Work Area: SMM	
Work Type: I&M	
Originator Company: GEOCISA	

C435
Farringdon Main Station

CRL Lead reviewer: [redacted]	
CRL Reviewer:	

Monitoring Close-Out Report:
Section L

CRL Document Number: C435-BFK-C2-RGN-M123-51660

Supplier Document Number: N/A

Contract MDL reference C14.022

1. Contractor Document Submittal History:

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
1.0	29-04-2016	[redacted]			For acceptance
2.0	13-06-2016				For acceptance

2a. Stakeholder Review Required? YES ☐ NO ☒

Stakeholder submission required: LU ☐ RfL ☐ Purpose of submission: For no objection ☐
NR ☐ LO ☐ For information ☐
DLR ☐ Other: _____

This document has been reviewed by the following individual for coordination, compliance, integration and acceptance and is acceptable for transmission to the above stakeholder for the above stated purpose.

Sign: _____ Role: _____ Name: _____ Date: _____

Sign: _____ Role: _____ Name: _____ Date: _____

2b. Review by Stakeholder (if required):

Stakeholder Organisation	Job Title	Name	Signature	Date	Acceptance
					☐
					☐
					☐

compliance with their contractual obligations and does not constitute
ds or materials developed or selected by the designer/supplier.

3. Acceptance by *Crossrail*:

[redacted]

13/10/2016

Contents

A. INTRODUCTION

In line with the C122 – M&W Specification KX10 – Instrumentation & Monitoring C122-OVE-Z4-RSP-CR001-00007, this Close-Out Report aims to address the following points in relation to the instrumentation defined in Section B.

- Identify movements observed by the relevant instruments;
- Relate these movements to construction activities, where applicable;
- Identify trigger breaches that may have occurred;
- Demonstrate that the rate of change of the data is either in line with the required rate or such that residual risks are minimal;
- Identify any such residual risks should there be considered to be any.

Based on the above points, this close out reports will provide justification for the decommissioning of the instruments.

B. INSTRUMENTS

B.1 Description of the Instruments

This Close-Out Report relates the monitoring devices installed in Section L, all of these devices were installed from street level. See Table 1 below with the details for the devices.

Sensor	Depth (below the ground level)	Location	Easting (m)	Northing (m)	Elevation (mATD)
C435-XR22000	7, 13, 18 and 23 (m)	38-42 Charterhouse St	82255.7079	36566.2416	116.3004
C435-XR23000	5, 10 and 15 (m)	Charterhouse Sq	82277.6703	36603.3954	117.2908
C435-XR24000	5, 10, 15, 22 and 18 (m)	Charterhouse Sq	82295.7103	36582.8272	117.4776
C435-SD00005	1m	36-37 Charterhouse Sq	82327.6819	36584.0123	117.3039
C435-SD00007	1m	Charterhouse Sq	82368.0019	36620.7770	117.7133

Table 1. Details of the devices installed on Section L.

Installation and as-built-details are available in the following documents:

Drawings:

- C122-OVE-C2-DDA-CR001_Z-31531. Asset Protection I&M ground Surface and in-ground.
- C435-BFK-C2-DWG-M123-50042. In ground devices installed for Farringdon Station.

Installation Reports:

- C435-BFK-C-RGN-M123-50933. Installation Report In-ground Monitoring Extensometer XR22000.
- C435-BFK-C2-RGN-M123-50052. Installation Report In-ground Monitoring Extensometer XR23000.
- C435-BFK-C2-RGN-M123-50053. Installation Report In-ground Monitoring Extensometer XR24000.
- C435-BFK-C2-RGN-M123-50982. Installation Report In-ground Monitoring Shallow Datum SD00005.
- C435-BFK-C2-RGN-M123-50983. Installation Report In-ground Monitoring Shallow Datum SD00007.

B.2 Location of the Instruments

Devices associated with Section L are located on the plan below highlighted in yellow

Figure 1 – Map showing the Location for the devices on Section L

C. MOVEMENTS

C.1 Movements Resulting from Construction Activities

C.1.1 Relevant Crossrail (BFK) Works

The construction activities affecting these instruments are outlined in the Table 2 below:

Activity	Start Date	End Date
ETH Excavation	26-04-2013	28-10-2014
EB TBM passage	20-01-2014	24-01-2014
PTE enlargement	29-11-2014	27-01-2015
STE2	02-02-2015	12-02-2015
CP8	16-06-2015	22-06-2015
CP9	10-06-2015	14-06-2015
VA2	16-04-2015	02-05-2015

Table 2 – Construction Activities associated with Section L

C.1.2 Resulting Movements

- **Extensometer XR22000.**

The monitoring data for the extensometer is shown in Appendix B.

- ETH excavation caused 6mm of settlement maximum from 03-07-2013 to 17-01-2014.
- EB TBM caused maximum 4mm of settlement between 20-01-2014 to 22-01-2014.
- Compensation grouting from Moorgate Shaft 2 caused maximum 10mm of heave from 28-05-2014 to 23-09-2014.
- Ground treatment caused 32mm maximum of heave in October 2014.
- PTE enlargement caused maximum 14mm of settlement from 29-11-2014 to 10-12-2014.
- Maximum settlement at the end of the works was 28mm

- **Extensometer XR23000.**

The monitoring data for the extensometer is shown in Appendix B.

- ETH excavation caused maximum 6mm of settlement from 26-04-2013 to 23-09-2014.
- EB TBM caused maximum 1mm of settlement on 22-01-2014.
- PTE enlargement works caused maximum 3-4mm of settlement from 14-01-2015 to 27-01-2015.
- Maximum settlement at the end of the works was 8mm

- **Extensometer XR24000.**

The monitoring data for the extensometer is shown in Appendix B.

- ETH excavation caused maximum 6mm from 26-04-2013 to 22-01-2014.
- EB TBM caused maximum 9-10mm of settlement from 22-01-2014 to 24-01-2014.
- Residual movement caused 8mm of settlement.
- Ground treatment caused 14-15mm of heave in October 2014.
- PTE construction works caused maximum 4-6mm of settlement from 17-01-2015 to 27-01-2015.
- STE2 caused maximum 2mm of settlement from 02-05-2015 to 05-02-2015.
- VA2 construction caused maximum 8-10mm of settlement between 16-04-2015 and 02-05-2015
- Maximum settlement at the end of the works was 29mm

- **Shallow Datum SD00005.**

The monitoring data for the Shallow Datum is shown in Appendix B.

- ETH excavation caused maximum 2mm of settlement from 02-07-2013 to 14-01-2014.
- EB TBM caused 2-3mm of settlement from 23-01-2014 to 24-01-2014
- Residual settlement caused 4mm.
- Compensation grouting from Charterhouse Shaft caused 6mm maximum of heave from 22-10-2014 to 24-01-2015.
- STE2 caused maximum 6mm of settlement maximum from 02-02-2015 to 12-02-2015.
- VA2 caused 2-3mm of settlement from 16-04-2015 to 12-02-2015.
- Maximum settlement at the end of the works was 18mm

- **Shallow Datum SD00007.**

The monitoring data for the Shallow Datum is shown in Appendix B.

This Shallow Datum was not affected by any works carried out on the project. This is the reason why this device did not show any movement, just the typical noise from the levelling.

C.2 Trigger Breaches

The Instrumentation and Monitoring Plan: Farringdon Station Ground Movement and Asset Protection C122-OVE-C2-RGN-M123-50013 in section 6.1, no triggers are applicable for in-ground monitoring.

C.3 Significant Issues with the Instrumentation

No issues with these devices.

C.4 Residual Risks

As per C435-PMI-00549 the Long Term Monitoring has been ceased by Contract C435 in this area. The last measurement carried out for this device on 03-12-2015. This PMI affected to the extensometer C435-XR22000. For the rest of the device the rate of settlement has been analyse and in all case the rate is less then 2mm/year.

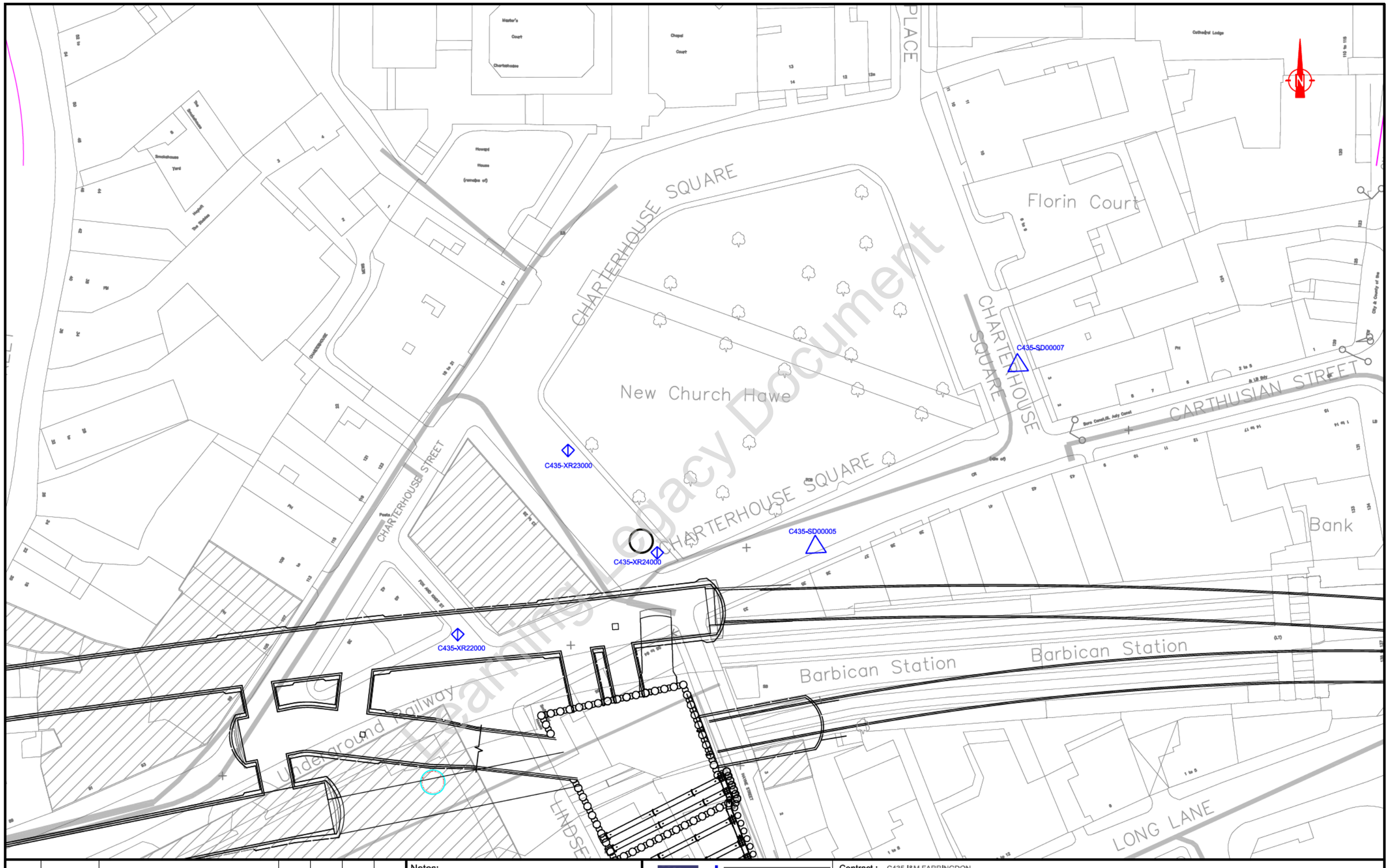
Long term monitoring will be continued by Crossrail to review long term stability.

D. CONCLUSIONS

No triggers breached, monitoring stable. No residual risks remain. Long term monitoring to be completed by Crossrail.

APPENDIX A: DRAWINGS

APPENDIX B: GRAPHS



Rev.	Date	Description	By	Chkd	App	Auth
1	20-02-2014					

Notes:

Crossrail

BFK Bam | Ferrovial | Kier

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Contract : C435 I&M FARRINGDON

Originator : GEOCISA

Location : CROSSRAIL GENERAL

Title : C435 INSTRUMENTATION AND MONITORING, IN-GROUND DEVICE

By : [redacted]

Chk :

App :

Scale : @ A3

Drg No : C435-BFK-C2-DWG-M123-50042

Rev :

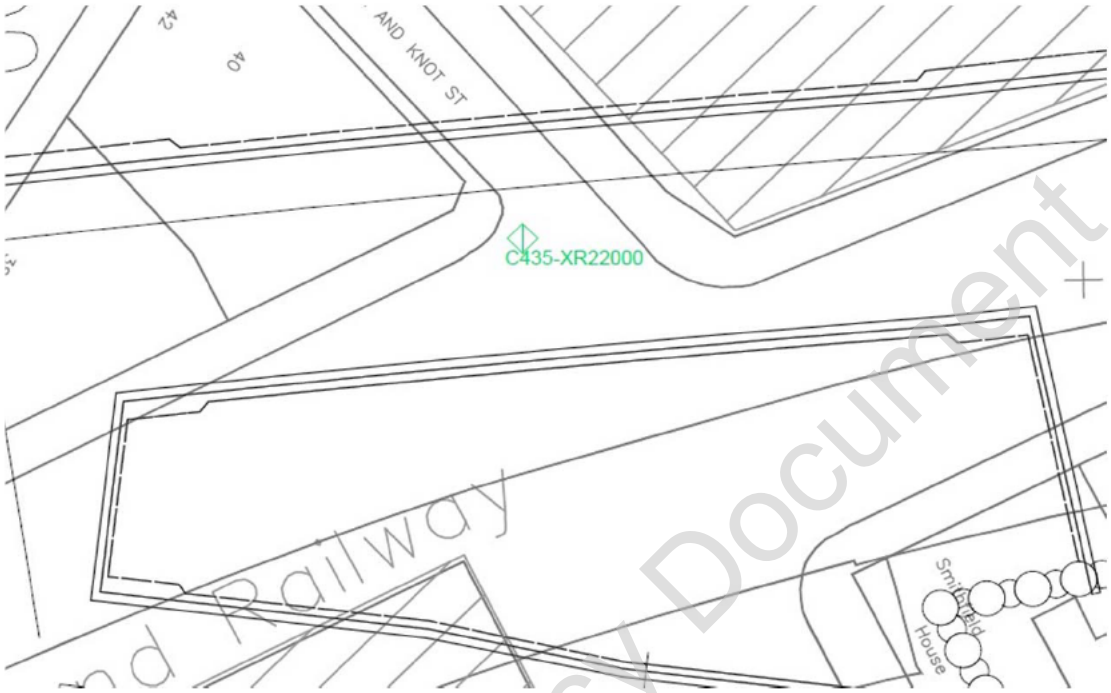
Suit :

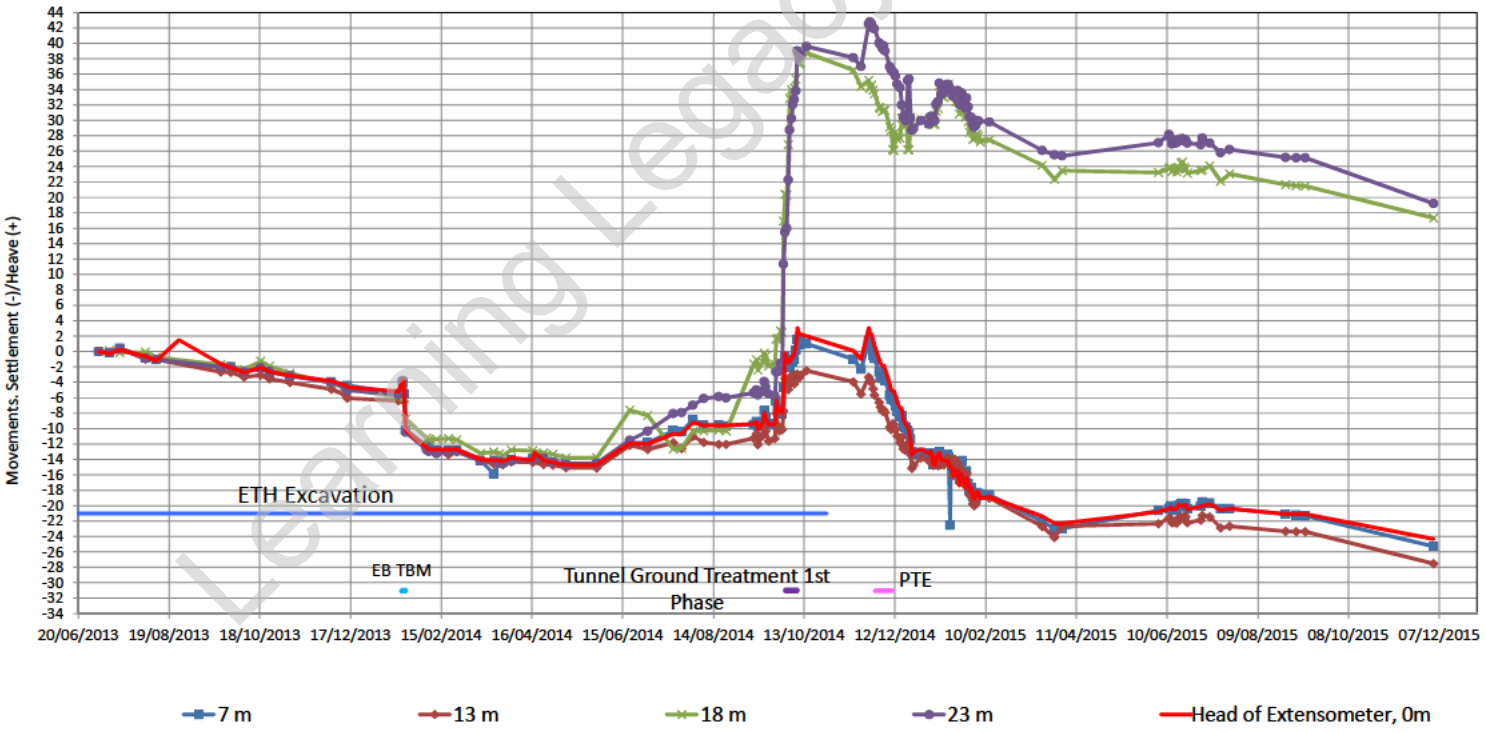
Auth : GEOCISA

Pby

AREA: Fox and Knot

DEVICE: Extensometers

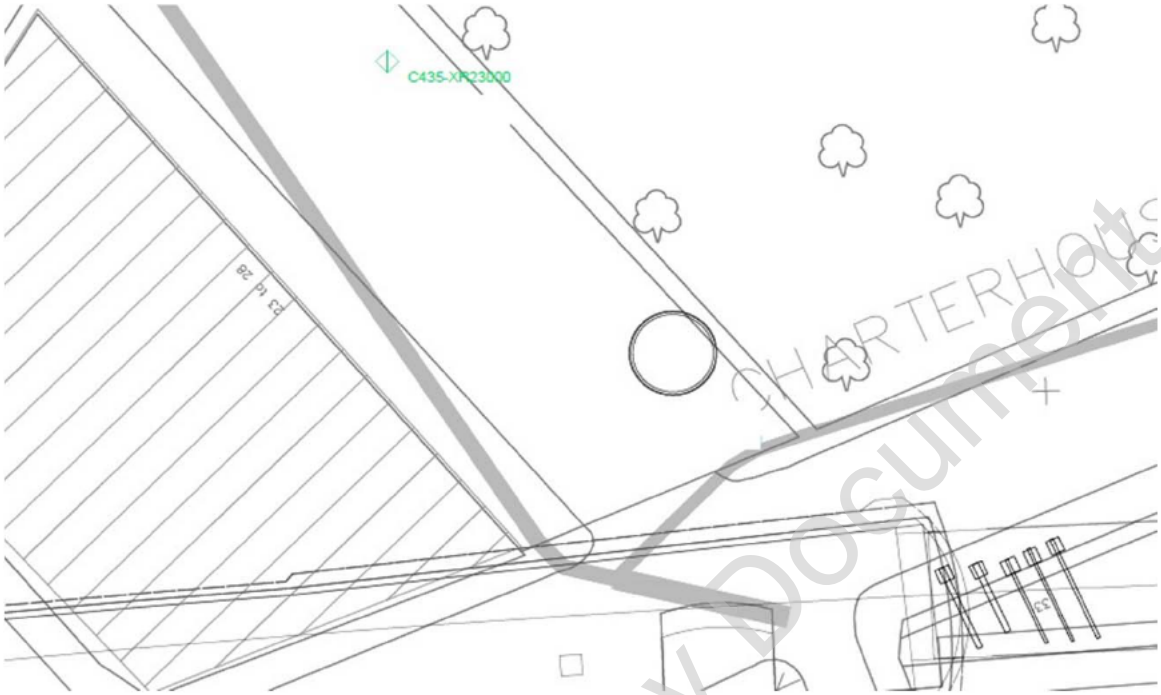




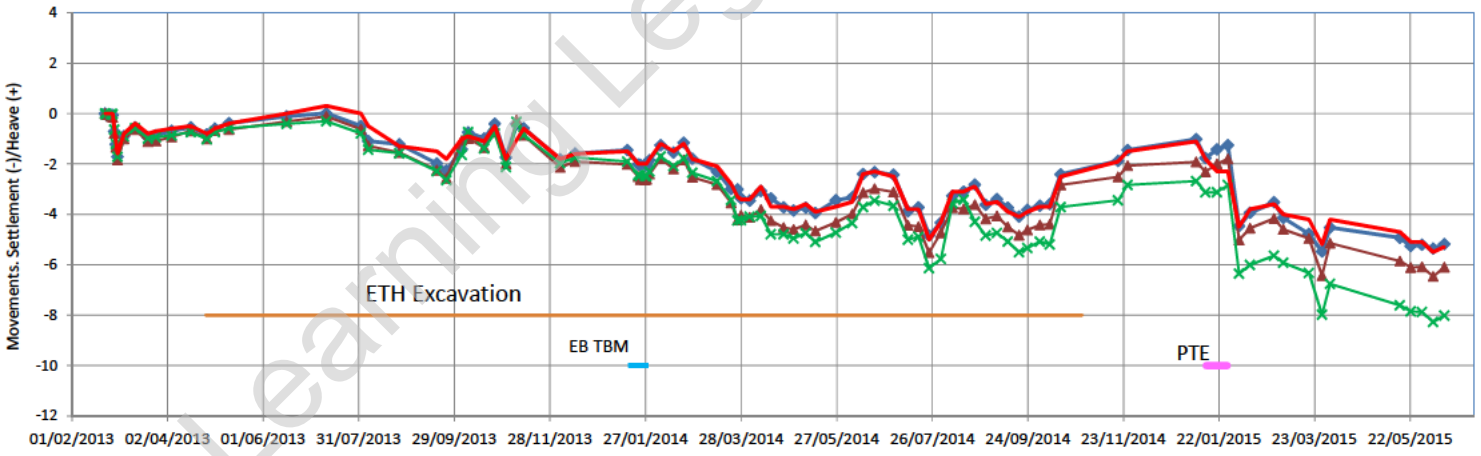
REMARKS:

AREA: Charterhouse Sq

DEVICE: Extensometers



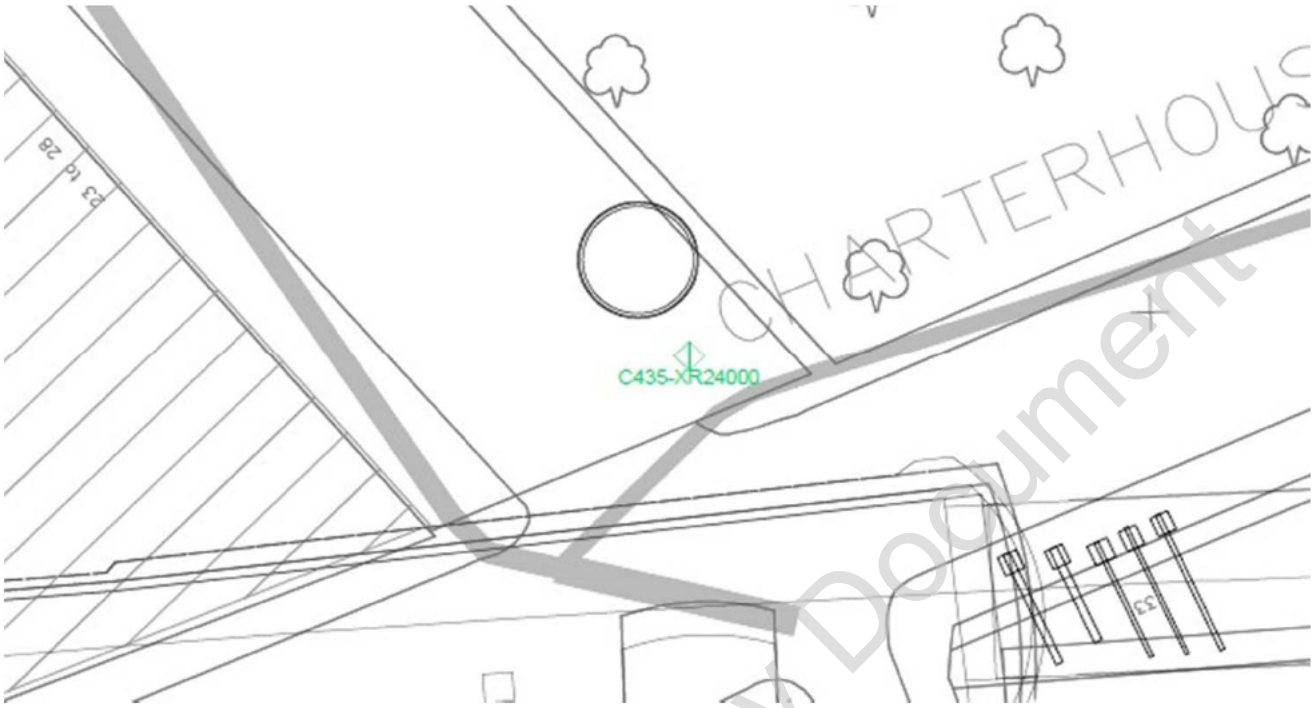
Extensometer C435-XR23000

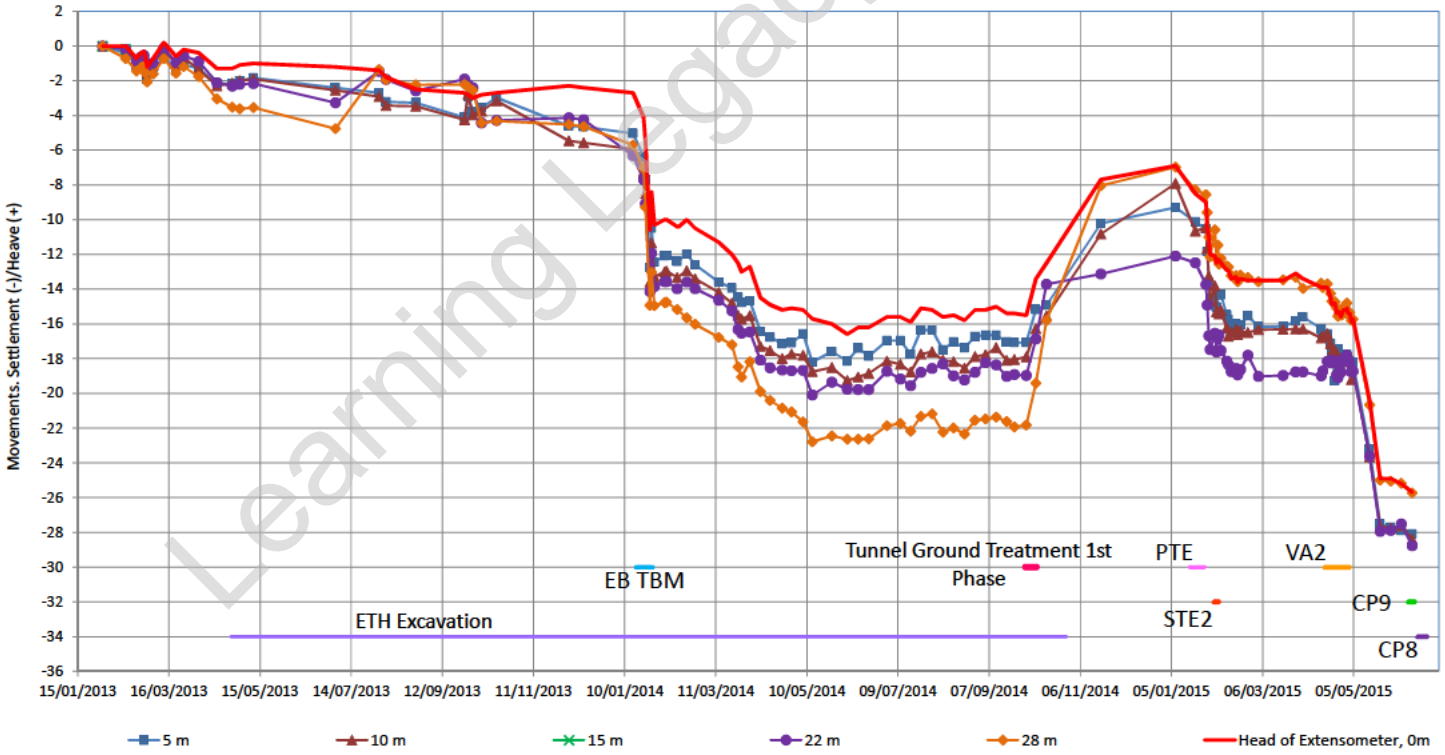


5 m 10 m 15 m Head of Extensometer, 0m

REMARKS:

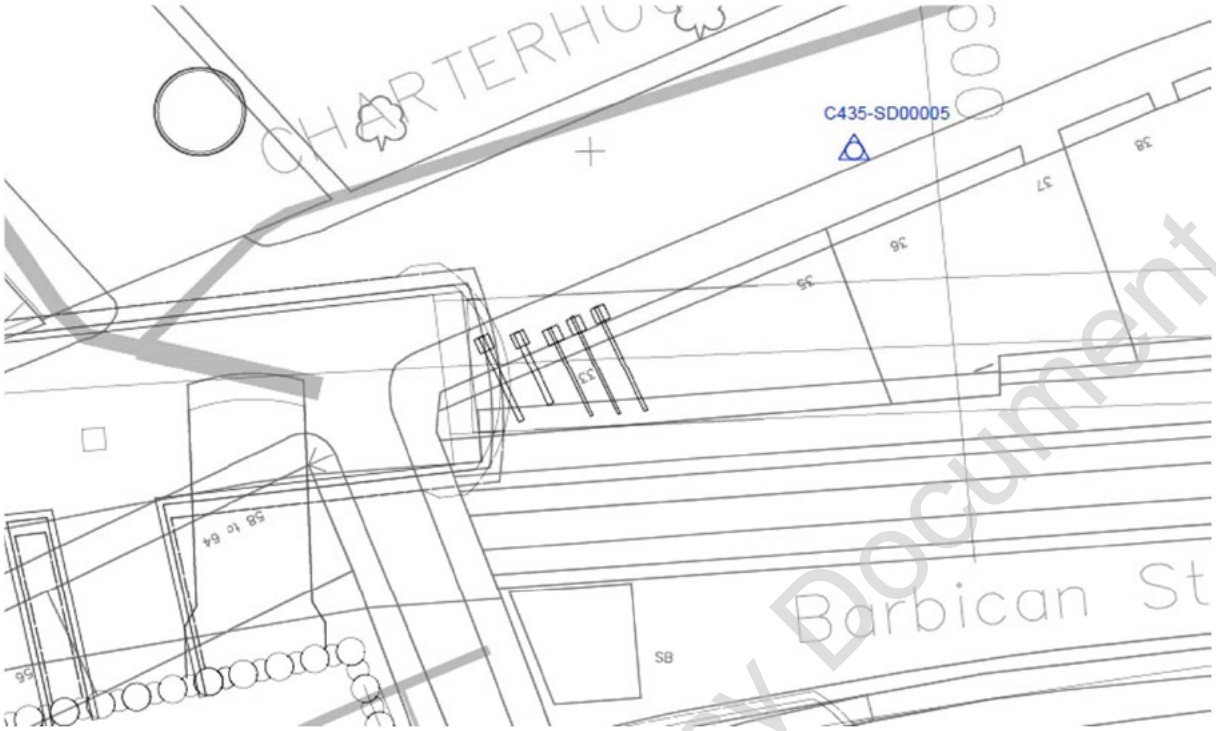
AREA: Charterhouse Sq
DEVICE: Extensometers

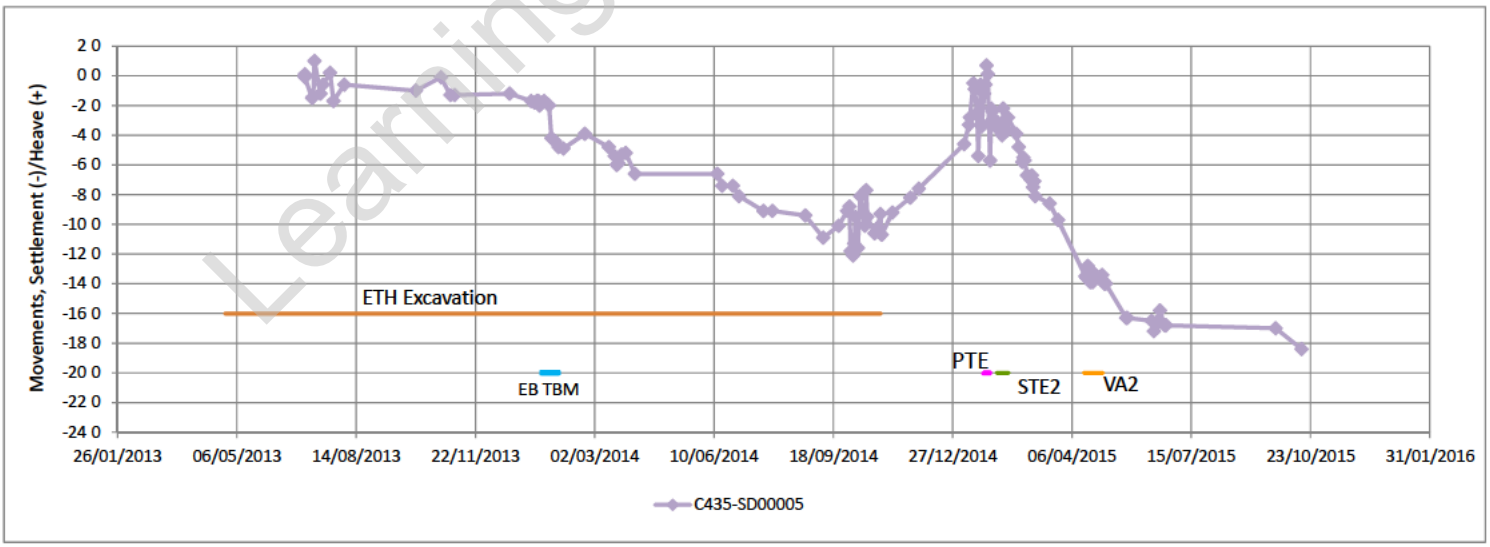




REMARKS:

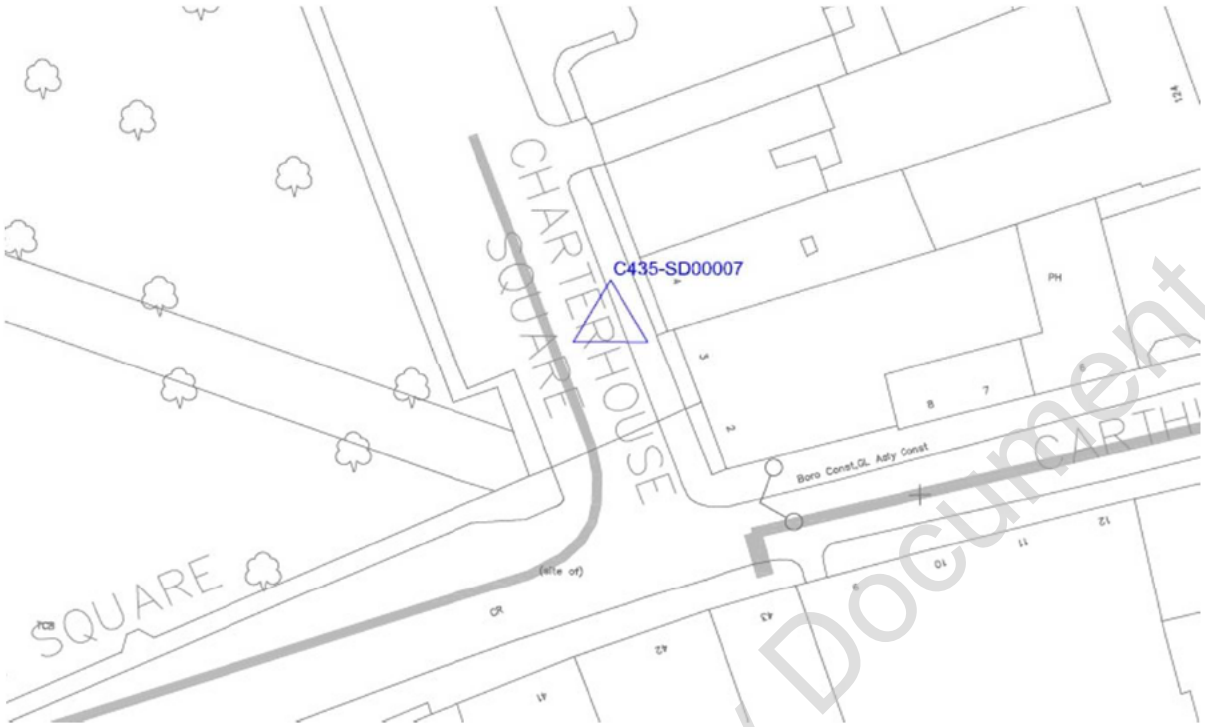
DEVICE: Shallow Datum
LOCATION: 36-37 Charterhouse Sq.

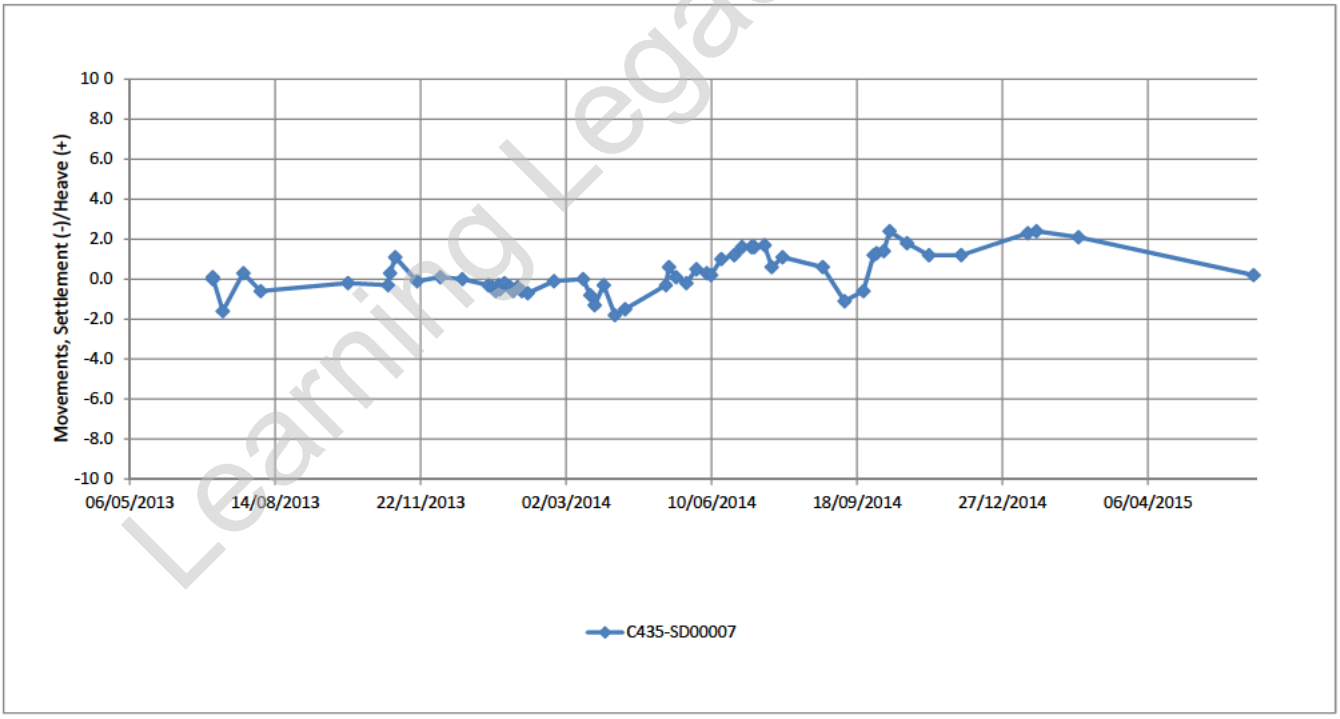




REMARKS:

DEVICE: Shallow Datum
LOCATION: 36-37 Charterhouse Sq.





REMARKS:

APPENDIX C: GLOSSARY

➢ ATS	Automatic Total Station.
➢ ETH	Eastern Ticket Hall.
➢ WB	Westbound.
➢ TBM	Tunnel Boring Machine.
➢ EB	Eastbound.
➢ PTW	Platform Tunnel West
➢ PTE	Platform Tunnel East
➢ CP	Cross passages.
➢ CH	Concourse Hall.
➢ VA	Ventilation Adit
➢ STE	Stub Tunnel East
➢ RTE	Running Tunnel East.
➢ ES	Escalator Shaft
➢ TaM	Tube a Manchette.