GEOTECHNICAL INVESTIGATION:

New Houses and Pools at **27 Alan Avenue, Seaforth**

1. Proposed Development

1.1 Demolish the existing house, subdivide the block into two lots and construct a new house on each lot by excavating to a maximum depth of 2.0m.

1.2 Construct a new pool on the uphill side of each lot by excavating to a maximum depth of 2.0m

1.3 Details of the proposed development are shown on 5 drawings prepared by Nick Bell Architects, drawings numbered Alan-DA-100, 101 and 200 - 202, Revision A and dated 27/9/19.

2. Site Description

2.1 The site was inspected on the 26th September, 2019.

2.2 This residential property is on the uphill side of the road and has a N aspect. It is located on the gently graded upper reaches of a hillslope. The slope rises across the site at an average angle of ~3°. The slope above the property continues at gentle angles. The grade below the property continues at gentle angles before increasing to moderate angles as middle harbour is approached.

2.3 At the road frontage a concrete driveway runs to a garage attached to the W side of the house. Between the road frontage and the house is a gently sloping lawn covered fill. The fill is supported by a stable ~1.0m high brick retaining wall (Photo 1). The single story brick house will be demolished as part of the proposed works (Photo 2). The Piers stand vertical and are considered stable. A brick paved patio extends off the uphill side of the house (Photo 3). Above the patio a gently sloping lawn extends to the uphill common boundary. Outcropping sandstone is visible across the lawn (Photo 4).

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

One auger was put down to identify soil materials. Eight DCP (Dynamic Cone Penetrometer) tests were carried out 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 and the results are as follows:

AUGER HOLE 1 (~RL57.7) **–** AH1 (Photo 5)

Depth (m)	Material Encountered
0.0 to 0.1	**TOPSOIL**, brown, medium grained with trace organic matter
0.1 to 0.3	**SANDY SOIL**, dark brown, medium grained with sandstone gravel

Refusal @ 0.3m grinding on gravel. No watertable encountered.

DCP TEST RESULTS ON THE 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 1** (RL56.9)	**DCP 2** (RL57.1)	**DCP 3** (RL57.7)	**DCP 4** (RL57.9)
0.0 to 0.3	2	3	6	5
0.3 to 0.6	#	#	5	#
0.6 to 0.9			#	
	Refusal on rock @ 0.05m	Refusal on rock @ 0.05m	Refusal on rock @ 0.45m	Refusal on rock @ 0.30m
Depth(m) Blows/0.3m	**DCP 5** (RL58.5)	**DCP 6** (RL59.0)	**DCP 7** (RL59.5)	**DCP 8** (RL60.5)
0.0 to 0.3	5	1	1	Rock exposed at surface
0.3 to 0.6	24	#	#	
0.6 to 0.9	#			
	Refusal on rock @ 0.60m	Refusal on rock @ 0.05m	Refusal on rock @ 0.05m	

#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 @ 0.05m, DCP bouncing off rock surface, white sandstone fragments on dry tip.

DCP2– Refusal on rock @ 0.05m, DCP bouncing off rock surface, white sandstone fragments on dry tip.

DCP3 – Refusal on rock @ 0.45m, DCP bouncing off rock surface, white sandstone fragments on wet sandy tip.

DCP4 – Refusal on rock @ 0.30m, DCP bouncing off rock surface, white sandstone fragments on wet sandy tip.

DCP5 – Refusal on rock @ 0.60m, DCP bouncing off rock surface, white sandstone fragments on dry tip.

DCP6 – Refusal on rock @ 0.05m, DCP bouncing off rock surface, clean dry tip.

DCP7 – Refusal on rock @ 0.05m, DCP bouncing off rock surface, clean dry tip.

DCP8 – Rock exposed at surface.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the outcropping and underlying sandstone bedrock that steps up 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. The rock is overlain by manmade fill over natural sandy soils over firm to stiff sandy clays that fill the bench-step formation. In the test locations, where it was not exposed, the depth to Medium Strength Sandstone ranged between 0.0 to 0.6m below the current surface, being slightly deeper where filling is present across the downhill side of the property and due to the stepped nature of the underlying rock. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

Normal ground water seepage is expected to move over the buried surface of the rock and through the cracks.

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

7. Surface Water

No evidence of significant surface flows were observed on the property during the inspection. It is expected that normal sheet wash will move onto the site from above the property during heavy down pours.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below or beside the property. A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process is a potential hazard (**Hazard One**).The vibrations from the proposed excavations are a potential hazard (**Hazard Two**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process.	The vibrations produced during the proposed excavation impacting on the surrounding structures.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (20%)	'Medium' (15%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	2.32×10^{-5}/annum	5.3×10^{-6}/annum
COMMENTS	This level of risk to life and property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels the recommendations in **Section 13** are to be followed.	This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels the recommendations in **Section 12** 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 Alan Avenue below. Roof water 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

Two Excavations are required to construct the proposed basement levels of the houses. Two more excavations are required to install the proposed pools. The excavations are all expected to reach a maximum depth of ~2.0m. The excavation works are anticipated to be through sandy soil over Medium Strength Sandstone that is expected at a maximum depth of 0.6m below the current surface. It is envisaged that excavations through sandy soil be carried out with a bucket and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavation through sandy soil will be below the threshold limit for building damage. The majority of the proposed excavations are expected to be taken through Medium Strength Sandstone.

Excavations through Medium Strength Rock should be carried out to minimise the potential to cause vibration damage to the E and W neighbouring houses. The E neighbouring house will be as close as ~7.5m from the garage excavations and W neighbouring house ~2.5m away. The no. 27 pool excavation will be as close as ~2.0m from the E neighbouring pool. Close controls by the contractor over rock excavation are recommended so excessive vibrations are not generated.

Excavation methods are to be used that limit peak particle velocity to 10mm/sec at the common boundaries and supporting walls of the subject house. Vibration monitoring will be required to verify this is achieved.

If a milling head is used to grind the rock, vibration monitoring will not be required. Alternatively, if rock sawing is carried out around the perimeter of the excavation boundaries in not less than 1.0m lifts, a rock hammer up to 300kg could be used to break the rock without vibration monitoring. Peak particle velocity will be less than 10mm/sec at the common boundaries using this method provided the saw cuts are kept well below the rock to broken.

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

13. Excavation Support Requirements

No structures or boundaries will be within the zone of influence of the excavation. In this instance, the zone of influence is the area above a theoretical 30° line through soil from the top of Medium Strength Rock towards the surrounding structures and boundaries. In the location of the proposed excavations, rock is expected at shallow depths of ~0.6m or less.

All the shallow cut batters through soil are expected to stand at near-vertical angles for short periods of time until retaining walls/pool structures are installed, provided the cut batters are kept from becoming saturated. Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. The materials and labour to construct the retaining walls/pool structures are to be organised so on completion of the excavations they can be constructed as soon as possible.

During the excavation process, the geotechnical consultant is to inspect the excavation as it is lowered in 1.5m intervals to ensure the ground materials are as expected and no wedges or other geological defects are present that could require additional support. Should additional ground support be required, this will likely involve the use of mesh, sprayed concrete, and rock bolts.

Upon completion of the excavation, it is recommended all cut faces be supported with retaining walls to prevent any potential future movement of joint blocks in the cut faces that can occur over time, when unfavourable jointing is obscured behind the excavation faces. Additionally, retaining walls will help control seepage and to prevent minor erosion and sediment movement.

Excavation spoil can be used as filing on site provided it is supported by retaining walls. Alternatively it is to be removed from the site following the NSW Environmental Protection Agency (EPA) Waste Classification Guidelines.

14. Retaining Structures

For cantilever or singly-propped retaining structures, it is suggested the design be based on a triangular pressure 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
Fill and Sandy Soil	20	0.4	0.55
Medium Strength Sandstone	24	0.00	0.01

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region". Australian Geomechanics Journal 1978.

It is to be noted that the earth pressures in Table 1 assume a level surface above the structure, do not account for any surcharge loads, and assume retaining structures are fully drained. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

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.

15. Foundations

Spread footings supported on Medium Strength Sandstone are suitable foundations for the houses. This material is expect across the whole site at shallow depths. The proposed garages and pools are expected to be seated on Medium Strength Sandstone. This is a suitable foundation material. A maximum allowable bearing pressure of 1000KPa can be assumed for footings on Medium Strength Sandstone

Naturally occurring vertical cracks (known as joints) commonly occur in sandstone. These are generally filled with soil and are the natural seepage paths through the rock. They can extend to depths of several metres and are usually relatively narrow but can range between 0.1 to 0.8m wide. If a footing falls over a joint in the rock, the construction process is simplified if with the approval of the structural engineer the joint can be spanned or alternatively the footing can be repositioned so it does not fall over the joint.

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.

- During the excavation process, the geotechnical consultant is to inspect the cut faces as they are lowered in 1.5m intervals to ensure ground materials are as expected and that there are no wedges or other defects present in the rock that may require additional support.

- All footings are to be inspected and approved by the geotechnical consultant while the excavation equipment is still onsite and before steel reinforcing is placed or concrete is poured.

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 – AH1

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.

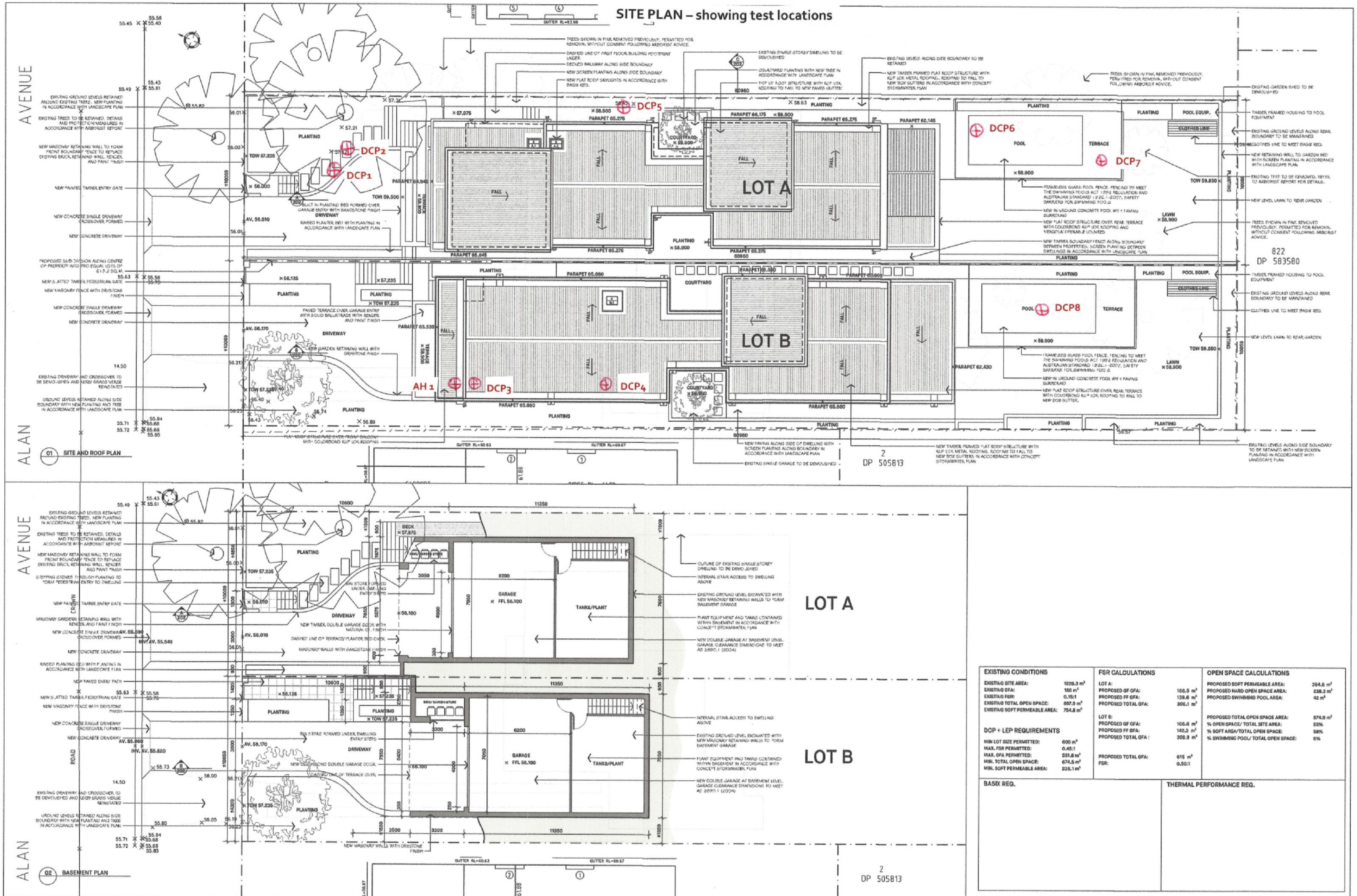
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



EXISTING CONDITIONS	
EXISTING SITE AREA:	1226.3 m²
EXISTING GFA:	180 m²
EXISTING FSR:	0.15:1
EXISTING TOTAL OPEN SPACE:	887.9 m²
EXISTING SOFT PERMEABLE AREA:	754.8 m²

DCP + LEP REQUIREMENTS	
MIN LOT SIZE PERMITTED:	600 m²
MAX. FSR PERMITTED:	0.45:1
MAX. GFA PERMITTED:	551.8 m²
MIN. TOTAL OPEN SPACE:	674.5 m²
MIN. SOFT PERMEABLE AREA:	236.1 m²

FSR CALCULATIONS	
LOT A:	
PROPOSED GF GFA:	166.5 m²
PROPOSED FF GFA:	139.6 m²
PROPOSED TOTAL GFA:	306.1 m²
LOT B:	
PROPOSED GF GFA:	166.6 m²
PROPOSED FF GFA:	142.3 m²
PROPOSED TOTAL GFA :	308.9 m²
PROPOSED TOTAL GFA:	615 m²
FSR:	0.50:1

OPEN SPACE CALCULATIONS	
PROPOSED SOFT PERMEABLE AREA:	394.6 m²
PROPOSED HARD OPEN SPACE AREA:	238.3 m²
PROPOSED SWIMMING POOL AREA:	42 m²
PROPOSED TOTAL OPEN SPACE AREA:	674.9 m²
% OPEN SPACE/ TOTAL SITE AREA:	55%
% SOFT AREA/TOTAL OPEN SPACE:	58%
% SWIMMING POOL/ TOTAL OPEN SPACE:	6%

BASIX REQ.

THERMAL PERFORMANCE REQ.

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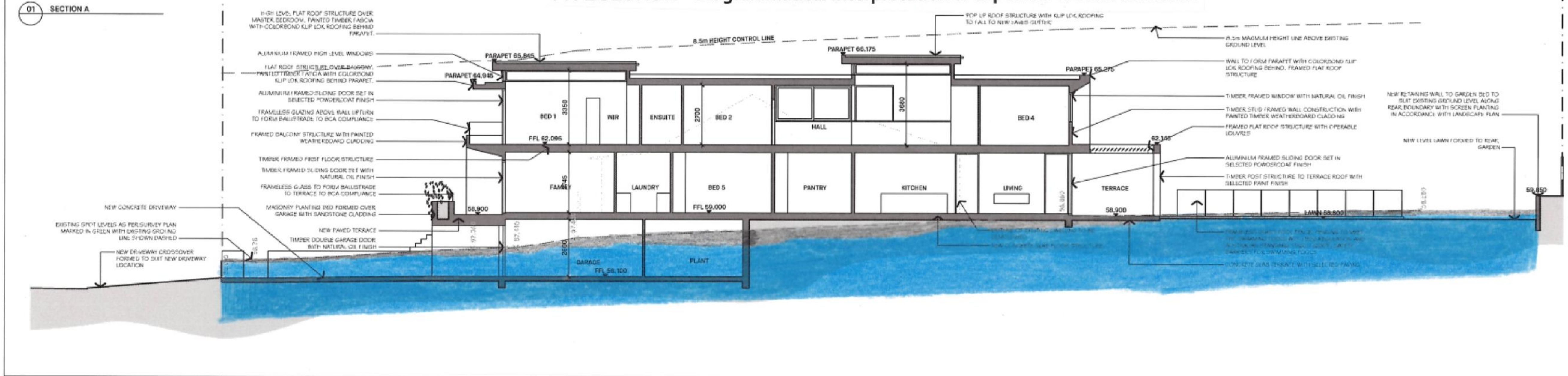
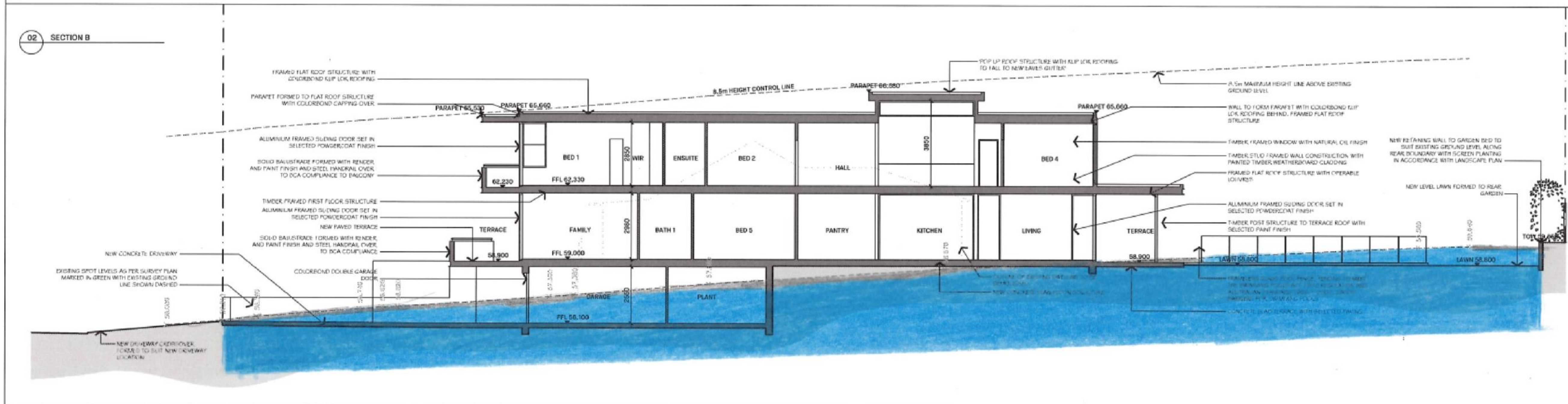
REV	DATE	DESCRIPTION
A	27.09.19	ISSUED FOR CONSULTANT REVIEW

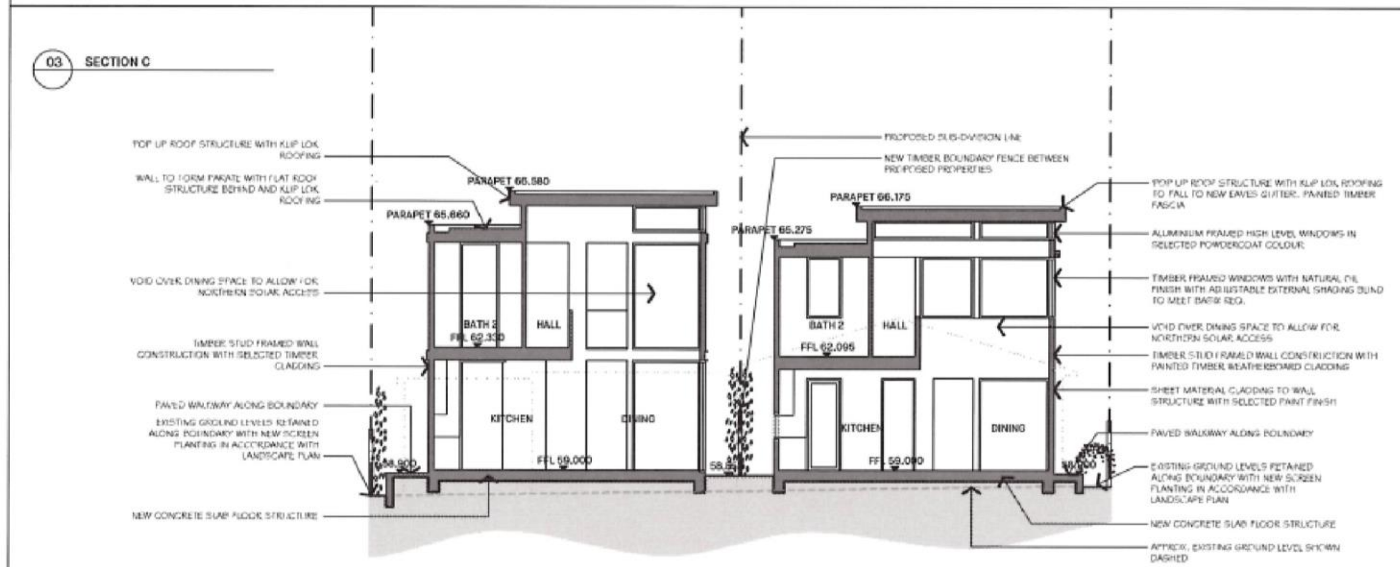
KEY
- EXISTING STRUCTURE IN SECTION
- NEW STRUCTURE IN SECTION
- OUTLINE OF EXISTING STRUCTURE TO BE REMOVED

CLIENT	O'HANLON, GIULIANO & EL KHOURI
ADDRESS	27 ALAN AVENUE SEAFORTH NSW 2092
DRAWING	SITE/ROOF PLAN AND BASEMENT PLAN
SCALE	1:100 @ A1
DWG NO.	ALAN-DA-100
REVISION	A

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials







- Fill
- Sandy Soil
- Sandy Clay
- Hawkesbury Sandstone – Medium Strength

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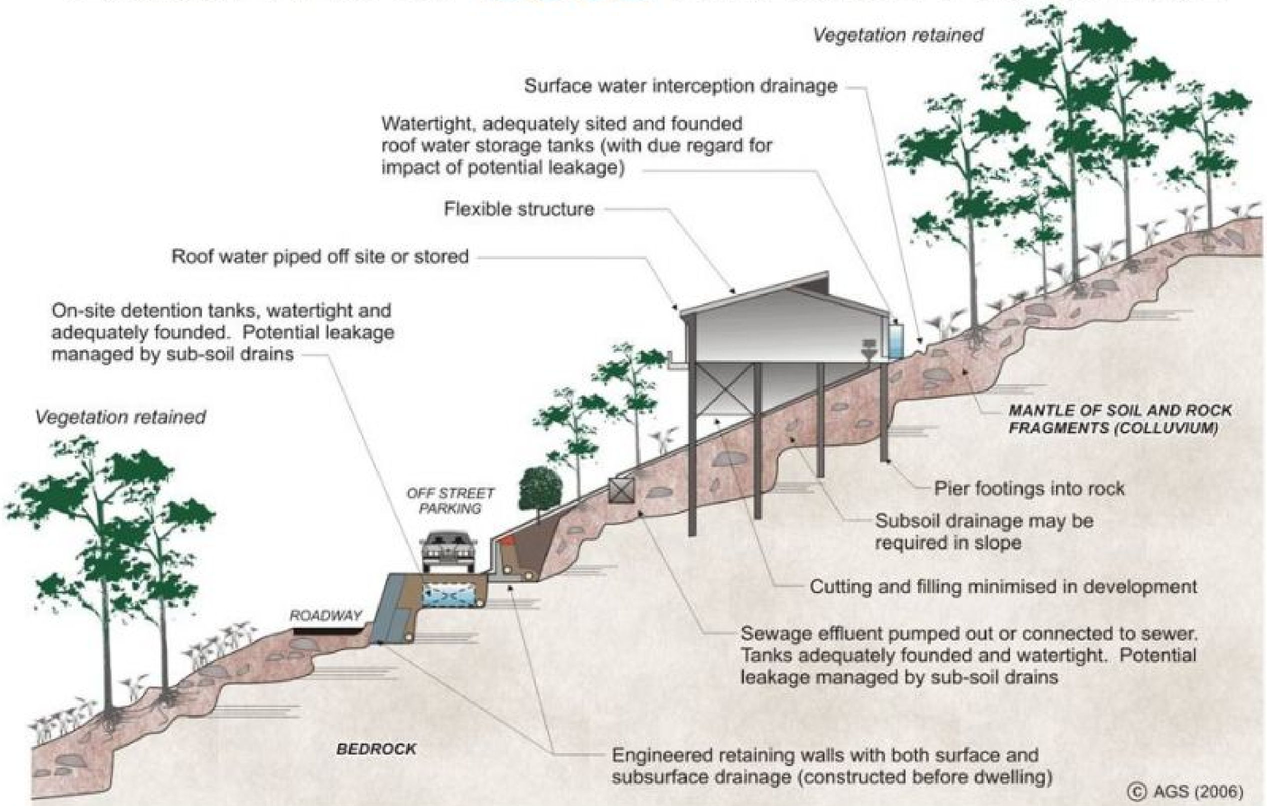
CLIENT	O'HANLON, GIULIANO & EL KHOURI
ADDRESS	27 ALAN AVENUE SEAFORTH NSW 2092
DRAWING	SECTIONS
SCALE	1:100 @ A1
DWG NO.	ALAN-DA-202
REVISION	A

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE