

GEOTECHNICAL INVESTIGATION:

For Proposed Landscaping at **15 Myoora Road, Terrey Hills**

1. Proposed Development

- 1.1** Re-landscape a large portion of the N side of the property by excavating to a maximum depth of ~1.8m and filling to a maximum height of ~2.6m.
- 1.2** Construct a new fence at the road frontage to the property.
- 1.3** Details of the proposed development are shown on 7 drawings prepared by Cadence and Co Design, Project number FON, drawings numbered DA00 to DA06, Issue PC2, dated 6/5/2020.

2. Site Description

- 2.1** The site was inspected on the 3rd June, 2020, and previously on the 20th February, 2018.
- 2.2** This large rural/residential property is on the low side of the road and has a N aspect. The block runs longways to the W so the slope is a cross-fall. The block is located on the gentle to moderately graded upper reaches of a hillslope. The slope falls gently across the E quarter of the site before increasing to an average angle of ~18° across the remainder of the site. The slope above the property continues at gentle angles. The grade below the property continues at moderate angles.
- 2.3** At the N end of the road frontage, a concrete driveway runs to a brick and weatherboard clad house on the E side of the property that will be demolished as part of a previous DA (Photos 1 & 2). Another gravel driveway extends off the S end of the road frontage and runs along the uphill side of the property past construction works which are also part of a previous DA (Photo 3). The fill batter for the equestrian arena is lawn-covered, battered to stable angles, and merges into the natural slope (Photo 4). At the base of the fill batter is a small dam that will be filled in as part of the

proposed works (Photo 5). The gravel driveway runs to the main house near the W end of the property (Photo 6). The two-storey brick house is supported on brick walls and brick piers (Photo 7). The supporting brick walls display no significant signs of movement and the supporting brick piers stand vertical. An excavation has been made on the downhill side of the house for a pool (Photo 8). The slope between the house and the pool has been terraced with a series of low timber retaining walls. The retaining walls and pool will be demolished as part of the previous DA. The slope below the house and pool is lawn-covered and fenced off for paddocks (Photos 9 & 10). Competent Medium Strength Sandstone outcrops through the lawn in places (Photo 11). Filling has been placed within a paddock on the downhill side of the property, to the N of the existing pool (Photo 12). The fill batter in this location is lawn-covered, battered to stable angles, and merges into the natural slope.

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by Hawkesbury Sandstone. It is described as a medium to coarse grained quartz sandstone with very minor shale and laminite lenses.

4. Subsurface Investigation

Ground testing was carried out during the previous inspection on the 20th February, 2018 (DCPs 1 to 11). These tests encountered shallow rock across the entire property. During the foundation excavations for the approved stables, it was found that a large ~1.5m deep fill overlies natural sands and clayey sands in the location of that location and most likely under the equestrian arena also. Thus, some of the original DCPs likely encountered refusal on obstructions within this fill. Additionally, a relatively large amount of groundwater was encountered during these foundation excavations.

Fourteen Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to bedrock. The locations of the tests are shown on the site plan. 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 not expected to be an issue for the testing on this site. However, excavation and foundation budgets should always allow for the possibility that the interpreted ground conditions in this report vary from those encountered during excavations. See the appended "Important information about your report" for a more comprehensive explanation. The results are as follows:

DCP TEST RESULTS – Dynamic Cone Penetrometer							
Equipment: 9kg hammer, 510mm drop, conical tip.				Standard: AS1289.6.3.2 - 1997			
Depth(m) Blows/0.3m	DCP 1 (~RL185.0)	DCP 2 (~RL184.0)	DCP 3 (~RL181.8)	DCP 4 (~RL182.4)	DCP 5 (~RL177.4)	DCP 6 (~RL176.7)	DCP 7 (~RL173.5)
0.0 to 0.3	8	20	53	4	33	28	Rock Exposed at Surface
0.3 to 0.6	16	#	30	30	30	#	
0.6 to 0.9	#		#	#	#		
	Refusal on Rock @ 0.5m	Refusal on Rock @ 0.2m	End of Test @ 0.4m	Refusal on Rock @ 0.5m	Refusal on Rock @ 0.5m	Refusal on Rock @ 0.3m	

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

DCP RESULTS CONTINUED 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/0.3m	DCP 8 (~RL175.2)	DCP 9 (~RL175.7)	DCP 10 (~RL179.3)	DCP 11 (~RL180.6)	DCP 12 (~RL177.5)	DCP 13 (~RL175.1)	DCP 14 (~RL168.1)
0.0 to 0.3	22	47	6	10	15	29	4
0.3 to 0.6	18	40	37	34	8F	6	21
0.6 to 0.9	#	#	#	#	2	12	35
0.9 to 1.2					7	22	10
1.2 to 1.5					#	17	21
1.5 to 1.8						13	#
1.8 to 2.1						18	
2.1 to 2.4						#	
	Refusal on Rock @ 0.4m	End of Test @ 0.6m	Refusal on Rock @ 0.6m	End of Test @ 0.6m	Refusal on Rock @ 1.1m	Refusal on Rock @ 1.9m	Refusal on Rock @ 1.3m

#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 @ 0.5m, DCP bouncing off rock surface, white and maroon sandstone fragments on dry tip.

DCP2 – Refusal on rock @ 0.2m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP3 – End of test @ 0.4m, DCP still very slowly going down, orange sandstone fragments on dry tip.

DCP4 – Refusal on rock @ 0.5m, DCP bouncing off rock surface, brown and orange sandstone fragments on dry tip.

DCP5 – Refusal on rock @ 0.5m, DCP thudding, white and brown sandstone fragments on dry tip.

DCP6 – Refusal on rock @ 0.3m, DCP bouncing off rock surface, white impact dust on dry tip.

DCP7 – Rock exposed at surface.

DCP8 – Refusal on rock @ 0.4m, DCP bouncing off rock surface, brown, orange, and maroon sandstone fragments on dry tip.

DCP9 – End of test @ 0.6m, DCP still very slowly going down, brown sandstone fragments on dry tip.

DCP10 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, orange and maroon sandstone fragments on dry tip.

DCP11 – End of test @ 0.6m, DCP still very slowly going down, orange and maroon sandstone fragments on dry tip.

DCP12 – Refusal on rock @ 1.1m, DCP bouncing off rock surface, dark brown soil on damp tip.

DCP13 – Refusal on rock @ 1.9m, DCP bouncing off rock surface, brown clay on wet tip.

DCP14 – Refusal on rock @ 1.3m, DCP bouncing off rock surface, brown and orange sand on wet tip.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the outcropping and underlying sandstone bedrock that steps down the property forming sub-horizontal benches between the steps. Where the grade is steeper, the steps are larger and the benches narrower. Where the slope eases, the opposite is true. Filling has been placed across the N side of the property for landscaping. Where the rock is not exposed, it is overlain by manmade fill, sandy soils, and sandy clays that fill the bench step formation. In the test locations, rock was encountered at shallow depths of ~0.6m or less below the current surface but extended to a maximum depth of ~1.9m. As stated above, some of the previous tests are likely to have encountered refusal on obstructions within the fill and during the foundation excavations for the approved stables, rock was not encountered until depths of between 2.0 to 3.6m in that location. The variation in the rock depth are likely due to the rock being slightly deeper where filling has been placed across the site and due to the stepped nature of the underlying bedrock. During previous inspections on site, it was found that the fill for the equestrian arena reaches a maximum depth of ~1.5m, and it is interpreted that the fill within the paddock on the downhill side of the property also reaches a maximum depth of ~1.5m. The sandstone underlying the property was found to be of low to medium strength and similar strength rock is expected to underlie the entire site. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

During the inspections of the foundation excavations for the approved stables it was found that a relatively large amount of groundwater was flowing over a buried clayey sand layer of the profile in this location. This is interpreted to be a perched water table and may extend across more of the property.

Due to the slope and elevation of the block, the water table is expected to be many metres below the base of the proposed excavation.

7. Surface Water

During the original geotechnical inspection, some evidence of surface flows was observed on the property downslope of the existing horse stables. The water was observed to have flowed into a dam on the slope below the existing equestrian arena.

No other evidence of surface flows were observed on the property during the inspection. Normal sheet wash will move onto the site from the slope above during heavy down pours.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The vibrations from the proposed excavations are a potential hazard (**Hazard One**). The proposed fill is a potential hazard until retaining walls are in place (**Hazard Two**).

RISK ANALYSIS SUMMARY ON THE NEXT PAGE

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The vibrations produced during the proposed excavation impacting on the surrounding structures and boundaries.	The proposed fills failing and impacting on the property.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (25%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7} /annum	7.0×10^{-5} /annum
COMMENTS	This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in Section 12 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

No significant stormwater runoff will be created by the proposed development.

11. Excavations

An excavation to a maximum depth of ~1.8m is required to re-landscape the area to the N of the house. The excavation is expected to be through a maximum of ~1.5m of manmade fill over a thin sandy soil and firm to stiff sandy clay. Medium Strength Sandstone may be

encountered near the base of the proposed excavation. It is envisaged that excavations through fill, sandy soil, and sandy clays can be carried out with a bucket and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

The proposed excavation on the rural property is set back sufficiently from any surrounding structures or boundaries so that vibrations from the excavation will not exceed tolerable limits for building or infrastructure damage.

13. Excavation Support Requirements

The proposed excavation will reach a maximum depth of ~1.8m. However, due to the nature of the existing slope and the desired new levelled slope, the excavation will essentially be equivalent to the removal of a mound of earth and will not leave any excavation batters. The entire excavation will be battered at less than 26° and will therefore be considered stable.

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

14. Fill

From the plans, it is apparent that a fill to maximum height of ~2.6m will be placed across a large portion of the N side of the property for landscaping. Filling to this depth without appropriate compaction will result in a significant settlement. All fill brought onto site is to be certified as 'clean fill' with a VENM certificate or similar documentation in accordance with EPA guidelines.

Site Preparation

The existing dam below the equestrian arena will need to be emptied. The dam liner, whether it be clay or synthetic, will need holes punched through it so seepage can move through the soil profile.

Before any fills are lain, the site is to be properly prepared by stripping the existing loose organic top soil layer and removing all organic matter. This material can be stockpiled for later use as topsoil or removed from site. The upper 150mm depth of the exposed surface is to be compacted to a density index not less than 80% (AS1289.5.6.1–1998). Areas which show visible heave under compaction equipment should be over-excavated a further 0.3m and replaced with approved fill compacted to a density index not less than 80%. Once this is done, the site preparation for the fill can be considered complete.

Compaction

To avoid excessive settlement in filling for landscaping, the fill is to be placed in loose layers not exceeding 0.2m in thickness before being compacted as follows:

Non-Cohesive Soils (sandy fills)

The proposed fill is to be compacted to a Minimum Density Index (ID) of 75%.

Cohesive Soils (clayey fill & excavated bedrock)

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

Where the fill will be placed over the existing dam, the material is to be compacted in an equivalent manner to the surrounding soil.

The geotechnical consultant is to inspect and test the fill as it is laid in 1.2m rises, while the compaction equipment is still on site, to ensure the required density has been achieved.

No structures are to be supported on fill.

Safe Batter Angles – Retaining Walls

The fills will stand permanently at a maximum batter ratio of 1.0 Horizontal: 2.0 Vertical (26°).

Where there is no room for a 1:2 batter, batters can be steepened provided they are supported with boulder walls. Boulders are to be suitably sized - approximately one third the height of the fill in diameter. Any required boulder walls are to have a layer of geotextile fabric between the fill and the rock components of the wall so the fill cannot wash out from

the spaces between the rock during heavy down pours. The fabric is to extend from behind the base of the wall to the behind the very top boulder component. Any boulder walls that may be required are to be designed by a structural engineer.

15. Foundations

The proposed fence at the road frontage will likely be founded on shallow rock though firm to stiff clay is also a suitable footing. Footings can be proportioned for an allowable bearing pressure of 200kPa in firm to stiff clay and 1000kPa on Medium Strength Sandstone.

NOTE: If the contractor is unsure of the footing material required, it is more cost-effective to get the geotechnical consultant 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.

16. 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 owner or the regulating authorities if the following inspections have not been carried out during the construction process.

- The geotechnical consultant is to inspect and test the fill as it is raised to heights not exceeding ~1.2m. This is to ensure the required density has been achieved during compaction.

White Geotechnical Group Pty Ltd.



Ben White M.Sc. Geol.,
AusIMM., CP GEOL.
No. 222757
Engineering Geologist



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6



Photo 7

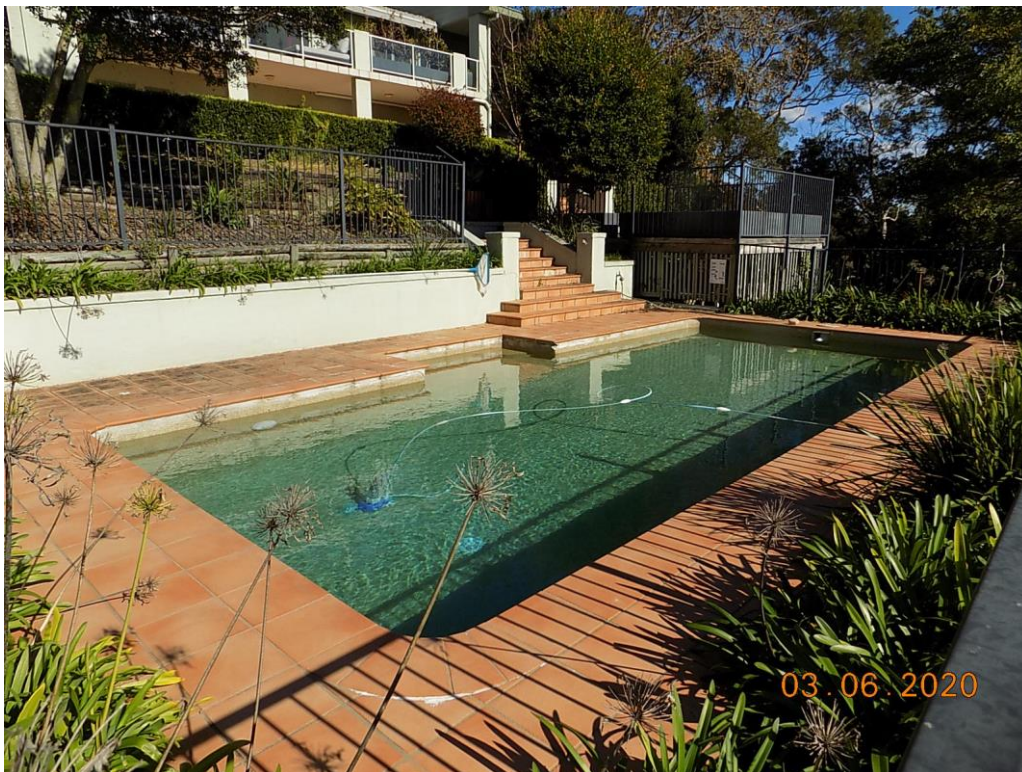


Photo 8



Photo 9



Photo 10



Photo 11



Photo 12

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:

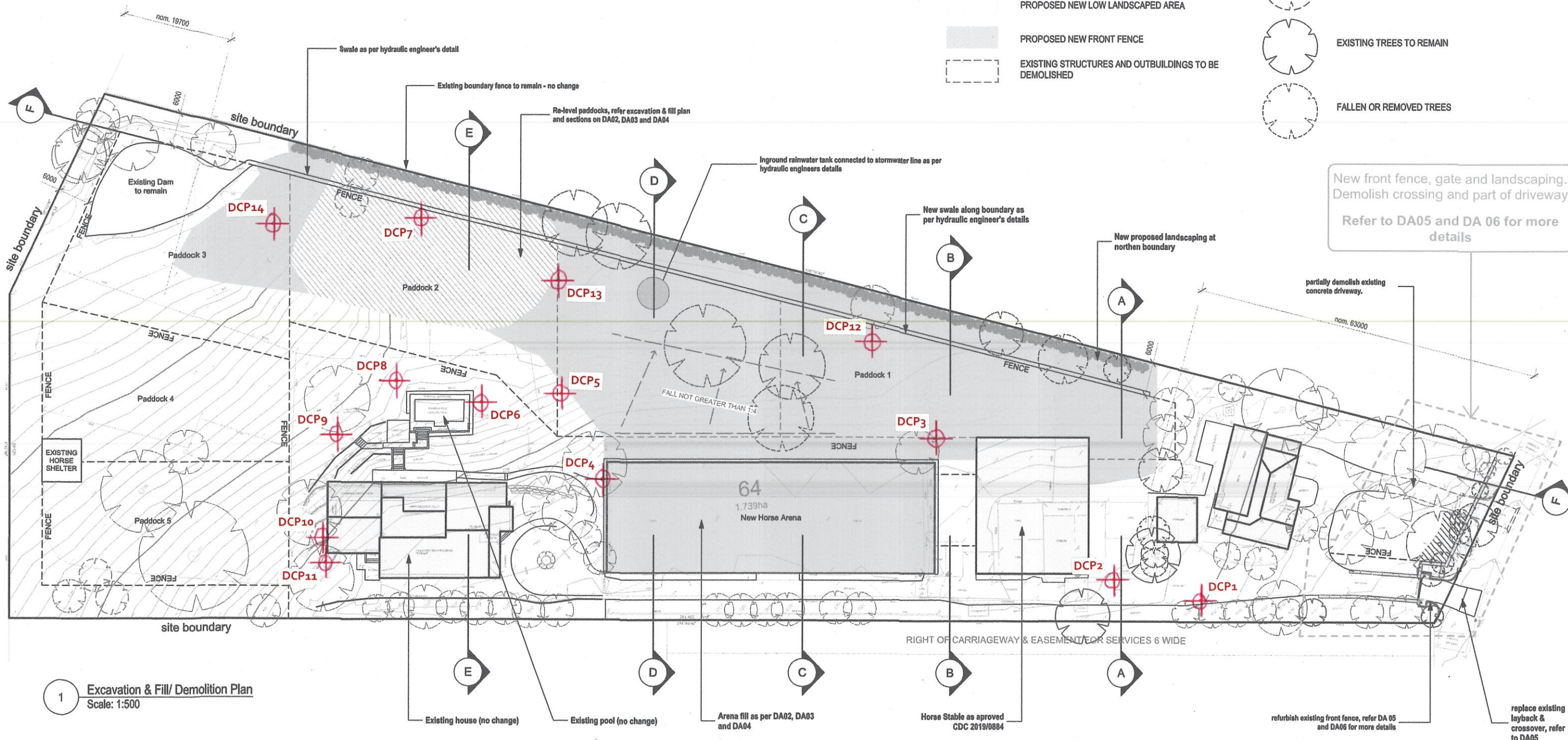
- If upon the commencement of the works the subsurface ground or ground water conditions prove different from those described in this report, it is advisable to contact White Geotechnical Group immediately, as problems relating to the ground works phase of construction are far easier and less costly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

DRAWING REFERENCE KEY

- PROPOSED AREA OF SITE FILL
- PROPOSED AREA OF EXCAVATION
- PROPOSED NEW EVERGREEN SHRUB LANDSCAPING
- PROPOSED NEW LOW LANDSCAPED AREA
- PROPOSED NEW FRONT FENCE
- EXISTING STRUCTURES AND OUTBUILDINGS TO BE DEMOLISHED

- EXISTING TREES PROPOSED TO BE REMOVED IN THIS DA - REFER TO ARBORIST REPORT
- TREES APPROVED TO BE REMOVED UNDER TA2019/0552
- EXISTING TREES TO REMAIN
- FALLEN OR REMOVED TREES



New front fence, gate and landscaping.
Demolish crossing and part of driveway
Refer to DA05 and DA 06 for more details

1 Excavation & Fill/ Demolition Plan
Scale: 1:500

DRAWING NOTES:
- Paddic fencing to furture detail

CADENCE & CO DESIGN
PTY LTD
Suite 7, 287 Mona Vale Rd,
Terrey Hills, NSW, 2084,
P 94501950
E info@cadenceandco.com.au
ABN: 12 168 714 752
Copyright © CADENCE & CO DESIGN PTY LTD

REVISION	DATE	REVISION NOTE

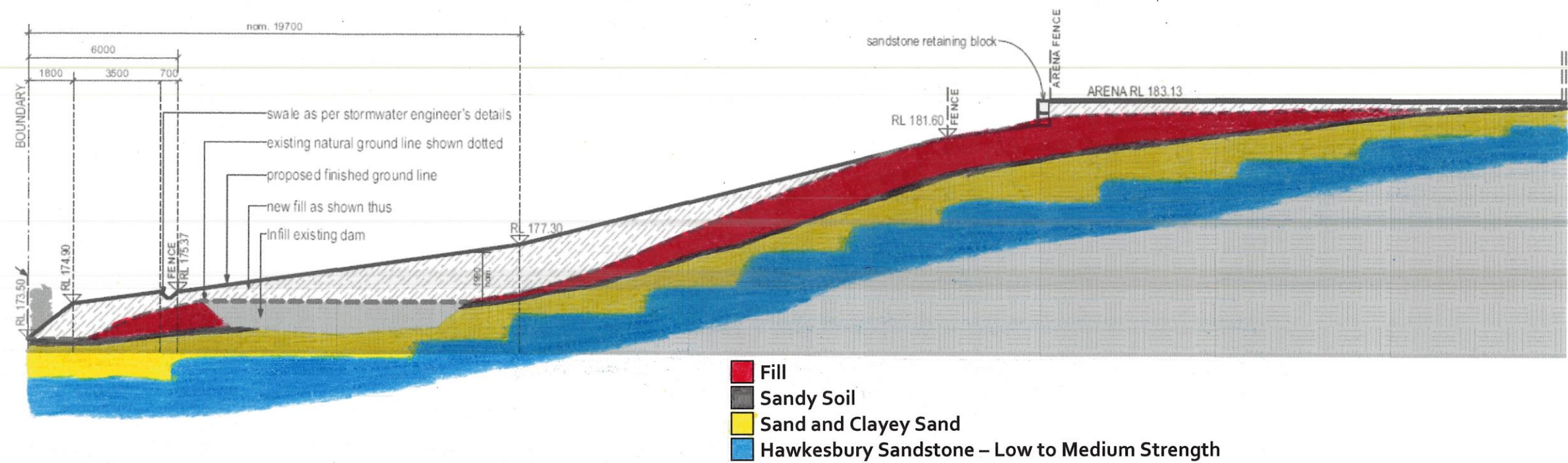
CLIENT:
Mr & Mrs FONSECA
PROJECT:
15 MYOORA RD, TERREY HILLS
Being LOT 64 in D.P. 752017

DRAWING:
Site, Excavation/fill & Landscape Plan
PROJECT NO:
FON
ISSUE TYPE:
PC2

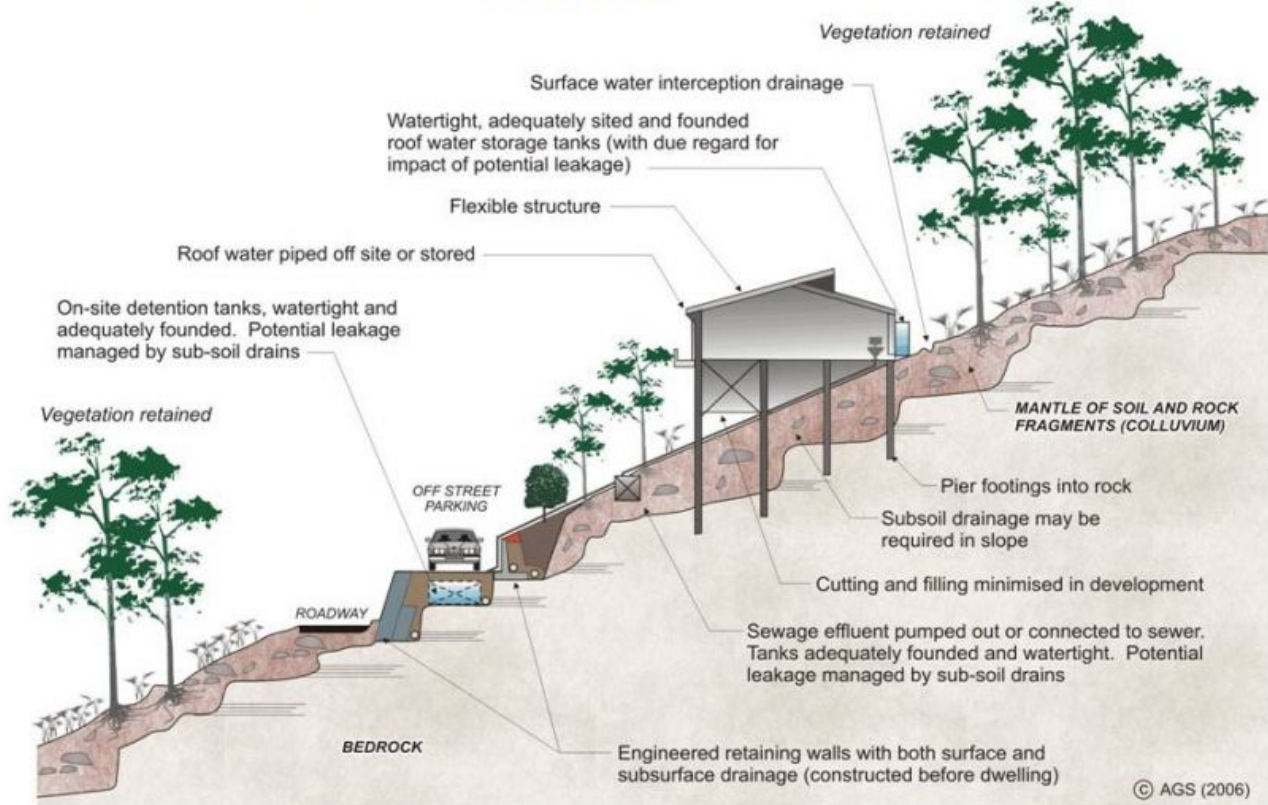
DRAWN: KR	SHEET NO: DA02
CHKD:	SCALE @ A2: 1:500
ISSUE DATE: 06.05.20	REVISION:

GENERAL NOTES: ALL RL'S SHOWN ARE FINISHED LEVELS, BUILDER TO PROVIDE SET DOWNS & ALLOWANCES AS REQUIRED, ALL OPENING DIMENSIONS ARE NOMINAL, BUILDER TO CHECK SIZES ON-SITE BEFORE ORDERING WINDOW AND DOOR UNITS.

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE

