



Geotechnical Investigation Report

Lot 97, Stage 6, Country Palms Subdivision,
Halswell, Christchurch

Suburban Estates Ltd

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Prepared by

PP

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Contents

1. Introduction	3
2. Site Information.....	3
3. Recommendations.....	5
4. Construction Considerations	5
5. Further Geotechnical Involvement	6
Appendix A Limitations.....	7
Appendix B Test Location Plan	8
Appendix C Hand Auger & Scala Logs	9

1. Introduction

CGW Consulting Engineers have been engaged by Suburban Estates Ltd, to undertake a geotechnical investigation and report at Lot 97, Country Palms Subdivision, Halswell, Christchurch and this report can be relied upon as part of the residential development of this allotment.

The site has been investigated as part of the wider development and the subdivision report should be referred to in conjunction with the Geotechnical Subdivision Report by Soil and Rock Consultants on the 2nd September 2016. The purpose of this investigation is to confirm the shallow bearing capacity and soils as well as provide foundation recommendations.

This report summarises our findings and recommendations and may be used to support a Building Consent application to Christchurch City Council. Our geotechnical limitations are presented in Appendix A.

2. Site Information

2.1. Site Description

The subject site, located at Lot 97, Country Palms Subdivision, Halswell is situated approximately 8.3km southwest of Central Christchurch. The site (Depicted in Figure 1) is located within Stage 6 of the subdivision located to the west of Country Palms Drive.

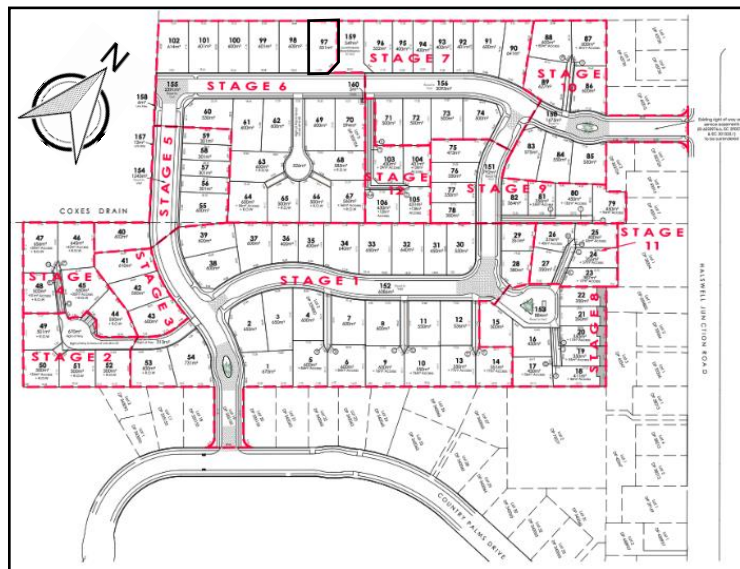


Figure 1: Site Location

2.2. Land Classification

Based on the subdivision specific geotechnical report, the site has been assessed as being consistent with a Technical Category TC2 area (Yellow) as per the Ministry of Business Innovation and Employment (MBIE) Technical Category classification.

2.3. Site Specific Investigation

Following an initial site walkover, the field investigations comprised:

- Two hand augerholes and two Machine Dynamic Cone Penetrometer Tests undertaken from the surface.

A visual-tactile field classification of the subsoils encountered during hand augerhole drilling was carried out in accordance with 'Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes' (NZGS, 2005) and Scala Penetrometer testing was carried out in accordance with NZS 4402:1988, Test 6.5.2, 'Dynamic Cone Penetrometer'.

Investigation details are provided in Table 3. The tests were positioned to provide coverage of the site considering site access and the proposed dwelling footprint. Test locations are approximate only.

Test ID	Termination Depth (m bgl)	Further Information (Groundwater, piezometer, etc.)
HA01	2.40	Groundwater Standing at 2.30 m.
HA02	2.50	Groundwater Standing at 2.50 m.
MDCP01	3.02	No Groundwater Recorded
MDCP02	3.07	No Groundwater Recorded

All test locations are presented on drawing 17069/1 in Appendix B with hand augerhole and Machine Dynamic Cone Penetrometer results showing detailed soil descriptions and blows per 100 mm penetration are presented in Appendix C.

2.4. Site Subsurface Conditions

Subsurface conditions based on those encountered within the hand augerholes is given in Table 4.

Soil Type	Depth to bottom of Layer (m)	Layer Thickness (m)	DCP Reading (Blows/100mm)	Relative Density / Consistency
SILT (Topsoil)	0.20 – 0.30	0.20 – 0.30	1 – 12+	Soft to Stiff
SILT	1.70 – 1.90	1.40 – 1.70	3 – 12+	Firm to Stiff
SAND	2.40 – 2.50	0.60 – 0.70	5 – 12+	Medium Dense to Dense

2.5. Groundwater

Based on site investigations and previous data collected for the site we consider groundwater depths to be approximately 2.5 m bgl.

2.6. Geotechnical Ultimate Bearing Capacity

With reference to Scala Penetrometer results, an Ultimate Bearing Capacity (UBC) of 200kPa is available within the engineered fill at a depth of 0.3 m bgl below the topsoil layer. In accordance with the principles of AS/NZS1170:2002 Section 3.2, a Strength Reduction Factor of $\Phi = 0.5$, as per B1/VM4 Section 3.5, should be applied to the Ultimate Bearing Capacity, which should then equal or exceed the factored Ultimate Limit State design actions.

3. Recommendations

We recommend that an enhanced foundation solution in accordance with Section 5 of the MBIE Guidelines for the proposed residential development. An Ultimate Bearing Capacity of 200kPa is available at 0.3 m bgl. Whilst any of the MBIE Guidance Section 5 enhanced foundation solutions would be suitable, we recommend a waffle slab solution to be the most appropriate which is consistent with an Option 4 solution.

This Option 4 (Waffle Slab) foundation system would require digging out to 0.3 m depth. Any topsoil or organic material below this depth is to be removed. No geogrid reinforcing is required.

Placed fill should comprise well graded crushed aggregate (CAP65 to Christchurch City Council standard specifications) and should extend at least 1000 mm beyond the edge of the foundations. The granular fill should be compacted to achieve no less than 95% maximum dry density as achieved with a vibratory hammer compaction curve. Excavation sidewalls should be battered no steeper than 1H:1V to a maximum depth of 1 m bgl.

4. Construction Considerations

4.1. Site Formation Works

All earthworks should be carried out to the requirements of NZS 4431:1989, 'Code of Practice for Earth filling for Residential Development'. All unsuitable materials (vegetation, organic or deleterious material, topsoil and non-engineered fill etc.) should be stripped from any areas of earthworks and stockpiled well clear of earthwork operations or carted from the site. Compaction of non-cohesive fill should be carried out using pad foot compaction plant of a minimum 10 tonne static weight, in loose layers no greater than 200 mm thickness. All fill materials should be clear of unsuitable materials as described above.

4.2. Excavations

If works are undertaken following a period of precipitation the subgrade should be protected to minimise disturbance or contamination of the exposed subgrade. This may require filter fabric (Bidim A19) which should be confirmed by a geotechnical engineer familiar with this report once the subgrade has been excavated.

5. Further Geotechnical Involvement

5.1. Geotechnical Drawing Review

A geotechnical engineer familiar with the findings of this report should be engaged to review the final working drawings of the proposed development prior to submission to the Building Consent Authority, to ensure the geotechnical recommendations of this report have been implemented correctly. Further geotechnical analysis may be warranted at this stage subject to the specifics of the development proposal.

5.2. Construction Observations

A Geotechnical Engineer familiar with the findings of this report should be engaged to carry out observations during foundation excavations to confirm soil and foundation conditions are consistent with those adopted within this report. Inspections will not be carried out prior to Council issuing the required Building Consents, and unconsented works will not be inspected.

The recommendations given in this report are based on limited site data from discrete locations. Variations in ground conditions could exist across the site. It is in the interests of all parties that we be retained to observe excavations and foundation conditions exposed during construction, so that ground conditions can be compared with those assumed in formulating this report. In any event, we should be notified of any variations in ground conditions from those described or assumed to exist.

Without sufficient observations during the subgrade preparation prior to placement of fill or concrete, CGW Consulting Engineers will not be in a position to provide engineering signoff (i.e. Producer Statement PS4). We recommend once a Building Consent be issued it be forwarded to us for review. We will then on-forward a schedule of inspections required by us in order to meet the consent conditions. Areas where concrete or fill are placed without prior geotechnical observation will be specifically excluded from completion documentation.

Appendix A Limitations

CGW CONSULTING ENGINEERS - LIMITATIONS

The professional services and this document provided by CGW Consulting Engineers Ltd ("CGW") are subject to the following limitations:

Reliance: This document has been prepared solely for the benefit of our client, as per our brief and an agreed consultancy agreement. The document is confidential and reliance by any other parties on the information or opinions contained in this document shall, without our prior agreement in writing, be at such parties' sole risk. CGW accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this document.

Our Brief: This document has been prepared solely to address the issues raised in our brief, and shall not be relied on for any other purpose. The scope and the period of CGW's services are as described in CGW's proposal, and are subject to restrictions and limitations. CGW did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by CGW in regards to it.

Unforeseen Ground Conditions: The conclusions and recommendations contained within this document are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this document based on accepted normal methods of site investigation. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this document does not purport to completely describe all the site characteristics and properties. The nature and continuity of ground and groundwater conditions are inferred using experience and judgement and it must be appreciated that actual conditions could vary considerably from the assumed model. Defects and unforeseen ground conditions may remain undetected which might adversely affect the stability of the site and the recommendations made herein.

Third Party Data: In the event that external third party investigation data has been utilised or provided to us, the client acknowledges that we have placed reliance on this information to produce our document and CGW will accept no liability resulting from any errors or defect in the external third party data.

Ground Investigation Data: The Client grants permission to CGW to upload any factual data collected during the works to the National Geotechnical Database (or other similar database) as appropriate.

Warranty: Any assessments made in this document are based on the conditions indicated from published sources and the investigations described. No warranty is included, either express or implied, that the actual conditions will conform exactly to the assessments contained in this document.

Time: In addition, it is recognised that the passage of time affects the information and assessment provided in this document. CGW's opinions are based upon information that existed at the time of the production of the document. It is understood that the services provided allowed CGW to form no more than an opinion of the actual conditions of the site at the time the site was visited and cannot be used to assess the effect of any subsequent changes in the quality or features of the site, or its surroundings, or any laws or guidance or regulations.

Construction Issues: It is common that not all site issues will necessarily be dealt with at site assessment stage. As the project progresses through design towards construction, if issues arise, allow CGW to develop alternative solutions to problems, that will be of benefit both in time and cost. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. Contractors should perform any additional tests as necessary for their own purposes.

Geoenvironmental: Unless specifically stated the document will not relate any findings, conclusions or recommendations about the potential for hazardous or contaminated materials existing at the site. Specialist equipment, techniques, laboratory testing and personnel are required to perform geoenvironmental (ie. HAIL) assessments.

Sub-Contractors and Staff: CGW may have retained sub-consultants or sub-contractors to provide services for the benefit of CGW. To the maximum extent allowed by law, the Client acknowledges and agrees it will not have any direct legal recourse to, and waives any claim, demand, or cause of action against, CGW's sub-consultant or sub-contractor companies, and CGW's employees, officers and directors.

Copyright: This document is not to be reproduced either wholly or in part without our prior written permission. The document should not be altered in any way. Logs, figures, designs and drawings are included in our documents. These inclusions, logs etc., should not under any circumstances be redrawn for inclusion in other documents or separated from the source document in any way.

Intellectual Property Rights: All intellectual property (IP), designs and documents created or provided by CGW in the provision of the services shall remain the property of CGW. Subject to the Client complying with its obligations under the agreed consultancy agreement, the Client shall upon payment own all deliverables provided to it in the provision of the Services, and CGW grants to the Client a nonexclusive, non-transferable license to use the IP for the purposes described in the Proposal. The Client shall not use, or make copies of, the deliverables in connection with any work not included in the Proposal without prior written consent from CGW. If the Client is in breach of any obligation to make a payment to CGW, then CGW may revoke the license to use the IP and the Client shall return to CGW all originals of deliverables provided under the services and any copies thereof.

Assignment: Neither party and their respective successors may assign, transfer, or sublet any obligation under this Agreement without the prior written consent of the other party. Unless stated in writing to the contrary, no assignment, transfer, novation or sublet shall release the assignor from any obligation under this Agreement.

Standard Terms: These Limitations should be read in conjunction with the IPENZ/ACENZ Standard Terms of Engagement as per our proposal and agreed consultancy agreement.

Appendix B Test Location Plan



Approximate
True North

Legend:



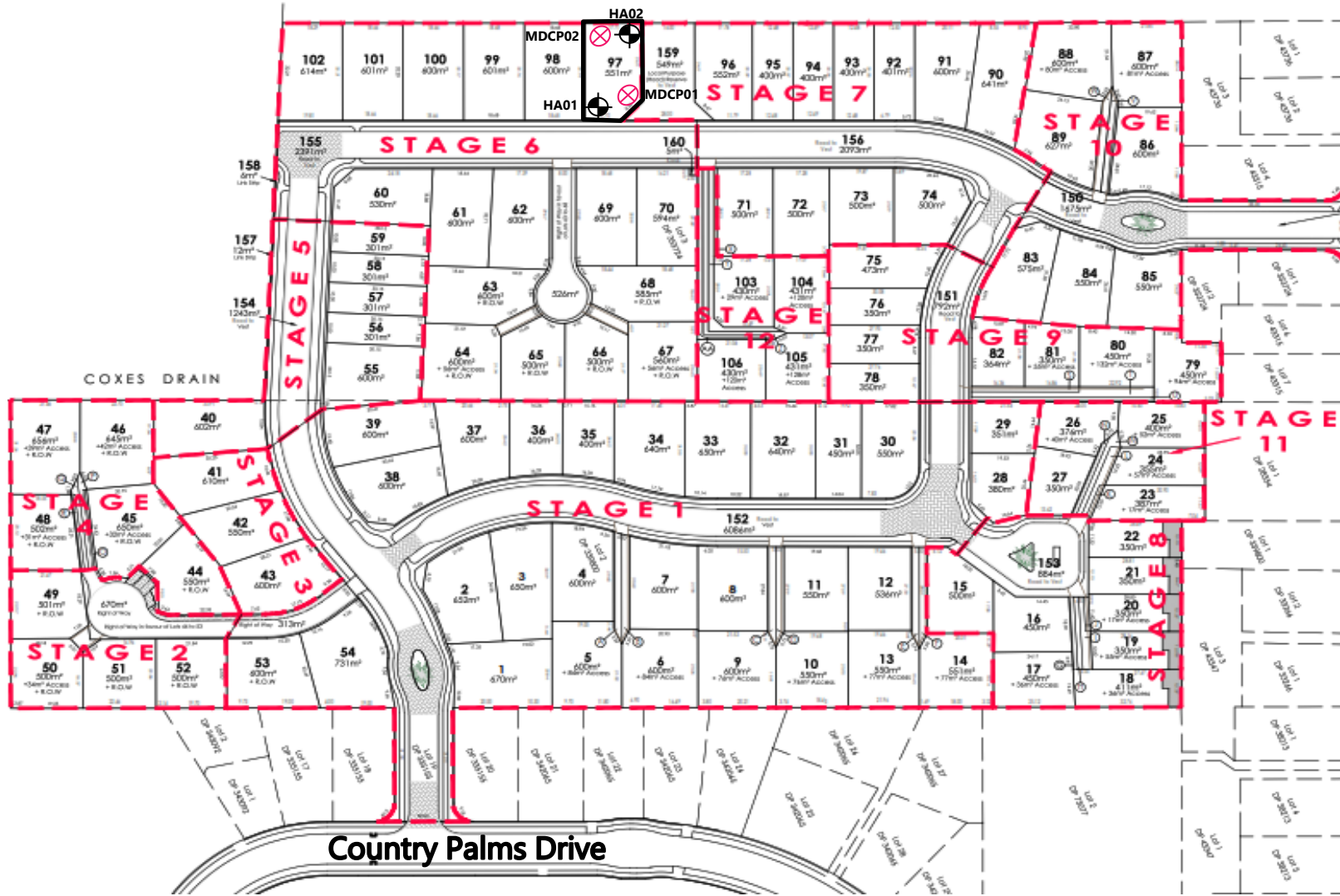
Approximate Hand
Auger Locations

HA



Approximate Machine
Dynamic Cone
Penetrometer Locations

DCP



Halswell Junction Road

Country Palms Drive

Notes:

1. CGW Consulting Engineers Test Location Plan adapted from Ecan or Google maps.
2. It should be borne in mind that locations of features are approximate only.
3. Original plan size A4.



Civil Structural Environmental Geotechnical
 Nelson Ph: 548 - 8259
 Christchurch Ph: 348 - 1000

DATE:	April 2019
DRAWN:	JF
SCALE:	NTS
CAD REF:	17069

Test Location Plan
Lot 97, Stage 6, Country Palms
Halswell
Christchurch

DRAWING NO:	17069/1
SHEET	1 OF 1

Appendix C Hand Auger & Scala Logs



Project Title: Country Palms Drive Subdivision		Lot 97, HA02
Project Number: 17069	Client: Suburban Estates Ltd	
GL (mAOD):	N Coord: 0	E Coord: 0
Date: 11/04/2019	Method: Hand Auger	Logged By: JF
		Scale: 1:25 Sheet 1 Of 1

Blows (per 100mm)			UBC (kPa) (Stockwell)				Level	Legend	Depth (m)	Description	Water
3	6	9	100	200	300	400					
								0.30	SILT, some fine to coarse, sub rounded gravel, trace rootlets; dark brown. Soft to firm, moist, low plasticity (TOPSOIL).		
								0.60	SILT; dark brown. Firm, moist, low plasticity to moderate plasticity.		
								1.00	0.60 Becomes light brown mottled orange-brown.		
								1.30	0.90 Becomes with minor fine sand. Low plasticity.		
								1.70	1.30 Becomes brown mottled orange-brown.		
								2.00	1.60 Becomes with some fine sand.		
								2.50	SAND with trace silt; brown mottled orange-brown. Medium dense to dense; moist to wet; poorly graded. Sand is fine to medium.		
								3.00	2.30 Becomes bluish grey. Saturated.	▼	
								4.00	End Of Hole At 2.50 m		

KEY

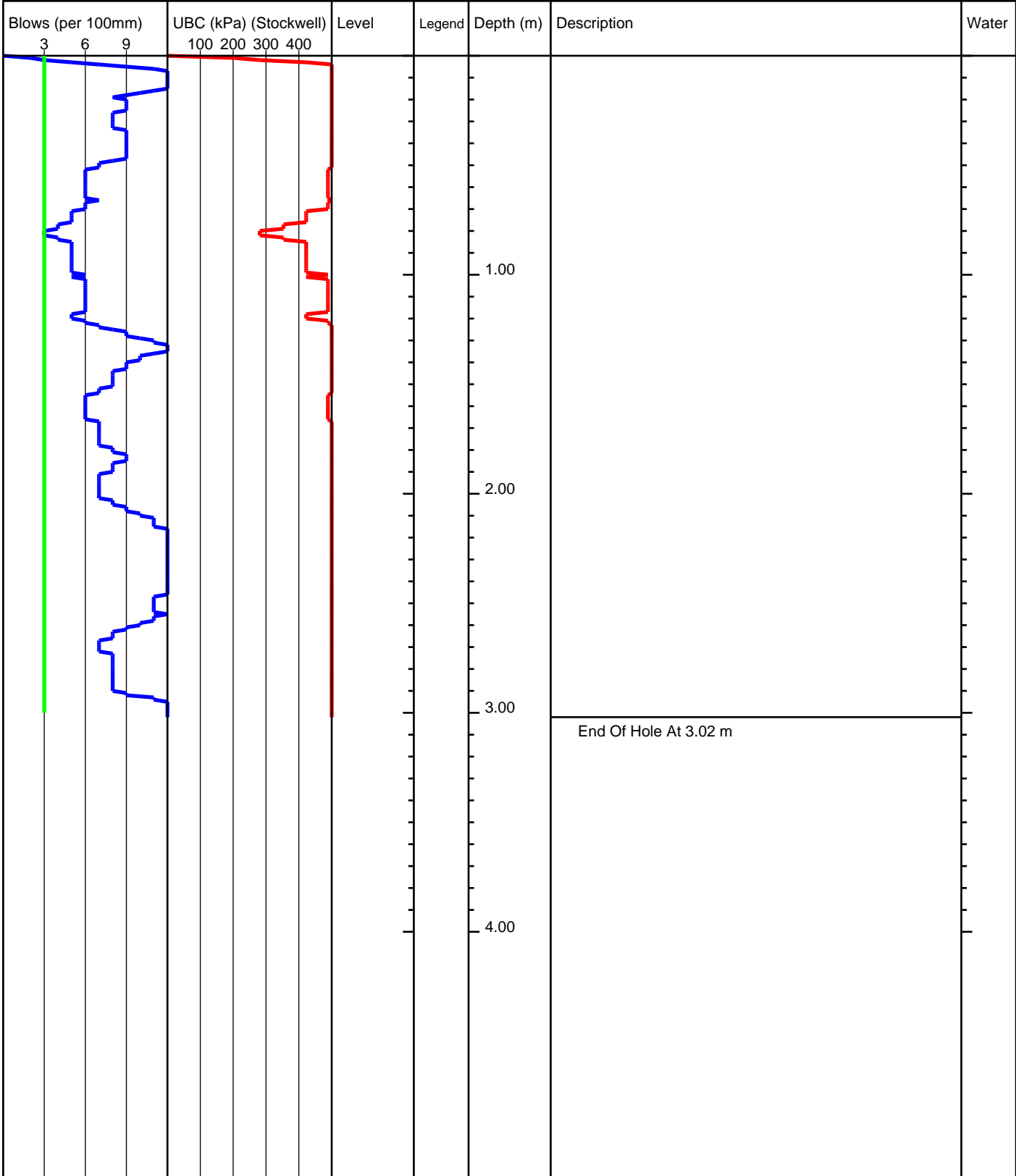
- D - Disturbed Sample
- B - Bulk Sample
- W - Water Sample
- V - Hand Shear Vane kPa
- ▼ - Groundwater Strike
- ▼ - Groundwater Level

REMARKS

End of Hole at 2.5m.
Hole Collapse.



Project Title: Country Palms Drive Subdivision		Lot 97, MDCP01
Project Number: 17069	Client: Suburban Estates Ltd	
GL (mAOD):	N Coord: 0	E Coord: 0
Date: 28/03/2019	Method: MDCP	Logged By: JF
		Scale: 1:25 Sheet 1 Of 1



KEY

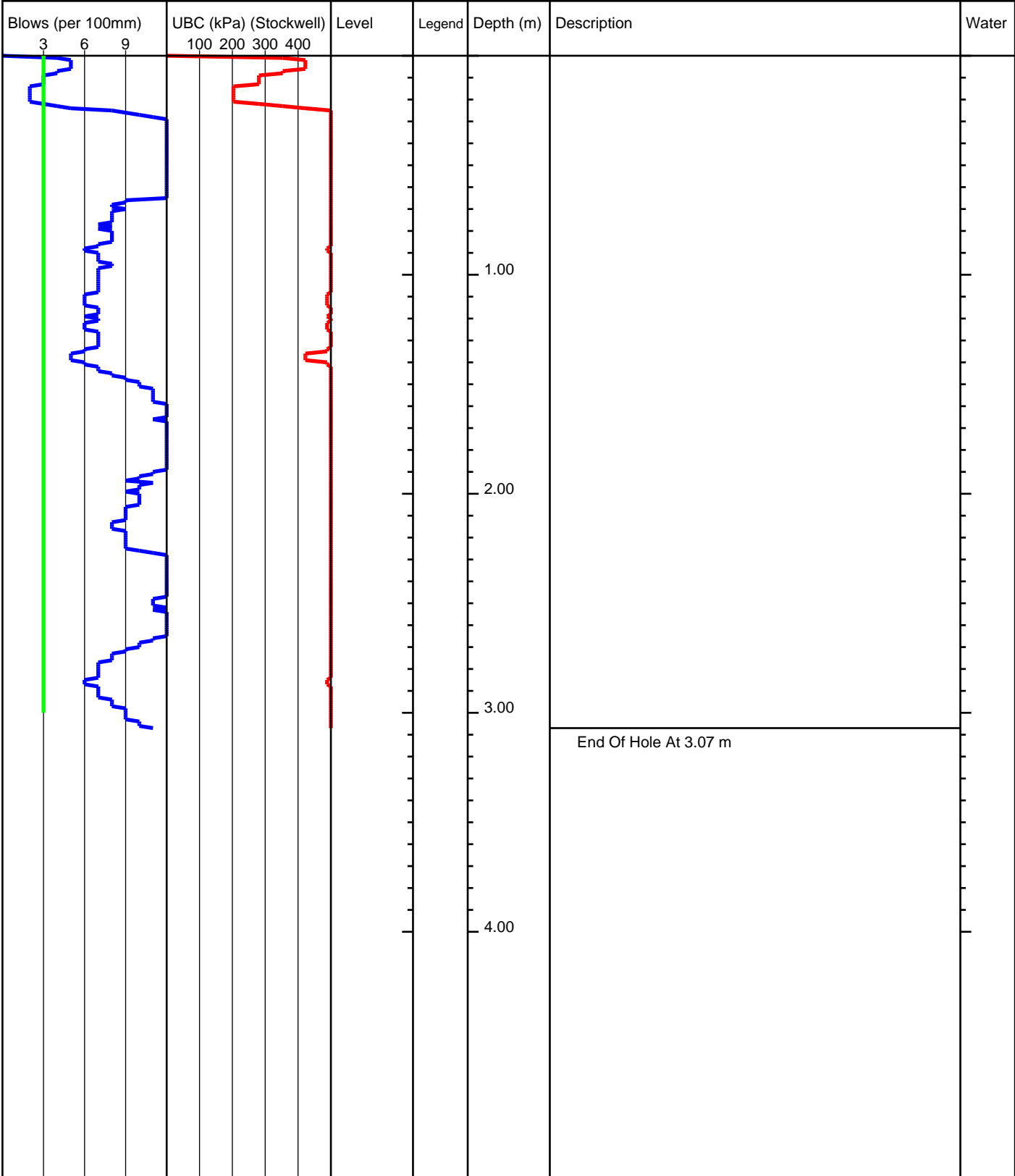
- D - Disturbed Sample
- B - Bulk Sample
- W - Water Sample
- V - Hand Shear Vane kPa
- ▽ - Groundwater Strike
- ▼ - Groundwater Level

REMARKS

End of Hole at 3.02 m.
Target Depth Reached.
No Groundwater Recorded.



Project Title: Country Palms Drive Subdivision		Lot 97, MDCP02
Project Number: 17069	Client: Suburban Estates Ltd	
GL (mAOD):	N Coord: 0	E Coord: 0
Date: 28/03/2019	Method: MDCP	Logged By: JF
		Scale: 1:25 Sheet 1 Of 1



KEY D - Disturbed Sample B - Bulk Sample W - Water Sample V - Hand Shear Vane kPa ▽ - Groundwater Strike ▼ - Groundwater Level	REMARKS End of Hole at 3.07 m. Target Depth Reached. No Groundwater Recorded.
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