GEOTECHNICAL INVESTIGATION:

Additions and Alterations at **546 Pittwater Road, North Manly**

1. Proposed Development

1.1 Construct an extension on the uphill side of the house by excavating to a maximum depth of ~3.0m.

1.2 Re-landscape the uphill side of the property by excavating to a maximum depth of ~2.0m.

1.3 Other minor internal and external additions and alterations.

1.4 Details of the proposed development are shown on 14 drawings prepared by Ava Shirley, Project Title: Tidal House, drawings numbered DA-00, DA-01, DA-10, DA-11, DA-12, DA-20, DA-21, DA-30, DA-40, DA-50, DA-60, DA-61, DA-62, and DA-63 Issue B, dated 16/9/21.

2. Site Description

2.1 The site was inspected on the 13th October, 2021.

2.2 This residential property has dual access. It is on the high side of Pittwater Road and is also accessed by a Right of Carriageway (ROW) off of Hope Avenue. The property has a S aspect. The block runs SW – NE so there is a slight crossfall. It is located on the moderately graded lower reaches and toe of a hillslope. The slope rises across the property at an average angle of ~14°. The slope above the property continues at similar angles. The slope below eases to near level angles.

2.3 At the road frontage, a mortared sandstone driveway runs up the slope to a garage underneath the downhill side of the house (Photo 1). Between the road frontage and the house is a gently sloping lawn area. The ~1.0m high cut batter for the driveway is lined with sandstone flagging. The fill for the gently sloping lawn is

supported by a stable ~1.2m high stack rock retaining wall (Photo 2). The two-storey rendered brick house is supported on brick walls and brick piers (Photo 3). The brick walls show no significant signs of movement and the brick piers stand vertical. A ~2.0m cut to create a level platform for the house is supported by a stable mortared sandstone retaining wall (Photo 4). Competent Medium Strength Sandstone bedrock can be seen outcropping at the base of the wall. This wall is to be demolished as part of the proposed works. Immediately above the wall, outcropping sandstone bedrock steps up to a secondary dwelling on the uphill side of the property (Photo 5). Part of the sandstone outcrop was observed to be undercut slightly but is considered stable. The single-storey dwelling is supported on rendered brick walls and steel posts. The brick walls show no significant signs of movement and the steel posts stand vertical. A concrete driveway runs from the ROW to a carport underneath the secondary dwelling (Photo 6). A ~0.8m high stable concrete block retaining wall supports a fill for a level lawn area on the uphill side of the property (Photo 7).

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 hand Auger Hole (AH) 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 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 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:

AUGER HOLE 1 (~RL13.5) **–** AH1 (Photo 8)

Depth (m)	**Material Encountered**
0.0 to 0.6	**FILL**, dark brown sandy soil, medium to coarse grained, loose to medium dense, fine trace of organic matter, rock fragments, orange and yellow sand intermixed, damp.
0.6 to 0.9	**SAND**, white and yellow, derived from Very Low Strength Sandstone, coarse grained, medium dense, large sandstone fragments, dry.

Refusal @ 0.9m on rock. No water table 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** (~RL9.2)	**DCP 2** (~RL13.5)	**DCP 3** (~RL13.6)	**DCP 4** (~RL12.0)	**DCP 5** (~RL11.6)
0.0 to 0.3	1	2	Rock exposed at the surface	4	Rock exposed at the surface
0.3 to 0.6	1	2		3	
0.6 to 0.9	3	4		#	
0.9 to 1.2	15	15			
1.2 to 1.5	7	13			
1.5 to 1.8	#	11			
1.8 to 2.1		#			
	Refusal on Rock @ 1.25m	Refusal on Rock @ 1.85m		Refusal on Rock @ 0.5m	

#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 @ 1.25m, DCP bouncing off rock surface, orange sandy clay on damp tip, orange sand clay smeared up length of DCP.

DCP2 – Refusal on rock @ 1.85m, DCP bouncing off rock surface, orange impact dust on dry tip.
DCP3 – Rock exposed at the surface.
DCP4 – Refusal on rock @ 0.5m, DCP bouncing off rock surface, white impact dust on dry tip.
DCP5 – Rock exposed at the 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. Where the rock is not exposed, it is overlain by sandy soils and clays that fill the bench step formation. Filling has been placed on the uphill side of the property for landscaping. In the test locations, where the rock is not exposed, the depth to rock ranged between 0.5m and 1.85m below the current surface, being deeper due to the presence of fill, and the stepped nature of the underlying bedrock. The outcropping sandstone on the property is estimated to be medium strength or better. On the adjoining property to the NW, the underlying rock was of slightly poorer quality than the outcropping rock and was considered Low to Medium strength (Photo 8). Similar strength rock will likely underlie this 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 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 below or beside the property. The moderately graded slope that rises across the property and continues above is a potential hazard (**Hazard One**). The vibrations from the proposed excavations are a potential hazard (**Hazard Two**). The proposed excavations are a potential hazard until retaining walls are in place (**Hazard Three**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two	Hazard Three
TYPE	The moderate slope that rises across the property and continues above failing and impacting on the proposed works.	The vibrations produced during the proposed excavation impacting on the surrounding structures.	The excavations to create the level platforms for the house and courtyard (up to a maximum depth of 3.0m) partially collapsing onto the work site before retaining structures are in place.
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	5.3×10^{-7}/annum	8.3×10^{-6}/annum
COMMENTS	This level of risk is 'ACCEPTABLE'.	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 property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 13 and 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 Pittwater Road below. All stormwater or drainage runoff 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 up to a maximum depth of ~3.0m is required to create the level platform for the ground floor extension. Where the rock is not exposed, the excavation is expected to be through fill with Low to Medium Strength Rock expected at depths of between ~1.1m and ~1.8m below the current surface in the area of the proposed works.

Another excavation to a maximum depth of ~2.0m is required to re-landscape the uphill side of the property. Where the rock is not exposed, the excavation is expected to be through fill and shallow clays with Medium Strength Rock expected at depths of up to ~0.5m below the current surface in the area of the proposed works.

It is noted that prior works on the adjoining property to the NW identified that the Sandstone Bedrock in this area was of a lower strength than what was exposed at the surface (Photo 8).

It is envisaged that excavations through fill, soil, sand, and clay can be carried out with an excavator and bucket, and excavations through rock will require grinding or rock sawing and breaking.

12. Vibrations

Possible vibrations generated during excavations through fill, soil, sand, and clay will be below the threshold limit for building damage. It is expected that the majority of the excavations will be through Low to Medium Strength Sandstone.

Excavations through rock should be carried out to minimise the potential to cause vibration damage to the subject house and neighbouring properties to the SE and NW. Allowing for 0.5m of backwall drainage, the setbacks are as follows:

- ~2.0m from the SE neighbouring house.
- ~2.5m from the NW neighbouring house.
- ~6.0m from the remaining walls of the subject house (following the demolition of the uphill side of the house)

Dilapidation reporting carried out on the NW and SE neighbouring properties is recommended prior to the excavation works commencing.
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 8mm/sec at the property boundaries. Vibration monitoring will be required to verify this is achieved. The vibration monitoring equipment must include a light/alarm so the operator knows if vibration limits have been exceeded. It also must 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.

13. Excavation Support Requirements

The excavations on the uphill side of the house will reach a maximum depth of ~3.0m. Allowing for 0.5m of backwall drainage, the setbacks are as follows:

- Near flush with the SE common boundary.
- Near flush with the NW common boundary.
- ~2.0m from the SE neighbouring house.
- ~2.0m from the NW neighbouring house.

As the SE neighbouring house is founded at a lower level to the subject property, and the shallow depth to rock on the NW side of the cut, only the SE and NW common boundaries will lie within the zone of influence of the proposed excavation. In this instance, the zone of influence is the area above a theoretical 30° line from the base of the excavation or top of Medium Strength Rock, whichever is encountered first, towards the surrounding structures and boundaries.

The SE and NW common boundary fences are to be braced prior to the excavation commencing.

Where the SE common boundary falls within the zone of influence of the excavation, the cut faces through fill, soil, and clay will require the installation of shoring as the excavation is progressed prior to the excavation through rock commencing. The support is to be designed by the structural engineer. If the support is temporary, it is to remain in place until the retaining walls are built. See site plan attached for extent of minimum required shoring.

Where room permits, the remaining soil and sand portions of the excavation face are to be battered temporarily at 1.0 Vertical to 1.7 Horizontal (30°) until the retaining walls are in place. Excavations through natural clay are expected to stand unsupported for a short period of time at near vertical angles until the retaining walls are in place, provided they are kept from becoming saturated. 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. Unsupported cut batters through fill, soil, clay, and sand are to be covered to prevent access of water in wet weather and loss of moisture in dry weather. The covers are to be tied down with metal pegs or other suitable fixtures so they can't blow off in a storm. The materials and labour to construct the pool structure/retaining walls are to be organised so on completion of the excavations they can be constructed as soon as possible. The excavations are to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

During the excavation process, the geotechnical consultant is to inspect the cuts in 1.5m intervals as they are lowered 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 excavations, it is recommended all cut faces be supported with retaining walls to prevent any potential future movement of joint blocks in the cut face that can occur over time, when unfavourable jointing is obscured behind the excavation face. Additionally, retaining walls will help control seepage and to prevent minor erosion and sediment movement. Excavation spoil may be used for landscaping on site.

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

14. Retaining Walls

For cantilever or singly-propped retaining walls, 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 Walls

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Fill and Sandy Soil	20	0.40	0.55
Clays and Sands	20	0.30	0.40
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 walls are fully drained. Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

All retaining walls 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 walls, the likely hydrostatic pressures are to be accounted for in the structural design.

15. Foundations

A concrete slab and shallow piers supported directly off Medium Strength Sandstone are suitable footings for the proposed extension on the uphill side of the house and the proposed

lower courtyard on the uphill side of the property. This ground material is expected to be exposed across the uphill side of the excavations. Where the bedrock steps down past the base of the excavation, the works can be supported off piers taken to Medium Strength Sandstone where necessary.

The proposed upper courtyard can be supported off a concrete slab supported directly off Medium Strength Sandstone. This ground material is expected to be exposed across the entire area of the proposed works.

A maximum allowable bearing pressure of 1000kPa can be assumed for footings 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.

- 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 and contractors are still onsite and before steel reinforcing is placed or concrete is poured.

White Geotechnical Group Pty Ltd.

Ben White M.Sc. Geol.,
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Engineering Geologist.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

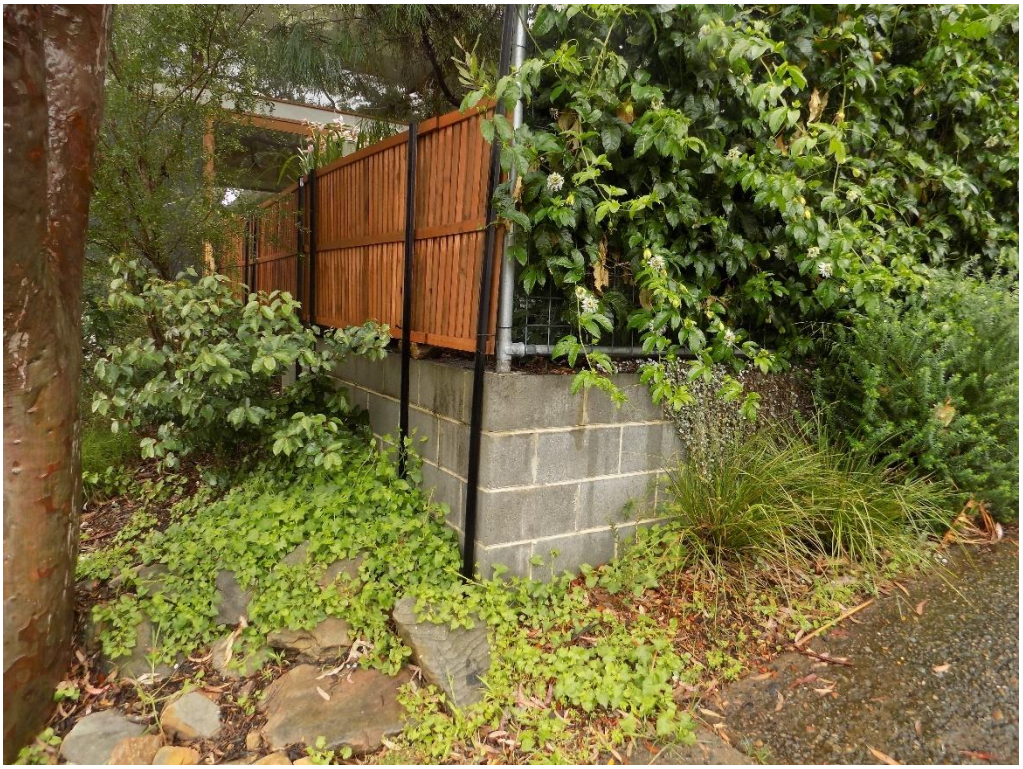


Photo 7

Photo 8 (Excavation at adjoining property – 548 Pittwater Rd)

Photo 9 (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.

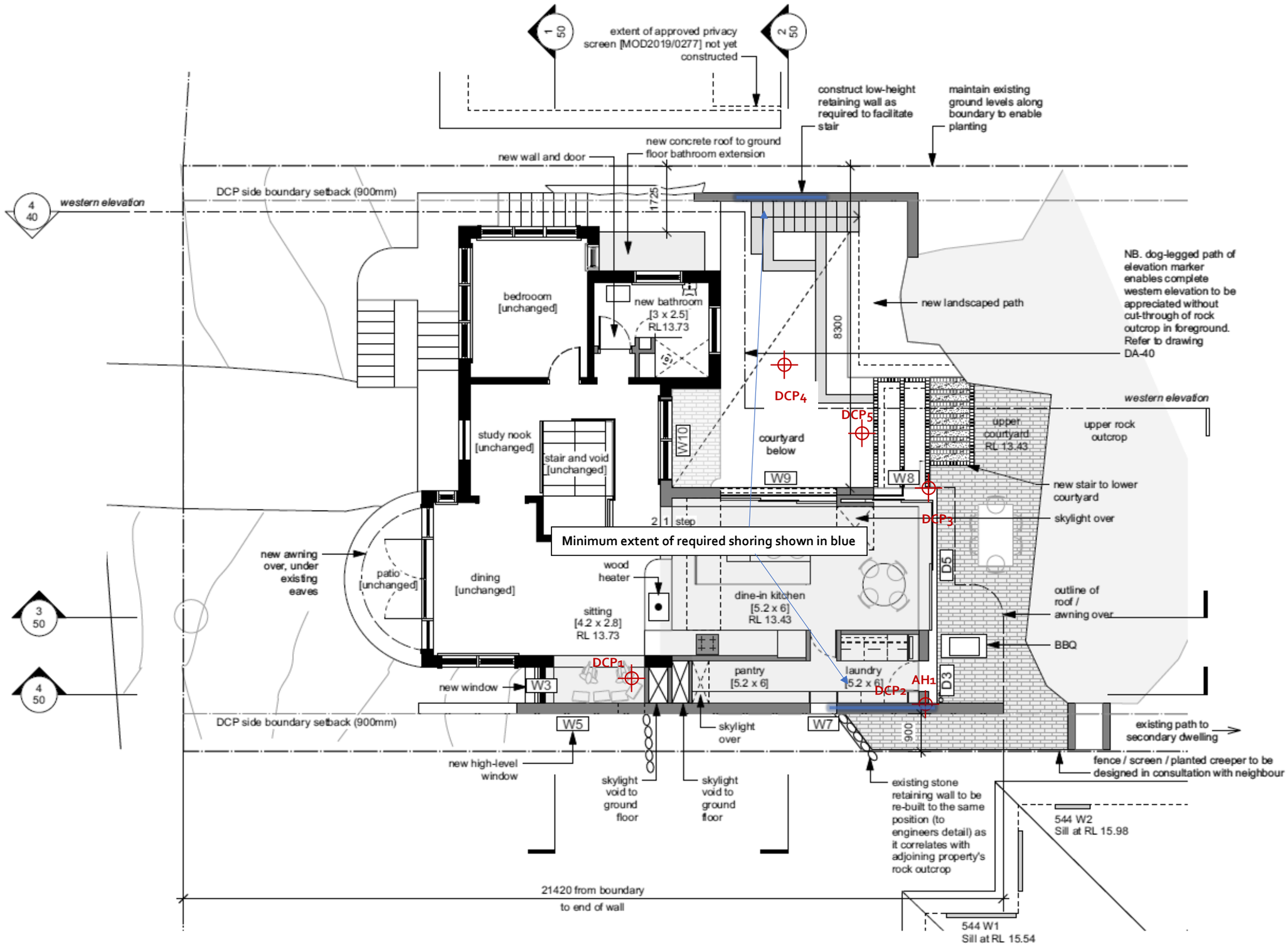
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



PLOT DATE : 27/9/21

DRAWING ISSUE

NOTES

- W1 new window - labelled in accordance with BASIX report
- D1 new door - labelled in accordance with BASIX report
- existing wall
- new wall
- new floor space

Project
Tidal House - Alts and Ads

Client
Ava Shirley and Michael Hilton

Address
546 Pittwater Road
North Manly, NSW
Lot 3, DP 391122

Architect
Ava Shirley NSW No. 10339
546 Pittwater Road
North Manly NSW 2100
p. 0438 109 803
e. ava@avashirley.com

Drawn By: AS

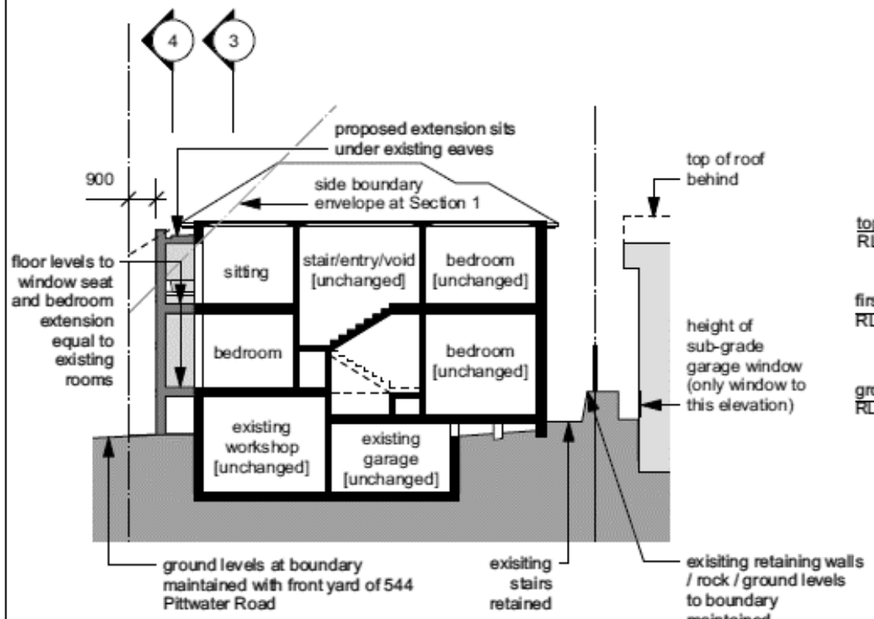
Scale: 1:100 at A3

Drawing
First Floor Plan Proposed

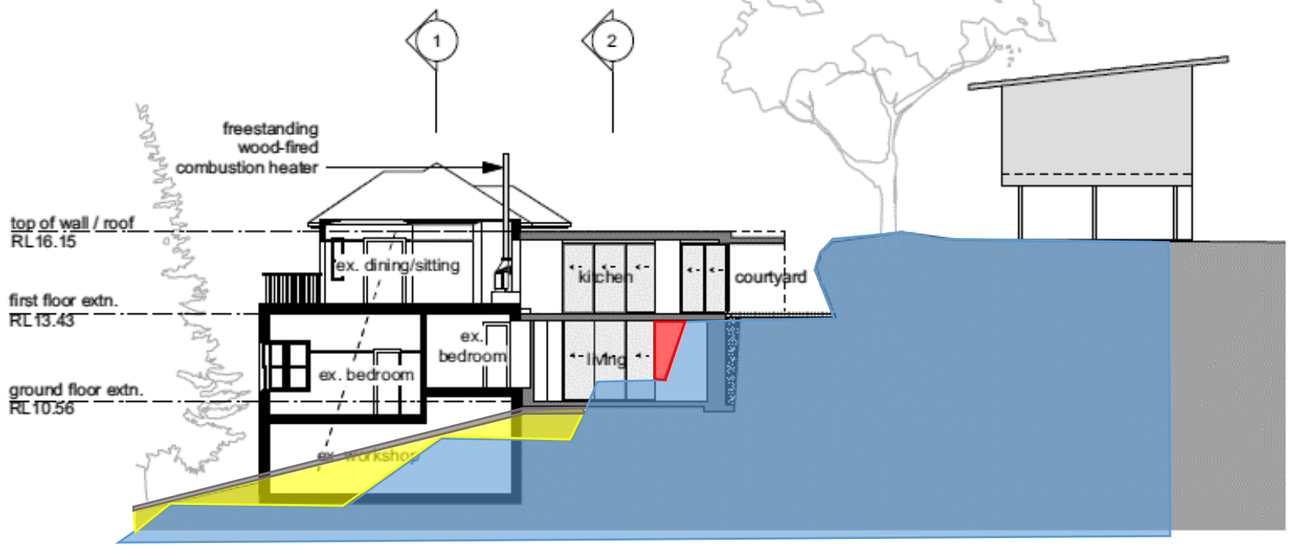
Rev. B

Dwg No. DA-21

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



1 Section 1



3 Long Section A
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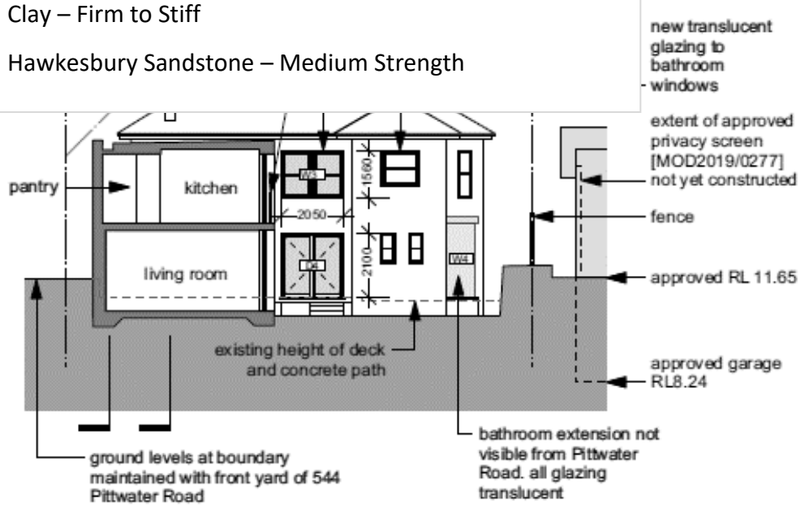
Expected Ground Materials

- Fill
- Topsoil
- Clay – Firm to Stiff
- Hawkesbury Sandstone – Medium Strength



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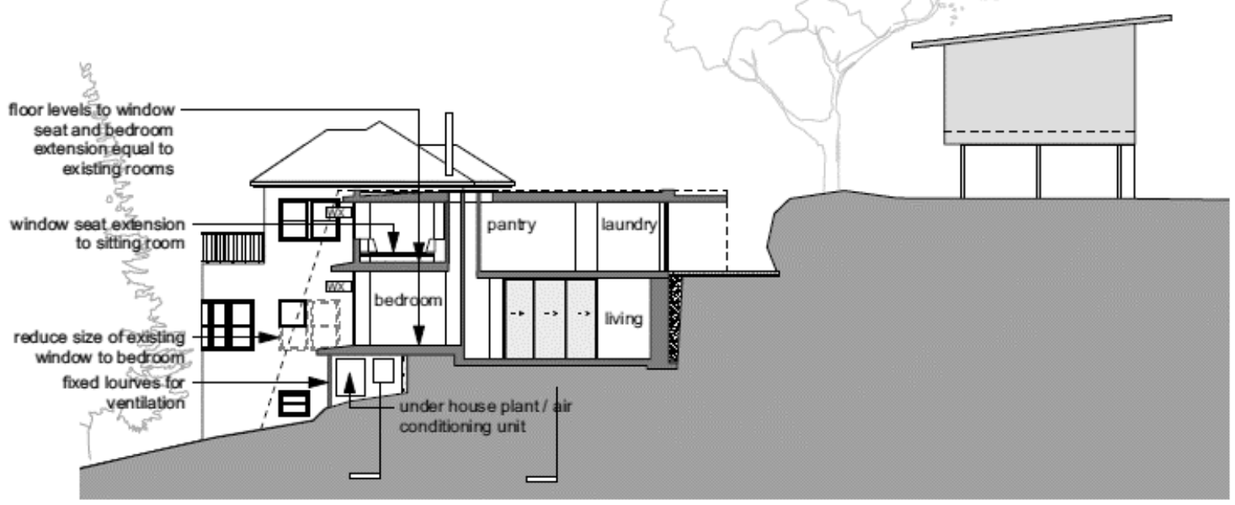

4 Long Section B
Scale: 1:200

PLOT DATE : 27/9/21

DRAWING ISSUE

NOTES

Project
Tidal House - Alts and Ads

Client
Ava Shirley and Michael Hilton

Address
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Drawn By: AS

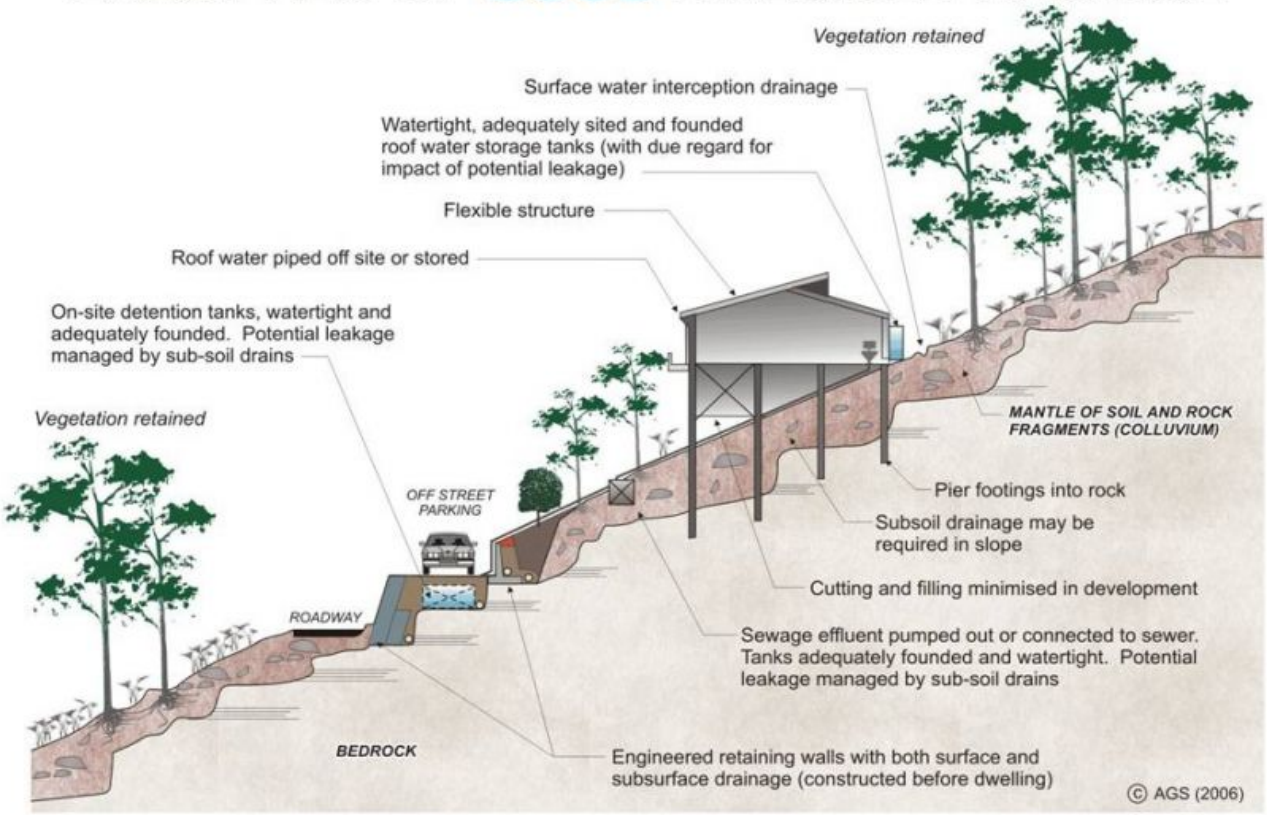
Scale: 1:200 at A3

Drawing
Proposed Sections

Rev.
B

Dwg No.
DA-50

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE