INITIA
GEOTECHNICAL SPECIALISTS

Goodman Nominee (NZ) Ltd
Via – email - Peter.Yendell@goodman.com

Our Reference: P-000982-2
27 May 2022

Attention: Peter Yendell/ Ben Shaw/Phil Crampsie

Villa Maria –Settlement Analyses Memo (Geotechnical Zones 1 – 4)

1. Introduction

A commercial/industrial development of the existing Villa Maria (118 Montgomerie Road, Mangere) site is proposed by Goodman, which will likely comprise a combination of large warehouse structures and one to two storey office buildings. We understand that the existing Villa Maria production facility will remain in the western part of the site. Initia undertook a staged geotechnical investigation for the for the due diligence and the proposed development at Villa Maria. The results of the investigations are presented in factual report dated April 2022 (attached to this memo).

These investigations encountered variable ground conditions and the site has been divided into 7 No. zones based on the likely geotechnical implications on the development of the site. These zones are indicated in Figure 982-2-300 in Appendix A.

Zones 1 – 4 are considered critical to the development of the site based on the weak, compressible ground encountered within the investigations. The ground within these zones has the potential to consolidate (settle) under the fill and future building zones and will need to be preloaded/surcharged to mitigate the effects of consolidation on future buildings/services.

This memo presents the results of consolidation settlement analyses undertaken for Zones 1 – 4. Implications on the development are also discussed with the intent to allow cut/fill plans and programme to be progressed. Further analyses and reporting will be required prior to consenting and construction to allow volumes and construction sequencing to be optimised.

2. Ground model

The typical ground model for Zones 1 - 4 are summarised in Table 1, while the typical in situ strengths encountered for each unit during the investigations are presented in Table 2.

Table 1: Summary of ground models for Zones 1 - 3

Unit	Zone 1	Zone 2	Zone 3	Zone 4
	Thickness (m)			
Fill – very stiff clayey silt	-	-	3	-
Auckland Volcanic Field (AVF) Ash and Tuff	-	-	-	4
Fibrous Peat	2	3	-	-
Soft to firm clayey silt (amorphous)	-	5	6	-
Very stiff silt	-	-	-	6
Basalt	Present	Present	Present	Not Present

Table 2: Summary of typical in situ material strengths based on geotechnical investigations

Unit	Undrained Shear Strengths , kPa	Cone Tip Resistance, q_c, MPa
Fill – very stiff clayey silt	80 – 220+	2 – 5
AVF Ash and Tuff	140 - UTP	6 - >20
Fibrous Peat	35 - 55	0.1 – 0.2
Soft to firm clayey silt (amorphous peat)	30 - 50	0.1 – 0.3
Basalt	N/A	>20

Based on groundwater monitoring undertaken to date, groundwater is very close to the surface and for analysis purposes is assumed to be at the existing ground surface.

3. Laboratory testing

Select samples from the machine boreholes were collected during geotechnical investigations for purposes of laboratory testing.

A summary of the laboratory tests undertaken is presented in Table 3, Table 4 and Figure 1. Figure 1 shows reasonable consistency in the one dimensional consolidation test results from samples of the clayey SILT.

The test results are presented in the factual report (dated April 2022).

Table 3: Summary of laboratory samples on clayey silt (amorphous peat)

Sample ID	Material description	Sample depth (m)	Laboratory test completed	Natural Water Content	Organic Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %
BH105-02	Clayey SILT	4.5	1D consolidation; Natural water content; Organic content	211%	9	294	86	208
BH110-02	Clayey SILT	4.5	1D consolidation; Natural water content; Organic content	265%	20	446	143	303
BH104A-02	Clayey SILT	3.25	1D consolidation			N/A		
BH106-01	Clayey SILT	1.5	1D consolidation					
BH108-01	Clayey SILT	3.4	1D consolidation					
BH3-2	Clayey SILT	4.75	1D consolidation					
BH4-1	Clayey SILT	3.3	1D consolidation					

Table 4: Summary of laboratory samples completed on fibrous peat

Sample ID and material description		Sample depth (m)	Laboratory test completed	Natural Water Content
BH104A-01	PEAT	1.5	1D consolidation	N/A
BH102-01	PEAT	1.5	Natural water content	210%
BH107-01	PEAT	1.5	Natural water content	734%

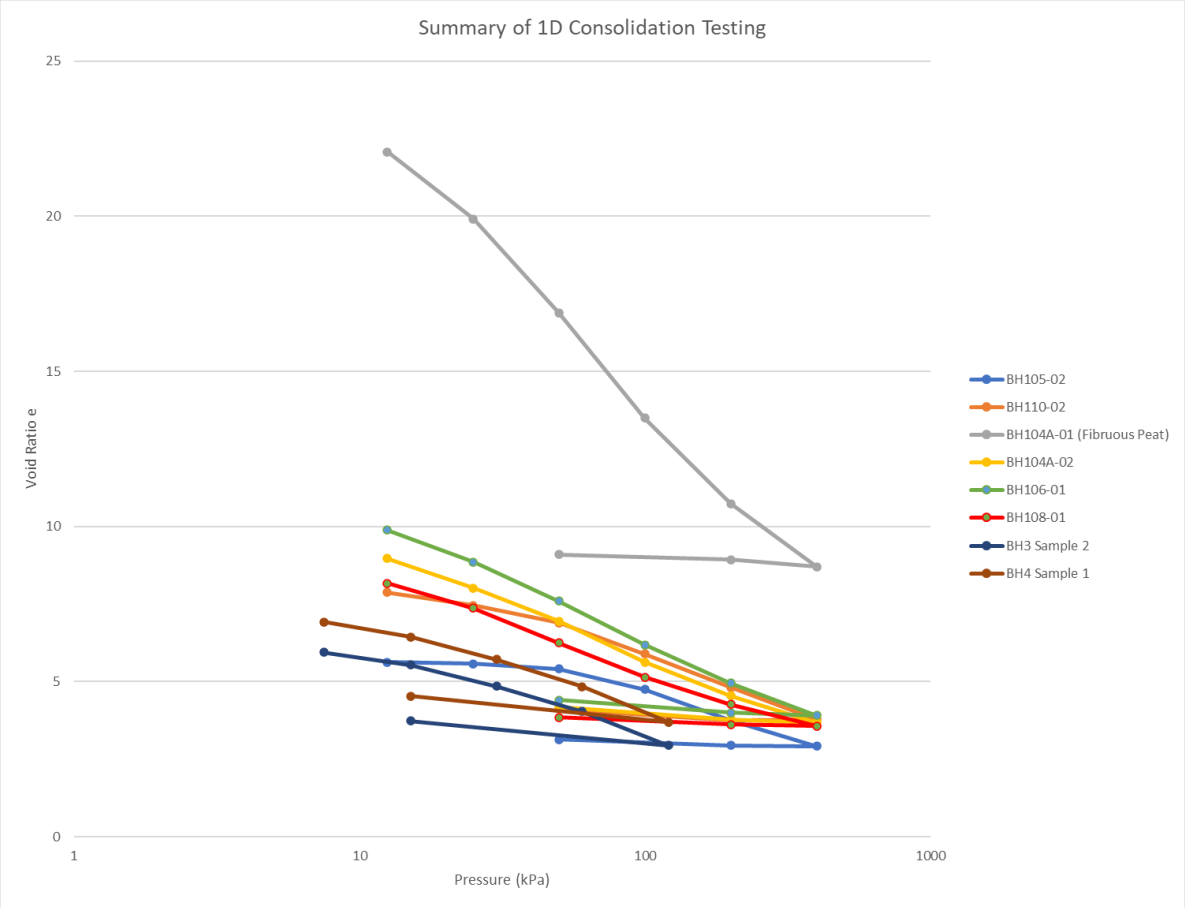


Figure 1 - Summary of 1D Consolidation Testing

From Figure 1, we note that the change in the void ratio with pressure for the fibrous peat (~22 to ~9) compared with the soft clayey silt (~10 to ~ 5) indicates that the fibrous peat is significantly more compressible that the organic silt.

4. Consolidation Settlement Analyses

4.1 Geotechnical Parameters and Methods to Assess Settlement

4.1.1 Zones 1 - 3

Assessment of expected primary and secondary settlement for Zones 1 – 3 has been principally assessed using two different methods as follows:

- **Noto Method** –For estimating settlement in peats developed by Noto (1991)[1] which is based on strain obtained from the 1D consolidation test undertaken in the laboratory and water content of the material.

  For analysis purposes, we have combined the fibrous peat and soft to firm clayey silt materials encountered within Zones 1 and 2, which are likely to perform in a relatively similar manner.

- **Non-linear assessment using parameters obtained from 1D consolidation tests** - Software package Settle 3 has been used to assess the primary and secondary settlement using non-linear C_c input parameters for the compressible materials (peat and clayey silt) in combination with the law of compressibility (C_a/C_c) developed by Mesri et al. (1994). The C_a/C_c parameter has been selected based on recommendations proposed by Mesri and has not been derived from laboratory testing.

  Non linear parameters for adopted for primary consolidation were selected based on a typical range from the laboratory testing completed on the peat and clayey silt materials. Elastic parameters for the fill material were derived from published correlations with CPTs and our experience with similar materials. The underlying basalt material is considered incompressible and forms the base of the model. We have modelled double drainage paths.

  Loading cycles during the one dimensional consolidation testing were accelerated (approximately 3 hours each stage) to expedite test results, which affects the coefficient of volume compressibility (Cv) calculated in the laboratory test result. Additionally, research indicates that C_v values derived from thin samples (20mm) within peat materials and high water content soft clayey silts are generally not representative of actual values. Accordingly, C_v values measured in the laboratory testing are not considered representative of the in situ conditions. As such, time-based analysis, including secondary settlement has been assessed in accordance with the method developed by Noto (1991) and other case histories. Double drainage was assumed for this assessment.

A summary of the geotechnical parameters adopted for the Noto and C_c methods are presented in Table 5 and Table 6 respectively, based on the results of the laboratory testing and correlations with in situ testing.

Table 5: Summary of geotechnical design parameters adopted for Noto Method

Material	Water Content (%)	ε_f	C_α	Zone 1 (H = 2 m) Coefficient of Primary Consolidation, C_p	Zone 2 (H = 8 m) Coefficient of Primary Consolidation, C_p	Zone 3 (H = 6 m) Coefficient of Primary Consolidation, C_p
Fibrous peat and soft to firm clayey silt	230 - 370	0.14 - 0.4	0.04 – 0.05	3.3	18.7	13

Note:

1. Parameters for Noto method calculated as follows.

[1] S. Noto (1991). *Simplification of Modified Prediction method of Settlement for Peaty Soft Ground, pp. 37-41.* Monthly Report of Civil Engineering Research Institute, No. 460, (in Japanese)

Settlement in the primary consolidation region, S_p (cm):

$$S_p = \left(\varepsilon_f / \left(1 + C_p \times t^{-0.62}\right)\right) \times H \quad (1)$$

where ε_f is the final strain in primary consolidation, C_p is the coefficient of the primary consolidation rate, t is the given time (days) and H is the initial thickness of the peat layer (cm).

Time when primary consolidation ceases, t_s:

$$t_s = 0.0055\ H^2 \quad (2)$$

where the dimension of the constant (0.0055) is day/cm^2.

Settlement in the secondary consolidation region, S_s (cm):

$$S_s = S_{pf} + C_\alpha \times H \times \log\ (t/t_s) \quad (3)$$

where S_{pf} is the settlement at the time when t=t_s in Eq. (1) (i.e., the total settlement due to primary consolidation) and C_α is the coefficient of secondary consolidation (%).

The coefficients used in Eqs. (1), (3) are calculated by the following equations, for which P is the incremental load due to the embankment (kN/m^2) and W is the water content of the peat (%).

$$\varepsilon_f = 1/(1 + (2.74 \times 10^4/(W \times P^{0.8}))) \quad (4)$$

$$C_p = 0.0044\ H^{1.25} \quad (5)$$

$$C_\alpha = 3.3 + 0.0043\ W \quad (6)$$

Table 6: Summary of geotechnical design parameters adopted for C_c Method

Material	Unit weight, kPa	Cc [C'c]	e0	Cα/Cc(1)	Cv (2) (m²/year)	Es (MPa)
Fill	18	N/A	N/A	N/A	N/A	40
Fibrous Peat	14	6 – 10 [0.25 – 0.4]	23	0.03 - 0.06	4 - 6	-
Soft to firm clayey silt	12	3 - 3.5 [0.33 – 0.38]	8 - 12	0.03 – 0.06	4 - 6	-
Basalt	23	Incompressible				

Note:

1. Based on research completed by Mesri (1994)
2. Derived in accordance with the Noto Method assuming two way drainage.

4.1.2 Zone 4

The very stiff silt encountered in Zone 4 is generally considered moderately compressible and risk of secondary settlement within this material is considered negligible.

Mv method

Consolidation parameters have been assessed based on published correlations with CPTs and our experience with similar materials. Medium dense to very dense sands were encountered below the very stiff silt within Zone 4.

The consolidation parameters presented in Table 7 were adopted for the settlement analyses in Zone 4.

Table 7: Summary of geotechnical design parameters adopted for m_v Method (Zone 4 only)

Material	Unit weight, kPa	m_v (m^2/MN)	Cv [2] (m^2/year)	Es (MPa)
AVF Ash and Tuff	18	-	-	50
Very stiff silt	18	0.1 – 0.25	10 - 15	-

4.2 Calculated Settlement

Calculated expected primary and secondary settlement has been estimated for a range of loads, over an assumed 50 year design life and are presented in Appendix A; however are summarised in Table 8 below.

As can be seen in Table 8 below, Zone 2 is the most compressible area of the site. Loading implications on the development are discussed below.

Table 8: Summary of estimated primary, secondary and total settlement for zones 1 - 3

Zone	Load, kPa	Primary Consolidation mm	Secondary Compression (over 50 year design life) mm	Total (over 50 year design life) mm
Zone 1	40	650 – 1100	200	850 – 1300
	60	750 – 1300	150 – 200	900 – 1500
	100	850 – 1500	200 – 300	1050 – 1800
	120	900 – 1600	150 – 300	1050 – 1900
Zone 2	40	1000 - 2400	250 – 300	1250 – 2700
	60	1300 – 3000	250 – 200	1550 – 3200
	100	1800 – 3700	250 – 300	2050 – 4000
	120	2000 – 4000	250 – 300	2250 – 4300
Zone 3	40	750 – 1100	200 – 300	950 – 1400
	60	1000 – 1450	150 – 250	1150 – 1700
	100	1350 – 1900	150 – 300	1500 – 2200
	120	1450 – 2100	150 – 300	1600 – 2400
Zone 4	40	30 – 70	-	30 – 70
	60	40 – 100	-	40 – 100
	100	70 – 160	-	70 – 160
	120	80 - 190	-	80 - 190

Note:

1. 1 m of soil is approximately 20 kPa

Estimated timeframes to achieve 80% and 90% consolidation are presented in Table 9. Note that these timeframes below are from when the maximum surcharge height is achieved. Allowance will need to be made for staged filling of the ground to ensure stability is maintained. Pore pressures and

lateral deformations near the toe of the fill embankments will need to be monitored. We recommend allowing for filling to be undertaken over a 4 to 6 month period.

Table 9: Estimated timeframes to achieve 80% and 90% consolidation for each zone

Zone	Time to achieve 80% consolidation	Time to achieve 90% consolidation
Zone 1	1 – 2 months	2 – 3 months
Zone 2	12 – 18 months	18 months - 3 years
Zone 3	9 – 12 months	18 - 24 months
Zone 4	4 – 6 months	6 – 9 months

Note: The time above is from when the final surcharge height is reached.

Trial preloads are recommended to calibrate the analyses above. Further details on the trial preloads are provided in Section 6.

5. Discussion and Implications on the Development

For the purposes of discussion, we have assumed likely ground levels as developed by Harrison Grierson during the Due Diligence stage. These indicative cut fill levels are shown of Figure 2 below. In addition, we have assumed future structures are to have floor loads in the order of 40 kPa. This is equivalent to about 2 m of engineered fill.

Figure 2 - Indicative fill from ground raising for discussion purposes

To mitigate the risk of the large calculated primary consolidation settlement, consideration can be given to preloading the ground (i.e. simulating future building loads). However, as indicated in Section 4, the material encountered in the investigations is susceptible to secondary compression under constant stress. Calculated secondary compression could be in the order of about 150 mm to 300 mm over an assumed 50 year period. While the effects on structures from secondary compression are likely to be minor, serviceability could be affected. Typically, to mitigate the risk of secondary compression, surcharges can be used, which have the effect of artificially "aging the soil". This is achieved through increasing the "preload" by about 1.5 – 2 times the future working load and holding this load for a sufficient period to ensure 'aging' of the ground ahead of the future building loads. Material will need to be placed gradually and observations undertaken on pore pressures to ensure stability is maintained.

We recommend allowing for 1.5 times the working load and targeting at least 80% consolidation. We expect this to between 1 to 2 months (Zone 1), 12 months to 18 months (Zone 2) and 9 months to 12 months (Zone 3) to limit secondary compression to about 50 mm over a 50 year period.

Based on the above, and allowing for the calculated settlements, Table 10 presents the initial fill and residual fill following surcharging. Note - the fill thicknesses assumed are "solid" values. A compaction factor for 1.3 should be applied to determine loose quantities.

The residual fill is the initial fill less the estimated settlement at 80% consolidation in Section 4.2 above.

Table 10: Estimated initial and residual fill

Zone	Initial Fill	Approximate Residual Fill (Initial fill less settlement during preload period (primary consolidation))
1	7.5 m [60 kPa fill (3 m), 40 kPa future building load (2 m), 50 kPa surcharge (2.5 m)]	6 - 7 m
2	6 m [(40 kPa fill (2m), 40 kPa future building load (2 m), 40 kPa surcharge (2 m)]	2 – 4 m
3	6 m [(40 kPa fill (2m), 40 kPa future building load (2 m), 40 kPa surcharge (2 m)]	4 – 4.5 m
4	5 m [(60 kPa fill (3m), 40 kPa future building load (2 m)]	Minimal material loss due to consolidation settlement expected in this zone

The values above should be reviewed following revision of the cut/fill plans. The thicknesses of surcharge can be varied to match the undulating thickness of compressible material and proposed fill to raise the ground above existing levels. Allowance should also be made for a 500 mm thick drainage blanket.

It is recommended that trial preloads be constructed to validate and calibrate the analyses undertaken. Preliminary details for the trial preloads are presented in Section 6.

Contingent on the results of the trials it is expected that the bulk filling will commence in Zone 1 & 4 with the residual fill rolled over to Zones 2 & 3 with a reduced requirement for further imported material.

6. Trial Preload

To allow validation and calibration of the analyses undertaken, we recommend that 3 no. trial preload embankments (one in each zone) be constructed. Recommended locations for the proposed trial embankments and monitoring are shown in Appendix C.

The following outlines the general methodology for the proposed trial preloads. In each location:

- Preparation of access roads to the preload site for delivery of preload materials;
- Installation of any sediment and erosion control measures that may be required by Council (e.g. silt fence/bunding around the perimeter);
- Drilling of 2 No. wash drilled machine boreholes **per trial preload location** for installation of instrumentation. Borehole should extent to top of basalt (expected to be between 3 m and 8 m depth below ground level);
- Installation of 2 No. vibrating wire piezometers **per trial preload location** within the cored machine borehole for monitoring of excess porewater pressure.
- Installation of 1 No. magnetic extensometers **per trial preload location** (with 2 No. anchor points per extensometer);
- Installation of a geotextile filter cloth over the preload platform and 2m beyond the extent of the trial preload area – 52 m x 52 m area – using Bidim A19 or similar;
- Installation of 6 No. settlement plates **per trial preload location**;
- Supply and placement of 500 mm thick drainage layer over 52 m x 52 m area (2 m beyond the extent of the trial preload area); and
- Supply and placement (by track rolling) of preload materials, estimated at 30 m x 30 m x 2.5 m high **per trial preload location**.

Monitoring frequency of all the instrumentation points will be provided prior to construction.

7. Further Work

Following construction of trial embankments and prior to bulk earthworks the following further work is recommended:

- Back analyse the results of monitoring of the trial preloads to confirm surcharge heights for the bulk earthworks;
- Finalise geotechnical reporting suitable for resource consenting and bulk earthworks, including analyses on Zones not discussed within this report;
- Preparation of a specification and monitoring plan for the trial embankments and bulk filling; and
- Localised investigations during detailed design of structures to further delineate transitions in ground conditions.

8. Applicability

This letter has been prepared for Goodman Nominee (NZ) Ltd, with respect to the brief provided to us. The advice and recommendations presented in this report should not be applied to any other project or used in any other context without prior written approval from Initia Limited.

This memo was prepared to allow preliminary programme and cut/fill plans to be developed. Further work is required prior to consenting and construction.

Yours sincerely,

Andy Pomfret
Senior Geotechnical Engineer, Director

Memo prepared by Abby Wake-Mayo and Nathan Hickman – Geotechnical Engineers

Attached:

- Appendix A: Figures – Site Investigation Plan and Geotechnical Zoning Plan
- Appendix B: Factual Report
- Appendix C: Trial Preload Recommendations

Appendix A: Figures

LEGEND

INITIA INVESTIGATIONS (MAR 2022)

- BH101 — MACHINE BOREHOLE

INITIA INVESTIGATIONS (OCT 2021)

- CPT101 — CONE PENETRATION TEST

INITIA INVESTIGATIONS (DEC 2020 & FEB 2021)

- CPT01 — CONE PENETRATION TEST
- BH01 — MACHINE BOREHOLE

HISTORICAL INVESTIGATIONS

- HA01-19 — HAND AUGER (CMW - JULY 2019)
- HA01-20 — HAND AUGER (CMW - JUNE 2020)
- MB1 — MACHINE BOREHOLE (HG - JULY 2000)

- SITE BOUNDARY
- 0.5 EXISTING GROUND CONTOUR (0.5m INTEVAL)
- EXTENSION OF BASALT
- EXTENSION OF THE PEAT

NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: MOUNT EDEN 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE, PROPERTY BOUNDARY, LIDAR CONTOUR AND EXISTING SERVICES TAKEN FROM AUCKLAND COUNCIL DATE 2017.

SCALE A1 1:2000
SCALE A3 1:4000

0 20 40 60 80 100 120 140 160 180 200m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
B	ADDITIONAL INVESTIGATION (02/05/2022)		GG	
A	INVESTIGATION LOCATION (20/12/2021)	BS	GG	BS

NOT FOR CONSTRUCTION

THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS

Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052

Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

GEOTECHNICAL INVESTIGATION LOCATION PLAN

Initia Project ref: P000982

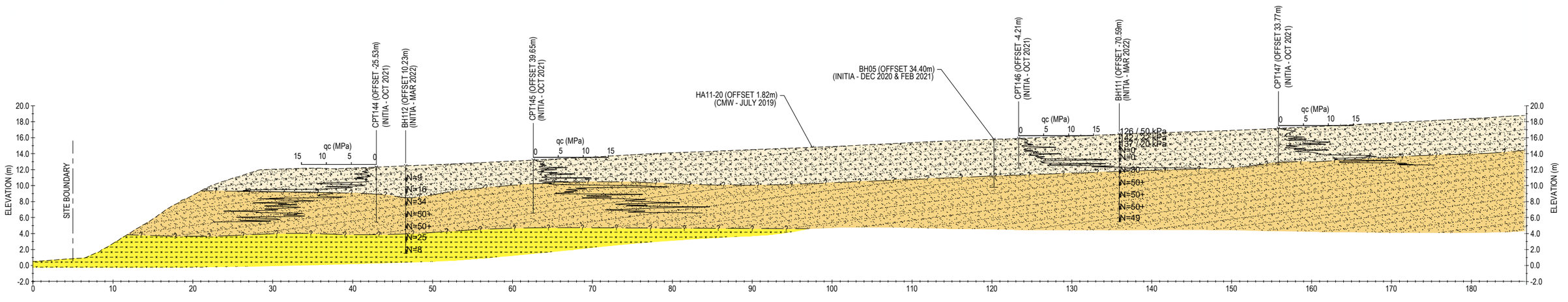
Figure Number 982-2-001

Revision B

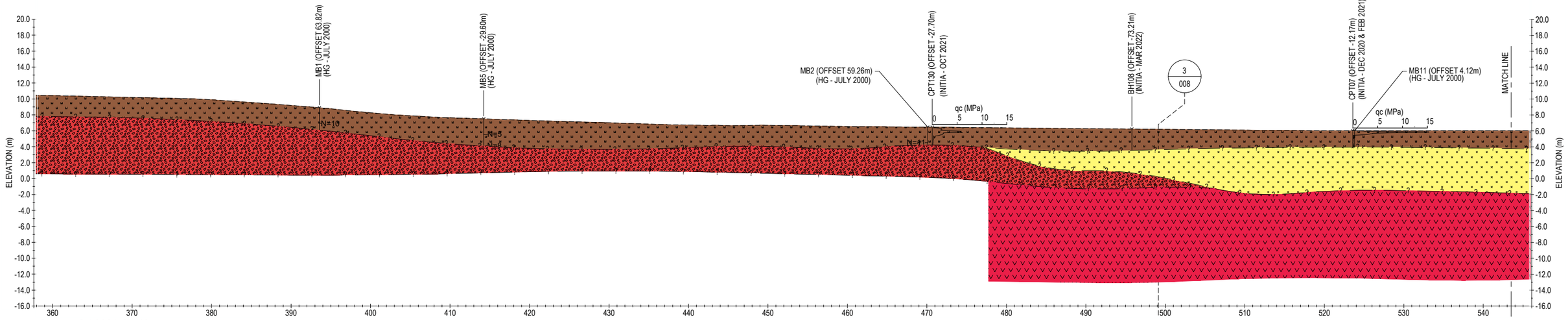
D:\INITIA LIMITED\INITIA LIMITED - TEAM SITE - PROJECTS\P-000982-2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-001.DWG, 4/5/2022 1:17 PM

LEGEND

- SILT WITH SANDY SILT AND GRAVEL LENSES (PUKETOKA FORMATION)
- SAND WITH GRAVELLY SAND LENSES (PUKETOKA FORMATION)
- CLAYEY SILT WITH MINOR ORGANICS (PUKETOKA FORMATION)
- PEAT (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- GRAVEL LENSES TO COURSE BASALT (AUCKLAND VOLCANIC FIELD)
- BASALT (AUCKLAND VOLCANIC FIELD)
- EXISTING GROUND
- INFERRED GEOLOGICAL BOUNDARY



CHAINAGE 0 TO 180



CHAINAGE 360 TO 540

1/003 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

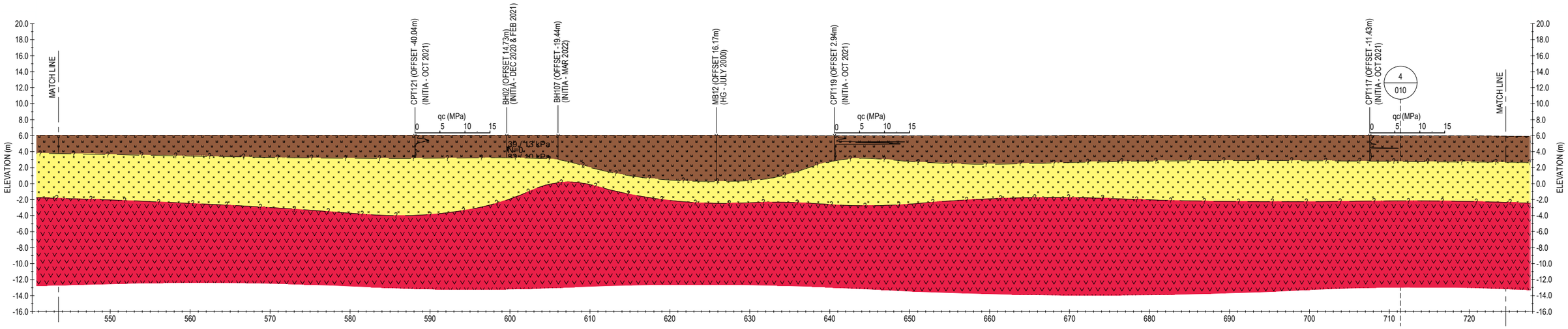
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 1
(SHEET 1 OF 3)

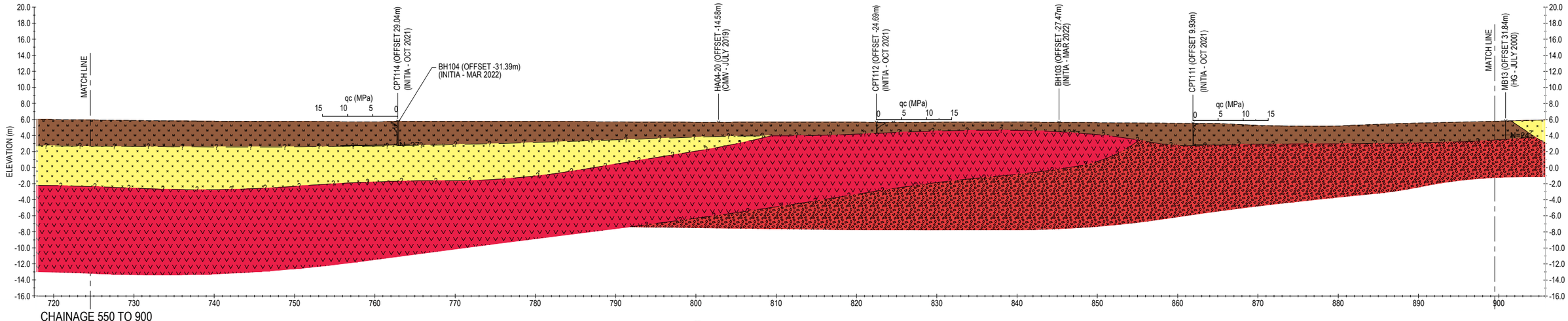
Initia Project ref: P000982
Figure Number 982-2-003
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982-2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 7:25 AM

LEGEND

- PEAT (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- GRAVEL LENSES TO COURSE BASALT (AUCKLAND VOLCANIC FIELD)
- BASALT (AUCKLAND VOLCANIC FIELD)
- EXISTING GROUND
- INFERRED GEOLOGICAL BOUNDARY





1/004 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

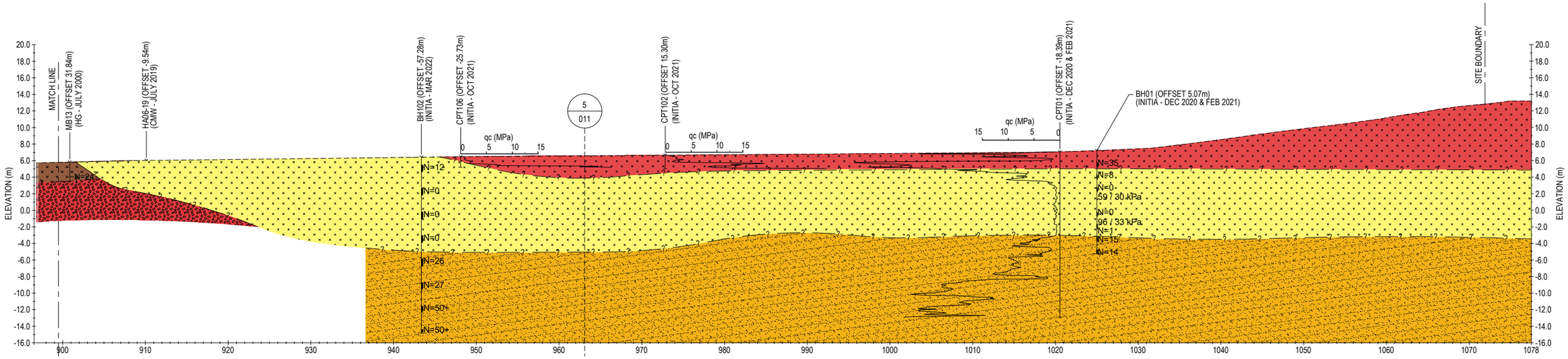
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 1
(SHEET 2 OF 3)

Initia Project ref: P000982
Figure Number 982-2-004
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982\2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 7:25 AM

LEGEND

- PEAT (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- SILT WITH SAND AND GRAVEL (AUCKLAND VOLCANIC FIELD)
- GRAVEL LENSES TO COURSE BASALT (AUCKLAND VOLCANIC FIELD)
- SAND MEDIUM DENSE TO VERY DENSE (PUKETOKA FORMATION)
- EXISTING GROUND
- ——?——?—— INFERRED GEOLOGICAL BOUNDARY



1/005 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN | Original Size A3

INITIA GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

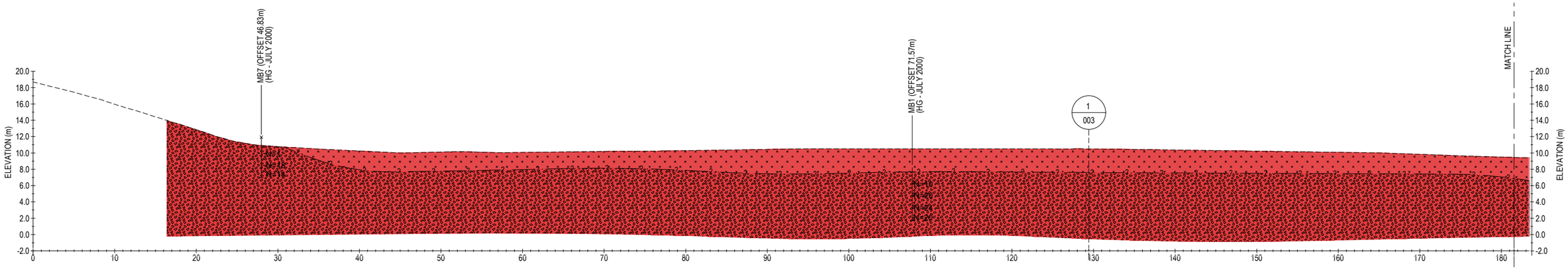
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 1
(SHEET 3 OF 3)

Initia Project ref: P000982
Figure Number 982-2-005
Revision A

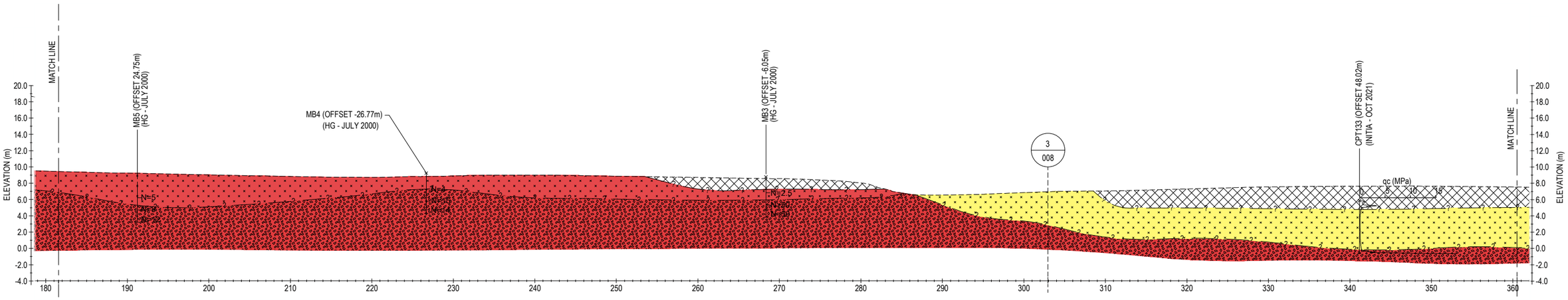
D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982\2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 7:25 AM

LEGEND

- FILL (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- SILT WITH SAND AND GRAVEL (AUCKLAND VOLCANIC FIELD)
- GRAVEL LENSES TO COURSE BASALT (AUCKLAND VOLCANIC FIELD)
- EXISTING GROUND
- ——?——?—— INFERRED GEOLOGICAL BOUNDARY



CHAINAGE 0 TO 180



CHAINAGE 180 TO 360

SCALE A3 1:500

0 5 10 15 20 25m

2/006 SECTION
SCALE 1:500 (A3)

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges
Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

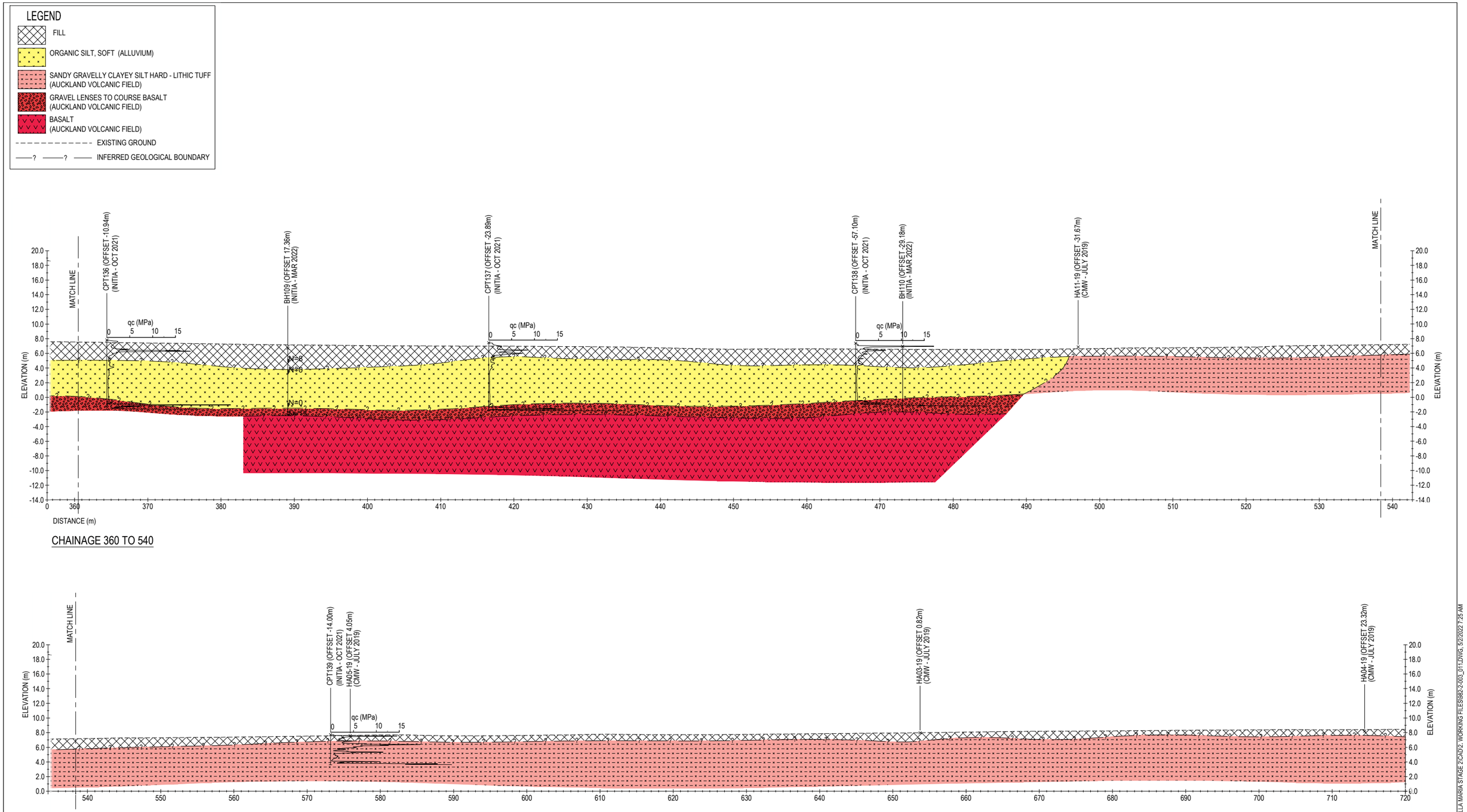
GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 2
(SHEET 1 OF 3)

Initia Project ref: P000982
Figure Number 982-2-006
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982\2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 8:26 AM



2/007 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN | Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

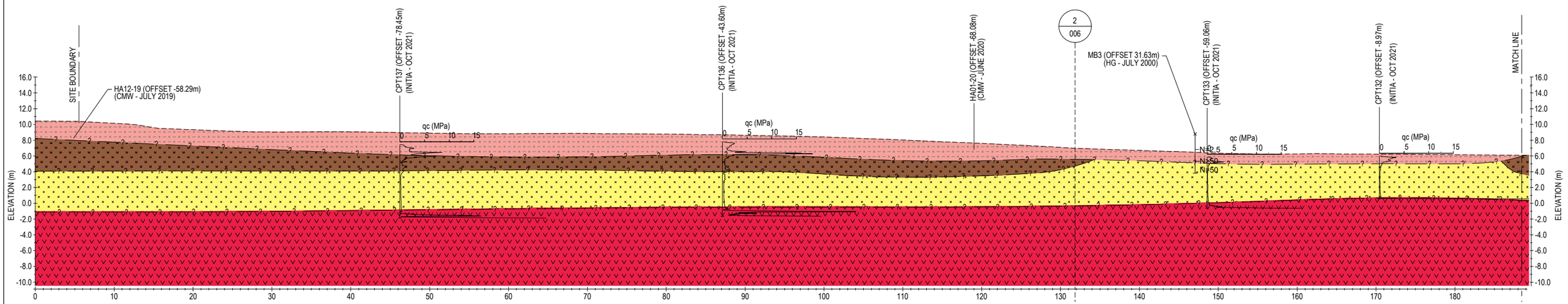
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 2
(SHEET 2 OF 3)

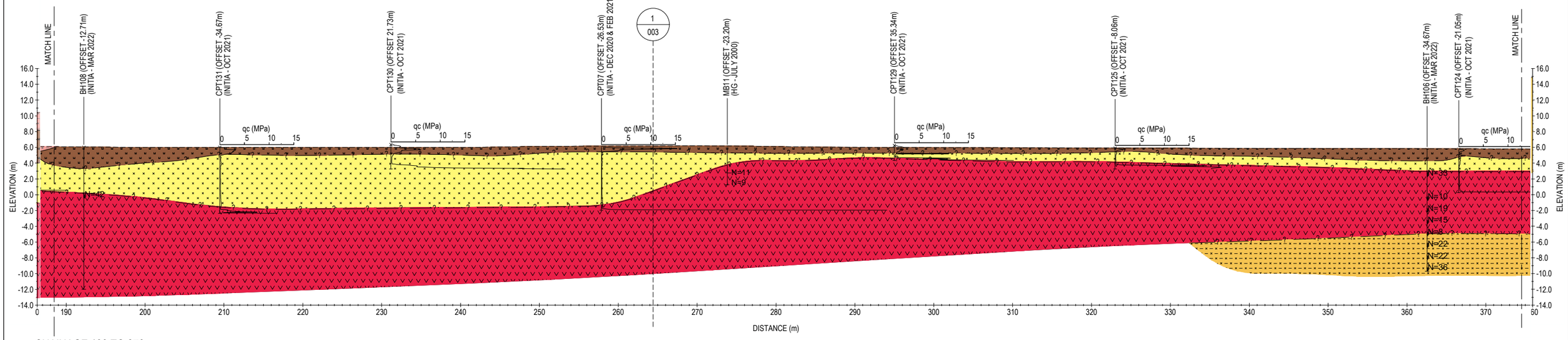
Initia Project ref: P000982
Figure Number 982-2-007
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982-2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_01.DWG, 5/2/2022 7:25 AM

LEGEND

- PEAT (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- CLAYEY SILT WITH SAND LENSES (TUFF - AUCKLAND VOLCANIC FIELD)
- BASALT (AUCKLAND VOLCANIC FIELD)
- CLAYEY SILT WITH ORGANIC SAND LENSES (PUKETOKA FORMATION)
- EXISTING GROUND
- INFERRED GEOLOGICAL BOUNDARY





SCALE A3 1:500
0 5 10 15 20 25m

3/008 SECTION
SCALE 1:500 (A3)

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

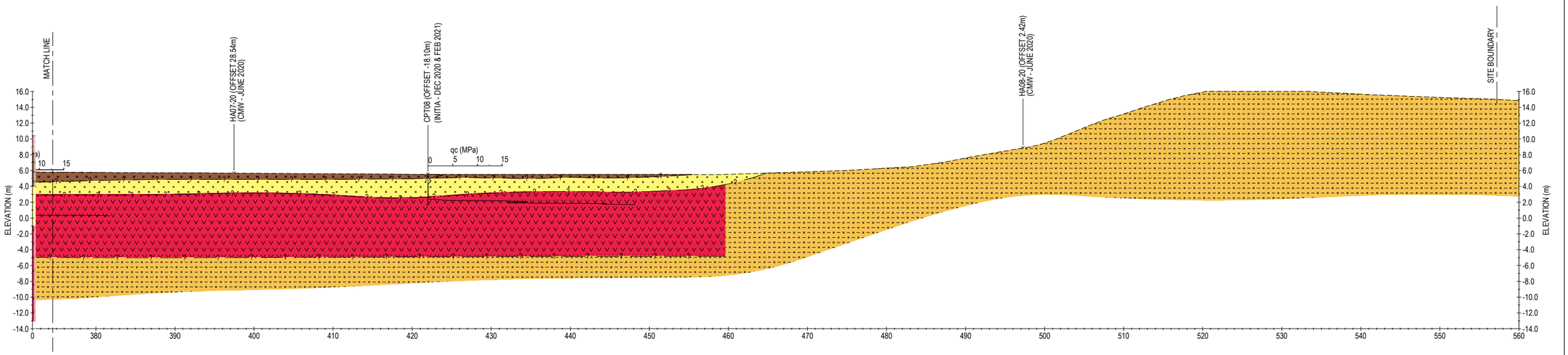
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 3
(SHEET 1 OF 2)

Initia Project ref: P000982
Figure Number 982-2-008
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982\2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 7:25 AM

LEGEND

- PEAT (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- BASALT (AUCKLAND VOLCANIC FIELD)
- CLAYEY SILT WITH ORGANIC SAND LENSES (PUKETOKA FORMATION)
- EXISTING GROUND
- INFERRED GEOLOGICAL BOUNDARY



CHAINAGE 380 TO 560

3/009 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

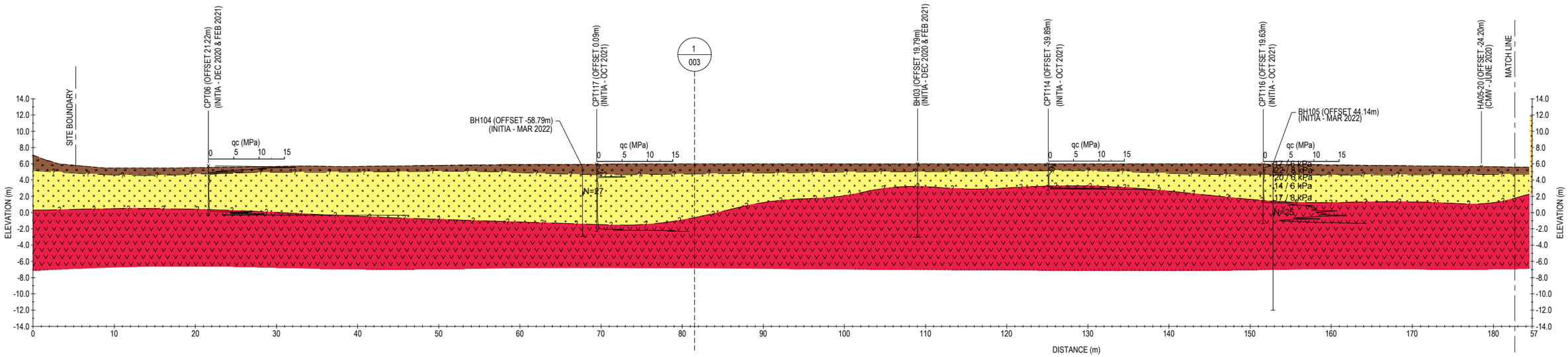
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 3
(SHEET 2 OF 2)

Initia Project ref: P000982
Figure Number 982-2-009
Revision A

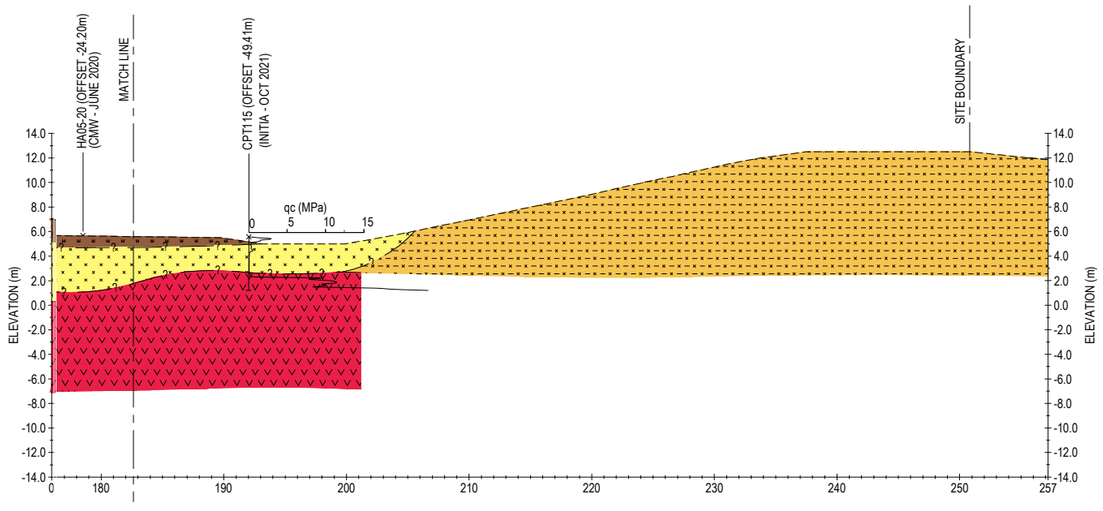
D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982-2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-009_011.DWG, 5/2/2022 7:25 AM

LEGEND

- PEAT (ALLUVIUM)
- ORGANIC SILT, SOFT (ALLUVIUM)
- BASALT (AUCKLAND VOLCANIC FIELD)
- CLAYEY SILT WITH ORGANIC SAND LENSES (PUKETOKA FORMATION)
- EXISTING GROUND
- INFERRED GEOLOGICAL BOUNDARY



CHAINAGE 0 TO 180



CHAINAGE 180 TO 257

4 / 010 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS

Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

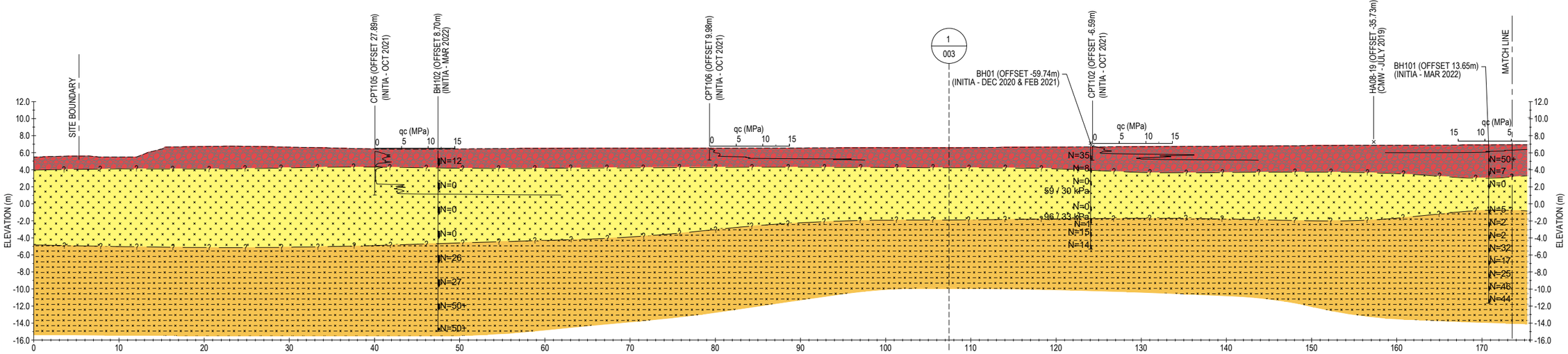
GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 4

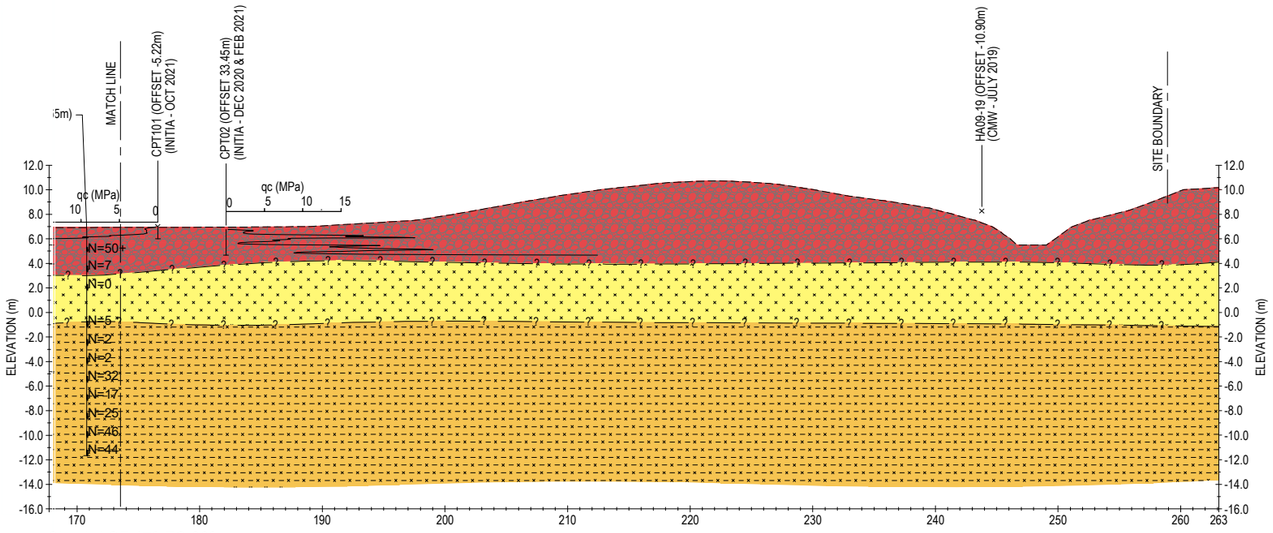
Initia Project ref: P000982
Figure Number 982-2-010
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982\2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 7:25 AM

LEGEND

- GRAVELLY SILT AND SAND (AUCKLAND VOLCANIC FIELD)
- ORGANIC SILT, SOFT (ALLUVIUM)
- CLAYEY SILT WITH ORGANIC SAND LENSES (PUKETOKA FORMATION)
- EXISTING GROUND
- INFERRED GEOLOGICAL BOUNDARY





5 / 011 SECTION
SCALE 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (02/05/2022)		GG	

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

GEOTECHNICAL INVESTIGATION
GEOLOGICAL SECTION 5

Initia Project ref: P000982
Figure Number 982-2-011
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982-2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-003_011.DWG, 5/2/2022 7:25 AM

LEGEND

INITIA INVESTIGATIONS (MAR 2022)

BH101 — MACHINE BOREHOLE

INITIA INVESTIGATIONS (OCT 2021)

CPT101 — CONE PENETRATION TEST

INITIA INVESTIGATIONS (DEC 2020 & FEB 2021)

CPT01 — CONE PENETRATION TEST

BH01 — MACHINE BOREHOLE

HISTORICAL INVESTIGATIONS

HA01-19 — HAND AUGER (CMW - JULY 2019)

HA01-20 — HAND AUGER (CMW - JUNE 2020)

MB1 — MACHINE BOREHOLE (HG - JULY 2000)

SITE BOUNDARY

0.5 EXISTING GROUND CONTOUR (0.5m INTEVAL)

EXTENT OF BASALT

EXTENT OF PEAT AND SOFT CLAYEY SILT

ZONE 1: UP TO 3m SHALLOW PEAT

ZONE 2: UP TO 3m FIBROUS PEAT OVERLYING ABOUT 5m SOFT CLAYEY SILT

ZONE 3: UP TO 3m FILL OVERLYING ABOUT 6m SOFT CLAYEY SILT

ZONE 4: AVF AND PUKETOKA FORMATION

ZONE 5: VERY STIFF TO HARD CLAYEY SILT OVERLYING VERY DENSE SAND

ZONE 6: FILL OVERLYING AVF TUFF

ORUARANGI ROAD

MONTGOMERIE ROAD

PAVILION DRIVE

ZONE 1A
AREA: 36,777m²
EARTHWORKS: 3m FILL
PRELOAD HEIGHT: 7.5m
BATTER AT 1V:3H

ZONE 1B
AREA: 19,730m²
EARTHWORKS: 3m FILL
PRELOAD HEIGHT: 7.5m
BATTER AT 1V:3H

ZONE 2
AREA: 53,255m²
EARTHWORKS: 2m FILL
PRELOAD HEIGHT: 6m
BATTER AT 1V:3H

ZONE 3
AREA: 39,675m²
EARTHWORKS: 2m FILL
PRELOAD HEIGHT: 6m
BATTER AT 1V:3H

ZONE 4A
AREA: 25,369m²
EARTHWORKS: 3m FILL
PRELOAD HEIGHT: 5m
BATTER AT 1V:3H

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: MOUNT EDEN 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE, PROPERTY BOUNDARY, LIDAR CONTOUR AND EXISTING SERVICES TAKEN FROM AUCKLAND COUNCIL DATE 2017.

SCALE A1 1:2000
SCALE A3 1:4000

0 20 40 60 80 100 120 140 160 180 200m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (26/05/2022)	AWM	JG	AWM

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Scale AS SHOWN | Original Size A3

INITIA GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

GEOTECHNICAL ZONES AND PRELIMINARY PRELOAD PLAN

Initia Project ref: P000982

Figure Number 982-2-300

Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982\2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-300.DWG, 5/26/2022 11:40 am

LEGEND

INITIA INVESTIGATIONS (MAR 2022)

BH101 — MACHINE BOREHOLE

INITIA INVESTIGATIONS (OCT 2021)

CPT101 — CONE PENETRATION TEST

INITIA INVESTIGATIONS (DEC 2020 & FEB 2021)

CPT01 — CONE PENETRATION TEST

BH01 — MACHINE BOREHOLE

HISTORICAL INVESTIGATIONS

HA01-19 — HAND AUGER (CMW - JULY 2019)

HA01-20 — HAND AUGER (CMW - JUNE 2020)

MB1 — MACHINE BOREHOLE (HG - JULY 2000)

SITE BOUNDARY

0.5 — EXISTING GROUND CONTOUR (0.5m INTEVAL)

EXTENT OF BASALT

EXTENT OF PEAT AND SOFT CLAYEY SILT

ZONE 1: UP TO 3m SHALLOW PEAT

ZONE 2: UP TO 3m FIBROUS PEAT OVERLYING ABOUT 5m SOFT CLAYEY SILT

ZONE 3: UP TO 3m FILL OVERLYING ABOUT 6m SOFT CLAYEY SILT

ZONE 4: AVF AND PUKETOKA FORMATION

ZONE 5: VERY STIFF TO HARD CLAYEY SILT OVERLYING VERY DENSE SAND

ZONE 6: FILL OVERLYING AVF TUFF

TRIAL PRELOAD 3
REFER TO FIGURE NO. 982-2-302
DETAIL A FOR TYPICAL DETAIL

TRIAL PRELOAD 2
REFER TO FIGURE NO. 982-2-302
DETAIL A FOR TYPICAL DETAIL

TRIAL PRELOAD 1
REFER TO FIGURE NO. 982-2-302
DETAIL B FOR TYPICAL DETAIL

ORUARANGI ROAD

MONTGOMERIE ROAD

PAVILION DRIVE

NOTES
1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE DATUM: MOUNT EDEN 2000
3. LEVEL DATUM: NEW ZEALAND VERTICAL DATUM 2016 (NZVD2016)
4. AERIAL IMAGE, PROPERTY BOUNDARY, LIDAR CONTOUR AND EXISTING SERVICES TAKEN FROM AUCKLAND COUNCIL DATE 2017.

SCALE A1 1:2000
SCALE A3 1:4000

0 20 40 60 80 100 120 140 160 180 200m

FOR INFORMATION

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (26/05/2022)	AWM	JG	AWM

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED

APPROVED:

DATE:

Scale AS SHOWN | Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS

Unit 6, Level 1, 114 St Georges
Bay Road Parnell, Auckland, 1052

Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

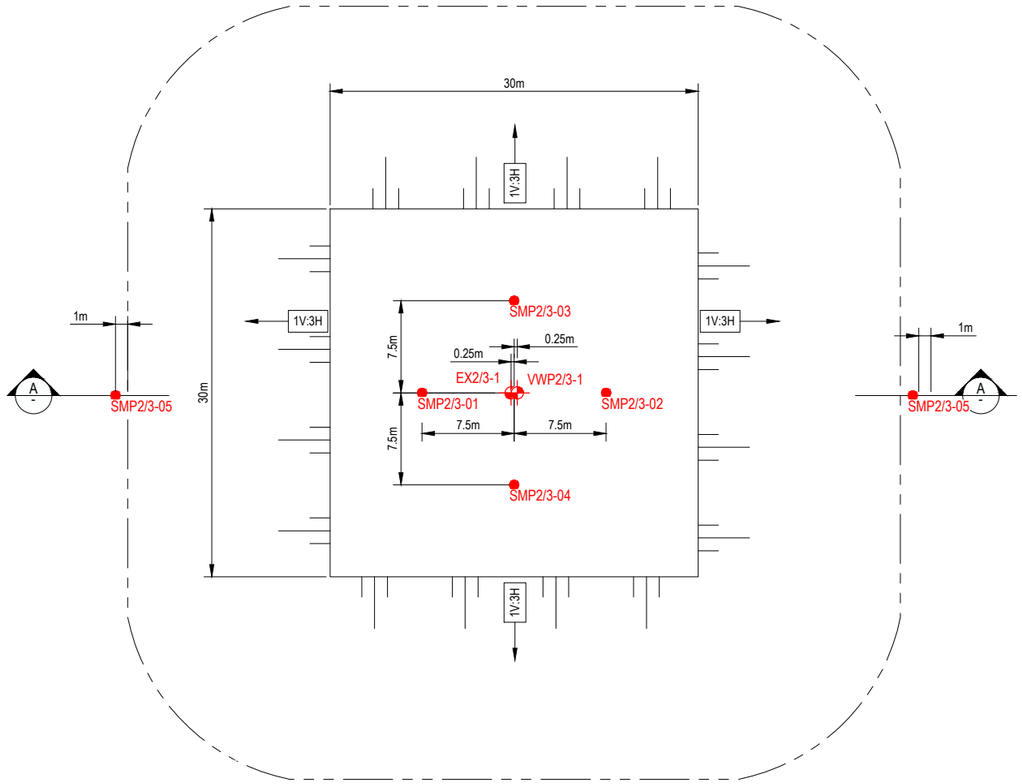
TRAIL PRELOAD LOCATION

Initia Project ref: P000982

Figure Number 982-2-301

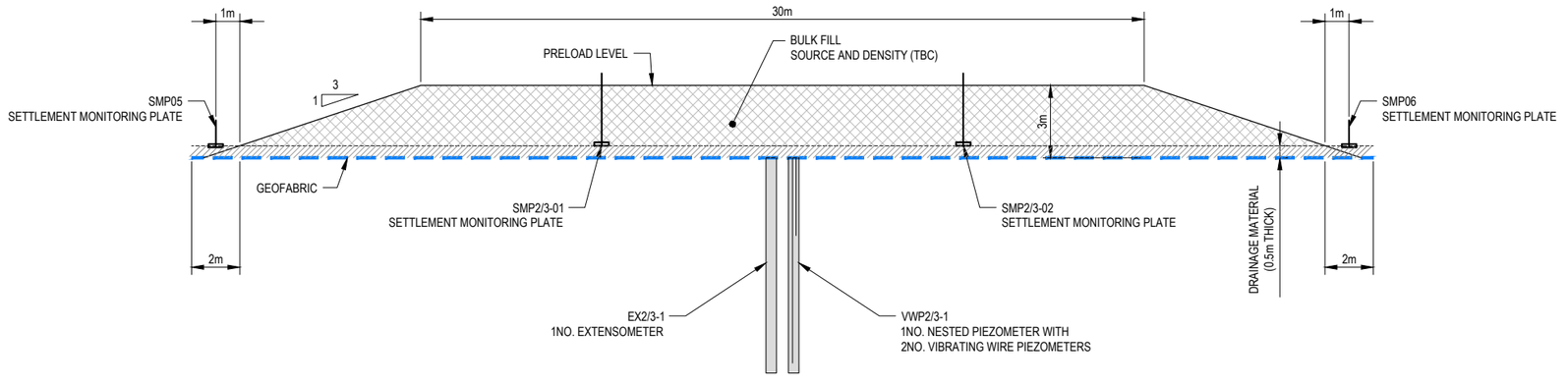
Revision A

D:\INITIA LIMITED\INITIA LIMITED TEAM SITE - PROJECTS\P-000982-2 - VILLA MARIA STAGE 2\CAD\2. WORKING FILES\982-2-301.DWG 5/26/2022 2:14 pm



PLAN : TRIAL PRELOAD
SCALE : 1:500 (A3)

SCALE A3 1:500
0 5 10 15 20 25m



A / - DETAIL
SCALE 1:250 (A3)

SCALE A3 1:250
0 2.5 5 7.5 10 12.5m

INFORMATION ONLY

Rev	Revision Description	Designed	Drawn	Checked
A	FIRST ISSUE (26/05/2022)	AWM	JG	AWM

NOT FOR CONSTRUCTION
THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SIGNED AS APPROVED
APPROVED:
DATE:
Scale AS SHOWN
Original Size A3

INITIA
GEOTECHNICAL SPECIALISTS
Unit 6, Level 1, 114 St Georges
Bay Road Parnell, Auckland, 1052
Phone: +64 09 977 0460
Email: enquiries@initia.co.nz

GOODMAN PROPERTY

VILLA MARIA PROJECT - 118 MONTGOMERIE ROAD, MANGERE - STAGE 2

TRAIL PRELOAD
TYPICAL DETAILS

Initia Project ref: P000982
Figure Number 982-2-302
Revision A

Appendix B: Factual Report