GEOTECHNICAL INVESTIGATION:

Alterations and Additions at **139 Lagoon Street, Narrabeen**

1. Proposed Development

1.1 Construct a new driveway, garage and entryway on the W side of the property by excavating to a maximum depth of ~2.9m.

1.2 Details of the proposed development are shown on 9 drawings prepared by MHDP Architects, project number 2122. Drawings numbered A001 to A004, A100, A101, A201 and A211 are Revision A, dated 16/1/24. Drawing number SK10 is Revision A/P1, dated 18/12/23.

2. Site Description

2.1 The site was inspected on the 20th November, 2023.

2.2 This residential property is on the high side of the road and has a NW aspect. The block runs longways to the E so the slope is a cross-fall. It is located on gently graded terrain.

2.3 A concrete Right of Carriageway (ROW) runs from Malcom Street to a garage on the ground floor of the house (Photos 1 & 2). The part two storey brick and rendered masonry house is supported on masonry walls (Photos 2 & 3). The external supporting walls show no significant signs of movement. A deck and balcony extend off the NW side of the house (Photo 4). Fill provides level platforms for lawn and garden areas on the W side of the house (Photos 5 & 6). The fill is supported by stable low timber retaining walls (Photo 6). No signs of slope instability were observed on the property. The adjoining neighbouring properties were observed to be in good order as seen from the street and subject property.

3. Geology

The Sydney 1:100 000 Geological Sheet indicates the contact of Alluvial Stream and Estuarine Sediment (Qha) and marine sand (Qhf) of the foredune is at the E side of the property. Sandy fill and sand was encountered to the extent of the ground tests.

4. Subsurface Investigation

One hand Auger Hole (AH) was put down to identify the soil materials. Three Dynamic Cone Penetrometer (DCP) tests were put down to determine the relative densities of the sands underlying the site. 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. But due 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 (~RL8.0) **–** AH1 (Photo 7)

Depth (m)	Material Encountered
0.0 to 0.9	**SANDY FILL**, sandy soil and silty sand, with some rock fragments, dark brown, brown, grey, medium dense, dry, fine to coarse grained.
0.9 to 3.7	**SAND**, orange, orange brown, yellow brown, brown, medium dense, dry to moist, medium grained.

End of Test @ 3.7m in Medium Dense Sand. No water table encountered.

DCP TEST 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** (~RL8.0)	**DCP 2** (~RL8.0)	**DCP 3** (~RL8.0)
0.0 to 0.3	8	8	6F
0.3 to 0.6	7	8	1F
0.6 to 0.9	8	5	4
0.9 to 1.2	12	7	5
1.2 to 1.5	13	10	5
1.5 to 1.8	13	9	9
1.8 to 2.1	17	12	15
2.1 to 2.4	15	16	15
2.4 to 2.7	10	15	15
2.7 to 3.0	18	17	14
3.0 to 3.3	25	15	17
3.3 to 3.6	25	16	18
3.6 to 3.9	42	18	25
3.9 to 4.2	58	52	18
4.2 to 4.5	#	#	15
4.5 to 4.8			24
4.8 to 5.1			27
5.1 to 5.4			#
	End of Test @ 4.1m	End of Test @ 4.2m	End of Test @ 5.1m

#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 @ 4.1m, DCP still very slowly going down, orange brown sand on moist tip.

DCP2 – End of Test @ 4.2m, DCP still very slowly going down, orange brown sand on moist tip.

DCP3 – End of Test @ 5.1m, DCP still going down, dark brown sandy soil and orange brown sand on moist tip.

5. Geological Observations/Interpretation

The site is underlain by sandy fill over sand that was encountered to the extent of the testing. Fill to a maximum depth of ~1.5m provides level platforms for lawn and garden areas on the W side of the property. In the test locations, Very Loose to Medium Dense sandy fill extends to depths of between ~0.5m to ~1.5m which overlies Medium Dense sands to a depth of ~3.6m. These are underlain by sands of variable density that range from Medium Dense to Dense to the extent of the testing at 5.1m. See Type Section attached for a diagrammatical representation of the expected ground materials.

6. Groundwater

The water table was not encountered to the extent of AH1 at ~RL4.3. This is below the base of the excavation at ~RL5.0. The water table is expected in the vicinity of ~RL0.0 to ~RL2.0.

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, below or beside the property. The proposed excavation for the garage, driveway and entryway is a potential hazard until retaining structures are in place (**Hazard One**).

RISK ANALYSIS SUMMARY ON NEXT PAGE

Geotechnical Hazards and Risk Analysis - Risk Analysis Summary

HAZARDS	Hazard One
TYPE	The proposed excavation for the garage, driveway and entryway collapsing onto the work site, impacting the neighbouring properties and undercutting the subject house and structures on the N neighbouring property before retaining structures are in place.
LIKELIHOOD	'Likely' (10^{-2})
CONSEQUENCES TO PROPERTY	'Medium' (20%)
RISK TO PROPERTY	'High' (2×10^{-3})
RISK TO LIFE	7.4×10^{-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.

(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 Lagoon Street. All stormwater 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 to a maximum depth of ~2.9m with be required to construct the proposed garage, driveway and entryway.

The excavation is interpreted to be through sandy fill and sand. It is envisaged that excavations through sandy fill and sand can be carried out with an excavator and bucket or hand tools.

12. Vibrations

It is expected the proposed excavation will be carried out with an excavator and bucket or hand tools and the vibrations produced will be below the threshold limit for building or infrastructure damage using a domestic sized excavator up to 20 tonne.

13. Excavation Support Requirements

An excavation to a maximum depth of ~2.9m with be required to construct the proposed garage, driveway and entryway. Allowing for backwall drainage, the setbacks are as follows:

- Flush with and underneath a small section of the subject house.
- Flush with the road reserve.
- Flush with the N common boundary, close to flush with the N neighbouring low keystone retaining wall and ~0.6m from the N neighbouring driveway.
- ~0.6m from the S common boundary.

These structures and common boundaries will be within the zone of influence of the excavation. In this instance, the zone of influence is the area above a theoretical 30° line (from horizontal) through fill/sand from the base of the excavation towards the surrounding structures and boundaries.

Due to the depths of the garage and entryway portions of the excavation and their proximity to the nearby structures and common boundaries, the uphill side of the garage and entryway

excavation will need to be permanently supported prior to the excavation commencing, or during the excavation process in a staged manner.

Where the excavation is outside the footprint of the existing house/balcony (See Garage Floor Plan appended & Photo 4), it is to be permanently supported with ground support prior to the commencement of the excavation under the existing house.

Due to the presence of deep sand, secant or contiguous piled retaining walls are suitable forms of support. See the Garage Floor Plan attached for the minimum extent of the required piling shown in blue. If the wall is contiguous, any gaps between the piles are to be grouted closed immediately as the excavation is lowered. The water table is expected in the vicinity of ~RL0.0 to ~RL2.0. The piles may encounter the water table, depending on the required depths of the piles. As such, the rig will need to be a CFA rig (capable of grout injection during the drilling process due to the presence of the water table). The piles can be temporarily supported by embedment below the base of the excavation or with a combination of embedment and propping. The walls are to be tied into the garage floor and roof slabs and entryway slab to provide permanent bracing after which any temporary bracing can be released.

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.

Following the installation of the ground support, the existing house/balcony (See Garage Floor Plan appended & Photo 4) is to be underpinned and propped in a staged manner. The underpinning will need to be progressed one drive at a time in the horizontal plane and in a staged manner in the vertical plane due to the limited depth each underpin lift can be lowered to maintain drive stability in sand. The width of each drive and depth of each underpin is to be proportioned dependent on the stability of the sand on site, but these should not exceed 0.6m in width or depth. An Excavation Management Plan detailing the sequence of shoring, and detailing the method and stages of underpinning and propping will be required prior to

the commencement of the excavation so the builders and contractors have a clear understanding of the required process prior to the works commencing. The Geotechnical Consultant is to review this plan before the works commence.

Alternatively, the existing house/balcony can be demolished where it is located over the footprint of the excavation to allow space to install a secant or contiguous piled retaining wall.

The driveway portion of the excavation and the downhill side of the garage and entryway portion of the excavation will need to be temporarily or permanently supported prior to the commencement of the excavation, or during the excavation process in a staged manner, so cut batters are not left unsupported. The support will need to be designed by the structural engineer. See the Garage Floor Plan attached for the minimum extent of the required shoring shown in green.

The materials and labour to construct the retaining structures are to be organised so shoring walls can be installed as required. The excavation is to be carried out during a dry period. No excavations are to commence if heavy or prolonged rainfall is forecast.

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

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	Passive
Very Loose to Medium Dense Sandy Fill	20	0.40	0.55	N/A
Medium Dense to Dense Sands	20	0.40	0.55	K_p = 3.8 'ultimate'

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 and do not account for any surcharge loads, noting that surcharge loads from the structures above will be acting on the wall. It also assumes retaining structures 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 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 likely hydrostatic pressures are to be accounted for in the structural design.

15. Foundations

The perimeter walls of the proposed garage can be supported off the required secant or contiguous piled shoring walls. These continuous piles will act like a strip footing. Assume a

maximum allowable bearing pressure 300kPa for shoring piles in sand embedded at least 2.5m below the excavation.

Where the proposed additions are not supported off the piled retaining walls, spread footings or raft slabs embedded at least 0.4m below the current surface or below the garage level and into the sands of the natural profile will be required. A maximum allowable bearing pressure of 100kPa can be assumed for footings embedded in the Medium Dense Sand of the natural profile.

The footing excavation walls in sand are to be shored with timber to prevent collapse prior to the concrete pour. The base of the footing excavations 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, correlating to a Very Dense Sand.

The geotechnical consultant is to inspect and test the compacted bases of all prepared foundations in sand to ensure the required density has been achieved.

NOTE: If the contractor is unsure of the footing material required it is more cost effective to get the geotechnical professional 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.

REQUIRED INSPECTIONS ON NEXT PAGE

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 owners or the regulating authorities 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 pile for the ground support is being dug to assess the ground strength and to ensure it is in line with our expectations. All finished pile holes for the piled wall/excavations for ground support are to be inspected and measured before concrete is placed.

- The geotechnical consultant is to inspect and test the compacted bases of all prepared foundations in sand to ensure the required density has been achieved. 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.

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Photo 1

Photo 2

Photo 3

Photo 4

Photo 5

Photo 6

Photo 7: 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.

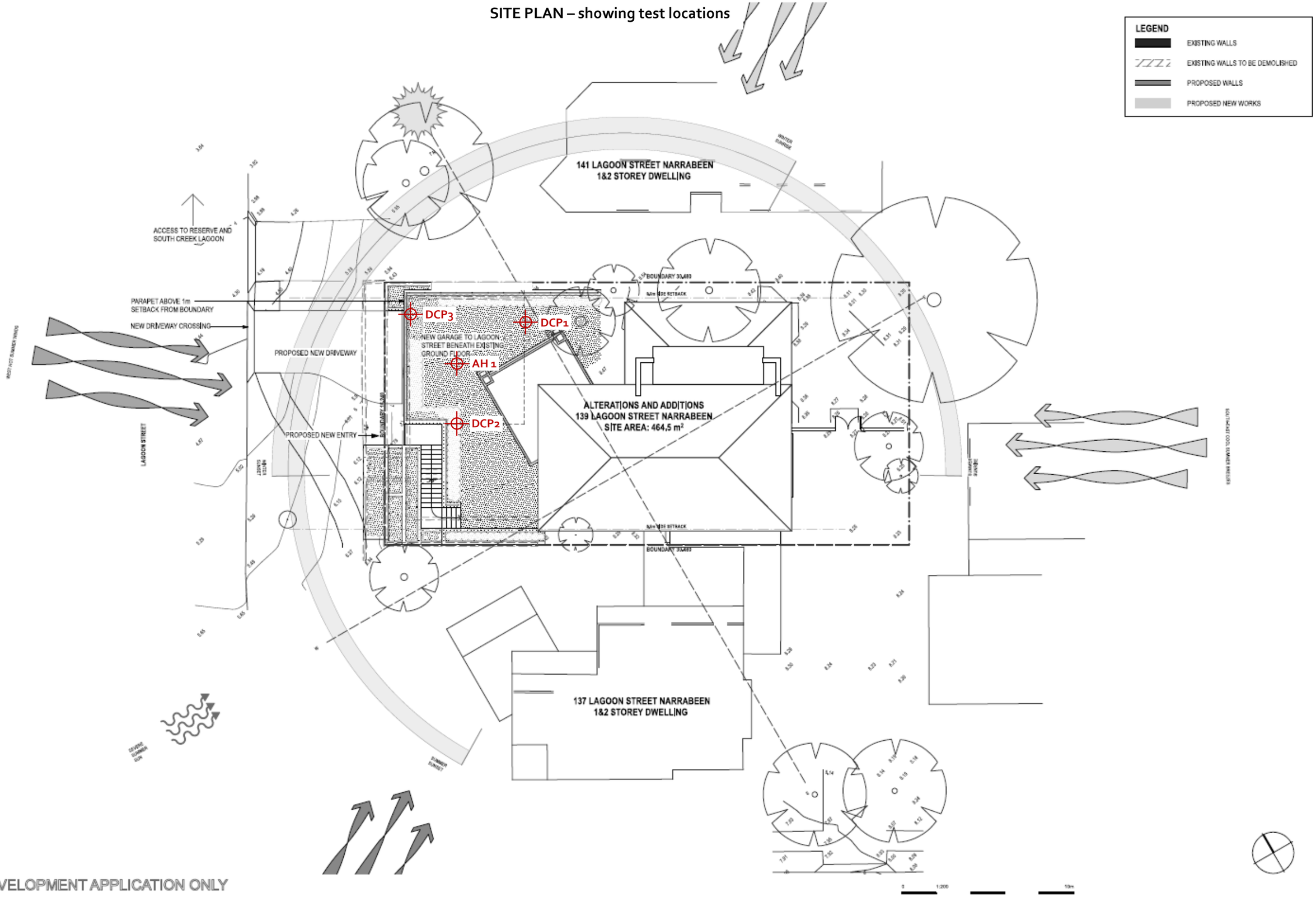
- The report addresses issues relating to your specific design and site. If the proposed project design changes, aspects of the report may no longer apply. Contact White Geotechnical if this occurs.

- 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



FOR DEVELOPMENT APPLICATION ONLY

ISSUED FOR DA	15/1/24	A
AMENDMENT	DATE	REVISION

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ALTERATIONS AND ADDITIONS
139 LAGOON STREET NARRABEEN

SITE PLAN AND SITE ANALYSIS

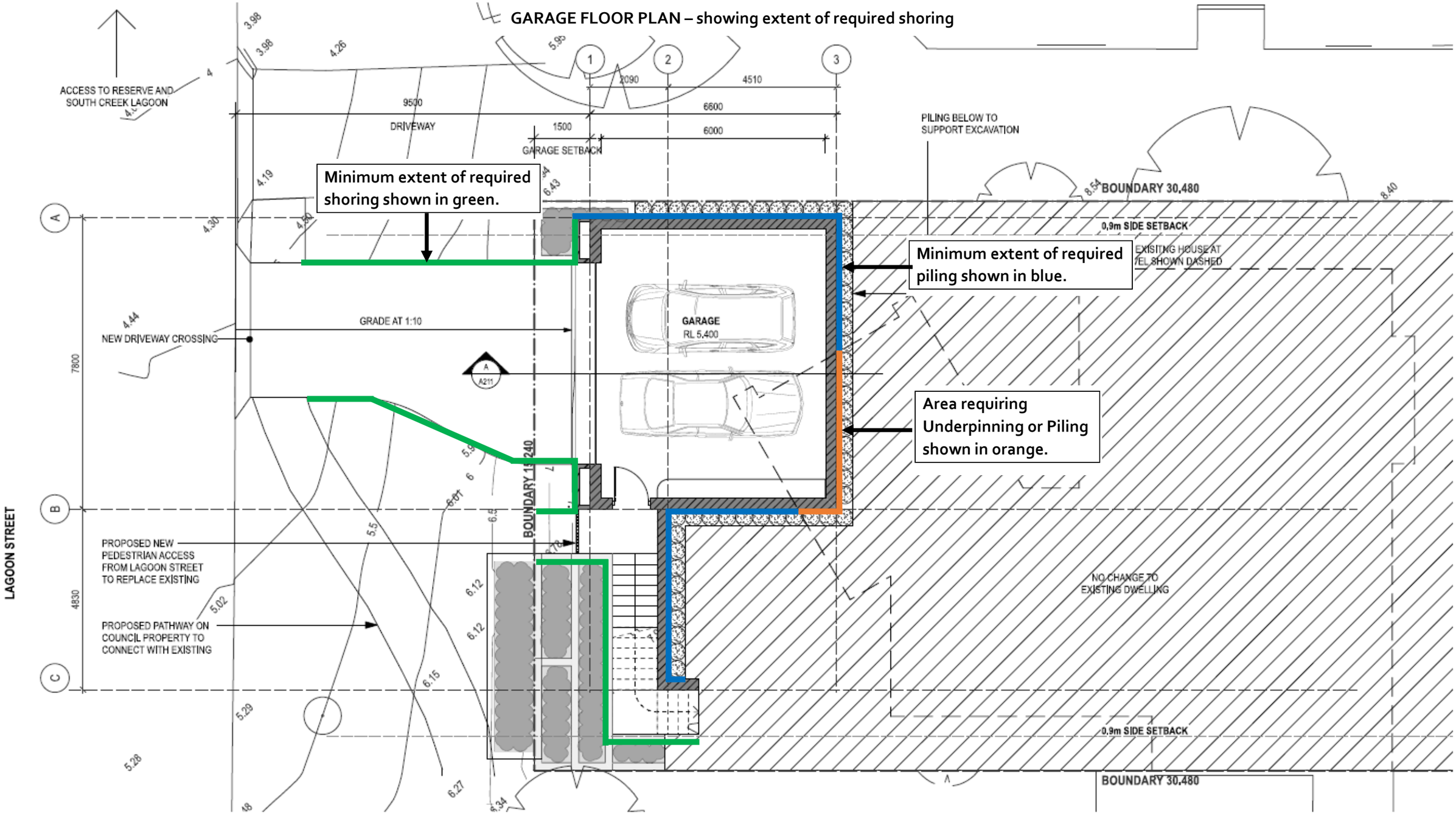
1:200 @ A3

2122 A001 A

NOVEMBER 2023

MHDP ARCHITECTS

GARAGE FLOOR PLAN – showing extent of required shoring



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ALTERATIONS AND ADDITIONS
139 LAGOON STREET NARRABEEN

PROPOSED GARAGE FLOOR PLAN

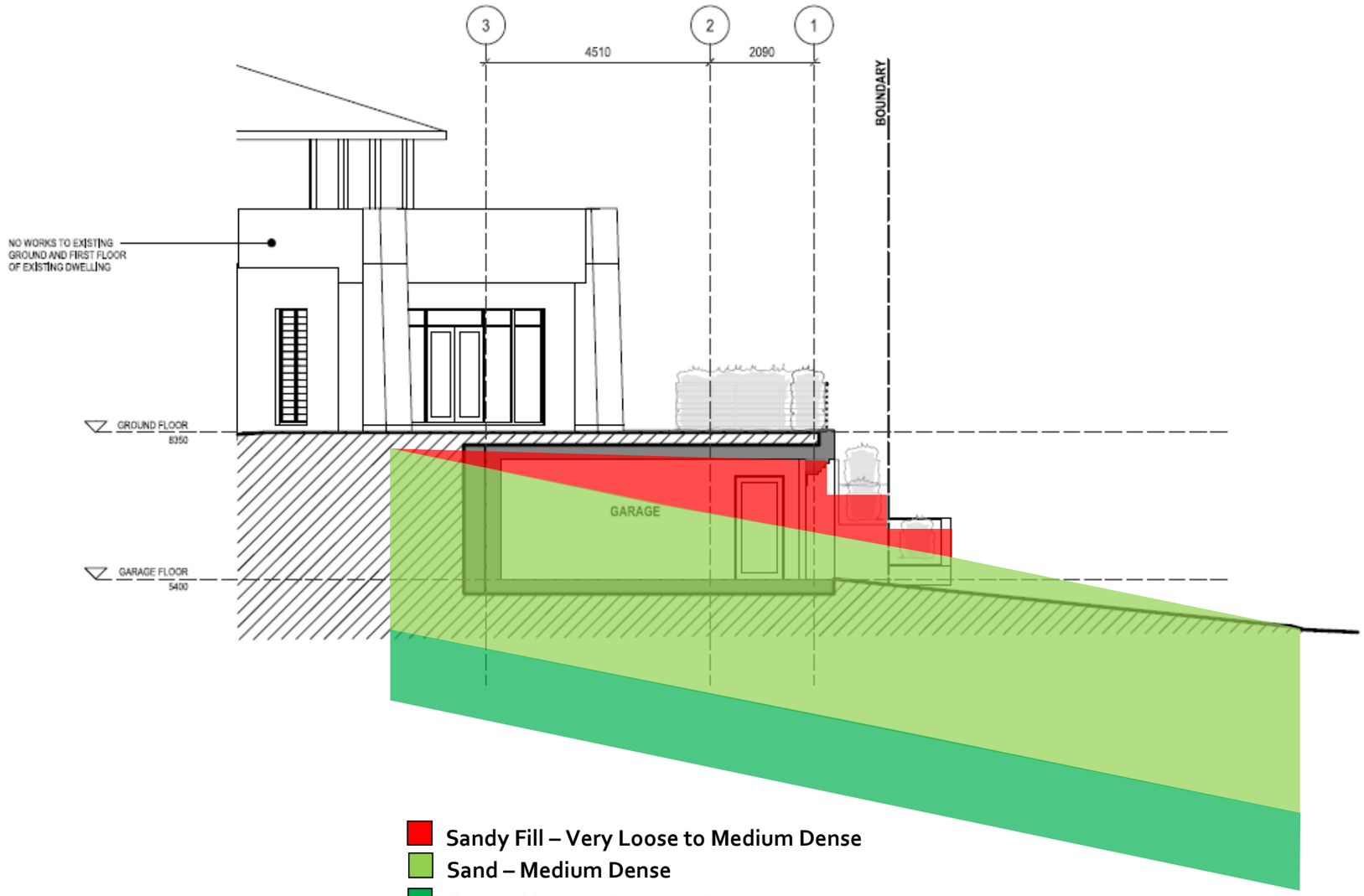
1:100 @ A3

2122 A101 A

NOVEMBER 2023

MHDP ARCHITECTS

TYPE SECTION – Diagrammatical Interpretation of expected Ground Materials



Sandy Fill – Very Loose to Medium Dense

Sand – Medium Dense

Sand – Medium Dense to Dense

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ALTERATIONS AND ADDITIONS
139 LAGOON STREET NARRABEEN

SECTION AA

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2122 A211 A

NOVEMBER 2023

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