GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1 – To be submitted with Development Application

Development Application for _____
Name of Applicant

Address of site 1164 Barrenjoey Road, Palm Beach

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk ***Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report***

I, Ben White *on behalf of* White Geotechnical Group Pty Ltd
(Insert Name) (Trading or Company Name)

on this the 6/11/24 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $10million.

I:
Please mark appropriate box

☒ have prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☒ am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☐ have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.

☐ have examined the site and the proposed development/alteration in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.

☐ have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.

☐ have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: Geotechnical Report **1164 Barrenjoey Road, Palm Beach**
Report Date: 6/11/24

Author: BEN WHITE

Author's Company/Organisation: **WHITE GEOTECHNICAL GROUP PTY LTD**

Documentation which relate to or are relied upon in report preparation:

Australian Geomechanics Society Landslide Risk Management March 2007.

White Geotechnical Group company archives.

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature _____

Name Ben White

Chartered Professional Status MScGEOLAusIMM CP GEOL

Membership No. 222757

Company **White Geotechnical Group Pty Ltd**

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1(a) - Checklist of Requirements for Geotechnical Risk Management Report for Development Application

Development Application for _____
Name of Applicant

Address of site 1164 Barrenjoey Road, Palm Beach

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Geotechnical Report. This checklist is to accompany the Geotechnical Report and its certification (Form No. 1).

Geotechnical Report Details:

Report Title: Geotechnical Report **1164 Barrenjoey Road, Palm Beach**

Report Date: 6/11/24

Author: BEN WHITE

Author's Company/Organisation: WHITE GEOTECHNICAL GROUP PTY LTD

Please mark appropriate box

- ☒ Comprehensive site mapping conducted **27/8/24** (date)
- ☒ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)
- ☒ Subsurface investigation required
  - ☐ No Justification _____
  - ☒ Yes Date conducted **27/8/24**
- ☒ Geotechnical model developed and reported as an inferred subsurface type-section
- ☒ Geotechnical hazards identified
  - ☒ Above the site
  - ☒ On the site
  - ☒ Below the site
  - ☐ Beside the site
- ☒ Geotechnical hazards described and reported
- ☒ Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
  - ☒ Consequence analysis
  - ☒ Frequency analysis
- ☒ Risk calculation
- ☒ Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ☒ Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ☒ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009
- ☒ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.
- ☒ Design Life Adopted:
  - ☒ 100 years
  - ☐ Other _____ specify
- ☒ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified
- ☒ Additional action to remove risk where reasonable and practical have been identified and included in the report.
- ☐ Risk assessment within Bushfire Asset Protection Zone.

I am aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ensuring that the geotechnical risk management aspects of the proposal have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated, and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature _____

Name Ben White

Chartered Professional Status MScGEOLAusIMM CP GEOL

Membership No. 222757

Company **White Geotechnical Group Pty Ltd**

GEOTECHNICAL INVESTIGATION:

New House at **1164 Barrenjoey Road, Palm Beach**

1. Proposed Development

1.1 Demolish the existing house.

1.2 Construct a new part four storey house with garage and driveway below by excavating to a maximum depth of ~13.7m. The garage floor, services floor, ground floor, first floor and second floor portions of the excavation reach maximum depths of ~13.7m, ~10.0m, ~6.3m, ~4.7m and ~6.0m respectively.

1.3 Construct a new pool attached to the proposed house that is accessed from the second floor.

1.4 Landscaping works at the downhill side of the house and above the proposed garage requiring filling to a maximum depth of ~2.7m.

1.5 Details of the proposed development are shown on 24 drawings prepared by Rama Architects, drawings numbered DA-000, DA-001, DA-100 to DA-105, DA-300 to DA-303, DA-400, DA-401, DA500 to DA0505, DA-800, and DA-900 to DA-902, Revision 01, dated 5/11/24.

2. Site Description

2.1 The site was inspected on the 27th August, 2024.

2.2 This residential property is on the high side of the road and has a N aspect. It is located on the steeply graded middle reaches of a hillslope. The natural slope rises across the property at an average angle of ~29°. The slopes above and below the property gradually decrease in grade.

2.3 A steeply graded garden area rises from the road frontage (Photos 1 & 2). Fill to an estimated depth of ~1.0m provides a level platform for a lawn area at the downhill side of the house (Photo 3). The fill batter merges into the natural steep slope below (Photos 1 & 2). The single storey house with balcony is supported on sandstone block walls, sandstone block piers and brick piers (Photos 3 & 4). Some of the supporting piers are tilting downslope slightly (Photo 4), but the house will be demolished as part of the proposed works. Medium Strength Sandstone bedrock outcrops at the uphill side of the house and steps up the steep slope at the uphill side of the property (Photos 5 to 7). Some of the exposed rock faces display some minor jointing and undercutting, but appear to be currently stable. The slope across the uphill side of the property is densely vegetated (Photo 8).

3. Geology

The Sydney 1:100 000 Geological Sheet indicates the contact of Hawkesbury Sandstone and the Narrabeen Group Rocks is near the uphill property boundary, although at a residential scale the map is not always accurate. It is interpreted from ground testing and observations of the slope geomorphology that the contact is near the existing house and the proposed works are underlain by the Narrabeen Group at the downhill side and Hawkesbury Sandstone at the uphill side. The Narrabeen Group rocks are described as interbedded laminite, shale, and quartz to lithic quartz sandstone. Hawkesbury Sandstone is described as a medium to coarse grained quartz sandstone with very minor shale and laminite lenses.

4. Subsurface Investigation

One hand Auger Hole (AH) was put down to identify the soil materials. Eight Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to weathered rock. The locations of the tests are shown on the site plan attached. It should be noted that a level of caution should be applied when interpreting DCP test results. The test will not pass through hard buried objects so in some instances it can be difficult to determine whether refusal has occurred on an obstruction in the profile or on the

natural rock surface. This is expected to have occurred for DCP5. Due to the possibility that the actual ground conditions vary from our interpretation there should be allowances in the excavation and foundation budget to account for this. We refer to the appended "Important Information about Your Report" to further clarify. The results are as follows:

AUGER HOLE 1 (~RL26.0) **–** AH1 (Photo 9)

Depth (m)	Material Encountered
0.0 to 0.4	**FILL**, sandy soil, with some rock fragments, dark brown, dry, fine to coarse grained.
0.4 to 0.9	**TOPSOIL**, sandy soil, dark brown, moist, fine to medium grained.
0.9 to 1.2	**CLAY**, yellow brown, stiff to very stiff, moist.
1.2 to 1.4	**CLAY**, derived from weathered shale, grey, orange red, maroon, mottled, very stiff to hard, moist.

Refusal @ 1.4m on weathered shale. No water table encountered.

DCP TEST RESULTS ON NEXT PAGE

DCP TEST RESULTS – Dynamic Cone Penetrometer								
Equipment: 9kg hammer, 510mm drop, conical tip.						Standard: AS1289.6.3.2 -1997		
Depth(m) Blows/0.3 m	**DCP 1** (~RL36.4)	**DCP 2** (~RL32.0)	**DCP 3** (~RL32.4)	**DCP 4** (~RL27.2)	**DCP 5** (~RL25.7)	**DCP 6** (~RL23.9)	**DCP 7** (~RL30.0)	**DCP 8** (~RL26.0)
0.0 to 0.3	5	17	8	4	6	3	Rock exposed at the surface	6
0.3 to 0.6	4	12	17	10	6	4		10
0.6 to 0.9	5	11	10	32	#	5		10
0.9 to 1.2	14	25	11	#		12		17
1.2 to 1.5	#	55	12			14		30
1.5 to 1.8		#	14			28		11
1.8 to 2.1			#			27		#
2.1 to 2.4						35		
2.4 to 2.7						39		
2.7 to 3.0						#		
	Refusal on Rock @ 1.0m	Refusal on Rock @ 1.4m	Refusal on Rock @ 1.8m	Refusal on Rock @ 0.9m	Refusal @ 0.5m	End of Test @ 2.7m		Refusal on Rock @ 1.6m

#refusal/end of test. F=DCP fell after being struck showing little resistance through all or part of the interval.

DCP Notes:

DCP1 – Refusal on Rock @ 1.0m, DCP bouncing off rock surface, white sandstone fragments and dark brown soil on moist tip.

DCP2 – Refusal on Rock @ 1.4m, DCP bouncing off rock surface, white sandstone fragments and dark brown soil on dry tip.

DCP3 – Refusal on Rock @ 1.8m, DCP bouncing off rock surface, white sandstone fragments and dark brown soil on dry tip.

DCP4 – Refusal on Rock @ 0.9m, DCP bouncing off rock surface, orange impact dust and dark brown soil on dry tip.

DCP5 – Refusal @ 0.5m, DCP bouncing, white and brown impact dust on dry tip.

DCP6 – End of Test @ 2.7m, DCP still very slowly going down, light grey shale fragments and dark brown soil on dry tip.

DCP7 – Medium Strength Sandstone exposed at the surface.

DCP8 – Refusal on Rock @ 1.6m, DCP bouncing off rock surface, white rock fragments and light brown/orange clay on moist tip.

5. Geological Observations/Interpretation

The uphill side of the property is underlain by fill and topsoil over Medium Strength Sandstone bedrock that was exposed at the surface at various locations (Photos 5 to 7). DCPs 1 to 4 encountered this ground material at depths of between ~0.9m to ~1.8m below the current surface, being deeper in the filled areas and slightly variable due to the stepped nature of the rock. The contact between Hawkesbury Sandstone and the Narrabeen Group Rocks is interpreted to be at a level close to the ground floor of the existing house. Below this level the downhill side of the proposed works are interpreted to be underlain by the Narrabeen Group Rocks.

The downhill side of the property is underlain by fill, topsoil, and clay over weathered rock. In DCPs 6 & 8, the clays merge into the weathered zone of the underlying rock at depths of between ~1.4m to ~2.1m below the current surface, being deeper where the fill is deeper (DCP6). The weathered zone of the underlying rock is interpreted as Extremely Low to Low Strength Rock. It is to be noted that this material is a soft rock and can appear as a mottled stiff clay when it is cut up by excavation equipment. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

Ground water seepage is expected to move over the denser and less permeable clay and weathered rock layers in the sub-surface profile and to a lesser extent, through the cracks in the rock. Due to the slope and elevation of the block, the water table is expected to be many metres below the base of the proposed works. Ground water seepage may be slightly elevated around the contact of the Hawkesbury Sandstone and Narrabeen Group Rocks.

7. Surface Water

No evidence of surface flows were observed on the property during the inspection. Due to the steep grade of the slope above the uphill side of the property, it is recommended as part of the development a cut off drain be installed across the upper reaches of the site to catch

surface flows from the slope above. A suitable location for this cut off drain would be near the uphill side of the proposed new house. The captured flows from this drain should be piped to the street. As current modelling indicates weather conditions on the East Coast will become more extreme into the future all drains, pits and associated plumbing are to be oversized and designed to cope with extreme prolonged rainfall events. The drain is to be the first thing constructed on the site as part of the development and is to be designed by a stormwater or civil engineer in consultation with the geotechnical consultant. It is a condition of the slope stability assessment in Section 8 (**Hazard One**) that this be done.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The steeply graded slope that rises across the property and continues above and below is a potential hazard (**Hazard One**). The vibrations produced during the proposed excavation are a potential hazard (**Hazard Two**). The proposed excavation is a potential hazard until retaining structures are in place (**Hazard Three**). The proposed landscaping fill is a potential hazard until retaining walls are in place (**Hazard Four**).

RISK ANALYSIS SUMMARY ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The steep slope that rises across the property and continues above and below failing and impacting on the property.	The vibrations produced during the proposed excavation for the house impacting on the surrounding structures.
LIKELIHOOD	'Unlikely' (10^{-4})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})
RISK TO LIFE	8.3×10^{-7}/annum	5.3×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE', provided the recommendations in **Section 7 & 18** are carried out.	This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Sections 11 & 12** are to be followed.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

RISK ANALYSIS SUMMARY CONTINUES ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard Three	Hazard Four
TYPE	The proposed excavation for the house collapsing onto the worksite and impacting the neighbouring properties during the excavation process.	The proposed landscaping fill failing and impacting on the workers below before the retaining walls are in place.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Major' (45%)	'Medium' (13%)
RISK TO PROPERTY	'High' (6×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	7.4×10^{-4}/annum	3.7×10^{-5}/annum
COMMENTS	This level of risk to life and property is 'UNACCEPTABLE'. To move the risk to 'ACCEPTABLE' levels, the recommendations in **Section 13** are to be followed.	This level of risk to life and property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels the recommendations in **Section 14** are to be followed.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

9. Suitability of the Proposed Development for the Site

The proposed development is suitable for the site. No geotechnical hazards will be created by the completion of the proposed development provided it is carried out in accordance with the requirements of this report and good engineering and building practice.

10. Stormwater

The fall is to Barrenjoey Road. All stormwater from the proposed development is to be piped to the street drainage system through any tanks that may be required by the regulating authorities.

11. Excavations

An excavation to a maximum depth of ~13.7m is required to construct the proposed new house with garage and driveway below. The garage floor, services floor, ground floor, first floor and second floor portions of the excavation reach maximum depths of ~13.7m, ~10.0m, ~6.3m, ~4.7m and ~6.0m respectively.

The second and first floor portions of the excavation are expected to be through fill and topsoil, with Medium Strength Sandstone or better expected at depths of up to 1.8m below the current surface where it is not exposed.

The garage floor, services and lower ground floor portions of the excavation are expected to encounter similar ground materials at the uphill side. But the majority is expected to be through fill, topsoil, and clay, with Extremely Low to Low Strength Rock expected at depths of between ~1.0m to ~2.1m below the current surface, being deeper in the filled areas.

It is envisaged that excavations through fill, soil, clay, and rock up to Low Strength can be carried out with an excavator and toothed bucket and excavations through Medium Strength Rock or better will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavations through fill, soil, clay, and rock up to Low Strength will be below the threshold limit for building damage utilising a domestic sized excavator up to 16 tonnes.

Excavations through Medium Strength Rock or better should be carried out to minimise the potential to cause vibration damage to the W neighbouring pool, W neighbouring house, E neighbouring house, the water main (100mm diameter Cast Iron Cement Lined pipe, invert depth is unknown) and the sewer main (150mm diameter vitrified clay pipe, invert at 1.4m). Allowing for backwall drainage, the setbacks as follows:

- ~2.5m from the sewer main and over the footprint of the water main at the location of the proposed driveway. The invert depth of the water main is currently unknown. The water main will likely need to be diverted under the guidance and approval of Sydney Water. This approval is to be determined prior to the excavation commencing.

- ~3.8m from the W neighbouring pool, ~5.1m from the W neighbouring house and ~4.1m from the E neighbouring house.

Dilapidation reporting carried out on the W and E neighbouring properties is recommended prior to the excavation works commencing to minimise the potential for spurious building damage claims.

Excavation methods are to be used that limit peak particle velocity to 5mm/sec at the W neighbouring pool, W neighbouring house, E neighbouring house, the water main and the sewer main. Vibration monitoring will be required to verify this is achieved. Vibration monitoring must include a light/alarm so the operator knows if vibration limits have been exceeded. The equipment is to log and record vibrations throughout the excavation works.

In Medium Strength rock or better techniques to minimise vibration transmission will be required. These include:

- Rock sawing the excavation perimeter to at least 1.0m deep prior to any rock breaking with hammers, keeping the saw cuts below the rock to be broken throughout the excavation process.
- Limiting rock hammer size.
- Rock hammering in short bursts so vibrations do not amplify.
- Rock breaking with the hammer angled away from the nearby sensitive structures.
- Creating additional saw breaks in the rock where vibration limits are exceeded, as well as reducing hammer size as necessary.
- Use of rock grinders (milling head).

Should excavation induced vibrations exceed vibration limits after the recommendations above have been implemented, excavation works are to cease immediately and our office is to be contacted.

It is worth noting that vibrations that are below thresholds for building damage may be felt by the occupants of the neighbouring houses.

13. Excavation Support Requirements

It is recommended, before the structural design commences for the project, exploration core drilling is to be carried out on the site to confirm to the rock quality and strength below the existing house. This is to be arranged and supervised by the geotechnical consultant and should consist of a minimum of two cored bore holes taken to a depth of not less than 9.0m at the downhill side of the existing house and 11.0m near the uphill side. The following ground support advice can be considered preliminary and will be reviewed on recovery of the drill core. It may change as a result of the assessment of the drill core.

As this job is considered technically complex and due to the depth of the excavation, we recommend it be carried out by builders and contractors who are well experienced in similar work and can provide a proven history of completed work. We recommend a pre-construction meeting between the structural engineer, the builder, and the geotechnical consultant to discuss and confirm the excavation plan and to ensure suitable excavation equipment will be on site.

On steep sites such as this one, to help maintain excavation stability before retaining walls are in place, it is critical upslope runoff be diverted from the proposed excavation with the permanent drainage measures outlined in **Section 7**.

An excavation to a maximum depth of ~13.7m is required to construct the proposed new house with garage and driveway below. Allowing for backwall drainage, the setbacks are as follows:

- Over the footprint of the water main at the location of the proposed driveway. The invert depth of the water main is currently unknown. The water main will likely need to be diverted under the guidance and approval of Sydney Water. This approval is to be determined prior to the excavation commencing.

- The garage floor and services floor portions of the excavation are set back ~2.0m from the E common boundary, ~4.1m from the E neighbouring house and ~3.9m from the W common boundary.

- The ground floor and first floor portions of the excavation are set back ~1.2m from the W common boundary.

- Given the exposed Medium Strength Sandstone bedrock and the depth to rock shown by the test results, the second floor portion of the excavation is set back sufficiently from the surrounding structures and property boundaries.

The above structures and property boundaries within the zone of influence of the excavation. In this instance, the zone of influence is the area above a theoretical 30° line (from horizontal) through fill/soil and a 45° line through clay / weathered rock from the base of the excavation or the top of Medium Strength Rock, whichever comes first, towards the surrounding structures and boundaries.

The uphill portion of the proposed excavation is interpreted to through fill, topsoil and Medium Strength Hawkesbury Sandstone or better. The downhill portion from the ground floor level of the existing house is interpreted to be through fill, topsoil, clay and Extremely Low to Low Strength Rock of the Narrabeen Group Rocks. The contact between these two

rock groups is expected to be at or slightly downslope of the outcropping rock at the uphill side of the existing house (Photo 5).

It is recommended the excavation be carried out from uphill side of the second floor to the downhill side of the ground floor before commencing the lower levels of the excavation for the services floor, garage floor and driveway. The second floor, ground floor and first floor portions of the excavation are expected to be through mostly Hawkesbury Sandstone geology.

Bulk Excavation for Second Floor, First Floor and Ground Floor

Due to the proximity of the ground and first floors to the E common boundary and the depths of the cut faces, the perimeter of the excavation through fill, soil, clay, and rock up to Low Strength will need to be temporarily or permanently supported prior to the commencement of the excavation, or during the excavation process in a staged manner, so cut batters through fill, soil, clay and rock up to Low Strength are not left unsupported. The support will need to be designed by the structural engineer. See the site plan attached for the minimum extent of the required shoring shown in green.

Medium Strength Sandstone or better is expected to stand at vertical angles unsupported subject to approval by the geotechnical consultant.

During the excavation process, the geotechnical consultant is to inspect the excavation in 1.5m intervals as it is lowered to ensure ground materials are as expected and no wedges or other geological defects are present that could require additional support. If additional ground support is required this will likely involve the use of mesh, rock bolts and sprayed concrete. This may be required if Narrabeen Shale is encountered below the Hawkesbury Sandstone during the excavation for the ground floor.

The excavation perimeter will need to be slightly widened/extended where required to allow sufficient space to install the required ground support for the Garage Floor and Services Floor as discussed below:

Bulk Excavation for Services Floor, Garage Floor and Driveway

Due to the depth of the excavation and its proximity to the surrounding structures and common boundaries, all sides of the services floor, garage floor and driveway will require ground support prior to the commencement of these portions of the excavation. The ground support is to be installed following the completion of the second, first and ground floor portions of the excavation.

A spaced pile retaining wall is one of the suitable methods of support. See the Garage Floor and Services Floor plans attached for the minimum extent of the required piling shown in blue. Pier spacing is typically ~2.0m but can vary between 1.6 to 2.4m depending on the design. As the excavation is lowered in 1.5m lifts, infill sprayed concrete panels or similar are added between the piers to form the wall. Drainage is to be installed behind the panels. To drill the pier holes for the walls, a pilling rig that can excavate through Medium to High Strength Rock will be required. The piers can be temporarily supported by embedment below the base of the excavation or with a combination of embedment and propping. The walls are to be tied into the driveway, garage floor, services floor and ground floor slabs to provide permanent bracing after which any temporary bracing can be released.

The geotechnical consultant is to inspect the drilling process of the entire first pile and the ground materials at the base of all pile holes/excavations installed for ground support purposes.

During the excavation process, the geotechnical consultant is to inspect the cut face in 1.5m intervals as it is lowered to ensure ground materials are as expected and that additional support is not required.

Advice Applying to all Levels of the Excavation

Loose boulders or detached joint blocks immediately above the proposed excavation faces are to be removed before any excavation commences.

Any trees near the proposed cut are to be assessed by an arborist and removed if their stability will be detrimentally impacted by the excavation.

As discussed above upslope runoff is to be diverted from the cut faces by drainage diversion works. The materials and labour to construct the retaining walls are to be organised so shoring walls can be installed as required. The excavation is to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

All excavation spoil is to be removed from site following the current Environmental Protection Agency (EPA) waste classification guidelines.

14. Fill

Fill will be placed for landscaping at the downhill side of the house and above the proposed garage. No fills are to be laid until the retaining walls are in place. The fill will reach a maximum depth of ~2.7m. Filling to this depth without appropriate compaction will result in significant settlement.

To avoid excessive settlement, the fill is to be placed in loose layers not exceeding 0.15m thick before being compacted as follows:

Non-Cohesive Soils (sandy fills)

The proposed fill for landscaping is to be compacted to a Minimum Density Index (ID) of 65%.

Cohesive Soils (clayey fill & excavated bedrock)

The proposed fill for landscaping is to be compacted to at least 95% of Standard Maximum Dry Density.

The geotechnical consultant is to inspect and test the fill as it is laid in 0.9m rises to ensure the required density has been achieved.

The fill should be compacted with light weight equipment such as a hand operated plate compacter or similar so as to not damage the retaining wall or slab below. No pavements or structures are to be supported on fill.

15. Retaining Structures

For cantilever or singly propped retaining structures it is suggested the design be based on a triangular distribution of lateral pressures using the parameters shown in Table 1.

Table 1 – Likely Earth Pressures for Retaining Structures

Unit	Earth Pressure Coefficients				
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0	Passive	Bond Stress
Fill and Topsoil	20	0.40	0.55	N/A	N/A
Residual Clays	20	0.35	0.45	Kp = 2.0 'ultimate'	20kPa 'ultimate'
Extremely Low to Very Low Strength Rock	22	0.25	0.38	Kp = 2.5 'ultimate'	70kPa 'ultimate'
Low Strength Rock	24	0.20	0.35	1000kPa 'ultimate'	300kPa 'ultimate'
Medium Strength Rock	24	0.00	0.01	2000kPa 'ultimate'	600kPa 'ultimate'

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region".

It is to be noted that the earth pressures in Table 1 assume a level surface above the structure and do not account for any surcharge loads, noting that surcharge loads from the structures and slope above will be acting on the wall. It also assumes retaining structures are fully

drained. It should be noted that passive pressure and bond stress are ultimate values and should have an appropriate safety factor applied. No passive resistance should be assumed for the top 0.4m to account for any disturbance from the excavation. Ground materials and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

A multi-propped or anchored shoring system can be designed using a rectangular lateral earth pressure distribution using a pressure of 4H kPa for soil/clay and 3H kPa for rock up to low strength, where H is the depth of the excavation in metres (or to the top of competent medium strength rock). Where small movements are not tolerable, the wall can be designed using a pressure of 6H kPa for soil/clay and 4H kPa for rock up to low strength. Using these values will give relatively conservative support. More refined design can be obtained using an appropriate retaining wall design program.

All retaining structures are to have sufficient back-wall drainage and be backfilled immediately behind the structure with free-draining material (such as gravel). This material is to be wrapped in a non-woven Geotextile fabric (i.e. Bidim A34 or similar), to prevent the drainage from becoming clogged with silt and clay. If no back-wall drainage is installed in retaining structures, the likely hydrostatic pressures are to be accounted for in the structural design.

16. Site Classification

The site classification in accordance with AS2870-2011 is Class P due to the depth of the fill and the steep grade of the slope.

17. Foundations

The majority of the proposed house, garage and driveway are expected to be seated in Extremely Low Strength Rock or better. This is a suitable foundation material. Where the proposed structures are not seated in weathered rock, such as at the NW corner of the ground floor and downhill edge of the driveway, piers taken to and embedded no less than 0.6m into

Extremely Low Strength Rock or better will be required to maintain a uniform foundation material across the structure. This ground material is expected at depths up to ~2.1m below the current surface where it is not exposed, being deeper in the filled areas. A maximum allowable bearing pressure of 600kPa can be assumed for footings embedded in Extremely Low Strength Rock or better.

As the bearing capacity of weathered rock reduces when it is wet, we recommend the footings be dug, inspected, and poured in quick succession (ideally the same day if possible). If the footings get wet, they will have to be drained and the soft layer of weathered rock on the footing surface will have to be removed before concrete is poured.

If a rapid turnaround from footing excavation to the concrete pour is not possible, a sealing layer of concrete may be added to the footing surface after it has been cleaned and inspected.

NOTE: If the contractor is unsure of the footing material required it is more cost effective to get the geotechnical professional on site at the start of the footing excavation to advise on footing depth and material. This mostly prevents unnecessary over excavation in clay like shaly rock but can be valuable in all types of geology.

18. Ongoing Maintenance

Where slopes are steep and approach or exceed 30°, such as on this site, it is prudent for the owners to occasionally inspect the slope (say annually or after heavy and prolonged rainfall events, whichever occurs first). Should any of the following be observed: movement or cracking in retaining walls, cracking in any structures, cracking or movement in the slope surface, tilting or movement in established trees, leaking pipes, or newly observed flowing water, or changes in the erosional process or drainage regime, then a geotechnical consultant should be engaged to assess the slope. We can carry out these inspections upon request. The risk assessment in **Section 8** is subject to this ongoing maintenance being carried out.

19. Geotechnical Review

The structural plans are to be checked and certified by the geotechnical engineer as being in accordance with the geotechnical recommendations. On completion, a Form 2B will be issued. This form is required for the Construction Certificate to proceed.

20. Inspections

The client and builder are to familiarise themselves with the following required inspections as well as council geotechnical policy. We cannot provide geotechnical certification for the Occupation Certificate if the following inspections have not been carried out during the construction process.

- The geotechnical consultant is to inspect the ground materials while the first pile for the ground support is being dug to assess the ground strength and to ensure it is in line with our expectations. All finished pile holes for piled wall/excavations for ground support are to be inspected and measured before concrete is placed.
- During the excavation process, the geotechnical consultant is to inspect the cut face in 1.5m intervals as it is lowered to ensure ground materials are as expected and that additional support is not required.
- All footings are to be inspected and approved by the geotechnical consultant while the excavation equipment and contractors are still onsite and before steel reinforcing is placed or concrete is poured.

White Geotechnical Group Pty Ltd.

Reviewed By:

Dion Sheldon
BEng(Civil)(Hons),
Geotechnical Engineer.

Ben White M.Sc. Geol.,
AIG., RPGeo Geotechnical & Engineering.
No. 10306
Engineering Geologist.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

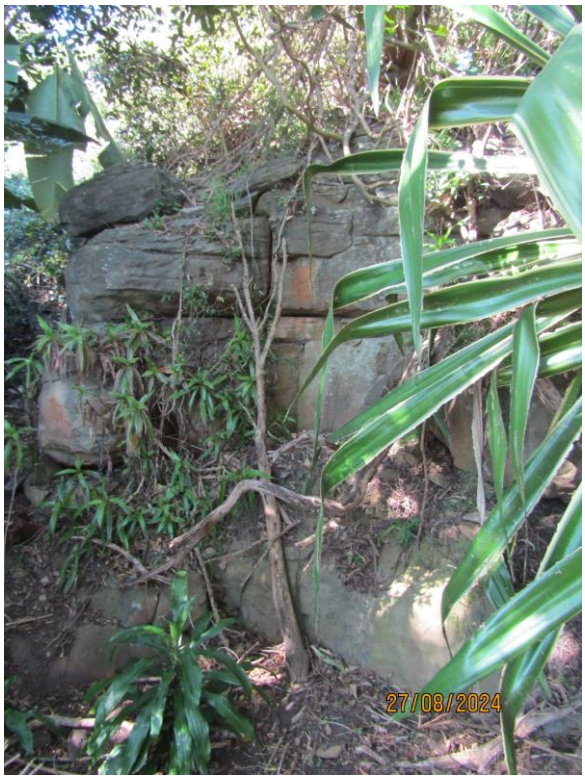


Photo 6

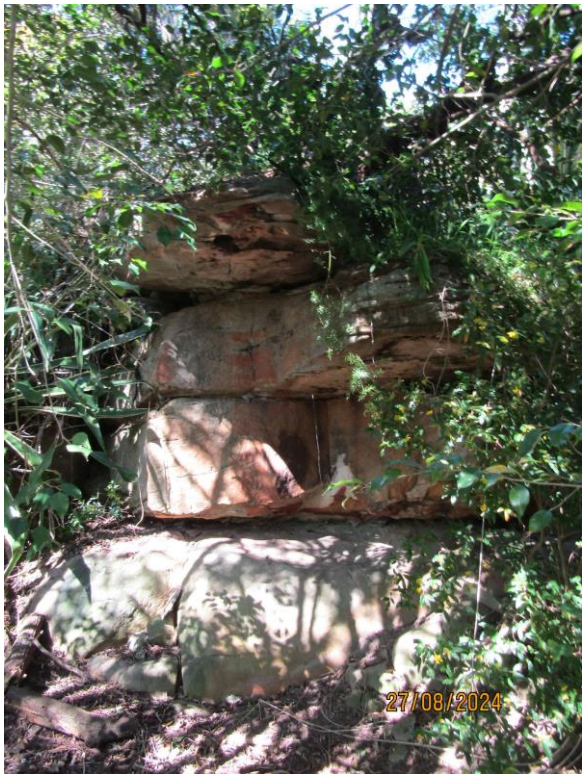


Photo 7

Photo 8

Photo 9: AH1 – Downhole is from top to bottom.

Important Information about Your Report

It should be noted that Geotechnical Reports are documents that build a picture of the subsurface conditions from the observation of surface features and testing carried out at specific points on the site. The spacing and location of the test points can be limited by the location of existing structures on the site or by budget and time constraints of the client. Additionally, the test themselves, although chosen for their suitability for the particular project, have their own limiting factors. The testing gives accurate information at the location of the test, within the confines of the test's capability. A geological interpretation or model is developed by joining these test points using all available data and drawing on previous experience of the geotechnical consultant. Even the most experienced practitioners cannot determine every possible feature or change that may lie below the earth. All of the subsurface features can only be known when they are revealed by excavation. As such, a Geotechnical report can be considered an interpretive document. It is based on factual data but also on opinion and judgement that comes with a level of uncertainty. This information is provided to help explain the nature and limitations of your report.

With this in mind, the following points are to be noted:

- If upon the commencement of the works the subsurface ground or ground water conditions prove different from those described in this report, it is advisable to contact White Geotechnical Group immediately, as problems relating to the ground works phase of construction are far easier and less costly to overcome if they are addressed early.

- If this report is used by other professionals during the design or construction process, any questions should be directed to White Geotechnical Group as only we understand the full methodology behind the report's conclusions.

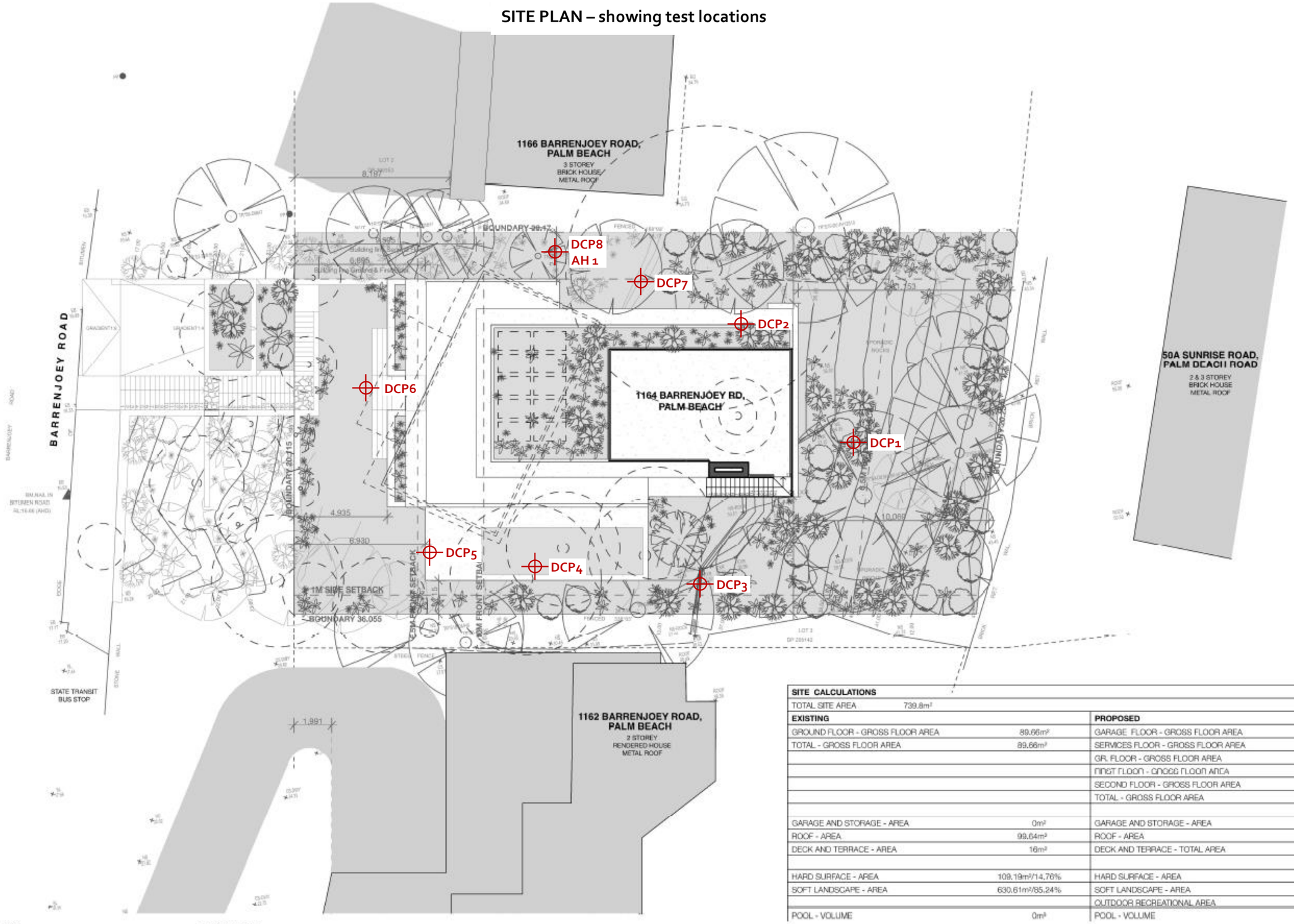
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- This report should not be applied to any other project other than that outlined in section 1.0.

- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar with a variety of techniques to reduce risk and can advise if your proposed methods are suitable for the site conditions.

SITE PLAN – showing test locations



SITE CALCULATIONS			
TOTAL SITE AREA	739.8m²		
EXISTING		**PROPOSED**	
GROUND FLOOR - GROSS FLOOR AREA	89.66m²	GARAGE FLOOR - GROSS FLOOR AREA	23.63m²
TOTAL - GROSS FLOOR AREA	89.66m²	SERVICES FLOOR - GROSS FLOOR AREA	58.37m²
		GR. FLOOR - GROSS FLOOR AREA	139.16m²
		FIRST FLOOR - GROSS FLOOR AREA	126.48m²
		SECOND FLOOR - GROSS FLOOR AREA	117.36m²
		TOTAL - GROSS FLOOR AREA	465m²
GARAGE AND STORAGE - AREA	0m²	GARAGE AND STORAGE - AREA	124.72m²
ROOF - AREA	99.64m²	ROOF - AREA	199.38m²
DECK AND TERRACE - AREA	16m²	DECK AND TERRACE - TOTAL AREA	124.7m²
HARD SURFACE - AREA	109.19m²/14.76%	HARD SURFACE - AREA	286.3m²/38.7%
SOFT LANDSCAPE - AREA	630.61m²/85.24%	SOFT LANDSCAPE - AREA	405.4m²/54.8%
		OUTDOOR RECREATIONAL AREA	48.1m²/6.5%
POOL - VOLUME	0m³	POOL - VOLUME	46.82m³

SITE PLAN A1 @1:200

NORTH

NOTE: THESE DRAWINGS ARE NOT FOR CONSTRUCTION, FOR DA APPROVAL ONLY
NOTE: DO NOT SCALE OFF THIS DRAWING
NOTE: ALL WORKS TO BE IN ACCORDANCE WITH THE N.C.C. 2022
NOTE: ALL WORKS TO BE IN ACCORDANCE WITH THE RELEVANT AUSTRALIAN STANDARDS
NOTE: ALL WORKS TO BE IN ACCORDANCE WITH THE BASIX REQUIREMENTS
NOTE: ALL WORKS TO BE IN ACCORDANCE WITH CONSULTANTS REQUIREMENTS

KEY:

- DENOTES EXISTING STRUCTURE TO BE RETAINED
- DENOTES PROPOSED NEW STRUCTURE
- DENOTES AREA OF SOFT LANDSCAPING
- DENOTES AREA OF SWIMMING POOL
- DENOTES EXISTING STRUCTURE TO BE DEMOLISHED

PROJECT: NEW RESIDENTIAL DWELLING

CLIENT: JOHNSON & THOMSON

LOCATION: 1164 BARRENJOEY ROAD, PALM BEACH, NSW

PROJECT STAGE: DEVELOPMENT APPLICATION

DRAWING TITLE: COVER & SITE INFORMATION: SITE PLAN

SCALE: 1:200 @ A3

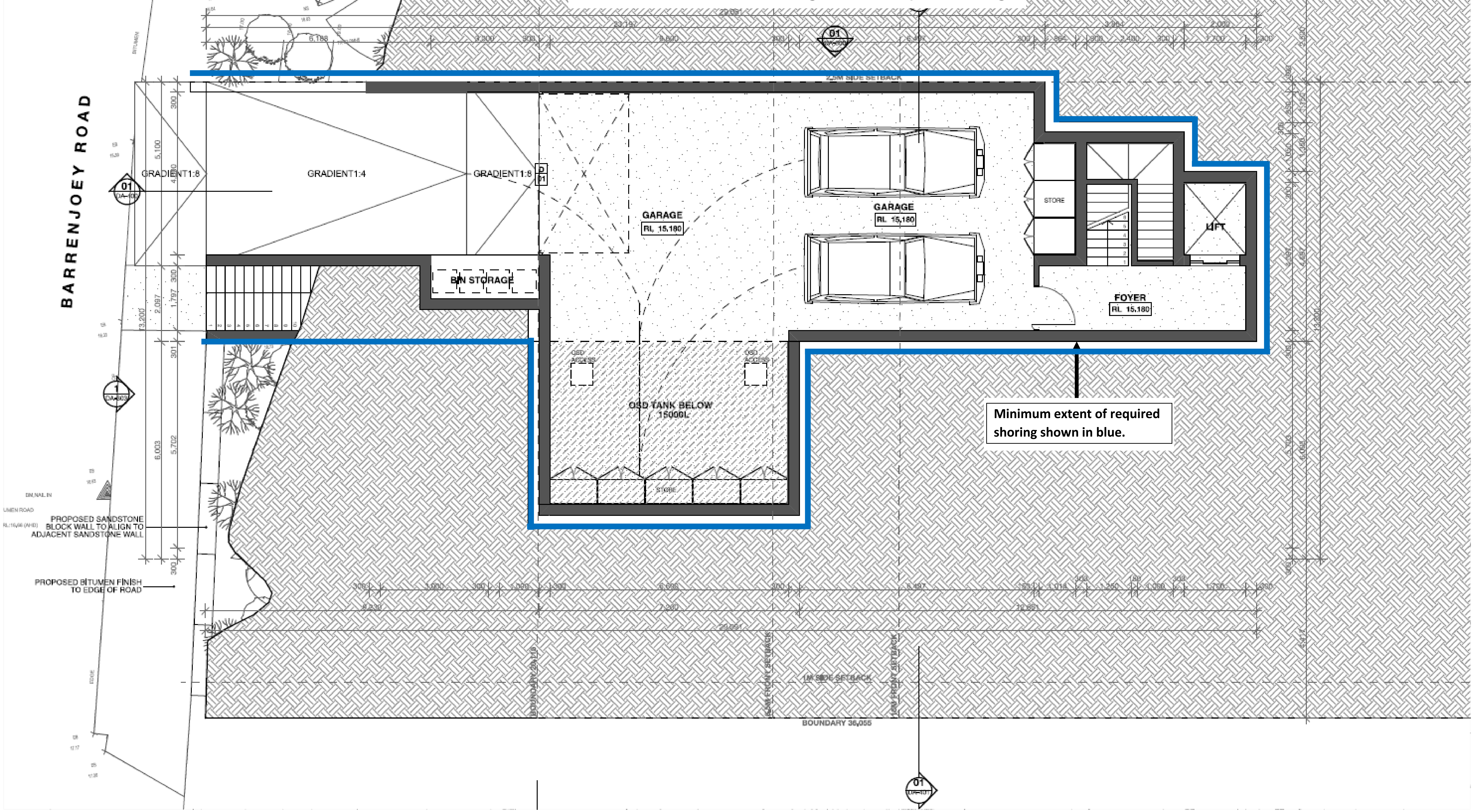
DATE OF ISSUE: 5/11/24

DRAWING NO. DA-001

REVISION: 01

r a m a

GARAGE FLOOR PLAN – showing extent of required shoring



GARAGE FLOOR A3 @1:100

NORTH

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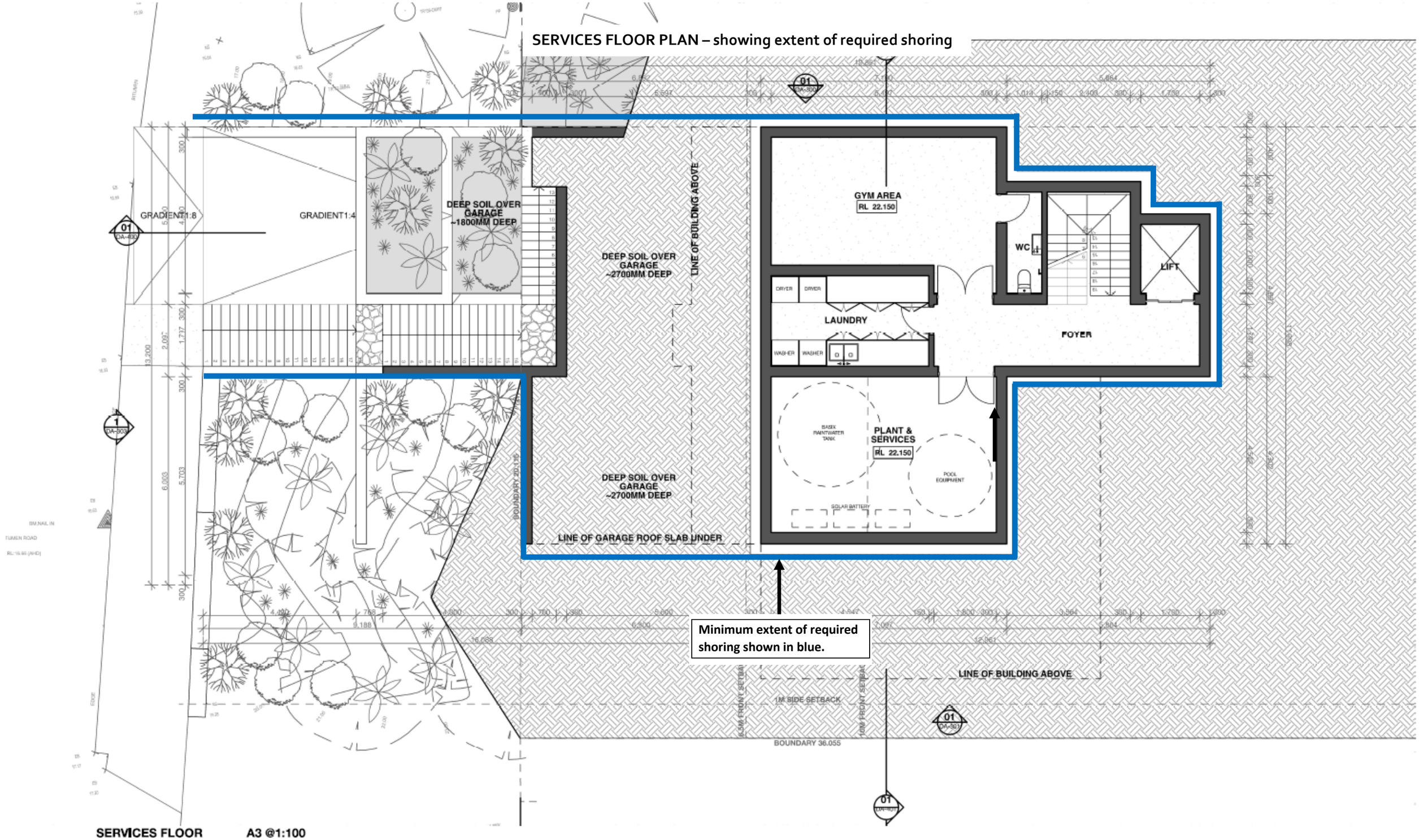
PROJECT: NEW RESIDENTIAL DWELLING
CLIENT: JOHNSON & THOMSON
LOCATION: 1164 BARRENJOEY ROAD, PALM BEACH, NSW

PROJECT STAGE: DEVELOPMENT APPLICATION
DRAWING TITLE: GENERAL ARRANGEMENT PLANS: GARAGE FLOOR
SCALE: 1:100 @ A3

DATE OF ISSUE: 5/11/24
DRAWING NO. DA-100
REVISION: 01

r a m a

SERVICES FLOOR PLAN – showing extent of required shoring



SERVICES FLOOR A3 @1:100

NORTH

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PROJECT:
NEW RESIDENTIAL DWELLING

CLIENT:
JOHNSON & THOMSON

LOCATION:
1164 BARRENJOEY ROAD,
PALM BEACH, NSW

PROJECT STAGE:
DEVELOPMENT APPLICATION

DRAWING TITLE:
GENERAL ARRANGEMENT PLANS: SERVICES FLOOR

SCALE:
1:100 @ A3

DATE OF ISSUE:
5/11/24

DRAWING NO.
DA-101

REVISION:
01

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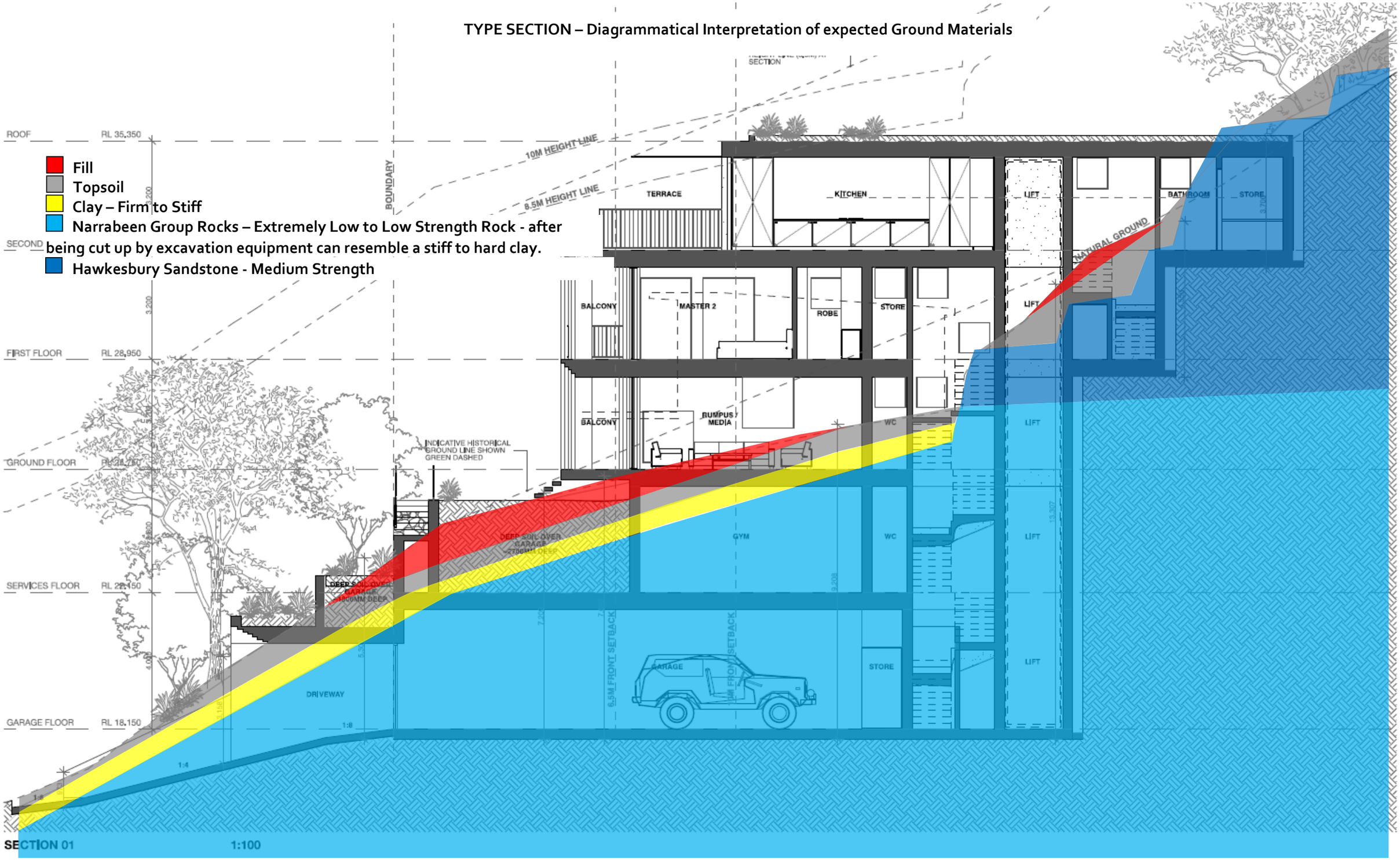
TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials

- Fill
- Topsoil
- Clay – Firm to Stiff
- Narrabeen Group Rocks – Extremely Low to Low Strength Rock - after being cut up by excavation equipment can resemble a stiff to hard clay.
- Hawkesbury Sandstone - Medium Strength



SECTION 01 1:100

KEY:

- DENOTES EXISTING STRUCTURE TO BE RETAINED
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PROJECT: NEW RESIDENTIAL DWELLING

CLIENT: JOHNSON & THOMSON

LOCATION: 1164 BARRENJOEY ROAD, PALM BEACH, NSW

PROJECT STAGE: DEVELOPMENT APPLICATION

DRAWING TITLE: SECTIONS: SHEET 01

SCALE: 1:100 @ A3

DATE OF ISSUE: 5/11/24

DRAWING NO. DA–400

REVISION: 01

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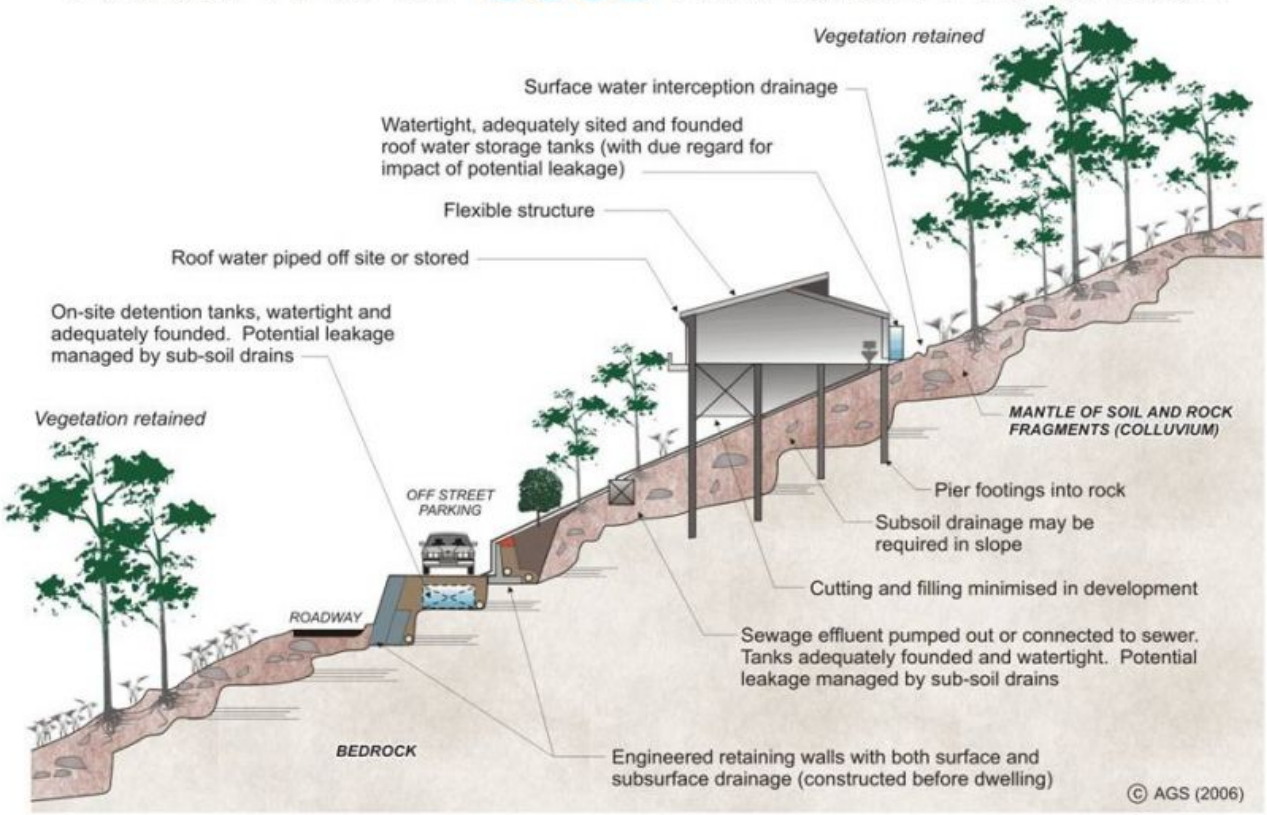
EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE