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

C435
Farringdon Main Station

CRL Lead reviewer: [redacted]
CRL Reviewer:

Monitoring Close-Out Report:
Internal monitoring at 23-28 Charterhouse Square

CRL Document Number: C435-BFK-C2-RGN-M123-51650

Supplier Document Number: N/A

Contract MDL reference C13.012

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1. Contractor Document Submittal History:

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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.

[redacted]

3. Acceptance by *Crossrail*:

31/10/2016

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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 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 report will provide justification for the decommissioning of the instruments.

B. INSTRUMENTS

B.1 Description of the Instruments

This Close-Out Report relates the monitoring located inside 23-28 Charterhouse Square building, consisting of Tiltmeters and Electrolevel beams read manually. See Table 1 below with details.

LOCATION	SENSOR TYPE	SENSOR CODE
23-28 Charterhouse Square	Tiltmeter	C435-TB00001 A/B
	Tiltmeter	C435-TB00002 A/B
	Tiltmeter	C435-TB00003 A/B
	Electrolevel Beam	C435-EL000011
	Electrolevel Beam	C435-EL000012
	Electrolevel Beam	C435-EL000013
	Electrolevel Beam	C435-EL000014
	Electrolevel Beam	C435-EL000015
	Electrolevel Beam	C435-EL000026
	Electrolevel Beam	C435-EL000027

Table 1: Details of 23-28 Charterhouse Square Internal Monitoring instrumentation

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

Drawings:

- Asset Protection I&M 23-28 Charterhouse Square (MDC3_00037) Basement – Plan C435
- Asset Protection I&M Buildings Farringdon Station C435: C122-OVE-C2-DDA-CR001_Z-31402

Installation Reports:

- Installation Report for Internal monitoring at 23-28 Charterhouse Square: C435-BFK-C2-RGN-M123-50035.

FCD:

- C435-FCD-000343: Internal Monitoring Proposal version 2

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B.2 Location of the Instruments

As per Figure 1 below, the instruments described in Section B.1 are located in 23-28 Charterhouse Square building. A drawing showing the location of these devices can be found in the Appendix A.

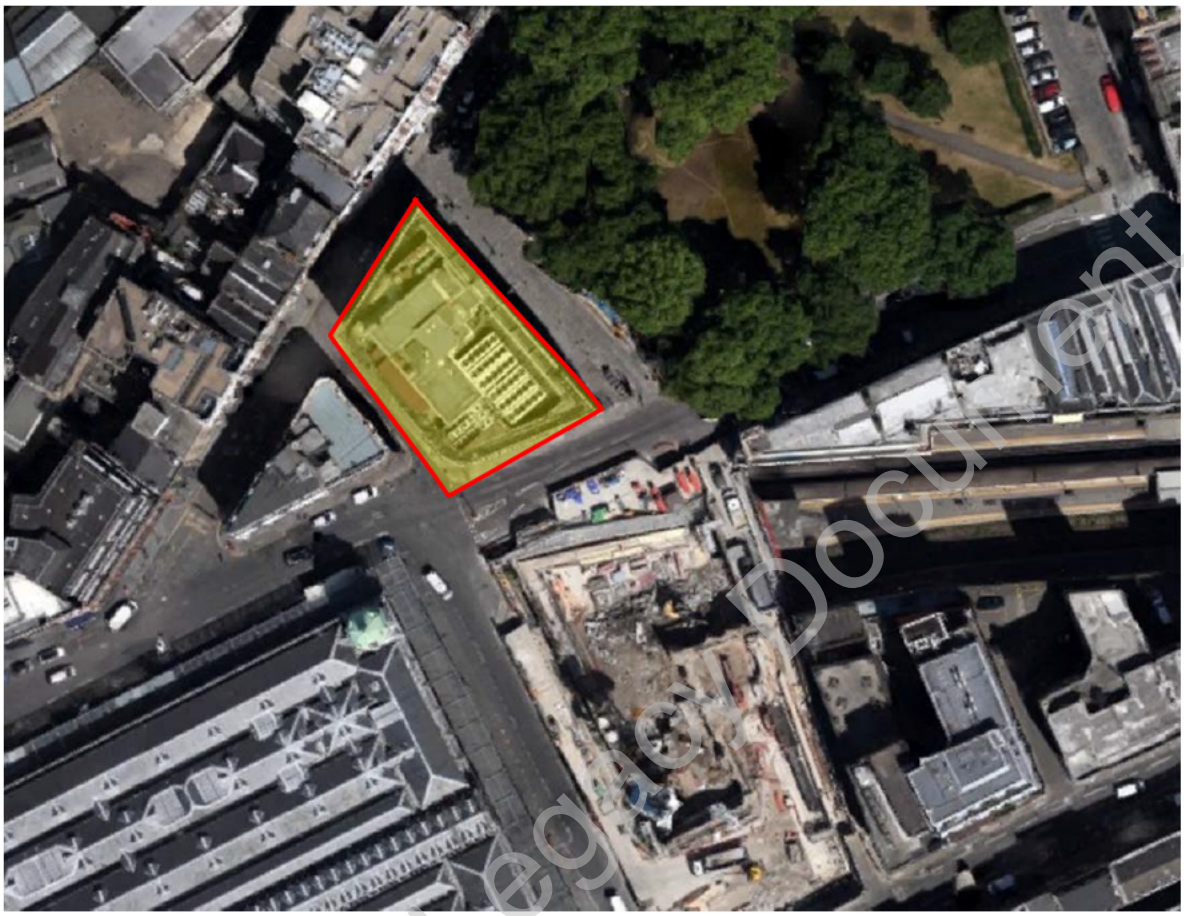

Figure 1 – Map showing the location of monitored building.

C. MOVEMENTS

C.1 Movements Resulting from Construction Activities

C.1.1 Relevant Crossrail (BFK) Works

The construction activities associated with these instruments are related to Crossrail tunnelling works. In all cases, these comprise of the passage of a TBMs (C300) and a platform tunnel enlargement.

ACTIVITY	START DATE	END DATE
Charterhouse Shaft TAM Installation	27/06/2013	30/10/2013
Charterhouse Shaft Pre-Treatment works	27/09/2013	08/11/2013
ETH Excavation	26-04-2013	28-10-2014
EB TBM	20-01-2014	24-01-2014
PTE	27-10-2014	27-01-2015
CH2	05-03-2015	28-05-2015
CP6	12-11-2014	25-11-2014
CP7	23-02-2015	25-02-2015

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ACTIVITY	START DATE	END DATE
CP8	16-06-2015	22-06-2015
CP9	10-06-2015	14-06-2015
VA2	16-04-2015	02-05-2015
STE2	02-02-2015	12-02-2015
ES2	04-06-2015	21-09-2015

Table 2 – Construction Activities associated with the devices

C.1.2 Resulting Movements

Monitoring data for these devices is presented in Appendix B.

- Around 2mm settlement produced because of the EB TBM passage from 16/01/2014 to 23/01/2014.
- During the PTE, RTE2 and CH2E period, a total of 8mm settlement was captured by these devices from 17/10/2014 to 23/03/2015.
- ES2 caused until 2mm settlement from 04/06/2014 to 21/09/2015.
- 3mm settlement recorded as a residual settlement after last excavation activity taking place until 21/09/2015, showing a trend of settlement still ongoing when last monitoring reading was taken on 15/12/2015.
- Compensation Grouting carried out in October 2014 caused until 5mm heave.
- Compensation Grouting carried out in March 2015 caused 3mm heave.
- Maximum Settlement captured of 10mm.

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.

No triggers breached. The table below shows the 10mm default alerts breached

MONITORING GROUP (Location)	POINT ID	TYPE	DIRECTION	DATE OF LAST READING	LAST READING VALUE (mm)	TRIGGER LEVEL	
						WORST HISTORICAL STATUS	CURRENT STATUS
23-28 Charterhouse Square	C435-EL000011	Electrolevel beam	Z	15/12/2015 10:58	-0.77	Clear	Clear
	C435-EL000012	Electrolevel beam	Z	15/12/2015 10:58	-2.47	Clear	Clear
	C435-EL000013	Electrolevel beam	Z	15/12/2015 10:58	-3.39	Clear	Clear
	C435-EL000014	Electrolevel beam	Z	15/12/2015 10:58	-8.74	Clear	Clear
	C435-EL000015	Electrolevel beam	Z	15/12/2015 10:58	-9.39	Clear	Clear
	C435-EL000026	Electrolevel beam	Z	15/12/2015 10:58	-3.67	Clear	Clear
	C435-EL000027	Electrolevel beam	Z	15/12/2015 10:58	-3.02	Clear	Clear
	C435-TB00001A	Tiltmeter	A	15/12/2015 10:58	-2.90	Clear	Clear
	C435-TB00001B	Tiltmeter	B	15/12/2015 10:58	-0.24	Clear	Clear
	C435-TB00002A	Tiltmeter	A	15/12/2015 10:58	-0.26	Clear	Clear
	C435-TB00002B	Tiltmeter	B	15/12/2015 10:58	-1.30	Clear	Clear
	C435-TB00003A	Tiltmeter	A	15/12/2015 10:58	-0.82	Clear	Clear
	C435-TB00003B	Tiltmeter	B	15/12/2015 10:58	-1.42	Clear	Clear

Table 3 – Default alerts breached by the devices

C.3 Significant Issues with the Instrumentation

- Initial 5mm drift recorded on Water Settlement Cells from installation date to middle of August 2013 when a maintenance survey was carried out.

C.4 Residual Risk

The rates of residual settlement for the prisms have been determined and in all cases these rates are less than 2mm/year.

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D. CONCLUSIONS

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

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APPENDIX A: DRAWINGS.

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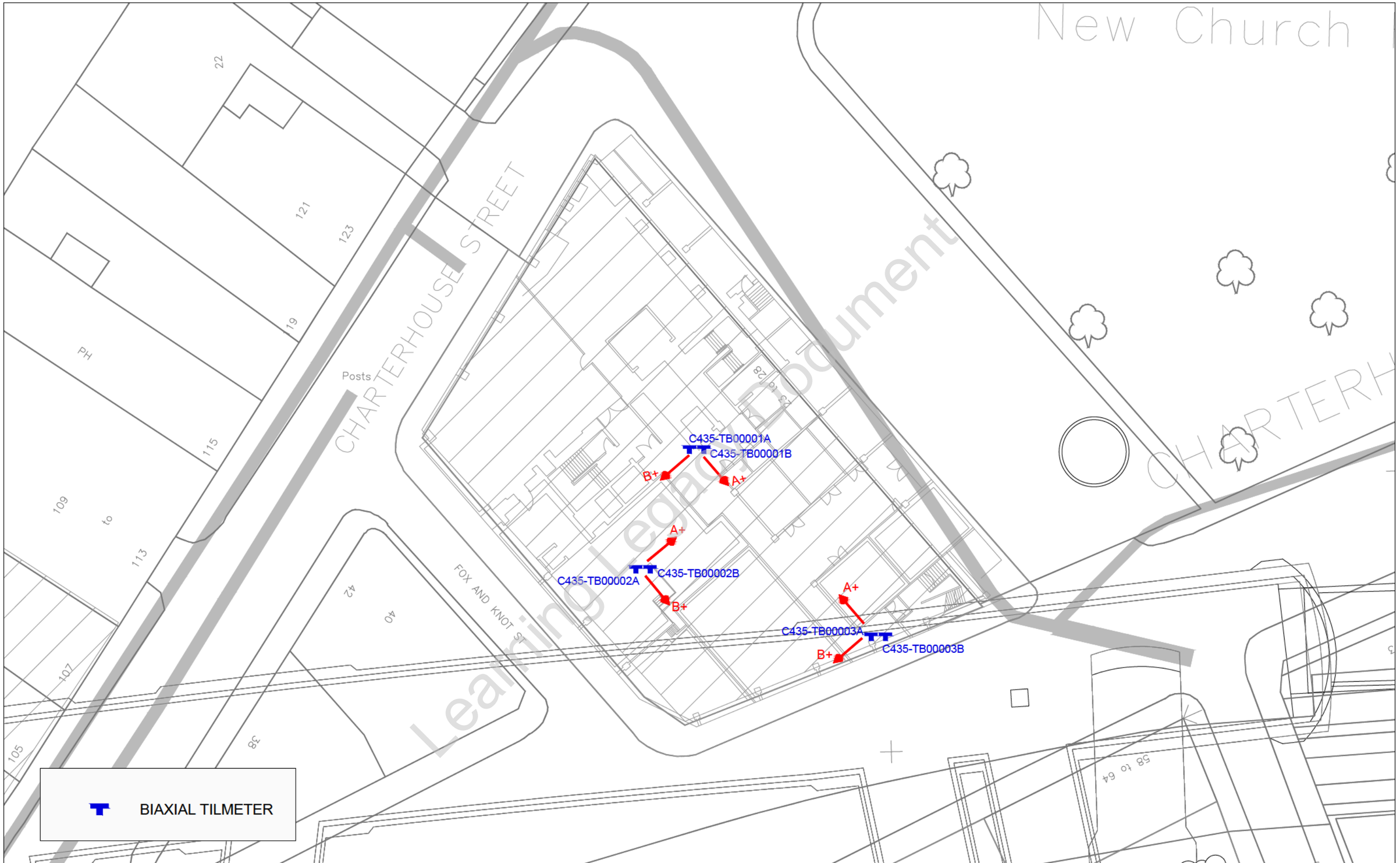

Rev.	Date	Description	By	Chkd	App	Auth
01	24-05-2013					

Notes:

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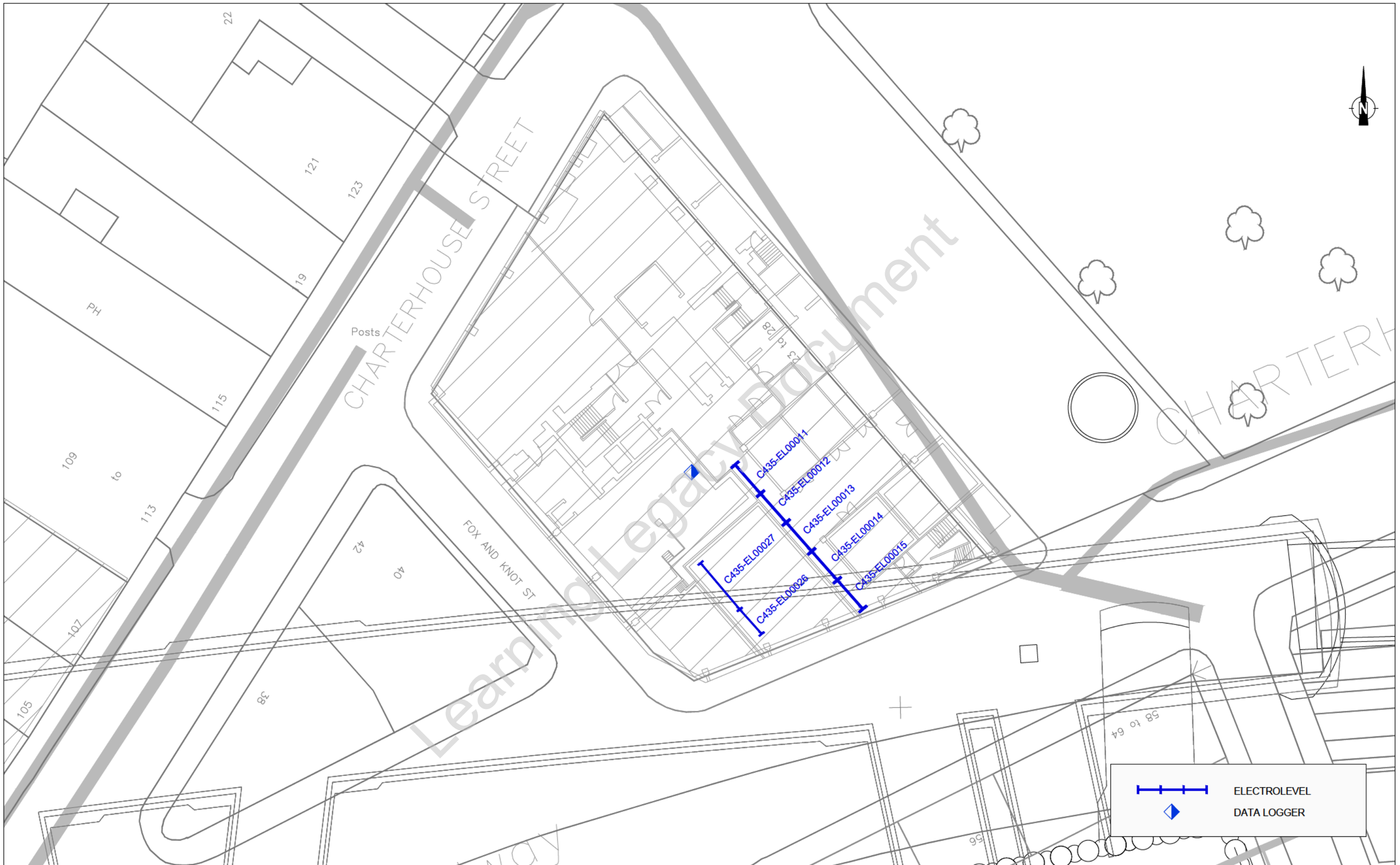
Contract : C435 I&M FARR NGDON STATION
Originator : GEOCISA
Loca ion : CROSSRA L GENERAL
Title : Biaxial Tiltmeters – Royal Bank of Scotland
By : [redacted]
Chk :
App :
Scale : @ A3
Drg No : C435-BFK-C2-RGN-M123-50035-IR-TB-RBS
Rev :
Suit :
Auth : GEOCISA

Pby
$Date$



Rev.	Date	Description	By	Chkd	App	Auth
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Contract : C435 I&M FARR NGDON STATION
Originator : GEOCISA
Loca ion : CROSSRA L GENERAL
Title : Electrolevel beams – Royal Bank of Scotland
By : [redacted]
Chk :
App :
Scale : @ A3
Drg No : C435-BFK-C2-RGN-M123-50035-IR-EL-RBS
Rev :
Suit :
Auth : GEOCISA

Day

APPENDIX B: GRAPHS

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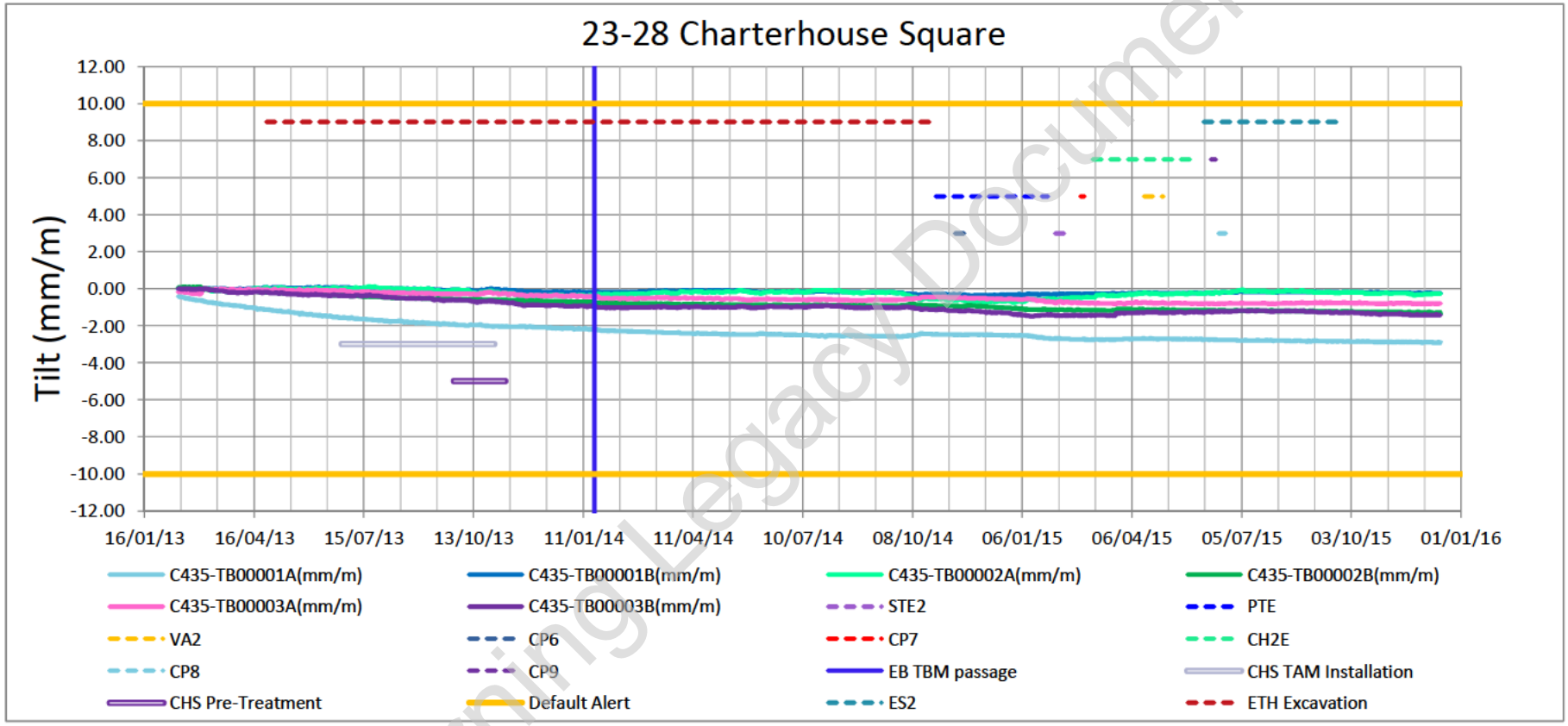

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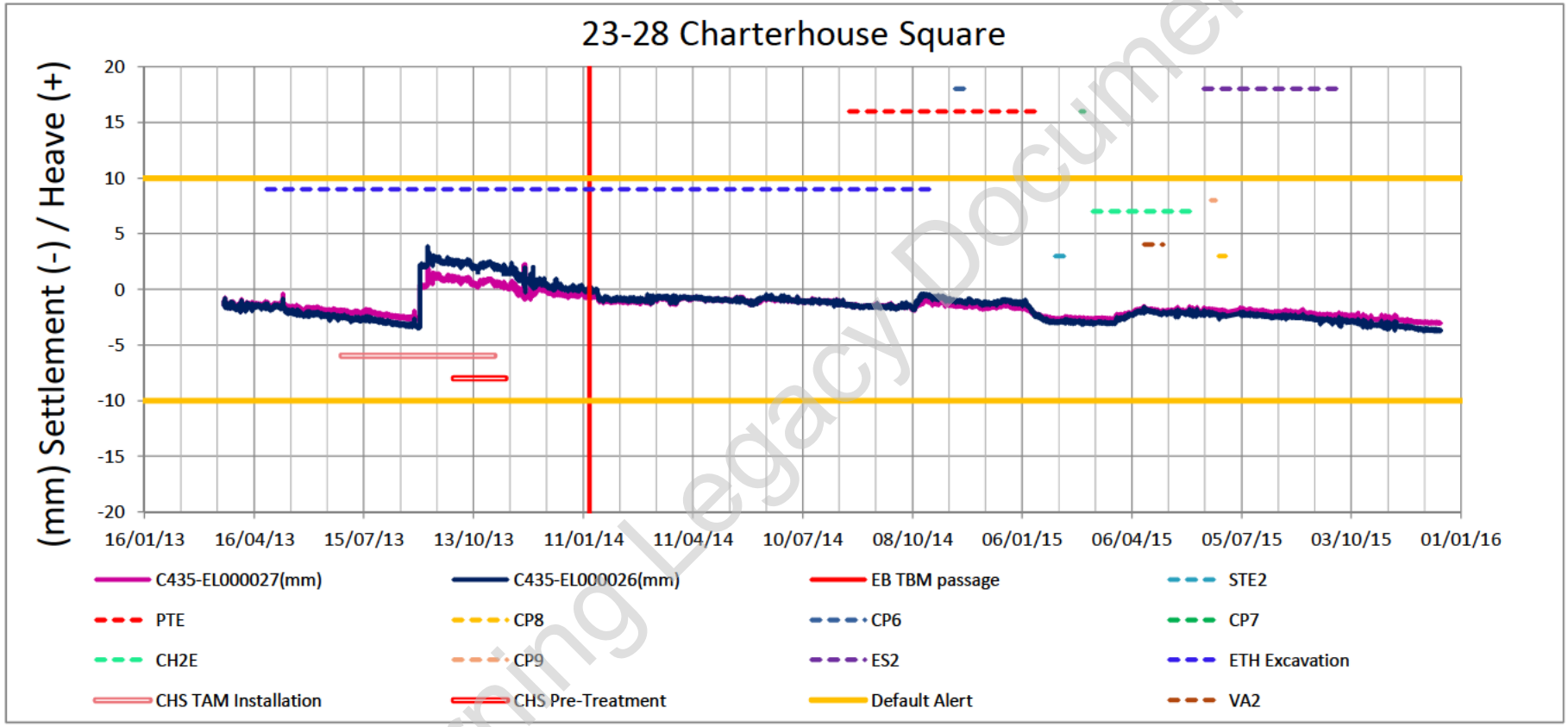
REMARKS:



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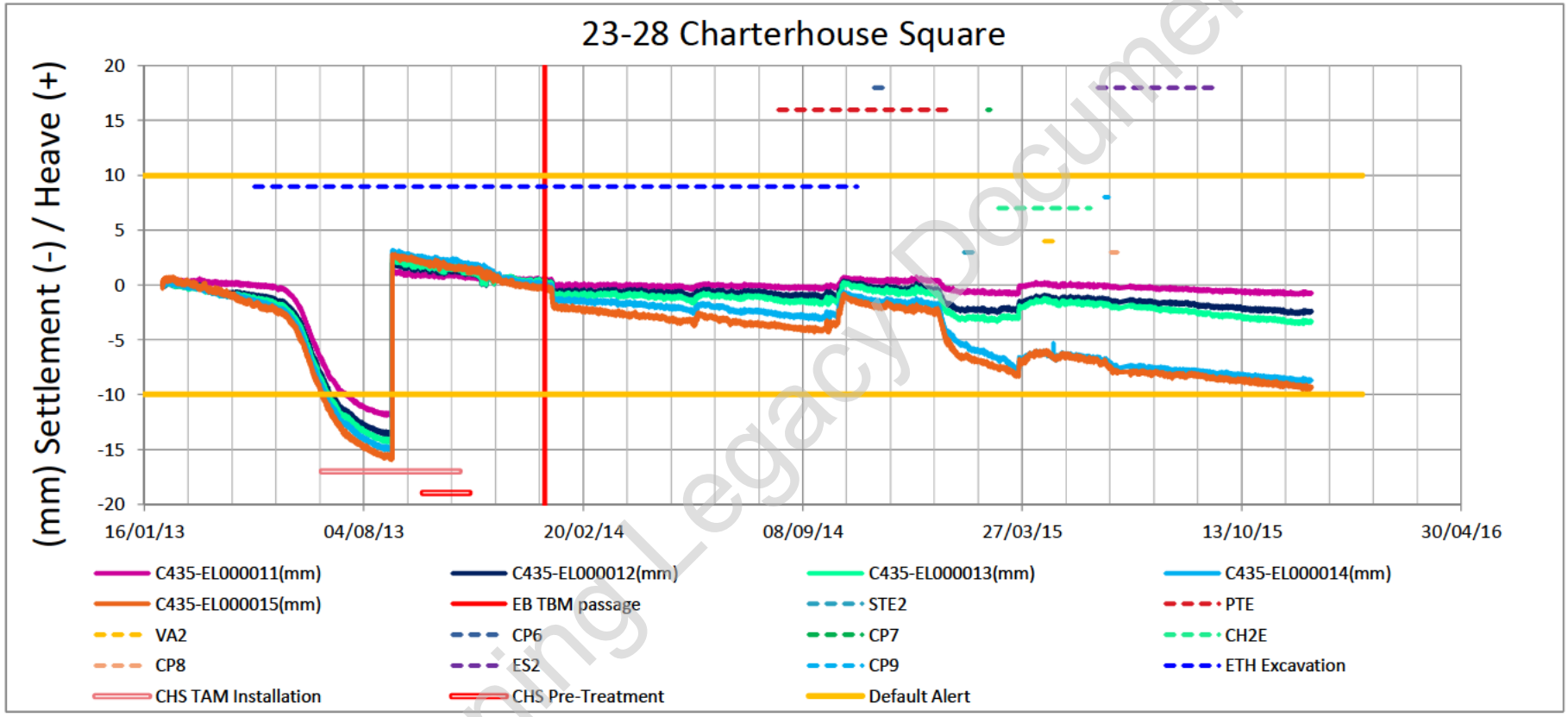
REMARKS:
Inaccurate behaviour and trend of settlement recorded from origin to 29/08/2013, when devices where fixed and readings ammended applying an offset on 30/08/2013 taking into account the behaviour recorded by surrounding devices in this period of time.



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REMARKS:
Inaccurate behaviour and trend of settlement recorded from origin to 29/08/2013, when devices where fixed and readings ammended applying an offset on 30/08/2013 taking into account the behaviour recorded by surrounding devices in this period of time.

APPENDIX C: GLOSSARY

- CH Concourse Hall.
- CP Cross Passage.
- EB Eastbound.
- ES Escalator Shaft.
- ETH Eastern Ticket Hall.
- PTE Platform Tunnel East.
- STE Stub Tunnel East
- TaM Tube a Manchette.
- TBM Tunnel Boring Machine.
- VA Ventilation Adit.

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