be required if medium strength or better rock, combined with unfavourable rock-defect geometry, is encountered. Although the areas of proposed excavation are reasonably distant from any adjoining structures, any use of such rock-breaking tools should consider the sensitivity of nearby structures to vibration.

Groundwater is unlikely to be encountered, although some minor seepage may occur, particularly along the soil bedrock interface and following rainfall events. Such seepage will be adequately controlled by pumping from a designated sump excavated into the base of the excavation.

3.2.2 Filling

Filling (where needed) is likely to comprise natural silty clay and sandy clay soil and weathered rock, sourced from the earthworks across the site. The importation of fill material onto site is not expected to be necessary, however, if required, it should be undertaken in such a manner that all obligations under the *Protection of the Environment and Operations Act 1997* and the *Environmental Planning Assessment Act 1979,* are met. This includes ensuring that any material imported to site be classified as Virgin Excavated Natural Material (VENM) or is waste exempt under the NSW Resource Recovery Exemptions.

Prior to filling, the site should be prepared as described in Section 3.1 and the subgrade test rolled in accordance with AS3798-2007 (reference 6), in the presence of a geotechnical engineer, to detect any weaker areas. Areas which show visible deformation or springing should be rectified and re-presented for test rolling. Based on the field investigations conducted herein, the natural clay soil profile, upon which fill will be placed, is firm and unyielding, therefore suitable for the placement of fill.

For future residential development, it is recommended that the fill should be placed on the prepared subgrade in horizontal layers of 250mm or less and compacted by rolling to achieve a minimum dry density ratio of at least 98% standard maximum density. Consideration should also be given to achieving 100% standard compaction if there is proven to be a significant increase in CBR and reduction in swelling of clay soils. The moisture content during compaction should also be maintained at approximately ±2% of Standard Optimum, which along with the level of compaction is also important to minimise swelling of clay material during the construction phase.

During filling, inspections and *in-situ* density tests should be carried out at regular and appropriate intervals to check the quality of fill materials and that adequate compaction has been achieved in every layer (AS3798-2007 – reference 6). Given the end-use of the site (low density residential uses), GEE considers that 'Level 1 inspection and testing' as defined by AS3798 is appropriate. In this regard, an independent Geotechnical Inspection and Testing Authority (GITA) should be appointed to carry out sampling and testing with the same GITA providing a report at the completion of the work, which details the sampling and testing completed (including the locations and results) and an opinion as to the final compliance of the earthworks. The frequency of testing should be in accordance with 'Type 1 - large scale operations' as specified in Table 8.1 of AS3798-2007. Finally, the report should be made available to all future allotment owners to assist with the design and construction of any dwelling.

3.2.3 Batter Slopes

At this preliminary stage, and assuming silty clay and sandy clay soils, temporary soil batters of up to 1 Horizontal (H) to 1 Vertical (V) could be adopted with permanent batters to be no steeper than 1.5H:1V. The bedrock formation (where encountered) can stand vertically, however, inspections by an experienced engineer or engineering geologist is recommended and may require localised remedial measures such as rock bolting or similar. Additionally, exposes shale bedrock will likely require some form of protection in the long term to prevent ongoing weathering.

The preliminary batter slopes quoted above assume that the ground surface beyond the crest of the slope is horizontal and surcharge loads are not placed within a distance from the crest equal to the vertical height of the cut.

3.2.4 Construction / Excavation Induced Vibration

Structures and utilities adjacent to the excavation area are potentially sensitive to vibrations above certain threshold levels (regarding potential for cracking). When using a hydraulic hammer, vibrations will be transmitted through the ground and potentially impact on adjoining structures. Where possible, the use of other techniques not involving impact (*e.g.* rock saws), should be adopted as they would reduce or possibly eliminate risks of damage due to vibrations.

Where vibration intensive works such as hydraulic hammering of competent rock is proposed, contractors should assess the potential impact of their works based on the borehole logs and local knowledge of similar bedrock formations. Monitoring of construction induced vibration should be undertaken at the commencement of such activities at the nearest vibration receptor and in consultation with the project superintendent and geotechnical engineer so that excessive vibration effects are not generated.

Peak Particle Velocity (PPV) is usually the adopted measure of ground vibration, and the safe limits depend on the sensitivity of the adjoining structures. There are several Australian and overseas publications which provide vibration velocity guideline levels (or safe limits) including:

◊ Australian Standard AS2187.2-2006 Explosives - Storage and use - Use of explosives - Appendix J: Ground Vibrations and Airblast Overpressure (reference 10).

◊ Australian Standard AS2670.2-1990 Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz) (reference 11).

◊ DIN 4150 – Part 3 – 1999. Effects if Vibration on Structures (reference 12).

◊ Department of Environment and Conservation NSW, 2006. Assessing Vibration: a technical guideline (reference 13).

◊ British Standard BS 7385-1:1990. Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings (reference 14).

◊ British Standard BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration (reference 15).

Furthermore, the owners of adjoining assets/utilities sometimes have their own limits. In the absence of PPV guidelines from affected asset owners, GEE recommends the following limits be placed on vibrations:

◊ 5 mm/s for the adjoining residential structures.

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

◊ The use of smaller excavation plant and hydraulic hammers,

- ◊ The use of a rock sawing or grinder adjacent to the site boundaries. GEE notes that this equipment also reduces the possibility of over-break and loosening of the rock mass.
- ◊ Hammering at 50% capacity in short bursts to prevent the buildup of resonant frequencies,
- ◊ The use of low vibration techniques such as rotary grinders or chemical rock splitting,
- ◊ Progressive breakage from open excavated faces,
- ◊ Selective breakage along open joints, where present, and
- ◊ Orientation of the rock hammer pick away from property boundaries and into the existing open excavation.

Finally, human discomfort levels caused by vibration are typically less than the levels that are likely to cause cosmetic or structural damage to structures. Therefore, complaints may be lodged by neighbours before any cosmetic or structural damage occurs. In this regard, consideration may be given to adopting more stringent vibration limits recommended for human amenity or, as a minimum, ensuring that vibration monitoring is undertaken as reassurance to confirm that vibrations are within safe limits. Acceptable vibration limits for human comfort caused by construction and excavation equipment are provided in DEC (2006) (reference 13). Specifically, maximum acceleration limits as specified in Table 2.2 of the guideline should be adopted.

3.3 GEOTECHNICAL SITE CLASSIFICATION

The geotechnical site classification to AS2870-2011 (reference 13) for the various residential allotments will depend on the final soil / bedrock profile after completion of the bulk earthworks. However, at this preliminary stage and based on local knowledge, the natural clay soil profile encountered beneath the site is expected to be moderately to highly reactive.

Oakdale has a Thornthwaite Moisture Index (TMI) of between -5 and +10 (reference 14) which equates to a climatic zone of 1 and based on AS2870-2011 this equates to a design soil suction change (H_s) of 1.5m and a change of soil suction at the surface (Δ_u) of 1.2 pF.

In this regard, final soil profiles comprising deep clay soil profile (at least 1.5m depth) the likely site classification would be Class ‘M’ to ‘H1’, which equates to a characteristic free surface movement (Ys) in the range of 20 to 60mm with changes in moisture. With decreasing depth of the highly reactive clay soil, the amount of characteristic surface movement would reduce accordingly from Class M to Class S and finally, Class A in areas where bedrock is at the near surface. For more accurate site classification, additional investigations would be required following the bulk earthworks and the formation of the individual allotments.

GEE notes that this classification may change significantly with any earthworks and, if required, further advice should be sought, if necessary.

3.4 FOUNDATIONS

Following earthworks, the entire site is expected to be underlain by either natural undisturbed clay-based soil, engineered fill or bedrock, all of which are expected to be suitable as a founding medium below future buildings. However, a detailed and intrusive geotechnical investigation is required to determine the allowable bearing capacity of the soil and bedrock formations to assist with structural design of the buildings. For consistency and to minimise the risk of differential settlements, future building footings should be founded on a consistent medium to minimise any potential differential settlements.

3.5 PAVEMENTS

Pavement designs are based on the CBR, and modulus of the subgrade materials encountered after any excavation or re-grading has taken place. The principal aim of the subgrade preparation is to provide a uniform foundation over the entire pavement formation which will not give rise to unevenness in the pavement surface under the design loads.

At this preliminary stage, any internal road pavement subgrade (following earthworks) is likely to comprise natural silty clay / sandy clay soil or engineered fill comprising similar clay-based soil. Each are suitable as a subgrade provided the material performs satisfactorily under proof rolling and meets the definition of suitable material as defined in as defined by Section 4.4 of AS3798-2007 (reference 6).

For silty clay soils, it is likely that a design CBR value of 3% or less would be achieved and slightly higher CBR values for sandy clay soils. Compaction to a level of 95% standard is normally acceptable for residential road subgrades, however, given the likely reactivity of the clay and potential for swelling, an increase in compaction may be more appropriate. In fact, future geotechnical investigations should also assess whether additional compaction to at least 100% standard will significantly increase the CBR value and reduce the potential for swelling when saturated.

Given the very low CBR values, which are typical for the clay-based soils, consideration should be given to improving the subgrade along the future roadways. This may be achieved by introducing fill material with better CBR qualities such as crushed sandstone which typically has a CBR value of at least 25%. Depending on the thickness of this layer and the design traffic Equivalent Standard Axles (ESA's) adopted for the pavement, the CBR values for the clay soil may become obsolete. Alternatively, lime stabilisation of the pavement subgrade can achieve a higher design CBR, therefore minimising the depth of any pavement materials.

Finally, GEE recommends subsoil drains are adopted to protect the pavement and subgrade from becoming saturated.

4 CONCLUSION AND RECOMMENDATIONS

In conclusion, GEE considers that the proposed residential subdivision is feasible and the existing soil and/or rock formation is expected to be capable of withstanding the proposed building loads to be imposed. However, GEE notes that a site-specific geotechnical investigation is recommended prior to Construction Certificate (CC) stage to accurately define the sub-surface conditions including the depth and quality of the bedrock. This will minimise the uncertainty for earthworks contractors and structural design engineers when planning and designing the proposed excavation and foundations.

GEE will be pleased to assist with any further advice or geotechnical services required in regard to the proposed development.

5 GENERAL LIMITATIONS

Soil and rock formations are variable. The logs or other information presented as part of this report indicate the approximate subsurface conditions only at the specific test locations. Boundaries between zones on the logs or stratigraphic sections are often not distinct, but rather are transitional and have been interpreted.

The precision with which subsurface conditions are indicated depends largely on the frequency and method of sampling, and on the uniformity of subsurface conditions. The spacing of test sites also usually reflects budget and schedule constraints. Groundwater conditions described in this report refer only to those observed at the place and under circumstances noted in the report. The conditions may vary seasonally or as a consequence of construction activities on the site or adjacent sites.

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities or changes to the design of the development, it is a condition of this report that GEE be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of changed soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

The comments given in this report are intended only for the guidance of the design engineer, or for other purposes specifically noted in the report. The number of boreholes or test excavations necessary to determine all relevant underground conditions which may affect construction costs, techniques and equipment choice, scheduling, and sequence of operations would normally be greater than has been carried out for design purposes. Contractors should therefore rely on their own additional investigations, as well as their own interpretations of the borehole data in this report, as to how subsurface conditions may affect their work.

6 REFERENCES

1. Land and Property Information NSW, 2002: *1:25,000 Camden topographical map (Sheet 9029-4N).*
2. Department of Mineral Resources, 1985: Wollongong - Port Hacking 1:100,000 Geological Series Map Sheet 9029-9129 (Edition 1).
3. Soil Conservation Service of NSW, 1990: Wollongong - Port Hacking 1:100,000 Soil Landscape Series Sheet 9029-9129 (first edition).
4. DLWC, 1997: Department of Land and Water Conservation of NSW, 1997: Sydney Heads Acid Sulfate Soil Risk Map – Edition Two.
5. New South Wales Environment Protection Authority (NSW EPA), 2014: Waste classification guidelines – Part 1 classifying waste. November 2014.
6. Australian Standard (AS) 3798 – 2007: *Guidelines on earthworks for commercial and residential developments*.
7. Australian Standard AS4678-2002: Australian Standard, 2002: Earth Retaining Structures.
8. Australian Standard AS2187.2-2006 Explosives - Storage and use - Use of explosives - Appendix J: Ground Vibrations and Airblast Overpressure.
9. Australian Standard AS2670.2-1990: Evaluation of human exposure to whole-body vibration - Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz).
10. DIN 4150 – Part 3 – 1999. Effects if Vibration on Structures.
11. Department of Environment and Conservation NSW, 2006. Assessing Vibration: a technical guideline.
12. British Standard BS 7385-1:1990. Evaluation and measurement for vibration in buildings. Guide for measurement of vibrations and evaluation of their effects on buildings.
13. British Standard BS 7385-2:1993. Evaluation and measurement for vibration in buildings. Guide to damage levels from groundborne vibration.
14. Australian Standard: AS2870-2011. *Residential slabs and footings.*
15. Chan. I and Mostyn. G, 2008: *Climatic Factors for AS2870 for the Metropolitan Sydney Area.* Australian Geomechanics Volume 43 No. 1 March 2008.

FIGURES

Image Source: www.whereis.com Map data © OpenStreetMap contributors

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TITLE:	SCALE: N.T.S	DATE: 3 July 2023	FIGURE No.: 1
SITE LOCATION MAP	DRAWN: S. McC	JOB No.: E23010OAK	REVISION: A

Aerial Image provided by Nearmap (https://www.nearmap.com/au/en) - Image Dated 20th February 2022

DRAWN:	SCALE:	JOB No.:	DATE:	REVISION:	FIGURE No.:
S. McC	N.T.S	E23010OAK	3 July 2023	A	2

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TITLE:

SITE LAYOUT

Image Source: Nearmap Limited (www.nearmap.com.au) - Image Date 9 Jan 2023

geo-environmental ENGINEERING UNIT 2 / 5 - 7 MALTA STREET FAIRFIELD EAST NSW 2165 P - 61 (2) 9420 3361 E - info@geoenvironmental.com.au www.geoenvironmental.com.au	TITLE: SITE PLAN (South) 1838 Barkers Lodge Road, Oakdale NSW	SCALE: N.T.S DRAWN: S. McC	DATE: 12 July 23 JOB No.: E23010OAK
			FIGURE No.: 3 REVISION: A

Aerial Image provided by Nearmap (https://www.nearmap.com/au/en) - Image Dated 20th February 2022

DRAWN:	SCALE:	JOB No.:	DATE:	REVISION:	FIGURE No.:
S. McC	N.T.S	E23010OAK	12 July 2023	A	4

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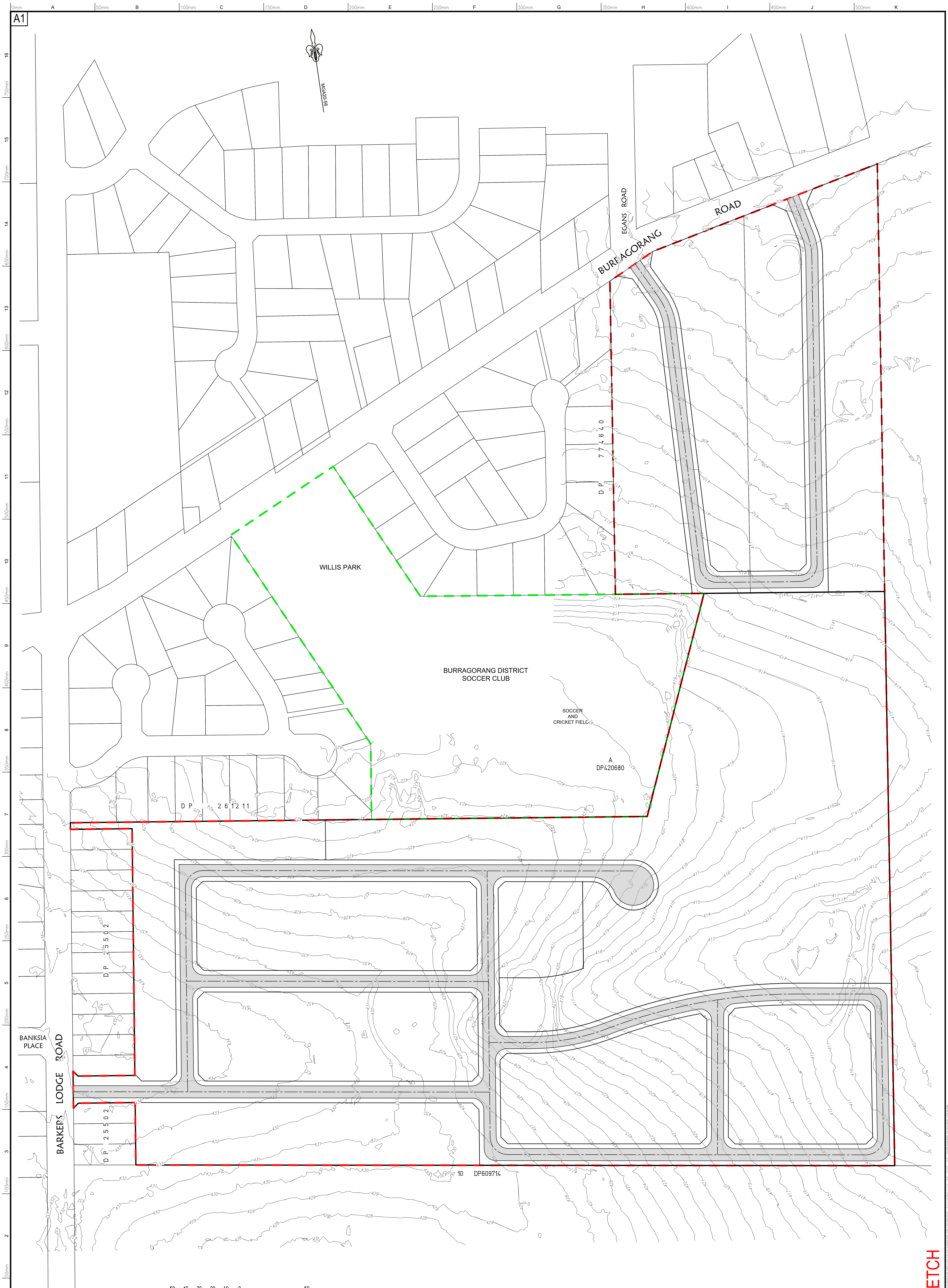
TITLE:

SITE PLAN (North)
1455 & 1475 Burragorang Road

APPENDIX A

PROPOSED RE-ZONING PLAN (1 SHEET)



AMEND.	DATE	CALC	DRAFTED	P.M.	CHECKED	APPROVED
00	23-02-2024	N.P.	G.W.E.	A.H.		

DETAILS
ORIGINAL ISSUE

50 40 30 20 10 0 50
1:1250 @ A1

CADASTRAL BOUNDARY
EXISTING OPEN SPACE

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APPROVED COMPANY ISO 45001 Occupational Health & Safety Management Systems — QMS Certification Services
APPROVED COMPANY ISO 14001 Environmental Management Systems — QMS Certification Services
APPROVED COMPANY ISO 9001 Quality Management Systems — QMS Certification Services

Project:
SKETCH OVER
LOTS 1, 2 & 6 DP734561
BARKERS LODGE ROAD AND BURRAGORANG ROAD,
OAKDALE

Principal:			
Scale 1:1250	Date 11/10/2023	Council Ref.	
	Datum AHD	L.G.A. WOLLONDILLY SHIRE COUNCIL	
Calc's A.H.	Drawn. G.W.E.	Proj.Man. A.H.	Client Ref:

Colliers

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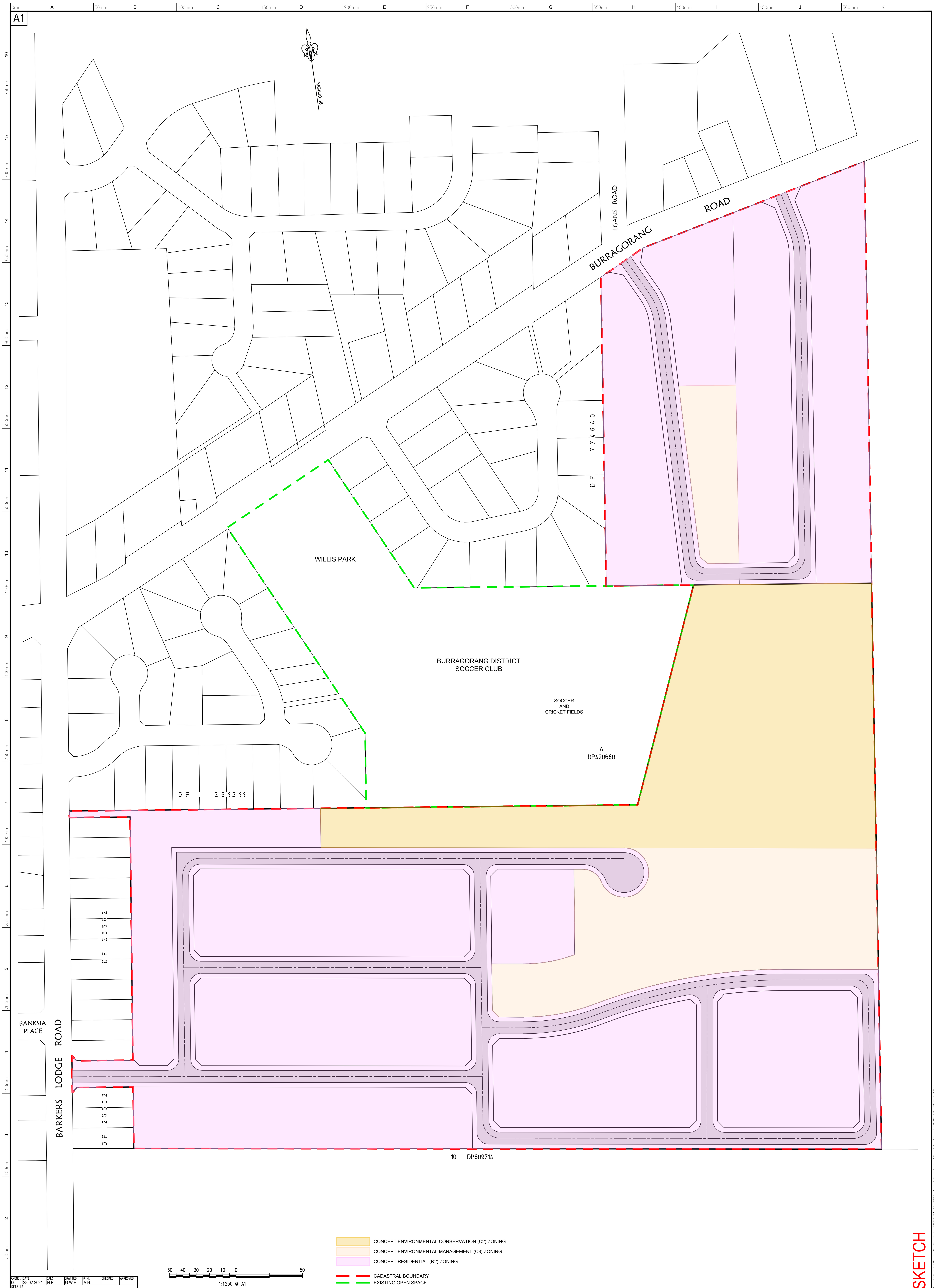
Our Ref. 030-22
Dwg File Ref. [Rev] - Sheet Ref.
030-22G L07 [00]
- Concept Rd Layout



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- Concept Rd and Zoning