GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **101 Woodland Street, Balgowlah Heights**

1. Proposed Development

1.1 Construct a new garage by excavating to a maximum depth of ~2.2m and extend the existing driveway.

1.2 Extend the NE corner of the first floor of the house over the existing deck.

1.3 Various other internal and external alterations to the existing house.

1.4 Details of the proposed development are shown on 10 drawings prepared by Beecraft, sheets numbered 1 to 10, DA Issue, dated April 2020.

2. Site Description

2.1 The site was inspected on the 31st of July, 2020.

2.2 This residential property is on the high side of the road and has a N aspect. The block runs longways to the W, so the slope is a cross-fall. It is located on the moderately graded upper reaches of a hillslope. The natural slope falls across the property at an average angle of ~12°. The slopes above and below the property gradually decrease in grade.

2.3 At the road frontage a concrete driveway runs up the slope to a carport on the E side the house (Photo 1). Hawkesbury Sandstone bedrock is outcropping on the S side of the driveway (Photo 2). Sandstone joint blocks are located on the S and N sides of the driveway (Photo 3). The two storey rendered house is supported by rendered masonry walls and a concrete slab (Photos 4 & 5). The external supporting walls show no significant signs of movement. A stable sandstone stack rock wall supports fill along part of the S common boundary (Photo 6). A pool in good condition is located on the W side of the property (Photo 7). A concrete block wall/retaining wall ~1.8m high in good condition supports the pool pavement and lawn fill (Photo 8). No signs of slope instability were observed on the property. The adjoining neighbouring properties were observed to be in good order as seen from the street and subject property.

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 hole was put down to identify the soil materials. Five 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. 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. But 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 (~RL63.4) **–** AH1 (photo 9)

Depth (m)	Material Encountered
0.0 to 0.4	**TOPSOIL**, dark brown, fine to medium grained, moist with fine trace organic matter.
0.4 to 0.6	**SANDY CLAY**, light orange brown, firm to stiff, moist.

End of Test @ 0.6m in sandy clay. No watertable encountered.

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 (~RL62.5)	DCP 2 (~RL62.6)	DCP 3 (~RL63.4)	DCP 4 (~RL63.1)	DCP 5 (~RL61.9)
0.0 to 0.3	#	5	3	4	12
0.3 to 0.6		8	7	9	12
0.6 to 0.9		5	12	9	17
0.9 to 1.2		#	5	7	15
1.2 to 1.5			#	#	#
	Rock at Surface	Refusal @ 0.8m	Refusal @ 1.0m	Refusal @ 1.1m	Refusal @ 1.0m

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

DCP Notes:

DCP1 – Rock Exposed at Surface
DCP2 – Refusal @ 0.8m, DCP bouncing, orange and white rock fragments on damp tip.
DCP3 – Refusal @ 1.0m, DCP bouncing, orange and white rock fragments on damp tip.
DCP4 – Refusal @ 1.1m, DCP bouncing, orange and white rock fragments on damp tip.
DCP5 – Refusal @ 1.0m, DCP bouncing, orange and white rock fragments on damp tip.

5. Geological Observations/Interpretation

The surface features of the block are controlled by the 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. The rock is overlain by fill, topsoil and sandy clay that fills the bench step formation. Fill provides level platforms on the N and W sides of the house. In the test locations, the depth to rock ranged from between ~0.8 to ~1.1m below the current surface. The sandstone underlying the property is estimated to be Medium Strength or better. 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 in the rock.

Due to the slope and elevation of the block, the water table in the location is expected to be many metres below the proposed works.

7. Surface Water

No evidence of 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 beside the property. The moderate slope that falls across the property and continues above and below is a potential hazard (**Hazard One**). The proposed excavation is a potential hazard until retaining structures are in place (**Hazard Two**). The vibrations from the proposed excavation are a potential hazard (**Hazard Three**).

RISK ANALYSIS SUMMARY ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two	Hazard Two
TYPE	The moderate slope that falls across the property and continues above and below failing and impacting on the property.	The proposed excavation collapsing onto the worksite before retaining walls are in place.	The vibrations produced during the proposed excavation impacting on the surrounding structures.
LIKELIHOOD	'Unlikely' (10^{-4})	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Medium' (15%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	8.3×10^{-7}/annum	8.3×10^{-6}/annum	5.3×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE'.	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 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)

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 Woodland Street. 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 maximum depth of ~2.2m will be required to construct the proposed garage. The excavation is expected to be through topsoil and sandy clay, with Medium Strength Sandstone expected at depths of between ~0.8m to ~1.1m below the current surface. It is envisaged that excavations through soil and clay can be carried out with a machine and bucket and excavations through Medium Strength Sandstone or better will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavations through soil and clay will be below the threshold limit for building damage.

Excavations through Medium Strength Rock or better should be carried out to minimise the potential to cause vibration damage to the subject house and neighbouring house to the S. 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 subject house and property boundaries. 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 subject house and property 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 house and neighbouring properties.

13. Excavations Support Requirements

An excavation to maximum depth of ~2.2m will be required to construct the proposed garage. Allowing for backwall drainage, the excavation will come close to flush with the S common boundary.

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

The soil/clay portion of the S cut is to be permanently or temporarily supported before the excavation through rock commences. The support is to be installed systematically as the excavation progresses to ensure the integrity of the neighbouring property. If the support is temporary, it is to remain in place until the retaining wall is built as a sacrificial-type system.

For the W and E cuts, the soil portion of the excavation is to be battered temporarily at 1.0 Vertical to 1.7 Horizontal (30°) until the retaining walls are in place. Cut batters through clay and will stand at near-vertical angles for a short period of time until the retaining walls are in place, provided the cut batters are kept from becoming saturated. Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

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.

Should any large boulders be encountered in the excavation face the geotechnical consultant is to assess the rock for stability before the excavation proceeds further.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. All unsupported cut batters are to be covered to prevent access of water in wet weather and loss of moisture in dry weather. The materials and labour to construct the retaining walls are to be organised so on completion of the excavation they can be constructed as soon as possible. The excavation is to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast. If the retaining walls are not constructed within a few days of the excavation being completed temporary shoring will be required.

All excavation spoil is to be removed from site or be supported by engineered retaining walls.

14. 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
Soil	20	0.40	0.55
Residual Clays	20	0.35	0.45
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 full hydrostatic pressures are to be accounted for in the retaining structure design.

15. Foundations

The proposed garage is expected to be seated in Medium Strength Sandstone. This is a suitable bearing material. Where the rock drops away with the slope on the N side, spread footings or shallow piers will be required to maintain a uniform bearing material across the structure. A maximum allowable bearing pressure of 1000kPa can be assumed for spread 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 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.

REQUIRED INSPECTIONS ON NEXT PAGE

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 Occupation Certificate 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 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 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

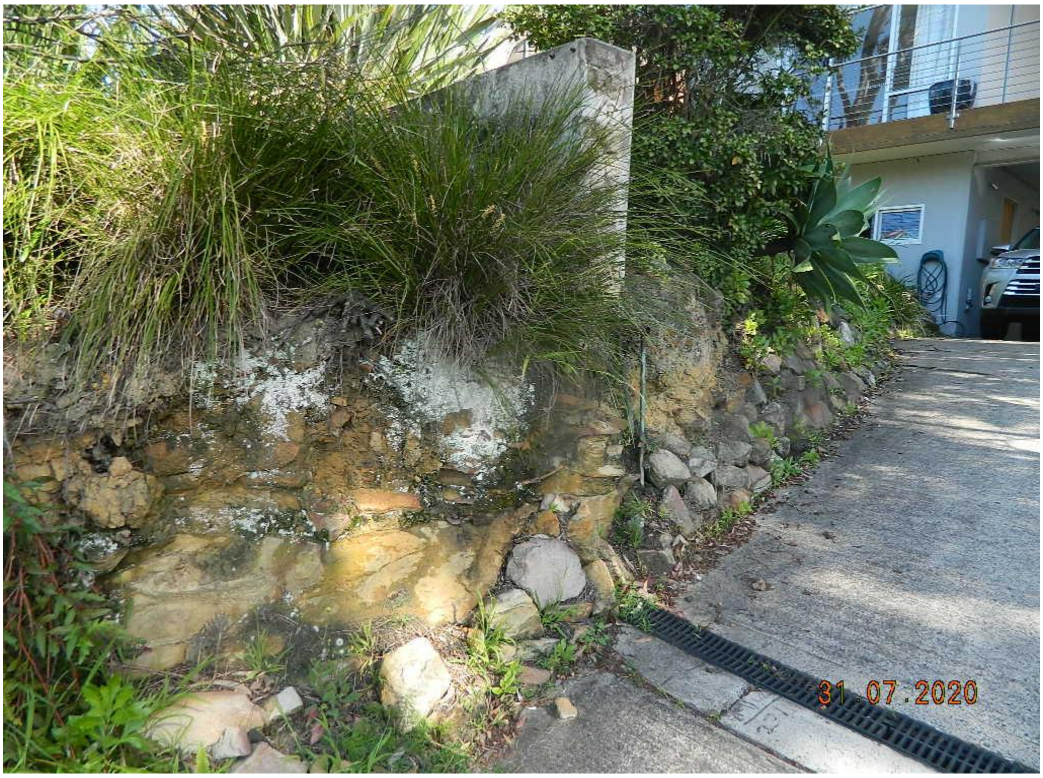


Photo 2

Photo 3

Photo 4

Photo 5

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.

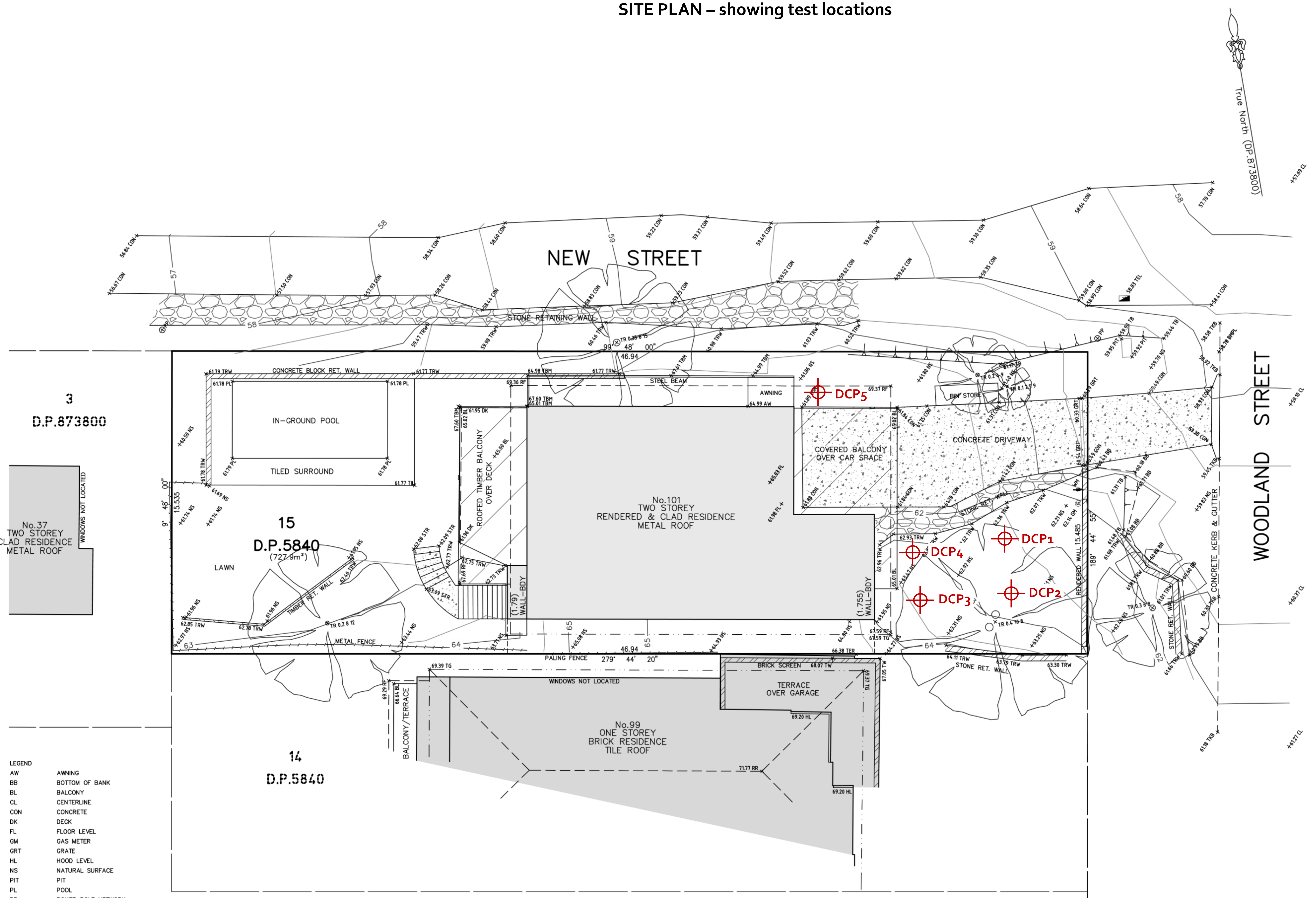
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



LEGEND

AW	AWNING
BB	BOTTOM OF BANK
BL	BALCONY
CL	CENTERLINE
CON	CONCRETE
DK	DECK
FL	FLOOR LEVEL
GM	GAS METER
GRT	GRATE
HL	HOOD LEVEL
NS	NATURAL SURFACE
PIT	PIT
PL	POOL
PP	POWER POLE NETWORK
RF	ROOF
RR	ROOF RIDGE
STR	STAIRS
TB	TOP OF BANK
TBM	TOP BEAM
TEL	TELSTRA
TER	TERRACE
TG	TOP OF GUTTER
TIL	TILE
TKB	TOP OF KERB
TR	TREE-DIA,SPREAD,HEIGHT
TRW	TOP OF RETAINING WALL
TW	TOP OF WALL
WM	WATER METER

0 1 2 3 4 5 6 7 8 9 10

SCALE 1:100

TITLE INDICATES THAT LOT 15 IN D.P.5840 IS SUBJECT TO:
– RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S).

A	FIRST ISSUE	20/04/20

· BOUNDARIES SHOWN HEREON HAVE BEEN DEFINED FOR DESIGN AND DA PURPOSES AND ARE MY OPINION ONLY, OFFSETS FROM STRUCTURES TO BOUNDARY SHOULD NOT BE USED FOR CONSTRUCTION SETOUT.

· IF CONSTRUCTION ON OR NEAR BOUNDARIES IS UNDERTAKEN THE BOUNDARIES OF THE LAND SHOULD BE MARKED OR THE WORKS SETOUT BY A REGISTERED SURVEYOR.

· TREE SIZES ARE ESTIMATES ONLY.

· THIS PLAN HAS BEEN PREPARED FOR THE EXCLUSIVE USE OF BEECRAFT

· RELATIONSHIP OF IMPROVEMENTS TO BOUNDARIES IS DIAGRAMMATIC ONLY. WHERE OFFSETS ARE CRITICAL THEY SHOULD BE CONFIRMED BY FURTHER SURVEY.

· EXCEPT WHERE SHOWN BY DIMENSION LOCATION OF DETAIL WITH RESPECT TO BOUNDARIES IS INDICATIVE ONLY.

· ONLY VISIBLE SERVICES HAVE BEEN LOCATED. UNDERGROUND SERVICES HAVE NOT BEEN LOCATED. DIAL BEFORE YOU DIG SERVICES (ph 1100) SHOULD BE USED AND A FULL UTILITY INVESTIGATION, INCLUDING A UTILITY LOCATION SURVEY, SHOULD BE UNDERTAKEN BEFORE CARRYING OUT ANY CONSTRUCTION ACTIVITY IN OR NEAR THE SURVEYED AREA.

· CRITICAL SPOT LEVELS SHOULD BE CONFIRMED WITH SURVEYOR.

· THIS PLAN IS ONLY TO BE USED FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS AT FRONT OF PROPERTY.

· CONTOURS SHOWN DEPICT THE TOPOGRAPHY. EXCEPT AT SPOT LEVELS SHOWN, THEY DO NOT REPRESENT THE EXACT LEVEL AT ANY PARTICULAR POINT. ONLY SPOT LEVELS SHOULD BE USED FOR CALCULATIONS OF QUANTITIES WITH CAUTION.

· CONTOUR INTERVAL – 0.5 metre. – SPOT LEVELS SHOULD BE ADOPTED.

· POSITION OF RIDGE LINES ARE DIAGRAMMATIC ONLY (NOT TO SCALE).

· THE INFORMATION IS ONLY TO BE USED AT A SCALE ACCURACY OF 1:100.

· DO NOT SCALE OFF THIS PLAN / FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED READINGS.

· IF ACCURATE TRUE NORTH IS REQUIRED A FURTHER SURVEY WOULD BE NECESSARY.

MICHAEL K JOYCE
REGISTERED SURVEYOR I.D 8268

Waterview SURVEYING SERVICES
1A Mona Street Mona Vale NSW 2103
ACN 610 583 572
michael@wvsurveying.com.au
0474 843 180

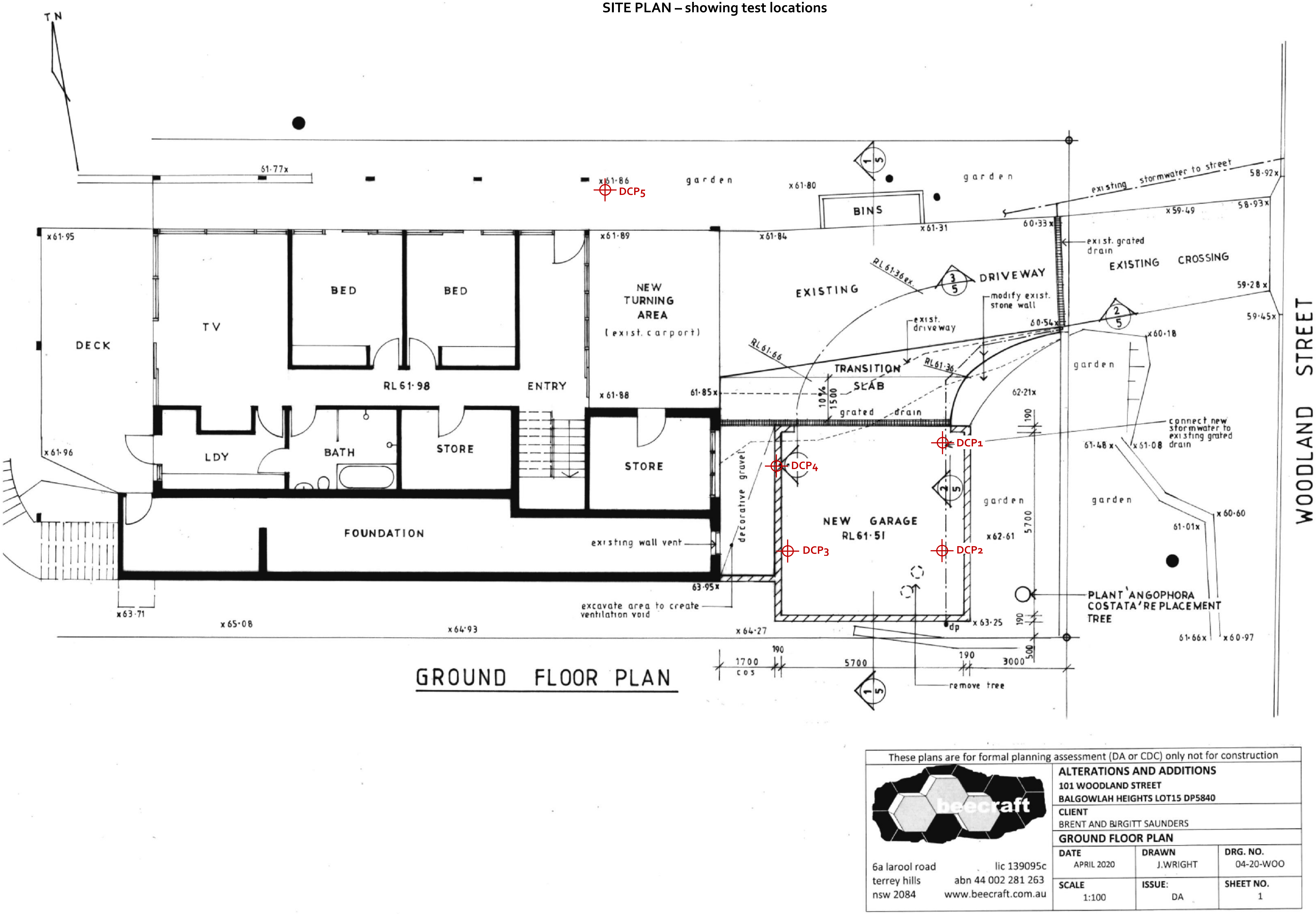
Vertical Datum
DATUM: AUSTRALIAN HEIGHT DATUM (AHD)
B.M. PM 1136
R.L. 62.148
SOURCE: S.C.I.M.S.

Client Details
BEECRAFT
6A LAROOL ROAD
TERREY HILLS NSW 2084

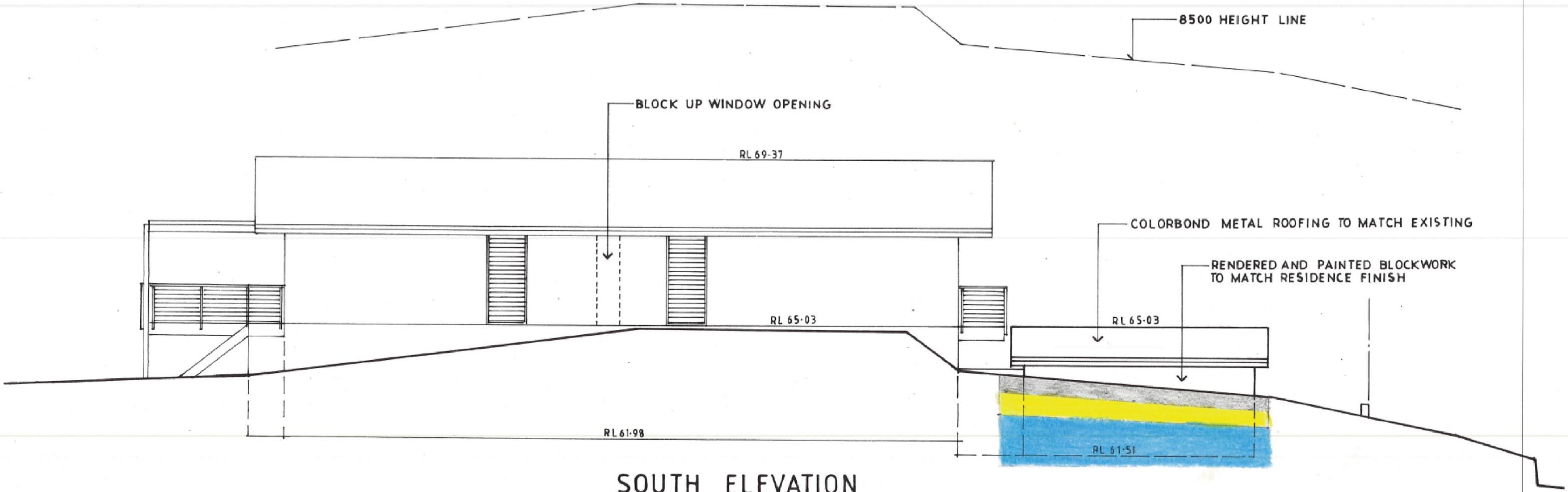
Drawing Title
DETAIL AND LEVELS OVER
101WOODLAND STREET
BALGOWLAH HEIGHTS NSW 2093
BEING LOT 15 IN DP.5840

PROJECT: 1096	PAGE 1 OF 1
Date of survey 16/04/2020	Drawing No. 1096detail 1
Scale 1:100 @ A1	Rev. A

SITE PLAN – showing test locations

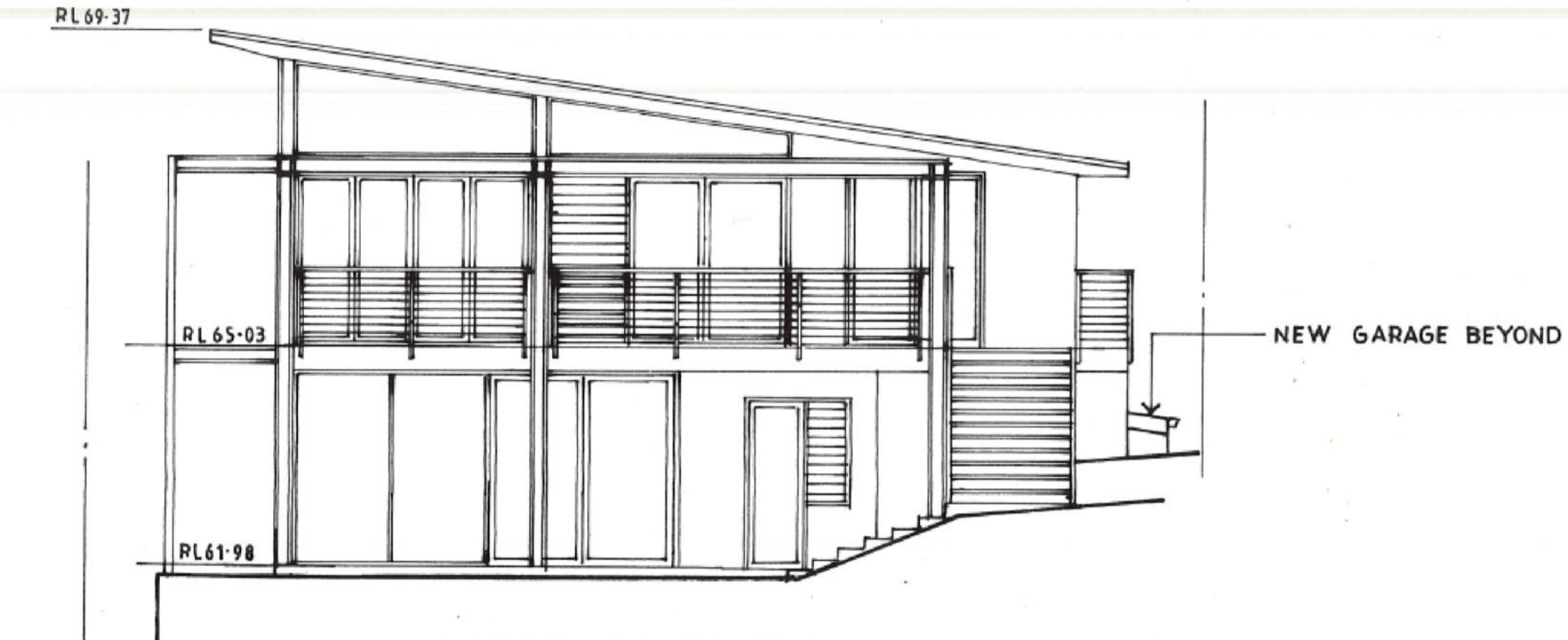


TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



SOUTH ELEVATION

- Topsoil
- Sandy Clay
- Hawkesbury Sandstone – Medium Strength



WEST ELEVATION

These plans are for formal planning assessment (DA or CDC) only not for construction

ALTERATIONS AND ADDITIONS
101 WOODLAND STREET
BALGOWLAH HEIGHTS LOT15 DP5840

CLIENT
BRENT AND BIRGITT SAUNDERS

SOUTH AND WEST ELEVATION

DATE	DRAWN	DRG. NO.
APRIL 2020	J.WRIGHT	04-20-WOO
SCALE	**ISSUE:**	**SHEET NO.**
1:100	DA	4

6a larool road
terrey hills
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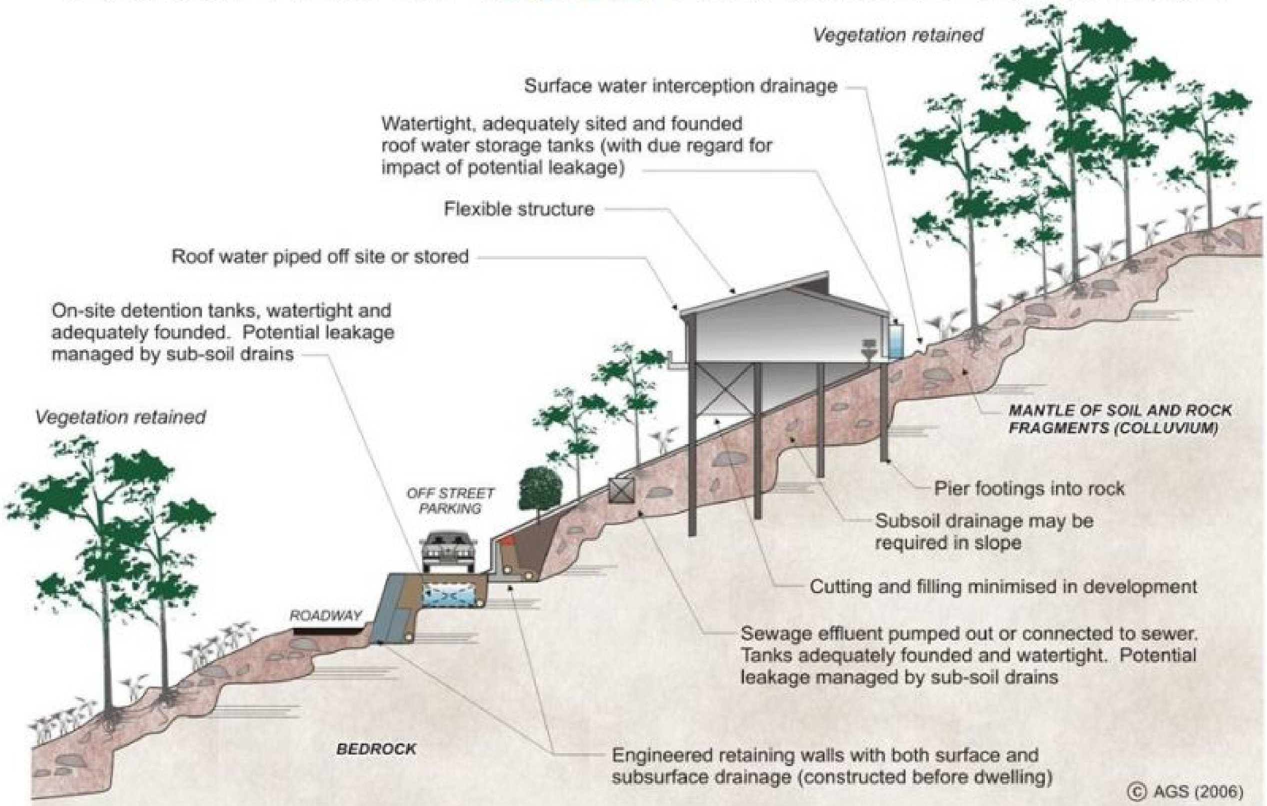
EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE