GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **35 Coles Road, Freshwater**

1. Proposed Development

1.1 Construct a new lower ground floor extension on the downhill side of the house by excavating to a maximum depth of ~2.2m.

1.2 Construct new ground floor extensions on the downhill and uphill sides of the house.

1.3 Construct a new upper floor addition over the footprint of the house.

1.4 Demolish the existing carport and construct a new garage on the downhill side of the property by excavating to a maximum depth of depth of ~3.4m.

1.5 Other minor internal and external additions and alterations.

1.6 Details of the proposed development are shown on 28 drawings prepared by Your Beautiful Home, Project Title: 35 Coles Road, Freshwater, drawings numbered DA01, DA02, DA100, DA110, DA120, DA130, DA140, DA150, DA200, DA210, DA220, DA230, DA300, DA400, DA500, DA600, DA610, DA620, SK700, SK702, MD01, MD02, MD04, and MD06 to MD10, dated 30/8/21.

2. Site Description

2.1 The site was inspected on the 11th October, 2021.

2.2 This residential property is on the high side of the road and has an SW aspect. The block runs N-S so there is a slight crossfall. It is located on the moderate to steeply graded upper reaches of a hillslope. The slope rises across the property at an average angle of ~18°. The slope below continues at similar angles. The slope above the property eases to the crest of the hill.

2.3 At the road frontage, a concrete driveway runs to a carport on the downhill side of the property (Photo 1). The ~3.5m cut for the carport has been taken entirely through outcropping Competent Medium Strength Sandstone (Photo 2). The carport will be demolished and replaced with a new garage as part of the proposed development. Between the road frontage and the house is a series of stable sandstone block retaining walls that terrace the slope (Photo 3). A level lawn area rises immediately above the cut for the carport (Photo 4). The fill batter for the lawn is lined with sandstone flagging, ~0.5m high. Stepped cracking was observed through the mortar of the flagging wall in some places. Competent Medium Strength Sandstone can be seen outcropping on the W side of the property (Photos 5 & 6). The single-storey rendered brick house is supported on brick walls and brick piers (Photo 7). The brick walls show no significant signs of movement and the brick piers stand vertical. Some of the supporting walls were observed to be supported directly onto outcropping sandstone bedrock across the downhill side of the house. Immediately above the house is a large outcrop of competent Medium Strength Sandstone. that is slightly undercut to ~1.5m (Photos 8 & 9). Given the thickness of the supporting cantilever arms with no additional significant visible geological defects, the undercut rock is considered to be stable. Above the large rock outcrop is another level patio and lawn area (Photo 10).

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 (~RL54.4) **–** AH1 (Photo 9)

Depth (m)	**Material Encountered**
0.0 to 0.8	**FILL**, dark brown mixed with yellow and white sand, fine to medium grained, loose, fine trace of organic matter, dry.

Refusal @ 0.8m. Auger grinding. 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** (~RL60.0)	**DCP 2** (~RL56.4)	**DCP 3** (~RL58.6)	**DCP 4** (~RL58.1)	**DCP 5** (~RL54.4)
0.0 to 0.3	4	4	Rock exposed at surface	Rock exposed at surface	6
0.3 to 0.6	12	12			6
0.6 to 0.9	18	8			13
0.9 to 1.2	#	3			#
1.2 to 1.5		#			
	Refusal on Rock @ 0.9m	Refusal on Rock @ 1.3m			Refusal on Rock @ 0.9m

#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 @ 0.9m, DCP bouncing off rock surface, white impact dust dry tip, orange sand in collar.
DCP2 – Refusal on rock @ 1.3m, DCP bouncing off rock surface, clean dry tip.
DCP3 – Rock exposed at surface.
DCP4 – Rock exposed at surface.
DCP5 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, clean dry tip.

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 soil and sands that fill the bench step formation. Filling has been placed across the downhill side of the property for landscaping. In the test locations, where the rock was not exposed, it was encountered at depths of between 0.9m and 1.3m below the current surface, being slightly 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 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 proposed works.

7. Surface Water

No evidence of surface flows were observed on the property during the inspection. As the site encompasses the crest of a hill, flows will drain away from the site.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above or beside the property. The moderate to steeply graded slope that rises across the property and continues below is a potential hazard (**Hazard One**). The undercut rock faces (Photos 8 & 9) above the house are a potential hazard (**Hazard Two**). The vibrations from the proposed excavations are a potential hazard (**Hazard Three**). The proposed excavations are a potential hazard until retaining walls are in place (**Hazard Four**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The moderate to steep slope that rises across the property and continues below failing and impacting on the proposed works.	The undercut rock faces (Photos 8 & 9) failing and causing damage to the subject house and proposed works.
LIKELIHOOD	'Unlikely' (10^{-4})	'Rare' (10^{-5})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Major' (60%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Low' (6×10^{-5})
RISK TO LIFE	8.3×10^{-7}/annum	8.3×10^{-7}/annum
COMMENTS	This level of risk is 'ACCEPTABLE'.	This level of risk is 'ACCEPTABLE'.

RISK ANALYSIS CONTINUES ON THE NEXT PAGE

HAZARDS	Hazard Three	Hazard Three
TYPE	The vibrations produced during the proposed excavations impacting on the surrounding structures.	The proposed excavations for the extension and garage (Up to a maximum depth of ~3.4m) collapsing onto the work site before retaining structures are in place.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (15%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	8.3×10^{-6}/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 **Sections 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 Coles 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 ~2.2m is required to construct the lower ground floor extension on the downhill side of the house. The excavation is expected to be taken

entirely through outcropping Medium Strength Rock. This rock is exposed across the entire footprint of the proposed excavation.

Another excavation up to a maximum depth of ~3.4m is required to create a level platform for the proposed garage. This excavation is expected to be through fill with Medium Strength Sandstone expected at depths of up to 1.3m below the surface in the area of the proposed excavation.

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

12. Vibrations

It is expected that the entirety of the excavation will be through Medium Strength Sandstone or better.

Excavations through rock should be carried out to minimise the potential to cause vibration damage to the subject house and neighbouring property to the E and W. Allowing for backwall drainage, the setbacks are as follows:

- Flush with the subject house.
- Flush with the remaining sandstone block retaining walls.
- ~4.0m from the W neighbouring house.
- ~8.5m from the E neighbouring house

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 walls of the subject house. 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

Bulk excavation for the lower ground floor extension

The excavation for the lower ground floor extension will reach a maximum depth of ~2.2m. Allowing for ~0.5m of backwall drainage, the setbacks are as follows:

- Flush with the subject house.
- ~2.5m from the W common boundary.

As the excavation is to be taken entirely through Medium Strength Sandstone and the surrounding structures were observed to be supported on the rock, no structures or boundaries will lie within the zone of influence of the proposed excavation.

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

Bulk excavation for the garage

The excavation for the proposed Garage will reach a maximum depth of ~3.4m. Allowing for ~0.5m of backwall drainage, the setbacks are as follows:

- Flush with the remaining portion of the sandstone block retaining wall on the lower boundary.
- Near flush with remaining portion of the upslope sandstone block retaining wall.

As such, the remaining portions of the two retaining walls 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.

Given the shallow depth to rock, we think it is likely the sandstone block retaining walls are supported on rock. However, to be sure, where the retaining walls fall within the zone of influence of the excavation, exploration pits along the walls will need to be put down by the builder to determine the foundation depth and material. These are to be inspected by the geotechnical consultant.

If the foundations are found to be supported on rock, the excavation may commence. If they are not, the walls will need to be underpinned to rock or to below the zone of influence of the cut prior to the excavation commencing. See the site plan attached for the minimum extent of the required exploration pits/underpinning.

Underpinning is to follow the underpinning sequence 'hit one miss two'. Under no circumstances is the bulk excavation to be taken to the edges of the walls and then underpinned. Underpins are to be constructed from drives that should be proportioned according to footing type and size. Allowances are to be made for drainage through the underpinning to prevent a build-up of hydrostatic pressure. Underpins that are not designed as retaining walls are to be supported by retaining walls. The void between the retaining walls and the underpinning is to be filled with free-draining material such as gravel.

During the excavation process, the geotechnical consultant is to inspect the excavation as they approach to within 1.0m of the supporting wall to confirm the stability of the cut to go flush with the footings.

Where room permits, the fill and soil 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 is 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.

Advice Applying to Both Excavations

All excavation margins are to be cut with a rock saw to create a clean, uniform cut.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. Unsupported cut batters through soil and clay 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 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.

During the excavation process, the geotechnical consultant is to inspect the excavations as they are 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 excavations, 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 face. Additionally, retaining walls will help control seepage and to prevent minor erosion and sediment movement.

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, Soil, and Residual Clay	20	0.40	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 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 both the proposed lower ground floor extension and the new garage. 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 excavations, the works can be supported off shallow piers taken to Medium Strength Sandstone.

The ground floor extension on the uphill side of the house, and any additional footings required for the upper floor addition are to be supported on piers taken to Medium Strength Sandstone.

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.

- The exploration pits to determine the foundation material along the retaining walls are to be inspected by the geotechnical consultant to determine if underpinning is necessary. This is to occur before the bulk excavation for the garage commences.

- During the excavation process, the geotechnical consultant is to inspect the excavations as they approach to within 1.0m of the supporting posts and piers of the house to confirm the stability of the cut to go flush with the footings.

- 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.,
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 (Right to Left)

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.

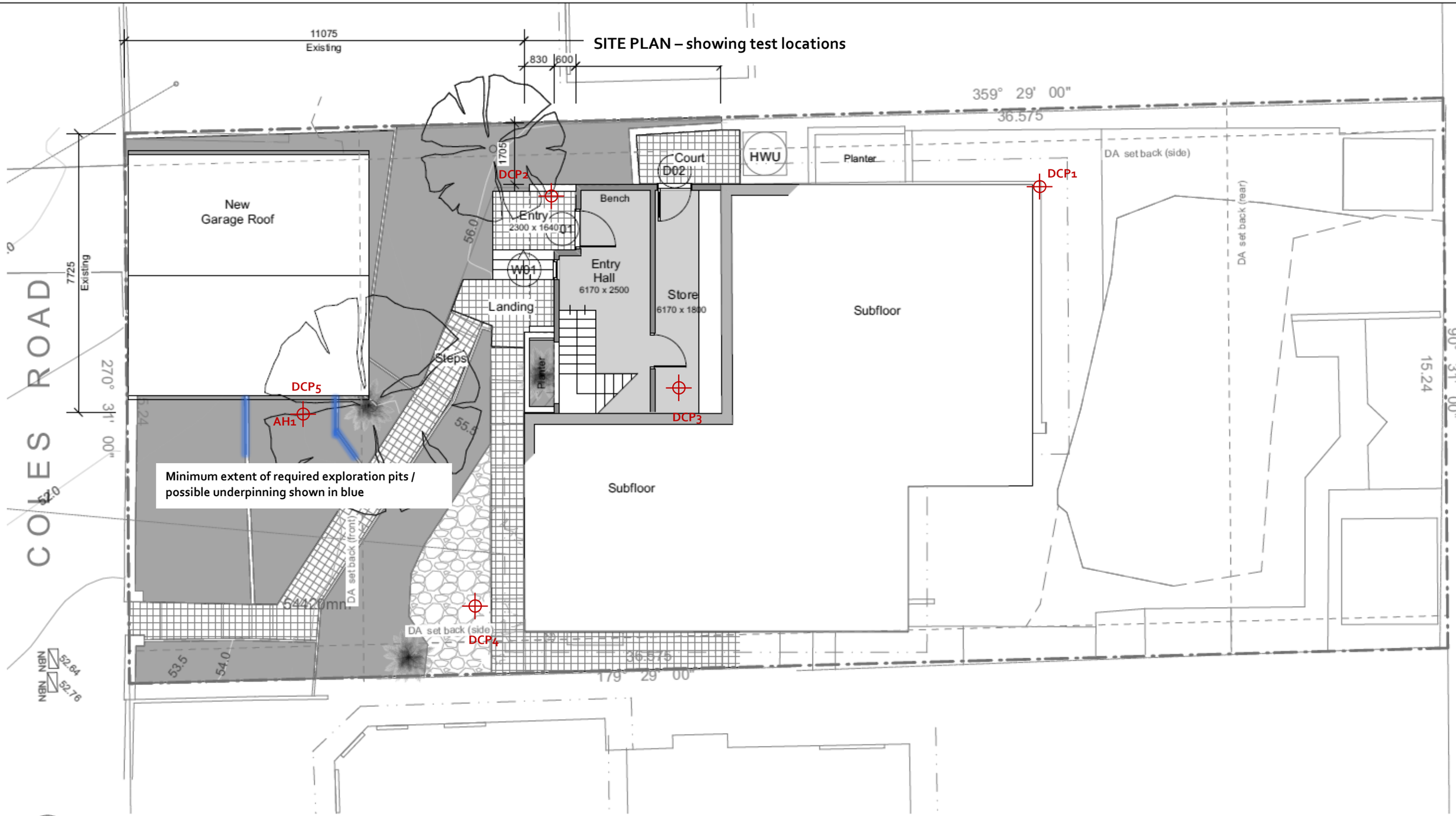
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



FOR DA APPROVAL

your beautiful HOME.

NOTES

All levels, contours,survey and cadastral information provided by Land Surveyors
YBH was provided with all site information including measured drawing. All dimensions will need to be confirmed on site.
The dimensions and profiles shown on the drawings are believed to be correct. It is the responsibility of those working on site to verify the dimensions and profiles and locate all services on site prior to commencing work
All dimensions in millimetres.Use figured dimensions only. Do not scale
If discrepancy exists notify designer immediately. All work shall comply with the Building Code of Australia, the rules and requirements of the Water Board, Council and the relevant Standards Association of Australia codes and specifications

DRAWING KEY

- New work
- New Walls
- Existing walls
- Demolish

PROJECT ADDRESS

35 Coles Road
Freshwater NSW 2096
Lot 64 DP 18880 557.3sqm

DATE

June 2021

CLIENT/S

Tennille Bignell &
Mark Lindon

STATUS

Preliminary DA

REVISION

A	16/7/21	For client review
B	23/7/21	For client review
C	30/8/21	Consultant Issue

LOWER GROUND FLOOR PLAN PROPOSED

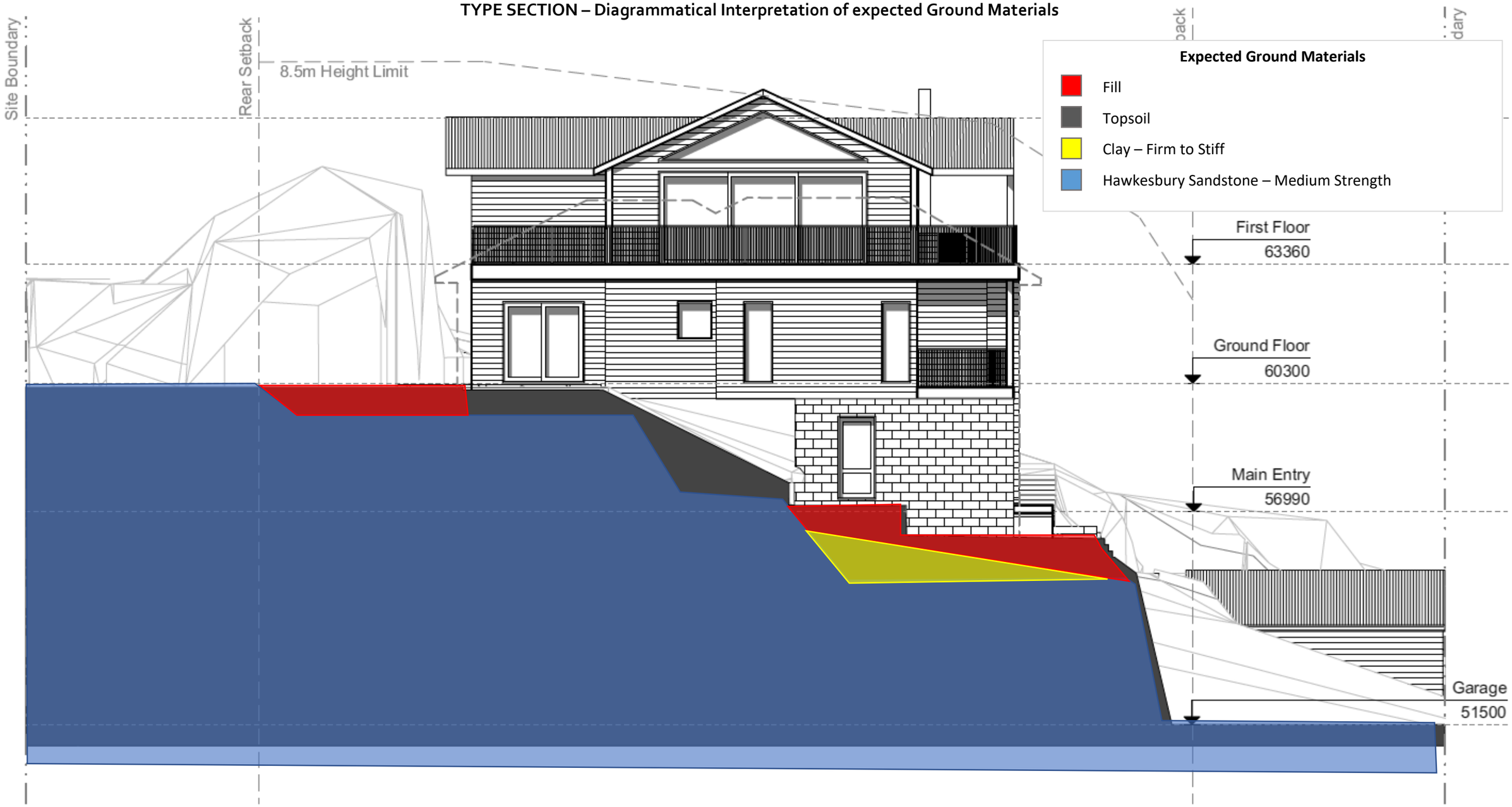
CLIENT REVIEW
NOT FOR CONSTRUCTION

DA | 120

SCALE

1:100

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



FOR DA APPROVAL

your beautiful HOME.

NOTES
All levels, contours,survey and cadastral information provided by Land Surveyors
YBH was provided with all site information including measured drawing. All dimensions will need to be confirmed on site.
The dimensions and profiles shown on the drawings are believed to be correct. It is the responsibility of those working on site to verify the dimensions and profiles and locate all services on site prior to commencing work
All dimensions in millimetres.Use figured dimensions only. Do not scale
If discrepancy exists notify designer immediately. All work shall comply with the Building Code of Australia, the rules and requirements of the Water Board, Council and the relevant Standards Association of Australia codes and specifications

DRAWING KEY
- New work
- New Walls
- Existing walls
- Demolish

PROJECT ADDRESS
35 Coles Road
Freshwater NSW 2096
Lot 64 DP 18880 557.3sqm

DATE
June 2021

CLIENT/S
Tennille Bignell &
Mark Lindon

STATUS
Preliminary DA

REVISION

A	16/7/21	For client review
B	23/7/21	For client review
C	30/8/21	Consultant Issue

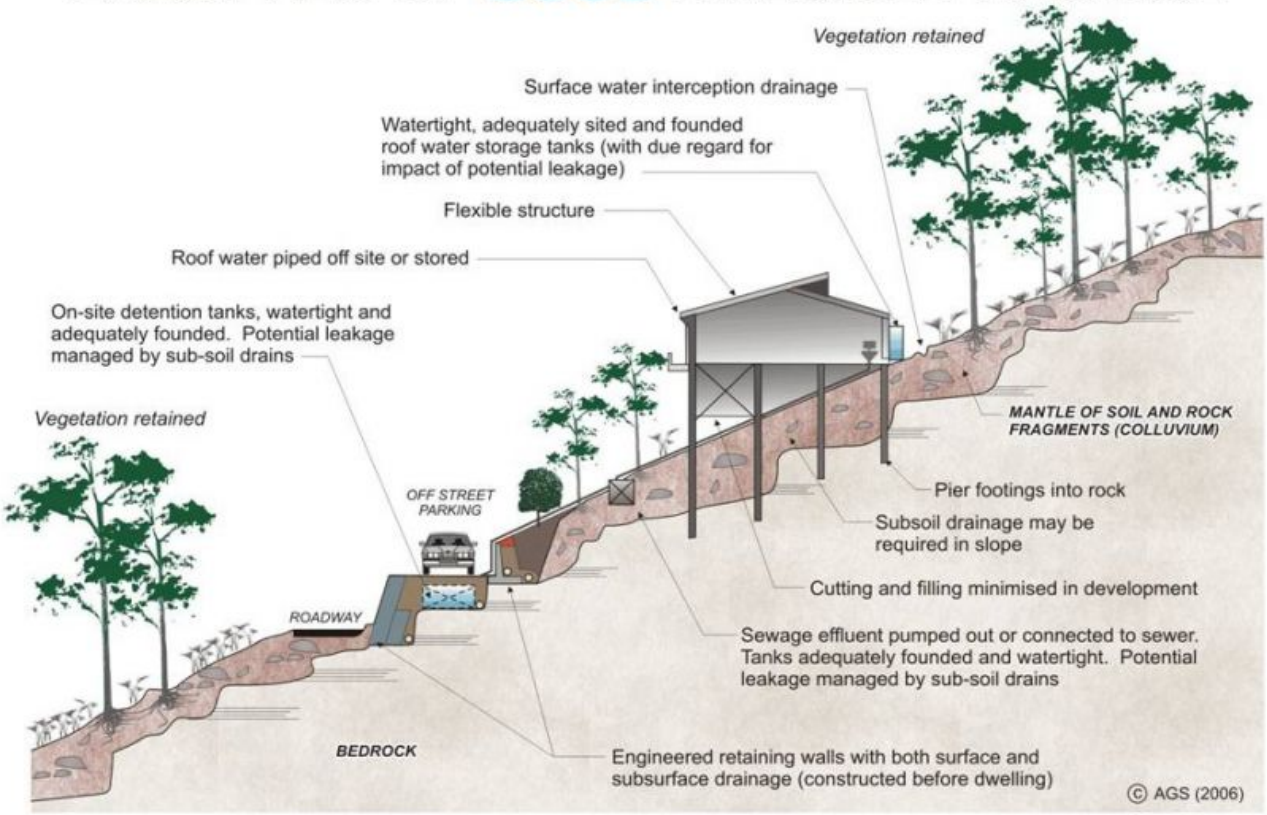
ELEVATION WEST PROPOSED

CLIENT REVIEW
NOT FOR CONSTRUCTION

DA | 230

SCALE
1:100

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE