



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

## C435 Farringdon Main Station

CRL Lead reviewer: [Redacted]
CRL Reviewer:

### Monitoring Close-Out Report: Automated Total Station ATS15 and 3D Targets read by ATS15.

**CRL Document Number: C435-BFK-C2-RGN-M123-51620**

**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	12-04-2016	[Redacted]	[Redacted]	[Redacted]	For acceptance
2.0	17-05-2016	[Redacted]	[Redacted]	[Redacted]	For acceptance
3.0	13-06-2016	[Redacted]	[Redacted]	[Redacted]	For acceptance

#### 2a. Stakeholder Review Required? YES NO

Stakeholder submission required: LU  NR  DLR  RFL  LO  Other: \_\_\_\_\_ Purpose of submission: For no objection  For information

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
					<input type="checkbox"/>
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compliance with their contractual obligations and does not constitute  
 ds or materials developed or selected by the designer/supplier.

#### 3. Acceptance by Crossrail:

[Redacted Signature]  
 21/06/2016

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## 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 2.

- 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 prisms read by ATS15. See Table 1 below with the details of the prisms read by ATS15

Sensor	Location	Easting (m)	Northing (m)	Elevation (mATD)
C435-RP01501	The Smokery	82084.2339	36538.6026	125.2862
C435-RP01502	The Smokery	82084.356	36538.4474	119.2646
C435-RP01503	85 Cowcross St	82086.1996	36541.0234	120.0171
C435-RP01504	85 Cowcross St	82086.1017	36541.03	125.9133
C435-RP01505	85 Cowcross St	82080.478	36541.7651	128.3697
C435-RP01506	85 Cowcross St	82080.4296	36541.793	119.9943
C435-RP01508	85 Cowcross St	82090.8325	36540.4151	119.7896
C435-RP01510	79-83 Charterhouse St	82097.7883	36507.7616	130.0585
C435-RP01511	1 Greenhill's Rent	82099.6793	36537.2559	125.4548
C435-RP01512	The Smokery	82084.0111	36535.7926	125.3091
C435-RP01513	The Smokery	82085.5506	36535.1604	126.1912
C435-RP01514	The Smokery	82087.1356	36532.8428	126.1978
C435-RP01515	The Smokery	82086.5531	36531.7579	125.3655
C435-RP01516	79-83 Charterhouse St	82104.5461	36507.3681	130.1916
C435-RP01518	85 Cowcross St	82093.6329	36540.2426	127.1373
C435-RP01519	The Smokery	82084.3596	36538.1964	125.305
C435-RP01520	85 Cowcross St	82094.1764	36538.1875	125.481

Table 1: Details of the prisms read by ATS15

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

Drawings:

- C435-BFK-C2-DWG-M123-50045. 3D Targets Installed for Farringdon Station.

Installation Reports:

- C435-BFK-C2-RGN-M123-50070. Installation Report of 3D Targets read by ATS15.
- C435-BFK-C2-RGN-M123-50016. Installation Report of ATS15.

## B.2 Location of the Instruments

Prisms associated with ATS15 are located on the plan below highlight in yellow. The location of ATS15 highlight in blue.



Figure 1 – Plan showing the Location of the prisms read by ATS15 and ATS15.

## 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 below:

Activity	Start Date	End Date
WB TBM	29-09-2013	30-09-2013
EB TBM	12-01-2014	15-01-2014
PTW	22-06-2014	30-07-2014
PTE	01-07-2014	28-08-2014
CP4	17-09-2014	23-10-2014

Table 2 – Construction Activities associated with prisms read by ATS15.

### C.1.2 Resulting Movements

To analyse the results for the prisms buildings will be assessed at individually:

- 1 Greenhill's Rent
- 79-83 Charterhouse St
- 79-85 Cowcross St
- The Smokery

- 1 Greenhill's Rent.

The monitoring data for the prisms located at this building are shown in Appendix B.

- Between 25-07-2014 and 04-08-2014 PTE enlargement works caused 22mm maximum of settlement.
- From 17-09-2014 to 21-07-2014 CP4 works caused 3-4mm of settlement maximum.
- Maximum Longitudinal movement +16mm
- Maximum Transversal movement +8mm

- 79-83 Charterhouse St.

The monitoring data for the prisms located at this building are shown in Appendix B.

- From 28-09-2013 to 30-09-2013 WB TBM caused 5-6mm maximum of settlement.
- Residual settlement caused 2mm of settlement.
- In January 2014 compensation grouting episode caused 4mm of heave.
- Concurrent grouting on 4<sup>th</sup> July 2014 caused 4mm of heave.
- Between 06-07-2014 and 20-07-2014 PTW enlargement caused 8mm of settlement.
- Maximum Longitudinal movement -4mm
- Maximum Transversal movement +18mm

- 79-85 Cowcross St

The monitoring data for the prisms located at this building are shown in Appendix B.

- From 13-01-2014 to 14-01-2014 EB TBM caused 2-3mm maximum of settlement.
- Between 21-07-2014 to 03-08-2014 PTE construction caused 22mm of settlement.
- Residual settlement after PTE works caused 4mm of settlement.
- Maximum Longitudinal movement +16mm
- Maximum Transversal movement +12mm

- The Smokery

The monitoring data for the prisms located at this building are shown in Appendix B.

- From 12-01-2014 to 15-01-2014 EB TBM caused 2-3mm maximum of settlement.
- Residual settlement caused 2mm of settlement.
- Between 13-07-2014 and 01-08-2014 PTE works caused 22-24mm maximum of settlement.
- No movements during CP4 construction.
- Maximum Longitudinal movement +12mm
- Maximum Transversal movement +14mm

## C.2 Trigger Breaches

The Instrumentation and Monitoring Plan: Farringdon Station Ground Movement and Asset Protection C122-OVE-C2-RGN-M123-50013 outlines the triggers associated with the works. The triggers breached are showed in the following table.

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE (mm)	TRIGGER LEVEL	
						WORST HISTORICAL STATUS	CURRENT STATUS
The Smokery	C435-RP01501	AUTOMATIC RP	Settlement	21/07/2015 16:00	-29.4	Amber	Green
	C435-RP01502	AUTOMATIC RP	Settlement	21/07/2015 16:00	-29.6	Amber	Green
	C435-RP01512	AUTOMATIC RP	Settlement	21/07/2015 16:00	-26.6	Green	Green
	C435-RP01513	AUTOMATIC RP	Settlement	21/07/2015 16:00	-25.7	Green	Green
	C435-RP01514	AUTOMATIC RP	Settlement	21/07/2015 16:00	-23.6	Green	Clear
	C435-RP01515	AUTOMATIC RP	Settlement	21/07/2015 16:00	-22.6	Green	Clear
1 Greenhill's Rent	C435-RP01519	AUTOMATIC RP	Settlement	21/07/2015 16:00	-29.1	Amber	Amber
	C435-RP01511	AUTOMATIC RP	Settlement	21/07/2015 16:00	-31.2	Amber	Amber
79-83 Charterhouse St	C435-RP01510	AUTOMATIC RP	Settlement	21/07/2015 16:00	-25.7	Default Alert	Default Alert
	C435-RP01516	AUTOMATIC RP	Settlement	21/07/2015 16:00	-27.3	Green	Green
85 Cowcross St	C435-RP01503	AUTOMATIC RP	Settlement	21/07/2015 16:00	-30.8	Amber	Amber
	C435-RP01504	AUTOMATIC RP	Settlement	21/07/2015 16:00	-29.2	Amber	Green
	C435-RP01505	AUTOMATIC RP	Settlement	21/07/2015 16:00	-28.6	Amber	Amber
	C435-RP01506	AUTOMATIC RP	Settlement	21/07/2015 16:00	-27.3	Green	Green
	C435-RP01508	AUTOMATIC RP	Settlement	21/07/2015 16:00	-29.4	Amber	Green
	C435-RP01518	AUTOMATIC RP	Settlement	21/07/2015 16:00	-31.2	Amber	Amber
	C435-RP01520	AUTOMATIC RP	Settlement	21/07/2015 16:00	-33.4	Amber	Amber

Table 3 – Triggers breached by the prisms read by ATS15.

## C.3 Significant Issues with the Instrumentation

No issues with these devices.

## C.4 Residual Risks

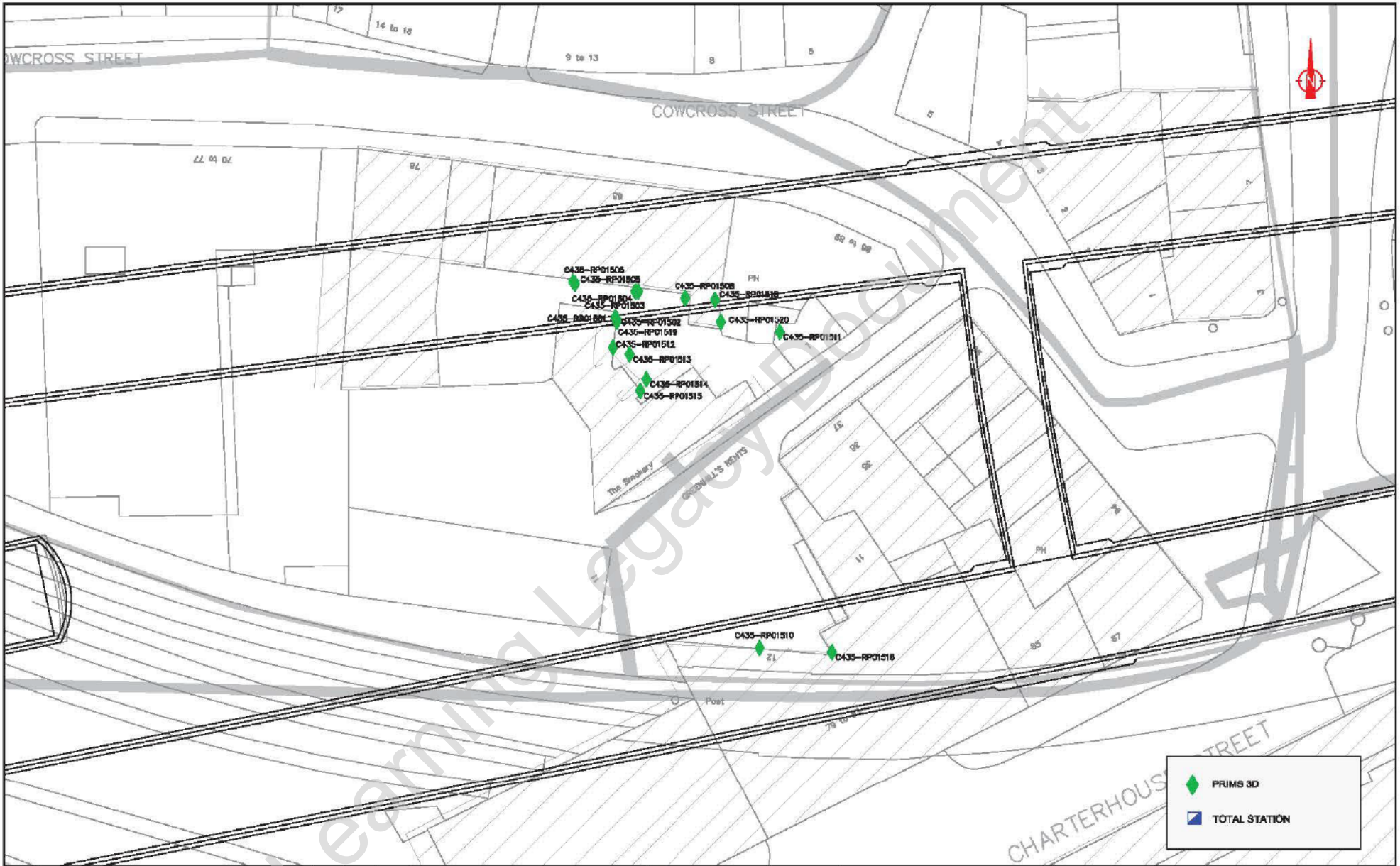
The rate of settlement for all instrumentation within this report has been analysed and in all cases the rate is less than 2mm/year



## D. CONCLUSIONS

Monitoring stable. No residual risks remain. Long term monitoring to be completed by Crossrail.

APPENDIX A: DRAWINGS

Learning Legacy Document



	PRIMS 3D
	TOTAL STATION

Notes:


**CROSSRAIL**  
**BFK**  
 Barreras Formosa Kier

Contract : C435 IEM FARRINGTON  
 Originator : GEOCSA  
 Location : CROSSRAIL GENERAL  
 Title :  
 3D PRIMS AT315

By :   
 Chk :   
 App :   
 Auth : 

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

Scale : @ A3  
 Dwg No : C435-BFK-C2-DWG-M123-50045

Rev :    Suf :    Auth : 

\$Pby\$



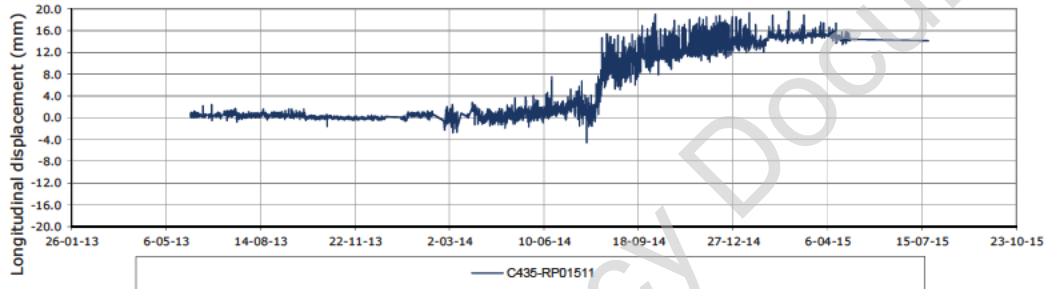
APPENDIX B: GRAPHS

Learning Legacy Document

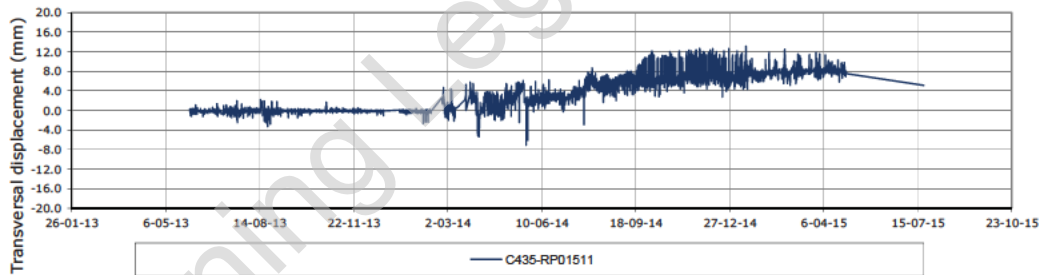
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 AREA Farringdon Station  
 DEVICE 3D Target



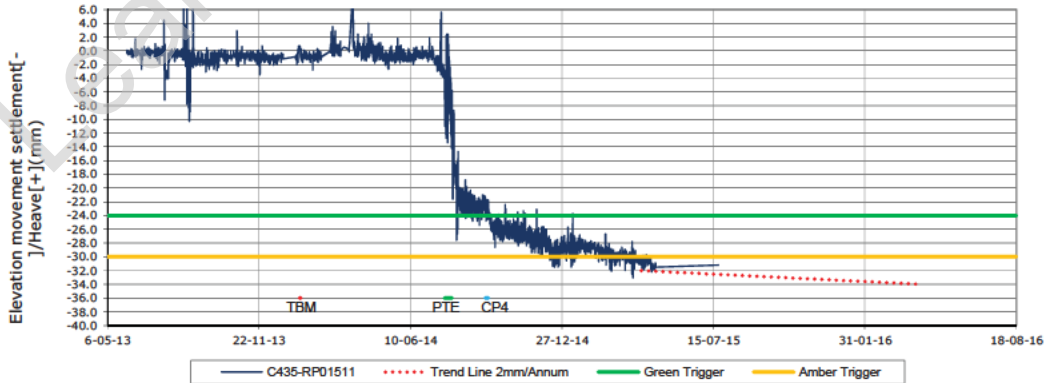
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Building: 1 GREENHILL'S RENTS



Building: 1 GREENHILL'S RENTS

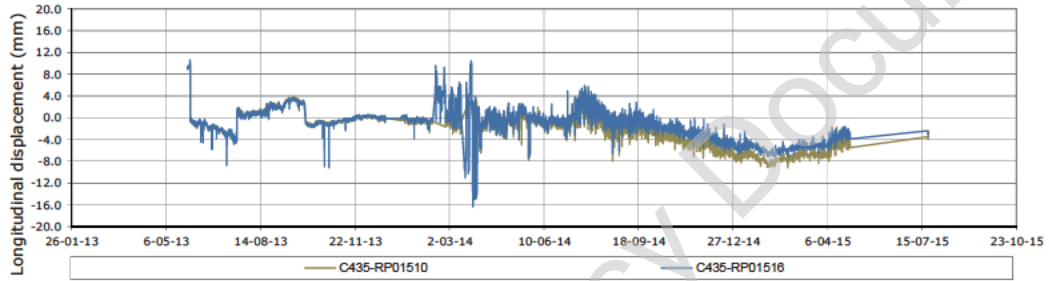


REMARKS

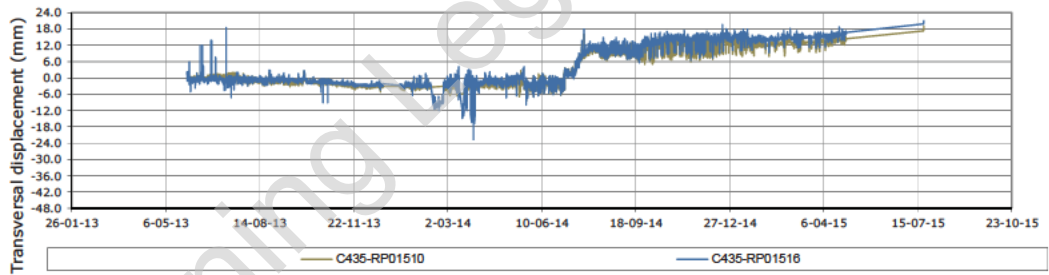
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 DEVICE 3D Target



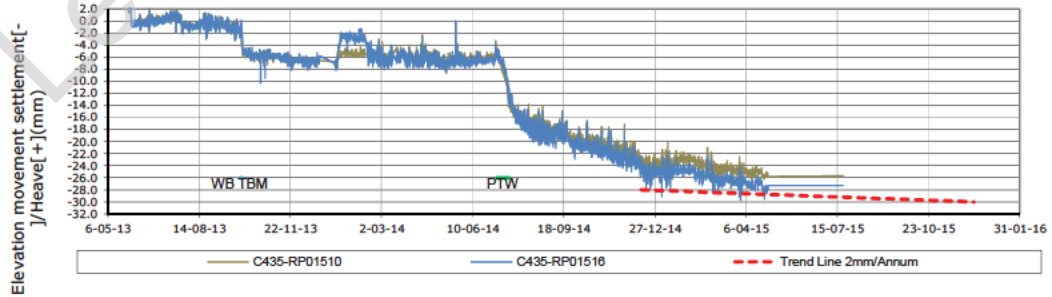
Building: 79-83 CHARTERHOUSE STREET



Building: 79-83 CHARTERHOUSE STREET

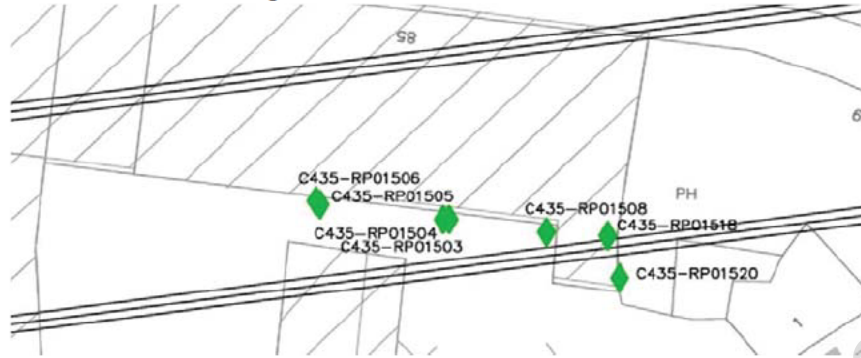


Building: 79-83 CHARTERHOUSE STREET

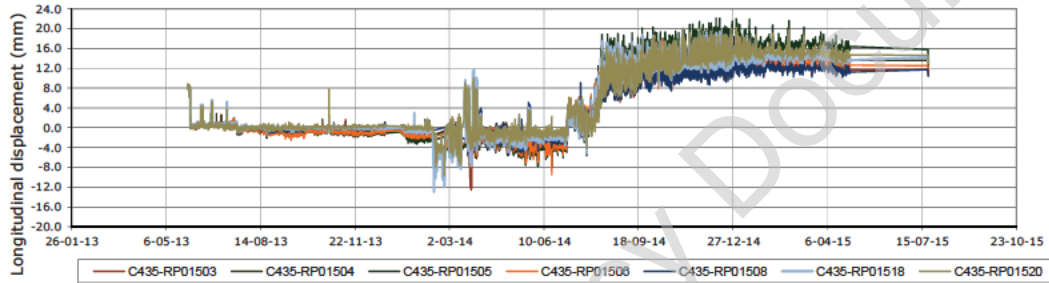


REMARKS

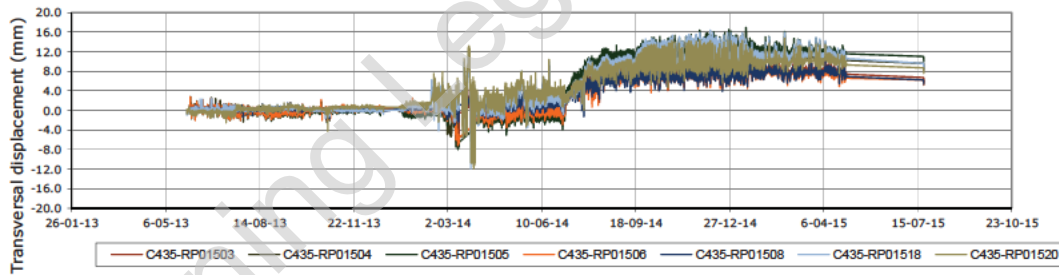
REPORT Automatic Prisms  
 AREA Farringdon Station  
 DEVICE 3D Target



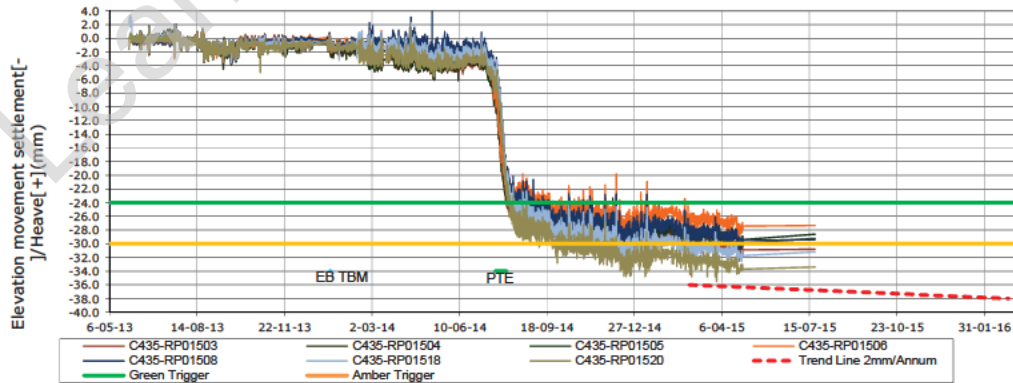
Building: 79-85 COWCROSS STREET



Building: 79-85 COWCROSS STREET

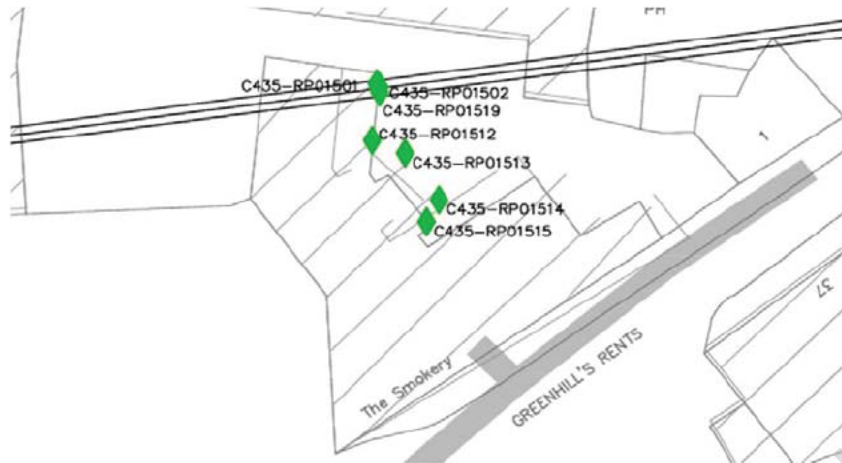


Building: 79-85 COWCROSS STREET

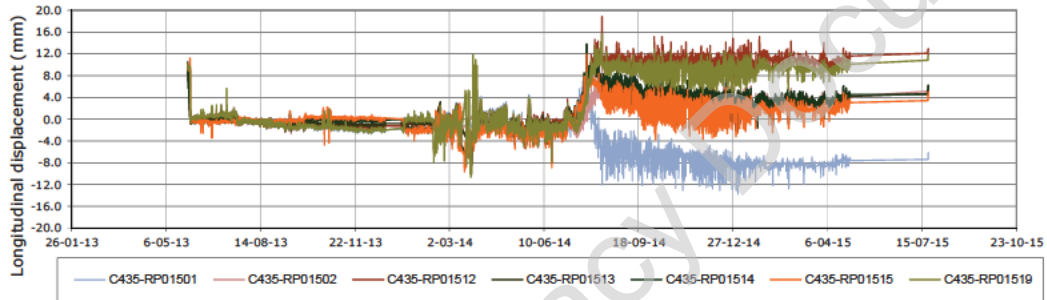


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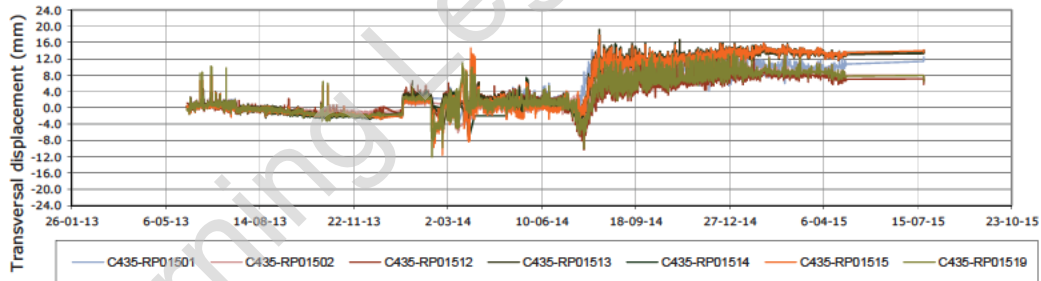
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 DEVICE 3D Target



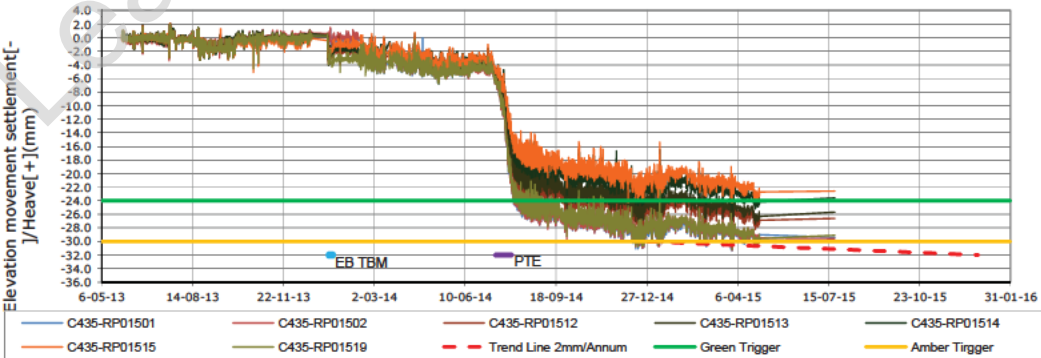
Building: THE SMOKERY-ATS15



Building: THE SMOKERY-ATS15



Building: THE SMOKERY-ATS15



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

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