GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **19 Tor Road, Dee Why**

1. Proposed Development

1.1 Demolish the S side of the existing house and construct a new part three-storey extension to the S side of the house by excavating to a maximum depth of ~2.5m.

1.2 Details of the proposed development are shown on 4 drawings by High Design, drawings numbered 1-3 to 3-3 953 21 and 3A-3 953 21, dated September, 2021.

2. Site Description

2.1 The site was inspected on the 25th November, 2021.

2.2 This residential property is on the corner of Tor Road and Stoddart Place. It is on the N side of Tor Road and is on the SW side of Stoddart Place. The property has a NE aspect. It is located on the gently graded lower reaches of a hillslope. The slope above and below the property continues at gentle angles.

2.3 At the road frontage to Tor Road, a brick-paved driveway runs to a stable carport attached to the E side of the house (Photo 1). Between both road frontages and the house are gently sloping lawn areas (Photos 2 & 3). The part two-storey brick house is supported on brick walls and brick piers (Photo 4). The external supporting walls show no significant signs of movement and the visible piers stand vertical.

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. Four Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and sand 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 (~RL19.1) **–** AH1 (Photo 5)

Depth (m)	Material Encountered
0.0 to 0.2	**TOPSOIL**, sandy soil, dark brown, loose, dry, fine to coarse grained with fine trace organic matter.
0.2 to 0.5	**SAND**, dark grey, loose, dry, coarse grained.
0.5 to 0.8	**SAND**, grey, loose to medium dense, dry, coarse grained.
0.8 to 1.4	**SAND**, grey, dark brown, brown, and orange, medium dense to dense, dry, coarse grained.
1.4 to 1.6	**CLAYEY SAND**, derived from weathered sandstone, brown, medium dense, dry, coarse grained with a sugary texture.

End of hole @ 1.6m in Medium Dense Clayey Sand. No water table encountered.

DCP RESULTS ON NEXT PAGE

DCP TEST RESULTS – Dynamic Cone Penetrometer			
Equipment: 9kg hammer, 510mm drop, conical tip.			Standard: AS1289.6.3.2 - 1997
Depth(m) Blows/0.3m	**DCP 1** (~RL18.6)	**DCP 2** (~RL18.9)	**DCP 3** (~RL19.1)
0.0 to 0.3	3	F	2
0.3 to 0.6	1F	4	2
0.6 to 0.9	7	8	6
0.9 to 1.2	43	23	20
1.2 to 1.5	22	6F	8
1.5 to 1.8	40	3	15
1.8 to 2.1	#	7	18
2.1 to 2.4		11	23
2.4 to 2.7		7	35
2.7 to 3.0		13	#
3.0 to 3.3		20	
3.3 to 3.6		18	
3.6 to 3.9		21	
3.9 to 4.2		35	
4.2 to 4.5		40	
4.5 to 4.8		#	
	End of Test @ 1.8m	End of Test @ 4.5m	End of Test @ 2.7m

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

DCP Notes:

DCP1 – End of test @ 1.8m, DCP still very slowly going down, brown clay fragments on dry tip.
DCP2 – End of test @ 4.5m, DCP still very slowly going down, maroon clay on damp tip, maroon clay in collar above tip.
DCP3 – End of test @ 2.7m, DCP still very slowly going down, brown and orange clay on damp tip.

5. Geological Observations/Interpretation

The site is underlain by sands and clayey sands that were encountered to the extent of the testing. To summarise the test results, very loose to medium dense sands occupy the top ~0.6m of the profile, these overlie medium dense to dense sands and clayey sands that extend to the extent of the testing at ~4.5m. Rock was not encountered to the depths tested up to 4.5m. However, clayey sands derived from weathered sandstone were encountered within AH1 from a depth of ~1.4m. The surface of the underlying bedrock is interpreted to step 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 deep overlying sand fills this bench/step formation. See the 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 that is generated on the property will be quickly be absorbed into the sandy soil where surfaces are unsealed.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed above or below the property. The proposed excavation is a potential hazard until retaining walls are in place (**Hazard One**). The proposed excavation undercutting the footings for the subject house is a potential hazard (**Hazard Two**).

Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The excavation collapsing onto the work site and impacting on the NE road reserve before retaining walls are in place.	The proposed excavation undercutting the footings of the subject house causing failure.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (25%)	'Medium' (35%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.0×10^{-5}/annum	5.3×10^{-5}/annum
COMMENTS	This level of risk to life and property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 13** are to be followed.	This level of risk to life and property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels, the recommendations in **Section 13** 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 Stoddart Place. Roof water from the 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 a maximum depth of ~2.5m is required to construct the proposed extension. It is expected to be through ~1.4m of sand over clayey sands. It is envisaged that excavations through sands and clayey sands can be carried out with a bucket.

12. Vibrations

No excessive vibrations will be generated by excavation through sands and clayey sands. Any vibrations generated by a domestic machine and bucket up to 16 ton will be below the threshold limit for infrastructure or building damage.

13. Excavation Support Requirements

It is recommended after the DA but before the structural design commences for the project, exploration drilling is to be carried out on the site to confirm the depth of rock that was not encountered to the depth of the testing. This is to be arranged and supervised by the geotechnical consultant and should consist of a minimum of two bore holes taken to the top of Medium Strength Rock at an expected depth of between 4.5-6.0m. The following ground support advice will not change as a result of the drilling. It will provide information on the required depth of embedment of the piles and the type of equipment required to drill them.

The proposed excavation will reach a maximum depth of ~2.5m and, accounting for 0.5m of back-wall drainage, will be set back as follows:

- ~2.4m from the remaining portion of the subject house.
- ~3.0m from the NE road reserve.
- ~6.1m from the S road reserve.
- ~6.2m from the W common boundary.

As such, only the S supporting wall of the remaining portion of the subject house, and the NE road reserve will be 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 towards the surrounding structures and boundaries.

The proposed excavation requires support installed along the N and E sides before excavations commence. See the minimum extent of the required shoring on the site plan attached. For ease of design and construction it may be better to continue the piers around the entire basement perimeter. In this instance, due to the presence of deep sand, secant or

contiguous piers are a suitable form of support. Secant piers are the preferred option but, if contiguous piers are used, the gaps between the piers are to be grouted closed as the excavation is lowered so no sand moves through the wall. The piers can be temporarily supported by bracing and/or embedment below the base of the excavation but are to be tied into the floor and ceiling slabs of the proposed structure during construction, after which any temporary support may be released.

As the depth to rock is not known, it is recommended a mini piling rig or a similar machine capable of drilling through Medium Strength Rock be used for the job. It is to be noted that a standard domestic excavator is not able to drill through Medium Strength Rock.

As the pier holes will be taken mostly through sand, it is recommended a rig with grout injection capabilities be used to minimise pier hole collapse.

The geotechnical consultant is to inspect the drilling process of the entire first pile and the ground materials at the base of all the piers before any steel or concrete is placed.

If the piled retaining wall is not continued around the S and W sides, these sides of the cut are to be temporarily battered at 1.0 Vertical: 1.7 Horizontal (30°) until the permanent retaining walls are in place, provided they are prevented from becoming saturated.

Upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. All unsupported cut batters through 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 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 cut in 1.5m intervals as it is lowered, while the machine/excavation equipment is on site, to ensure the ground materials are as expected and no additional temporary support is required.

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	Passive
Loose Sands	20	0.45	0.60	$K_p = 3$
Dense Sands	20	0.40	0.55	$K_p = 4.5$

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 wall, do not account for any surcharge loads (such as those from the remaining portion of the existing house), and assume retaining walls are fully drained. It should be noted that passive pressure is an ultimate value and should have an appropriate safety factor applied. No passive resistance should be assumed for the top 0.4m to account for any disturbance from the excavation. Ground materials 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 wall 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

The proposed contiguous piled retaining wall will likely be embedded into the Very Low Strength Rock and will be tied into the proposed structure. As such, the proposed structure is to be supported on piers taken to the Very Low Strength Rock to ensure a consistent bearing material across the proposed structure. A maximum allowable bearing pressure of 600kPa can be assumed for footings on Very Low Strength Rock.

Where the footprint of the proposed extension is not over the footprint of the excavation, it can be supported on spread footings taken to a depth of at least 0.6m into the underlying Medium Dense Sands of the natural profile, provided the retaining wall for the proposed basement level is designed to support the surcharge loads from this proposed extension. The footing walls are to be shored with timber to prevent collapse. A maximum allowable bearing pressure of 100kPa can be assumed for footings supported on the Medium Dense Sands of the natural profile.

The base of the footing excavations in sand should be compacted as the excavation will loosen the upper sands. This can be carried out with a hand-held plate compactor. Water may be used to assist in compaction in sand but footing materials should be kept damp but not saturated. As a guide to the level of compaction required a density index of >85% is to be achieved.

Ideally, footings should be founded on the same footing material across the old and new structures. Where the footing material changes across the structure, construction joints or similar are to be installed to prevent differential settlement, where the structure cannot tolerate such movement.

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 certification for the regulating authorities or the owner if the following inspections have not been carried out during the construction process.

- The geotechnical consultant is to inspect the ground materials while the first pier for the ground support is being dug to assess the ground strength and to ensure it is in line with our expectations.

- All finished pier holes for piled wall/excavations for ground support are to be inspected and measured before concrete is placed.

- During the excavation process, the geotechnical consultant is to inspect the cut in 1.5m intervals as it is lowered, while the machine/excavation equipment is on site, to ensure the ground materials are as expected and no temporary support is required

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

White Geotechnical Group Pty Ltd.

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Photo 1

Photo 2

Photo 3

Photo 4

Photo 5: AH1 – Downhole is from left to right.

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.

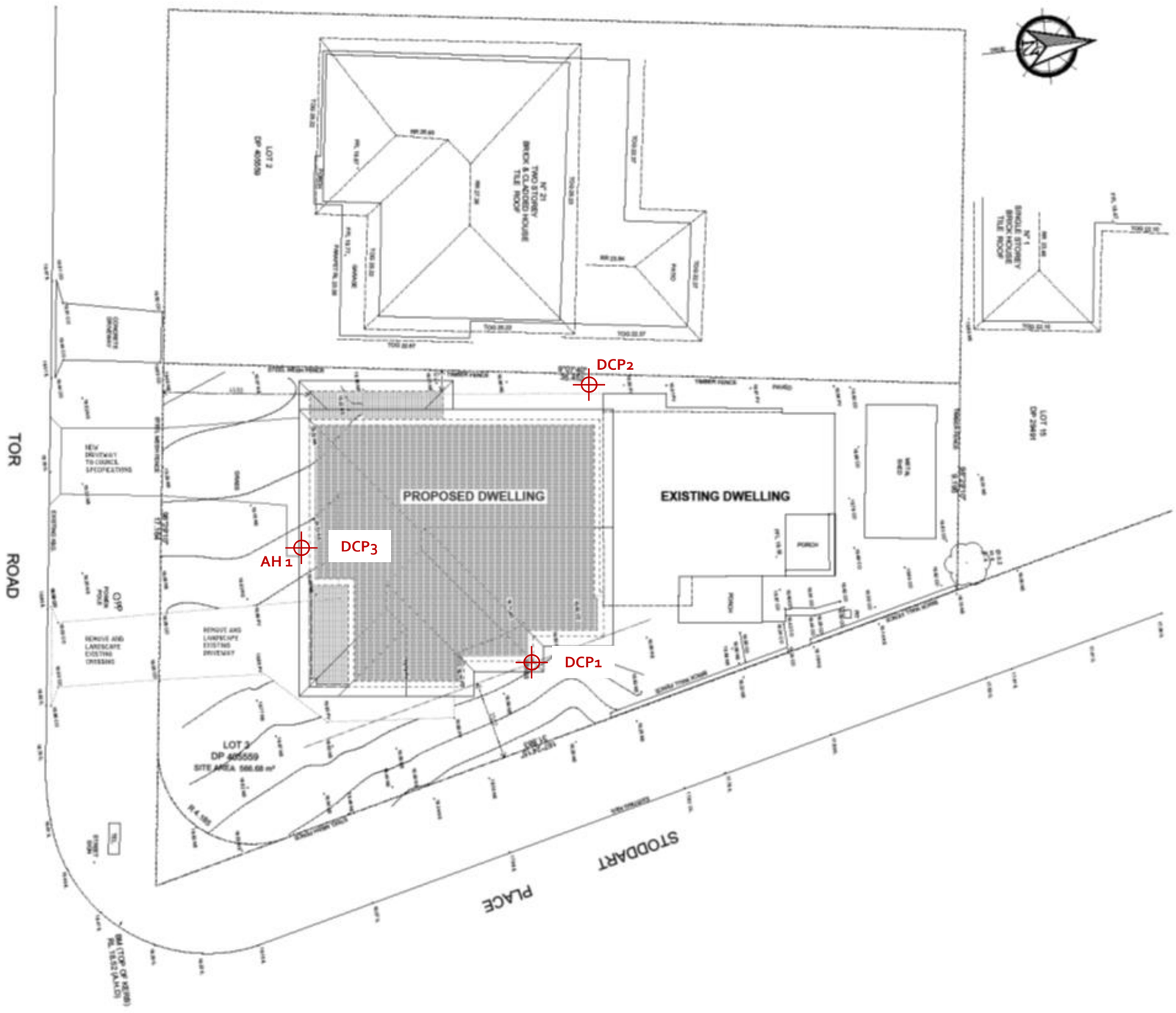
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



PROJECT ADDRESS: 11 TOR ROAD BEE WAY	DATE: SEPTEMBER, 2021		
CLIENTS:	DRAWN BY: S. V.	CHECKED:	
	DRAWING No: 1-3 953 21	Issue:	

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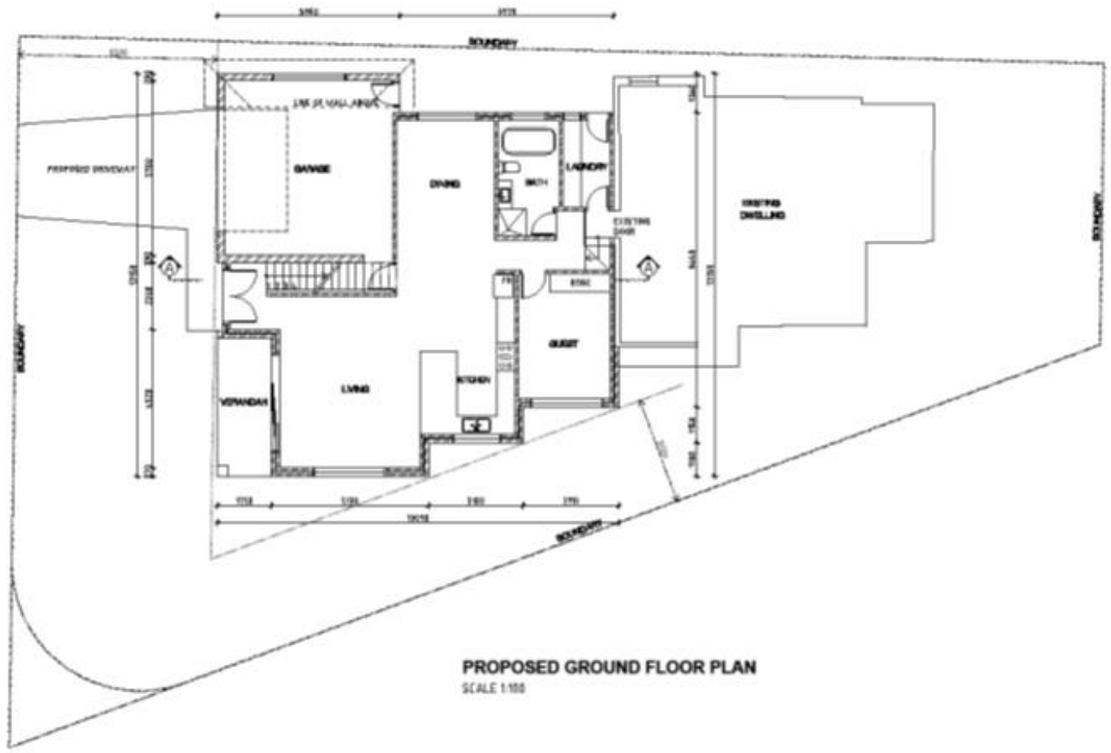
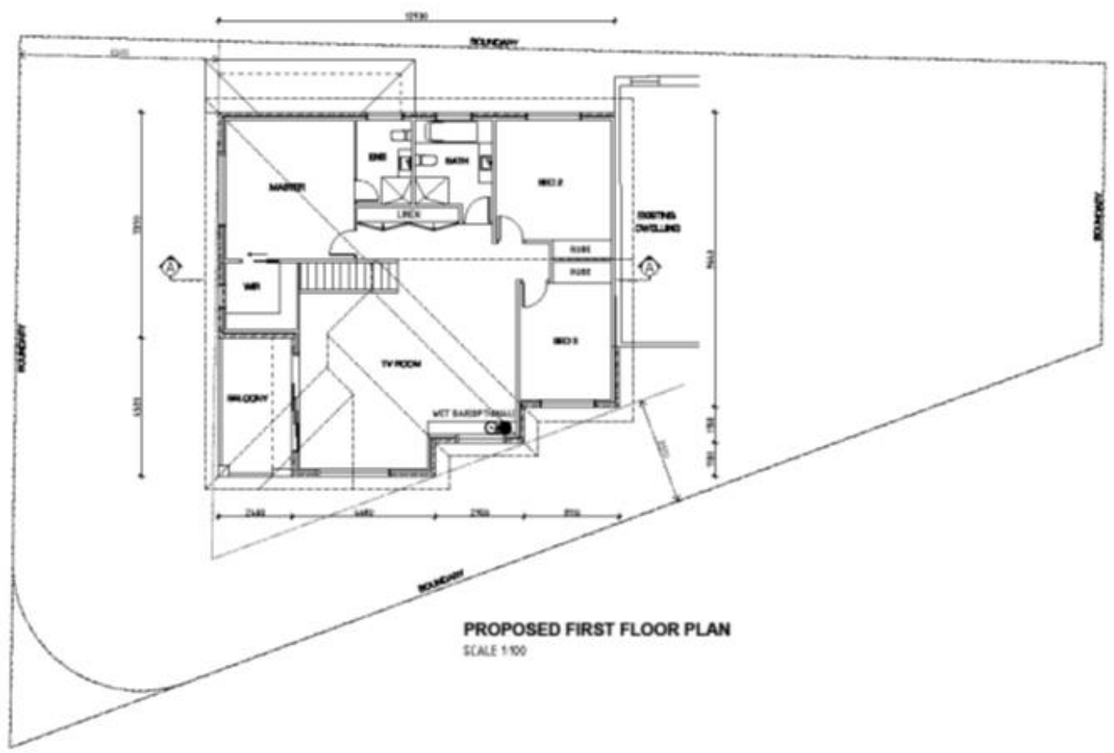
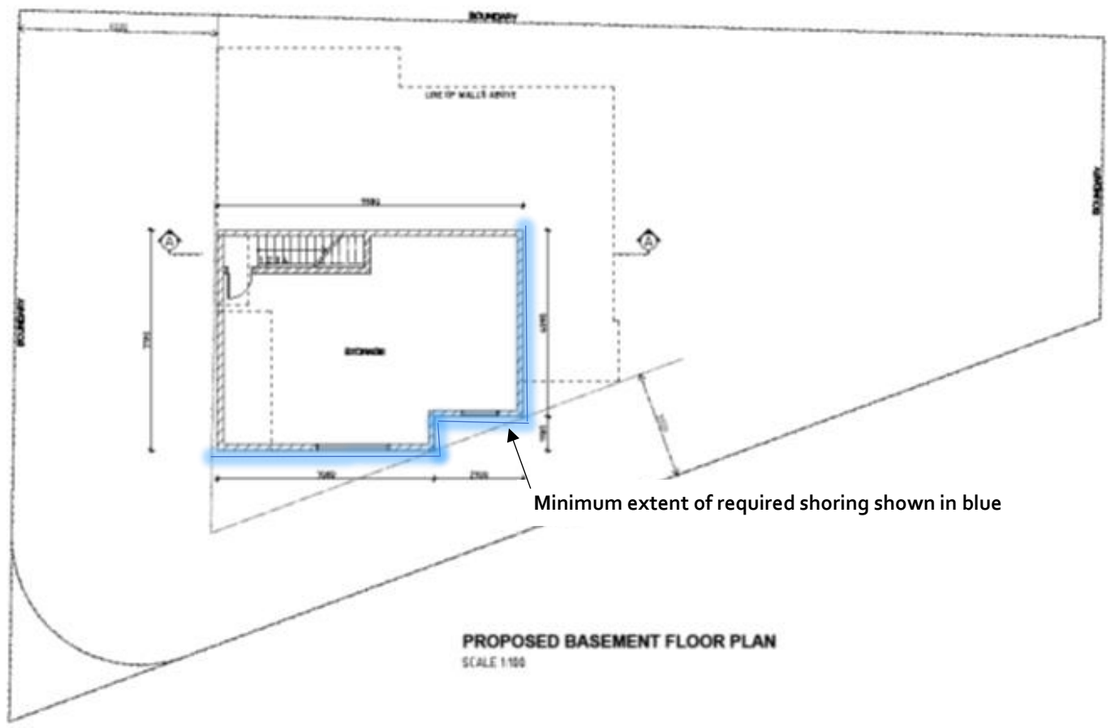
BASEMENT PLAN – showing minimum required extent of shoring



PROPOSED GROUND FLOOR PLAN
SCALE 1:100



PROPOSED FIRST FLOOR PLAN
SCALE 1:100



Minimum extent of required shoring shown in blue

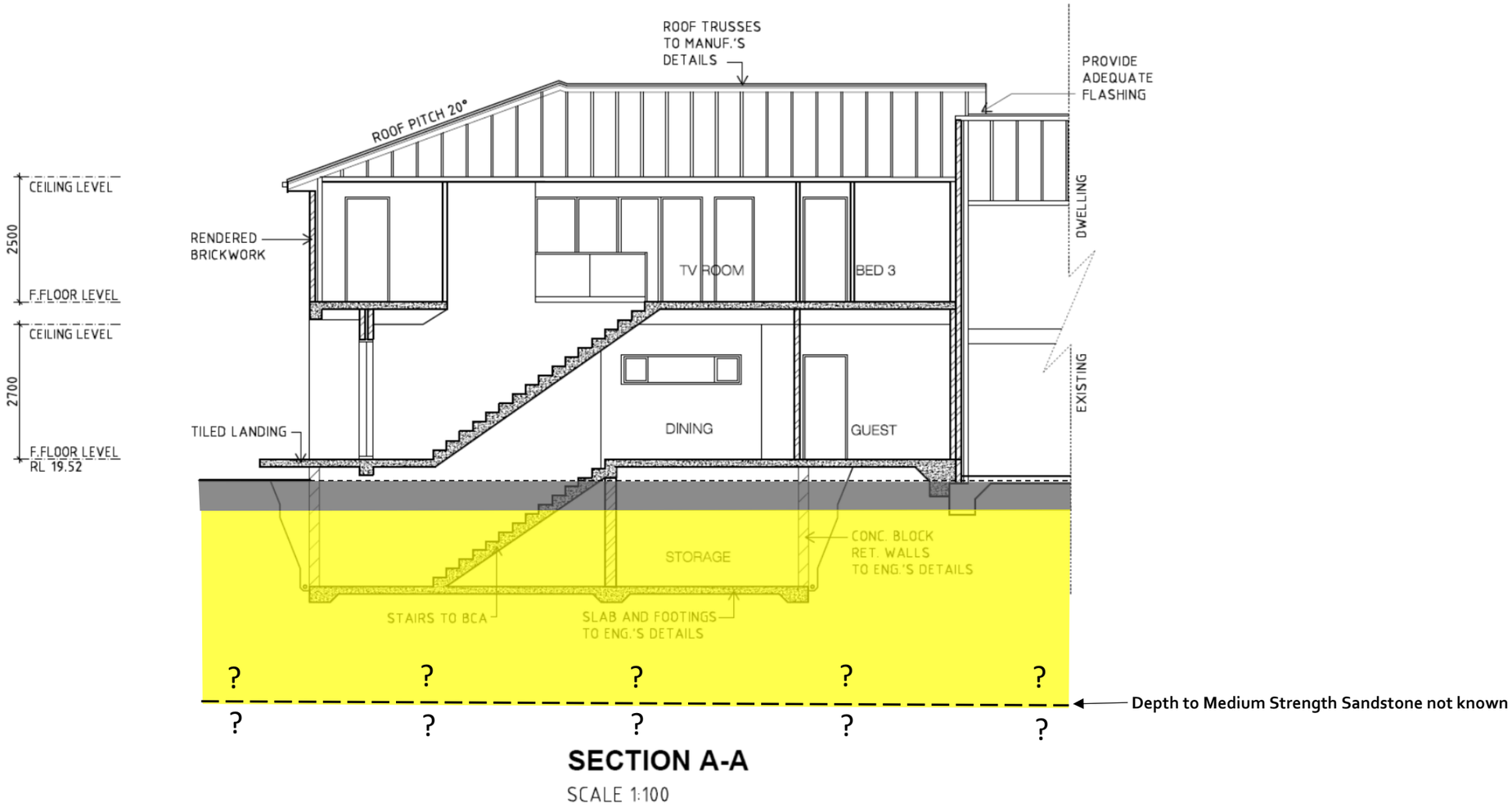
PROPOSED BASEMENT FLOOR PLAN
SCALE 1:100

SITE AREA 566.68 sqm
LANDSCAPE AREA 227 sqm OR 40 %

1. BUILDER TO CHECK AND CONFIRM ALL NECESSARY DIMENSIONS ON SITE PRIOR TO CONSTRUCTION. DO NOT SCALE THE DRAWING. 2. ALL DIMENSIONS THAT RELATE TO SITE BOUNDARIES/BUILDINGS AND EASEMENTS ARE SUBJECT TO VERIFICATION BY A SITE SURVEY. 3. ALL WORK TO BE IN ACCORDANCE WITH BUILDING CODE of AUSTRALIA & TO THE SATISFACTION OF LOCAL COUNCIL REQUIREMENTS. 4. ALL TIMBER CONSTRUCTION TO BE IN ACCORDANCE TO TIMBER FRAMING CODE. 5. ROOF WATER & SURFACE DRAINAGE TO BE DISPOSED OF IN THE APPROVED MANNER OR AS DIRECTED BY LOCAL COUNCIL. 6. ALL ELECTRICAL POWER & LIGHT OUTLETS TO BE DETERMINED BY OWNER 7. MAKE GOOD AND REPAIR ALL EXISTING FINISHES DAMAGED BY NEW WORK, MATCH EXISTING MATERIAL WHERE POSSIBLE. 8. ALL NEW DOWNPIPES ARE TO BE CONNECTED TO THE EXISTING STORM WATER SYSTEM. 9. COPYRIGHT OF ALL PLANS BELONGS TO "HIGH DESIGN" - Architectural Design	PROJECT ADDRESS: 11 TOR ROAD BEZ 4077 CLIENTS:	DATE: SEPTEMBER, 2021 DRAWN BY: S. V. SHEET No: 2-3 953 21	CHECKED: SHEET:	"HIGH DESIGN" - ABN 51 476 094 188 architectural design and drafting service mobile : 041 3389 035 fax : 9961 65 56 E-mail: hd@highdesign. com. au Web: highdesign.com.au

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials

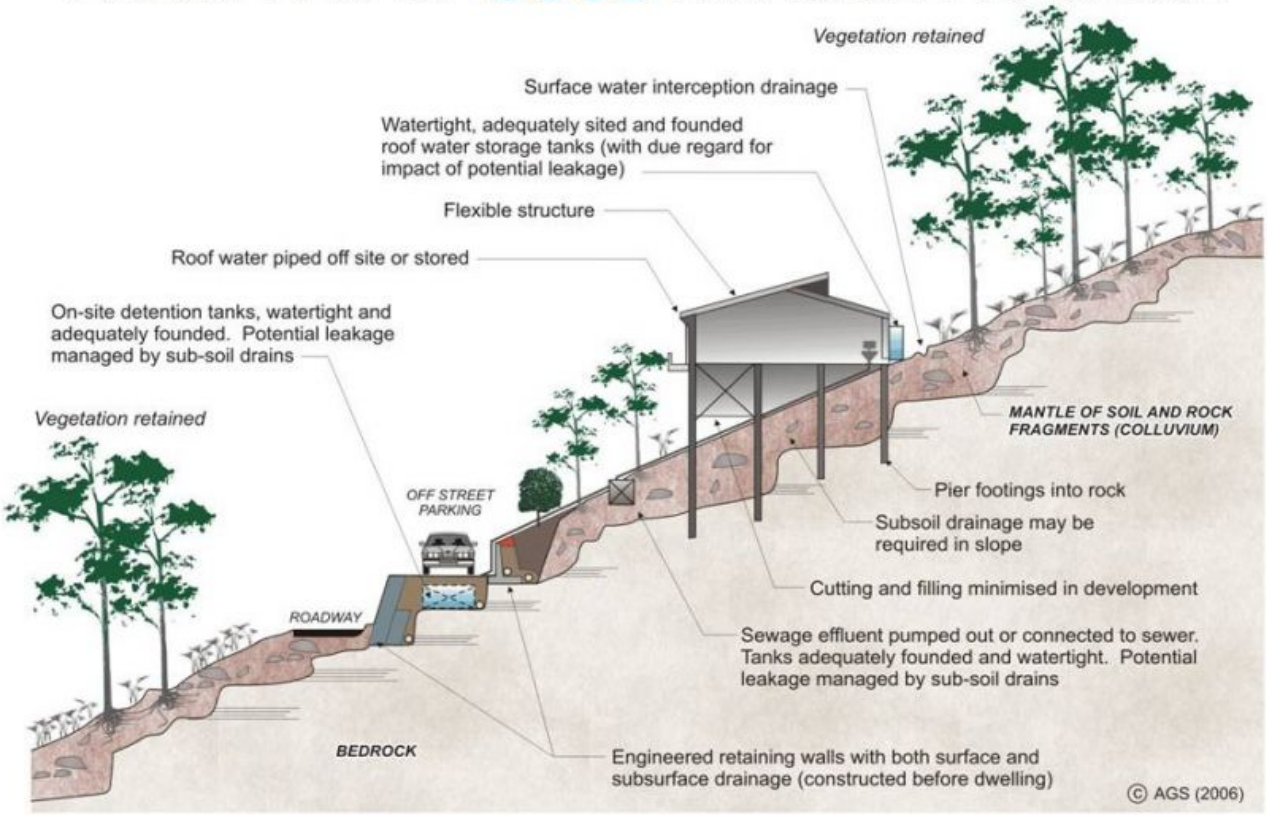
Sandy Soil and Sand – Very Loose to Medium Dense
Sand and Clayey Sand – Medium Dense to Dense



SECTION A-A

SCALE 1:100

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE