GEOTECHNICAL INVESTIGATION:

New Inclined Lift at **153 Seaforth Crescent, Seaforth**

1. Proposed Development

1.1 Construct a new inclined lift along the SW common boundary and trim rock at the top of cliff face to a depth of 0.7m.

1.2 Details of the proposed development are shown on a drawing prepared by Stephen Crosby and Associates, drawing labelled Site Plan and Section, numbered 2209- DA01 and dated 9/19.

2. Site Description

2.1 The site was inspected on the 3rd October, 2019.

2.2 This residential property is on the low side of the road and has a NW aspect. The block is located on the steeply graded middle to lower reaches of a hillslope. From the road frontage, the natural surface falls at an average angle of ~31° to the downhill side of the house. The slope below the property continues at steep angles. The slope above the property eases to moderate angles as it reaches the crest of the hill.

2.3 From the road frontage a concrete driveway extends to the garage and house (Photo 1). Outcropping rock was observed across the entire site. The two and three storey cement rendered brick house is supported on piers and walls. The piers stand vertical and are considered stable. The lower levels of the house have been cut 3.0m into sandstone that appears free of defects (Photo 2). On the downhill side of the house there is a suspended pool supported on concrete piers (Photo 3). A timber staircase runs down the slope on the SW side of the house (Photo 4). An inclined lift that runs downslope to the water front is proposed for this location. A ~5.0m rock face falls on the downhill side of the pool. This escarpment is undercut ~3.0m and has been partially supported by concrete piers (Photo 5). The slope below the rock face is

terraced in places with ~1.0m tall stack rock walls (Photo 6). Where terraces don't exist the steep natural slope is covered in native and exotic shrubs and trees. Below the rock face a rough stone path and sets of stairs traverse the steep slope diagonally until the waterfront is reached. At the waterfront a timber jetty and boat shed extends into Peach Tree Bay.

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 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 (~RL24.6) – AH1 (Photo 7)

Depth (m)	Material Encountered
0.0 to 0.4	**SANDY SOIL,** brown, medium grained with trace organic matter.
0.4 to 0.6	**SAND**, light brown, medium grained

Refusal @ 0.6m grinding on rock. 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** (~RL44.8)	**DCP 2** (~RL44.8)	**DCP 3** (~RL34.3)	**DCP 4** (~RL24.6)	**DCP 5** (~RL9.8)
0.0 to 0.3	2F	3F	1F	2	8
0.3 to 0.6	19	3	3	21	6
0.6 to 0.9	#	8	7	20	14
0.9 to 1.2		#	18	19	11
1.2 to 1.5			#	20	17
1.5 to 1.8				#	21
1.8 to 2.1					33
2.1 to 2.4					#
	Refusal on Rock @ 0.55m	Refusal on Rock @ 0.6m	Refusal on Rock @ 1.1m	Refusal on Rock @ 1.5m	Refusal on Rock @ 2.05m

#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 @ 0.55m, DCP bouncing off rock surface, white fragments on dry tip.
DCP2 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, white fragments on dry tip.
DCP3 – Refusal on rock @ 1.1m, DCP bouncing off rock surface, orange fragments on dry tip.
DCP4 – Refusal on rock @ 1.5m, DCP bouncing off rock surface, maroon fragments on dry tip.
DCP4 – Refusal on rock @ 1.5m, DCP bouncing off rock surface, maroon fragments on dry tip.
DCP5 – Refusal on rock @ 2.05m, DCP bouncing off rock surface, orange to yellow fragments on dry 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. Where the rock is not exposed, it is overlain by sandy soils over sandy clays that fill the bench step formation. In the test locations the depth to rock ranged between 0.55 to 2.05m below the current surface, being variable due to the jointed and

blocky nature of the top layer or bedrock. The outcropping sandstone on the property is estimated to be Medium Strength or better 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

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 excavation.

7. Surface Water

No evidence of significant surface flows were observed on the property during the inspection. Normal sheet wash from the slope above will be intercepted by the street drainage system for Seaforth Cres above.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above, below, or beside the property. The steeply graded land surface that falls across the property is a potential hazard (**Hazard One**). The ~3.0m undercut rock face is a potential hazard (**Hazard Two**). The vibrations from the proposed excavations are a potential hazard (**Hazard Three**).

Risk Analysis Summary on the Next Page

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The steep slope that falls across the property and continues above and below failing and impacting on the property.	The undercut rock face failing and impacting on the subject property (Photo 5)
LIKELIHOOD	'Unlikely' (10^{-4})	'Rare' (10^{-5})
CONSEQUENCES TO PROPERTY	'Medium' (20%)	'Major' (60%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Low' (2×10^{-5})
RISK TO LIFE	8.3×10^{-8}/annum	8.3×10^{-8}/annum
COMMENTS	'ACCEPTABLE' level of risk to life & property when the recommendation in **Section 15** are followed.	'ACCEPTABLE' level of risk to life & property when the recommendation in **Section 15** are followed.

HAZARDS	Hazard Three
TYPE	A loose boulder, wedge, or similar geological defect toppling onto the work site during the excavation process.
LIKELIHOOD	'Unlikely' (10^{-4})
CONSEQUENCES TO PROPERTY	'Minor' (10%)
RISK TO PROPERTY	'Low' (2×10^{-4})
RISK TO LIFE	2.98×10^{-8}/annum
COMMENTS	'ACCEPTABLE' level of risk to life & property when the recommendation in **Section 15** are 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 generated by the proposed development.

11. Excavations

Rock trimming to a depth of ~0.7m will be required to clear the path for the inclined lift. This cut will be through the top of the SW side of the ~5.0m tall rock face. The only other excavations required will be for footings.

12. Vibrations

The excavation is expected to be through Medium Strength Sandstone. Excavations through rock should be carried out to minimise the potential to cause vibration damage to the undercut rock face, subject house and SW neighbouring house. The excavation is immediately beside an undercut rock face and as close as 5.0m from subject house's pool. The SW neighbouring house will be as close as ~10.0m from the proposed excavation. 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 5mm/sec at the undercut rock face. Vibration monitoring will be required to verify this is achieved.

If rock saws are used to cut the rock into segments approx. 0.25m wide that can be easily removed with light breaking vibration monitoring will not be required. Peak particle velocity will be less than 5mm/sec at the undercut rock face using this method provided the saw cuts are kept not wider than prescribed.

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

13. Excavation Support Requirements

The excavation will come with in ~0.7m of the SW common boundary However, the excavation will be taken entirely through Medium Strength Sandstone. Thus, no structures or boundaries will be within the zone of influence of the excavation.

To minimise vibrations it is recommended the rock be sawn into segments so minimal rock hammer work is required. See 'Section 12'.

Excavations through Medium Strength Sandstone or better will stand at vertical angles unsupported subject to approval by the geotechnical consultant.

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

14. Foundations

Footing depth is expected to be variable on this site with visual observations and the ground testing indicating weathered rock ranges from exposed at the surface to 1.5m below. Spread Footing or Piers supported directly off the weathered rock are suitable footings for the proposed inclined lift. Where suitable sloping rock is exposed at the surface level pads are to be cut into the rock for the foundation surface. A maximum allowable bearing pressure of 450kPa can be assumed for footings on weathered rock.

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.

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

- 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.

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No. 222757
Engineering Geologist.

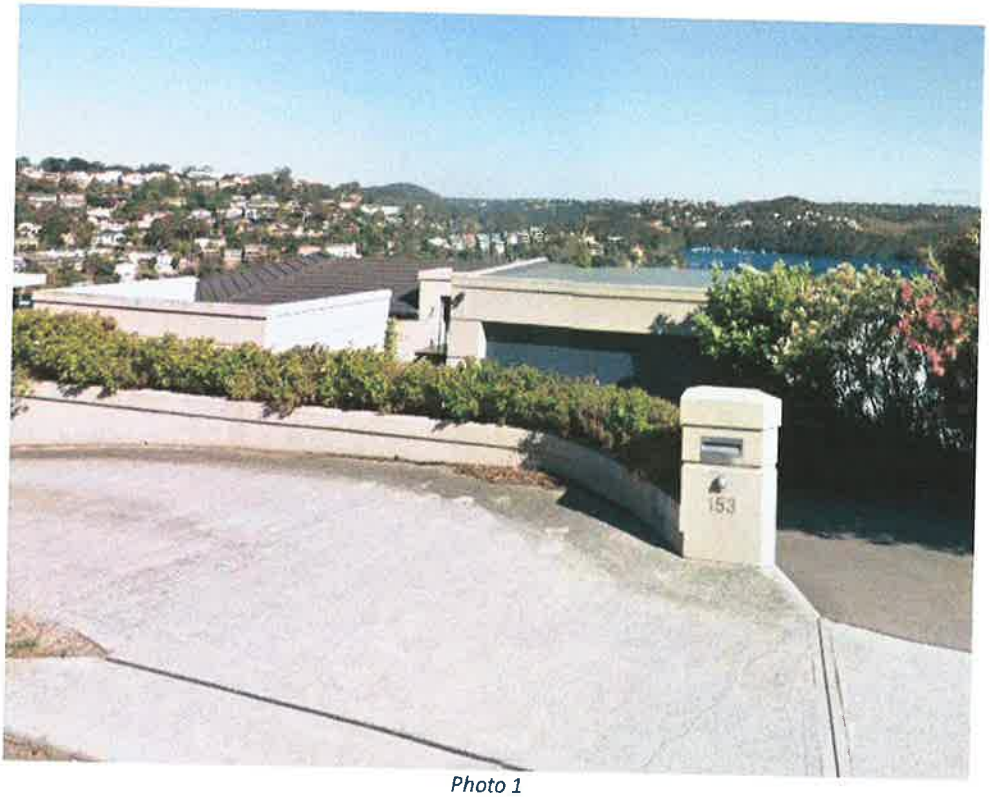


Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

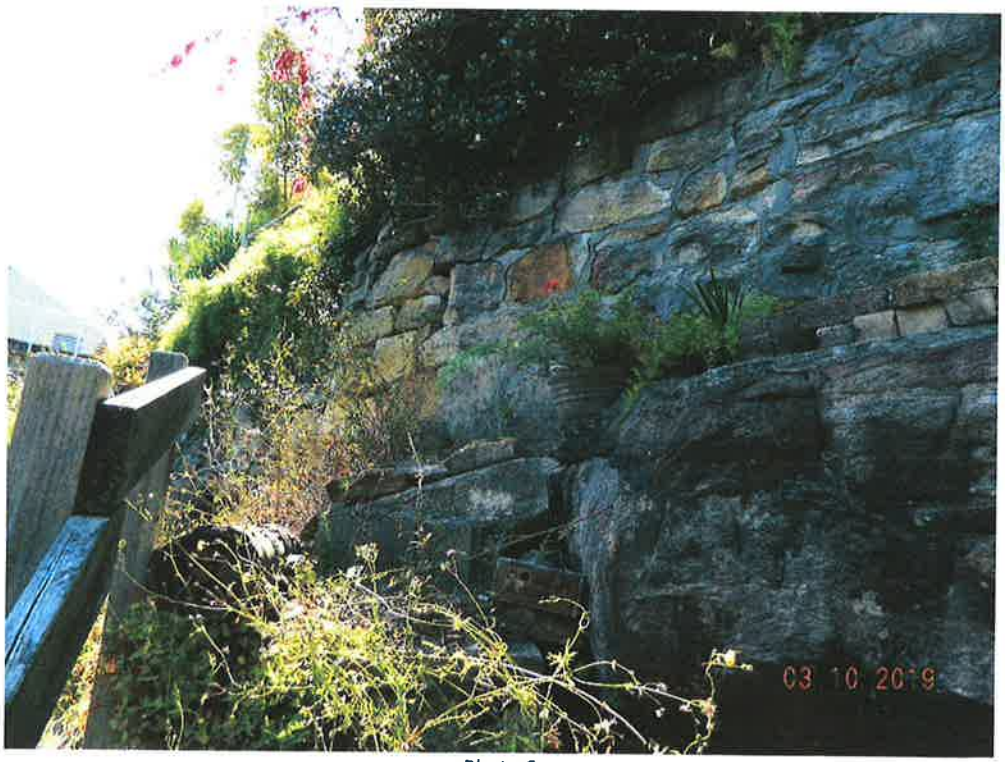


Photo 6

Photo 7 – 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.

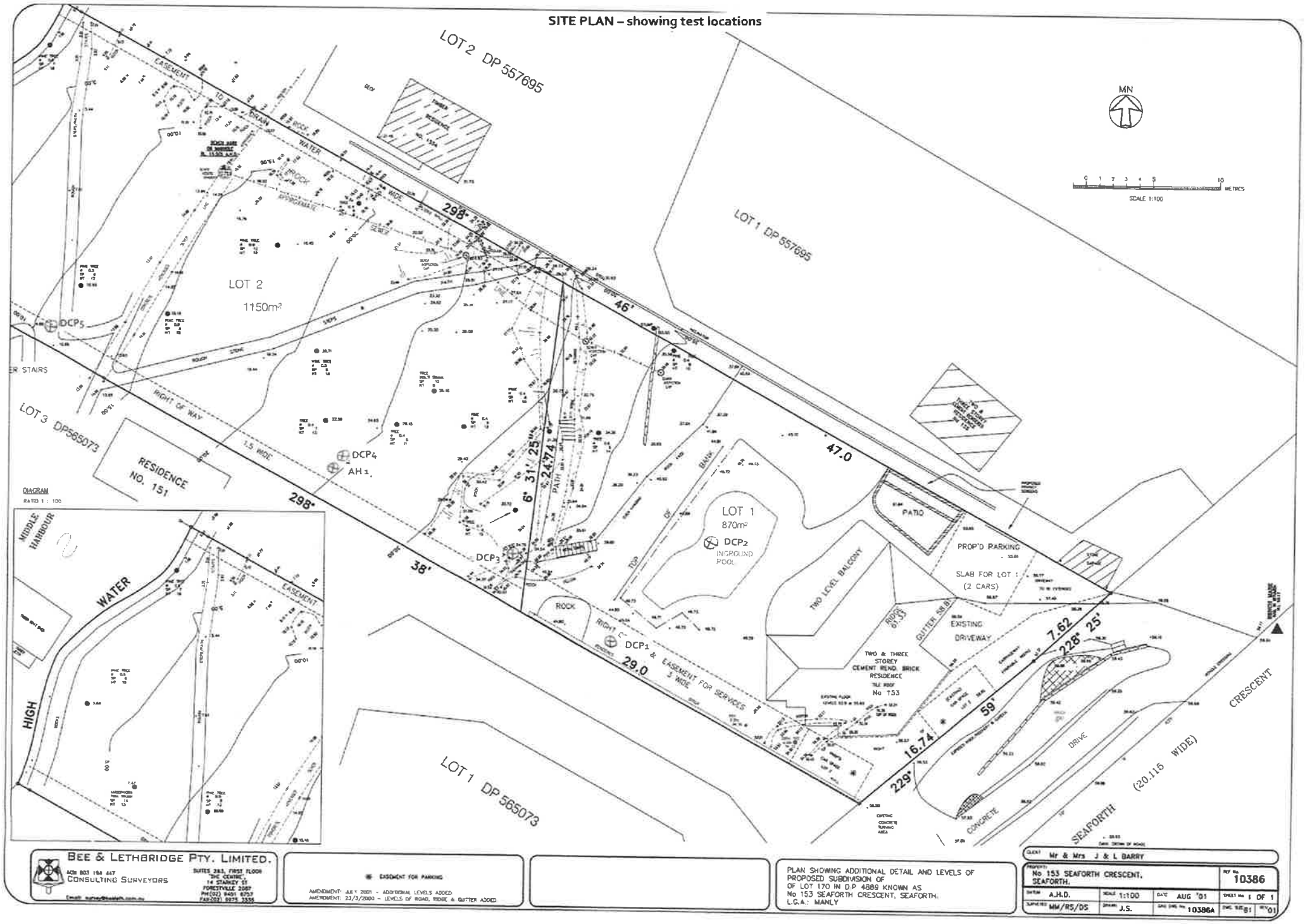
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



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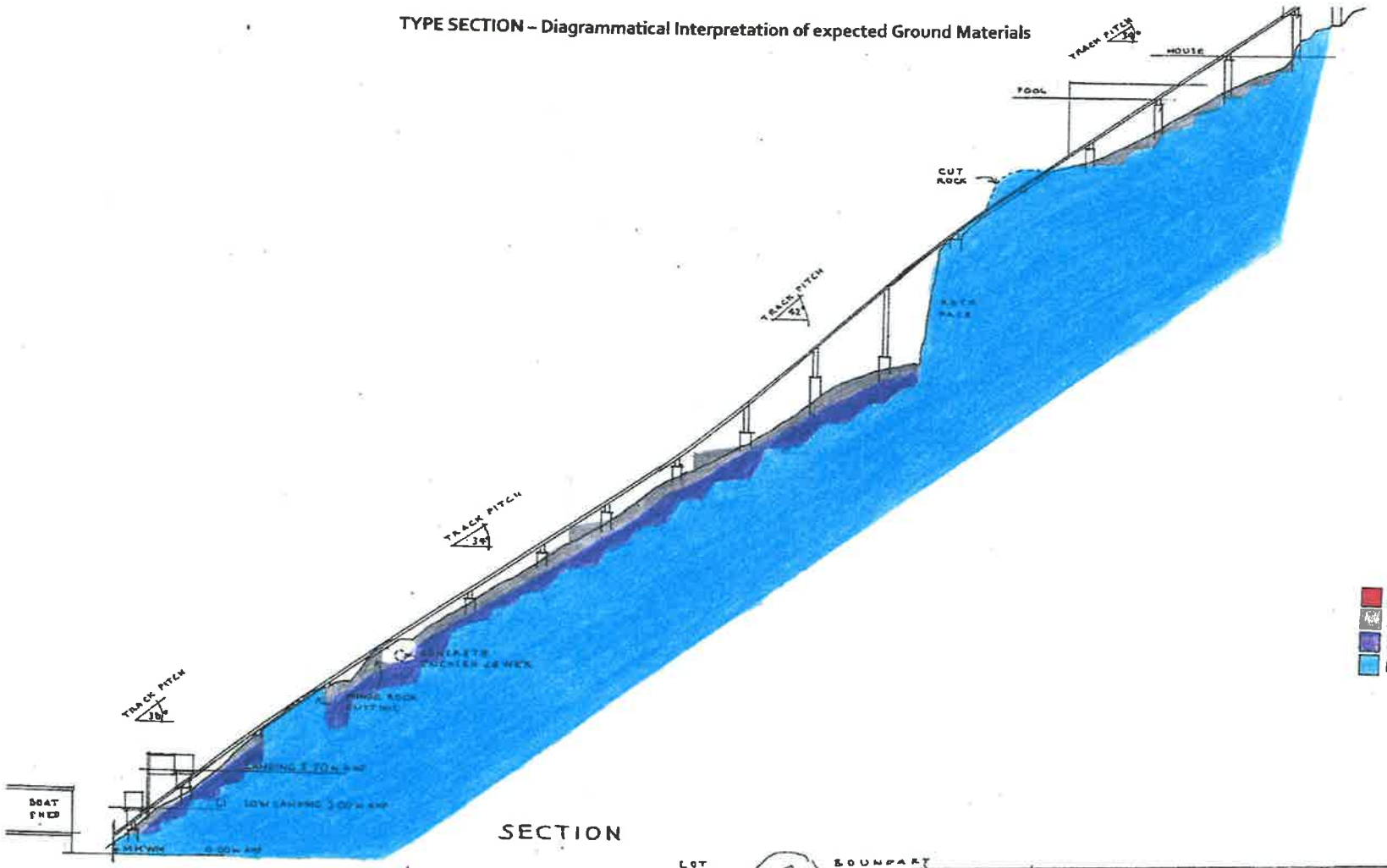
EASEMENT FOR PARKING

AMENDMENT: JULY 2001 – ADDITIONAL LEVELS ADDED
AMENDMENT: 23/3/2000 – LEVELS OF ROAD, RIDGE & GUTTER ADDED

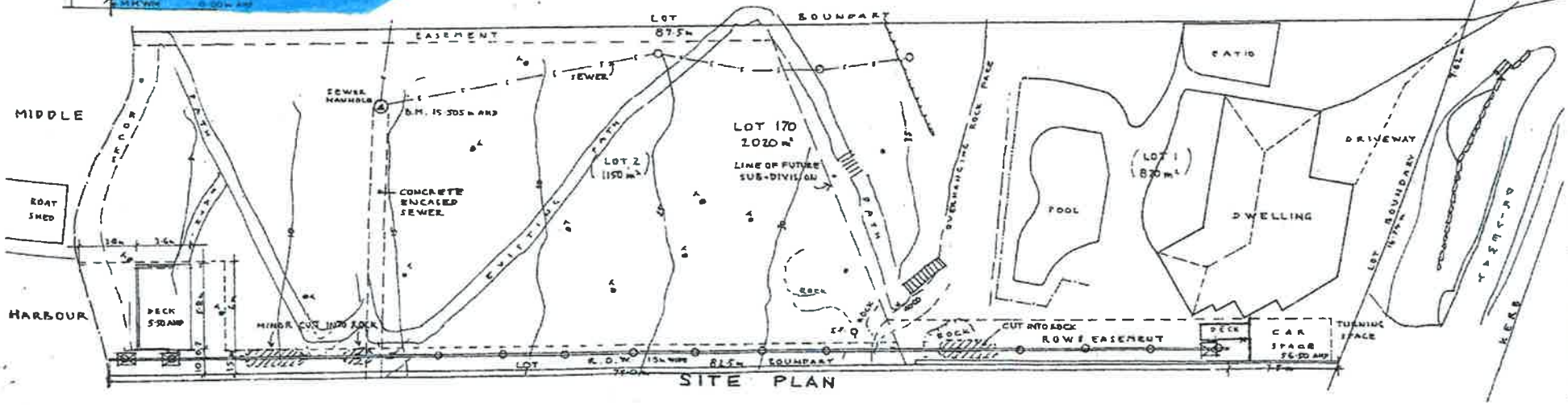
PLAN SHOWING ADDITIONAL DETAIL AND LEVELS OF PROPOSED SUBDIVISION OF OF LOT 170 IN D.P 4889 KNOWN AS No 153 SEAFORTH CRESCENT, SEAFORTH.
L.G.A.: MANLY

CLIENT: Mr & Mrs J & L BARRY
PROPERTY: No 153 SEAFORTH CRESCENT, SEAFORTH.
REF No. 10386
DATUM: A.H.D.
SCALE: 1:100
DATE: AUG '01
SHEET No. 1 OF 1
SURVEYED: MM/RS/DS
DRAWN: J.S.
DWG. DWG. No. 10386A
DWG. SIZE: A1
REV. '01

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



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



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INCLINE LIFT

153 SEAFORTH CR.
SEAFORTH
Lot 170 DP 4889

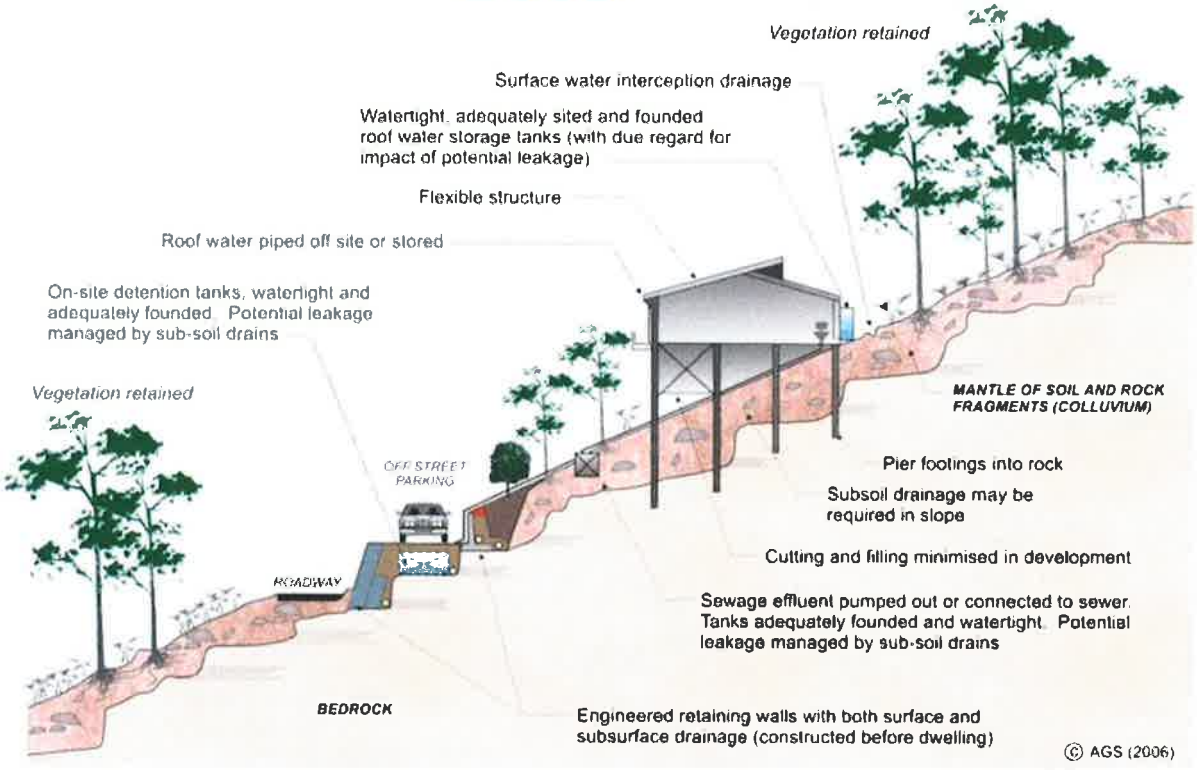
for J & L BARRY

SITE PLAN & SECTION

1:200 AT A3
SEPT. 2010
S.C.

2209 - DA 01

EXAMPLES OF GOOD HILLSIDE PRACTICE



EXAMPLES OF POOR HILLSIDE PRACTICE