Geotechnical Assessment Report

72 Glendower Street, Gilead NSW 2560

Prepared for: HT Building

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ADE CONSULTING GROUP

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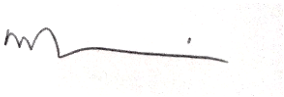
For and on behalf of
ADE Consulting Group Pty Ltd

Prepared by:

Oguzhan Baskan
Geotechnical Engineer

Reviewed by:



Michael Biabani
Associate Geotechnical Engineer

T. 1300 796 922| E. info@ade.group

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1 Introduction

At the request of HT Building (the Client), ADE Consulting Group (ADE) carried out a site observation and feasibility assessment of the proposed development at 72 Glendower Street, Gilead NSW 2560 (the Site). This report presents the results of a walkover assessment and landslide preliminary risk assessment for the proposed developments at 72 Glendower Street, Gilead NSW 2560. The site walkover was conducted by an ADE Geotechnical engineer on 27/10/2021. The site walkover was carried out in general accordance with ADE's proposal (Ref.: N-GEO-21-070 v1) and commissioned by Bill McGarry from HT Building Pty Ltd. A concept master plan provided by the Client (ref. Project no. 1901A, Drawing Nos. A-0002), to assist us with this preliminary assessment.

This report provides a preliminary assessment of the feasibility of the proposed construction and the risk of slope stability within the current site. Figure 1 shows the approximate current site location, and Figure 2 shows the extent of Lots 19 and 21. Also, Figure 3 shows the proposed development concept plan and present building and roads layout for the proposed development.

The objective of this report to carry out walkover assessment together with desktop study of the published information and provide comments on the geotechnical issues related to the site. This assessment is based upon a detailed inspection of the topographic, surface drainage and geological conditions of the site and its immediate environs.

Figure 1: Aerial view that shows approximate current site location (Reference Google map)

Figure 2: Site location showing Lot 21 and part Lot 19 (Reference: Google Earth)

Figure 3: Proposed developed concept plan

2 Available Information

Based on the concept master plan provided by the Client (ref. Project no. 1901A, Drawing Nos. A-0002), it is understood that the proposed development will be comprised of:

- Proposed Roundabout
- Landscaped Entry
- Mount Gilead Villas/ Level x2
- Mount Gilead Ilu's/ level x4
- Mount Gilead Allied Health/ level x3
- Managed Land to North
- Club Gilead
- Mount Gilead Stage 1 Villas
- Kilbride Nursing Home

2.1 Soil Landscape

Reference to the 1:100,000 scale Wollongong – Port Hacking Soil Landscape Series Sheet (9029 - 9129), indicates that the site is primarily underlain by Wianamatta Group shales (bt – Blacktown).

Gently undulating rises on Wianamatta Group shale. Local relief to 30 m; slopes are usually <5%. Broad rounded crests and ridges with gently inclined slopes. Almost completely cleared eucalypt woodland, open-forest and tall open-forest (wet sclerophyll forest).

Soils

Shallow to moderately deep (<150 cm) Red Podzolic Soils and Brown Podzolic Soils (Dr3.21, Dr3.41, Db2.11) on crests, upper slopes and well-drained areas; deep (150 – 300 cm) Yellow Podzolic Soils and Soloths (Dy2.11, Dy3.41) on lower slopes and in drainage depressions and localised areas of poor drainage.

Limitations – moderately reactive, highly plastic subsoils, low soil fertility.

A map excerpt of the Wollongong – Port Hacking Soil Landscape Series Sheet (9029 – 9129) is provided in Figure 4 below the location of the site is marked.

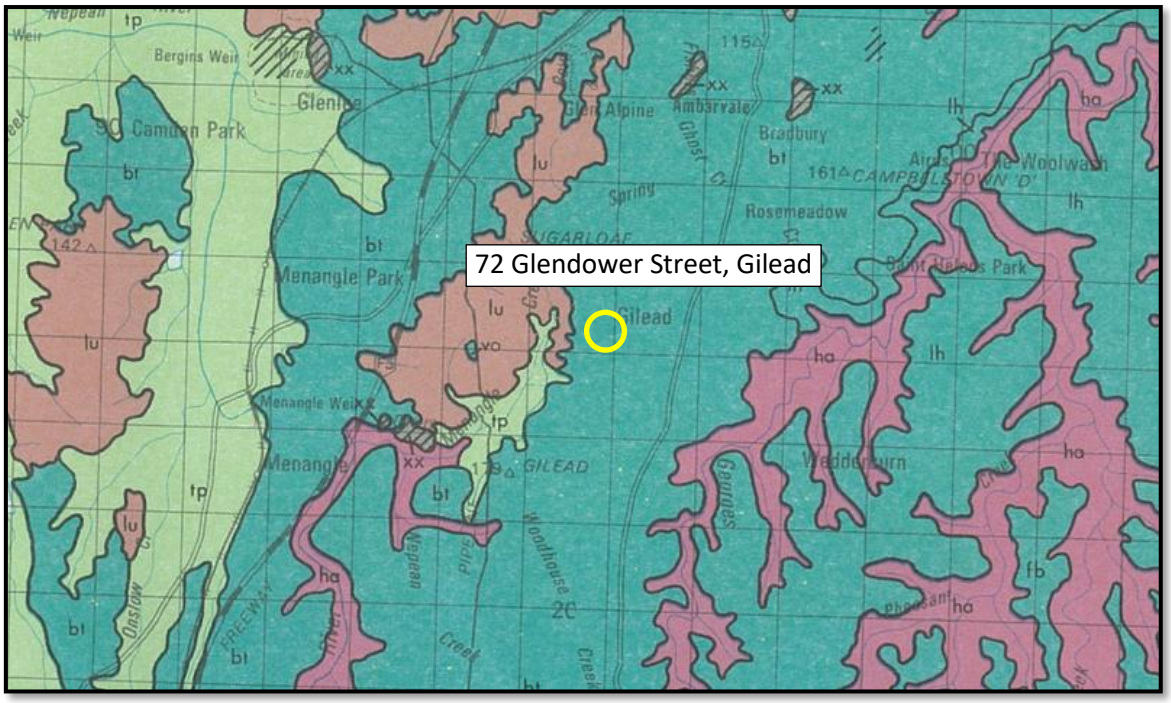

Figure 4: Excerpt of the Wollongong - Port Hacking Soil Landscape Series Sheet

2.2 Regional Geology

The 1: 125 000 Wollongong Geological Series Sheet (SI 56-9) indicates that the proposed development site is underlain by the Wianamatta Group – Liverpool Sub-Group comprising Shale with some sandstone beds. Figure 5 shows Wollongong-Port Hacking Geological map with respect to the current site location.

Figure 5: Excerpt of the Wollongong-Port Hacking Geological map

2.3 Expected Geological Model

Based on the landforms observed during the site walkover and experience with similar sites, we expect the subsurface conditions at the site will comprise the following:

Table 1: Expected Geological Model

Geotechnical Unit	Description	Expected thickness
Topsoil/Fill	Topsoil may consist of silty clay, with organic matter (root fibres).	This material covers the entirety of the site. The expected thickness is approximately 100mm – 150mm.
Residual Soil	Residual soil comprising Medium to high plasticity clayey soil.	Typically found between approximately 2.0m and 3.0m thick.
Weathered Shale Bedrock	Very low to low strength of extremely weathered shale bedrock, likely contains interbeds of siltstone/sandstone. The strength is expected to increase with depth.	Approximately below 2.0m – 3.0m depth.

3 Site Observations and Field Assessment

The subject site is located at Lot 21 in DP 1000643 and includes the western portion of Lot 19 in DP 1000643 (western of Glendower Street). The location of the site is marked.

Gonzalo street is located at the northeast boundary of Lot 19. Also, the site is bounded to Mount Gilead Estate at the southern boundary. The site is accessible through Glendower Street, which is located at the southeast boundary of Lot 19.

The site of the proposed development is currently vacant land. Vegetation over the site comprised of a mown grass cover and a number of small to medium size trees that appeared to be with a range of 20-30 years old with a few larger trees over the site. The ground surface over the site is near level and in some are gently to moderately sloping to undulating with some locally steeper areas.

The ground surface over the proposed development was relatively uniform, with no evidence of any significant erosion activity. The ground was relatively firm underfoot at the time of our observation. No obvious wet boggy areas or seepages were observed on the surface at the time of the walkover, other than in the beds of the existing dam and drainage channel. No rock outcrops were visible during our observation.

There is no evidence of previous landslide activity on the lower side slopes of Lot 19 and west boundary of Lot 19, where the surface is somewhat irregular or undulating.

Lot 19 comprises of relatively flat terrain and naturally sloping downwards towards the south with a gentle slope less than 5° (see Photo 1). Lot 19 is naturally slopped toward the northeast and eastern boundary lines, where surface-water flows into existing stormwater drainage outlets. There are two stormwater drainage outlets at the boundary of Lot 19, including an outlet located at the eastern corner of Lot 19 (Photo 2) as well as an outlet at the eastern boundary adjacent to Glendower Street and the northeast corner of Lot 19 (Photo 3)

There is a gentle to moderate slope, which is located at the southeast boundary of lot 21 adjacent to the southwestern boundary of Lot 19 (Photo 5). A section with moderate slope was observed with this area that slopes towards the west side of Lot 21.

Photo 1: General view (southeast – northwest) of Lot 19, from the corner of Charley Crescent and Glendower Street. Note residential properties on the northeast of Lot 19. Also, note medium-size trees within Lot 19

Photo 2: View (southeast–northwest) from Glendower Street to the west boundary of Lot 19. Note a stormwater drain located at the eastern corner of Lot 19 behind residential properties. Also, note scattered medium-size trees within Lot 19.

Photo 3: View (north – south) of Lot 19. Note existing stormwater drainage outlet, which is located at the eastern boundary adjacent to Glendower street and the northeast corner of Lot 19.

Photo 4: View (south – north) of the relatively flat terrain from the eastern end of Lot 21

Photo 5: View (west – east) of the moderately sloping area located at the southeast boundary of lot 21.

Photo 6: View (southwest–northeast) of an existing dam and surrounding gently to moderately sloping terrain located roughly in the middle of Lot 21. Note small to medium size trees within Lot 21

Photo 7: View (east – west) of an existing dam and surrounding moderately sloping terrain located approximately in the middle of Lot 21.

Photo 8: View (north – east) of moderately sloping area located at the southern boundary of Lot 21. Note small to medium size trees on the slope

4 Comments and Recommendations

4.1 General

Based on our site observations, preliminary geotechnical model, and experience on similar projects, the proposed development is considered feasible from a geotechnical perspective. Provided appropriate site investigation, design assessments, and construction monitoring normally associated with this type of development are carried out, the risks to adjacent structures and services should be able to be managed.

This assessment does not and is not intended to provide geotechnical information for design or construction purposes, and specific investigation should be carried out as appropriate for the structural requirements for the proposed developments.

4.2 Site Stability

On the basis of the above information, it is considered that a full geotechnical report, with respect to Landslip Risk, is not required. It is also considered that the proposed development can be successfully completed in a geotechnically stable condition, provided it is carried out in accordance with the following comments and recommendations and sound engineering practice.

The structural engineer should also confirm that the walls and footings of the existing buildings are adequate to support any new proposed loads arising from the additions and alterations. All new footings should be taken to found within insitu weathered bedrock of at least medium strength.

4.2.1 General site preparation and earthworks

Due to the presence of clay soils and clays with possibly some of the fill materials and relatively flat grades, surface water drainage over some parts of the site in its current condition will be relatively poor, therefore trafficability during construction is likely to be poor in wet conditions where clays are exposed. Allowance should be made for the placement of a working platform in construction vehicle access areas comprising a minimum of 250mm of crushed rock or approved recycled low plasticity or non-plastic material such as crushed concrete or quarry product for general site traffic. For heavy equipment such as mobile cranes or piling rigs, it will be necessary to assess platform requirements once details of the particular plant are known.

A number of trees occur across the site. Removal of trees, including root affected soils during site preparation works, will likely be required, and this may result in disturbance to the soils and changes to in situ moisture regimes, particularly if exposed to rain or surface runoff. This will need to be considered in the preparation of the building platform and design of high-level footings and also subgrades for carparks and accessways.

Underground services, including trenches or pits, may occur in a number of areas over the site within the footprint of the proposed building, particularly in the vicinity of existing residential properties to the eastern boundary. Where disused sewer, drainage or water pipes are intersected during site excavations, they should be checked to ensure that no further flows from these pipes will occur.

4.3 Excavation

4.3.1 Excavation Methods

Considering ground conditions within the proposed development area, it is anticipated that some areas of the site will be stripped and levelled to form the finished ground levels for the proposed construction. The re-levelling will likely include excavation into the soil profile and may extend into the residual soil/extremely weathered bedrock.

Based on the assessment results, the bulk excavation will encounter the soil profile and possibly extend into the underlying weathered bedrock. The excavation of the soil and very low strength bedrock (if encountered) may be completed using conventional earthworks equipment (e.g. hydraulic excavator, bulldozer, etc.) with rock breaking/ripping equipment required for the low strength and better. However, we expect excavation of low to medium and higher strength bedrock would be most effectively excavated using hydraulic impact hammers. This equipment would also be required for breaking up boulders or blocks, for trimming rock excavation side slopes, and for detailed rock excavations (such as for footings or buried services).
Site excavations for building and accessway construction and footing excavations will need to be approved by an experienced geotechnical engineer.

Any excavated soils used as fill will need to be retained and protected from erosion or slumping during construction. It is important on this site that all exposed soils (particularly fill) be carefully managed to prevent erosion and movement of soils downslope

4.3.2 Excavation Support requirements

Unretained cut batters on soil should not be steeper than 2H:1V, and extremely weathered bedrock should be temporarily battered to a side slope no steeper than 1V in 1H. Steeper batters may be feasible, but site-specific subsurface information would be required, together with daily monitoring of batter slopes and regular geotechnical inspections.

Fill should not be stockpiled on the slopes, and excavations will need to be retained as soon as possible after completion. All excavations and filling will need to be carefully managed to avoid erosion and landslide activity.

Subject to geotechnical inspections, excavations in Class IV and better-quality bedrock are expected to be able to stand unsupported vertically in the short term, with permanent support provided by basement structures in the long term.

Conventional retaining walls may then be constructed at the toe of the batters and subsequently backfilled. However, where temporary batters are not preferred or feasible, a retention system will be required and should be installed prior to commencing excavation. Suitable retention systems, given the subsurface conditions encountered, would include a soldier pile wall with shotcrete infill panels which is anchored progressively as excavation proceeds. Conventional bored piles would be suitable for use on this site. The piles should be installed to sufficient depth below the bulk excavation level to satisfy stability and founding considerations.

4.3.3 Re-use of excavated material

As earthworks required for the site will typically be associated with basement excavations, building footings, pavements, underground services installation and landscaping, it is likely that waste materials will be generated. Some of the fill materials may be suitable for re-use as general fill. However, this may involve significant time in separating materials. Topsoil and other mixed materials that are environmentally suitable may be re-used for landscaping or areas other than under pavements or buildings. The residual stiff clay soils are considered suitable for re-use as structural fill, provided the moisture content can be maintained prior to placement.

Where natural soils are considered suitable for re-use as structural fill, they should be compacted in layers not exceeding 200mm compacted thickness to a minimum density ratio of 100% Standard Maximum Dry Density and at a moisture content within 2% of Standard Optimum Moisture Content.

4.3.4 Vibration Effects

Care must be taken during rock excavation on this site, and there will likely be a direct transmission of ground vibrations to the buildings and structures to the south and east of the site. The excavation procedures and the dilapidation reports should be carefully reviewed before excavation commencing to use appropriate equipment. It is recommended that vibration monitoring be carried out during rock excavations when using rock breakers.

The following procedures are recommended to reduce vibrations if rock hammers are used:

- Maintain rock hammer orientated towards the face and enlarge excavation by breaking small wedges off the face.
- Operate the hammer, one at a time, and in short bursts only to reduce amplification of vibrations.
- Use excavation contractors with experience in confined work, with a competent supervisor who is aware of vibration damage risks, possible rock face instability issues, etc.

The contractor should be provided with a copy of this report and have all appropriate statutory and public liability insurances.

4.4 Foundations

Weathered shale bedrock, which likely contains interbeds of siltstone/sandstone, is expected to be exposed at shallow depth or at the base of any bulk excavations. We, therefore, recommend that the buildings be uniformly supported on footings founded within the weathered bedrock. Where the bedrock is at the bulk excavation level or at shallow depth (say less than 1m), strip or pad footings could be used, and where the bedrock is at greater depth, bored piles could be adopted.

Pad and strip footings founded within the weathered bedrock may be designed based on an allowable bearing capacity of 400kPa. For piles, a minimum socket of 1.5 times of pile dimension into the appropriate bedrock stratum is required to achieve these allowable end bearing pressures, provided the socket is satisfactorily cleaned and roughened.

For all footings, both shallow and piles, the lowest quality bedrock within 1.5 times the width/diameter of the footing will give the allowable bearing pressure for the design of footings. The allowable bearing pressures

and shaft adhesions are based on serviceability criteria and should result in settlements of less than 1% of the footing width/diameter.

Footings and structural retaining walls are to be designed by a suitably qualified structural engineer based on the geotechnical advice provided for each of the proposed buildings within the proposed development area.

4.5 Groundwater

Groundwater may encounter at the contact between soil profile and bedrock; however, quantity could be limited to seepage. It should be noted that fluctuations in groundwater levels may occur due to rainfall, seasonal changes, or damaged buried services.

Considering the vicinity of the current site to an existing creek on the west boundary, seepage flows also should be highly considered, which can be increased following periods of wet weather.

We anticipate that some groundwater seepage flows will likely occur at the soil and rock interface as well as through joints and other defects within the completed cut faces, particularly after periods of heavy rain. However, seepage during excavation is expected to be satisfactorily controlled by conventional sump pumping.

4.6 Surface water

Surface water interceptor drains should be provided across the slope uphill of proposed site excavations to divert runoff away from the site. Surface water will need to be intercepted at regular intervals along accessways and the drainage system will need to incorporate energy dissipation to minimise the risk of erosion.

Runoff is generally rapid during heavy rain and can cause severe erosion or slope instability where concentrated flows occur or where directed into areas with a steeper slope. Surface water will need to be managed during and following construction to avoid concentrated flows discharging onto the slopes. A series of temporary collection points or small onsite ponds may be required to allow treatment of surface water prior to discharge. Surface water collected from the site should be piped to a storm drain incorporated in the accessway.

Controls should be placed to prevent surface water flows from causing erosion and saturation of the batter. The crest of the cut batter must be graded away to divert surface water flow away from the excavation, or provision of sandbags or berm may be considered along the crest of excavation. In terms of site drainage measures, during and following construction at this site, all exposed soils in excavation batters should be protected from erosion. Temporary measures during construction such as covering exposed soils and batter slopes during rain events with plastic sheeting or geotextile matting may be required.

4.7 Slope Stability

This slope risk/stability assessment is based on visual observation of the topographic, surface drainage and geological conditions in the vicinity of the proposed development site.

According to our visual assessment of slope stability, no previous or existing slope instability or landslide activity was observed within the proposed development area. In addition, no sign of shallow local failure of the slope or soil creep movement over the steeper slopes within the current site at 72 Glendower Street, Gilead, was observed.

However, the qualitative measure of the consequences to the proposed development will depend on the final design and construction methods for the building. For this assessment, assuming recommendations provided in Section 4 of this report are followed, the implied level of risk to the property for the proposed development is assessed as low to moderate risk.

4.8 Further Geotechnical Investigations

The following summarises the further geotechnical work or inspections recommended within this report. For specific details, reference should be made to the relevant report sections:

- Detailed geotechnical site investigation within the proposed building footprint to determine geotechnical design parameters for the footing, pile and retaining wall.
- Dilapidation reports of neighbouring building and structures to the east and south.
- Periodic vibration monitoring during rock excavation.
- Inspection of the foundation material at the base of footing excavations by a qualified geotechnical engineer
- Allowance should be made to monitor the groundwater level
- Further settlement analyses to assess the suitability of high-level footings.

5 Limitations

This report has been prepared for use by the Client, who has commissioned the works in accordance with the project brief only and has been based on information provided by the Client. The advice herein relates only to this project, and all results, conclusions and recommendations made should be reviewed by a competent and experienced person with experience in environmental and geotechnical investigations before being used for any other purpose.

ADE Consulting Group Pty Ltd (ADE) accepts no liability for use or interpretation by any person or body other than the Client who commissioned the works. This report should not be reproduced or amended in any way without prior approval by the Client or ADE and should not be relied upon by any other party, who should make their own independent enquiries.

This report does not provide a complete assessment of the geotechnical status of the site, and it is limited to the scope defined herein. Should information become available regarding conditions at the site (e.g., Conditions exposed at the site during earthworks varying significantly with the results within this report), ADE reserves the right to review the report in the context of the additional information.

ADE's professional opinions are based upon its professional judgement, experience, training and results from analytical data. In some cases, further testing and analysis may be required, thus producing different results and/or opinions. ADE has limited investigation to the scope agreed upon with its Client.

This report has been written to provide information on the site subsurface to the Client for design and construction purposes. Subsurface conditions relevant to the works undertaken by the Client should be assessed by a competent contractor who can make their own interpretation of the data represented within this report. Subsurface conditions will always vary within a worksite, and the extremes of these variations cannot be defined by exhaustive investigations, and as such, the measurements and values obtained within this result may not be representative of these extremes.

6 References

Geological Survey of NSW, Department of Minerals and Energy, Wollongong 1:125,000 scale Geological Series Sheet SI 56-9, second edition, 1966;

Soil Conservation Service of NSW, Department of Lands, Wollongong – Port Hacking 1:100,000 scale Soil Landscape Series Sheet 9029 – 9129, 1990

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Further details regarding ADE's Services are available via

info@ade.group www.ade.group

ADE Consulting Group Pty Ltd

Sydney
Unit 6/7 Millennium Court,
Silverwater, NSW 2128 Australia

Newcastle
Unit 9/103 Glenwood Drive
Thornton, NSW 2322, Australia

ADE Consulting Group (QLD) Pty Ltd

Brisbane
Unit 3/22 Palmer Place
Murarrie, QLD 4172, Australia

ADE Consulting Group (VIC) Pty Ltd

Melbourne
Unit 4/95 Salmon Street
Port Melbourne, VIC 3207, Australia