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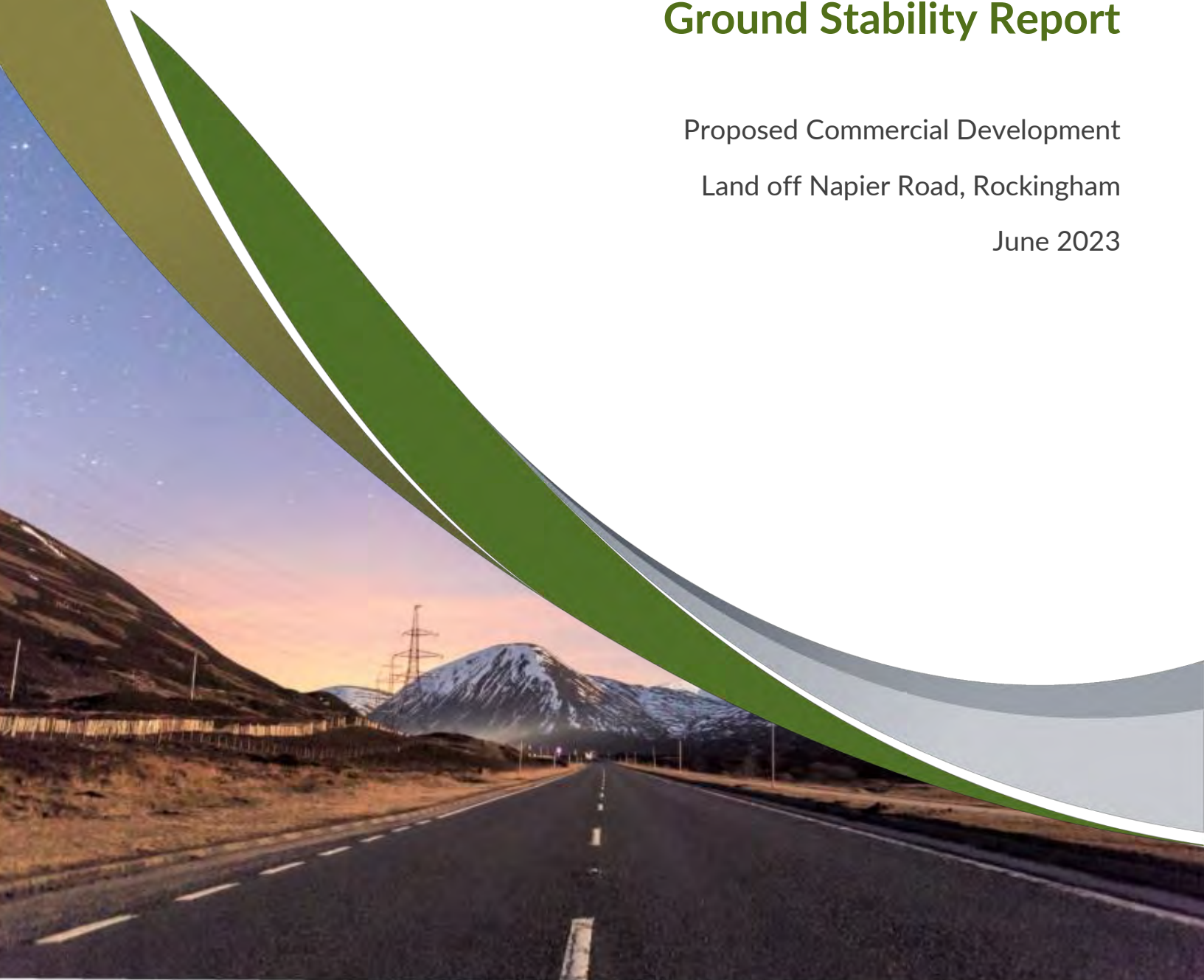
Ground Stability Report

Proposed Commercial Development

Land off Napier Road, Rockingham

June 2023



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Project Details

Site:	Land off Napier Road, Rockingham
Document Title:	Ground Stability Report
Document no.:	STT1234-R01 Rev A
Date:	June 2023
Client:	Storefield Group Limited
Issuing office:	Soiltechnics Ltd Cedar Barn, White Lodge, Walgrave, Northampton. NN6 9PY Tel: 01604 781 877 E-mail: mail@soiltechnics.net

Document history and status

Revision	Date	Description	Author	Reviewer
A	June 2023	First Issue	AW	SD

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Drawing Register

Title	Produced by	Date	Reference
Geotechnical monitoring installation location plan	Soiltechnics	June 2023	D-STP3966D-101

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1 Introduction

1.1 Background

1.1.1 The site is an extensive, former quarry and closed landfill site to the northeast of Corby. The site is currently an undeveloped parcel of land to the north of an existing industrial development, north of Steel Road in Corby. Much of the site is overgrown with rough vegetation. Willowbrook (or North Brook), which drains the northern part of Corby follows the southern boundary, flowing east.

1.1.2 Maps published by the British Geological Survey record the original geology of the site comprised the following sequence of soils:

Stratum	Typical soil type	Thickness (m)
Glacial Till (Boulder Clays)	Clays with stones (glacial deposits)	3.50
Lincolnshire Limestone	Limestone	1.20
Lower Estuarine Series	Interbedded silts, clays and fine sands	7.60
Northampton Sand Formation	Ironstone	2.00
	Grey green sandstone	1.00

Table 1-A: Summary geology

1.1.3 The area was subject to opencast extraction of the iron rich deposits of the Northampton Sands (as a source or iron ore) in the 1940s / 1950s forming part of Dene Quarry. Based on the above, the quarry was probably about 14m deep, and typically the 'overburden' soils (comprising Boulder Clays, Limestone and Estuarines) would have been used to backfill the excavation following removal of the iron ore. The grey green sandstone below the ironstone which typically had little iron content was generally left in place. The backfills would have not been compacted.

1.1.4 A ground investigation was undertaken by Soiltechnics at the site in 2020 which confirms the general sequence described above and thickness of backfilled material.

1.1.5 Subsequent to quarrying activities, the southern part of the site was occupied by Candy filter sludge ponds, with North brook lagoons to the east. These ponds / lagoons were licenced (by the British Steel Corporation) in the mid-1980s to receive industrial and special waste, and liquid sludge.

1.1.6 Records show the site was occupied by waste management facilities licenced to Corby Borough Council, Corus UK ltd, and Tata Steel, between the mid-1980s until around 2010. These facilities included management of industrial and household wastes.

1.1.7 It is understood that the lagoons were emptied by Tata Steel in recent years.

1.1.8 A topographical survey of the site shows site levels are low compared with perimeter site boundary levels to the north. Access to the site can be achieved from link roads to Steel Road to the south, Napier Road to the west, and a new link road (Mitchell Road) to the north.

1.2 Scheme Outline

1.2.1 The site is circa 8-10m lower than the link road to the north. The scheme comprises the development of an engineered platform at the site to facilitate future development as part of the Rockingham Enterprise Area.

1.2.2 Due to the previous site history and nature of soils already present on site, the proposed solution is to raise site levels with inert fill to a new finished ground level (FGL). The site will then be raised further to surcharge the newly placed fill and existing quarry backfill. The surcharge will then be removed and levels reduced to FGL.

1.2.3 This report is based on the project proposals and information outlined above; should the scheme change then it will be necessary to review the conclusions and recommendations presented in this report.

1.3 Brief

1.3.1 This report has been prepared following instructions received from our Client, Storefield Group Limited. The overall brief of works is to assess the geotechnical viability of developing an engineered platform. The environmental impacts are beyond the scope of this report.

1.3.2 The objectives of this report are outlined below:

i) Summarise the intrusive investigation works undertaken and post fieldwork monitoring.
ii) Provide a geotechnical appraisal of the monitoring and comment on the geotechnical viability of the scheme.

1.4 Limitations

1.4.1 Soiltechnics disclaims any responsibility to our Client and others in respect of any matters outside the scope of this report. This report has been prepared with reasonable skill, care and diligence in accordance with the terms of our contract, taking account of the manpower, resources, investigations and testing devoted to it by agreement with our Client. This report is confidential to our Client and Soiltechnics accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known. Any such party relies upon the report at their own risk.

2 Ground Investigation

2.1 Objectives

2.1.1 In order to assess the viability of a surcharging approach it was agreed that an instrument trial embankment would be constructed. The embankment would be monitored to establish the order of magnitude of settlement which could be anticipated for the project and the likely time it would take for substantial settlement to occur.

2.1.2 The ground investigation scope and location of exploratory holes was determined by Soiltechnics Ltd, based upon our overall brief.

2.1.3 The objectives of the fieldwork were to:

a) Install three vibrating wire piezometers and three extensometers at the location of the trial embankment.
b) Extend the monitoring installations as the trial embankment was constructed.
c) Undertake monitoring Install gas and groundwater monitoring wells and undertake a series of monitoring visits before, during and after embankment construction.

2.2 Fieldwork summary

2.2.1 Fieldwork was undertaken between 10th May and 18th May 2022 and is summarised below. Exploratory hole logs are presented as Appendix B. An exploratory hole location plan is presented in Appendix A.

Exploratory Hole	Method	Installation	Depth (m bgl)	Comments
BH101	Rotary	Extensometer	20.00	Open hole drilling – no recovery.
BH102	Rotary	Vibrating wire piezometer	15.00	Open hole drilling – no recovery.
BH103	Rotary	Extensometer	21.50	Open hole drilling – no recovery.
BH104	Cable percussion	Vibrating wire piezometer	15.38	Suspected natural ground encountered at 95.23m AOD
BH105	Cable percussion	Vibrating wire piezometer	13.21	Suspected natural ground encountered at 95.23m AOD
BH106	Rotary	Extensometer	20.00	Open hole drilling – no recovery.

Table 2-A: Summary of fieldwork undertaken

2.2.2 All soils encountered were described in accordance with BS EN ISO 14688 “Identification and Classification of soil”. Rock was described in accordance with BS EN ISO 14689 “Identification and classification of rock”.

2.2.3 The trial embankment was constructed by the Client and was approximately 20m x 40m in plan area and 4m high. It was constructed between 19 August and 02 September 2022. The soil was placed in layers and compacted prior to placing the next layer. During construction of the trial embankment the installations were extended commensurate with the rate of filling.

2.3 Sampling

2.3.1 During the fieldwork, sampling of soil, rock and groundwater for geotechnical purposes has been undertaken in accordance with BS EN ISO 22475-1 *"Geotechnical Investigation and testing – sampling by drilling and excavation and groundwater measurements".*

2.3.2 Samples collected for chemical analysis have been taken and handled in accordance with BS ISO 18400-105:2017 *"Soil quality — Sampling Part 105: Packaging, transport, storage and preservation of samples".*

2.3.3 Various sampling and sub-sampling methodologies have been adopted as appropriate, with the primary aim of obtaining the highest quality sample class practicable.

2.4 In-situ Testing

2.4.1 The following table summarises the field testing carried out. The results are summarised on individual exploratory hole logs where appropriate and detailed within the Appendices indicated.

Tests	Qty	Applicable standard / guidance	Location of Results
Standard penetration test (SPT)	18	BS EN ISO 22476-3	Included within logs Detailed in Appendix C

Table 2-B: Summary of field testing undertaken

2.5 Monitoring

2.5.1 A summary of the monitoring visits undertaken is outlined in the table below. Results of the vibrating wire piezometers and extensometers are presented in Appendix D and Appendix E respectively.

Date	Purpose
17/05/2022 – 11/07/2022 6 no. visits	Provide baseline monitoring data prior to construction of trial embankment
18/08/2022 – 02/09/2022 6 no. visits	Monitoring during construction of trial embankment
09/09/2022 – 20/06/2023 20 no. visits	Post construction monitoring

Table 2-C: Summary of monitoring

3 Geotechnical Discussion

3.1 Scheme Overview

3.1.1 The following assessments are made on the investigatory data presented in the preceding sections of this report and are made with reference to the specific nature of the development. Should scheme proposals change then it is recommended that the validity of the conclusions of this report in relation to the revised scheme are checked.

3.1.2 The project will comprise the raising of site levels to provide an engineered platform to facilitate future development. The site will be surcharged to induce settlement. The surcharge will then be removed and levels reduced to the design finished ground level.

3.1.3 In view of the ground conditions, the following list summarises the key geotechnical issues that may impact the scheme and will therefore need to be appropriately managed during the lifecycle of the project:

- Excessive total and differential settlement of the existing Made Ground
- Time for settlement to occur

3.2 Geotechnical Category

3.2.1 In accordance with BS EN1997-1:2004 + A1:2013 (Eurocode 7), the project is designated as Geotechnical Category 2. This category includes projects with *conventional types of structures and foundations with no exceptional risk, or difficult ground or loading conditions*. Furthermore, *routine design procedures* are appropriate.

3.2.2 It should be noted that this Report does not constitute a Geotechnical Design Report (GDR) as defined in Eurocode 7. Accordingly, a GDR should be prepared by the designer during the detailed design phase.

3.3 Magnetic Extensometers

3.3.1 The existing Made Ground at the site is conjectured to have been subject to minimal compaction when it was placed. Consequently, the soil will experience notable settlement as the levels are raised, and when the future development buildings are constructed.

3.3.2 A series of three extensometers were installed to monitor the settlement response of the soil to increased loading in the form of a trial embankment. The results are presented in Appendix E. An extract of the results from BH101 is presented as Figure 3-A. It should be noted that Day 0 refers to date of initial reading and therefore prior to construction of the trial embankment. Furthermore, each series label refers to the initial depth to the magnet prior to construction of the trial embankment.

3.3.3 The effect of construction of the trial embankment is clearly visible at circa Day 95. By Day 100 the settlement of the uppermost magnet (black) has already reached 40mm. It is estimated that immediate settlement is complete by circa Day 108 where approximately 55mm of settlement has occurred. Approximately 20mm of consolidation settlement is estimated to occur and be complete by circa Day 300. Creep settlement continues beyond this time but is <5mm and therefore considered negligible.

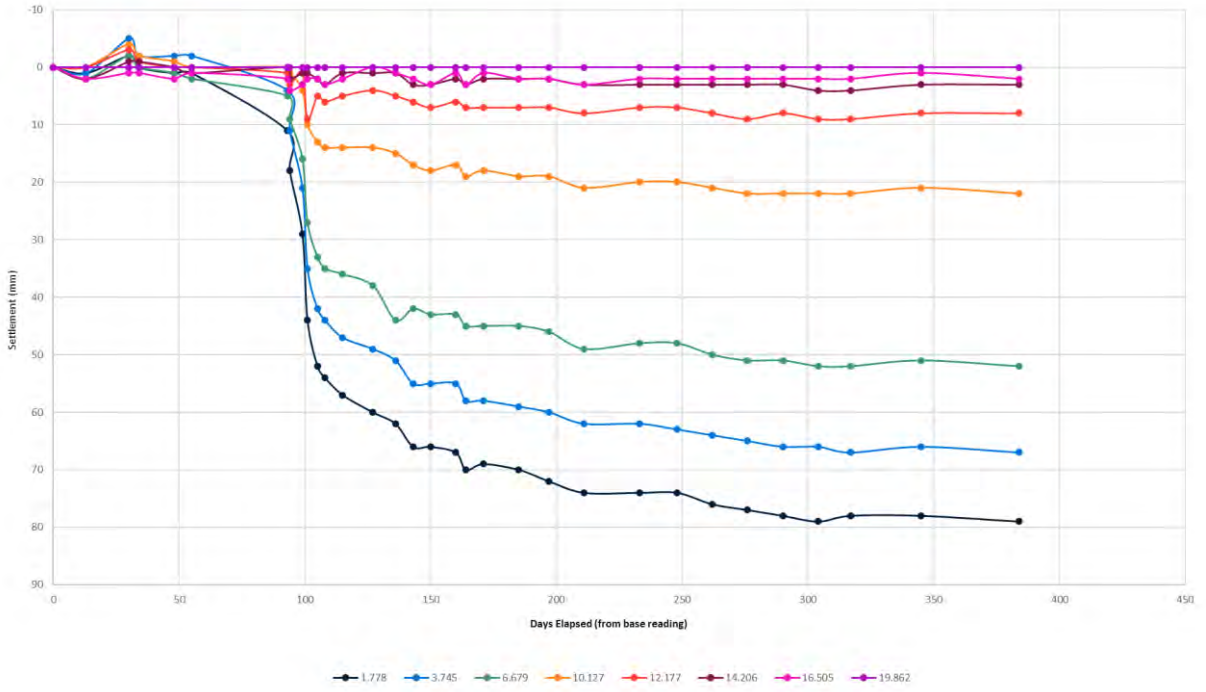

Figure 3-A: Extract of extensometer monitoring results (BH101)

3.3.4 The interpretation from the extensometers BH103 and BH106 is summarised below alongside BH101 for completeness. It should be noted that settlement values quoted are for the uppermost magnet which is considered to be representative of original ground level.

Extensometer	Immediate settlement	Consolidation settlement	Creep settlement
BH101	55mm over 10-15 days	20mm over 200 days	<5mm over 75 days to date
BH103	50mm over 10-15 days	25mm over 140 days	<5mm over 135 days to date
BH106	60mm over 10-15 days	See discussion below	

Table 3-A: Summary of extensometer interpretation

3.3.5 BH106 became unserviceable below 15.529m BGL after 21/09/2022. The cause is unknown. It was therefore not possible to monitor the datum magnet at the base of the borehole after this date. Normally this would render the installation redundant as movement is calculated by determining the difference between the datum magnet and magnet of interest. However, in order to provide indicative information on the movement of the upper magnets, and as settlement of the base magnet has been stable in the remaining boreholes, the last recorded value of the datum magnet has been used for comparison with higher magnet readings after 21/09/2022 in BH106. These results should be viewed with conservatism.

3.4 Vibrating Wire Piezometers

3.4.1 Vibrating wire piezometers were installed below the trial embankment to measure the pore water pressure response to upfilling.

3.4.2 In a clay soil the expected response would be a sudden rise in pore water pressure followed by a decay back to the original pressure level. The rate of decay is a function of the permeability of the soil. In a granular soil the drainage is instantaneous due to high permeability and consequently there is no rise in pore pressure nor subsequent decay.

3.4.3 The monitoring results of the vibrating wire piezometers are presented as Appendix D. An extract of the results from BH102 is presented as Figure 3-B.

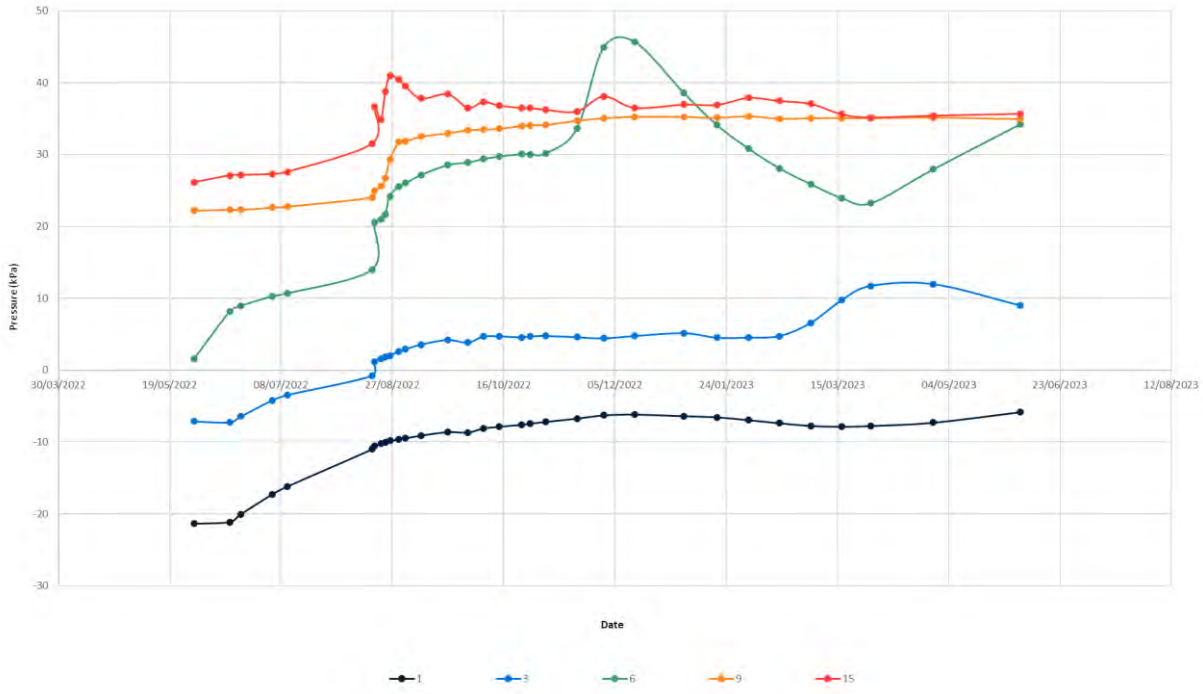

Figure 3-B: Extract of vibrating wire piezometer monitoring results (BH102)

3.4.4 In the above results the response to embankment construction can be seen by the rises in the individual piezometer lines just before 27th August 2023. This is most evident in the deeper piezometers represented by the green, orange, and red lines. It is noted that in this borehole there is no decay following construction.

3.4.5 The piezometer at 6m depth (green line) showed a second rise, peaking on 5th December 2022 and subsequently decaying over a period of 3 months. It is suspected that this is evidence of localised collapse settlement below this depth leading to a sudden rise in pressure. It is noted that such sudden movement has not been recorded in extensometer BH101 circa 2.3m away. The collapse has then migrated upward which possibly explains the corresponding rise seen in the light blue line (3m depth) towards the end of the monitoring period.

3.4.6 The other two vibrating wire piezometers showed limited response to the embankment construction indicating that drainage is relatively good.

4 Conclusions and Recommendations

4.1 Settlement

4.1.1 The monitoring demonstrates that notable surface settlement (80mm) occurs following application of load (circa 80kPa). A significant proportion of the settlement occurred within 2 weeks of construction of the embankment, with the remaining settlement substantially complete within six months. These findings should be used as a predictive tool to design the surcharge. It is recommended that the site is monitored during upfilling to validate the predictive model and provide quantitative evidence to inform removal of the surcharge.

4.2 Rate of filling

4.2.1 The monitoring results from the vibrating wire piezometers showed a limited response to application of load. On this basis no special measures are anticipated to be required to limit rate of filling. It is recommended that normal good practice be adopted when filling the site and that the site should be filled as uniformly as practicable.

4.3 Collapse settlement

4.3.1 The monitoring results recorded possible collapse settlement at a localised scale. Such settlement is common in uncompacted fills and should be accounted for in the next phase of the project.

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Appendix A Drawings

Rockingham Enterprise Area, Corby
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Indicative route of Corby North Orbital Road (CNOR)

Approximate location of trial embankment circa 40m x 20m x 4m

BH105
BH106
BH104
BH103
BH102
BH101

Inset view (scale 1:500)

Car park

Key

BH — Borehole with vibrating wire piezometer installation

BH — Borehole with Extensometer installation

Title	Scale	Drawing number
Geotechnical monitoring installation location plan	1:1250 at A1	101

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June 2023

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Appendix B Exploratory Hole Logs: Boreholes

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	OPEN HOLE. No recovery.																		

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 1 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.10	**Compiled by** SA	**Revision** 0
	Co-ordinates 490155mE, 290808mN	**Checked by** AW	**BH101**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 2 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.10	**Compiled by** SA	**Revision** 0
	Co-ordinates 490155mE, 290808mN	**Checked by** AW	**BH101**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	BOREHOLE TERMINATED AT 20.00m	20.00	87.10																

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 3 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.10	**Compiled by** SA	**Revision** 0
	Co-ordinates 490155mE, 290808mN	**Checked by** AW	**BH101**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	OPEN HOLE. No recovery.																		

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 1 of 2
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.15	**Compiled by** SA	**Revision** 0
	Co-ordinates 490155mE, 290810mN	**Checked by** AW	**BH102**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	BOREHOLE TERMINATED AT 15.00m	15.00	92.15																

Notes	Title		Date(s)
	Borehole record		11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 2 of 2
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.15	**Compiled by** SA	**Revision** 0
	Co-ordinates 490155mE, 290810mN	**Checked by** AW	**BH102**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	OPEN HOLE. No recovery.																		

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 1 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.52	**Compiled by** SA	**Revision** 0
	Co-ordinates 490159mE, 290815mN	**Checked by** AW	**BH103**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 2 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.52	**Compiled by** SA	**Revision** 0
	Co-ordinates 490159mE, 290815mN	**Checked by** AW	**BH103**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	BOREHOLE TERMINATED AT 21.50m	21.50	86.02																

Notes	**Title** Borehole record	**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI
		Sheet number Sheet 3 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.52	**Compiled by** SA
		Revision 0
	Co-ordinates 490159mE, 290815mN	**Checked by** AW
		BH103

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INSTALL	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	Grass onto soft to firm brownish grey sandy gravelly CLAY. Gravel is fine to coarse angular to subangular brick, concrete and slag. (MADE GROUND)											1.00	1.50	B
												1.70	1.80	D
												1.80	1.90	ES
												2.00	2.50	B
												2.70	2.80	D
												2.80	2.90	ES
											UT=20	3.00	3.45	UT
												3.45	3.50	D
												4.00	4.10	D
												4.20	4.30	ES
						S 4.50 - 4.95	(1) 1	1.60	DRY			4.50	4.95	D
												5.50	4.60	D
												5.60	5.70	ES

CONTINUED ON NEXT SHEET

Notes

Groundwater observations
No groundwater encountered.

Chiselling details		Drilling details	
Depth (m)	Duration (hh:mm)	Diameter	Base depth (m)
		200	9.00
		150	15.00

Water added details		Casing details	
Depth (m)	Water Added (l)	Diameter	Base depth (m)
		220	1.60
		170	10.00

Title
Borehole record

Date(s)
12/05/2022

Method
Cable tool percussion

Logged by
NI

Sheet number
Sheet 1 of 3

Level (m OD)
107.61

Compiled by
SA

Revision
0

Co-ordinates
490158mE, 290818mN

Checked by
AW

BH104

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INSTALL	STRATA				WATER STRIKES	SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
											UT=8	6.00	6.45	UT
												6.45	6.50	D
												7.00	7.10	D
												7.10	7.20	ES
						S 7.50 - 7.95	(1)	1.60	DRY			7.50	7.95	D
												8.50	8.60	D
												8.60	8.70	ES
											UT=12	9.00	9.45	UT
												9.45	9.50	D
												10.00	10.10	D
												10.10	10.20	ES
						S 10.50 - 10.95	(4) 9	10.50	DRY			10.50	10.95	D
												11.50	11.60	D

CONTINUED ON NEXT SHEET

Notes

Chiselling details

Depth (m)	Duration (hh:mm)

Drilling details

Diameter	Base depth (m)
200	9.00
150	15.00

Groundwater observations
No groundwater encountered.

Water added details

Depth (m)	Water Added (l)

Casing details

Diameter	Base depth (m)
220	1.60
170	10.00

Title
Borehole record

Date(s)
12/05/2022

Method
Cable tool percussion

Logged by
NI

Sheet number
Sheet 2 of 3

Level (m OD)
107.61

Compiled by
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Revision
0

Co-ordinates
490158mE, 290818mN

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INSTALL	STRATA: DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND	WATER STRIKES	SPT TESTING: TYPE / DEPTH (m)	SPT TESTING: RESULT	SPT TESTING: CASING DEPTH (m)	SPT TESTING: WATER LEVEL (m)	OTHER IN SITU TESTING: TYPE / DEPTH (m)	OTHER IN SITU TESTING: RESULT	SAMPLING: FROM (m)	SAMPLING: TO (m)	SAMPLING: TYPE
												11.60	11.70	ES
	Grey MUDSTONE with rare sand/sandstone bands.	12.00	95.61								UT=60	12.00	12.45	UT
												12.45	12.50	D
												13.00	13.10	D
												13.10	13.20	ES
						S 13.50 - 13.95	(4) 10	13.50	DRY			13.50	13.95	D
												14.10	15.20	D
												14.50	14.60	D
												14.60	14.70	ES
						S 15.00 - 15.38	(19) 50/225mm	15.00	DRY			15.00	15.30	B
												15.00	15.37	D
												15.20	15.30	ES
	BOREHOLE TERMINATED AT 15.38m	15.38	92.23											

Notes

Groundwater observations
No groundwater encountered.

Chiselling details		Drilling details	
Depth (m)	Duration (hh:mm)	Diameter	Base depth (m)
		200	9.00
		150	15.00

Water added details		Casing details	
Depth (m)	Water Added (l)	Diameter	Base depth (m)
		220	1.60
		170	10.00

Title
Borehole record

Date(s)
12/05/2022

Method
Cable tool percussion

Logged by
NI

Sheet number
Sheet 3 of 3

Level (m OD)
107.61

Compiled by
SA

Revision
0

Co-ordinates
490158mE, 290818mN

Checked by
AW

BH104

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INSTALL	STRATA: DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND	WATER STRIKES	SPT TESTING: TYPE / DEPTH (m)	SPT TESTING: RESULT	SPT TESTING: CASING DEPTH (m)	SPT TESTING: WATER LEVEL (m)	OTHER IN SITU TESTING: TYPE / DEPTH (m)	OTHER IN SITU TESTING: RESULT	SAMPLING: FROM (m)	SAMPLING: TO (m)	SAMPLING: TYPE
	Grass onto soft to firm brownish grey sandy gravelly CLAY. Gravel is fine to coarse angular to subangular brick, concrete and slag. (MADE GROUND)													
	...between 0m and 3m depth, frequent glass, metal, paper and tile.													
						S 1.00 - 1.30	(16) 50/145mm	1.00	DRY			1.00	1.30	B
												1.70	1.90	D
												1.80	1.90	ES
						S 2.00 - 2.28	(22) 50/130mm	2.00	DRY			2.00	2.50	B
												2.70	2.80	D
												2.80	2.90	ES
						S 3.00 - 3.32	(25) 50/165mm	3.00	DRY			3.00	3.50	B
												3.70	3.80	D
												3.80	3.90	ES
						S 4.00 - 4.24	(25) 50/90mm	4.00	DRY			4.00	4.50	B
												4.50	5.00	B
												4.70	4.80	D
												4.80	4.90	ES
						S 5.00 - 5.45	(1)	5.00	DRY			5.00	5.45	D
												5.50	6.00	B
												5.70	5.80	D

CONTINUED ON NEXT SHEET

Notes

Chiselling details

Depth (m)	Duration (hh:mm)
3.00 - 4.00	02:00

Drilling details

Diameter	Base depth (m)
200	11.45
150	13.00

Groundwater observations

Groundwater encountered at 9m depth. Groundwater at 9m at start of shift 12.05.2022.

Water added details

Depth (m)	Water Added (l)

Casing details

Diameter	Base depth (m)
220	4.00
170	9.00

Title
Borehole record

Date(s)
10/05/2022 - 12/05/2022

Method
Cable tool percussion

Logged by
NI

Sheet number
Sheet 1 of 3

Level (m OD)
107.23

Compiled by
SA

Revision
0

Co-ordinates
490163mE, 290827mN

Checked by
AW

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INSTALL	STRATA: DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND	WATER STRIKES	SPT TESTING: TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	OTHER IN SITU TESTING: TYPE / DEPTH (m)	RESULT	SAMPLING: FROM (m)	TO (m)	TYPE
						S 6.00 - 6.45	(2) 5	6.00	DRY			5.80	5.90	ES
												6.00	6.45	D
												6.50	7.00	B
												6.70	6.80	D
												6.80	6.90	ES
						S 7.00 - 7.45	(3) 10	7.00	DRY			7.00	7.45	D
												7.50	8.00	B
												7.70	7.80	D
												7.80	7.90	ES
						S 8.00 - 8.45	(1)	8.00	DRY			8.00	8.45	D
												8.50	9.00	B
												8.70	8.80	D
												8.80	8.90	ES
						S 9.00 - 9.45	(3) 11	9.00	DRY			9.00	9.45	D
	Firm to stiff slightly sandy gravelly CLAY. Gravel is fine to medium angular subangular brick and slag. (MADE GROUND)	9.50	97.73									9.50	10.00	B
												9.70	9.50	D
												9.80	9.90	ES
						S 10.00 - 10.45	(6) 21	9.00	DRY			10.00	10.45	D
												10.50	11.00	B
												10.70	10.80	D
												10.80	10.90	ES
						S 11.00 - 11.45	(7) 19	9.00	DRY			11.00	11.45	D
												11.50	12.00	B

CONTINUED ON NEXT SHEET

Notes

Groundwater observations
Groundwater encountered at 9m depth. Groundwater at 9m at start of shift 12.05.2022.

Chiselling details		Drilling details	
Depth (m)	Duration (hh:mm)	Diameter	Base depth (m)
		200	11.45
		150	13.00

Water added details		Casing details	
Depth (m)	Water Added (l)	Diameter	Base depth (m)
		220	4.00
		170	9.00

Title
Borehole record

Date(s)
10/05/2022 - 12/05/2022

Method
Cable tool percussion

Logged by
NI

Sheet number
Sheet 2 of 3

Level (m OD)
107.23

Compiled by
SA

Revision
0

Co-ordinates
490163mE, 290827mN

Checked by
AW

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INSTALL	STRATA: DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND	WATER STRIKES	SPT TESTING: TYPE / DEPTH (m)	SPT TESTING: RESULT	SPT TESTING: CASING DEPTH (m)	SPT TESTING: WATER LEVEL (m)	OTHER IN SITU TESTING: TYPE / DEPTH (m)	OTHER IN SITU TESTING: RESULT	SAMPLING: FROM (m)	SAMPLING: TO (m)	SAMPLING: TYPE
												11.70	11.80	D
												11.80	11.90	ES
	Grey MUDSTONE with rare sand/sandstone bands.	12.00	95.23			S 12.00 - 12.45	(12) 43	9.00	DRY			12.00	12.45	D
												12.50	13.00	B
												12.70	12.80	D
												12.80	12.90	ES
						S 13.00 - 13.26	(25) 50/105mm	9.00	DRY			13.00	13.21	D
	BOREHOLE TERMINATED AT 13.21m	13.21	94.02											

Notes

Chiselling details		Drilling details	
Depth (m)	Duration (hh:mm)	Diameter	Base depth (m)
		200	11.45
		150	13.00

Groundwater observations
Groundwater encountered at 9m depth. Groundwater at 9m at start of shift 12.05.2022.

Water added details		Casing details	
Depth (m)	Water Added (l)	Diameter	Base depth (m)
		220	4.00
		170	9.00

Title
Borehole record

Date(s)
10/05/2022 - 12/05/2022

Method
Cable tool percussion

Logged by
NI

Sheet number
Sheet 3 of 3

Level (m OD)
107.23

Compiled by
SA

Revision
0

Co-ordinates
490163mE, 290827mN

Checked by
AW

BH105

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	OPEN HOLE. No recovery.																		

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 1 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.44	**Compiled by** SA	**Revision** 0
	Co-ordinates 490164mE, 290823mN	**Checked by** AW	**BH106**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE

CONTINUED ON NEXT SHEET

Notes	**Title** Borehole record		**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI	**Sheet number** Sheet 2 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.44	**Compiled by** SA	**Revision** 0
	Co-ordinates 490164mE, 290823mN	**Checked by** AW	**BH106**

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INSTALL	STRATA				WATER STRIKES	CORING					SPT TESTING				OTHER IN SITU TESTING		SAMPLING		
	DESCRIPTION	DEPTH (m)	REDUCED LVL (m OD)	LEGEND		DEPTH (m)	TCR (%)	SCR (%)	RQD (%)	FI	TYPE / DEPTH (m)	RESULT	CASING DEPTH (m)	WATER LEVEL (m)	TYPE / DEPTH (m)	RESULT	FROM (m)	TO (m)	TYPE
	BOREHOLE TERMINATED AT 20.00m	20.00	87.44																

Notes	**Title** Borehole record	**Date(s)** 11/05/2022
	Method Rotary core	**Logged by** NI
		Sheet number Sheet 3 of 3
Groundwater observations No groundwater encountered.	**Level (m OD)** 107.44	**Compiled by** SA
		Revision 0
	Co-ordinates 490164mE, 290823mN	**Checked by** AW
		BH106

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Appendix C In Situ Test Results

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Table summarising Standard Penetration Test (SPT) results

Location	Start Depth (m)					Penetration (mm)	
		Seating 1-2	Main 1-4	Total Seating	Total Main	Total Seating	Total Main
BH104	4.50	1/0	1/0/0/0	1	1	150	300
BH104	7.50	1/0	0/0/0/0	1	0	150	300
BH104	10.50	2/2	2/2/2/3	4	9	150	300
BH104	13.50	2/2	2/2/3/3	4	10	150	300
BH104	15.00	9/10	12/16/22	19	50	150	225
BH105	1.00	7/9	22/28	16	50	150	145
BH105	2.00	8/14	26/24	22	50	150	130
BH105	3.00	12/13	20/22/8	25	50	150	165
BH105	4.00	18/7	24/26	25	50	150	90
BH105	5.00	1/0	0/0/0/0	1	0	150	300
BH105	6.00	1/1	1/1/2/1	2	5	150	300
BH105	7.00	1/2	2/2/3/3	3	10	150	300
BH105	8.00	1/0	0/0/0/0	1	0	150	300
BH105	9.00	1/2	2/3/3/3	3	11	150	300
BH105	10.00	3/3	3/5/6/7	6	21	150	300
BH105	11.00	3/4	4/5/5/5	7	19	150	300
BH105	12.00	5/7	9/10/12/12	12	43	150	300
BH105	13.00	15/10	32/18	25	50	150	105

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Appendix D Vibrating Wire Piezometer Monitoring

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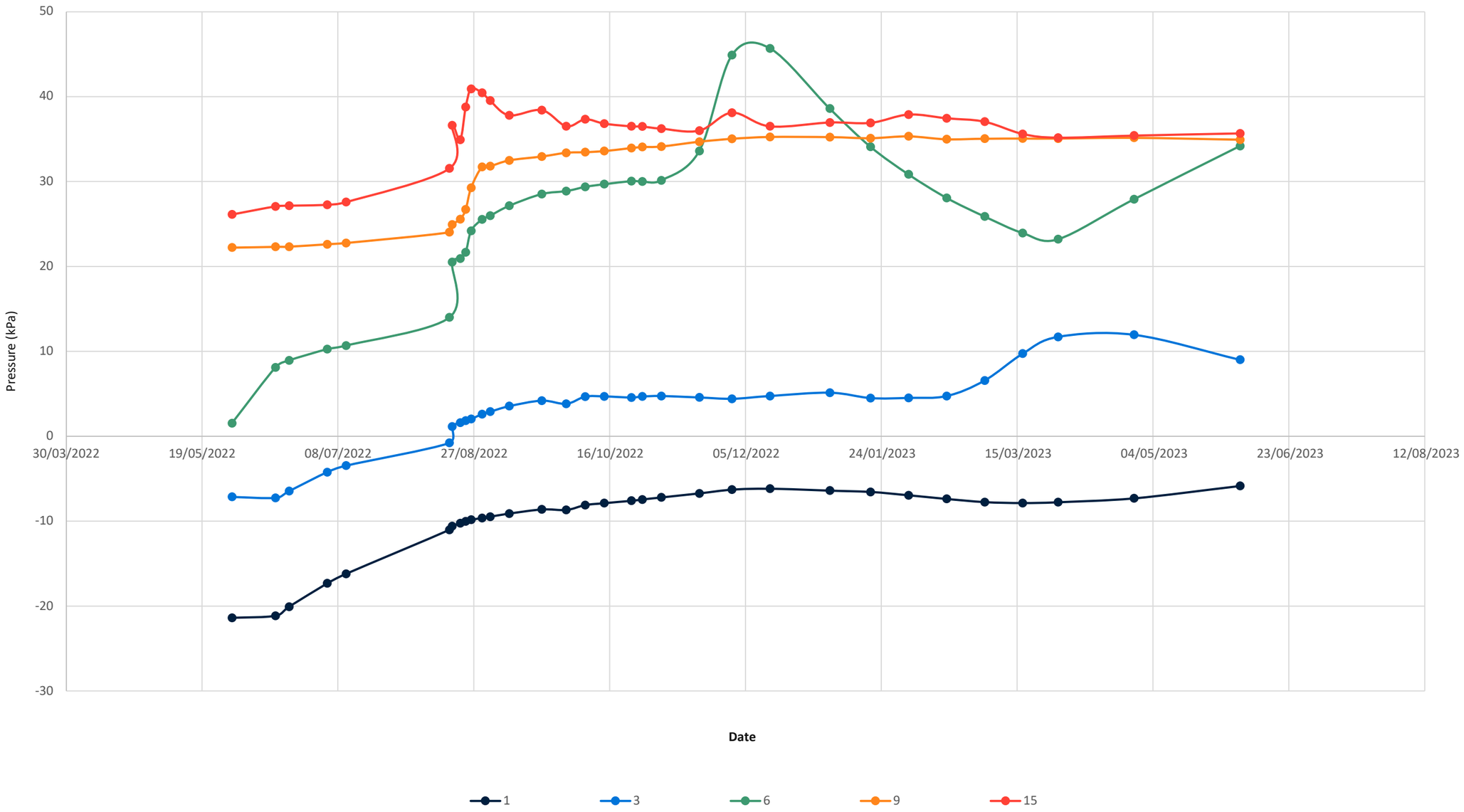
Piezometers (short term) - BH102



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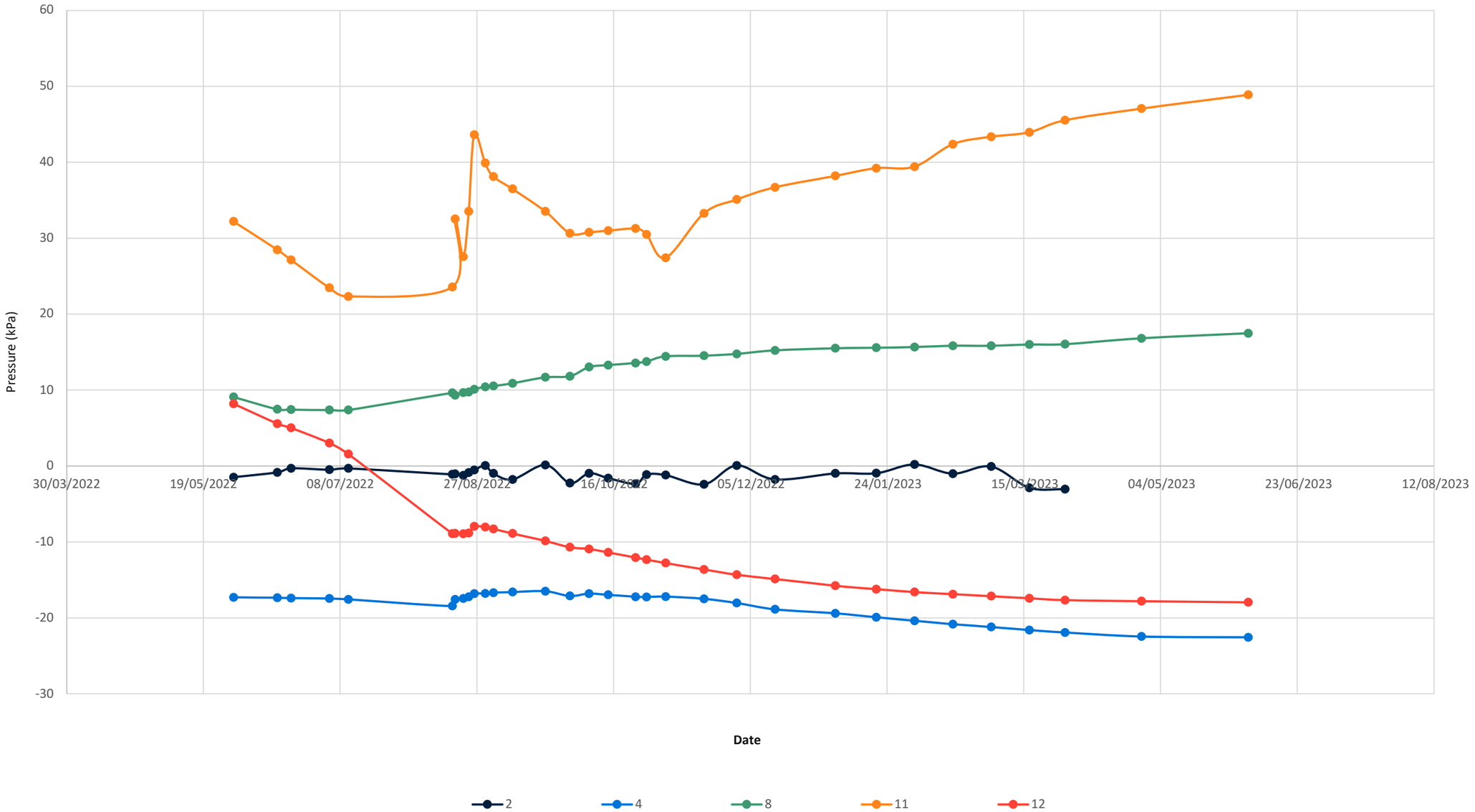
Piezometers (short term) - BH10



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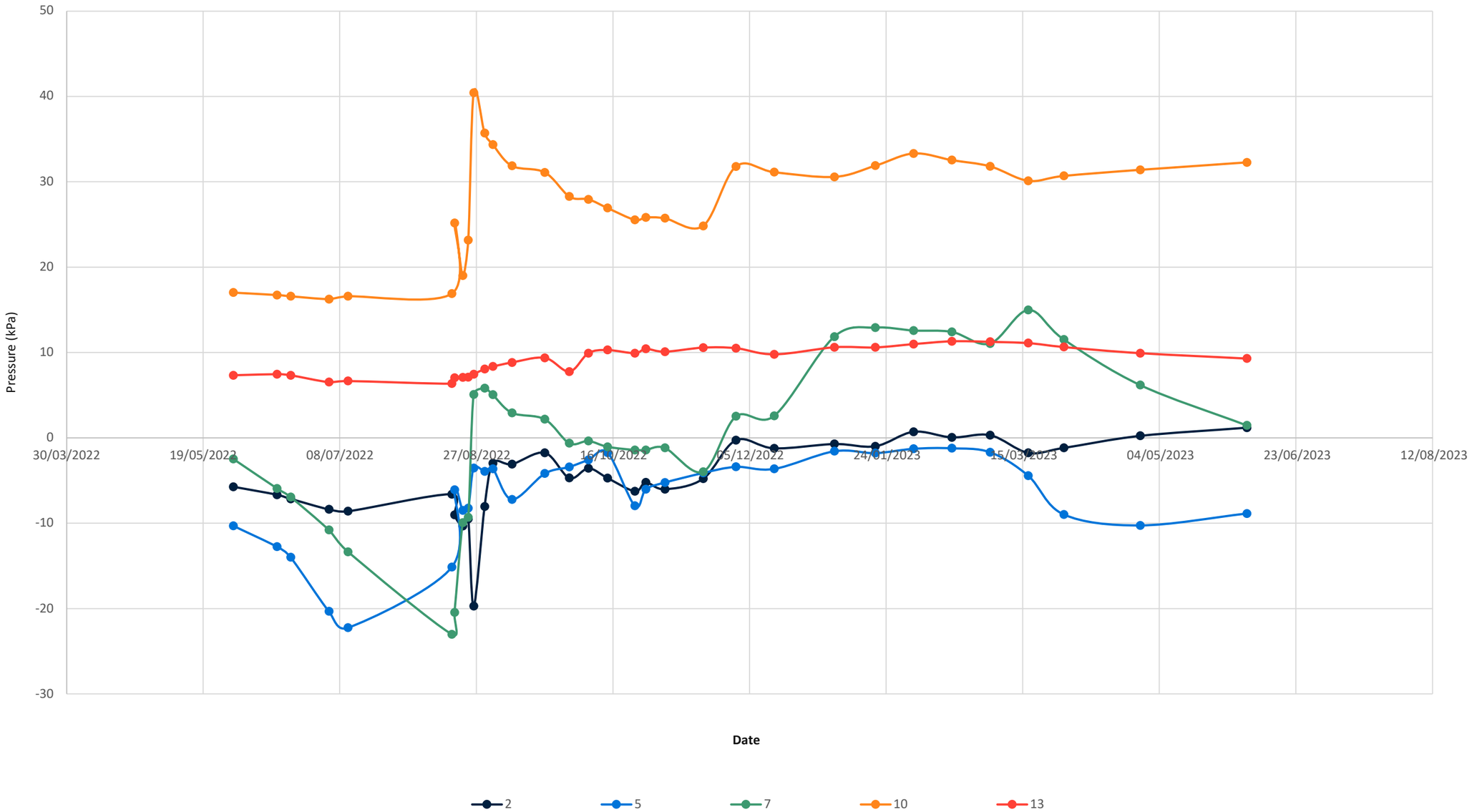
Piezometers (short term) - BH10



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Appendix E Extensometer Monitoring

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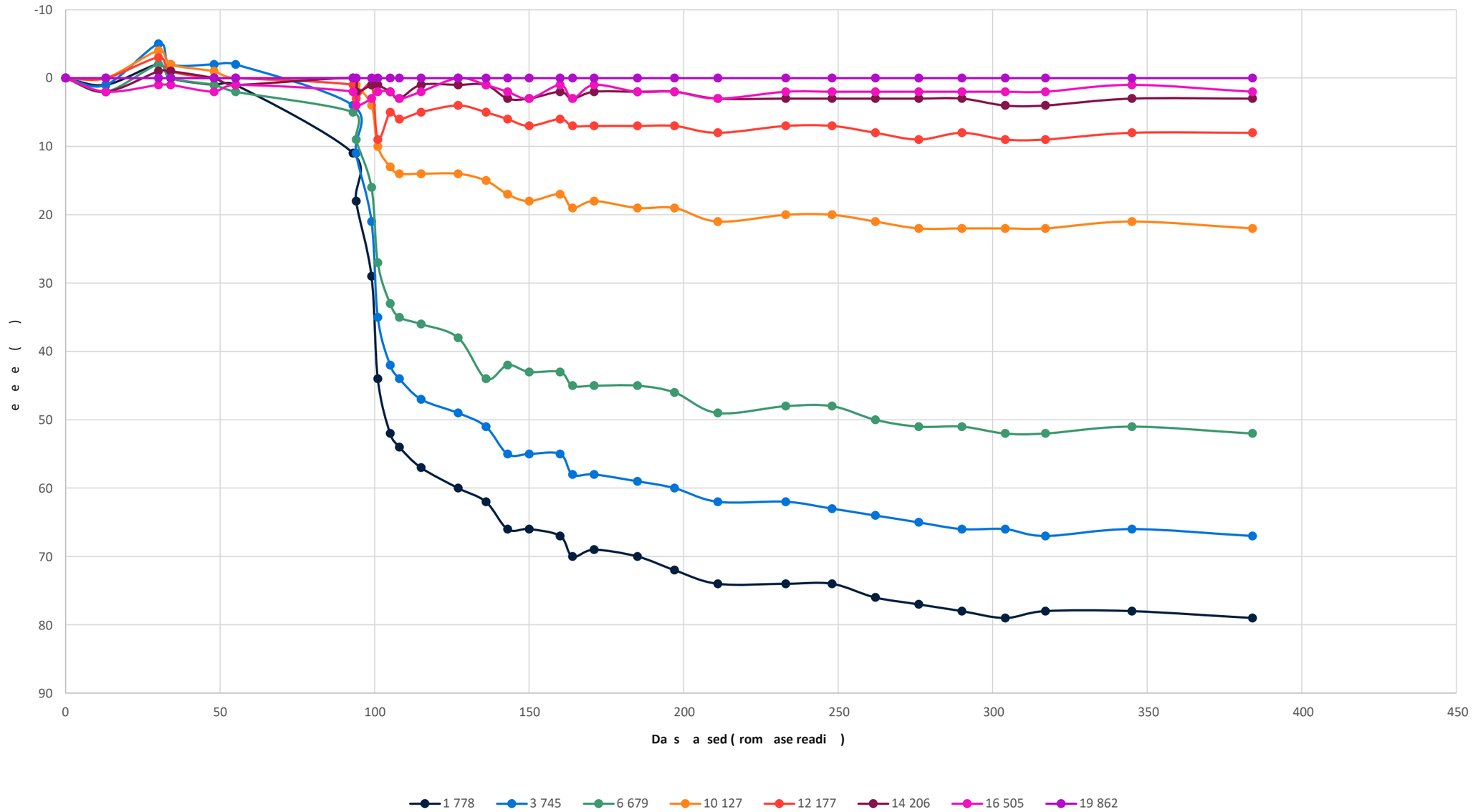
te someters - BH101



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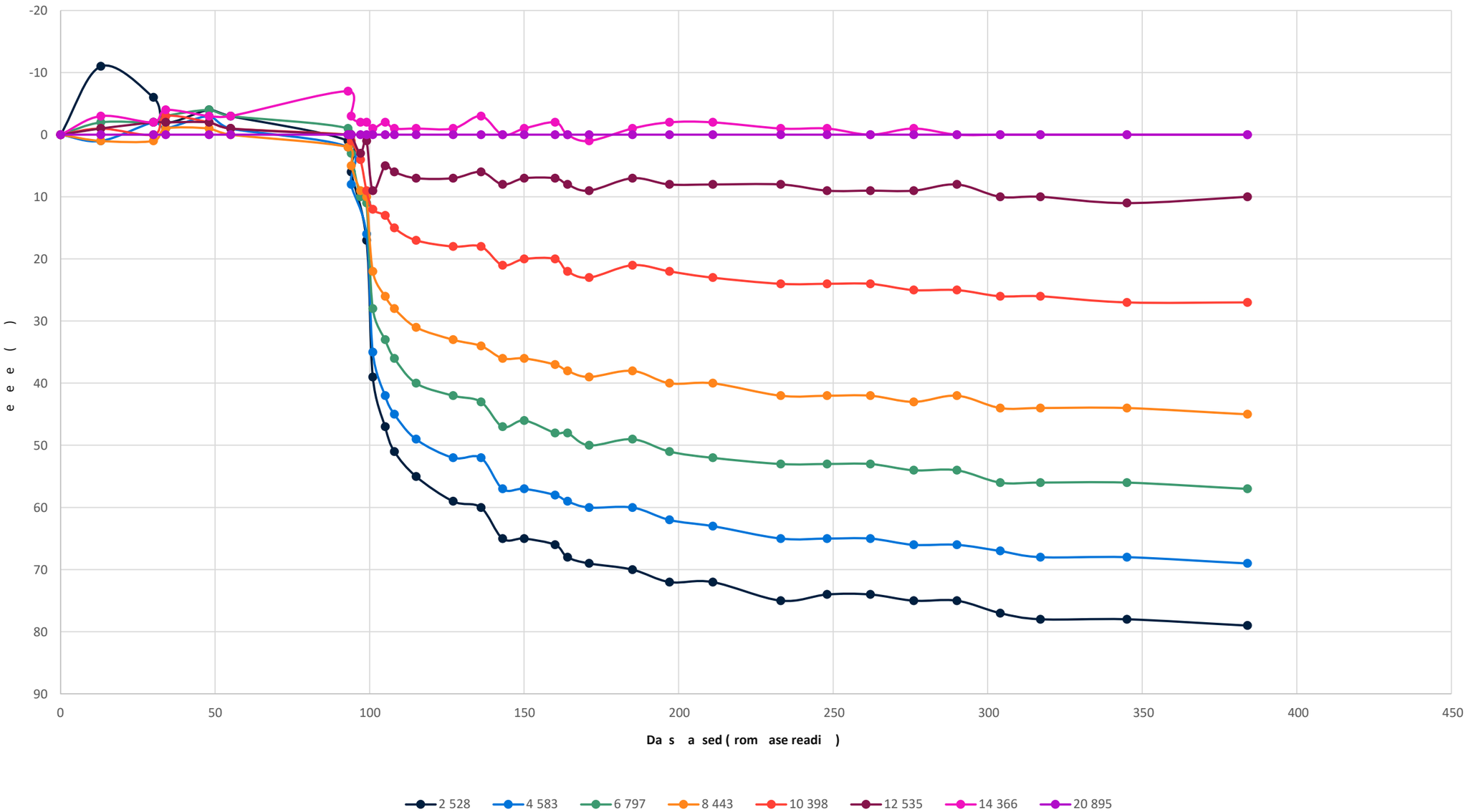
te someters - BH10



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te someters - BH10