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Our ref: MD/C12404

Cardno
Via email: john.sutcliffe@cardno.com.au

Attention: John Sutcliffe

PROPOSED HILLDOWNS SUBDIVISION
KALKITE ROAD, KALKITE, NSW
PRELIMINARY 'DESK TOP' GEOTECHNICAL ASSESSMENT

At the request of the client, ACT Geotechnical Engineers Pty Ltd carried out a desk-top preliminary geotechnical assessment as part of a proposed subdivision, in Kalkite, NSW.

The subdivision will comprise two sections of large lot housing, a crown land/town centre, and a Neighbourhood Centre/Community Space.

It is understood the study is required to provide preliminary geotechnical information and identify possible constraints for development of the site.

This report summarises expected site geotechnical and geological conditions based on research of available geological and topographical maps, past and recent aerial photographs, available geotechnical investigations conducted in the area, and a site walk-over conducted by a senior geotechnical engineer.

1 SITE DESCRIPTION & GEOLOGY

The proposed development site is located on the NE side of Lake Jindabyne, at 56 Hilldowns Road, in Kalkite, NSW. The site is bounded by Lake Jindabyne to the west and crosses over Kalkite Road towards the west. Figure 1 shows the site locality.

The site is presently undeveloped grazing land, fenced into paddocks with a single storey residence off Hilldowns Road. The topography of the site is dominated by several hills sloping west towards Lake Jindabyne/ Eucumbene River, with broad drainage gullies between. The highest point on site, east of Kalkite Road, is at about RL1075, with surface slopes within the large lot areas, between the two lengths of Kakite Road that intersect the site, of up to 10°. The groundsurface flattens out within the community space before sloping gently towards Lake Jindabyne. There are also some steeper slopes close to the drainage gullies. Road cuttings have been formed for Kalkite Road.

The groundsurface is covered in pasture grasses, and small rounded granite outcrops are present on the surface over most of the site, however, are more prevalent on the higher slopes. There are essentially no trees on the site, however, there is a farm house located off Hilldowns Road.

Figure 2 is a recent aerial photograph showing the present site layout, while Figure 3 is a topographical map showing the surface contours and topographic features of the site. Site Photos 2 to 4 taken during the site walk over are provided in Figure 6.

The 1:250,000 Bega-Mallacoota geology map indicates the site to be underlain by Silurian age Bullenbalong bedrock, which includes granodiorite and biotite-rich granodiorite. The granodiorite crops out as very numerous, small rounded boulders easily distinguishable from the larger outcrops in the Silurian age bedrock and within the road cutting.

3 EXPECTED SUBSURFACE CONDITIONS

ACT Geotechnical Engineers have conducted many investigations and been involved in various projects in and around Jindabyne. Our assessment was based on these past involvements, as well as reference to past and present topographical maps and local soil and geology maps. In addition, three push tube boreholes, designated 1A to 3A, were drilled at the site during the site walk over on 5 November 2021. The borehole logs are attached at the end of the report, and the location of the boreholes are shown on Figure 3. The Photo's in Figure 5 are of the push tube sample from the boreholes.

The subsurface profile at the site is expected to comprise the following:

Depth	Geological Profile
0m to ~0.1m/0.2m	TOPSOIL: Silty Sand; fine to coarse sand, low plasticity silt, black, grass roots, dry to moist, loose.
~0.1m/0.2m - ~0.5m/0.8m	RESIDUAL SOILS: Clayey Sand; low to medium plasticity clay, fine to coarse sand, brown, dry to moist, medium dense to dense.
below ~0.5m/0.8m	GRANODIORITE BEDROCK: coarse grained, extremely weathered (EW) and extremely weak rock.

The road cuttings were also logged, which exposed a subsurface profile of silty topsoil to 0.1m depth underlain by weathered granodiorite bedrock. The depth to bedrock is expected to vary depending on the topography. Near the tops of the hill tops, the depth to bedrock is expected to be shallower (maybe as shallow as 0.1m), and will be stronger and less weathered. Along the flanks of the drainage gullies, and in the flatter areas of the site, bedrock is expected to be deeper (maybe >1m).

4 EXPECTED GROUNDWATER CONDITIONS

The permanent groundwater table is expected to correspond to the water level of Lake Jindabyne. However, perched groundwater may be present at shallower depth within the more pervious residual soils, but seepage flows rates are expected to be relatively low.

5 PRELIMINARY ENGINEERING ASSESSMENT

5.1 Anticipated Excavation Conditions & Use of Excavated Material

The depth of proposed excavations is not known, however, it is expected that subdivision development may require excavations of up to 1m/2m (for roadways, footing excavations, forming level cut-to-fill platforms, or for trenching for installing underground services). Such excavations would be through topsoil, residual soils, and into granodiorite bedrock. The overburden soils and weak rock expected within the upper ~1.5m can be dug by backhoe and small to medium-sized excavator, however, medium strong and less weathered bedrock would require ripping or rock hammering. Table 1 summarises the expected bedrock strength and excavation condition at the site.

TABLE 1
Expected Bedrock Strength & Excavation Conditions

Location	Depth Interval	Expected Rock Strength & Defect Spacing	Required Excavation Equipment
Around the Hill Tops	0m to ~0.5m	Soil & weak rock - defect spacing <60mm	Excavator
	below ~0.5m	Medium strong rock - defect spacing of 30mm to 300mm	Mostly heavy (dozer) ripping, some rock hammering
Elsewhere on the site	0m to >1.5m	Soil & weak rock - defect spacing <60mm	Excavator

Any low and medium-plasticity colluvial and residual soils are expected to be suitable for use in controlled fill construction for new building platforms and pavement subgrades. The weak granodiorite bedrock is expected to be a source of good-quality select fill (CBR12%) material. The stronger rock could also be used as select fill, provided it is broken down to less than 75mm particle size.

Any topsoil and medium to high and high-plasticity clays are not generally suitable for controlled fill, but could be used in non-structural applications such as landscaping.

5.2 Structure Footings

Pad and/or strip footings founding in the medium dense residual soils, or on a properly constructed engineered fill platform, would be suitable for the proposed residential structures. Alternatively, bored piers founding deeper in the weak bedrock could be used. Footings should not be founded in the topsoil.

A detailed borehole investigation would be required to more accurately determine the foundation material. Indicative allowable end-bearing pressures for pad, strip, and pier footings in these foundation categories are summarised in Table 2.

TABLE 2
Indicative Allowable End-Bearing Pressures for Footings

Foundation Material Type	Depth Below Existing Surface Level	Allowable End-Bearing Pressure		
		Strips	Pads	Bulk or Bored Piers
Newly Placed Controlled Fill & Medium Dense Natural Residual Soil	~0.2m	100kPa	125kPa	N.A.
EW & less weathered Granodiorite Bedrock	0.5m/0.8m (neighbourhood community area) Surface/0.5m (upper slopes of the site)	500kPa	750kPa	1000kPa

All footing excavations should be inspected and approved by an experienced geotechnical engineer to confirm the foundation material and design values, and to ensure the excavations are clean and stable.

Groundslabs can be constructed directly on natural soil or bedrock. Cut subgrades should be proof-rolled by a vibratory pad-foot roller, and any wet or deforming subgrades replaced to their full depth. Suitable replacement fill can be placed in not thicker than 150mm layers to not less than 95%ModMDD.

5.3 Stable Batter Slopes

Temporary site excavations to 1.5m depth can be formed near-vertical, although any loose uncontrolled fill should be cut at 1(H):1(V). If required, deeper temporary cuts can be benched or formed at 1(H):1(V) in soils and at 0.5(H):1(V) in HW and less weathered bedrock. Exposed temporary batters in soil may require protection from the weather.

Permanent cut and fill batters should be formed at no steeper than 2(H):1(V), although permanent cuts in HW and less weathered bedrock could be formed at 1(H):1(V). All soil cut and fill surfaces should be protected against erosion by topsoiling and grassing, or other suitable means. Steeper permanent cuts should be supported by structural retaining walls.

5.4 Road Pavements

New road and carpark subgrades should be stripped of all topsoil, and soils subgrades then proof-rolled by a pad-foot roller to check for any wet or otherwise weak spots which may require additional removal. Suitable replacement fill can be compacted in not thicker than 150mm layers, to not less than 98%StdMDD.

Pavement subgrades could comprise residual soil, newly placed controlled fill, or cut weathered bedrock. An indicative design CBR value of 5% can be assumed for low plasticity soils and EW & EW/HW bedrock, and 12% for HW bedrock. CBR testing of the site soils should be carried out during a site-specific geotechnical investigation.

The pervious, fine grained, sandy/silty topsoil in the upper ~0.2m of the profile is readily susceptible to saturation and weakening, so the site may be difficult to traffic by wheeled earthmoving plant following rain, and anecdotal evidence suggests that boggy conditions are regularly encountered following rainfall. It is recommended that building platforms, access tracks, and traffickable areas are covered in a gravel hardstand to maintain a working platform and vehicle access.

5.6 Drainage & Groundwater Control

Surface drainage measures should ensure that rainwater or seepage water does not pond against structure footings or pavements.

The permanent groundwater table is expected to correlate to the water level of Lake Jindabyne. Potential excavations are expected to be above the permanent groundwater level, however, perched seepages could be encountered at shallower depth following rainfall. Groundwater levels would need to be better established during a site-specific geotechnical investigation.

5.7 Earthquake Site Factor

Table 2.3 of AS1170.4 "Minimum Design Loads on Structures - Part 4: Earthquake Loads" lists the earthquake acceleration coefficients for major centres to be considered in structural design. The Jindabyne area has an acceleration coefficient of 0.08.

Section 4 of AS1170.4 summarises the Site Subsoil Class which depends on the subsurface conditions at the site in question. A Site Subsoil Class C_e is expected for the site.

5.8 Expected Slope Stability

As the groundsurface slopes of the site are generally less than 10°, and as there are no scarps, humps, boulder trains or erosion gullies to indicate past instability, the hills are geotechnically stable. No special provisions are envisaged to be necessary for subdivision development on these slopes, beyond normal compliance with AS2870 "Residential Slabs & Footings", and the implementation of suitable engineering practice for sloping sites, such as minimisation of cut and/or fill, use of structural retaining walls, and surface stabilisation of disturbed or filled ground.

6 DISCUSSION & GEOTECHNICAL CONSTRAINTS

The site appears to be geotechnically suitable for the proposed subdivision development. The large lot dwelling areas and community area (apart from the tops of the hills, and close to the gullies) appears to be reasonably flat or slightly sloping and suitable topography for a subdivision development.

Some cut-to-fill earthworks would be required, with engineered retaining walls, would be required on the sloping site, but this would not preclude development.

7 FURTHER INVESTIGATION

This report is of a preliminary nature, based on limited information from past investigations, and on our knowledge of the various geological formations.

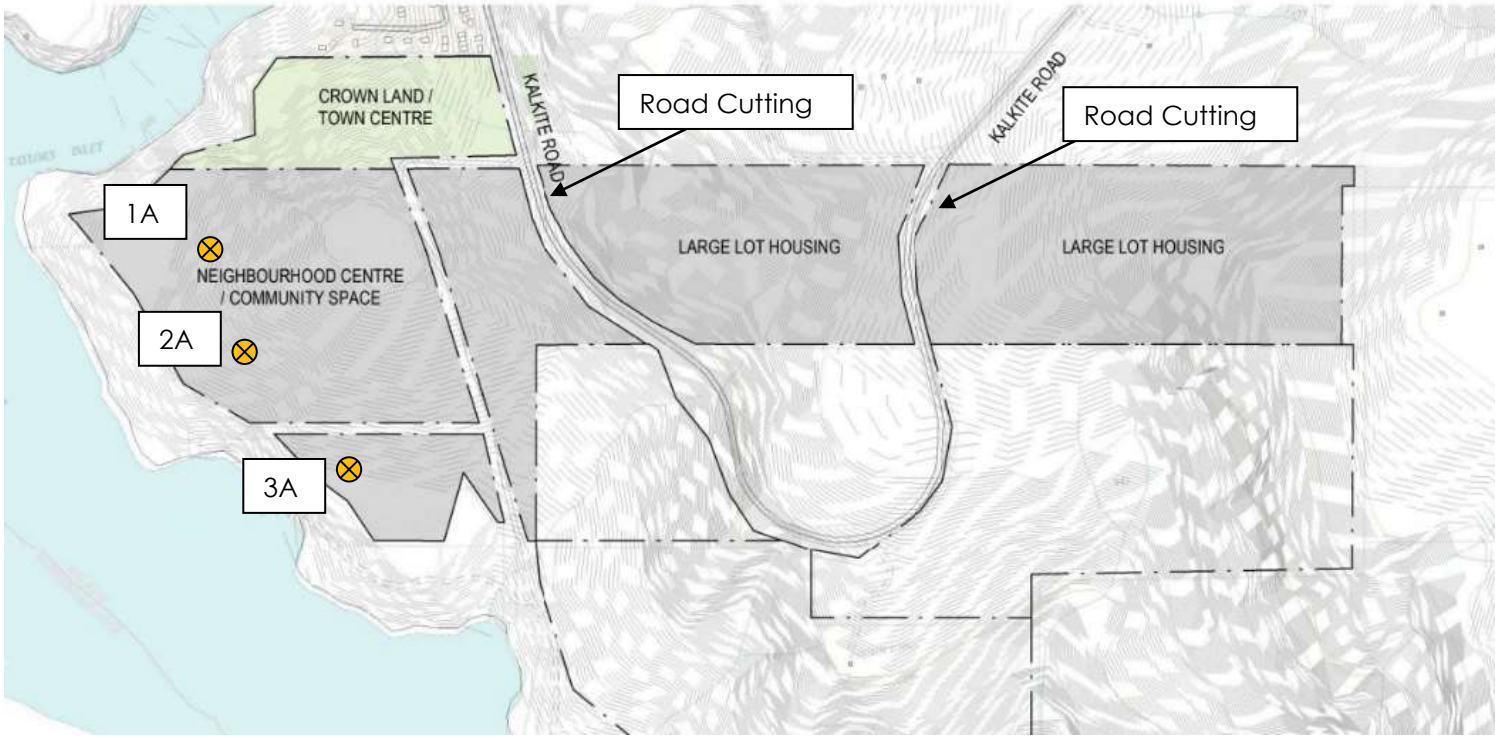
A comprehensive site-specific, detailed geotechnical investigation by test pits and/or boreholes will be required for any proposed development, to properly assess the depth of the bedrock, groundwater conditions, and material properties.

Should you require any further information, please contact our office.

Yours faithfully
ACT Geotechnical Engineers Pty Ltd

Jeremy Murray
Director
Senior Geotechnical Engineer

HILLDOWNS SUBDIVISION KALKITE ROAD KALKITE SITE LOCALITY		
ACT Geotechnical Engineers	C12404	FIGURE 1



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SITE LAYOUT & BOREHOLE LOCATIONS

ACT Geotechnical Engineers	C12404	FIGURE 2

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SITE PHOTOGRAPHS

ACT Geotechnical Engineers	C12404	FIGURE 3

HILLDOWNS SUBDIVISION KALKITE ROAD KALKITE SITE PHOTOGRAPHS		
ACT Geotechnical Engineers	C12404	FIGURE 4

HILLDOWNS SUBDIVISION
KALKITE ROAD KALKITE
SITE PHOTOGRAPHS

ACT Geotechnical Engineers	C12404	FIGURE 4

Excavation Log

Excavation No.	1A
Sheet	1 of 1
Job No.	C12404

CLIENT: Cardno

PROJECT: Proposed Subdivision
Kalkite Rd Kalkite NSW

Location : See Report

Surface Level : Not Known

Equipment Type : Push Tube Sampler
Excavation Dimensions : 50mm diameter

Samples	Casing	Depth (Metres)	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Consistency or Relative Density	Field Test Results	Geological Profile
		0.1		SM	Silty SAND; fine to medium sand, low plasticity silt, dark brown, some grass roots at the surface, dry to moist.	LOOSE		TOPSOIL
		0.5		SC	CLAYEY SAND; fine to coarse sand, low plasticity fines, brown, dry.	MEDIUM DENSE TO DENSE		RESIDUAL SOIL
		1.0			EW GRANODIORITE; coarse grained, brown.	EXTREMELY WEAK ROCK		BEDROCK
		1.2			EXCAVATION TERMINATED AT 1.2m			
		2.0						

Logged By : MD Date : 5/11/21 | Checked By : Date :

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BOREHOLE/EXCAVATION LOG C12404 - LOGS.GPJ ACT GEO.GDT 12/11/21

Excavation Log

Excavation No.	2A
Sheet	1 of 1
Job No.	C12404

CLIENT: Cardno

PROJECT: Proposed Subdivision
Kalkite Rd Kalkite NSW

Location : See Report

Surface Level : Not Known

Equipment Type : Push Tube Sampler
Excavation Dimensions : 50mm diameter

Samples		Casing	Depth Metres	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Consistency or Relative Density	Field Test Results	Geological Profile
					SM	Silty SAND; fine to medium sand, low plasticity silt, dark brown, some grass roots at the surface, dry to moist.	LOOSE		TOPSOIL
			0.15		SC	CLAYEY SAND; fine to coarse sand, low plasticity fines, brown, dry.	MEDIUM DENSE TO DENSE		RESIDUAL SOIL
			0.8			EW GRANODIORITE; coarse grained, brown.	EXTREMELY WEAK ROCK		BEDROCK
			1.0						
			1.5			EXCAVATION TERMINATED AT 1.5m			
			2.0						

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BOREHOLE/EXCAVATION LOG C12404 - LOGS.GPJ ACT GEO.GDT 12/11/21

Excavation Log

Excavation No.	3A
Sheet	1 of 1
Job No.	C12404

CLIENT: Cardno

PROJECT: Proposed Subdivision
Kalkite Rd Kalkite NSW

Location : See Report

Surface Level : Not Known

Equipment Type : Push Tube Sampler
Excavation Dimensions : 50mm diameter

Samples		Casing	Depth Metres	Graphic Log	U.S.C.S.	Material Description, Structure Soil Type: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components, Moisture, Structure	Consistency or Relative Density	Field Test Results	Geological Profile
					SM	Silty SAND; fine to medium sand, low plasticity silt, dark brown, some grass roots at the surface, dry to moist.	LOOSE		TOPSOIL
			0.2		SC	CLAYEY SAND; fine to coarse sand, low plasticity fines, brown, dry.	MEDIUM DENSE TO DENSE		RESIDUAL SOIL
			0.6			EW GRANODIORITE; coarse grained, brown.	EXTREMELY WEAK ROCK		BEDROCK
			1.0						
			1.5			EXCAVATION TERMINATED AT 1.5m			
			2.0						

Logged By : MD Date : 5/11/21 | Checked By : Date :

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