



C305 – Eastern Running Tunnels

I&M Close out report for Instrumentation at BT Tunnels (Drive Y)

CRL Document Number: C305-DSJ-C2-RGN-CRG03-50390

Supplier Document Number: N/A

Contract MDL reference C08.079

1. Contractor Document Submittal History:

Revision:	Date:	Prepared by:	Checked by:	Approved by:	Reason for Issue:
2.0	15-03-2016	[Redacted]	[Redacted]	[Redacted]	For approval

2a. Stakeholder Review Required? YES NO

Stakeholder submission required: LU RfL Purpose of submission: For no objection
 NR LO For information
 DLR Other: [Redacted]

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: [Redacted] Role: [Redacted] Name: [Redacted] Date: 31/3/16
 Sign: _____ Role: _____ Name: _____ Date: _____

2b. Review by Stakeholder (if required):

Stakeholder Organisation	Job Title	Name	Signature	Date	Acceptance
					<input type="checkbox"/>
					<input type="checkbox"/>
					<input type="checkbox"/>

3. Acceptance by Crossrail:

	Crossrail Review and Acceptance Decal	
	This decal is to be used for submitted documents requiring acceptance by Crossrail.	
<input checked="" type="checkbox"/>	Code 1.	Accepted. Work May Proceed
<input type="checkbox"/>	Code 2.	Not Accepted. Revise and resubmit. Work may proceed subject to incorporation of changes indicated
<input type="checkbox"/>	Code 3.	Not Accepted. Revise and resubmit. Work may not proceed
<input type="checkbox"/>	Code 4.	Received for information only. Receipt is confirmed
Reviewed/Accepted by:(signature)	[Redacted]	Date: 23/3/16
<small>Acceptance by Crossrail does not relieve the designer/supplier from full compliance with their contractual obligations and does not constitute Crossrail approval of design, details, calculations, analyses, test methods or materials developed or selected by the designer/supplier.</small>		

GEOCISA UK		C305-CLOUT-162701		
I&M Close out report for Instrumentation at BT Tunnels (Drive Y)				
C305 Crossrail Eastern Running Tunnels				
This Statement is the intellectual property of GEOCISA and is part of the Management, Environment and Quality System of the same Company.				
Current Version of the Documents & Signatures :				
Revision:	Date:	Prepared by:	Checked by:	Engineering Approved by:
2.0	15-03-2016	[REDACTED]		
Document History :				
Revision:	Date:	Prepared by:	Checked by:	Engineering Approved by:
1.0	09-02-2016	[REDACTED]		
2.0	15-03-2016	[REDACTED]		

TABLE OF CONTENTS

1.	CLOSE OUT REPORT PURPOSE	4
2.	LOCATION OF THE WORKS	4
3.	DOCUMENTATION SUMMARY	4
4.	SUMMARY OF INSTALLED INSTRUMENTATION ON SITE.....	5
5.	CONSTRUCTION ACTIVITY	5
6.	METHODOLOGY	6
7.	SUMMARY OF THE DATA	8
8.	SUMMARY STATEMENT	30

APPENDIX A: INSTRUMENT LOCATION

APPENDIX B: SUMMARY OF INSTRUMENTATION INSTALLED ON SITE

APPENDIX C: MINUTES CLOSE OUT MEETING

Learning Legacy Document

1. CLOSE OUT REPORT PURPOSE

As stated in the specification: C122-OVE-Z4-RSP-CR001-00007 Rev 7.0, the purpose of this close-out report is to summarise the data from the instrumentation included in this document and to relate the recorded movements to the construction activities which produce any observed changes. For construction activities it is intended excavation of the C305 twin bored tunnels and depressurization of cross passages; impacts from other CRL contracts are not included in this report.

The long term readings have been used to demonstrate that the subsequent movement has reached an acceptably stable rate within the accuracy of the system in order to decommission and/or that C305 works are no longer impacting the area concerned.

As stated in the specifications the settlement rate of 2 mm/yr has been defined. Where this is not achieved this report seeks agreement from all parties that the rate is acceptably low enough to cease monitoring and decommission.

2. LOCATION OF THE WORKS

This report covers the instrumentation and monitoring works in The BT Statutory authority Tunnels which are part of the BT tunnels network. The Crossrail Drive Y alignment is crossing the BT tunnel in two different locations: at Chainage 77800-78100, under Bishopsgate; at Chainage 78200-78500, under Brushfield Street and Commercial Street.

See Appendix A for the instrument location.

3. DOCUMENTATION SUMMARY

CROSSRAIL NUMBER	DOCUMENT NAME	REASON FOR ISSUE	TYPE AND NUMBER OF INSTRUMENTATION INSTALLED
C305-DSJ-C2-GMS-CRG03-50041 Rev 4.	MS Monitoring of BT Statutory Authority Service Tunnels Drive Y	Main Method statement	3 Lines of Electrolevels 3 Vibration monitors 3 Lasers Instruments 5 Tilt meter Sensors 3 arrays of levelling points
C305-DSJ-C2-RGN-CRG03-50386	Installation Report for I&M BT Tunnels Instrumentation (Drive Y)	Installation report	166 Electrolevels 64 Sockets 3 Digital Lasers 5 Tilt meter Sensors 3 Accelerometers

4. SUMMARY OF INSTALLED INSTRUMENTATION ON SITE

The total number of instruments installed, as per method statements listed in section above, was:

- 167 Electrollevels.
 - C305-EL101001-C305-EL101096
 - C305-EL101033 & C305-EL101097-C305-EL101106
 - C305-EL102001-C305-EL102061
- 64 Sockets.
 - C305-LB105001-C305-LB105096
 - C305-LB105098-C305-LB105106
 - C305-LB106001-C305-LB106061
- 3 Digital lasers.
 - C305-LC101001-C305-LC101003
- 5 Tiltmeter sensors..
 - C305-TU106101-C305-TU106105
- 3 Accelerometers
 - C305-AC10001-C305-AC10003

Detailed information of the installed instrumentation is reported in Appendix B.

5. CONSTRUCTION ACTIVITY

TBM PASSAGE Brushfield Street and Commercial Street BT Tunnel

DRIVE Y	RINGS	PROJECT CHAINAGE	DATES
Eastbound	3446-3535	78320-78470	11/12/14 to 19/12/14
Westbound	3523-3582	78350-78460	04/02/15 to 09/02/15

Stoppage period

Eastbound Drive-Y No stoppage
 Westbound Drive-Y No stoppage

TBM PASSAGE Bishopsgate BT Tunnel

DRIVE Y	RINGS	PROJECT CHAINAGE	DATES
Eastbound	3750-3765	77950-77980	17/01/15 to 18/01/15
Westbound	3855-3870	77900-77930	27/2/15 to 28/2/15

Stoppage period

Eastbound Drive-Y No stoppage
 Westbound Drive-Y No stoppage

The periods of TBM passage and stoppage are related to the rings located close to the instrumentation included in this close out report

CP6 WORKS

Cross passage CP6 depressurization dates 21/2/15 to 27/6/15
 Cross passage CP6 cross passage construction dates 29/3/15 to 07/6/15

6. METHODOLOGY

To determine the settlement rate the following methodology has been used. A Linear Regression has been applied for a defined period using long term readings after TBM construction. This uses the following formula to calculate the gradient or slope of the line:

$$b = \frac{\sum_{i=1}^n (X_i - \bar{X}_i) \cdot (Y_i - \bar{Y}_i)}{\sum_{i=1}^n (X_i - \bar{X}_i)^2}$$

Where:

B =gradient or slope

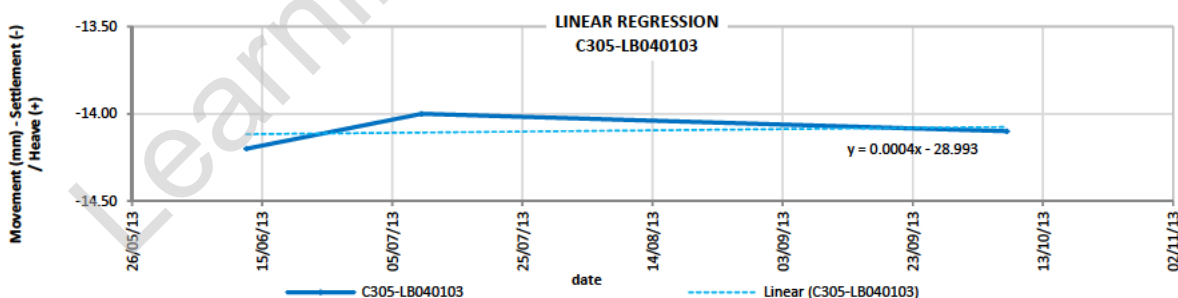
X (independent variable) = date

Y (dependent variable) = vertical movement

From this, the settlement rate per day can be calculated and rate per year determined (negative values is for settlement, positive is for heave). For these values, the percentage at or below 2 mm/yr will be used to determine the trend of the section/area being considered. Also for comparison, values at or below 3 mm/year are presented to highlight that the rate is close to achieving the 2 mm/yr. Note the percentages of settlement rate presented in the sections below refer to values rounded to the nearest integer.

One example of this calculation can be seen below

	Registered movement (mm)			RATE mm/year
	12/06/2013	09/07/2013	07/10/2013	
C305-LB040103	-14.20	-14.00	-14.10	0.146



CALCULATION - C305-LB040103

X_i	Y_i	$X_i - \bar{X}_i$	$Y_i - \bar{Y}_i$	$(X_i - \bar{X}_i)^2$	$(X_i - \bar{X}_i) \cdot (Y_i - \bar{Y}_i)$
12/06/2013	-14.2	-47.94	-0.10	2298.67	4.794
09/07/2013	-14	-21.03	0.10	442.17	-2.103
07/10/2013	-14.1	68.97	0.00	4757.17	0.000

\bar{X}_i	41485.53	
\bar{Y}_i	-14.10	
$\sum_{i=1}^n (X_i - \bar{X}_i)^2$	7498.00	(2)
$\sum_{i=1}^n (X_i - \bar{X}_i) \cdot (Y_i - \bar{Y}_i)$	2.692	(1)
m (SLOPE)	(1)/(2)	0.0004
Rate (mm/year)	m * 365	0.146

7. SUMMARY OF THE DATA

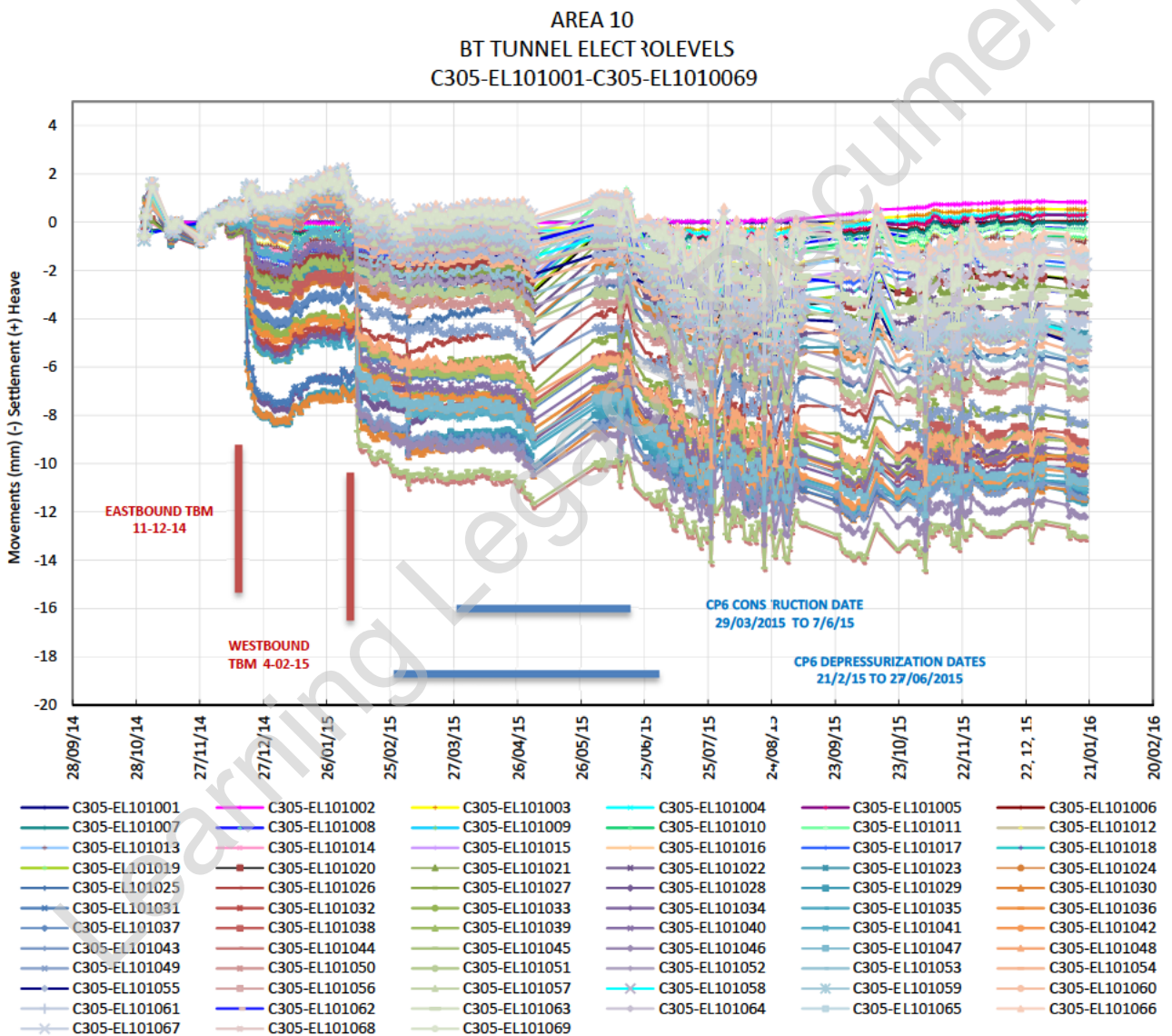
The methodology explained in section 6 is applied here for the electrolevel monitoring points and sockets.

Note: For the following data plots # I/A refers to instances where readings were not taken for that sensor (e.g. damaged sensor, no access, etc).

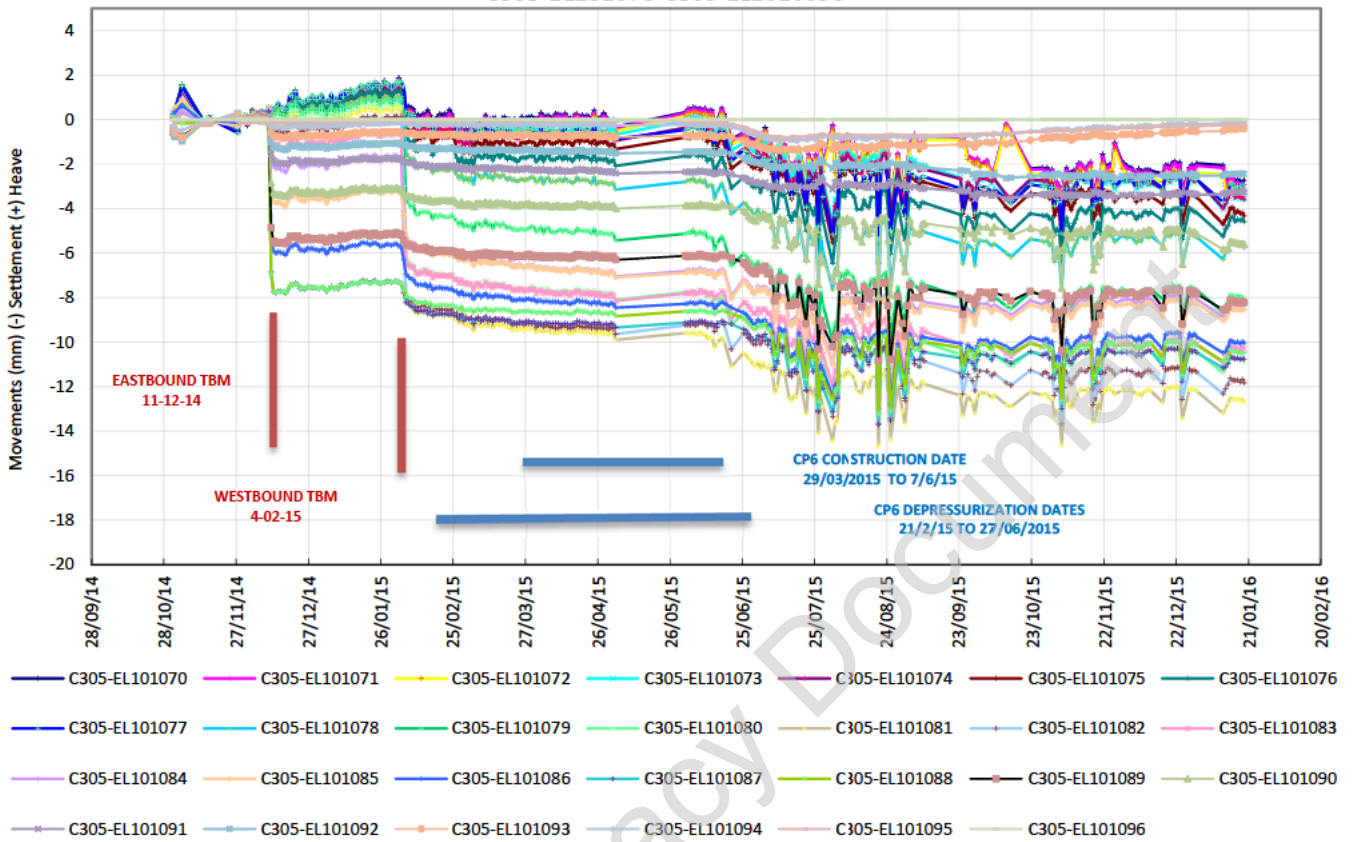
ELECTROLEVELS

C305-EL101001- C305-EL101096 Brusfield Street and Commercial Street BT Tunnel

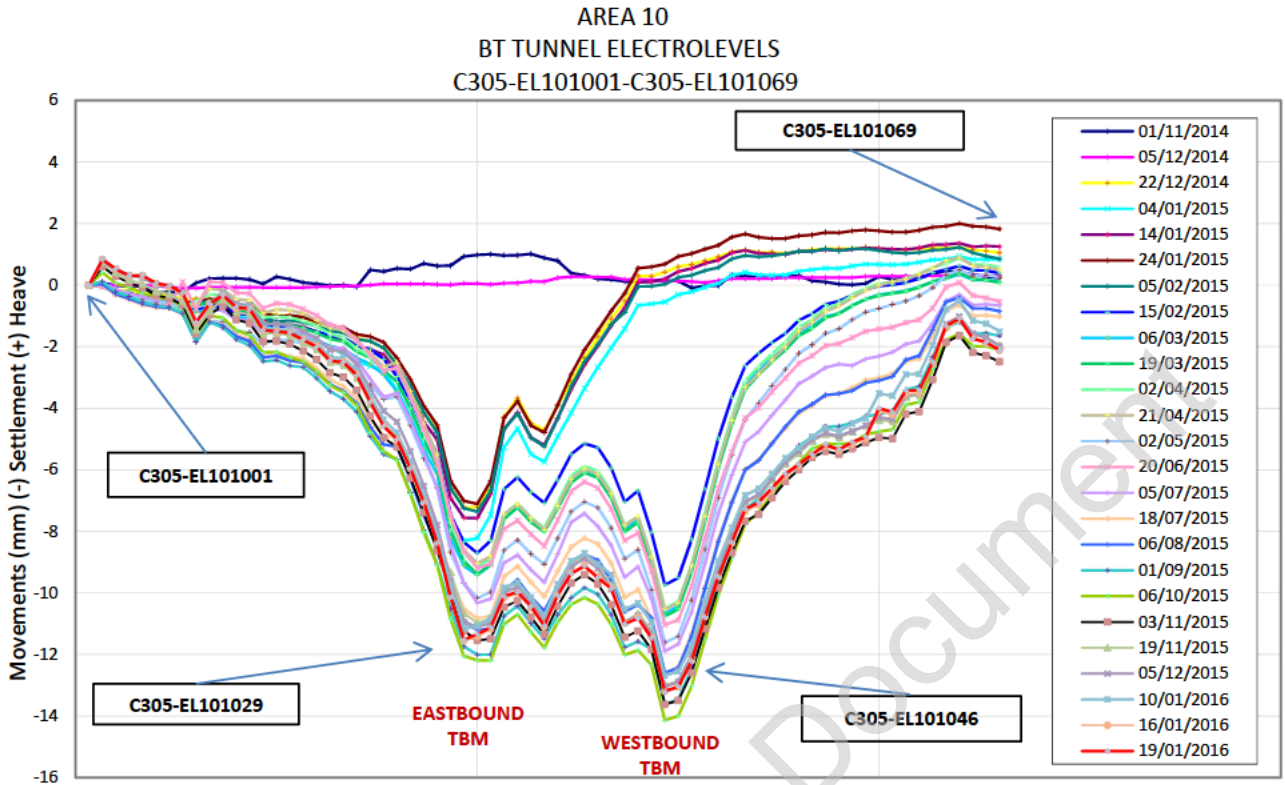
Data are presented below in a “movement vs. time” chart:



AREA 1
BT TUNNEL ELECTROLEVELS
C305-EL101070-C305-EL101096



Data are presented below in a "longitudinal profile" chart:



Electrolevel monitoring points C305-EL101001--C305-EL101096 recorded a maximum settlement of 14.0 mm during the Eastbound TBM & Westbound TBM transit.

There is no evidence of depressurization at CP-6 affecting settlements at this location. However the electrolevel chain recorded a drop of approx. 3 mm after CP6 construction, perhaps due to some sensors being knocked during tunnel maintenance activities. Minimal movement is in fact confirmed by the manual monitoring illustrated in the following section "Sockets".

Readings since October 2015 were used to calculate the annual projection.

	Registered movement (mm)				mm/year
	06/10/2015	15/11/2015	07/12/2015	19/01/2016	
C305-EL101001	0	0	0	0	0.000
C305-EL101002	0.41	0.73	0.8	0.83	1.439
C305-EL101003	0.06	0.4	0.53	0.52	1.612
C305-EL101004	-0.07	0.18	0.33	0.3	1.329
C305-EL101005	-0.25	0.06	0.25	0.31	1.992
C305-EL101006	-0.4	-0.14	-0.02	0.06	1.612
C305-EL101007	-0.46	-0.18	-0.05	-0.02	1.550
C305-EL101008	-0.68	-0.39	-0.26	-0.25	1.515
C305-EL101009	-1.61	-1.32	-1.2	-1.21	1.407
C305-EL101010	-0.99	-0.69	-0.58	-0.61	1.332
C305-EL101011	-1.07	-0.34	-0.21	-0.33	2.526
C305-EL101012	-1.47	-0.77	-0.6	-0.72	2.588
C305-EL101013	-1.63	-0.87	-0.66	-0.77	2.982
C305-EL101014	-2.18	-1.46	-1.27	-1.46	2.498
C305-EL101015	-2.18	-1.43	-1.26	-1.51	2.314
C305-EL101016	-2.35	-1.52	-1.31	-1.55	2.773
C305-EL101017	-2.48	-1.74	-1.52	-1.78	2.449
C305-EL101018	-2.81	-1.96	-1.72	-2.01	2.791
C305-EL101019	-3.25	-2.36	-2.14	-2.46	2.740
C305-EL101020	-3.49	-2.44	-2.18	-2.51	3.396
C305-EL101021	-3.91	-2.84	-2.6	-2.93	3.381
C305-EL101022	-4.79	-3.67	-3.44	-3.8	3.404
C305-EL101023	-5.39	-4.36	-4.13	-4.59	2.769
C305-EL101024	-5.69	-4.7	-4.48	-5.01	2.360
C305-EL101025	-6.79	-5.68	-5.41	-5.96	2.890
C305-EL101026	-8.04	-6.8	-6.51	-7.06	3.399
C305-EL101027	-9.1	-8.07	-7.8	-8.38	2.525
C305-EL101028	-10.85	-9.09	-9.63	-10.15	1.861
C305-EL101029	-12.05	-10.41	-10.97	-11.52	1.283
C305-EL101030	-12.19	-10.71	-11.14	-11.34	2.465
C305-EL101031	-12.2	-10.61	-11.01	-11.12	3.253
C305-EL101032	-11.02	-9.63	-10.02	-10.11	2.702
C305-EL101033	-10.7	-9.43	-9.83	-9.97	2.097
C305-EL101034	-11.27	-9.93	-10.37	-10.44	2.402
C305-EL101035	-11.78	-10.48	-10.9	-11.07	2.013
C305-EL101036	-10.96	-9.55	-9.94	-10.08	2.598
C305-EL101037	-10.38	-8.79	-9.16	-9.37	3.036
C305-EL101038	-10.15	-8.51	-8.9	-9.13	3.052
C305-EL101039	-10.37	-8.81	-9.25	-9.51	2.485
C305-EL101040	-11.03	-9.51	-9.93	-9.86	3.550
C305-EL101041	-12.02	-10.65	-10.99	-11.01	3.074
C305-EL101042	-11.86	-10.41	-10.74	-10.83	3.142
C305-EL101043	-12.34	-10.97	-11.31	-11.46	2.635
C305-EL101044	-14.14	-12.72	-13.06	-13.2	2.833
C305-EL101045	-14	-12.6	-12.91	-13.05	2.889
C305-EL101046	-13.03	-11.72	-12.04	-12.22	2.416
C305-EL101047	-11.52	-10.28	-10.58	-10.79	2.165
C305-EL101048	-10.07	-8.93	-9.21	-9.48	1.713
C305-EL101049	-8.87	-7.83	-8.13	-8.36	1.438
C305-EL101050	-7.76	-6.77	-7.04	-7.28	1.361
C305-EL101051	-7.39	-6.52	-6.79	-7.06	0.864
C305-EL101052	-6.8	-6	-6.28	-6.59	0.457
C305-EL101053	-6.23	-5.46	-5.76	-6.13	0.075
C305-EL101054	-5.78	-5.08	-5.39	-5.83	-0.433
C305-EL101055	-5.32	-4.67	-5	-5.5	-0.881
C305-EL101056	-5.15	-4.46	-4.78	-5.19	-0.405

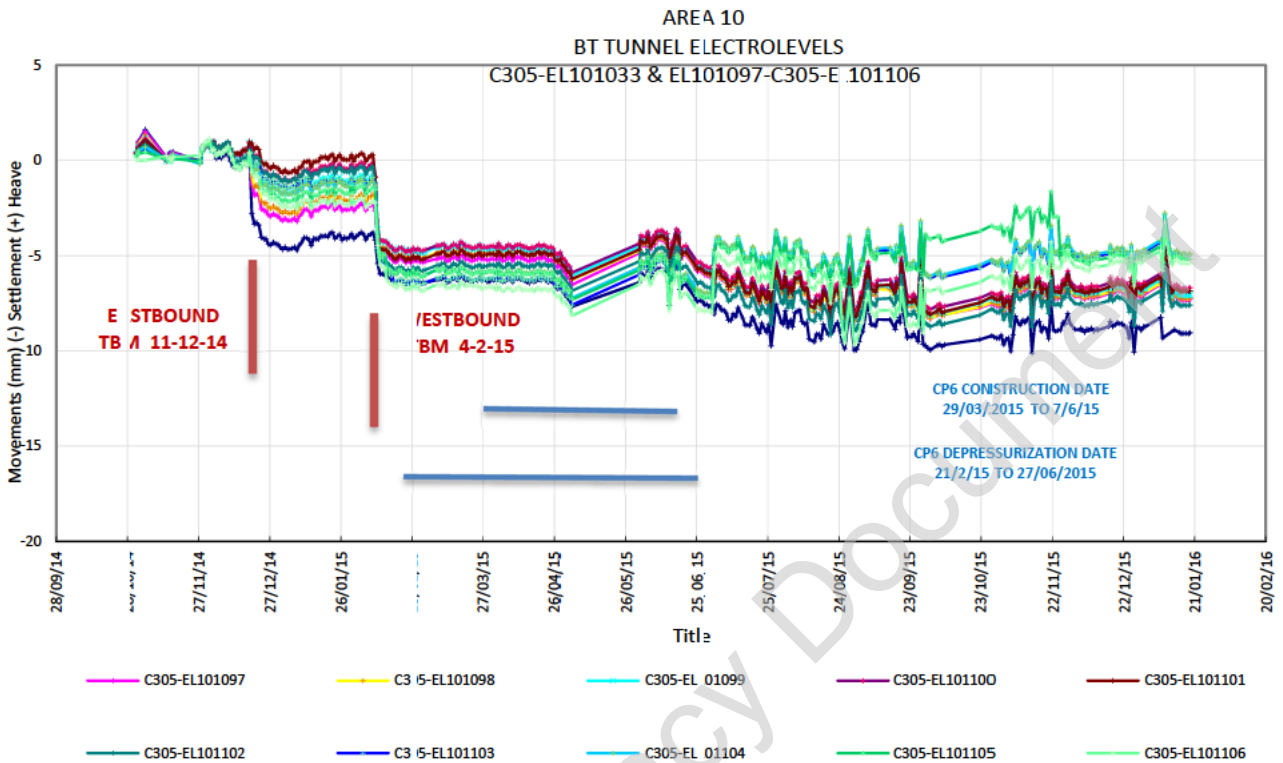
	Registered movement (mm)				mm/year
	06/10/2015	15/11/2015	07/12/2015	19/01/2016	
C305-EL101057	-5.17	-4.56	-4.87	-5.34	-0.831
C305-EL101058	-5.13	-4.43	-4.78	-5.1	-0.189
C305-EL101059	-4.86	-4.23	-4.6	-4.94	-0.568
C305-EL101060	-4.76	-4.02	-4.34	-4	2.296
C305-EL101061	-4.69	-4.06	-4.39	-4.13	1.622
C305-EL101062	-3.89	-3.25	-3.6	-3.43	1.270
C305-EL101063	-3.8	-3.19	-3.55	-3.42	0.996
C305-EL101064	-2.71	-2.18	-2.54	-2.5	0.428
C305-EL101065	-1.78	-0.97	-1.3	-1.33	1.235
C305-EL101066	-1.58	-0.74	-1.04	-1.09	1.388
C305-EL101067	-1.99	-1.28	-1.59	-1.74	0.581
C305-EL101068	-1.99	-1.33	-1.68	-1.86	0.153
C305-EL101069	-2.1	-1.54	-1.88	-2.12	-0.339
C305-EL101070	-2.45	-2.06	-2.35	-2.72	-1.137
C305-EL101071	-2.41	-2.13	-2.46	-2.92	-1.966
C305-EL101072	-2.54	-2.35	-2.7	-3.25	-2.648
C305-EL101073	-2.86	-2.62	-3	-3.57	-2.672
C305-EL101074	-2.79	-2.55	-2.94	-3.58	-2.949
C305-EL101075	-3.4	-3.22	-3.59	-4.33	-3.404
C305-EL101076	-4.38	-4.03	-4.36	-4.59	-0.957
C305-EL101077	-3.27	-2.7	-2.9	-3.07	0.496
C305-EL101078	-5.68	-5.18	-5.48	-5.77	-0.545
C305-EL101079	-8.07	-7.56	-7.89	-8.16	-0.565
C305-EL101080	-10.65	-10.24	-10.62	-10.92	-1.198
C305-EL101081	-12.5	-12.08	-12.42	-12.71	-0.970
C305-EL101082	-11.53	-11.21	-11.54	-11.83	-1.259
C305-EL101083	-10.23	-10	-10.31	-10.31	-0.494
C305-EL101084	-8.46	-8.09	-8.31	-8.34	0.229
C305-EL101085	-8.67	-8.27	-8.48	-8.54	0.267
C305-EL101086	-10.13	-9.73	-9.95	-10.03	0.159
C305-EL101087	-10.8	-10.42	-10.62	-10.76	-0.029
C305-EL101088	-10.36	-10.05	-10.27	-10.48	-0.577
C305-EL101089	-8.02	-7.72	-7.92	-8.22	-0.834
C305-EL101090	-5.08	-4.9	-5.15	-5.6	-1.938
C305-EL101091	-3.42	-3.4	-3.45	-3.27	0.473
C305-EL101092	-2.49	-2.51	-2.59	-2.45	0.084
C305-EL101093	-1.05	-0.75	-0.7	-0.41	2.171
C305-EL101094	-0.68	-0.38	-0.32	-0.09	2.009
C305-EL101095	-0.62	-0.44	-0.37	-0.23	1.350
C305-EL101096	0	0	0	0	0.000
	Rate less than -2.5 mm/year			% less 2 mm/ year	96%
	Rate greater than -3.5 mm/year			% less 3 mm/ year	100%

The table above shows the annual rate for the electrolevel monitoring points in this array.

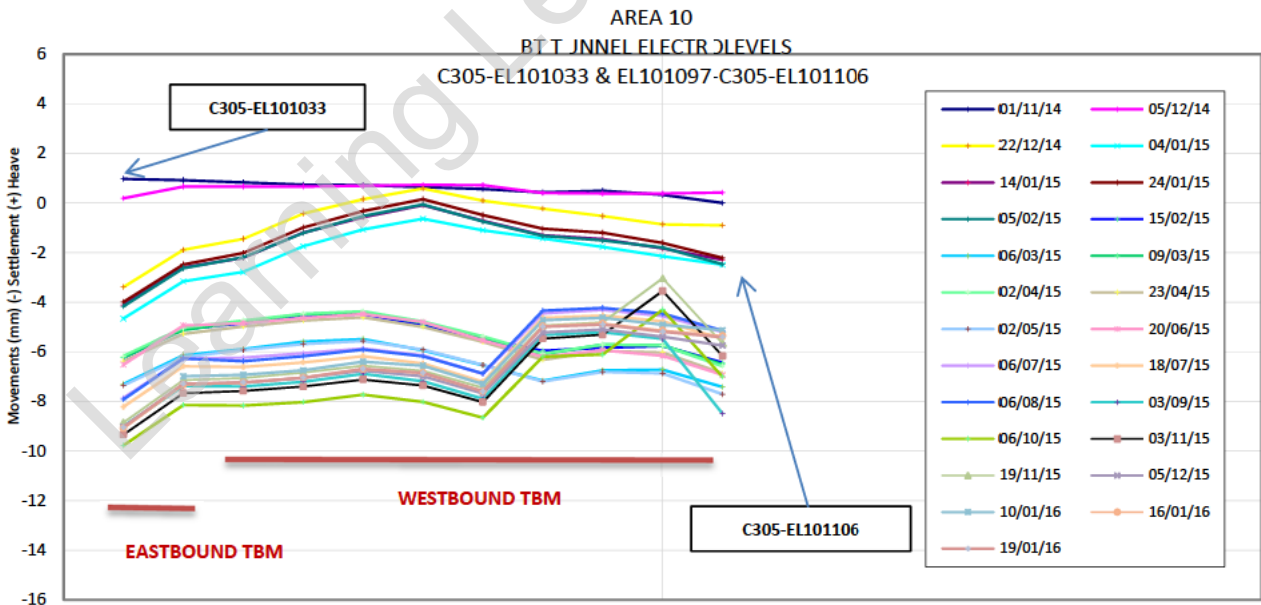
The percentage of sensors with a settlement rate less than 2 mm/year is 96%.

C305-EL101033 & C305-EL101097 - C305-EL101106 Adit of the Bushfield Street and Commercial Street BT Tunnel

Data are presented below in a "movement vs. time" chart:



Data are presented below in a "longitudinal profile" chart:



Electrolevel monitoring points C305-EL101033& EL101097-C305-EL101106 recorded a maximum settlement of 11 mm during the Eastbound TBM & Westbound TBM transit.

There is no evidence of depressurization at CP-6 affecting settlements at this location. However the electrolevel chain recorded a drop of approx. 3 mm after CP6 construction, perhaps due to some sensors being knocked during tunnel maintenance activities. Minimal movement is in fact confirmed by the manual monitoring illustrated in the following section "Sockets".

Readings since October 2015 were used to calculate the annual projection.

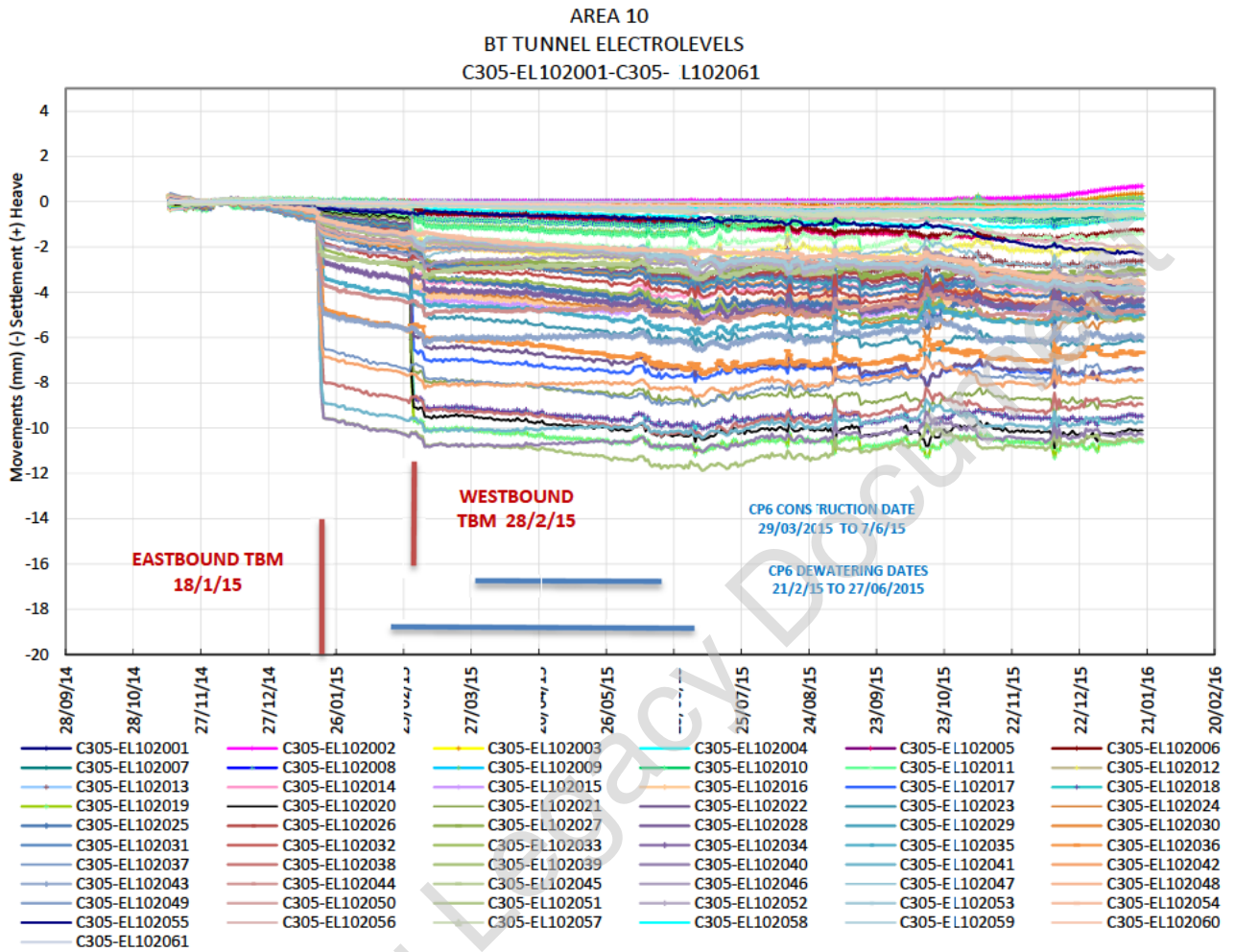
	Registered movement (mm)			mm/year
	05/11/2015	20/11/2015	18/01/2016	
C305-EL101033	-10.08	-10.28	-10.02	0.658
C305-EL101097	-8.39	-8.59	-8.27	0.973
C305-EL101098	-8.37	-8.56	-8.26	0.903
C305-EL101099	-8.16	-8.38	-8.05	0.955
C305-EL101100	-7.88	-8.1	-7.68	1.428
C305-EL101101	-8.1	-8.33	-7.84	1.760
C305-EL101102	-8.77	-9.04	-8.6	1.356
C305-EL101103	-6.27	-6.45	-5.95	1.990
C305-EL101104	-6.07	-6.32	-5.88	1.427
C305-EL101105	-4.25	-4.5	#N/A	#N/A
C305-EL101106	-6.87	-7.15	-6.34	3.265
	Rate less than -2.5 mm/year		% less 2 mm/ year	100%
	Rate greater than -3.5 mm/year		% less 3 mm/ year	100%

The table above shows the annual rate for the electrolevel monitoring points in this array.

The percentage of sensors with a settlement rate less than 2 mm/year is 100%.

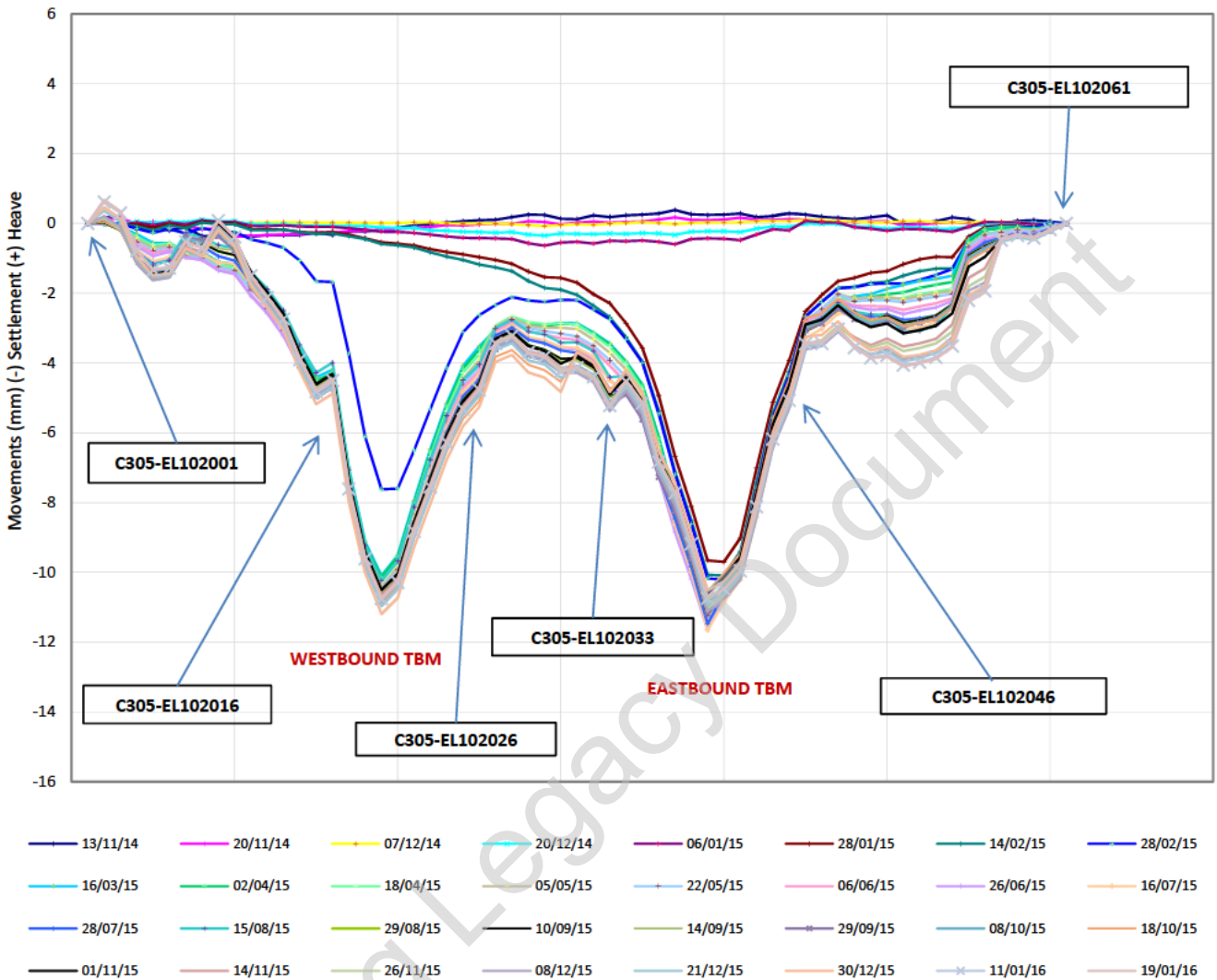
C305-EL102001-C305-EL102061 Bishopsgate BT Tunnel

Data are presented below in a "movement vs. time" chart:



Data are presented below in a "longitudinal profile" chart:

AREA 10
 BT TUNNEL ELECTROLEVELS
 C305-EL102001 C305-EL102061



Electrolevel monitoring points C305-EL102001 C305-EL102061 recorded a maximum settlement of 11 mm during the Eastbound TBM & Westbound TBM transit.

There is no evidence of depressurization at CP-6 affecting settlements in the BT Tunnel, as shown in the graphic above. Readings since December 2015 were used to calculate the annual projection.

	Registered movement (mm)				mm/year
	22/12/2015	02/01/2016	10/01/2016	19/01/2016	
C305-EL102001	0	0		0	0.000
C305-EL102002	0.31	0.46	0.57	0.62	4.199
C305-EL102003	-0.07	0.07	0.18	0.23	4.073
C305-EL102004	-1.22	-1.11	-1.02	-0.98	3.264
C305-EL102005	-1.82	-1.72	-1.64	-1.61	2.865
C305-EL102006	-1.79	-1.72	-1.63	-1.57	2.991
C305-EL102007	-1.05	-1	-0.9	-0.89	2.313
C305-EL102008	-1.32	-1.27	-1.16	-1.15	2.469
C305-EL102009	-0.49	-0.46	-0.37	-0.35	2.020
C305-EL102010	-6.02	-6	-5.92	-5.89	1.853
C305-EL102011	1.46	1.46	1.58	1.6	2.110
C305-EL102012	0.91	0.91	1.04	1.05	2.150
C305-EL102013	0.21	0.21	0.35	0.35	2.190

	Registered movement (mm)				mm/year
	22/12/2015	02/01/2016	10/01/2016	19/01/2016	
C305-EL102014	-0.94	-0.93	-0.81	-0.79	2.236
C305-EL102015	-1.91	-1.91	-1.78	-1.76	2.266
C305-EL102016	-1.68	-1.64	-1.5	-1.49	2.812
C305-EL102017	-4.82	-4.78	-4.67	-4.66	2.343
C305-EL102018	-6.91	-6.91	-6.78	-6.78	2.034
C305-EL102019	-8.1	-8.09	-7.98	-7.97	1.964
C305-EL102020	-7.71	-7.67	-7.58	-7.54	2.379
C305-EL102021	-6.28	-6.24	-6.16	-6.13	2.106
C305-EL102022	-5.06	-5.04	-4.95	-4.9	2.242
C305-EL102023	-3.87	-3.86	-3.76	-3.75	1.807
C305-EL102024	-2.97	-2.91	-2.84	-2.8	2.319
C305-EL102025	-2.53	-2.47	-2.39	-2.36	2.359
C305-EL102026	-1.24	-1.12	-1.02	-1	3.314
C305-EL102027	-1.11	-0.95	-0.87	-0.86	3.391
C305-EL102028	-1.69	-1.52	-1.44	-1.43	3.518
C305-EL102029	-1.84	-1.7	-1.61	-1.61	3.178
C305-EL102030	-2.31	-2.18	-2.07	-2.09	3.132
C305-EL102031	-2.1	-2.05	-1.97	-2.09	0.489
C305-EL102032	-2.52	-2.47	-2.38	-2.51	0.529
C305-EL102033	-3.48	-3.39	-3.29	-3.39	1.540
C305-EL102034	-2.78	-2.69	-2.54	-2.63	2.439
C305-EL102035	-3.51	-3.42	-3.22	-3.32	3.105
C305-EL102036	-5.22	-5.15	-4.98	-5.05	2.731
C305-EL102037	-6.1	-6	-5.84	-5.89	3.187
C305-EL102038	-7.65	-7.54	-7.41	-7.5	2.379
C305-EL102039	-9.31	-9.17	-9.06	-9.12	2.794
C305-EL102040	-9.07	-8.96	-8.87	-8.95	1.869
C305-EL102041	-8.59	-8.46	-8.38	-8.47	1.849
C305-EL102042	-6.86	-6.68	-6.67	-6.72	1.852
C305-EL102043	-5	-4.85	-4.83	-4.88	1.629
C305-EL102044	-3.97	-3.83	-3.79	-3.82	2.048
C305-EL102045	-2.36	-2.24	-2.19	-2.23	1.835
C305-EL102046	-2.37	-2.28	-2.25	-2.29	1.143
C305-EL102047	-2	-1.93	-1.93	-1.95	0.653
C305-EL102048	-2.68	-2.65	-2.7	-2.7	-0.403
C305-EL102049	-3.04	-3.02	-3.07	-3.12	-1.110
C305-EL102050	-3.07	-3.06	-3.12	-3.21	-1.858
C305-EL102051	-3.41	-3.39	-3.47	-3.54	-1.812
C305-EL102052	-3.41	-3.39	-3.47	-3.54	-1.812
C305-EL102053	-3.33	-3.3	-3.38	-3.47	-1.918
C305-EL102054	-3.09	-3.09	-3.16	-3.25	-2.141
C305-EL102055	-1.81	-1.85	-1.91	-2.01	-2.607
C305-EL102056	-1.61	-1.66	-1.71	-1.79	-2.344
C305-EL102057	-0.3	-0.29	-0.33	-0.33	-0.499
C305-EL102058	-0.22	-0.21	-0.21	-0.21	0.126
C305-EL102059	-0.35	-0.3	-0.32	-0.34	0.087
C305-EL102060	-0.18	-0.16	-0.17	-0.16	0.213
	Rate less than -2.5 mm/year			% less 2 mm/ year	98%
	Rate greater than -3.5 mm/year			% less 3 mm/ year	100%

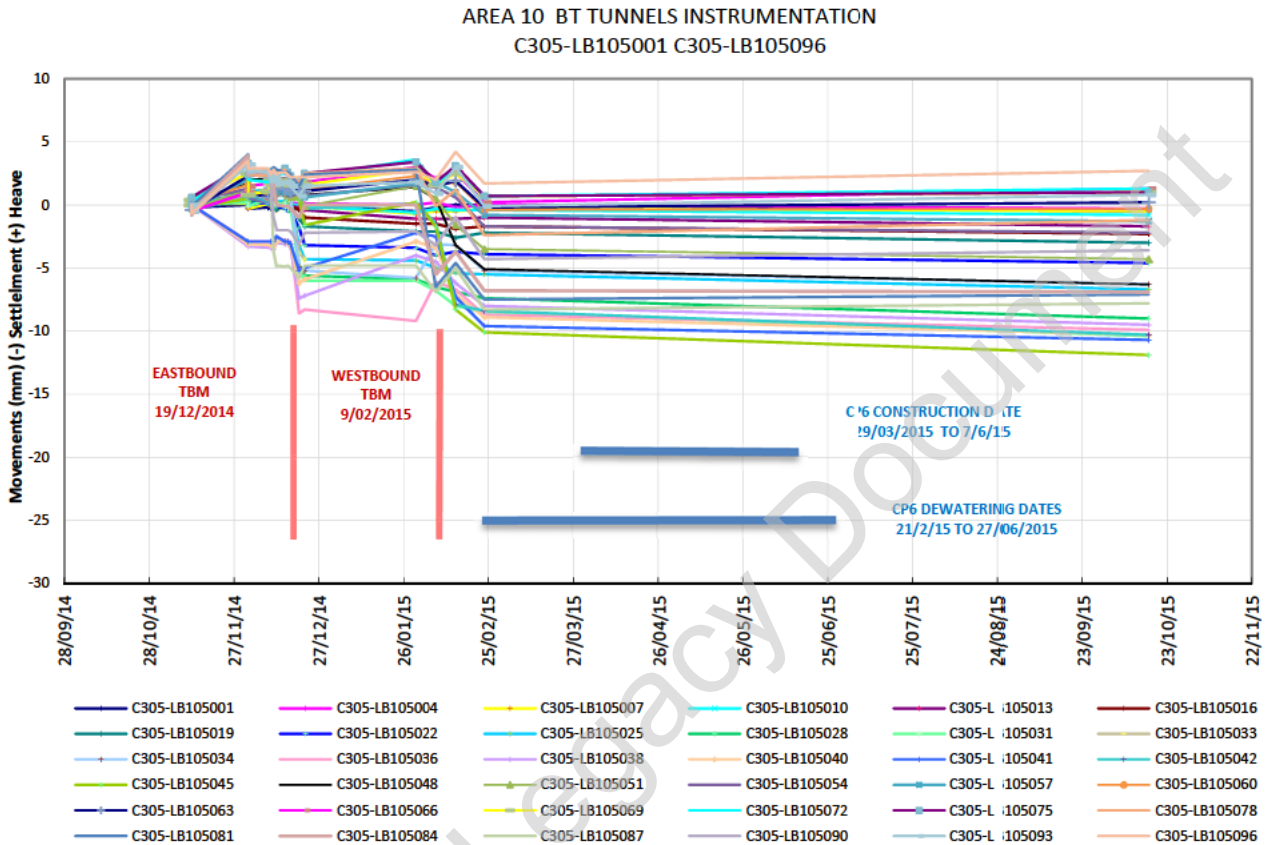
The table above shows the annual rate for the electrolevel monitoring points in this array.

The percentage of sensors with a settlement rate less than 2 mm/year is 98%.

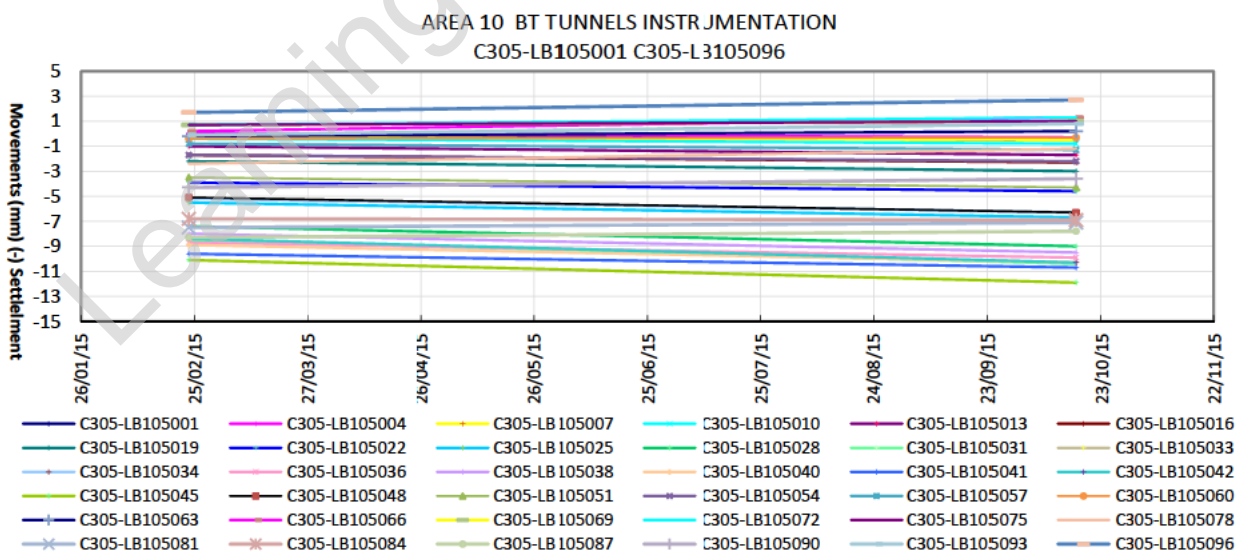
SOCKETS

C305-LB105001– C305-LB105096 Brusfield Street and Commercial Street BT Tunnel

The graph presented below shows the readings from the sockets of this array. A maximum settlement of 3.6 mm is recorded after the Eastbound TBM transit and 11.9 mm is after Westbound TBM transit.



The next plot shows the trend line adjustment for the sockets in this array.



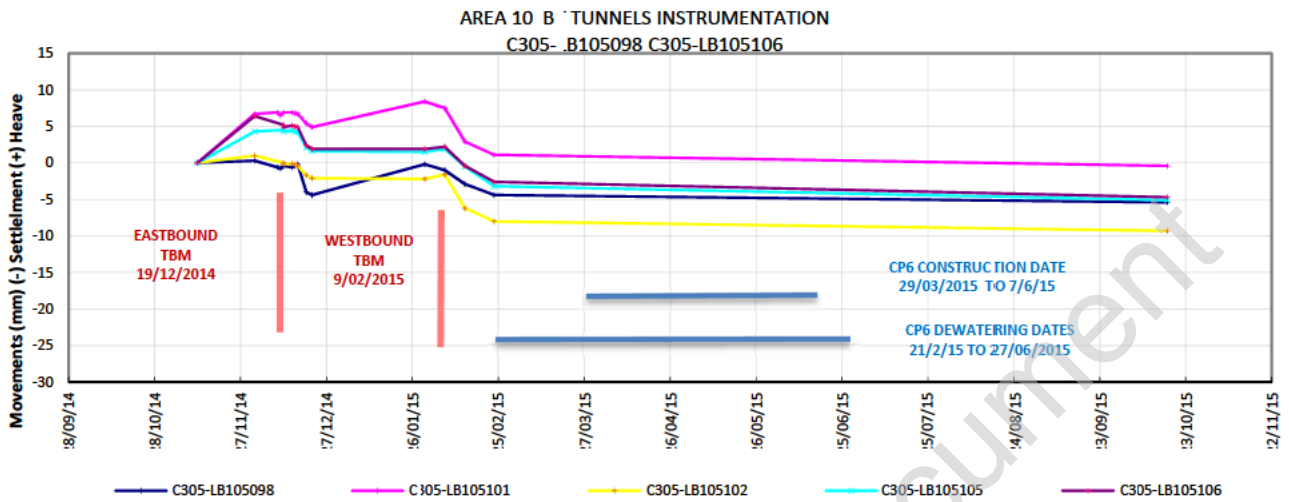
The table below illustrates the annual settlement rate for the sockets in this array.

	Registered movement (mm)		mm/year
	23/02/2015	16/10/2015	
C305-LB105001	0.00	-0.50	-0.777
C305-LB105004	0.00	-0.30	-0.466
C305-LB105007	-0.30	-0.50	-0.311
C305-LB105010	-0.40	-0.80	-0.621
C305-LB105013	-1.00	-1.70	-1.087
C305-LB105016	-1.70	-2.30	-0.932
C305-LB105019	-2.20	-3.00	-1.243
C305-LB105022	-3.90	-4.60	-1.087
C305-LB105025	-5.50	-6.70	-1.864
C305-LB105028	-7.40	-9.00	-2.485
C305-LB105031	-8.50	-10.40	-2.951
C305-LB105033	#N/A	#N/A	#N/A
C305-LB105034	-5.20	-6.30	-1.709
C305-LB105036	-8.70	-9.90	-1.864
C305-LB105038	-8.00	-9.50	-2.330
C305-LB105040	-8.90	-10.30	-2.174
C305-LB105041	-9.60	-10.70	-1.709
C305-LB105042	-8.40	-10.30	-2.951
C305-LB105045	-10.10	-11.90	-2.796
C305-LB105048	-5.10	-6.30	-1.864
C305-LB105051	-3.50	-4.30	-1.243
C305-LB105054	-1.70	-2.20	-0.777
C305-LB105057	-0.80	-1.30	-0.777
C305-LB105060	-0.40	-0.30	0.155
C305-LB105063	-0.20	0.20	0.621
C305-LB105066	0.20	1.30	1.709
C305-LB105069	0.70	1.00	0.466
C305-LB105072	0.70	1.30	0.932
C305-LB105075	0.70	1.00	0.466
C305-LB105078	-2.40	-1.20	1.864
C305-LB105081	-7.50	-7.10	0.621
C305-LB105084	-6.80	-6.90	-0.155
C305-LB105087	-8.30	-7.80	0.777
C305-LB105090	-4.30	-3.60	1.087
C305-LB105093	-0.10	0.80	1.398
C305-LB105096	1.70	2.70	1.553
	Rate less than -2.5 mm/year	% less 2 mm/year	92%
	Rate greater than -3.5 mm/year	% less 3 mm/year	100%

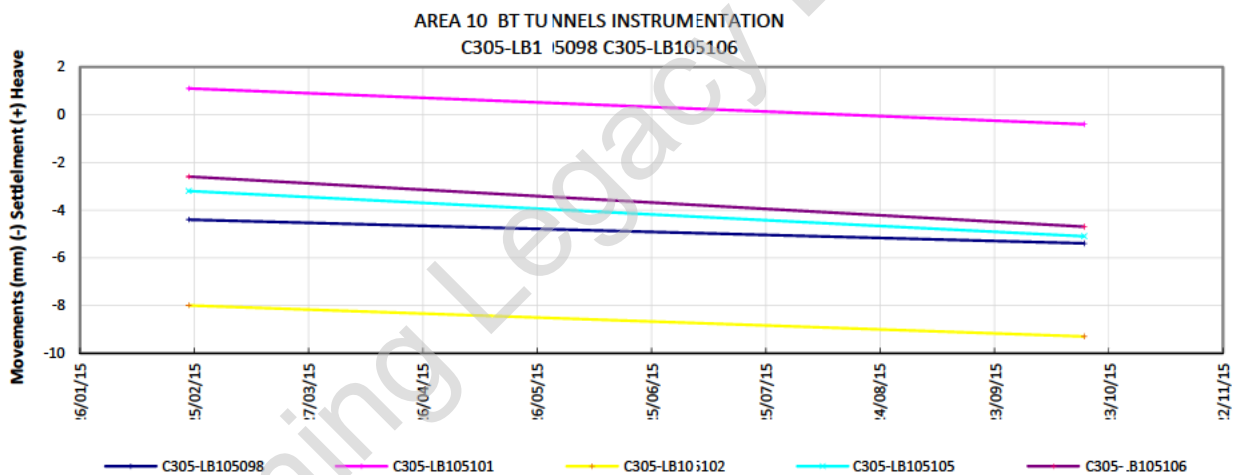
The percentage of the sockets with a settlement rate less than 2 mm/year is 92%.

C305-LB105098– C305-LB105106 Adit of the Brushfield Street and Commercial Street BT Tunnel

The graph presented below shows the readings from the sockets of this array. A maximum settlement of 1.4 mm is recorded after the Eastbound TBM transit and 9.3 mm is after Westbound TBM transit.



The next plot shows the trend line adjustment for the sockets in this array.



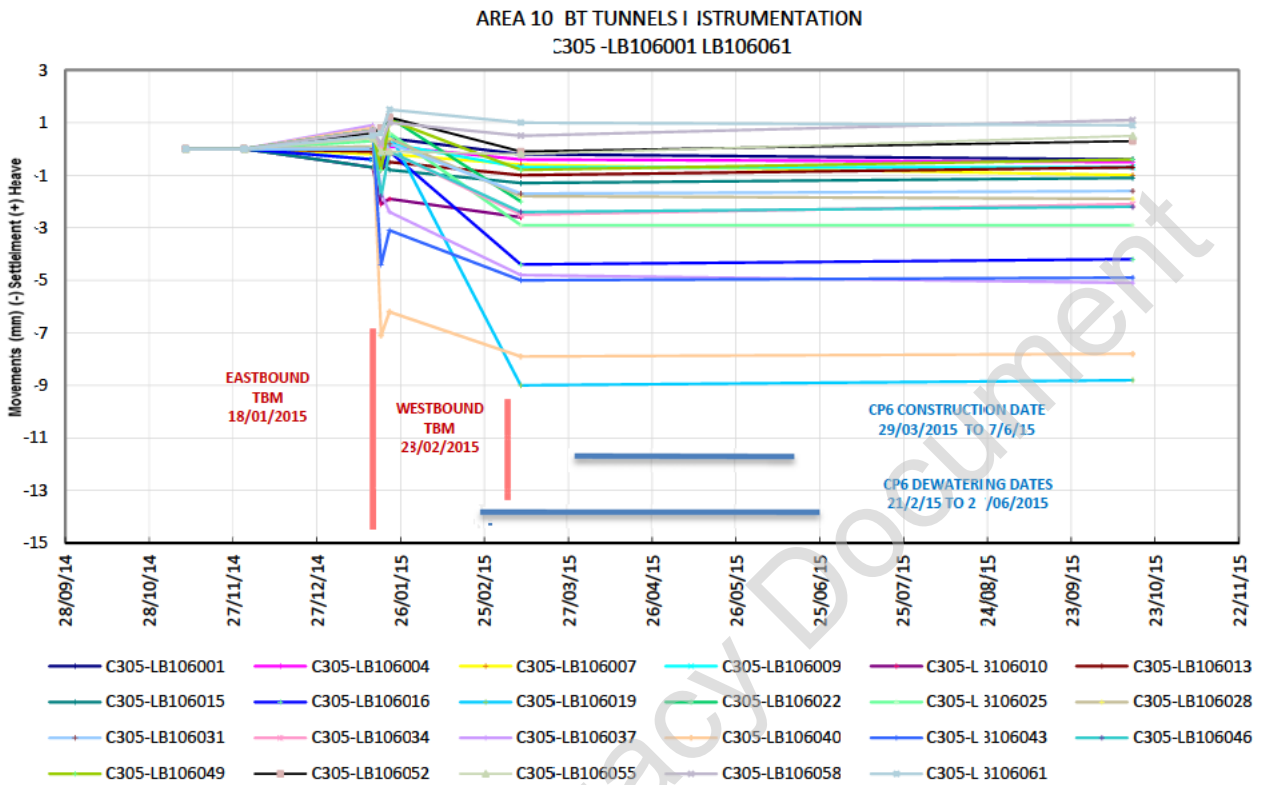
The table below illustrates the annual settlement rate for the sockets in this array.

	Registered movement (mm)		mm/year
	23/02/2015	16/10/2015	
C305-LB105098	-4.40	-5.40	-1.553
C305-LB105101	1.10	-0.40	-2.330
C305-LB105102	-8.00	-9.30	-2.019
C305-LB105105	-3.20	-5.10	-2.951
C305-LB105106	-2.60	-4.70	-3.262
	Rate less than -2.5 mm/year	% less 2 mm/ year	60%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100%

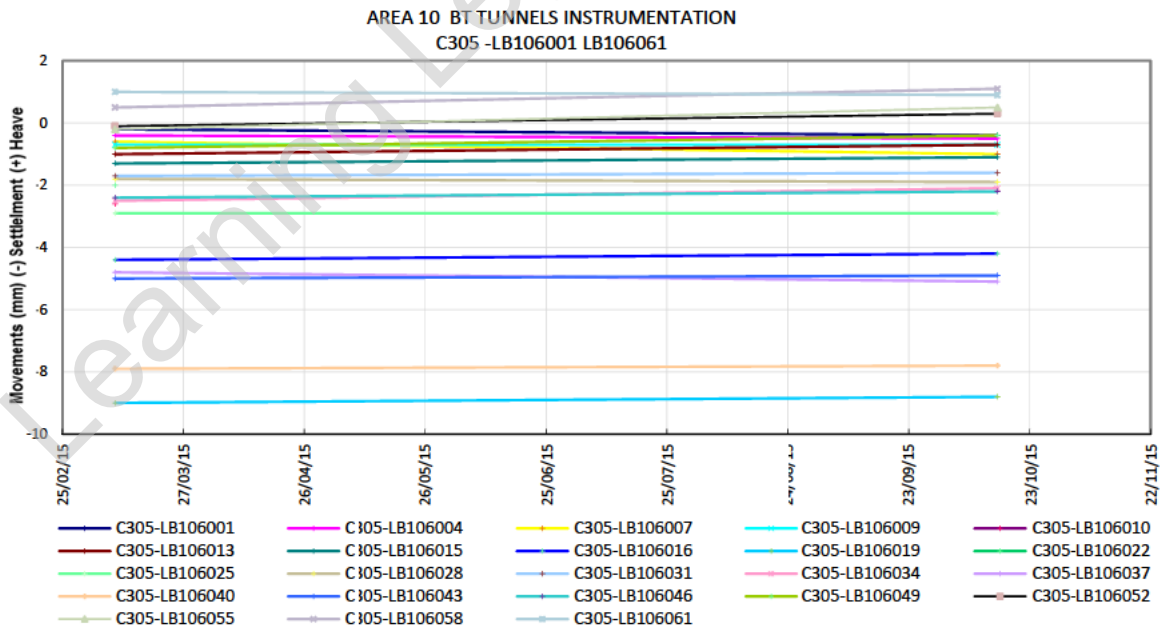
The percentage of the sockets with a settlement rate less than 2 mm/year is 60%.

C305-LB106001– C305-LB106061 Bishopsgate BT Tunnel

The graph presented below shows the readings from the sockets of this array. A maximum settlement of 7 mm is recorded after the Eastbound TBM transit and 9 mm is after Westbound TBM transit.



The next plot shows the trend line adjustment for the sockets in this array.



The table below illustrates the annual settlement rate for the sockets in this array.

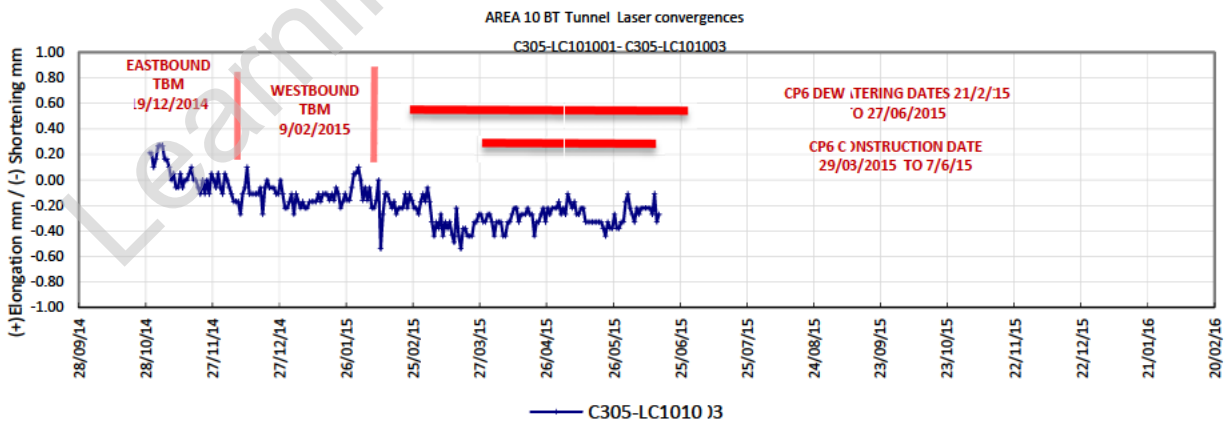
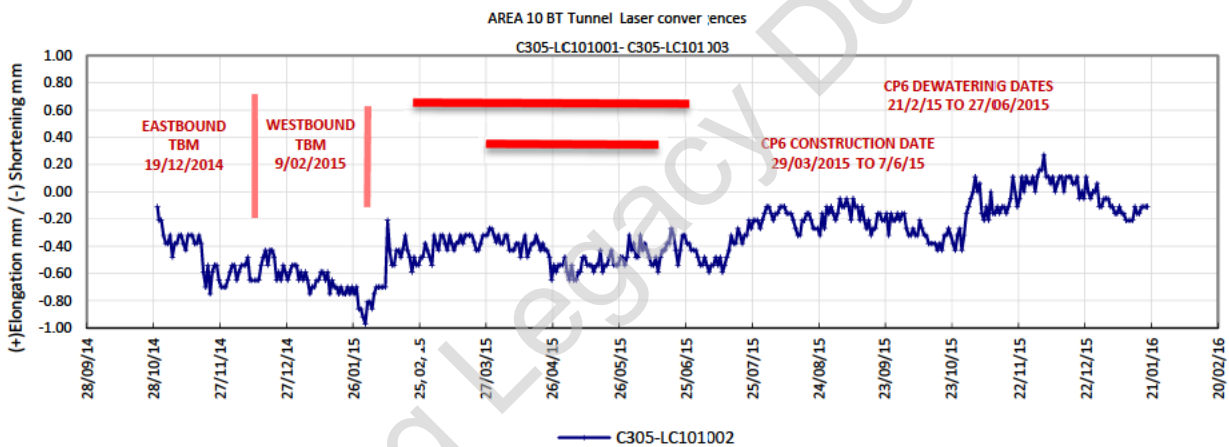
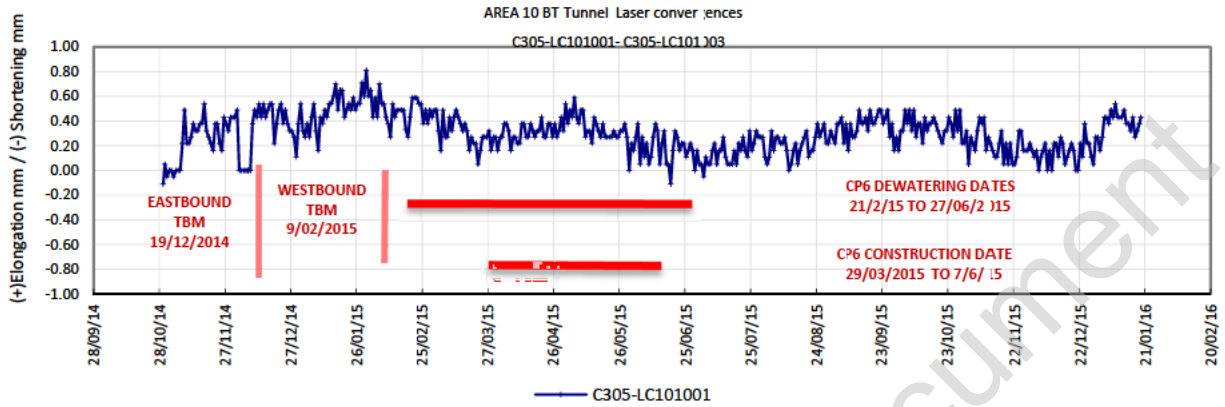
	10/03/2015	15/10/2015	mm/year
C305-LB106001	-0.20	-0.40	-0.333
C305-LB106004	-0.40	-0.50	-0.167
C305-LB106007	-0.60	-1.00	-0.667
C305-LB106009	-0.70	-0.70	0.000
C305-LB106010	-2.60	#N/A	#N/A
C305-LB106013	-1.00	-0.70	0.500
C305-LB106015	-1.30	-1.10	0.333
C305-LB106016	-4.40	-4.20	0.333
C305-LB106019	-9.00	-8.80	0.333
C305-LB106022	-2.00	#N/A	#N/A
C305-LB106025	-2.90	-2.90	0.000
C305-LB106028	-1.80	-1.90	-0.167
C305-LB106031	-1.70	-1.60	0.167
C305-LB106034	-2.50	-2.10	0.667
C305-LB106037	-4.80	-5.10	-0.500
C305-LB106040	-7.90	-7.80	0.167
C305-LB106043	-5.00	-4.90	0.167
C305-LB106046	-2.40	-2.20	0.333
C305-LB106049	-0.80	-0.40	0.667
C305-LB106052	-0.10	0.30	0.667
C305-LB106055	-0.20	0.50	1.167
C305-LB106058	0.50	1.10	1.000
C305-LB106061	1.00	0.90	-0.167
	Rate less than -2.5 mm/year	% less 2 mm/ year	100%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100%

The percentage of the sockets with a settlement rate less than 2 mm/year is 100%.

LASER CONVERGENCES

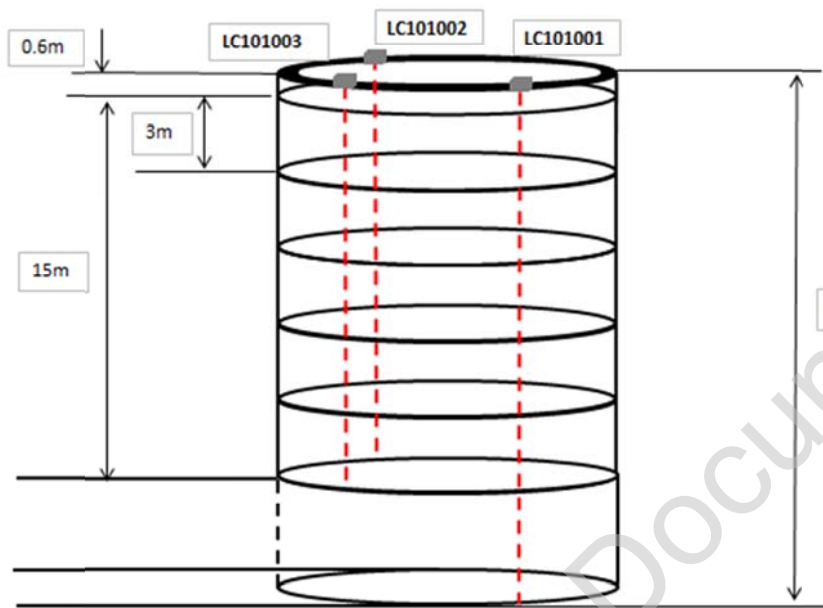
C305-LC101001- C305-LC101003

The graphs presented below shows the readings from the Laser of this array. A maximum movement of 0.8 mm to 1 mm is recorded after the Eastbound TBM transit and Westbound TBM transit.



See sketch below showing the positioning of the laser convergence system.

BT SHAFT INSTRUMENTATION

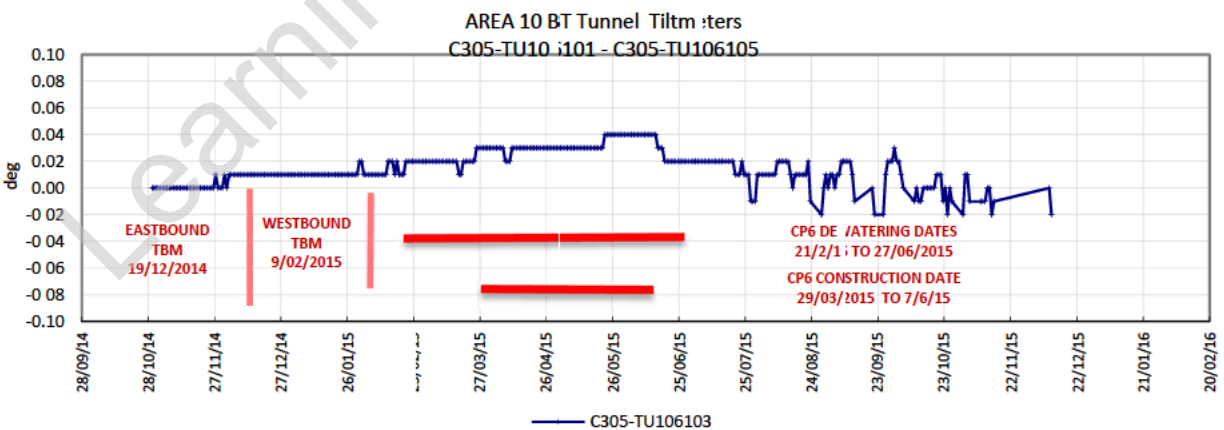
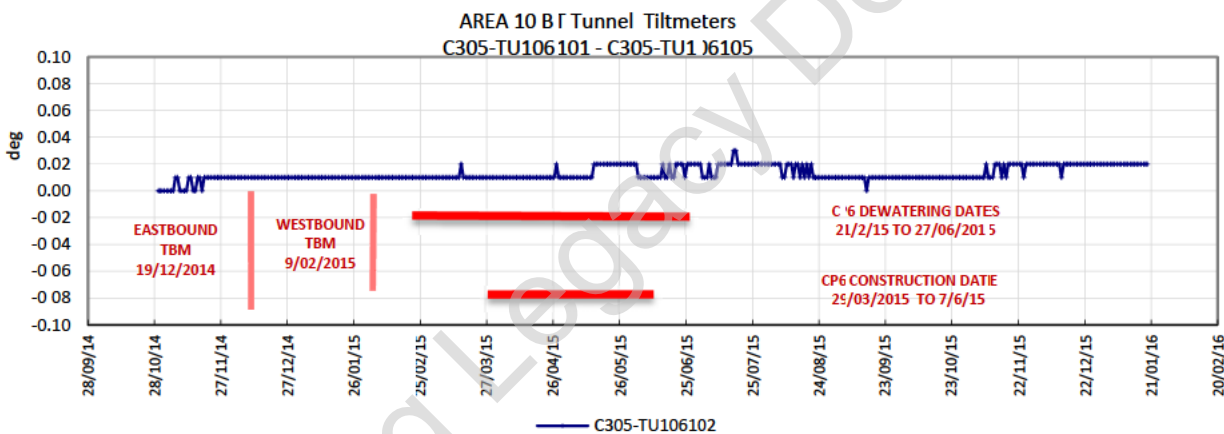
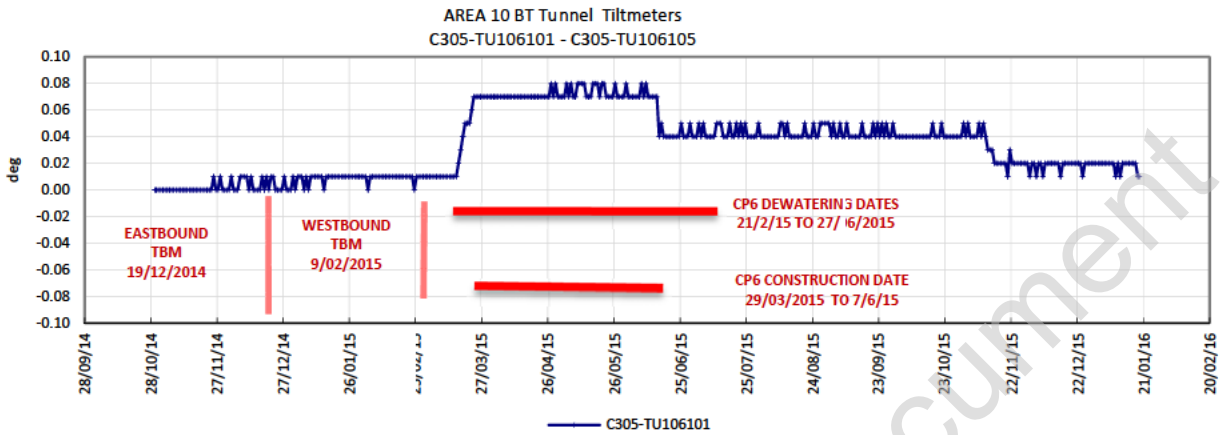


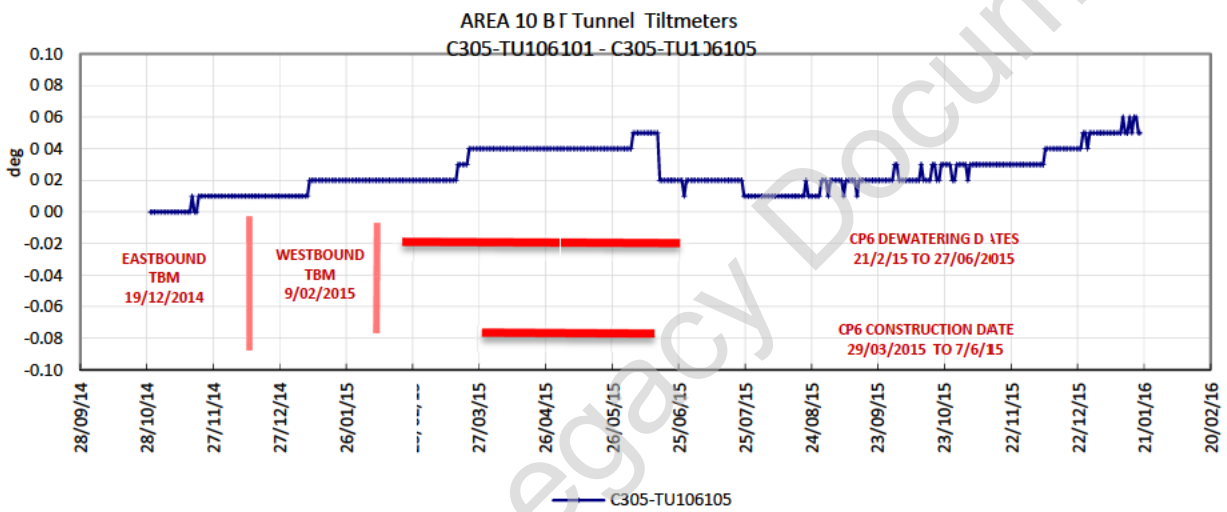
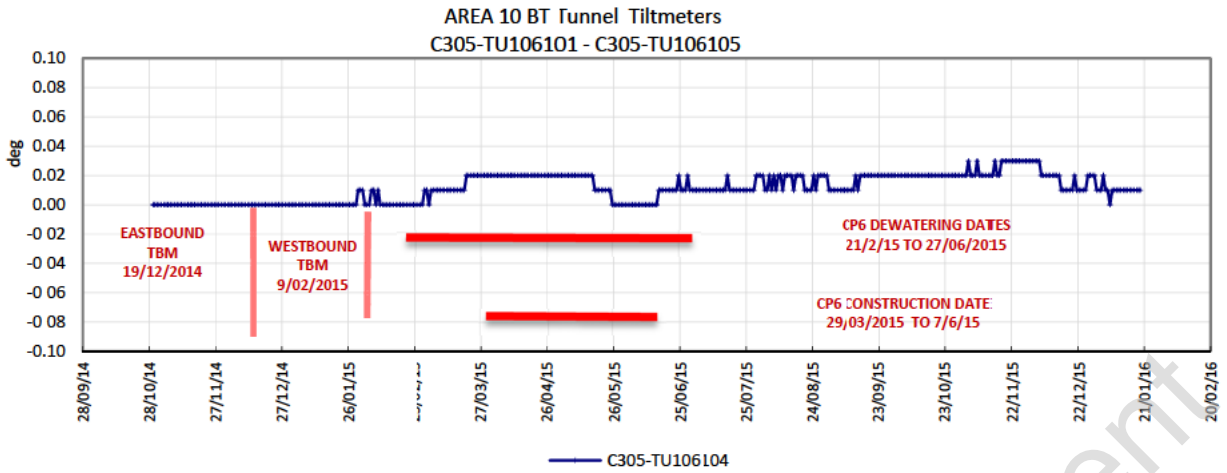
Learning Legacy Document

TILTMETERS

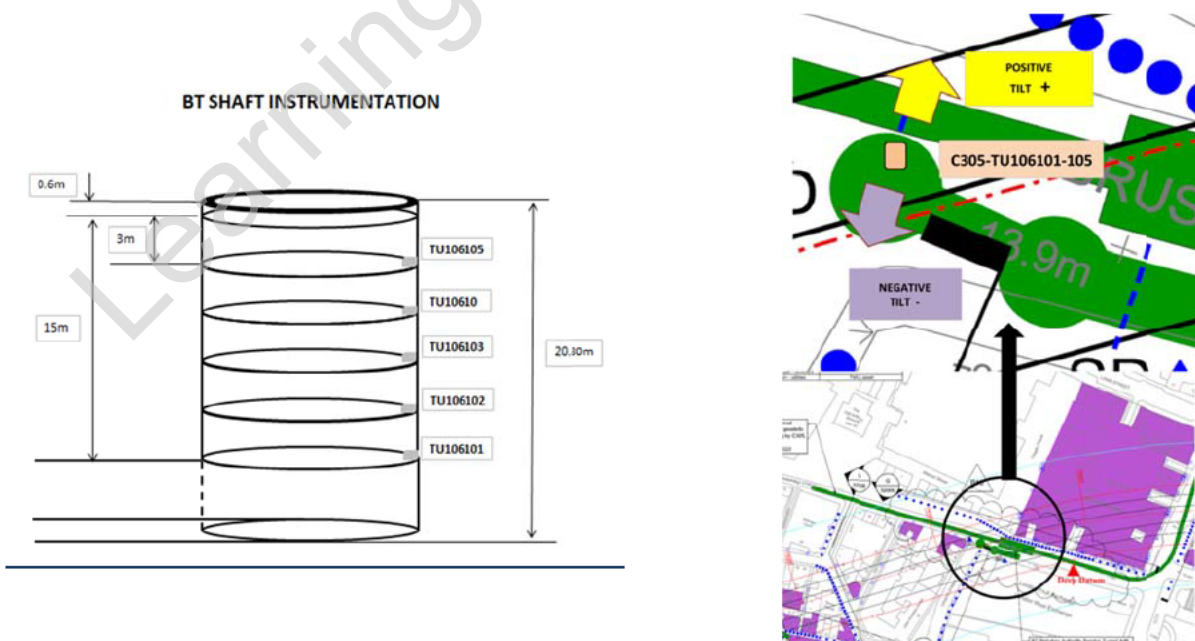
C305-TU106101 - C305-TU106105 BT Shaft

The graphs presented below shows the readings from the tiltmeters of this array. A maximum movement of 0.08 deg. is recorded after the Eastbound TBM transit and Westbound TBM transit.





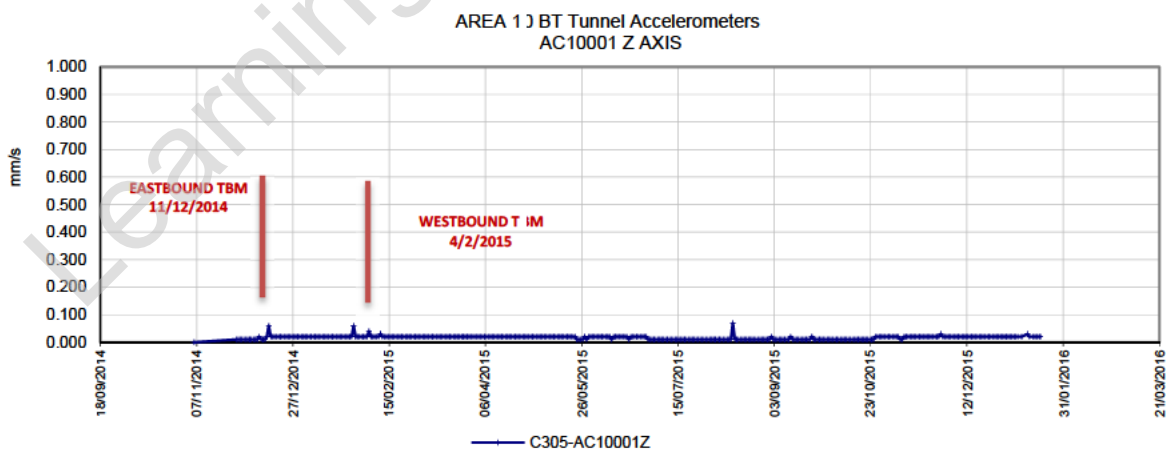
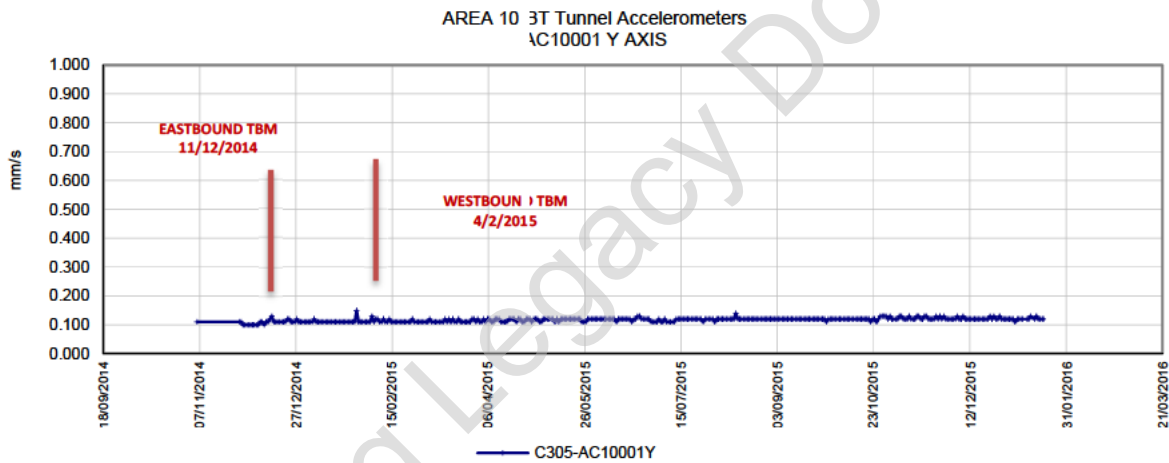
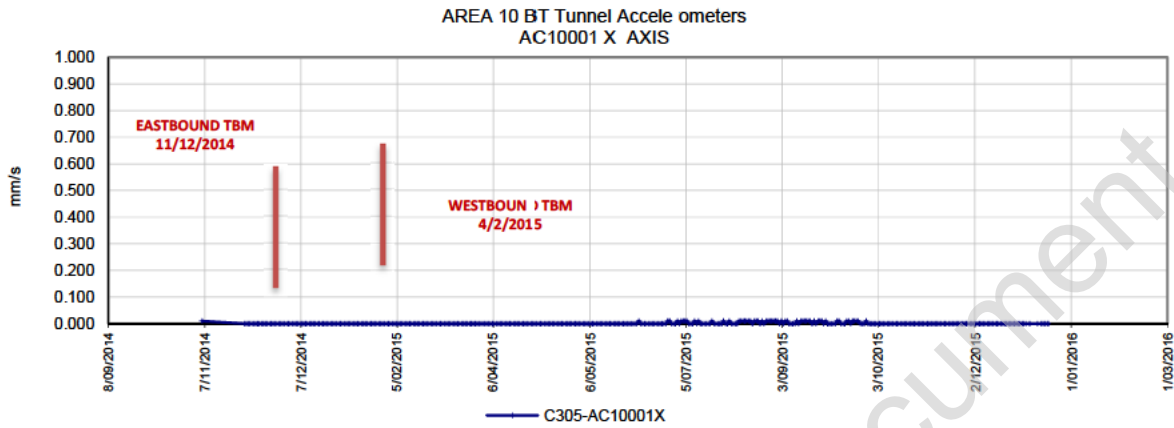
See sketch below showing the positioning and tilt criteria (+/-) of the Tiltmeter instruments .



ACCELEROMETERS

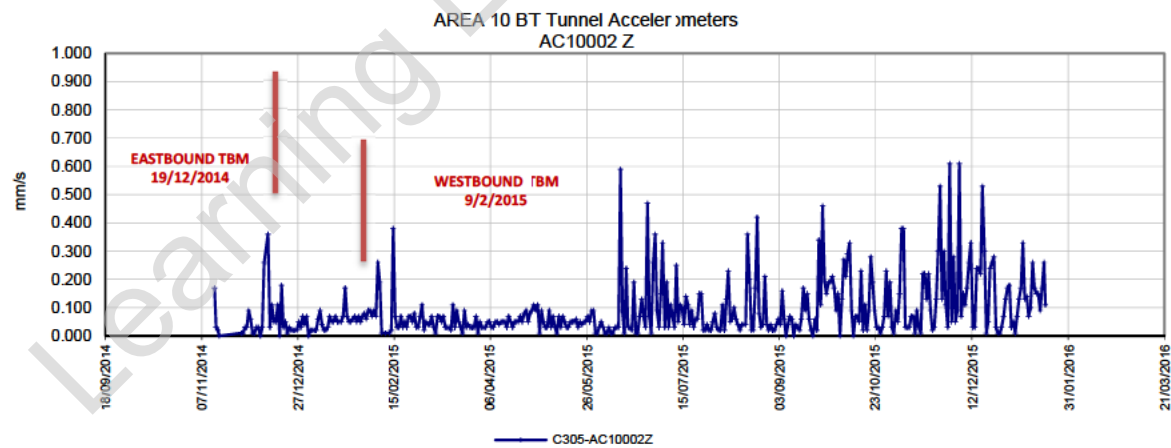
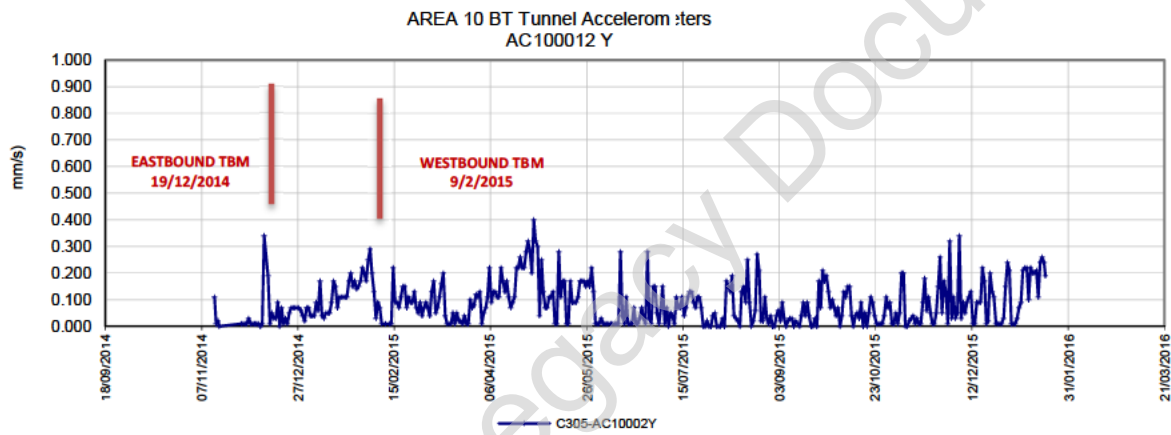
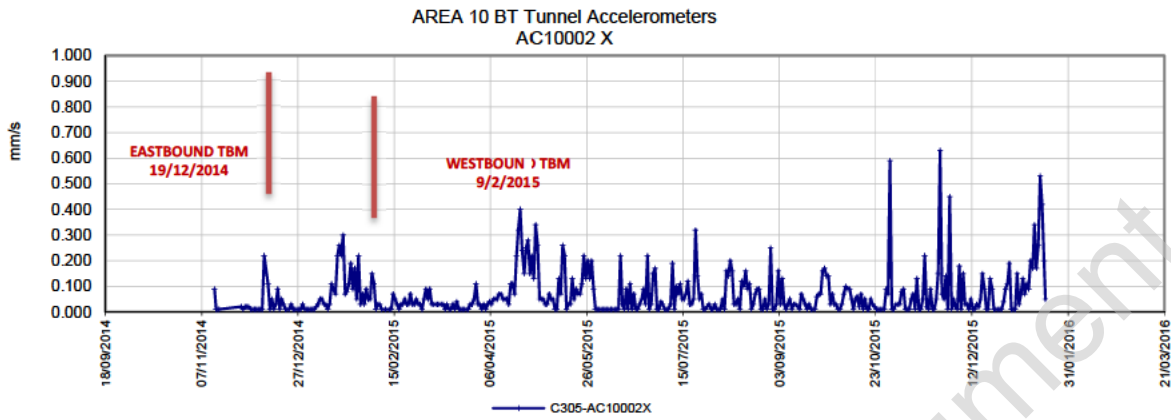
C305-AC101 001

The graphs presented below shows the readings from the Accelerometer of this array. A maximum of 0.15 mm/s (millimetres/second) is recorded after the Eastbound TBM transit and Westbound TBM transit.



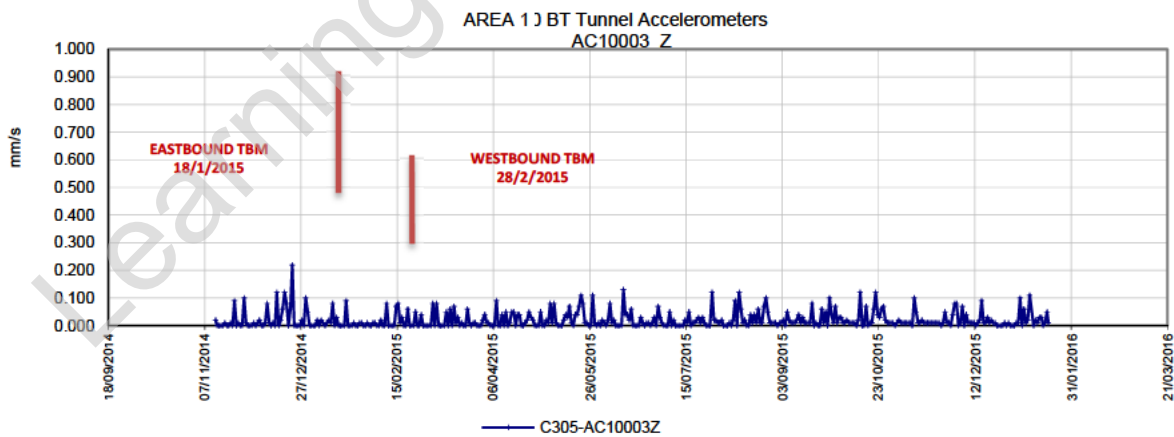
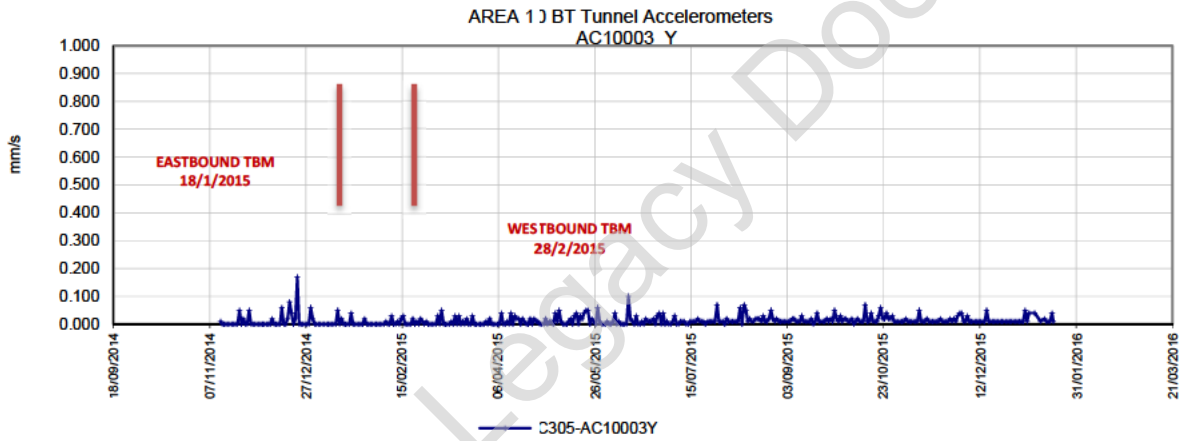
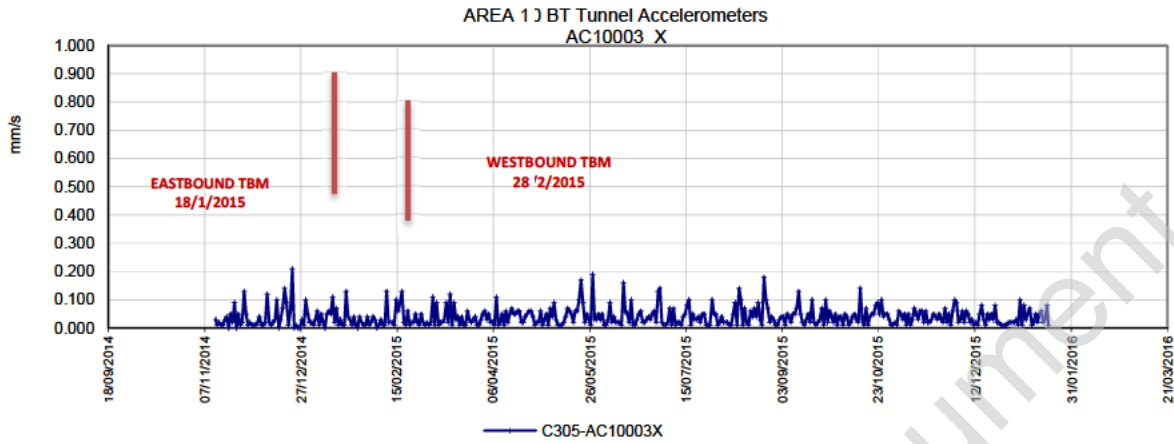
C305-AC101 102

The graphs presented below shows the readings from the Accelerometer of this array. A maximum of 0.6 mm/s is recorded after the Eastbound TBM transit and Westbound TBM transit.



C305-AC101 103

The graphs presented below shows the readings from the Accelerometer of this array. A maximum of 0.22 mm/s is recorded after the Eastbound TBM transit and West bound TBM transit.



8. SUMMARY STATEMENT

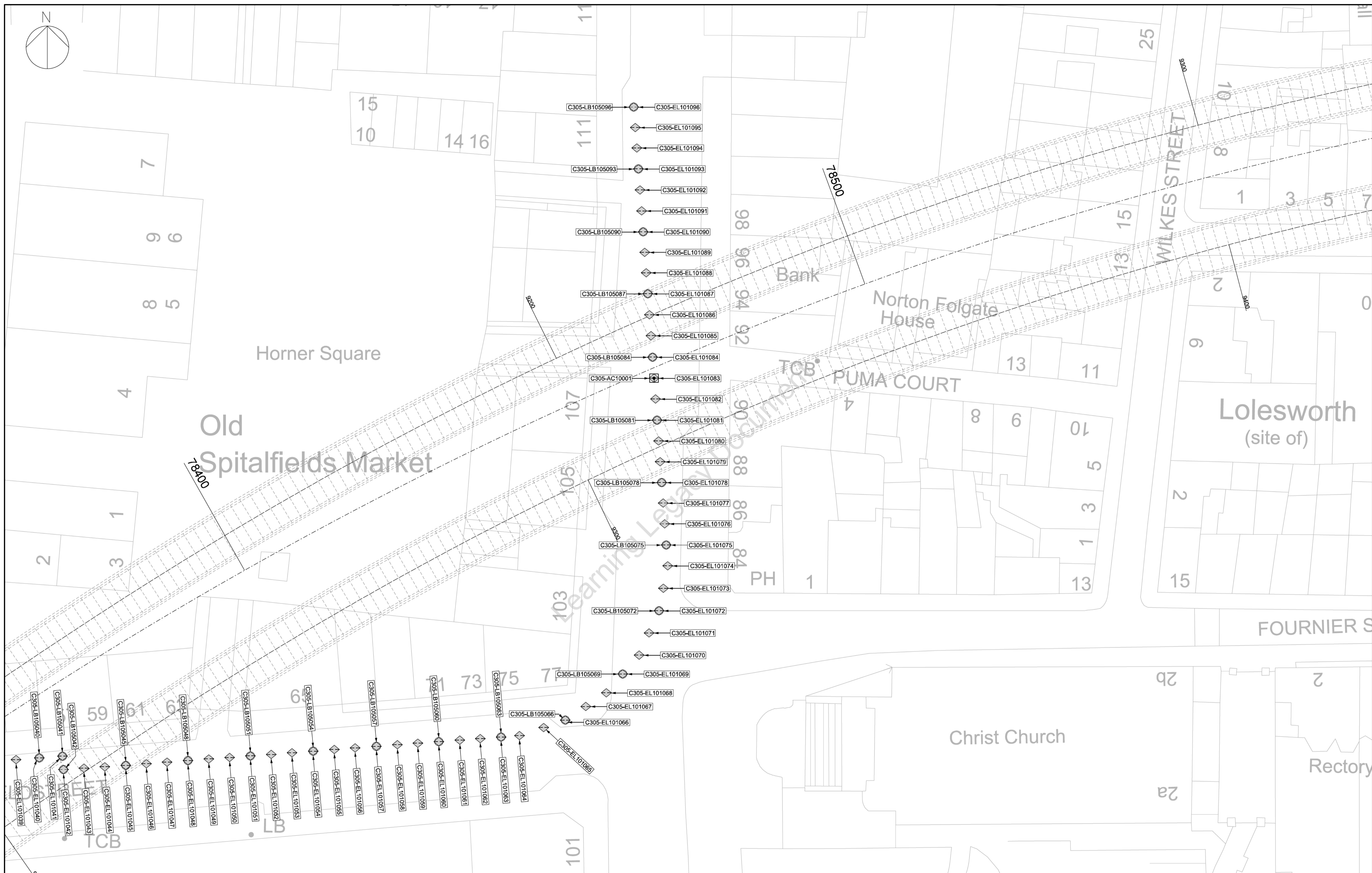
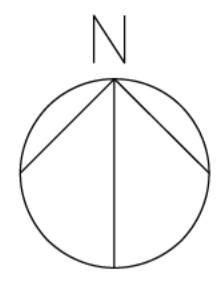
It has been agreed between the Project Manager, the Designer, the Contractor and the Sub Contractor that the instrumentation covered herein, for monitoring ground movement effects of Crossrail works, including long term effects, can be closed out for decommissioning as trends of the monitoring points were approaching or had achieved the specified 2 mm/year settlement rate.

Minutes of the Close Out meeting(s) are attached as Appendix C.

Learning Legacy Document

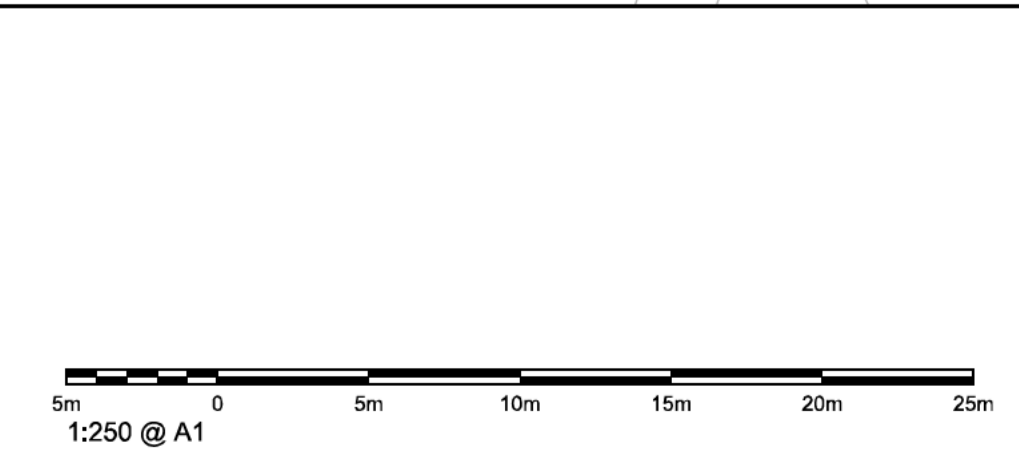
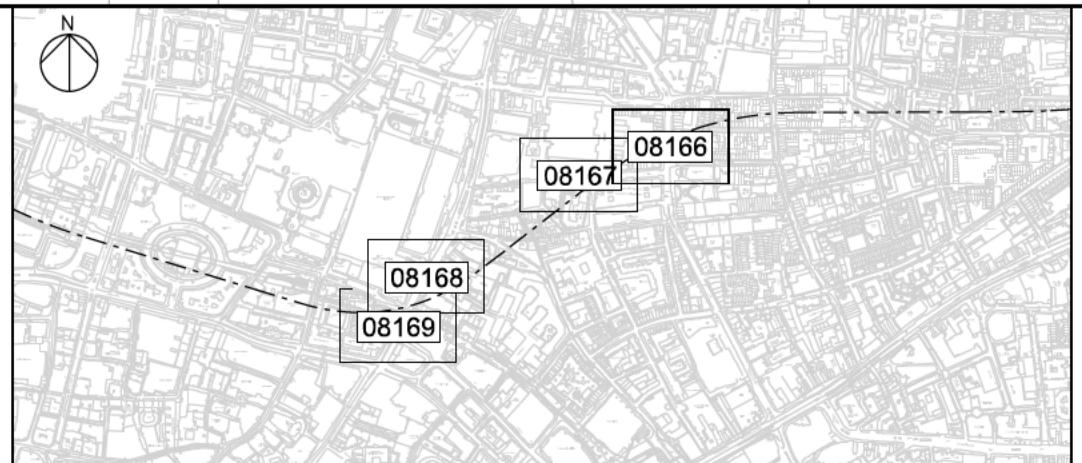
Learning Legacy Document

APPENDIX A: INSTRUMENT LOCATION



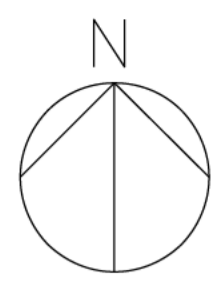
Rev.	Date	Description	By	Chkd	App	Auth
P01	03/03/2016	First Issue	MD	MD	MD	-

- Notes
- Socket
 - ◆ Electrolevel
 - ⊕ Tiltmeter
 - Accelerometer
 - ◇ Laser Convergence



<p>Crossrail Limited 25 Canada Square Canary Wharf London E14 6LQ</p> <p>© Crossrail</p> <p>www.crossrail.co.uk</p>	<p>Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G</p> <p>Originator: Dragados Sisk Joint Venture</p> <p>Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)</p>	<p>By: M.DAVIS</p> <p>Chk: M.DAVIS</p> <p>App: M.DAVIS</p> <p>Auth: -</p>
	<p>Title: Instrumentation & Monitoring I&M Installation Report for BT Tunnels (Drive Y)</p>	<p>Scale: 1:250 @ A1</p>
	<p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08166</p>	<p>Rev: P01</p>
	<p>Subsidiary: S4</p>	<p>Scale: 1:250 @ A1</p>

RESTRICTED

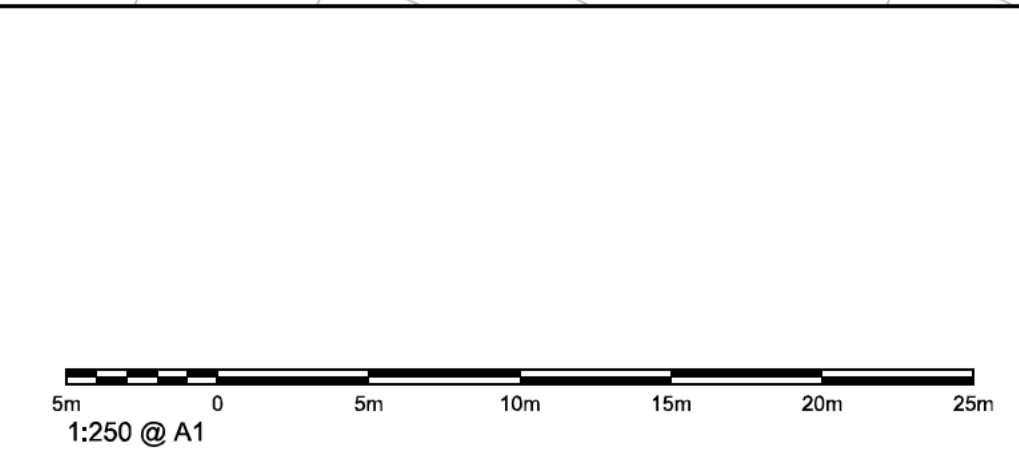
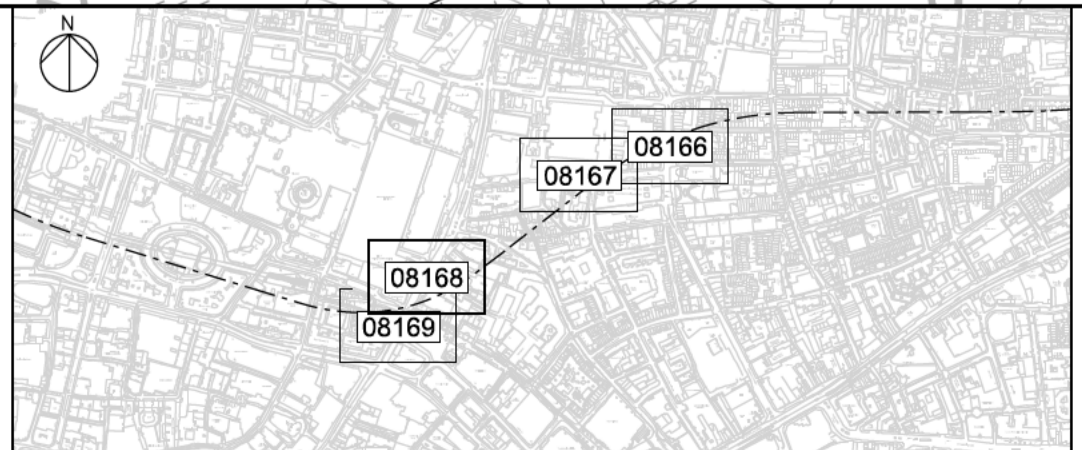


Site of
**Priory and Hospital
 of
 St Mary of Bethlehem**
 (Founded AD 1247)



Rev.	Date	Description	By	Chkd	App	Auth
P01	03/03/2016	First Issue	MD	MD	MD	-

- Notes
- Socket
 - ◊ Electrolevel
 - ⊗ Tiltmeter
 - ⊠ Accelerometer
 - ◇ Laser Convergence



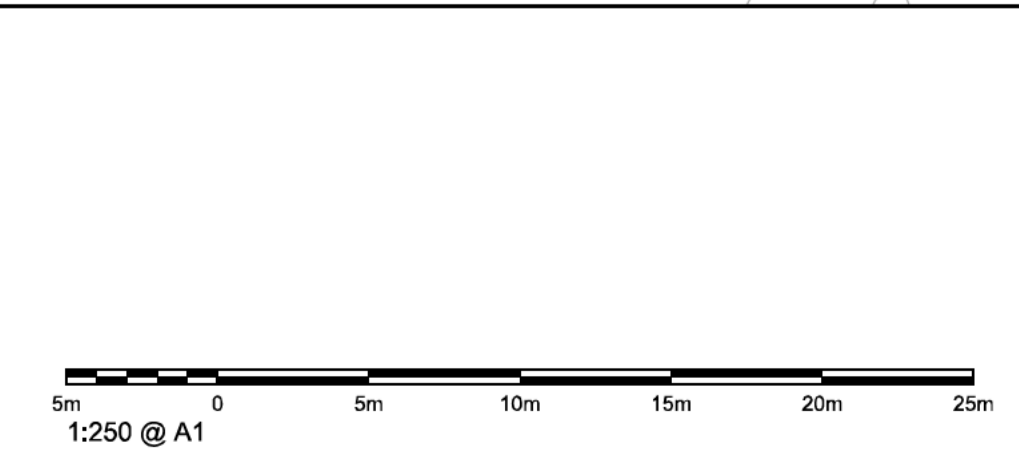
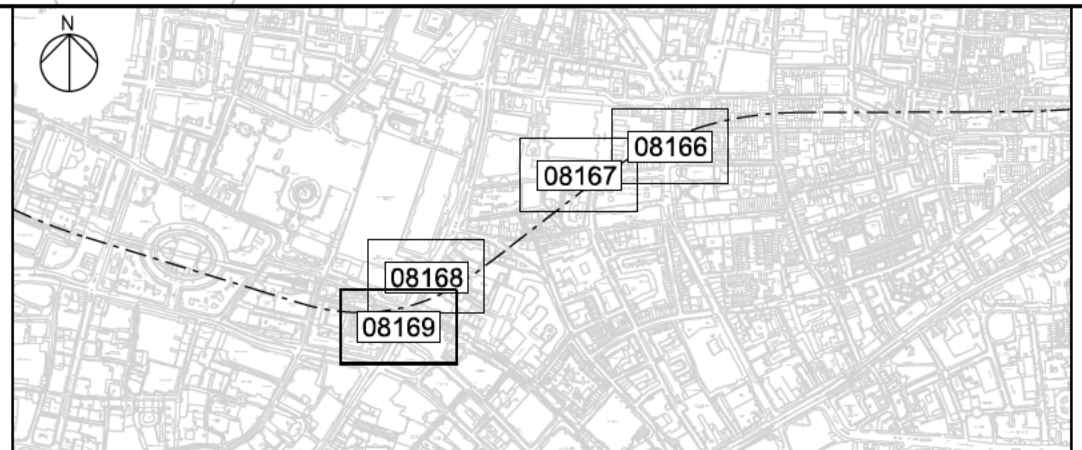
 Crossrail Limited 25 Canada Square Canary Wharf London E14 6LQ © Crossrail www.crossrail.co.uk	Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G	By: M.DAVIS
	Originator: Dragados Sisk Joint Venture	Chk: M.DAVIS
	Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)	App: M.DAVIS
	Title: Instrumentation & Monitoring I&M Installation Report for BT Tunnels (Drive Y) C305-DSJ-C2-RGN-CRG03-50390	Auth: -
Scale: 1:250 @ A1	Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08168	Rev: P01
		Suitability: S4

RESTRICTED



Rev.	Date	Description	By	Chkd	App	Auth
P01	03/03/2016	First Issue	MD	MD	MD	-

- Notes
- Socket
 - ◊ Electrolevel
 - ⊗ Tiltmeter
 - ⊙ Accelerometer
 - ◇ Laser Convergence



<p>Crossrail Limited 25 Canada Square Canary Wharf London E14 6LQ</p> <p>© Crossrail www.crossrail.co.uk</p>	<p>Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G</p> <p>Originator: Dragados Sisk Joint Venture</p> <p>Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)</p>	<p>By: M.DAVIS</p> <p>CHK: M.DAVIS</p> <p>APP: M.DAVIS</p> <p>Auth: -</p>	
	<p>Title: Instrumentation & Monitoring I&M Installation Report for BT Tunnels (Drive Y)</p> <p>C305-DSJ-C2-RGN-CRG03-50390</p>	<p>Scale: 1:250 @ A1</p>	<p>Rev: P01</p>
	<p>Drawing and CAD No: C305-DSJ-C2-DDA-CRT00_ST006_1-08169</p>	<p>Suitability: S4</p>	<p>Rev: P01</p>
	<p>www.crossrail.co.uk</p>		<p>Rev: P01</p>

RESTRICTED

Learning Legacy Document

APPENDIX B: SUMMARY OF INSTRUMENTATION INSTALLED ON SITE

Summary Installed Instrumentation - Electrolevels											
Sensor Type	Sensor ID	Sensor Serial Number	Date Installation	Status	Monitoring ID	Location MONR			Comm. Readings (mm)	Comm. Readings (mm)	Comm. Readings (mm)
						Eastings X (m)	Northing Y (m)	Elevation Z (mATD)			
Electrolevel Beam	S C305-EL101001	14084004	23/10/2014	INSTALLED	C305-EL101001	83839.251	36434.357	85.650	0.000000	0.000000	0.000000
Electrolevel Beam	S C305-EL101002	14084003	23/10/2014	INSTALLED	C305-EL101002	83842.243	36434.574	85.650	0.037333	0.037211	0.068785
Electrolevel Beam	S C305-EL101003	14084002	23/10/2014	INSTALLED	C305-EL101003	83845.285	36434.798	85.650	-0.037761	-0.062553	-0.028690
Electrolevel Beam	S C305-EL101004	14084001	23/10/2014	INSTALLED	C305-EL101004	83848.326	36435.033	85.650	-0.053157	-0.099414	-0.056584
Electrolevel Beam	S C305-EL101005	14081016	23/10/2014	INSTALLED	C305-EL101005	83851.392	36435.270	85.650	-0.015029	-0.055709	-0.010321
Electrolevel Beam	S C305-EL101006	14083004	23/10/2014	INSTALLED	C305-EL101006	83854.458	36435.507	85.650	-0.224459	-0.263225	-0.215096
Electrolevel Beam	S C305-EL101007	14084060	23/10/2014	INSTALLED	C305-EL101007	83857.502	36435.695	85.650	-0.218375	-0.279578	-0.231271
Electrolevel Beam	S C305-EL101008	14083016	23/10/2014	INSTALLED	C305-EL101008	83860.547	36435.874	85.650	-0.206431	-0.278743	-0.245616
Electrolevel Beam	S C305-EL101009	14083015	23/10/2014	INSTALLED	C305-EL101009	83863.616	36436.054	85.650	0.067354	-0.008749	0.036670
Electrolevel Beam	S C305-EL101010	14081004	23/10/2014	INSTALLED	C305-EL101010	83866.684	36436.261	85.650	0.178478	0.155731	0.210146
Electrolevel Beam	S C305-EL101011	14081020	23/10/2014	INSTALLED	C305-EL101011	83869.675	36436.499	85.650	0.201540	0.179265	0.215393
Electrolevel Beam	S C305-EL101012	14081009	23/10/2014	INSTALLED	C305-EL101012	83872.666	36436.737	85.650	0.185851	0.180460	0.205135
Electrolevel Beam	S C305-EL101013	14081003	23/10/2014	INSTALLED	C305-EL101013	83875.681	36436.976	85.650	0.156246	0.128976	0.143783
Electrolevel Beam	S C305-EL101014	14121020	23/10/2014	INSTALLED	C305-EL101014	83878.77	36437.234	85.650	0.035820	0.032885	0.023311
Electrolevel Beam	S C305-EL101015	14121005	23/10/2014	INSTALLED	C305-EL101015	83881.835	36437.489	85.650	0.228872	0.215848	0.221735
Electrolevel Beam	S C305-EL101016	14121006	23/10/2014	INSTALLED	C305-EL101016	83884.899	36437.744	85.650	0.162463	0.147407	0.160286
Electrolevel Beam	S C305-EL101017	14121016	23/10/2014	INSTALLED	C305-EL101017	83887.965	36437.982	85.650	0.059864	0.020234	0.040495
Electrolevel Beam	S C305-EL101018	14085020	23/10/2014	INSTALLED	C305-EL101018	83891.032	36438.207	85.650	0.023285	-0.014516	-0.001317
Electrolevel Beam	S C305-EL101019	14086001	23/10/2014	INSTALLED	C305-EL101019	83894.098	36438.433	85.650	-0.018970	-0.056407	-0.039963
Electrolevel Beam	S C305-EL101020	14085009	23/10/2014	INSTALLED	C305-EL101020	83897.115	36438.657	85.650	0.008355	-0.040437	-0.002905
Electrolevel Beam	S C305-EL101021	14085046	23/10/2014	INSTALLED	C305-EL101021	83900.131	36438.891	85.650	-0.070155	-0.119681	-0.074013
Electrolevel Beam	S C305-EL101022	14085019	23/10/2014	INSTALLED	C305-EL101022	83903.197	36439.130	85.650	0.337494	0.318530	0.407492
Electrolevel Beam	S C305-EL101023	14084033	23/10/2014	INSTALLED	C305-EL101023	83906.262	36439.370	85.650	0.299070	0.284427	0.348836
Electrolevel Beam	S C305-EL101024	14085050	23/10/2014	INSTALLED	C305-EL101024	83909.304	36439.589	85.650	0.383524	0.368020	0.445087
Electrolevel Beam	S C305-EL101025	14132009	23/10/2014	INSTALLED	C305-EL101025	83912.347	36439.803	85.650	0.376425	0.339342	0.428911
Electrolevel Beam	S C305-EL101026	14084049	23/10/2014	INSTALLED	C305-EL101026	83915.414	36440.019	85.650	0.536547	0.498043	0.627014
Electrolevel Beam	S C305-EL101027	14086003	23/10/2014	INSTALLED	C305-EL101027	83918.581	36440.245	85.650	0.496856	0.459447	0.562133
Electrolevel Beam	S C305-EL101028	14085052	23/10/2014	INSTALLED	C305-EL101028	83921.673	36440.469	85.650	0.518321	0.482742	0.589170
Electrolevel Beam	S C305-EL101029	14085051	23/10/2014	INSTALLED	C305-EL101029	83924.665	36440.686	85.650	0.711265	0.709650	0.794712
Electrolevel Beam	S C305-EL101030	14085017	23/10/2014	INSTALLED	C305-EL101030	83927.732	36440.908	85.650	0.767387	0.776523	0.843721
Electrolevel Beam	S C305-EL101031	14085018	23/10/2014	INSTALLED	C305-EL101031	83930.797	36441.155	85.650	0.849110	0.822889	0.896027
Electrolevel Beam	S C305-EL101032	14084071	23/10/2014	INSTALLED	C305-EL101032	83933.787	36441.397	85.650	0.829759	0.799675	0.867427
Electrolevel Beam	S C305-EL101033	14084072	23/10/2014	INSTALLED	C305-EL101033	83935.422	36441.529	85.650	0.842104	0.809914	0.864463
Electrolevel Beam	S C305-EL101034	14084013	23/10/2014	INSTALLED	C305-EL101034	83935.282	36443.480	85.650	0.854678	0.862491	0.921490
Electrolevel Beam	S C305-EL101035	14084014	23/10/2014	INSTALLED	C305-EL101035	83938.677	36443.730	85.650	0.732955	0.759809	0.800446
Electrolevel Beam	S C305-EL101036	14084012	23/10/2014	INSTALLED	C305-EL101036	83942.072	36443.980	85.650	0.577174	0.595604	0.676106
Electrolevel Beam	S C305-EL101037	14084011	23/10/2014	INSTALLED	C305-EL101037	83945.467	36444.230	85.650	0.145271	0.170656	0.198006
Electrolevel Beam	S C305-EL101038	14081017	23/10/2014	INSTALLED	C305-EL101038	83948.862	36444.480	85.650	0.093494	0.089397	0.122555
Electrolevel Beam	S C305-EL101039	14081018	23/10/2014	INSTALLED	C305-EL101039	83952.257	36444.730	85.650	-0.015491	-0.068949	-0.004863
Electrolevel Beam	S C305-EL101040	14081028	23/10/2014	INSTALLED	C305-EL101040	83955.653	36444.980	85.650	-0.024273	-0.109821	-0.068452
Electrolevel Beam	S C305-EL101041	14081029	23/10/2014	INSTALLED	C305-EL101041	83959.048	36445.230	85.650	-0.069091	-0.153314	-0.105365
Electrolevel Beam	S C305-EL101042	14081011	23/10/2014	INSTALLED	C305-EL101042	83959.196	36443.280	85.650	-0.105588	-0.192155	-0.120648
Electrolevel Beam	S C305-EL101043	14081026	23/10/2014	INSTALLED	C305-EL101043	83962.189	36443.480	85.650	-0.057023	-0.146888	-0.088484
Electrolevel Beam	S C305-EL101044	14081012	23/10/2014	INSTALLED	C305-EL101044	83965.233	36443.683	85.650	-0.063354	-0.152158	-0.119308
Electrolevel Beam	S C305-EL101045	14081010	23/10/2014	INSTALLED	C305-EL101045	83968.301	36443.889	85.650	-0.101433	-0.159259	-0.125595
Electrolevel Beam	S C305-EL101046	14085047	23/10/2014	INSTALLED	C305-EL101046	83971.317	36444.122	85.650	-0.301892	-0.358254	-0.320430
Electrolevel Beam	S C305-EL101047	14085058	23/10/2014	INSTALLED	C305-EL101047	83974.333	36444.356	85.650	-0.288033	-0.295409	-0.279243
Electrolevel Beam	S C305-EL101048	14085048	23/10/2014	INSTALLED	C305-EL101048	83977.399	36444.593	85.650	-0.350597	-0.289693	-0.271747

Summary Installed Instrumentation - Electrolevels											
Sensor Type	Sensor ID	Sensor Serial Number	Date Installation	Status	Monitoring ID	Location MONR Eastings X (m)	Location MONR Northings Y (m)	Location MONR Elevation Z (mATD)	Comm. Readings (mm) 01/11/2014	Comm. Readings (mm) 01/11/2014	Comm. Readings (mm) 01/11/2014
Electrolevel Beam	S C305-EL101048	14085048	23/10/2014	INSTALLED	C305-EL101049	83980.44	36444.821	85.650	-0.090529	-0.003459	0.017365
Electrolevel Beam	S C305-EL101049	14085059	23/10/2014	INSTALLED	C305-EL101050	83983.482	36445.045	85.650	-0.104021	0.006973	0.035481
Electrolevel Beam	S C305-EL101050	14081013	23/10/2014	INSTALLED	C305-EL101051	83986.524	36445.268	85.650	-0.131794	-0.025157	0.007454
Electrolevel Beam	S C305-EL101051	14081027	23/10/2014	INSTALLED	C305-EL101052	83989.565	36445.494	85.650	-0.144554	-0.048498	0.012020
Electrolevel Beam	S C305-EL101052	14084007	23/10/2014	INSTALLED	C305-EL101053	83992.606	36445.730	85.650	-0.114466	-0.004031	0.041123
Electrolevel Beam	S C305-EL101053	14085036	23/10/2014	INSTALLED	C305-EL101054	83995.697	36445.969	85.650	-0.145994	-0.007218	0.041844
Electrolevel Beam	S C305-EL101054	14084008	23/10/2014	INSTALLED	C305-EL101055	83998.788	36446.209	85.650	-0.268983	-0.166045	-0.114357
Electrolevel Beam	S C305-EL101055	14085035	23/10/2014	INSTALLED	C305-EL101056	84001.829	36446.439	85.650	-0.268558	-0.174130	-0.141285
Electrolevel Beam	S C305-EL101056	14084021	23/10/2014	INSTALLED	C305-EL101057	84004.945	36446.674	85.650	-0.315581	-0.241599	-0.186249
Electrolevel Beam	S C305-EL101057	14085037	23/10/2014	INSTALLED	C305-EL101058	84008.011	36446.905	85.650	-0.287142	-0.182696	-0.155773
Electrolevel Beam	S C305-EL101058	14085034	23/10/2014	INSTALLED	C305-EL101059	84011.003	36447.128	85.650	-0.260350	-0.160597	-0.127769
Electrolevel Beam	S C305-EL101059	14083009	23/10/2014	INSTALLED	C305-EL101060	84014.07	36447.354	85.650	0.001183	0.101553	0.137905
Electrolevel Beam	S C305-EL101060	14083003	23/10/2014	INSTALLED	C305-EL101061	84017.136	36447.580	85.650	-0.085643	0.039484	0.081039
Electrolevel Beam	S C305-EL101061	14121015	23/10/2014	INSTALLED	C305-EL101062	84020.128	36447.800	85.650	-0.047132	0.083037	0.120762
Electrolevel Beam	S C305-EL101062	14085041	23/10/2014	INSTALLED	C305-EL101063	84023.169	36448.033	85.650	-0.042980	0.086865	0.130719
Electrolevel Beam	S C305-EL101063	14083034	23/10/2014	INSTALLED	C305-EL101064	84025.857	36448.241	85.650	0.001390	0.149614	0.179728
Electrolevel Beam	S C305-EL101064	14085042	23/10/2014	INSTALLED	C305-EL101065	84029.396	36449.421	85.650	0.068647	0.216756	0.251626
Electrolevel Beam	S C305-EL101065	14086010	23/10/2014	INSTALLED	C305-EL101066	84032.556	36450.511	85.650	0.064677	0.152795	0.221901
Electrolevel Beam	S C305-EL101066	14081022	23/10/2014	INSTALLED	C305-EL101067	84035.557	36452.501	85.650	0.021522	0.109892	0.184302
Electrolevel Beam	S C305-EL101067	14081021	23/10/2014	INSTALLED	C305-EL101068	84038.559	36454.492	85.650	-0.053767	0.032930	0.109532
Electrolevel Beam	S C305-EL101068	14081025	23/10/2014	INSTALLED	C305-EL101069	84040.954	36457.249	85.650	-0.126768	-0.043555	0.039374
Electrolevel Beam	S C305-EL101069	14081015	23/10/2014	INSTALLED	C305-EL101070	84043.35	36460.005	85.650	-0.180543	-0.102418	-0.009761
Electrolevel Beam	S C305-EL101070	14084026	23/10/2014	INSTALLED	C305-EL101071	84044.808	36463.250	85.650	-0.153752	-0.057278	0.073673
Electrolevel Beam	S C305-EL101071	14084025	23/10/2014	INSTALLED	C305-EL101072	84046.266	36466.494	85.650	-0.065070	0.026315	0.137331
Electrolevel Beam	S C305-EL101072	14084009	23/10/2014	INSTALLED	C305-EL101073	84046.897	36469.780	85.650	-0.048533	0.044722	0.129578
Electrolevel Beam	S C305-EL101073	14084010	23/10/2014	INSTALLED	C305-EL101074	84047.528	36473.065	85.650	0.011584	0.122871	0.195067
Electrolevel Beam	S C305-EL101074	14084047	23/10/2014	INSTALLED	C305-EL101075	84047.31	36476.108	85.650	0.025924	0.137462	0.212949
Electrolevel Beam	S C305-EL101075	14081005	23/10/2014	INSTALLED	C305-EL101076	84047.088	36479.200	85.650	0.034039	0.140776	0.252621
Electrolevel Beam	S C305-EL101076	14084048	23/10/2014	INSTALLED	C305-EL101077	84046.869	36482.242	85.650	-0.015021	0.055133	0.174601
Electrolevel Beam	S C305-EL101077	14121001	23/10/2014	INSTALLED	C305-EL101078	84046.652	36485.234	85.650	0.545526	0.494498	0.491311
Electrolevel Beam	S C305-EL101078	14081014	23/10/2014	INSTALLED	C305-EL101079	84046.425	36488.276	85.650	0.423557	0.372407	0.383216
Electrolevel Beam	S C305-EL101079	14121002	23/10/2014	INSTALLED	C305-EL101080	84046.198	36491.317	85.650	0.071974	-0.007863	-0.027735
Electrolevel Beam	S C305-EL101080	14121017	23/10/2014	INSTALLED	C305-EL101081	84045.972	36494.359	85.650	0.061333	-0.052684	-0.057827
Electrolevel Beam	S C305-EL101081	14081019	23/10/2014	INSTALLED	C305-EL101082	84045.751	36497.451	85.650	0.124666	0.010528	0.014071
Electrolevel Beam	S C305-EL101082	14121018	23/10/2014	INSTALLED	C305-EL101083	84045.535	36500.493	85.650	0.171887	0.086191	0.069306
Electrolevel Beam	S C305-EL101083	14084022	23/10/2014	INSTALLED	C305-EL101084	84045.318	36503.560	85.650	0.209233	0.121936	0.111541
Electrolevel Beam	S C305-EL101084	14085024	23/10/2014	INSTALLED	C305-EL101085	84045.088	36506.702	85.650	0.506746	0.476507	0.473386
Electrolevel Beam	S C305-EL101085	14081030	23/10/2014	INSTALLED	C305-EL101086	84044.855	36509.768	85.650	0.334318	0.304514	0.302303
Electrolevel Beam	S C305-EL101086	14125016	23/10/2014	INSTALLED	C305-EL101087	84044.623	36512.834	85.650	-0.014365	-0.102220	-0.148720
Electrolevel Beam	S C305-EL101087	14081002	23/10/2014	INSTALLED	C305-EL101088	84044.392	36515.901	85.650	0.045919	-0.029951	-0.092597
Electrolevel Beam	S C305-EL101088	14085027	23/10/2014	INSTALLED	C305-EL101089	84044.166	36518.892	85.650	-0.514751	-0.575845	-0.641235
Electrolevel Beam	S C305-EL101089	14085007	23/10/2014	INSTALLED	C305-EL101090	84043.941	36521.884	85.650	-0.556257	-0.618932	-0.681628
Electrolevel Beam	S C305-EL101090	14085005	23/10/2014	INSTALLED	C305-EL101091	84043.711	36524.950	85.650	-0.558763	-0.618350	-0.680736
Electrolevel Beam	S C305-EL101091	14084068	23/10/2014	INSTALLED	C305-EL101092	84043.479	36528.016	85.650	-0.642503	-0.715256	-0.742123
Electrolevel Beam	S C305-EL101092	14085043	23/10/2014	INSTALLED	C305-EL101093	84043.246	36531.083	85.650	-0.509252	-0.551617	-0.572408
Electrolevel Beam	S C305-EL101093	14121019	23/10/2014	INSTALLED	C305-EL101094	84043.016	36534.149	85.650	-0.350548	-0.382771	-0.400510
Electrolevel Beam	S C305-EL101094	14084019	23/10/2014	INSTALLED	C305-EL101095	84042.789	36537.140	85.650	-0.077615	-0.077494	-0.086218
Electrolevel Beam	S C305-EL101095	14085003	23/10/2014	INSTALLED	C305-EL101096	84042.562	36540.131	85.650	0.000000	0.000000	0.000000

Summary Installed Instrumentation - Electrolevels											
Sensor Type	Sensor ID	Sensor Serial Number	Date Installation	Status	Monitoring ID	Location MONR	Location MONR	Location MONR	Comm. Readings (mm)	Comm. Readings (mm)	Comm. Readings (mm)
						Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	01/11/2014	01/11/2014	01/11/2014
Electrolevel Beam	S C305-EL101096	14085008	23/10/2014	INSTALLED	C305-EL101033	83935.422	36441.529	85.65	0.842104	0.809914	0.864463
Electrolevel Beam	S C305-EL101097	14084031	23/10/2014	INSTALLED	C305-EL101097	83935.645	36438.538	85.650	0.842104	0.809914	0.864463
Electrolevel Beam	S C305-EL101098	14084032	23/10/2014	INSTALLED	C305-EL101098	83935.744	36437.208	85.650	0.781174	0.747189	0.805312
Electrolevel Beam	S C305-EL101099	14085044	23/10/2014	INSTALLED	C305-EL101099	83939.657	36437.498	85.650	0.708637	0.672063	0.720316
Electrolevel Beam	S C305-EL101100	14085010	23/10/2014	INSTALLED	C305-EL101100	83943.57	36437.788	85.650	0.683947	0.654520	0.676042
Electrolevel Beam	S C305-EL101101	14085004	23/10/2014	INSTALLED	C305-EL101101	83947.483	36438.078	85.650	0.644223	0.652449	0.645592
Electrolevel Beam	S C305-EL101102	14081006	23/10/2014	INSTALLED	C305-EL101102	83947.631	36436.668	85.650	0.583845	0.592059	0.577149
Electrolevel Beam	S C305-EL101103	14085045	23/10/2014	INSTALLED	C305-EL101103	83944.89	36436.458	85.650	0.493887	0.500745	0.496591
Electrolevel Beam	S C305-EL101104	14084020	23/10/2014	INSTALLED	C305-EL101104	83942.149	36436.248	85.650	0.367864	0.394404	0.396036
Electrolevel Beam	S C305-EL101105	14132010	23/10/2014	INSTALLED	C305-EL101105	83939.409	36436.038	85.650	0.388072	0.416287	0.418778
Electrolevel Beam	S C305-EL101105	14132010	23/10/2014	INSTALLED	C305-EL101106	83936.669	36435.828	85.650	0.245260	0.275572	0.271662

Learning Legacy Document

Summary installed instrumentation - Electrolevels											
Sensor Type	Sensor ID	Sensor Serial Number	Date Installation	Status	Monitoring ID	Location MONR			Comm. Readings (mm)		
						Eastings X (m)	Northings Y (m)	Elevation Z (mATD)	19/11/2014	19/11/2014	19/11/2014
Electrolevel Beam	S C305-EL102001	14084034	23/10/2014	INSTALLED	C305-EL102001	83564.107	36144.228	82.550	0.000	0.000	0.000
Electrolevel Beam	S C305-EL102002	14132002	23/10/2014	INSTALLED	C305-EL102002	83565.533	36141.475	82.550	0.091120	0.149508	0.123624
Electrolevel Beam	S C305-EL102003	14084067	23/10/2014	INSTALLED	C305-EL102003	83566.886	36144.153	82.550	0.121324	0.129703	0.125914
Electrolevel Beam	S C305-EL102004	14132039	23/10/2014	INSTALLED	C305-EL102004	83568.273	36146.897	82.550	-0.028391	-0.007209	-0.005113
Electrolevel Beam	S C305-EL102005	14085029	23/10/2014	INSTALLED	C305-EL102005	83569.682	36149.658	82.550	0.029407	0.077257	0.045473
Electrolevel Beam	S C305-EL102006	14084042	23/10/2014	INSTALLED	C305-EL102006	83571.079	36152.398	82.550	-0.123760	-0.086222	-0.088266
Electrolevel Beam	S C305-EL102007	14085028	23/10/2014	INSTALLED	C305-EL102007	83572.476	36155.137	82.550	-0.095273	-0.053864	-0.039662
Electrolevel Beam	S C305-EL102008	14084041	23/10/2014	INSTALLED	C305-EL102008	83573.849	36157.860	82.550	-0.216277	-0.156755	-0.163720
Electrolevel Beam	S C305-EL102009	14132003	23/10/2014	INSTALLED	C305-EL102009	83575.223	36160.584	82.550	-0.249259	-0.141592	-0.148160
Electrolevel Beam	S C305-EL102010	14084070	23/10/2014	INSTALLED	C305-EL102010	83576.584	36163.285	82.550	-0.522868	-0.400959	-0.412769
Electrolevel Beam	S C305-EL102011	14084069	23/10/2014	INSTALLED	C305-EL102011	83575.471	36163.855	82.550	-0.529266	-0.385006	-0.385006
Electrolevel Beam	S C305-EL102012	14084075	23/10/2014	INSTALLED	C305-EL102012	83577.036	36166.929	82.550	-0.502339	-0.316968	-0.355669
Electrolevel Beam	S C305-EL102013	14081007	23/10/2014	INSTALLED	C305-EL102013	83578.602	36170.004	82.550	-0.535516	-0.326800	-0.327820
Electrolevel Beam	S C305-EL102014	14081008	23/10/2014	INSTALLED	C305-EL102014	83580.168	36173.079	82.550	-0.538097	-0.323481	-0.329133
Electrolevel Beam	S C305-EL102015	14085006	23/10/2014	INSTALLED	C305-EL102015	83581.734	36176.153	82.550	-0.479123	-0.261974	-0.261974
Electrolevel Beam	S C305-EL102016	14083033	23/10/2014	INSTALLED	C305-EL102016	83583.299	36179.228	82.550	-0.482190	-0.279344	-0.259308
Electrolevel Beam	S C305-EL102017	14085040	23/10/2014	INSTALLED	C305-EL102017	83584.413	36178.668	82.550	-0.425454	-0.230794	-0.198201
Electrolevel Beam	S C305-EL102018	14085011	23/10/2014	INSTALLED	C305-EL102018	83585.805	36181.409	82.550	-0.369216	-0.240869	-0.177971
Electrolevel Beam	S C305-EL102019	14084056	23/10/2014	INSTALLED	C305-EL102019	83587.256	36184.262	82.550	-0.307314	-0.192685	-0.151663
Electrolevel Beam	S C305-EL102020	14083030	23/10/2014	INSTALLED	C305-EL102020	83588.706	36187.114	82.550	-0.244719	-0.128976	-0.124994
Electrolevel Beam	S C305-EL102021	14084036	23/10/2014	INSTALLED	C305-EL102021	83590.115	36189.848	82.550	-0.217480	-0.080852	-0.101262
Electrolevel Beam	S C305-EL102022	14084006	23/10/2014	INSTALLED	C305-EL102022	83591.512	36192.559	82.550	-0.161652	-0.053466	-0.053466
Electrolevel Beam	S C305-EL102023	14084035	23/10/2014	INSTALLED	C305-EL102023	83592.931	36195.315	82.550	-0.162588	-0.025728	-0.053452
Electrolevel Beam	S C305-EL102024	14084055	23/10/2014	INSTALLED	C305-EL102024	83594.322	36198.085	82.550	-0.164244	-0.009944	-0.058704
Electrolevel Beam	S C305-EL102025	14084005	23/10/2014	INSTALLED	C305-EL102025	83595.676	36200.818	82.550	-0.137072	0.017663	-0.012068
Electrolevel Beam	S C305-EL102026	14081001	23/10/2014	INSTALLED	C305-EL102026	83597.030	36203.551	82.550	-0.077341	0.042619	0.015480
Electrolevel Beam	S C305-EL102027	14085012	23/10/2014	INSTALLED	C305-EL102027	83598.391	36206.281	82.550	-0.021960	0.032590	0.039408
Electrolevel Beam	S C305-EL102028	14083029	23/10/2014	INSTALLED	C305-EL102028	83599.763	36208.977	82.550	0.066272	0.085706	0.126416
Electrolevel Beam	S C305-EL102029	14085032	23/10/2014	INSTALLED	C305-EL102029	83601.147	36211.695	82.550	0.097116	0.104318	0.156117
Electrolevel Beam	S C305-EL102030	14084037	23/10/2014	INSTALLED	C305-EL102030	83602.540	36214.436	82.550	-0.019704	0.036311	0.024179
Electrolevel Beam	S C305-EL102031	14085033	23/10/2014	INSTALLED	C305-EL102031	83603.926	36217.181	82.550	-0.019821	0.029774	0.079113
Electrolevel Beam	S C305-EL102032	14084024	23/10/2014	INSTALLED	C305-EL102032	83605.303	36219.902	82.550	0.047087	0.100631	0.138222
Electrolevel Beam	S C305-EL102033	14132005	23/10/2014	INSTALLED	C305-EL102033	83606.669	36222.601	82.550	0.034472	0.066929	0.115587
Electrolevel Beam	S C305-EL102034	14084017	23/10/2014	INSTALLED	C305-EL102034	83608.035	36225.300	82.550	0.057053	0.105548	0.128610
Electrolevel Beam	S C305-EL102035	14132030	23/10/2014	INSTALLED	C305-EL102035	83609.401	36227.999	82.550	0.090463	0.136346	0.153553
Electrolevel Beam	S C305-EL102036	14132031	23/10/2014	INSTALLED	C305-EL102036	83610.791	36230.742	82.550	0.160304	0.162551	0.186995
Electrolevel Beam	S C305-EL102037	14132037	23/10/2014	INSTALLED	C305-EL102037	83612.179	36233.486	82.550	0.197646	0.220144	0.212839
Electrolevel Beam	S C305-EL102038	14132006	23/10/2014	INSTALLED	C305-EL102038	83613.566	36236.202	82.550	0.080123	0.119064	0.118170
Electrolevel Beam	S C305-EL102039	14132004	23/10/2014	INSTALLED	C305-EL102039	83614.966	36238.940	82.550	0.022100	0.096486	0.096486
Electrolevel Beam	S C305-EL102040	14084038	23/10/2014	INSTALLED	C305-EL102040	83616.362	36241.680	82.550	0.024901	0.128595	0.128595
Electrolevel Beam	S C305-EL102041	14132008	23/10/2014	INSTALLED	C305-EL102041	83617.737	36244.403	82.550	0.058020	0.157065	0.157065
Electrolevel Beam	S C305-EL102042	14132038	23/10/2014	INSTALLED	C305-EL102042	83619.134	36247.170	82.550	0.019767	0.088840	0.093826
Electrolevel Beam	S C305-EL102043	14084062	23/10/2014	INSTALLED	C305-EL102043	83620.531	36249.938	82.550	0.056054	0.082235	0.090260
Electrolevel Beam	S C305-EL102044	14085055	23/10/2014	INSTALLED	C305-EL102044	83621.952	36252.634	82.550	0.119937	0.134283	0.145197
Electrolevel Beam	S C305-EL102045	14084027	23/10/2014	INSTALLED	C305-EL102045	83623.397	36255.348	82.550	0.093962	0.153247	0.104829
Electrolevel Beam	S C305-EL102046	14084061	23/10/2014	INSTALLED	C305-EL102046	83624.818	36258.019	82.550	0.037885	0.088901	0.074141
Electrolevel Beam	S C305-EL102047	14084028	23/10/2014	INSTALLED	C305-EL102047	83626.199	36260.728	82.550	0.012529	0.082858	0.075380
Electrolevel Beam	S C305-EL102048	14085023	23/10/2014	INSTALLED	C305-EL102048	83627.536	36263.497	82.550	0.017478	0.044282	0.044102
Electrolevel Beam	S C305-EL102049	14086005	23/10/2014	INSTALLED	C305-EL102049	83628.874	36266.266	82.550	0.022687	0.037647	0.050420
Electrolevel Beam	S C305-EL102050	14086004	23/10/2014	INSTALLED	C305-EL102050	83630.200	36269.012	82.550	0.027928	0.088185	0.076713
Electrolevel Beam	S C305-EL102051	14084066	23/10/2014	INSTALLED	C305-EL102051	83631.585	36271.727	82.550	-0.087492	-0.035911	-0.044768
Electrolevel Beam	S C305-EL102052	14086009	23/10/2014	INSTALLED	C305-EL102052	83632.976	36274.469	82.550	-0.053022	-0.034855	-0.025383
Electrolevel Beam	S C305-EL102053	14084065	23/10/2014	INSTALLED	C305-EL102053	83634.367	36277.211	82.550	0.000116	0.009855	-0.002805
Electrolevel Beam	S C305-EL102054	14085054	23/10/2014	INSTALLED	C305-EL102054	83635.757	36279.954	82.550	0.023089	0.070018	0.070018
Electrolevel Beam	S C305-EL102055	14132040	23/10/2014	INSTALLED	C305-EL102055	83637.125	36282.652	82.550	-0.068014	0.030633	0.006780
Electrolevel Beam	S C305-EL102056	14084030	23/10/2014	INSTALLED	C305-EL102056	83638.515	36285.395	82.550	-0.164773	-0.061853	-0.072590
Electrolevel Beam	S C305-EL102057	14083021	23/10/2014	INSTALLED	C305-EL102057	83639.939	36288.205	82.550	-0.137609	-0.030577	-0.061419
Electrolevel Beam	S C305-EL102058	14083022	23/10/2014	INSTALLED	C305-EL102058	83641.329	36290.948	82.550	-0.054776	-0.003513	-0.012438
Electrolevel Beam	S C305-EL102059	14084029	23/10/2014	INSTALLED	C305-EL102059	83642.686	36293.624	82.550	-0.028050	0.011451	0.007301
Electrolevel Beam	S C305-EL102060	14086008	23/10/2014	INSTALLED	C305-EL102060	83644.042	36296.299	82.550	-0.003519	0.005508	0.006605
Electrolevel Beam	S C305-EL102061	14086008	23/10/2014	INSTALLED	C305-EL102061	83645.426	36299.017	82.550	0.00	0.00	0.00

IRS Installation Record Sheets – Sockets										
Sensor Type	Sensor ID	Date	Status	Sensor Location - GPS Reading			Commissioning Readings (mm)			
		Installation		Eastings X (m)	Northings Y(m)	Elevation Z(mATD)	Average	12/11/2014	12/11/2014	12/11/2014
Socket	C305-LB105001	12/11/2014	Installed	83839.251	36434.357	100.113	100.1132	100.1137	100.1126	100.1133
Socket	C305-LB105004	12/11/2014	Installed	83848.326	36435.033	100.135	100.1350	100.1346	100.1353	100.1351
Socket	C305-LB105007	12/11/2014	Installed	83857.502	36435.695	100.205	100.2053	100.2049	100.2058	100.2052
Socket	C305-LB105010	12/11/2014	Installed	83866.684	36436.261	100.273	100.2725	100.2729	100.2722	100.2724
Socket	C305-LB105013	12/11/2014	Installed	83875.681	36436.976	100.323	100.3228	100.3224	100.3231	100.3229
Socket	C305-LB105016	12/11/2014	Installed	83884.899	36437.744	100.344	100.3437	100.3436	100.3443	100.3432
Socket	C305-LB105019	12/11/2014	Installed	83894.098	36438.433	100.394	100.3936	100.3931	100.3937	100.3940
Socket	C305-LB105022	12/11/2014	Installed	83903.197	36439.130	100.451	100.4508	100.4512	100.4505	100.4507
Socket	C305-LB105025	12/11/2014	Installed	83912.347	36439.803	100.524	100.5242	100.5240	100.5245	100.5241
Socket	C305-LB105028	12/11/2014	Installed	83921.673	36440.469	100.564	100.5643	100.5640	100.5648	100.5641
Socket	C305-LB105031	12/11/2014	Installed	83930.797	36441.155	100.624	100.6241	100.6239	100.6246	100.6238
Socket	C305-LB105033	12/11/2014	Installed	83935.422	36441.529	100.631	100.6312	100.6306	100.6317	100.6313
Socket	C305-LB105034	12/11/2014	Installed	83935.282	36443.480	99.997	99.9973	99.9975	99.9967	99.9977
Socket	C305-LB105036	12/11/2014	Installed	83942.072	36443.980	99.999	99.9989	99.9994	99.9983	99.9990
Socket	C305-LB105038	12/11/2014	Installed	83948.862	36444.480	99.991	99.9912	99.9918	99.9911	99.9907
Socket	C305-LB105040	12/11/2014	Installed	83955.653	36444.980	99.986	99.9857	99.9854	99.9863	99.9854
Socket	C305-LB105041	12/11/2014	Installed	83959.048	36445.230	99.975	99.9745	99.9739	99.9751	99.9745
Socket	C305-LB105042	12/11/2014	Installed	83959.196	36443.280	100.732	100.7319	100.7317	100.7322	100.7318
Socket	C305-LB105045	12/11/2014	Installed	83968.301	36443.889	100.817	100.8165	100.8167	100.8163	100.8165
Socket	C305-LB105048	12/11/2014	Installed	83977.399	36444.593	100.851	100.8510	100.8511	100.8504	100.8515
Socket	C305-LB105051	12/11/2014	Installed	83986.524	36445.268	100.853	100.8528	100.8525	100.8531	100.8528
Socket	C305-LB105054	12/11/2014	Installed	83995.697	36445.969	100.897	100.8970	100.8974	100.8967	100.8969
Socket	C305-LB105057	12/11/2014	Installed	84004.945	36446.674	100.947	100.9470	100.9465	100.9473	100.9472
Socket	C305-LB105060	12/11/2014	Installed	84014.070	36447.354	100.997	100.9969	100.9974	100.9968	100.9965
Socket	C305-LB105063	12/11/2014	Installed	84023.169	36448.033	101.129	101.1291	101.1292	101.1288	101.1293
Socket	C305-LB105066	12/11/2014	Installed	84032.556	36450.511	101.111	101.1107	101.1112	101.1103	101.1106
Socket	C305-LB105069	12/11/2014	Installed	84040.954	36457.249	101.226	101.2256	101.2251	101.2261	101.2256
Socket	C305-LB105072	12/11/2014	Installed	84046.266	36466.494	101.291	101.2906	101.2901	101.2911	101.2906
Socket	C305-LB105075	12/11/2014	Installed	84047.310	36476.108	101.321	101.3205	101.3209	101.3201	101.3205
Socket	C305-LB105078	12/11/2014	Installed	84046.652	36485.234	101.372	101.3722	101.3723	101.3721	101.3722
Socket	C305-LB105081	12/11/2014	Installed	84045.972	36494.359	101.414	101.4138	101.4144	101.4136	101.4134
Socket	C305-LB105084	12/11/2014	Installed	84045.318	36503.560	101.460	101.4596	101.4592	101.4599	101.4597
Socket	C305-LB105087	12/11/2014	Installed	84044.623	36512.834	101.540	101.5395	101.5394	101.5397	101.5394
Socket	C305-LB105090	12/11/2014	Installed	84043.941	36521.884	101.580	101.5795	101.5790	101.5800	101.5795
Socket	C305-LB105093	12/11/2014	Installed	84043.246	36531.083	101.631	101.6312	101.6309	101.6314	101.6313
Socket	C305-LB105096	12/11/2014	Installed	84042.562	36540.131	101.629	101.6291	101.6295	101.6288	101.6290

IRS Installation Record Sheets – Sockets										
Sensor Type	Sensor ID	Date Installation	Status	Sensor Location - GPS Reading			Commisioning Readings (mm)			
				Eastings X (m)	Northings Y(m)	Elevation Z(mATD)	Average	10/11/2014	10/11/2014	10/11/2014
Socket	C305-LB106001	10/11/2014	Installed	83565.533	36141.475	99.932	99.9324	99.9327	99.9319	99.9326
Socket	C305-LB106004	10/11/2014	Installed	83569.682	36149.658	99.891	99.8913	99.8917	99.8910	99.8912
Socket	C305-LB106007	10/11/2014	Installed	83573.849	36157.860	99.859	99.8591	99.8592	99.8587	99.8594
Socket	C305-LB106009	10/11/2014	Installed	83576.584	36163.285	99.836	99.8357	99.8358	99.8356	99.8357
Socket	C305-LB106010	10/11/2014	Installed	83575.471	36163.855	99.166	99.1664	99.1663	99.1668	99.1661
Socket	C305-LB106013	10/11/2014	Installed	83580.168	36173.079	99.174	99.1740	99.1743	99.1736	99.1741
Socket	C305-LB106015	10/11/2014	Installed	83583.299	36179.228	99.365	99.3649	99.3643	99.3652	99.3652
Socket	C305-LB106016	10/11/2014	Installed	83584.413	36178.668	99.863	99.8628	99.8633	99.8622	99.8629
Socket	C305-LB106019	10/11/2014	Installed	83588.706	36187.114	99.915	99.9148	99.9151	99.9145	99.9148
Socket	C305-LB106022	10/11/2014	Installed	83592.931	36195.315	99.908	99.9080	99.9078	99.9083	99.9079
Socket	C305-LB106025	10/11/2014	Installed	83597.030	36203.551	100.009	100.0085	100.0081	100.0089	100.0085
Socket	C305-LB106028	10/11/2014	Installed	83601.147	36211.695	100.066	100.0656	100.0661	100.0651	100.0656
Socket	C305-LB106031	10/11/2014	Installed	83605.303	36219.902	100.106	100.1060	100.1066	100.1057	100.1057
Socket	C305-LB106034	10/11/2014	Installed	83609.401	36227.999	100.179	100.1791	100.1787	100.1792	100.1794
Socket	C305-LB106037	10/11/2014	Installed	83613.566	36236.202	100.224	100.2244	100.2239	100.2248	100.2245
Socket	C305-LB106040	10/11/2014	Installed	83617.737	36244.403	100.207	100.2070	100.2071	100.2069	100.2070
Socket	C305-LB106043	10/11/2014	Installed	83621.952	36252.634	100.266	100.2659	100.2654	100.2663	100.2660
Socket	C305-LB106046	10/11/2014	Installed	83626.199	36260.728	100.383	100.3831	100.3825	100.3837	100.3831
Socket	C305-LB106049	10/11/2014	Installed	83630.200	36269.012	100.407	100.4073	100.4075	100.4069	100.4075
Socket	C305-LB106052	10/11/2014	Installed	83634.367	36277.211	100.467	100.4667	100.4661	100.4668	100.4672
Socket	C305-LB106055	10/11/2014	Installed	83638.515	36285.395	100.469	100.4687	100.4692	100.4686	100.4683
Socket	C305-LB106058	10/11/2014	Installed	83642.686	36293.624	100.580	100.5803	100.5807	100.5799	100.5803
Socket	C305-LB106061	10/11/2014	Installed	83646.810	36301.735	100.607	100.6066	100.6068	100.6062	100.6068

IRS Installation Record Sheets – Sockets										
Sensor Type	Sensor ID	Date	Status	Sensor Location - GPS Reading			Commisioning Readings (mm)			
		Installation		Eastings X (m)	Northings Y(m)	Elevation Z(mATD)	Average	12/11/2014	12/11/2014	12/11/2014
Socket	C305-LB105098	12/11/2014	Installed	83939.657	36437.498	100.534	100.5340	100.5337	100.5342	100.5341
Socket	C305-LB105101	12/11/2014	Installed	83947.631	36436.668	100.539	100.5391	100.5390	100.5396	100.5387
Socket	C305-LB105102	12/11/2014	Installed	83944.890	36436.458	100.550	100.5498	100.5499	100.5494	100.5501
Socket	C305-LB105105	12/11/2014	Installed	83936.669	36435.828	99.909	99.9086	99.9085	99.9091	99.9082
Socket	C305-LB105106	12/11/2014	Installed	83937.611	36435.623	99.966	99.9656	99.9657	99.9653	99.9658

IRS Installation Record Sheets – Laser Convergence										
Sensor Type	Sensor ID	Date	Status	Sensor Location - GPS Reading			Commisioning Readings (mm)			
		Installation		Eastings X (m)	Northings Y(m)	Elevation Z(mATD)	Average	30/10/2014	30/10/2014	30/10/2014
Laser	C305-LC101001	30/10/2014	Installed	83935.736	36436.518	105.070	-0.0366	-0.0546	-0.1087	0.0534
Laser	C305-LC101002	30/10/2014	Installed	83931.768	36431.958	105.070	-0.0338	-0.1059	0.0022	0.0022
Laser	C305-LC101003	30/10/2014	Installed	83936.239	36431.187	105.070	0.1395	0.1575	0.1575	0.1034

Learning Legacy Document

IRS Installation Record Sheets – Accelerometers										
Sensor Type	Sensor ID	Date	Status	Sensor Location - GPS Reading			Commissioning Readings (mm/s)			
		Installation		Eastings X (m)	Northings Y(m)	Elevation Z(mATD)	Average	05/11/2014	05/11/2014	05/11/2014
Accelerometers	C305-AC10001X	05/11/2014	Installed	84045.535	36500.493	85.650	0.2971	0.4664	0.2473	0.1778
Accelerometers	C305-AC10001Y	05/11/2014	Installed	84045.535	36500.493	85.650	0.1549	0.2167	0.1689	0.0791
Accelerometers	C305-AC10001Z	05/11/2014	Installed	84045.535	36500.493	85.650	0.0871	0.0918	0.1298	0.0396
Accelerometers	C305-AC10002X	05/11/2014	Installed	83945.467	36441.230	85.650	0.0153	0.0153	0.0153	0.0153
Accelerometers	C305-AC10002Y	05/11/2014	Installed	83945.467	36441.230	85.650	0.0401	0.0296	0.0401	0.0505
Accelerometers	C305-AC10002Z	05/11/2014	Installed	83945.467	36441.230	85.650	0.0398	0.0398	0.0294	0.0503
Accelerometers	C305-AC10003X	05/11/2014	Installed	83606.669	36222.601	82.550	0.0211	0.0211	0.0211	0.0210
Accelerometers	C305-AC10003Y	05/11/2014	Installed	83606.669	36222.601	82.550	0.0001	0.0002	0.0001	0.0001
Accelerometers	C305-AC10003Z	05/11/2014	Installed	83606.669	36222.601	82.550	0.0065	0.0001	0.0001	0.0192

IRS Installation Record Sheets – Tilt meters											
Sensor Type	Sensor ID	Sensor serial number	Date	Status	Sensor Location - GPS Reading			Commisioning Readings (deg)			
			Installation		Eastings X (m)	Northings Y(m)	Elevation Z(mATD)	Average	31/10/2014	31/10/2014	31/10/2014
Tiltmeter	C305-TU106101	98587	31/10/2014	Installed	83933.0	36430.0	90.0	-0.0012	-0.0012	-0.0012	-0.0012
Tiltmeter	C305-TU106102	98581	31/10/2014	Installed	83933.0	36430.0	93.0	0.0032	0.0030	0.0030	0.0038
Tiltmeter	C305-TU106103	98585	31/10/2014	Installed	83933.0	36430.0	96.0	0.0008	0.0008	0.0008	0.0008
Tiltmeter	C305-TU106104	98586	31/10/2014	Installed	83933.0	36430.0	99.0	-0.0026	-0.0021	-0.0029	-0.0029
Tiltmeter	C305-TU106105	98579	31/10/2014	Installed	83933.0	36430.0	102.0	-0.0005	-0.0008	-0.0008	0.0000

Learning Legacy Document

Learning Legacy Document

APPENDIX C: MINUTES OF THE CLOSE OUT MEETING



I&M Close Out Meeting

Date & Time		25/09/2015 10:00	
Meeting No.		7	
<p>The purpose of this document is to record agreement to cease monitoring long term monitoring and decommission based on review of the data against the requirements. Agreement from this meeting is then considered acceptance from all parties that the Close Out Report can then be produced based on the data shown and this will be acceptable to the Project Manager.</p>			
Attendees:			
[Redacted]		[Redacted]	
Data Reviewed			
Monitoring References	Location	Settlement rate	Agreement to decommission
Area 6 - Limehouse Link Tunnel			
EL060101-EL060128	Westbound	N/A	2mm max, stable since TBM Yes. Annotate
EL060201-EL060228	Eastbound	N/A	4mm max, stable since TBM Yes.
Area 10 - BT Deep Level Tunnels and Shaft			
EL101001-EL101096	Commercial Street and Brushfield Street Tunnel	N/A	Annotate graphs for loss of data / knocked beam. Manual readings need to be reviewed.
EL101101-EL101111	Brushfield Street Adit	N/A	Annotate graphs as above and review with manual readings.
TU106101 - TU106105	Brushfield Street Shaft	N/A	Yes - convert degrees to mm/m
LC101001-LC101003	Brushfield Street Shaft	N/A	Yes -
EL102001-EL102061	Bishopsgate Tunnel	N/A	Review with manual readings.
Area 10 - Post Office Tunnel			
EL104001-EL104051	Widgate Street/ Middlesex Street	N/A	Yes - electrodes, data / covers box already removed. Last 2 manual readings < 1mm change.
Notes			
<p>- Annotate graphs to highlight knocks, loss of readings - For BT tunnels set of manual readings needed to confirm long term stability.</p>			
Sign off			
DSJV	Geocisa	Crosstail	C122
[Redacted]	[Redacted]	[Redacted]	[Redacted]