141 Riverview Road, Avalon

Comments on updates to Plans

We have reviewed the existing geotechnical report, the plans used to carry out the report, and the updated plans for DA shown on 19 drawings prepared by Fyffe Design, job number 20127, drawings numbered DA01 to DA19, Issue 08, dated 21/6/21.

The changes include:

- Minor alterations to the footprint of the house (upper, middle and lower levels) and courtyard.
- Various other minor modifications to the house.
- Add an above ground rainwater tank.
- Add a lawn area on the downhill side of the house, requiring filling to a maximum depth of ~2.2m.

The proposed change increases the overall risk of the development. As such we would add the following advice to the existing report, where the advice contradicts that in the existing report, it supersedes it:

Fill

Fill will be placed for landscaping purposes on the downhill side of the proposed house. The proposed fill is located above an existing sandstone flagging retaining supporting the cut for the right of carriageway below (Photo 4 in the original report). The sandstone flagging retaining wall is to be demolished from the top down prior to the filling commencing. The soil and clay immediately behind the wall is to be battered at 1.0 Vertical to 1.7 Horizontal (30°) as the wall is lowered and demolished.

No fills are to be laid until the new engineered retaining walls are in place.

The fill will reach a maximum depth of ~2.2m. Filling to this depth without appropriate compaction will result in a significant settlement. To avoid excessive settlement, the fill is to be placed in loose layers not exceeding 0.2m thick before being compacted as follows:

Before all fills are lain, strip the existing topsoil and remove all organic matter, stockpiling for later use as topsoil or remove from site.

Non-Cohesive Soils (sandy fills)

The proposed fill for landscaping is to be compacted to a Minimum Density Index (ID) of 65%.

Cohesive Soils (clayey fill & excavated bedrock)

The proposed fill for landscaping is to be compacted to at least 95% of Standard Maximum Dry Density.

The geotechnical consultant is to inspect and test the fill as it is laid in 1.0m rises to ensure the required density has been achieved.

Filling within ~1.5m behind retaining walls should be compacted with light weight equipment such as a hand operated plate compacter or similar so as to not damage the wall. No pavements or structures are to be supported on fill.

Foundations

The proposed above ground rainwater tank can be supported on piers embedded into Extremely Low Strength Rock or better. A maximum allowable bearing pressure of 600kPa can be assumed for footings supported on Extremely Low Strength Rock or better.

Inspection

The client and builder are to familiarise themselves with the following required inspection as well as council geotechnical policy. We cannot provide geotechnical certification for the

Occupation Certificate if the following inspection has not been carried out during the construction process.

- The geotechnical consultant is to inspect and test the landscaping fill on the downhill side of the house as it is raised to heights not exceeding ~1.0m. This is to ensure the required density has been achieved during compaction.

Conclusion

Provided these recommendations are followed as well as the recommendations in the original attached report carried out by this firm, we consider the proposed works have an 'acceptable' risk level in accordance with the 2009 Geotechnical Risk Management Policy for Pittwater.

White Geotechnical Group Pty Ltd.

Ben White M.Sc. Geol.,
AusIMM., CP GEOL.
No. 222757
Engineering Geologist.

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1 – To be submitted with Development Application

Development Application for _____
Name of Applicant

Address of site 141 Riverview Road, Avalon

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk ***Declaration made by geotechnical engineer or engineering geologist or coastal engineer (where applicable) as part of a geotechnical report***

I, Ben White *on behalf of* White Geotechnical Group Pty Ltd
(Insert Name) (Trading or Company Name)

on this the 23/2/21 certify that I am a geotechnical engineer or engineering geologist or coastal engineer as defined by the Geotechnical Risk Management Policy for Pittwater - 2009 and I am authorised by the above organisation/company to issue this document and to certify that the organisation/company has a current professional indemnity policy of at least $10million.

I:
Please mark appropriate box

☒ have prepared the detailed Geotechnical Report referenced below in accordance with the Australia Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☒ am willing to technically verify that the detailed Geotechnical Report referenced below has been prepared in accordance with the Australian Geomechanics Society's Landslide Risk Management Guidelines (AGS 2007) and the Geotechnical Risk Management Policy for Pittwater - 2009

☐ have examined the site and the proposed development in detail and have carried out a risk assessment in accordance with Section 6.0 of the Geotechnical Risk Management Policy for Pittwater - 2009. I confirm that the results of the risk assessment for the proposed development are in compliance with the Geotechnical Risk Management Policy for Pittwater - 2009 and further detailed geotechnical reporting is not required for the subject site.

☐ have examined the site and the proposed development/alteration in detail and I am of the opinion that the Development Application only involves Minor Development/Alteration that does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.

☐ have examined the site and the proposed development/alteration is separate from and is not affected by a Geotechnical Hazard and does not require a Geotechnical Report or Risk Assessment and hence my Report is in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009 requirements.

☐ have provided the coastal process and coastal forces analysis for inclusion in the Geotechnical Report

Geotechnical Report Details:

Report Title: Geotechnical Report **141 Riverview Road, Avalon**

Report Date: 23/2/21

Author: BEN WHITE

Author's Company/Organisation: **WHITE GEOTECHNICAL GROUP PTY LTD**

Documentation which relate to or are relied upon in report preparation:

Australian Geomechanics Society Landslide Risk Management March 2007.

White Geotechnical Group company archives.

I am aware that the above Geotechnical Report, prepared for the abovementioned site is to be submitted in support of a Development Application for this site and will be relied on by Pittwater Council as the basis for ensuring that the Geotechnical Risk Management aspects of the proposed development have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature _____

Name Ben White

Chartered Professional Status MScGEOLAusIMM CP GEOL

Membership No. 222757

Company White Geotechnical Group Pty Ltd

GEOTECHNICAL RISK MANAGEMENT POLICY FOR PITTWATER
FORM NO. 1(a) - Checklist of Requirements for Geotechnical Risk Management Report for Development Application

Development Application for _____
Name of Applicant

Address of site 141 Riverview Road, Avalon

The following checklist covers the minimum requirements to be addressed in a Geotechnical Risk Management Geotechnical Report. This checklist is to accompany the Geotechnical Report and its certification (Form No. 1).

Geotechnical Report Details:

Report Title: Geotechnical Report **141 Riverview Road, Avalon**

Report Date: 23/2/21

Author: BEN WHITE

Author's Company/Organisation: WHITE GEOTECHNICAL GROUP PTY LTD

Please mark appropriate box

☒ Comprehensive site mapping conducted **2/10/20**
(date)

☒ Mapping details presented on contoured site plan with geomorphic mapping to a minimum scale of 1:200 (as appropriate)

☒ Subsurface investigation required
- ☐ No Justification _____
- ☒ Yes Date conducted **2/10/20**

☒ Geotechnical model developed and reported as an inferred subsurface type-section

☒ Geotechnical hazards identified
- ☒ Above the site
- ☒ On the site
- ☒ Below the site
- ☐ Beside the site

☒ Geotechnical hazards described and reported

☒ Risk assessment conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009
- ☒ Consequence analysis
- ☒ Frequency analysis

☒ Risk calculation

☒ Risk assessment for property conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Risk assessment for loss of life conducted in accordance with the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Assessed risks have been compared to "Acceptable Risk Management" criteria as defined in the Geotechnical Risk Management Policy for Pittwater - 2009

☒ Opinion has been provided that the design can achieve the "Acceptable Risk Management" criteria provided that the specified conditions are achieved.

☒ Design Life Adopted:
- ☒ 100 years
- ☐ Other _____
specify

☒ Geotechnical Conditions to be applied to all four phases as described in the Geotechnical Risk Management Policy for Pittwater - 2009 have been specified

☒ Additional action to remove risk where reasonable and practical have been identified and included in the report.

☐ Risk assessment within Bushfire Asset Protection Zone.

I am aware that Pittwater Council will rely on the Geotechnical Report, to which this checklist applies, as the basis for ensuring that the geotechnical risk management aspects of the proposal have been adequately addressed to achieve an "Acceptable Risk Management" level for the life of the structure, taken as at least 100 years unless otherwise stated, and justified in the Report and that reasonable and practical measures have been identified to remove foreseeable risk.

Signature _____

Name Ben White

Chartered Professional Status MScGEOLAusIMM CP GEOL

Membership No. 222757

Company White Geotechnical Group Pty Ltd

GEOTECHNICAL INVESTIGATION:

New House at **141 Riverview Road, Avalon**

1. Proposed Development

1.1 Construct a new suspended driveway and carport with storage room below requiring minor levelling.

1.2 Construct a new three storey house with terrace below requiring three excavations. The excavation for the second floor reaches a maximum depth of ~1.5m. The first floor and terrace level require a stepped excavation. The upper and lower steps reach maximum depths of ~2.4m and ~1.3m respectively. The S portion of the excavation for the terrace is not part of the stepped excavation and reaches a maximum depth of ~2.3m.

1.3 Details of the proposed development are shown on 13 drawings prepared by Fyffe Design, job number 20127, drawings numbered 01 to 09, 11 and 12, Issue 03 dated 10/2/21.

2. Site Description

2.1 The site was inspected on the 2nd October, 2020.

2.2 This residential property is on the low side of the road and has a W aspect. From the road frontage, the natural surface falls at steep angles at an average angle of ~25° up to a maximum angle of ~36°. The slope above and below the property continues at similar angles.

2.3 At the road frontage, the fill batter for the road drops steeply across the vacant block for a short distance before merging into the natural slope (photos 1 & 2). Sandstone joint blocks are exposed at the surface across the slope (photo 3). It is unclear whether these are dislodged boulders from above, or are bands of outcropping sandstone bedrock. At the W boundary of the property a stable

sandstone flagging retaining wall supports the cut batter for the neighbouring concrete driveway (photo 4). The surface of the slope is lawn covered and has a scattering of shrubs and mature gums. No significant signs of movement were observed on the block.

3. Geology

The Sydney 1:100 000 Geological sheet indicates the site is underlain by the Newport Formation of the Narrabeen Group. This is described as interbedded laminite, shale and quartz to lithic quartz sandstone.

4. Subsurface Investigation

Nine Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative density of the overlying soil and the depth to bedrock. One auger hole and five DCP tests from a previous geotechnical report completed in 2019 are shown (AH1 and DCP1 to DCP5). The locations of the tests are shown on the site plan. It should be noted that a level of caution should be applied when interpreting DCP test results. The test will not pass through hard buried objects so in some instances it can be difficult to determine whether refusal has occurred on an obstruction in the profile or on the natural rock surface. This is not expected to be an issue for the testing on this site. But to the possibility that the actual ground conditions vary from our interpretation there should be allowances in the excavation and foundation budget to account for this. We refer to the appended "Important Information about Your Report" to further clarify. The results are as follows:

AUGER HOLE 1 (~RL35.8) **–** AH1 (photo 5)

Depth (m)	**Material Encountered**
0.0 to 0.2	**SANDY SOIL**, brown, fine to medium grained, dry.
0.2 to 0.5	**SANDY CLAY**, brown, firm, dry.

End of hole @ 0.5m in Sandy Clay. 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** (~RL36.2)	**DCP 2** (~RL34.3)	**DCP 3** (~RL34.0)	**DCP 4** (~RL31.0)	**DCP 5** (~RL31.2)	**DCP 6** (~RL28.3)	**DCP 7** (~RL29.3)
0 to 0.3	18	17	45	31	31	6	24
0.3 to 0.6	25	31	#	40	40	14	25
0.6 to 0.9	21	40		#	#	18	14
0.9 to 1.2	45	#				#	10
1.2 to 1.5	#						#
	End of test @ 1.2m	End of test @ 0.8m	End of test @ 0.3m	End of test @ 0.4m	End of test @ 0.5m	Refusal @ 0.9m	Refusal @ 1.2m

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

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 8** (~RL28.2)	**DCP 9** (~RL26.0)	**DCP 10** (~RL27.4)	**DCP 11** (~RL29.9)	**DCP 12** (~RL32.8)	**DCP 13** (~RL32.7)	**DCP 14** (~RL25.2)
0 to 0.3	6	#	14	22	5F	13	19
0.3 to 0.6	15		17	21	4	23	15
0.6 to 0.9	19		6	24	#	20	21
0.9 to 1.2	24		#	31		#	#
1.2 to 1.5	30			7			
1.5 to 1.8	16			#			
1.8 to 2.1	#						
	Refusal @ 1.7m	Rock at surface	Refusal @ 0.6m	Refusal @ 1.3m	Refusal @ 0.4m	Refusal @ 0.7m	Refusal @ 0.7m

DCP Notes:

DCP1 – End of test @ 1.2m, DCP still very slowly going down, orange shale fragments on dry tip.

DCP2 – End of test @ 0.8m, DCP still very slowly going down, orange shale fragments on dry tip.

DCP3 – End of test @ 0.3m, DCP still very slowly going down, white impact dust on dry tip.

DCP4 – End of test @ 0.4m, DCP still very slowly going down, orange shale fragments on dry tip.
DCP5 – End of test @ 0.5m, DCP still very slowly going down, orange shale fragments on dry tip.
DCP6 – Refusal on rock @ 0.9m, DCP bouncing off rock surface, orange and light brown rock fragments on dry tip.
DCP7 – Refusal on rock @ 1.2m, DCP bouncing off rock surface, orange, red and white rock fragments on dry tip.
DCP8 – Refusal on rock @ 1.7m, DCP bouncing off rock surface, white and orange rock fragments on dry tip.
DCP9 – Rock exposed at surface.
DCP10 – Refusal on rock @ 0.6m, DCP bouncing off rock surface, white and orange rock fragments on dry tip.
DCP11 – Refusal on rock @ 1.3m, DCP bouncing off rock surface, red orange rock fragments on dry tip.
DCP12 – Refusal on rock @ 0.4m, DCP bouncing off rock surface, clean dry tip.
DCP13 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, clean dry tip.
DCP14 – Refusal on rock @ 0.7m, DCP bouncing off rock surface, orange and light brown rock fragments on dry tip.

5. Geological Observations/Interpretation

The slope materials are colluvial at the near surface and residual at depth. In the test locations, the ground materials consist of a sandy topsoil over sandy clays. The clays merge into the underlying weathered rock at a maximum depth of ~1.7m below the current surface. The weathered rock is interpreted to be variable ranging from Extremely Low to Medium Strength Rock or better and it appears the majority of the proposed house will be underlain by sandstone and that shale is present from the uphill side of the proposed house to the street. The exact extent of the sandstone will only be known once the footing excavations are carried out. 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 Riverview Road above.

8. Geotechnical Hazards and Risk Analysis

No geotechnical hazards were observed beside the property. The steeply graded land surface that falls across the property and continues above and below is a potential hazard (**Hazard One**). The proposed excavations are a potential hazard until retaining structures are in place (**Hazard Two**). The vibrations from the proposed excavations are a potential hazard (**Hazard Three**). The additional surcharge loads from the proposed house and terrace are a potential hazard to the existing sandstone flagging retaining wall (Photo 4) (**Hazard Four**).

RISK ANALYSIS SUMMARY ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard One	Hazard Two
TYPE	The steep slope that falls across the property and continues above failing and impacting on the property.	The proposed excavations for the house and terrace collapsing onto the worksite and impacting the neighbouring properties before retaining walls are in place.
LIKELIHOOD	'Unlikely' (10^{-4})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (12%)	'Medium' (15%)
RISK TO PROPERTY	'Low' (2×10^{-5})	'Moderate' (2×10^{-4})
RISK TO LIFE	8.3×10^{-7}/annum	8.3×10^{-6}/annum
COMMENTS	This level of risk is 'ACCEPTABLE' provided the recommendations in **Section 16** are carried out.	This level of risk to life and property is 'UNACCEPTABLE'. To move the risk to 'ACCEPTABLE' levels, the recommendations in **Section 13** are to be followed.

(See Aust. Geomech. Jnl. Mar 2007 Vol. 42 No 1, for full explanation of terms)

RISK ANALYSIS SUMMARY CONTINUES ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard Three	Hazard Four
TYPE	The vibrations produced during the proposed excavation for the house impacting on the surrounding structures.	The additional surcharge loads from the proposed house and terrace transferring onto the existing sandstone flagging retaining wall (Photo 4) that leads to failure.
LIKELIHOOD	'Possible' (10^{-3})	'Possible' (10^{-3})
CONSEQUENCES TO PROPERTY	'Medium' (15%)	'Medium' (35%)
RISK TO PROPERTY	'Moderate' (2×10^{-4})	'Moderate' (2×10^{-4})
RISK TO LIFE	5.3×10^{-7}/annum	5.6×10^{-6}/annum
COMMENTS	This level of risk to property is 'UNACCEPTABLE'. To move risk to 'ACCEPTABLE' levels the recommendations in **Sections 11 & 12** are to be followed.	This level of risk to life and property is 'UNACCEPTABLE'. To move the risk to 'ACCEPTABLE' levels the recommendations in **Section 15** are to be followed.

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

All stormwater or drainage runoff from the proposed development is to be piped to the existing easement through any tanks that may be required by the regulating authorities.

11. Excavations

Three excavations are required to construct the proposed new house with terrace below. The excavations for the second floor reaches a maximum depth of ~1.5m. The first floor and terrace level require a stepped excavation. The upper and lower steps reach maximum depths of ~2.4m and ~1.3m respectively. The S portion of the excavation for the terrace is not part of the stepped excavation and reaches a maximum depth of ~2.3m. The excavations are interpreted to be through topsoil and sandy clay with Extremely Low to Medium Strength Rock expected from the surface to a depth of ~0.7m below.

It is envisaged that excavations through soil, clay and rock up to Low Strength can be carried out with a machine and bucket and excavations through Medium Strength Rock or better will require grinding or rock sawing.

12. Vibrations

Possible vibrations generated during excavations through soil, clay and rock up to Low Strength will be below the threshold limit for building damage.

Excavations through Medium Strength Rock or better should be carried out to minimise the potential to cause vibration damage to the neighbouring suspended garage to the S and neighbouring house to the N. The excavations for the second floor, first floor and terrace are set back ~3.1m, ~4.3m and ~8.0m respectively from the S neighbouring garage. The excavation for the first floor is set back ~9.1m from the N 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 10mm/sec at the property boundaries. Vibration monitoring will be required to verify this is achieved.

If a milling head is used to grind the rock, vibration monitoring will not be required. Alternatively, if rock sawing is carried out around the perimeter of the excavation boundaries in not less than 1.0m lifts, a rock hammer up to 300kg could be used to break the rock without

vibration monitoring. Peak particle velocity will be less than 10mm/sec at the property boundaries using this method provided the saw cuts are kept well below the rock to broken.

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

13. Excavation Support Requirements

On steep sites such as this one, to help maintain excavation stability before retaining walls are in place, it is critical upslope runoff be diverted from the proposed excavations with temporary or permanent drainage measures. Temporary measures may be trenches and sandbag mounds and permanent measures could be a wide diameter dish drain or similar. These are to be installed before any excavation work commences.

Three excavations are required to construct the proposed new house with terrace below. The excavations for the house are set back sufficiently from the property boundaries and adjoining structures to negate excavation induced instability. Allowing for backwall-drainage, the S portion of the terrace excavation (to a maximum depth of ~2.3m) comes flush with the S common boundary.

The S cut for the terrace excavation is to be permanently or temporarily supported before the excavation through Medium Strength Rock commences. The support is to be installed systematically as the excavation progresses to ensure the integrity of the neighbouring property. If the support is temporary, it is to remain in place until the retaining wall is built as a sacrificial-type system. See the site plan attached for the minimum required extent of the shoring shown in blue.

Where shoring is not required, the soil portion of the excavation is to be battered temporarily at 1.0 Vertical to 2.0 Horizontal (26°) until the retaining walls are in place. Cut batters through clay and rock up to Low Strength are expected to stand at near vertical angles for a short period of time until the retaining walls are in place, provided the cut batters are kept from

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

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

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

Any trees immediately above the proposed excavations are to be assessed by an arborist and removed if their stability will be detrimentally impacted by the excavation.

During the excavation process, the geotechnical consultant is to inspect the cut face in 1.5m intervals as it is lowered to ensure ground materials are as expected and that additional support is not required.

As discussed above upslope runoff is to be diverted from the cut faces by sandbag mounds or other diversion works. All unsupported cut batters through soil, clay and rock up to Low Strength are to be covered to prevent access of water in wet weather and loss of moisture in dry weather. The materials and labour to construct the retaining walls are to be organised so on completion of the 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. If the retaining walls are not constructed within a few days of the excavation being completed temporary shoring will be required.

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

14. Retaining Structures

For cantilever or singly propped retaining structures it is suggested the design be based on a triangular distribution of lateral pressures using the parameters shown in Table 1.

TABLE 1 ON NEXT PAGE

Table 1 – Likely Earth Pressures for Retaining Structures

Unit	Earth Pressure Coefficients		
	Unit weight (kN/m^3)	'Active' K_a	'At Rest' K_0
Soil	20	0.40	0.55
Residual Clays	20	0.35	0.45
Extremely Low Strength Rock	22	0.25	0.35
Medium Strength Rock	24	0.00	0.01

For rock classes refer to Pells et al "Design Loadings for Foundations on Shale and Sandstone in the Sydney Region". Australian Geomechanics Journal 1978.

It is to be noted that the earth pressures in Table 1 assume a level surface above the structure, do not account for any surcharge loads and assume retaining structures are fully drained.

Rock strength and relevant earth pressure coefficients are to be confirmed on site by the geotechnical consultant.

All retaining structures are to have sufficient back-wall drainage and be backfilled immediately behind the structure with free draining material (such as gravel). This material is to be wrapped in a non-woven Geotextile fabric (i.e. Bidim A34 or similar), to prevent the drainage from becoming clogged with silt and clay. If no back-wall drainage is installed in retaining structures the full hydrostatic pressures are to be accounted for in the retaining structure design.

15. Foundations

The proposed suspended driveway and carport can be supported on piers embedded at least 0.8m into Extremely Low Strength rock or better. We would expect the minimum pier depth to be in the order of ~1.8m from the surface. Sections of the proposed new house and terrace

are cut into the slope and are expected to be seated in Extremely Low Strength Rock or better. This is a suitable foundation material. Where the new house and terrace are not cut into rock, they can be supported on piers embedded into Extremely Low Strength Rock or better. A maximum allowable bearing pressure of 600kPa can be assumed for footings supported on Extremely Low Strength Rock or better.

The piers on the downhill edge of the house/terrace near the existing sandstone flagging retaining wall (Photo 4) are to be taken to beyond the zone of influence of the wall. Provided this occurs no additional loads will be transferred onto the existing retaining wall. In the instance the zone of influence is the area above a theoretical 45^{o} line extending from the base of the wall towards the piered foundation.

We note that the rock strength is variable across the site. Ideally, footings should be founded on the same footing material across the structure. Where the footing material does change across the structure construction joints or similar are to be installed to prevent differential settlement, where the structure cannot tolerate such movement.

As the bearing capacity of weathered rock reduces when it is wet we recommend the footings be dug, inspected and poured in quick succession (ideally the same day if possible). If the footings get wet, they will have to be drained and the soft layer of weathered rock on the footing surface will have to be removed before concrete is poured.

If a rapid turnaround from footing excavation to the concrete pour is not possible a sealing layer of concrete may be added to the footing surface after it has been cleaned.

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. Ongoing Maintenance

Where slopes are steep and approach or exceed 30°, such as on this site, it is prudent for the owners to occasionally inspect the slope (say annually or after heavy rainfall events, whichever occurs first). Should any of the following be observed: movement or cracking in retaining walls, cracking in any structures, cracking or movement in the slope surface, tilting or movement in established trees, leaking pipes, or newly observed flowing water, or changes in the erosional process or drainage regime, then a geotechnical consultant should be engaged to assess the slope. We can carry out these inspections upon request.

The risk assessment in **Section 8** is subject to this ongoing maintenance being carried out.

17. 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.

- During the excavation process, the geotechnical consultant is to inspect the cut face in 1.5m intervals as it is lowered to ensure ground materials are as expected and that additional support is not required.

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

White Geotechnical Group Pty Ltd.

Ben White M.Sc. Geol.,
AusIMM., CP GEOL.
No. 222757
Engineering Geologist.

Photo 1

Photo 2

Photo 3

Photo 4

Photo 5: AH1 – Downhole is from top to bottom.

Important Information about Your Report

It should be noted that Geotechnical Reports are documents that build a picture of the subsurface conditions from the observation of surface features and testing carried out at specific points on the site. The spacing and location of the test points can be limited by the location of existing structures on the site or by budget and time constraints of the client. Additionally, the test themselves, although chosen for their suitability for the particular project, have their own limiting factors. The testing gives accurate information at the location of the test, within the confines of the test's capability. A geological interpretation or model is developed by joining these test points using all available data and drawing on previous experience of the geotechnical consultant. Even the most experienced practitioners cannot determine every possible feature or change that may lie below the earth. All of the subsurface features can only be known when they are revealed by excavation. As such, a Geotechnical report can be considered an interpretive document. It is based on factual data but also on opinion and judgement that comes with a level of uncertainty. This information is provided to help explain the nature and limitations of your report.

With this in mind, the following points are to be noted:

- If upon the commencement of the works the subsurface ground or ground water conditions prove different from those described in this report, it is advisable to contact White Geotechnical Group immediately, as problems relating to the ground works phase of construction are far easier and less costly to overcome if they are addressed early.

- If this report is used by other professionals during the design or construction process, any questions should be directed to White Geotechnical Group as only we understand the full methodology behind the report's conclusions.

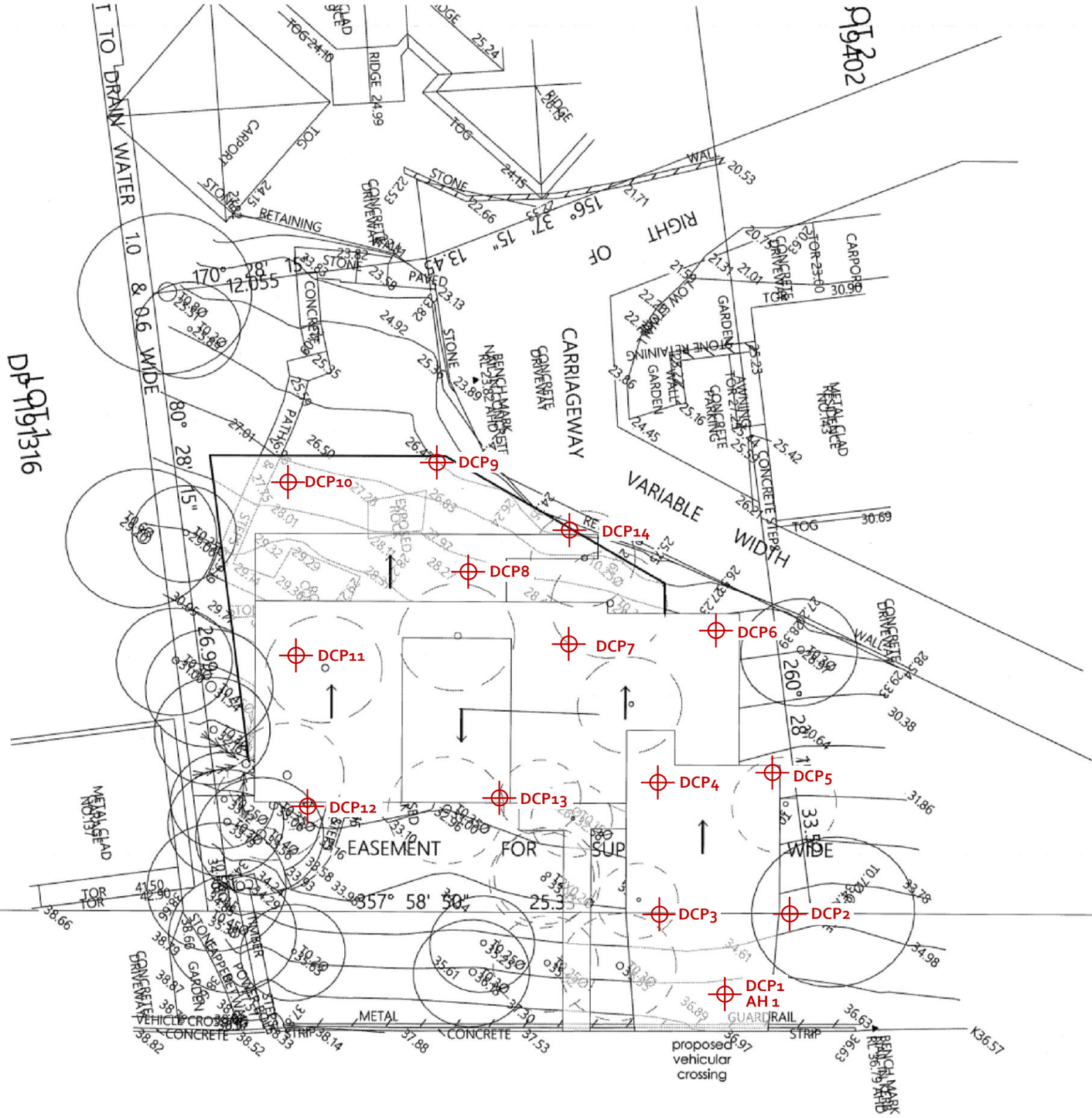
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- This report should not be applied to any other project other than that outlined in section 1.0.

- This report is to be read in full and should not have sections removed or included in other documents as this can result in misinterpretation of the data by others.

- It is common for the design and construction process to be adapted as it progresses (sometimes to suit the previous experience of the contractors involved). If alternative design and construction processes are required to those described in this report, contact White Geotechnical Group. We are familiar with a variety of techniques to reduce risk and can advise if your proposed methods are suitable for the site conditions.

SITE PLAN – showing test locations

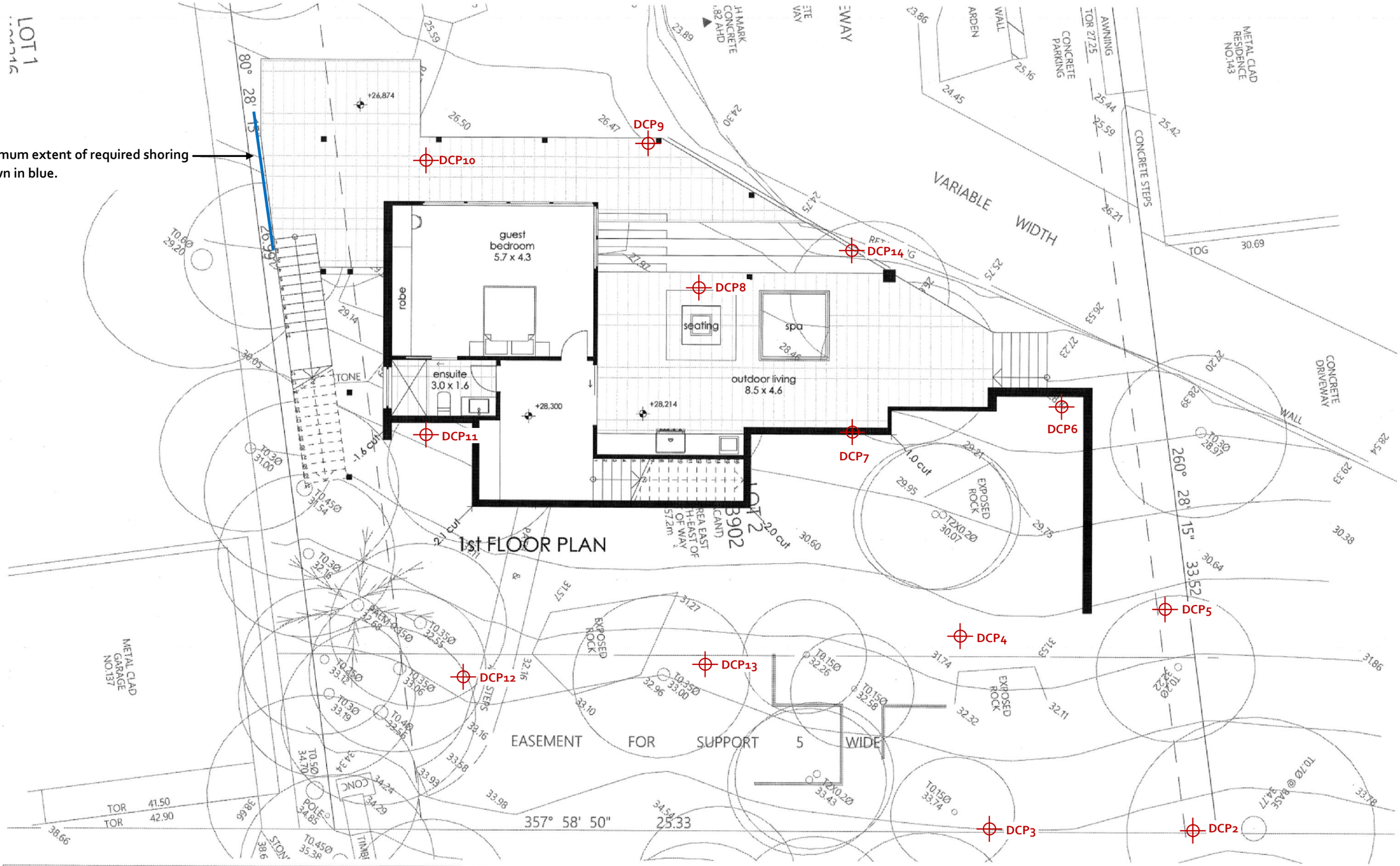


FYFFE DESIGN residential and building design www.fyffedesign.com.au | info@fyffedesign.com.au | 02 9634 3600 5G/ 256 New Line Road Dural 2158	NORTH	DATE	AMENDMENTS	NO	BY	ADDRESS 141 Riverview Road Avalon Beach 2/-/DP833902	DRAWING TITLE SITE PLAN
		21/01/2021	design development	3	HH	CLIENT Uday Bonu	PROJECT New Dwelling
bda Full Member No. 1672 - 14							

DRAWING STATUS		
design development		
DRAWN BY	DATE	SCALE
AW	10/02/2021	1:200 @ A3
DWG NO	JOB NUMBER	ISSUE
02	20127	03

SITE PLAN – showing test locations

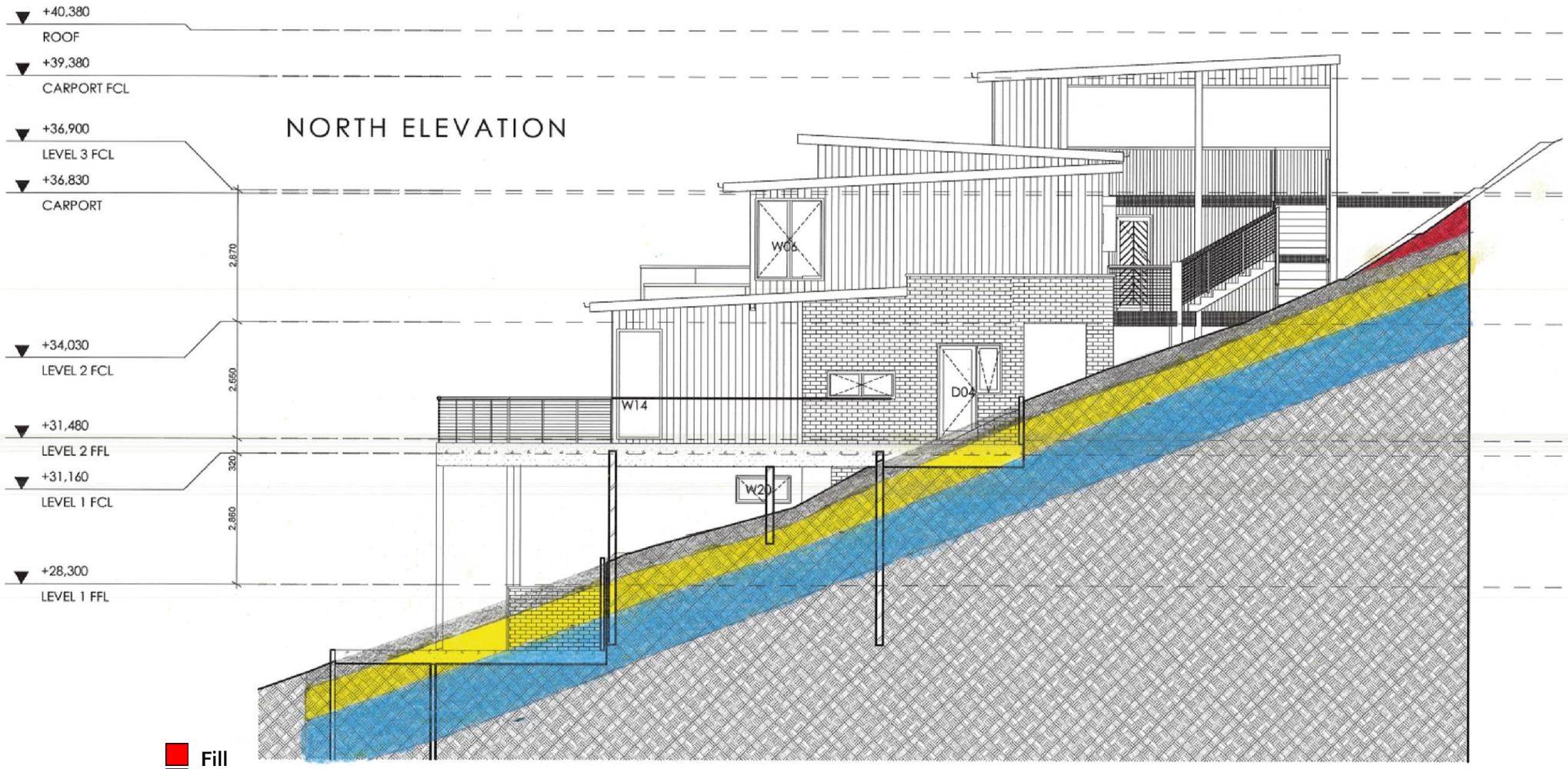
Minimum extent of required shoring shown in blue.



FYFFE DESIGN residential and building design www.fyffedesign.com.au | info@fyffedesign.com.au | 02 9634 3600 5G/ 256 New Line Road Dural 2158	NORTH	DATE	AMENDMENTS	NO	BY	ADDRESS 141 Riverview Road Avalon Beach 2/-/DP833902	DRAWING TITLE 1ST FLOOR PLAN
		21/01/2021	design development	3	HH	CLIENT Uday Bonu	PROJECT New Dwelling
bda Full Member No. 1672 - 14							

DRAWING STATUS		
design development		
DRAWN BY	DATE	SCALE
AW	10/02/2021	1:100 @A3
DWG NO	JOB NUMBER	ISSUE
05	20127	03

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



Fill
Topsoil
Sandy Clay
Narrabeen Group Rocks – Extremely Low to Medium Strength Rock.

WEST ELEVATION

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DATE	AMENDMENTS	NO	BY
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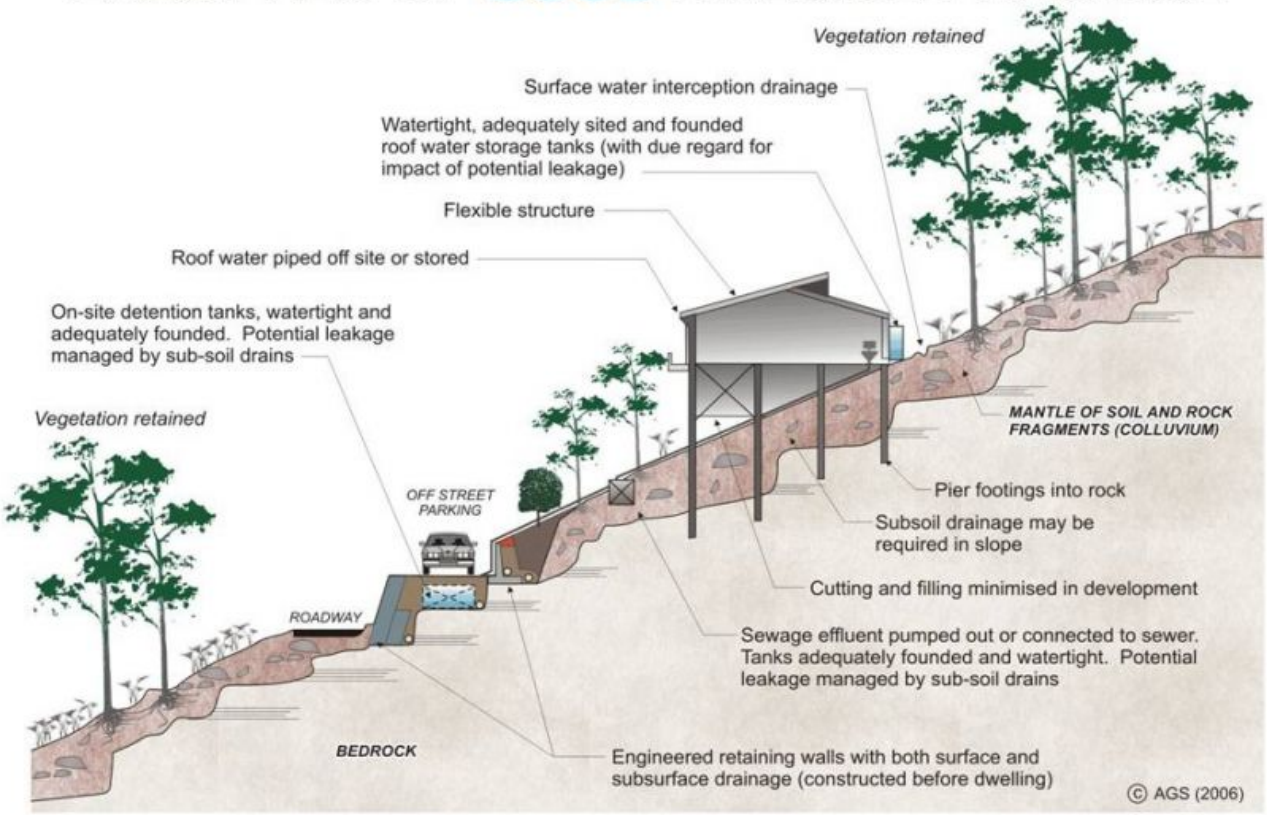
ADDRESS: 141 Riverview Road Avalon Beach 2/-/DP833902
CLIENT: Uday Bonu
DRAWING TITLE: NORTH ELEVATION
PROJECT: New Dwelling
DRAWING STATUS: design development

DRAWN BY	DATE	SCALE
AW	10/02/2021	1:100 @ A3
DWG NO	JOB NUMBER	ISSUE
08	20127	03

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE