



C305– Eastern Running Tunnels

I&M Close out report for Levelling Points & 3D Prisms: East India Dock Wall (Drive Y)

CRL Document Number: C305-DSJ-C2-RGN-CRG03-50357

Supplier Document Number:
Contract MDL reference C08.079

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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.

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2b. Review by Stakeholder (if required):

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

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I&M Close out report for Levelling Points & 3D Prisms: East India Dock Wall (Drive Y)
C305-DSJ-C2-RGN-CRG03-50357

C305 Crossrail Eastern Running Tunnels

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Current Version of the Documents & Signatures :

Revision:	Date:	Prepared by:	Checked by:	Engineering Approved by:
2.0	05.01.16	[Redacted]	[Redacted]	[Redacted]
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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 summarize 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 dewatering of cross passages; impacts from cross passage excavation or 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.

The settlement rate of monitoring locations, covered by this close-out report, had generally reached the specified rate of 2mm/year post TBM works but they are located in an area affected by dewatering works associated with cross passage construction. Monitoring of instruments close to the dewatering works is included in this report to provide evidence that settlement due to the dewatering works has now reached the specified rate. Therefore by inference, instruments located in the vicinity of the dewatering would have also reached the specified rate.

2. LOCATION OF THE WORKS

The instrumentation included within this report is situated within Area 4, Limmo Shaft to Canary Wharf Station, between project chainage 84400-84500. The instruments were installed along the western footpath of East India Dock.

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-CRG03-50019	Method Statement for I&M Studs & 3D Prisms: East India Dock Wall (84500-84400)	Main Method Statement	9 3D Prisms 7 Levelling points
C305-DSJ-C2-CCN-CRG03-50027	C305: Eastern Running Tunnels SNC for East India Dock	Installation of additional Levelling points	29 Levelling points

CROSSRAIL NUMBER	DOCUMENT NAME	REASON FOR ISSUE	TYPE AND NUMBER OF INSTRUMENTATION INSTALLED
C305-DSJ-C2-GMS-CRG03-50017	Sockets & Prisms: Pilgrims Mews (8400-84500)	Main Method Statement	7 3D Prisms
C305-DSJ-C2-RGN-CRG03-50210	IR for I&M MS 'Studs & 3D Prisms: East India Dock Wall (84500-84400)'	Installation Report	11 3D Prisms 36 Levelling points

4. SUMMARY OF INSTALLED INSTRUMENTATION ON SITE

The total number instruments installed as per method statement and SNC, was:

- 11 – 3D Prisms
- 36 – Levelling points

See Appendix B for further information of the installed instrumentation.

The average commissioning readings included in Appendix B have been used to calculate the relative movements provided in the graphs of this report. In some of them, new values were determined as a baseline according to the requirement of the client in CTC meeting. The dates of the new baselines are as follows:

- C305-LP042001 - C305- LP042007: 25th February 2013
- C305-LP042050 - C305- LP042078: No new baseline was applied
- C305-RP042001 - C305-RP042015: No new baseline was applied

5. CONSTRUCTION ACTIVITY

TBM PASSAGE

DRIVE Y	RINGS	PROJECT CHAINAGE	DATES
Eastbound	262 – 292	84446 – 84397	25/03/2013 to 28/03/2013
Westbound	258 – 287	84452 - 84406	09/04/2013 to 11/04/2013

No stoppage periods

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

DEWATERING

Cross passage 13 26th November 2013 to 3rd August 2015
Cross passage 14 16th December 2013 to 17th January 2014

28th July 2014 to 27th July 2015
 Limmo 4th November 2013 (still on)
 Canary Wharf It is understood that Canary Wharf dewatering systems were switched on throughout the monitoring period

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.

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

Where:

B =gradient or slope

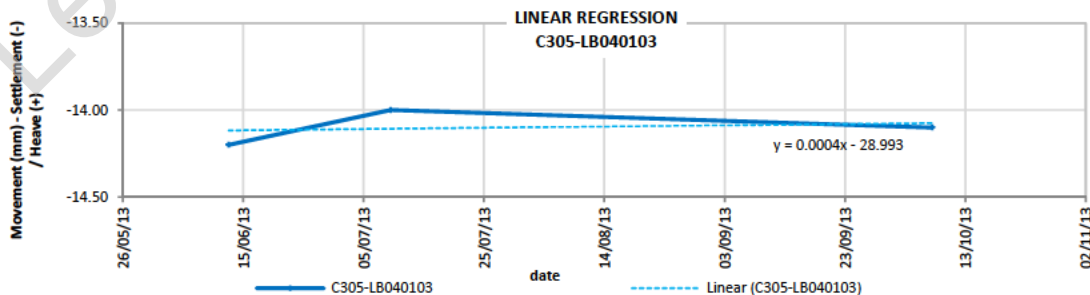
X (independent variable) = date

Y (dependent variable) = vertical movement

From this, the settlement rate per day can be calculated and rate per year determined (negative value 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 3mm/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 for one socket and its projection.

	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

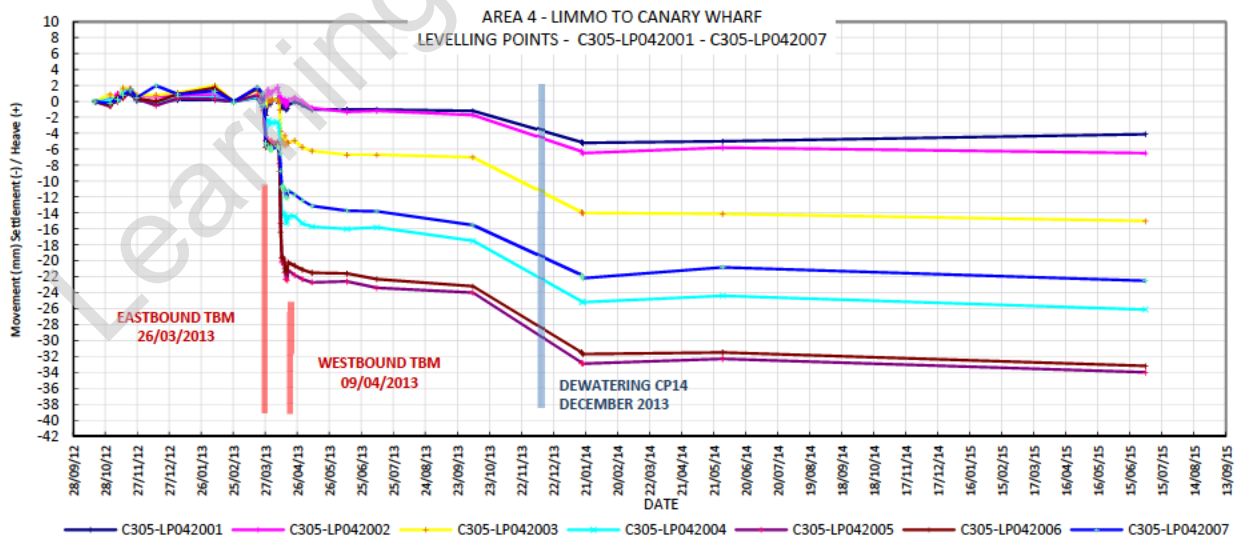
7. SUMMARY OF THE DATA

The methodology described for sockets in section 6, is applied here for levelling points.

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

LEVELLING POINTS

C305-LP042001 - C305-LP042007



As can be seen in the graph above the levelling point C305-LP042007 recorded a maximum settlement of -6mm during the Eastbound TBM transit and -17 mm settlement in the C305-LP042005 during the Westbound TBM transit.

The effect of the dewatering in the Cross Passage 14 can be observed in the graphic above. To analyse whether the rate of change in the data has reached an acceptably small rate, the last three readings after the dewatering were used to calculate the annual projection.

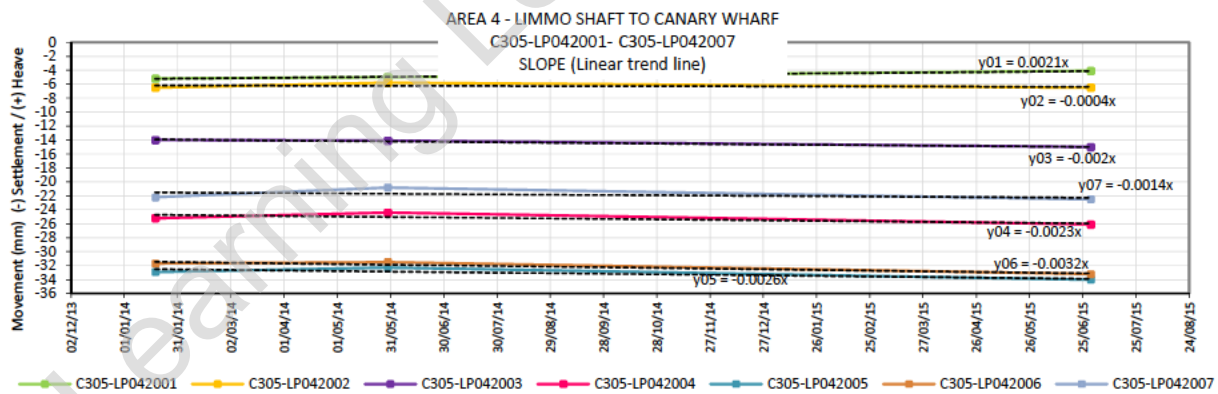
The table below shows the annual rate for the levelling points in this array.

	Recorded Movement (mm)			Rate (mm/year)
	18/01/2014	29/05/2014	29/06/2015	
C305-LP042001	-5.20	-5.00	-4.10	0.073
C305-LP042002	-6.50	-5.80	-6.50	-0.146
C305-LP042003	-14.00	-14.10	-15.00	-0.730
C305-LP042004	-25.20	-24.40	-26.10	-0.840
C305-LP042005	-32.90	-32.30	-34.00	-0.949
C305-LP042006	-31.70	-31.50	-33.20	-1.168
C305-LP042007	-22.20	-20.80	-22.50	-0.511
	Rate less than -2.5 mm/year		% less 2 mm/ year	100.00%
	Rate greater than -3.5 mm/year		% less 3 mm/ year	100.00%

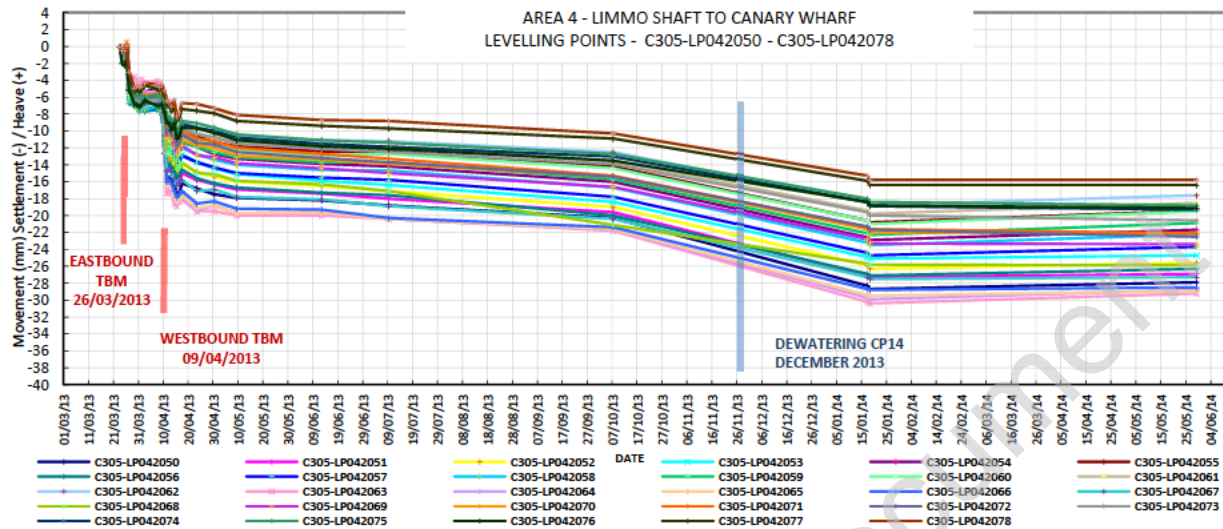
Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of the sockets with a settlement rate less than 2 mm/year is 100%. See section 8 Summary of movements related to dewatering activities.

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



C305-LP042050 - C305-LP042078



As can be seen in the graph above there is a maximum settlement of -8mm during the Eastbound TBM transit and -12 mm settlement during the Westbound TBM transit.

The effect of the dewatering in the Cross Passage 14 can be observed in the graphic above. To analyse whether the rate of change in the data has reached an acceptably small rate, the last three readings after the dewatering were used to calculate the annual projection.

The table below shows the annual rate for the levelling points in this array.

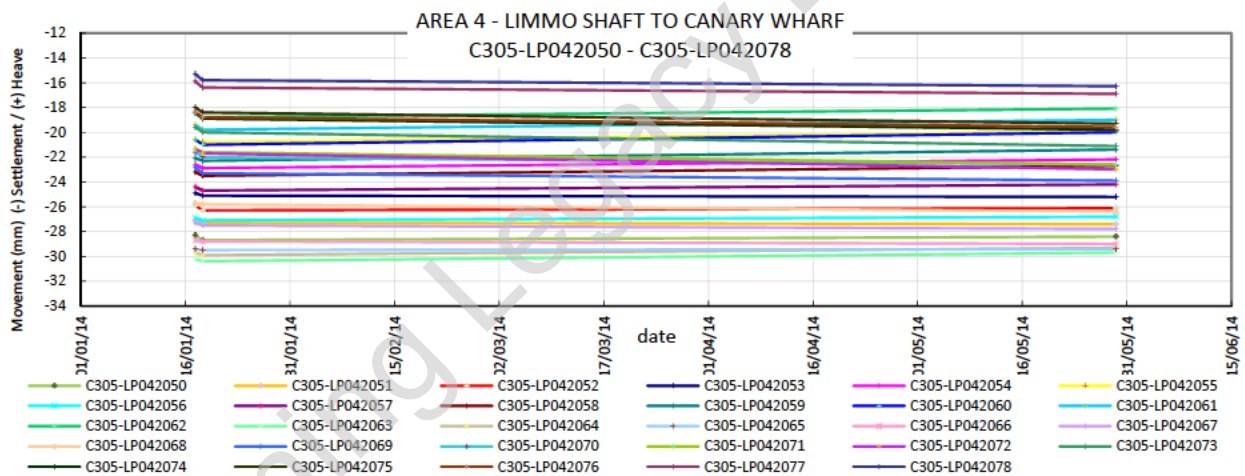
	Recorded Movement (mm)			Rate (mm/year)
	17/01/2014	18/01/2014	29/05/2014	
C305-LP042050	-28.30	-28.70	-28.40	0.256
C305-LP042051	-27.10	-27.30	-27.40	-0.548
C305-LP042052	-25.90	-26.30	-26.10	-0.007
C305-LP042053	-24.90	-25.10	-25.20	-0.548
C305-LP042054	-22.60	-22.90	-22.20	1.533
C305-LP042055	-20.60	-20.80	-19.90	2.227
C305-LP042056	-26.90	-27.10	-26.80	0.548
C305-LP042057	-24.40	-24.70	-24.20	0.949
C305-LP042058	-23.20	-23.50	-22.70	1.789
C305-LP042059	-22.10	-22.30	-21.40	2.227
C305-LP042060	-20.60	-21.00	-20.00	2.227
C305-LP042061	-19.40	-19.80	-19.00	1.643
C305-LP042062	-18.50	-18.80	-18.10	1.533
C305-LP042063	-30.20	-30.40	-29.70	1.679
C305-LP042064	-29.70	-29.90	-29.30	1.387
C305-LP042065	-29.40	-29.50	-29.40	0.015
C305-LP042066	-28.70	-28.80	-29.00	-0.694
C305-LP042067	-27.30	-27.50	-27.80	-1.132
C305-LP042068	-25.70	-25.80	-26.40	-1.789
C305-LP042069	-22.80	-23.30	-23.90	-2.373

	Recorded Movement (mm)			Rate (mm/year)
	17/01/2014	18/01/2014	29/05/2014	
C305-LP042070	-21.60	-22.00	-22.60	-2.227
C305-LP042071	-21.40	-21.60	-22.60	-3.066
C305-LP042072	-21.30	-21.70	-23.00	-4.161
C305-LP042073	-19.60	-20.00	-21.10	-3.614
C305-LP042074	-18.40	-18.90	-19.80	-3.212
C305-LP042075	-18.00	-18.40	-19.30	-3.103
C305-LP042076	-18.40	-18.80	-19.60	-2.774
C305-LP042077	-15.90	-16.40	-16.90	-2.081
C305-LP042078	-15.30	-15.80	-16.30	-2.081
	Rate less than -2.5 mm/year		% less 2 mm/ year	79.31%
	Rate greater than -3.5 mm/year		% less 3 mm/ year	93.10%

Note: All the movements are in mm. (-) Settlement / (+) Heave

The percentage of the sockets with a settlement rate less than 2 mm/year is 79.31%, whereas a 93.10% is less than 3 mm/year. See section 8 Summary of movements related to dewatering activities.

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

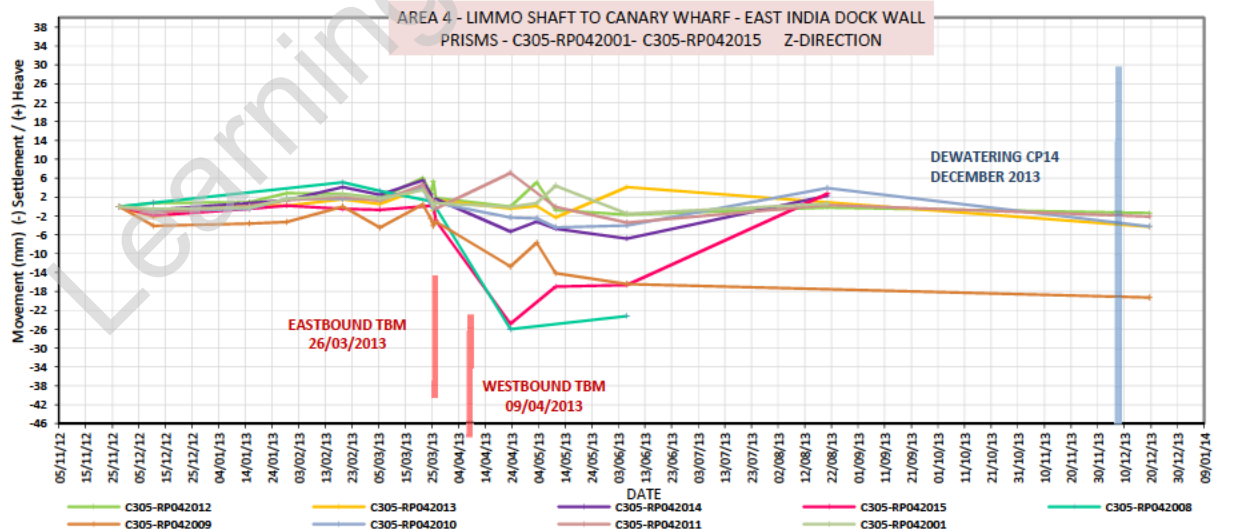
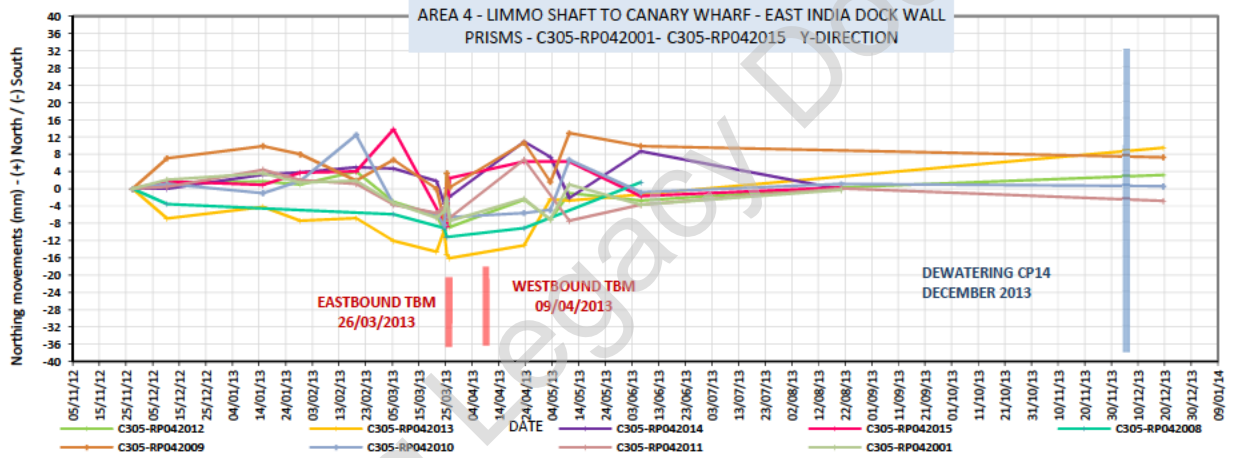
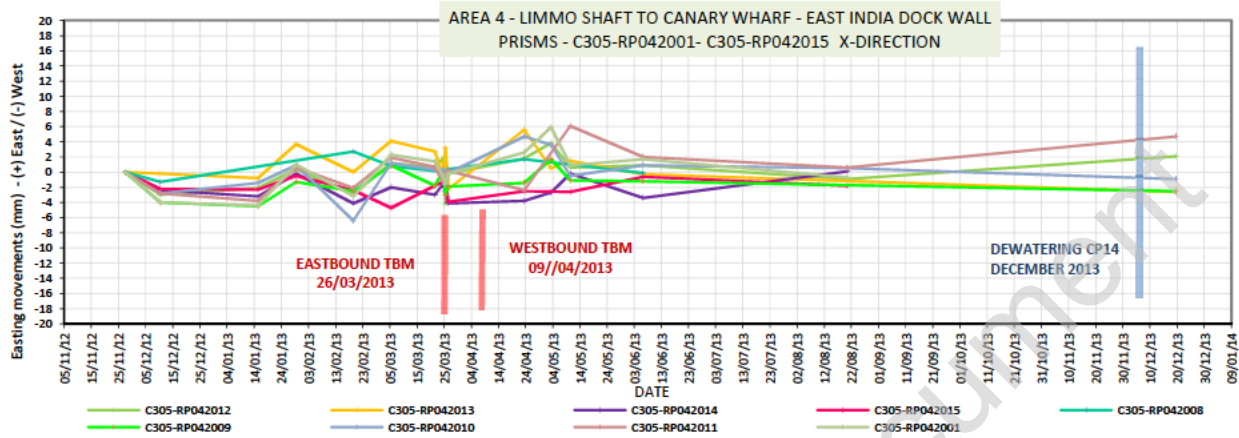


3D PRISMS

Please note the variability of the 3D prism readings shown in the charts below is mainly due to either limited or lost reference points.

Additionally, the accuracy of this monitoring system compared to the levelling points is lower.

C305-RP042001 - C305-RP042015



Readings in X direction show a negative movement of -5 mm during the Eastbound TMB transit for the prism C305-RP042013 and a positive movement of +8 mm during the Westbound TMB transit.

The Y axis shows a positive movement of +14 mm during the Eastbound TMB transit for the prism C305-RP042012 and a positive movement of +13 mm during the Westbound TMB transit for the prism C305-RP042011.

Readings in Z direction show a settlement of -4 mm during the Eastbound TMB transit for the prism C305-RP042009 and -26 mm for the prism C305-RP042008 during the Westbound TMB transit.

8. SUMMARY OF MOVEMENTS RELATED TO DEWATERING ACTIVITIES

The effect of dewatering systems being switched on is clearly illustrated in the graphs presented in section 7 above.

Where possible, the monitoring data sets used to calculate the settlement projections in this report were selected up to this stage of works (ie: they do not include the periods affected by dewatering activities). In some instances the period from which the data sets were used to calculate the settlement projections was two months. This limited monitoring period has resulted in slightly higher settlement ratios. Furthermore, for some areas it is evident that dewatering systems were switched on before ground movements could be demonstrated to have stabilised for post TBM works.

Monitoring data graphs from transects installed to monitor the dewatering activities have been included in this report. These graphs present over a year collection of data. The description and location of these transects, relative to this report's instruments are shown in the list and figure below:

- The transect 4D (C305-LP040001-C305-LP040030) is not covered by this close out report . It is included in Cross Passage 14 and their data will be summarised in a separate Close out report (I&M Close out report for Cross Passages: Phase I - C305-DSJ-C2-RGN-CRG03-50374).

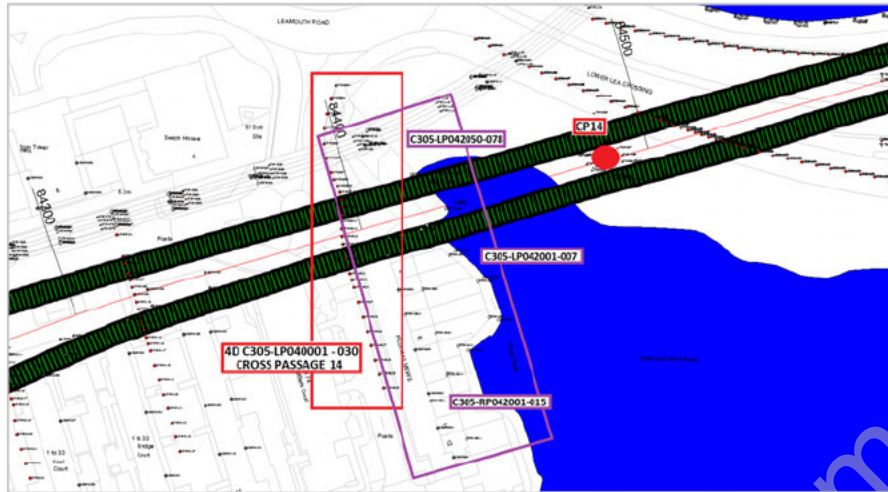
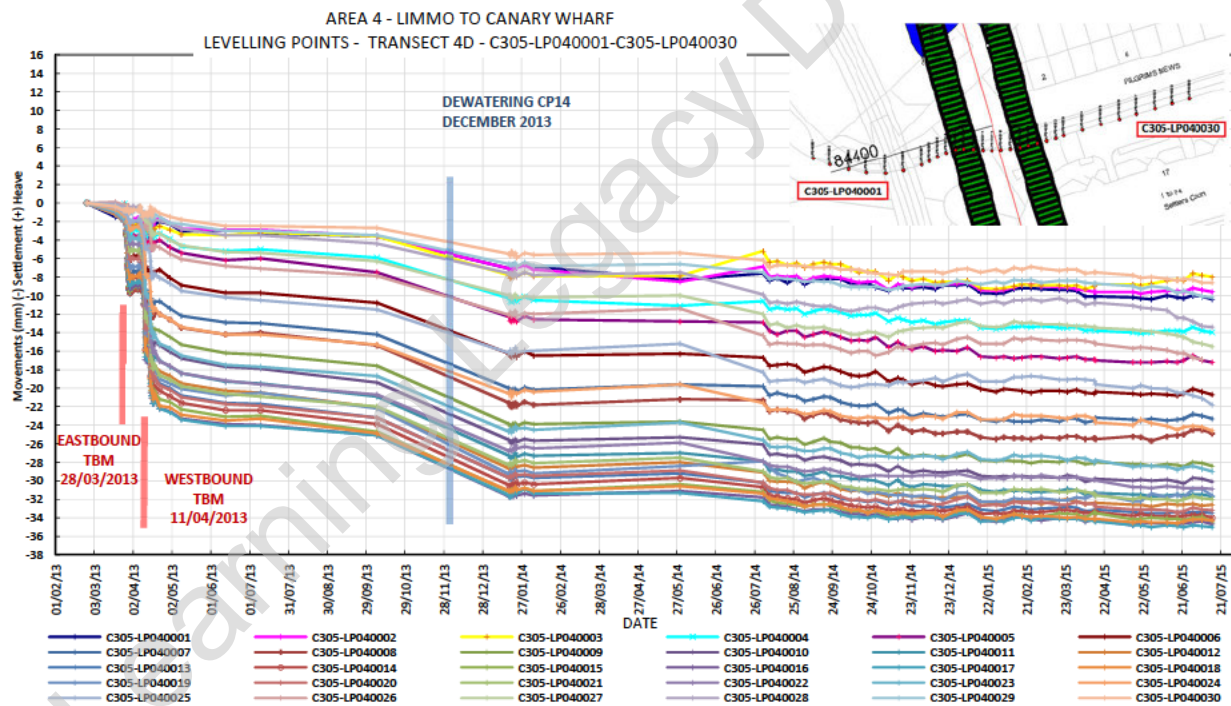


Figure 1: Studs & 3D Prisms East India Dock Wall and Cross Passages sections 4D

TRANSECT 4D C305-LP040001 to C305-LP040030 (CROSS PASSAGE 14)

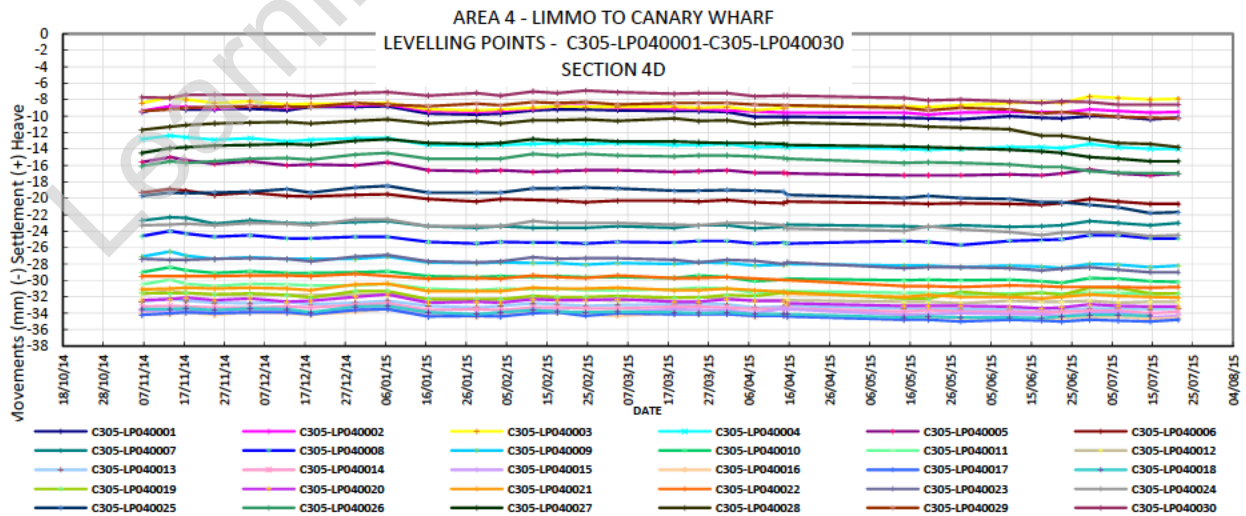


These levelling points close to the area covered in this Close Out Report reach an annual rate less than 2mm/year for the 100%.

The graph and the table below show the data from November 2014 to July 2015 and the annual rate calculated for each levelling point.

	Registered movement (mm)		Rate mm/Year
C305-LP040001			-2.0
C305-LP040002			-1.0
C305-LP040003			0.10
C305-LP040004			-1.9
C305-LP040005			-2.5
C305-LP040006			-2.1
C305-LP040007			-0.8
C305-LP040008			-0.7
C305-LP040009			-2.0
C305-LP040010			-1.9
C305-LP040011			-2.0
C305-LP040012			-1.6
C305-LP040013			-1.5
C305-LP040014			-1.0
C305-LP040015			-0.7
C305-LP040016			-1.0
C305-LP040017			-1.7
C305-LP040018			-1.6
C305-LP040019			0.3
C305-LP040020			-1.5
C305-LP040021			-1.8
C305-LP040022			-2.4
C305-LP040023			-2.2
C305-LP040024			-1.9
C305-LP040025			-2.5
C305-LP040026			-1.4
C305-LP040027			-1.7
C305-LP040028			-2.4
C305-LP040029			-1.2
C305-LP040030			-1.5
	READINGS FROM 06/11/2014 TO 14/07/2015 WERE TAKEN FROM THE GRAPH ILLUSTRATED BELOW		
	Rate less than -2.5 mm/year	% less 2 mm/ year	100.00%
	Rate greater than -3.5 mm/year	% less 3 mm/ year	100.00%

Note: All the movements are in mm. (-) Settlement / (+) Heave



The graph and table of settlement rate for the transect show that settlement rate due to dewatering works is less than 2 mm/year. As the instruments in this report are located close to this transect it is concluded that they will behave in a similar manner and hence their settlement rate will be less than the 2 mm/year rate.

9. 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, but which have been subsequently affected by dewatering of cross passages, stations or shafts, prior to the achievement of 12 months 'post-TBM' long term monitoring, can be closed out for decommissioning as the following criteria has been met:

- The trends of the monitoring points, prior to commencement of dewatering, was approaching or had achieved the specified 2 mm/year settlement rate; and
- Local monitoring of the effects of dewatering, directly around the Cross passage 14, shows that ground movement has stabilised to an acceptable rate (<2 mm/year) for a period of at least three months.

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

Learning Legacy Document

APPENDIX A: INSTRUMENT LOCATION

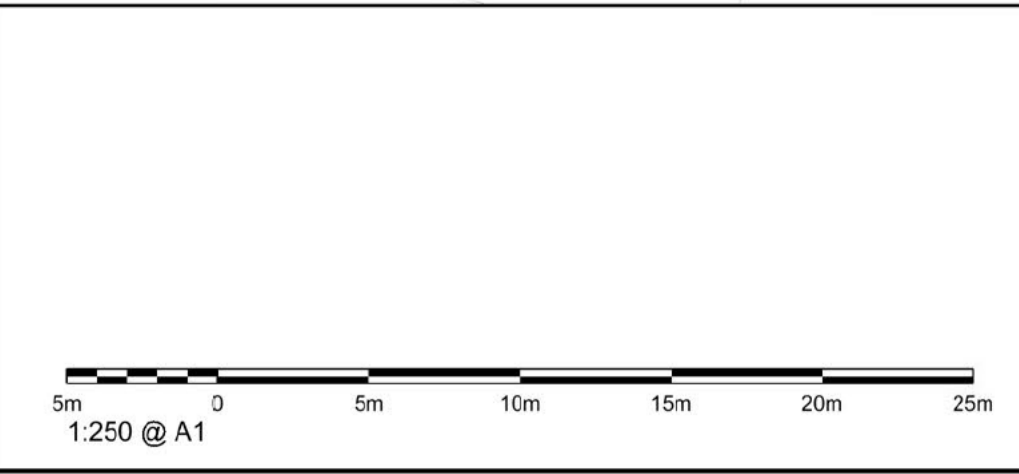


Rev.	Date	Description	By	Chkd	App	Auth
P01	22/01/2015	First Issue	AH	AH	RC	-
P02	18/03/2015		MD	AH	RC	-
P03	13/10/2015		MD	RC	RC	-

Notes

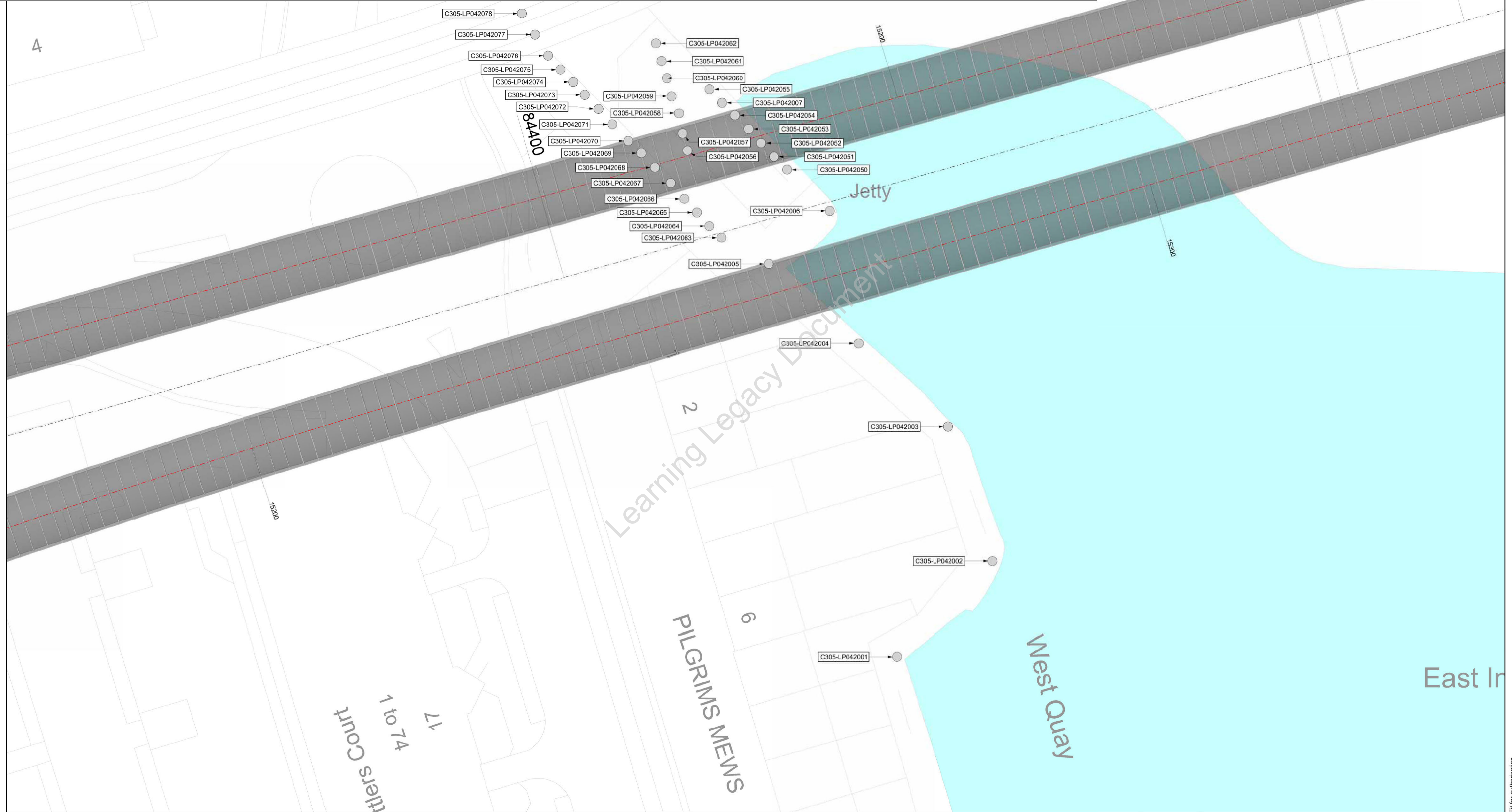
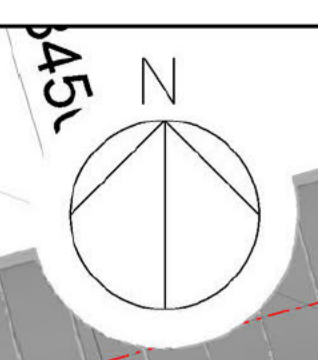
- 3D Prism

Learning Legacy Document



	Contract	Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G
	Originator	Dragados Sisk Joint Venture
	Location	Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Strn)
	Title	Instrumentation & Monitoring Installation Report for I&M MS Studs & 3D Prisms East India Dock Wall (84500-84400) C305-DSJ-C2-GMS-CRG03-50019
	By	M.DAVIS
	CHK	R.CULLEN
	App	R.CULLEN
	Auth	-
© Crossrail	Scale	1:250 @ A1
www.crossrail.co.uk	Drawing and CAD file No.	C305-DSJ-C2-DDA-CRT00_ST006_Z-08101
	Rev.	P03
	Suitability	S4

RESTRICTED
Fit for authorisation

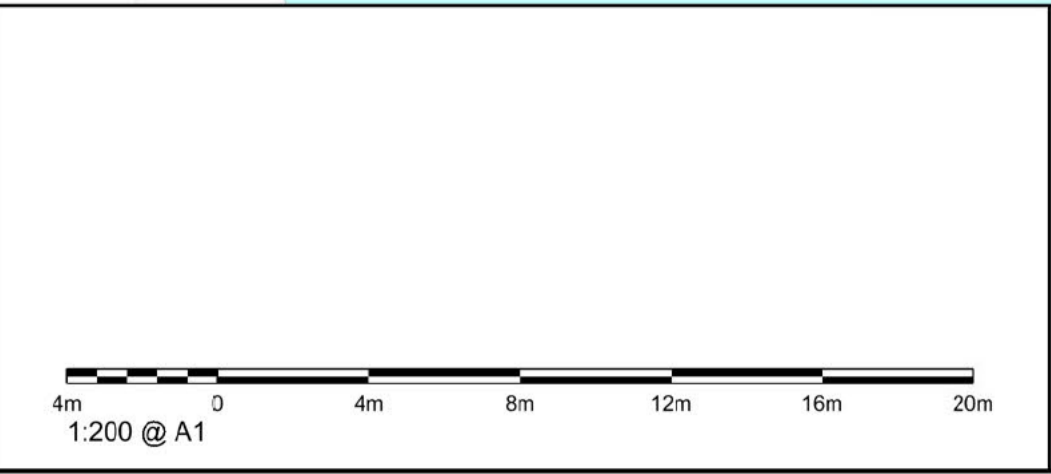


Rev.	Date	Description	By	Chkd	App	Auth
P01	22/01/2015	First Issue	AH	AH	RC	-
P02	18/03/2015		MD	AH	RC	-
P03	13/10/2015		MD	RC	RC	-

Notes

- Levelling Point

PILGRIMS MENS



<p>Crossrail Limited 25 Canada Square London E14 5LQ</p>	<p>Contract: Tunnels East - Drive Y LIM to FAR & Drive Z SGJ to PML & Drive G</p>	<p>By: M.DAVIS</p>
	<p>Originator: Dragados Sisk Joint Venture</p>	<p>CHK: R.CULLEN</p>
<p>Title: Instrumentation & Monitoring Studs & 3D Prisms East India Dock Wall (84500-84400)</p>	<p>App: R.CULLEN</p>	<p>Auth: ...</p>
<p>Location: Crossrail Tunnels - Drive Y (Limmo Peninsula to Farringdon Stn)</p>	<p>Drawing and CAD file No.: C305-DSJ-C2-GMS-CRG03-50019</p>	<p>Rev: P03</p>
<p>Scale: 1:200 @ A1</p>	<p>www.crossrail.co.uk</p>	<p>Suitability: S4</p>

RESTRICTED

APPENDIX B: SUMMARY OF INSTRUMENTATION INSTALLED ON SITE

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IRS Installation Record Sheets - Levelling points

Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
				Eastings X	Northings Y	Elevation Z (mATD)	AVERAGE	18/10/2012	18/10/2012	18/10/2012
Levelling Point	C305-LP042001	18/10/2012	Installed	89326.578	35370.567	105.265	105.1774	105.1777	105.1773	105.1772
Levelling Point	C305-LP042002	18/10/2012	Installed	89336.802	35380.785	105.195	105.136	105.1363	105.1359	105.1357
Levelling Point	C305-LP042003	18/10/2012	Installed	89332.048	35395.165	105.247	105.1827	105.1824	105.1831	105.1826
Levelling Point	C305-LP042004	18/10/2012	Installed	89322.508	35404.048	105.241	105.162	105.1621	105.1618	105.1622
Levelling Point	C305-LP042005	18/10/2012	Installed	89312.889	35412.547	104.849	104.7935	104.7932	104.7937	104.7936
Levelling Point	C305-LP042006	18/10/2012	Installed	89319.429	35418.187	104.865	104.8006	104.8003	104.8009	104.8005
Levelling Point	C305-LP042007	18/10/2012	Installed	89307.909	35429.759	104.154	104.0823	104.0825	104.0822	104.0822
							AVERAGE	25/03/2013	25/03/2013	25/03/2013
Levelling Point	C305-LP042050	22-25/03/2013	Installed	89314.865	35422.604	104.064	104.0842	104.0839	104.0845	104.0841
Levelling Point	C305-LP042051	22-25/03/2013	Installed	89313.449	35423.985	104.092	104.0964	104.0964	104.0962	104.0967
Levelling Point	C305-LP042052	22-25/03/2013	Installed	89312.062	35425.446	104.092	104.097	104.0967	104.0971	104.0972
Levelling Point	C305-LP042053	22-25/03/2013	Installed	89310.725	35426.944	104.09	104.0978	104.0974	104.0979	104.0981
Levelling Point	C305-LP042054	22-25/03/2013	Installed	89309.27	35428.41	104.086	104.0841	104.0841	104.0839	104.0844
Levelling Point	C305-LP042055	22-25/03/2013	Installed	89306.573	35431.202	104.067	104.0824	104.0822	104.0828	104.0821
Levelling Point	C305-LP042056	22-25/03/2013	Installed	89304.212	35424.643	104.75	104.7324	104.7326	104.7324	104.7321
Levelling Point	C305-LP042057	22-25/03/2013	Installed	89303.698	35426.473	104.173	104.1658	104.1655	104.1663	104.1656
Levelling Point	C305-LP042058	22-25/03/2013	Installed	89303.316	35428.621	104.146	104.1615	104.1617	104.1618	104.1611
Levelling Point	C305-LP042059	22-25/03/2013	Installed	89302.528	35430.436	104.127	104.137	104.1368	104.137	104.1372
Levelling Point	C305-LP042060	22-25/03/2013	Installed	89302.027	35432.362	104.153	104.1451	104.1453	104.145	104.1449
Levelling Point	C305-LP042061	22-25/03/2013	Installed	89301.453	35434.2	104.143	104.1253	104.1253	104.1255	104.1251
Levelling Point	C305-LP042062	22-25/03/2013	Installed	89300.857	35436.109	104.149	104.0842	104.0841	104.0845	104.0841
Levelling Point	C305-LP042063	22-25/03/2013	Installed	89307.849	35415.332	104.76	104.7651	104.7648	104.7652	104.7651
Levelling Point	C305-LP042064	22-25/03/2013	Installed	89306.555	35416.568	104.727	104.7518	104.7515	104.7521	104.7517
Levelling Point	C305-LP042065	22-25/03/2013	Installed	89305.223	35418.021	104.743	104.7571	104.7573	104.7571	104.757
Levelling Point	C305-LP042066	22-25/03/2013	Installed	89303.892	35419.489	104.82	104.7723	104.7719	104.7726	104.7724
Levelling Point	C305LP042067	22-25/03/2013	Installed	89302.437	35421.168	104.812	104.82	104.8205	104.8203	104.8191
Levelling Point	C305-LP042068	22-25/03/2013	Installed	89300.754	35422.83	104.919	104.9005	104.9007	104.9008	104.8999
Levelling Point	C305-LP042069	22-25/03/2013	Installed	89299.293	35424.37	104.969	104.9687	104.9685	104.9689	104.9687
Levelling Point	C305-LP042070	22-25/03/2013	Installed	89297.89	35425.676	105.017	105.0451	105.0451	105.0448	105.0453

Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
				Eastings X	Northings Y	Elevation Z (mATD)				
Levelling Point	C305-LP042071	22-25/03/2013	Installed	89296.193	35427.447	105.11	105.1251	105.125	105.1249	105.1255
Levelling Point	C305-LP042072	22-25/03/2013	Installed	89294.749	35429.105	105.196	105.2022	105.2022	105.2019	105.2025
Levelling Point	C305-LP042073	22-25/03/2013	Installed	89293.286	35430.613	105.294	105.2827	105.2832	105.2825	105.2824
Levelling Point	C305-LP042074	22-25/03/2013	Installed	89292.039	35431.962	105.344	105.3504	105.3504	105.3506	105.3501
Levelling Point	C305-LP042075	22-25/03/2013	Installed	89290.693	35433.272	105.414	105.4249	105.4249	105.4251	105.4248
Levelling Point	C305-LP042076	22-25/03/2013	Installed	89289.358	35434.762	105.411	105.4236	105.4238	105.4239	105.4231
Levelling Point	C305-LP042077	22-25/03/2013	Installed	89287.963	35437.029	103.681	105.4237	105.4235	105.424	105.4236
Levelling Point	C305-LP042078	22-25/03/2013	Installed	89286.568	35439.295	110.574	105.4687	105.4689	105.4684	105.4687

IRS Installation Record Sheets - 3D PRISMS

Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
				Eastings X	Northings Y	Elevation Z (mATD)		Eastings X	Northings Y	Elevation Z (mATD)
3D Prisms	C305-RP042001	18/11/2012	INSTALLED	89326.2	35340.939	111.935	AVERAGE	89326.1953	35340.9417	111.9405
							27/11/2012	89326.1951	35340.9418	111.9403
							27/11/2012	89326.1953	35340.9419	111.9407
							27/11/2012	89326.1956	35340.9415	111.9406
3D Prisms	C305-RP042002	18/11/2012	INSTALLED	89305.75	35382.626	110.695	No readings (1)			
3D Prisms	C305-RP042003	18/11/2012	INSTALLED	89314.09	35353.827	110.02	No readings (1)			
3D Prisms	C305-RP042008	18/11/2012	INSTALLED	89311.02	35411.16	107.689	AVERAGE	89311.0194	35411.1890	107.6911
							27/11/2012	89311.0193	35411.1890	107.6909
							27/11/2012	89311.0195	35411.1891	107.6913
							27/11/2012	89311.0194	35411.1889	107.6910
3D Prisms	C305-RP042009	18/11/2012	INSTALLED	89311.54	35391.135	111.69	AVERAGE	89311.5417	35391.1370	111.7005
							27/11/2012	89311.5417	35391.1368	111.7003
							27/11/2012	89311.5418	35391.1372	111.7004
							27/11/2012	89311.5415	35391.1371	111.7007
3D Prisms	C305-RP042010	18/11/2012	INSTALLED	89315.9	35376.429	111.941	AVERAGE	89315.8981	35376.4319	111.9486
							27/11/2012	89315.8979	35376.4321	111.9485
							27/11/2012	89315.8983	35376.4319	111.9487
							27/11/2012	89315.8980	35376.4317	111.9486

Sensor Type	Sensor ID	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
				Eastings X	Northings Y	Elevation Z (mATD)				
3D Prisms	C305-RP042011	18/11/2012	INSTALLED	89319.79	35362.538	111.932	AVERAGE	89319.7910	35362.5377	111.9373
							27/11/2012	89319.7912	35362.5374	111.9375
							27/11/2012	89319.7911	35362.5378	111.9373
							27/11/2012	89319.7908	35362.5379	111.9372
3D Prisms	C305-RP042012	18/11/2012	INSTALLED	89323.34	35372.066	107.958	AVERAGE	89323.3383	35372.0632	107.9596
							27/11/2012	89323.3381	35372.0630	107.9594
							27/11/2012	89323.3384	35372.0633	107.9597
							27/11/2012	89323.3385	35372.0632	107.9596
3D Prisms	C305-RP042013	18/11/2012	INSTALLED	89333.86	35381.708	107.921	AVERAGE	89333.8567	35381.7123	107.9260
							27/11/2012	89333.8565	35381.7120	107.9258
							27/11/2012	89333.8568	35381.7123	107.9262
							27/11/2012	89333.8569	35381.7125	107.9261
3D Prisms	C305-RP042014	18/11/2012	INSTALLED	89330.25	35393.836	107.919	AVERAGE	89330.2471	35393.8326	107.9236
							27/11/2012	89330.2469	35393.8325	107.9236
							27/11/2012	89330.2472	35393.8328	107.9234
							27/11/2012	89330.2471	35393.8325	107.9237
3D Prisms	C305-RP042015	18/11/2012	INSTALLED	89320.56	35402.566	107.923	AVERAGE	89320.5590	35402.5675	107.9293
							27/11/2012	89320.5587	35402.5673	107.9291
							27/11/2012	89320.5592	35402.5677	107.9293
							27/11/2012	89320.5591	35402.5676	107.9294

⁽¹⁾ No line of sight from the ATS (Automatic Total Station). No other alternative was found.

Note: The difference between the Elevation Z reading and Commissioning reading results from the use of a GPS and a manual level respectively.

All elevations or levels presented in this document are metres above tunnel datum (mATD).

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APPENDIX C: MINUTES OF THE CLOSE-OUT MEETINGS



I&M Close Out Meeting

Date & Time		15/07/2015 09:00		
Meeting No.		1		
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.				
Attendees:				
[Redacted]				
Data Reviewed				
Monitoring References	Location	Settlement rate	Cease Monitoring?	Decommission/ prepare report?
Levelling Points Area 4 Limmo to Canary Wharf Station				
LP045100-LP045147	Area 4 - River Lea River West Bank Wall (4A)	74% at 2mm/year 80% at 3mm/year	Yes	Yes
LP040101-LP040124	Area 4 - Bridge Court	0% at 2mm/year 0% at 3mm/year	Yes - CP13/14	Yes
LP040201-LP040226	Area 4 - Keel Court	40% at 2mm/year 68% at 3mm/year	Yes - CP13/14	Yes
LP040301-LP040330	Area 4 - John Smith Mews	73% at 2mm/year 83% at 3mm/year	Yes - CP13/14	Yes
LP040422-LP040431	Area 4 - Reuters Car Park	90% at 2mm/year 90% at 3mm/year		
LP041301-LP041328	Area 4 - Poplar Dock	68% at 2mm/year 82% at 3mm/year		
LP041401-LP041425	Area 4 - Boardwalk Place	100% at 2mm/year 100% at 3mm/year		
LP041501-LP041536	Area 4 - Trafalgar Way	36% at 2mm/year 44% at 3mm/year		
LP042301-LP042327	Area 4 - Billingsgate Market	96% at 2mm/year 100% at 3mm/year		
LP04472-LP04477	Area 4 - Lower Lea Crossing	50% at 2mm/year 83% at 3mm/year	Yes - CP14	Yes
LP04301-LP04310	Area 4 - Bow Creek River Wall	90% at 2mm/year 100% at 3mm/year	Yes - CP14	Yes
LP043201-LP043210	Area 4 - Orchard Place	20% at 2mm/year 20% at 3mm/year	Yes - temporary studs due to storage	Yes
LP042050-LP042078	Area 4 - East India Dock	79% at 2mm/year 90% at 3mm/year	Yes - CP13/14	Yes
LP040801-LP040805	Area 4 - Prestons Road	100% at 2mm/year 100% at 3mm/year		
LP040201-LP040216	Area 4 - Aspen Way Underpass	100% at 2mm/year 100% at 3mm/year		
LP041701-LP041719	Area 4 - Prestons Road	95% at 2mm/year 95% at 3mm/year		
LP042001-LP042007	Area 4 - East India Dock	100% at 2mm/year 100% at 3mm/year	Yes - CP13/14	Yes
LP042201-LP042211	Area 4 - Billingsgate Market	64% at 2mm/year 82% at 3mm/year		
LP042401-LP042440	Area 4 - Billingsgate Market	67% at 2mm/year 78% at 3mm/year		
LP43201-LP43227	Area 4 - Blackwall Tunnel NB	89% at 2mm/year 100% at 3mm/year		
LP04478-LP04483	Area 4 - Lower Lea Crossing	??% at 2mm/year ??% at 3mm/year		
LP045301-LP045321	Area 4 - Orchard Place (4B)	52% at 2mm/year	Yes	Yes
LP045201-LP045212	Area 4 - Orchard Place (4B)	59% at 3mm/year	Yes	Yes

LPO41241-LPO41249	Area 4 - Poplar Dock	67% at 2mm/year 100% at 3mm/year		
Sockets Area 4 Limmo to Canary Wharf Station				
LB04301-LB04312	Area 4 - Orchard Place	83% at 2mm/year 92% at 3mm/year	Yes	Yes
LB040101-LB040110	Area 4 - Sail Court	100% at 2mm/year 100% at 3mm/year	Yes - CP13/CP14	Yes
LB040201-LB040211	Area 4 - Bridge/Keel Court	100% at 2mm/year 100% at 3mm/year	Yes - CP13/CP14	Yes
LB040301-LB040304	Area 4 - Sexton Court	75% at 2mm/year 100% at 3mm/year	Yes - CP13/14	Yes
LB040401-LB040412	Area 4 - John Smith Mews	80% at 2mm/year 90% at 3mm/year	Yes - CP13/14	Yes
LB040501-LB040506	Area 4 - Proton/Neutron Towers	100% at 2mm/year 100% at 3mm/year	Yes - CP13/14	Yes
LB040701-LB040706	Area 4 - Billingsgate Market	100% at 2mm/year 100% at 3mm/year		
LB041101-LB041110	Area 4 - Boardwalk Place	20% at 2mm/year 50% at 3mm/year		
LB041201-LB041210	Area 4 - Boardwalk Place	20% at 2mm/year 60% at 3mm/year		
LB041301-LB041308	Area 4 - Boardwalk Place	100% at 2mm/year 100% at 3mm/year		
LB041401-LB041410	Area 4 - Boardwalk Place	90% at 2mm/year 100% at 3mm/year		
LB044101-LB044105	Area 4 - Blackwall Tunnel Ventilation Tower (SB)	80% at 2mm/year 100% at 3mm/year		
Notes				
<p>-Cells in yellow indicate data review needs amending. <i>to included for rounding.</i></p> <p>-Limmo dewatering switch on 04/11/13, CP13 dewatering switch on 26/11/13.</p> <p>* -include CP13/CP14 data to demonstrate area is stable after last TBW readings in close out reports affected by dewatering works. Next meeting tomorrow after CTC.</p>				
Sign off				
DSJV	Geosira	Crossrail	C122	

I&M Close Out Template - 13th July 2015



I&M Close Out Meeting

Date & Time		16/07/2015 13:00		
Meeting No.		2		
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.				
Attendees:				
Data Reviewed				
Monitoring References	Location	Settlement rate	Cease Monitoring?	Decommission/ prepare report?
Levelling Points Area 4 Limmo to Canary Wharf Station				
LP040422-LP040431	Area 4 - Reuters Car Park	90% at 2mm/year 90% at 3mm/year	Yes - CP13	Yes - CP13
LP041301-LP041328	Area 4 - Poplar Dock (4L)	68% at 2mm/year 82% at 3mm/year	Yes - CP13	Yes - CP13 + readings in June '15
LP041401-LP041425	Area 4 - Boardwalk Place	100% at 2mm/year 100% at 3mm/year	Yes - CP13	Yes - CP13
LP041501-LP041536	Area 4 - Trafalgar Way	36% at 2mm/year 44% at 3mm/year	Yes - CP13	Yes - CP13
LP042301-LP042327	Area 4 - Billingsgate Market	96% at 2mm/year 100% at 3mm/year	Yes	Yes
LP040801-LP040805	Area 4 - Prestons Road	100% at 2mm/year 100% at 3mm/year	Yes	Yes
LP040201-LP040216	Area 4 - Aspen Way Underpass	100% at 2mm/year 100% at 3mm/year	Yes	Yes
LP041701-LP041719	Area 4 - Prestons Road	95% at 2mm/year 95% at 3mm/year	Yes	Yes
LP042201-LP042211	Area 4 - Billingsgate Market	64% at 2mm/year 82% at 3mm/year	Yes	Yes
LP042401-LP042440	Area 4 - Billingsgate Market	67% at 2mm/year 78% at 3mm/year	Yes	Yes
LP43201-LP43227	Area 4 - Blackwall Tunnel NB	89% at 2mm/year 100% at 3mm/year	No - Review with CP13 post.	Post CP13
LP04478-LP04483	Area 4 - Lower Lea Crossing	??% at 2mm/year ??% at 3mm/year	Yes	Yes
LP041241-LP041249	Area 4 - Poplar Dock	67% at 2mm/year 100% at 3mm/year	Yes - CP13	Yes
Sockets Area 4 Limmo to Canary Wharf Station				
LB040701-LB040706	Area 4 - Billingsgate Market	100% at 2mm/year 100% at 3mm/year	Yes	Yes
LB041101-LB041110	Area 4 - Boardwalk Place	20% at 2mm/year 50% at 3mm/year	Yes - 4L	Yes
LB041201-LB041210	Area 4 - Boardwalk Place	20% at 2mm/year 60% at 3mm/year	Yes - 4L	Yes
LB041301-LB041308	Area 4 - Boardwalk Place	100% at 2mm/year 100% at 3mm/year	Yes - 4L	Yes
LB041401-LB041410	Area 4 - Boardwalk Place	90% at 2mm/year 100% at 3mm/year	Yes - 4L	Yes
LB044101-LB044105	Area 4 - Blackwall Tunnel Ventilation Tower (SB)	80% at 2mm/year 100% at 3mm/year	No - Review with CP13 post.	Post CP13
Notes				

-Cells in yellow indicate data review needs amending.

-Limmo dewatering switch on 04/11/13, CP13 dewatering switch on 26/11/13.

* -For cp dewatering effects plot representative points from cp monitoring alongside data on same graph for comparison.

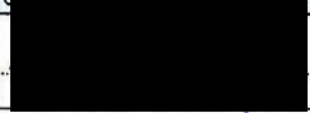
Sign off

DSJV

Geocisa

Crosstail

G122



I&M Close Out Template - 13th July 2015

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