C305– Eastern Running Tunnels

Close out report for: "MS I&M Sockets: Virginia Quay (84350-84100)"

CRL Document Number: C305-DSJ-C2-RGN-CRG03-50339

Supplier Document Number:

Contract MDL reference C08.079

1. Contractor Document Submittal History:

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Stakeholder submission required: LU ☐ RfL ☐ NR ☐ LO ☐ DLR ☐ Other: _____

Purpose of submission: For no objection ☐ For information ☐

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

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

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

2b. Review by Stakeholder (if required):

Stakeholder Organisation	Job Title	Name	Signature	Date	Acceptance
					☐

3. Acceptance by *Crossrail*:

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Reviewed/Accepted by (signature)	Print Name:	Position:	Date:
[redacted]	[redacted]	[redacted]	3/12/15

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GEOCISA UK	C305-CLOUT-150323

Close out report for "MS I&M Sockets: Virginia Quay (84350-84100)" - C305-DSJ-C2-RGN-CRG03-50339

C305 Crossrail Eastern Running Tunnels

Current Version of the Documents & Signatures :

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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 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 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 84100-84350. The instruments were installed on mainly residential properties situation around East India DLR Station.

Sockets were proposed to be installed onto the following buildings:- Sail Court, Bridge Court, Keel Court, Sexton Court, Explorers Court, 1-14 John Smith Mews, Neutron Tower and Proton Tower.

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-CRG03-50018	Method Statement I&M Sockets: Virginia Quay (84350-84100)	Main Method statement	42-Sockets
C305-DSJ-C2-RGN-CRG03-50207	Installation Report for I&M MS "Sockets: Virginia Quay (84350-84100)"	Installation report	-

4. SUMMARY OF INSTALLED INSTRUMENTATION ON SITE

As per the associated method statement and C122 drawings, all proposed positions were installed:

- Sail Court – 10 sockets
- Keel Court – 6 sockets
- Bridge Court – 5 sockets
- Sexton Court – 4 sockets
- Explorers Court – 4 sockets
- Neutron Tower – 4 sockets
- Proton Tower – 2 sockets
- John Smith Mews – 7 sockets

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-LB040101 - C305-LB040110: 20th March 2013
- C305-LB040201 - C305-LB040211: 7th February 2013
- C305-LB040301 - C305-LB040304: 28th February 2013
- C305-LB040401 - C305-LB040412: No new baseline was applied
- C305-LB040501 - C305-LB040506: 3rd April 2013

5. CONSTRUCTION ACTIVITY

TBM PASSAGE

DRIVE Y	RINGS	PROJECT CHAINAGE	DATES
Eastbound	316 – 466	84359 – 84124	30/03/2013 to 11/04/2013
Westbound	314 – 464	84358 - 84115	16/04/2013 to 27/04/2013

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.

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
Canary Wharf	During all the surveying period
Limmo	4th November 2013 (still on)

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:

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

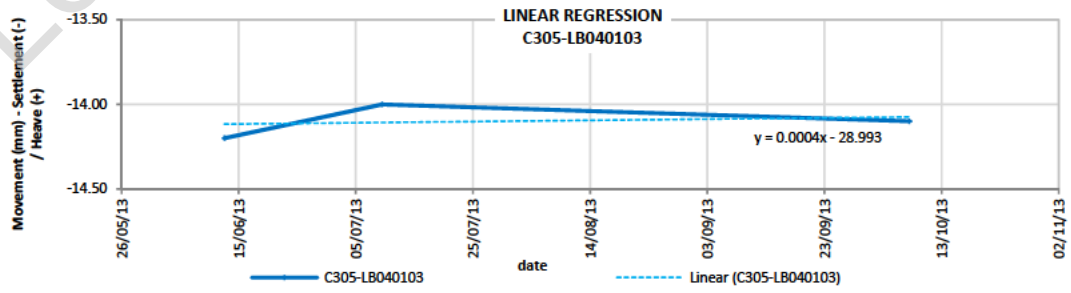
Where:

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 the socket C305-LB040103 and its projection included in this Close Out Report.

	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	$X_i - \overline{X}_i$	$Y_i - \overline{Y}_i$	$(X_i - \overline{X}_i)^2$	$(X_i - \overline{X}_i) \cdot (Y_i - \overline{Y}_i)$
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

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

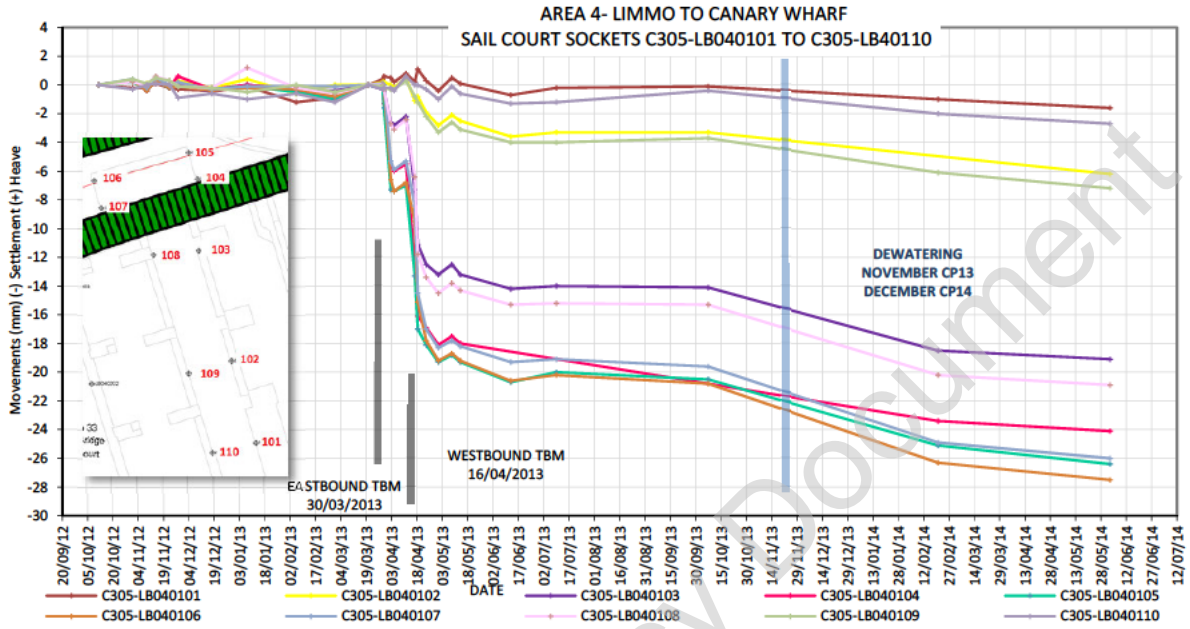
For these rate values, the percentage at or below 2 mm/year will be used to determine the trend of the section/area being considered. Also for comparison, values at or below 3 mm/year are presented to highlight that the rate is close to achieving the 2 mm/year.

7. SUMMARY OF THE DATA

Note: For the following data plots #N/A refers to instances where readings were not taken for that sensor (e.g. damaged sensor, not access, etc)

SOCKETS

C305-LB040101 - C305-LB040110



The sockets C305-LB040105 and C305-LB040106 recorded a maximum settlement of -7 mm during the Eastbound TBM transit and -12 mm during the Westbound TBM transit.

The effect of the dewatering in the Cross Passage 13 and 14 can be observed in the graphic above. In order to differentiate the movement due to the TBM transit from the dewatering and analyse whether the rate of change in the data has reached an acceptably small rate, the three readings before the dewatering were used to calculate the annual projection.

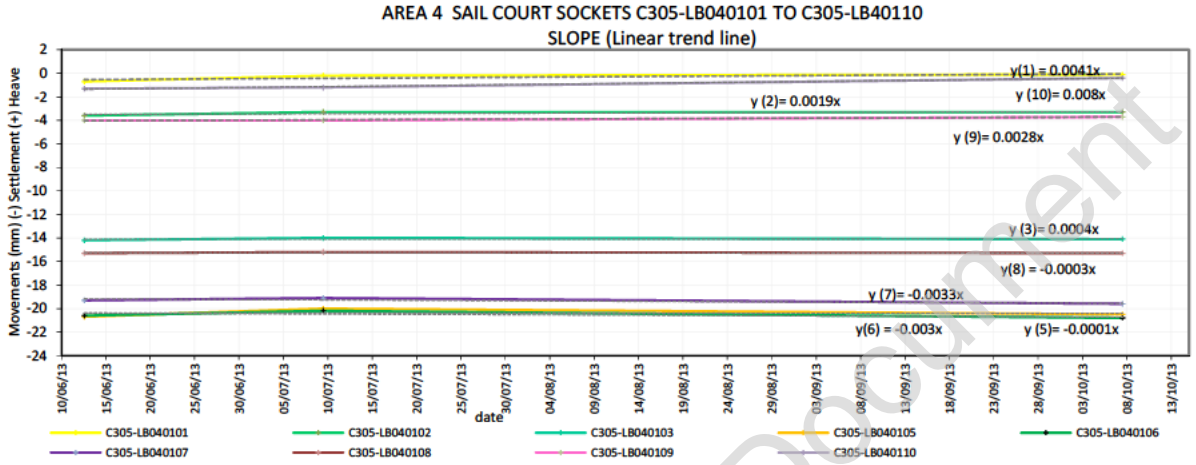
The table below shows the annual rate for each socket.

	Recorded Movement (mm)			Rate (mm/year)
	12/06/2013	09/07/2013	07/10/2013	
C305-LB040101	-0.70	-0.20	-0.10	1.497
C305-LB040102	-3.60	-3.30	-3.30	0.694
C305-LB040103	-14.20	-14.00	-14.10	0.146
C305-LB040104	#N/A	#N/A	#N/A	-
C305-LB040105	-20.70	-20.00	-20.50	-0.037
C305-LB040106	-20.60	-20.20	-20.80	-1.095
C305-LB040107	-19.30	-19.10	-19.60	-1.205
C305-LB040108	-15.30	-15.20	-15.30	-0.110
C305-LB040109	-4.00	-4.00	-3.70	1.022
C305-LB040110	-1.30	-1.20	-0.40	2.920
	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%

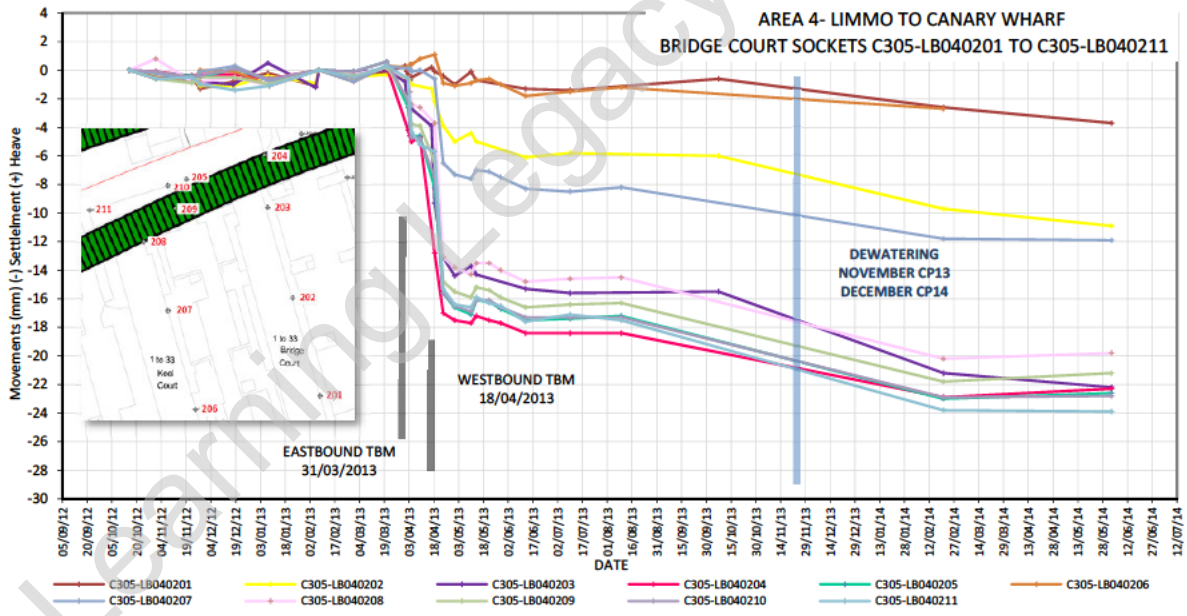
Note: All the movements are in mm. (-) Settlement / (+) Heave
#N/A : No readings

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 each socket.



C305-LB040201 - C305-LB040211



The socket C305-LB040204 recorded a maximum settlement of -5 mm during the Eastbound TBM transit and -12 mm during the Westbound TBM transit.

The effect of the dewatering in the Cross Passage 13 and 14 can be observed in the graphic above. In order to differentiate the movement due to the TBM transit from the dewatering and analyse whether

the rate of change in the data has reached an acceptably small rate, the four readings before the dewatering were used to calculate the annual projection.

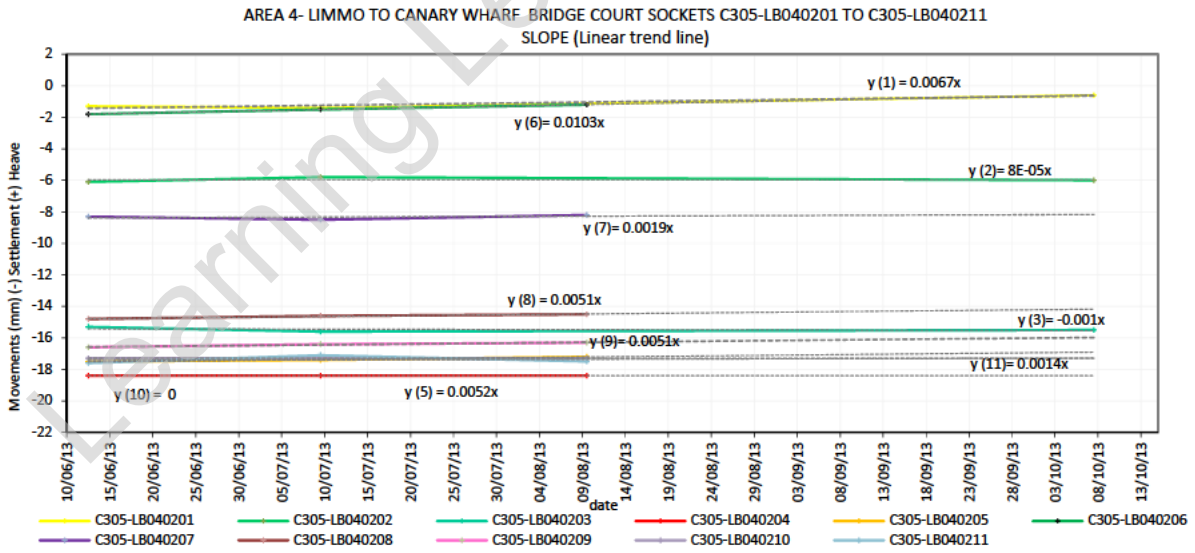
The table below shows the annual rate for each socket.

	Recorded Movement (mm)				Rate (mm/year)
	12/06/2013	09/07/2013	09/08/2013	07/10/2013	
C305-LB040201	-1.30	-1.40	#N/A	-0.60	2.446
C305-LB040202	-6.10	-5.80	#N/A	-6.00	0.029
C305-LB040203	-15.30	-15.60	#N/A	-15.50	-0 365
C305-LB040204	-18.40	-18.40	-18.40	#N/A	0.000
C305-LB040205	-17.50	-17.40	-17.20	#N/A	1.898
C305-LB040206	-1.80	-1.50	-1.20	#N/A	3.760
C305-LB040207	-8.30	-8.50	-8.20	#N/A	0.694
C305-LB040208	-14.80	-14.60	-14.50	#N/A	1.862
C305-LB040209	-16.60	-16.40	-16.30	#N/A	1.862
C305-LB040210	-17.30	-17.30	-17.30	#N/A	0.000
C305-LB040211	-17.60	-17.10	-17.50	#N/A	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%

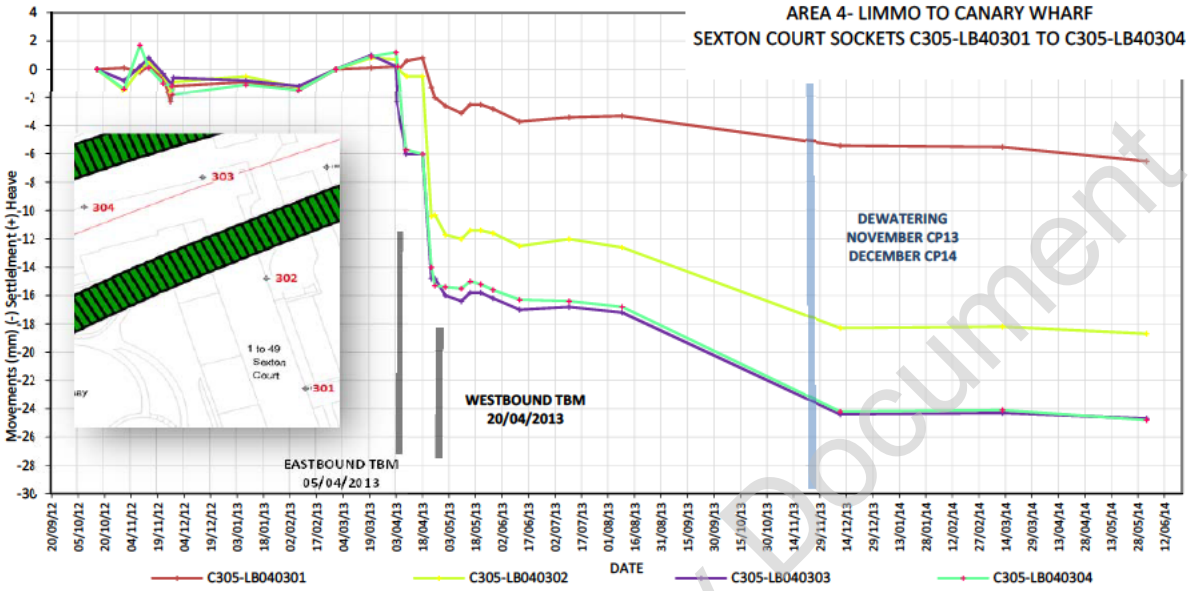
Note: All the movements are in mm. (-) Settlement / (+) Heave
#N/A: No readings

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 each socket.



C305-LB040301 - C305-LB040304



The socket C305-LB040303 recorded a maximum settlement of -6 mm during the Eastbound TBM transit and -10 mm during the Westbound TBM transit.

The effect of the dewatering in the Cross Passage 13 and 14 can be observed in the graphic above. In order to differentiate the movement due to the TBM transit from the dewatering and analyse whether the rate of change in the data has reached an acceptably small rate, the three readings before the dewatering were used to calculate the annual projection.

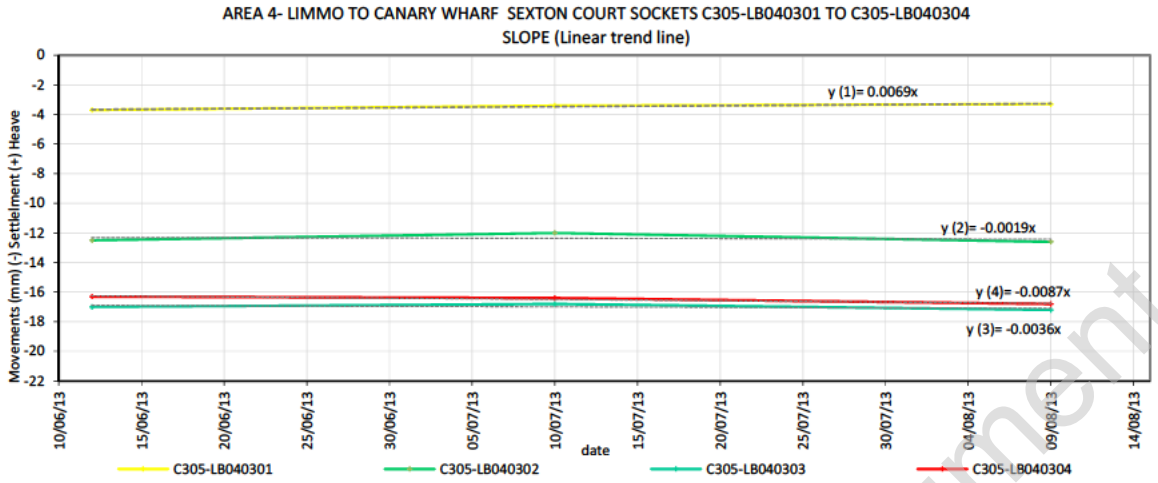
The table below shows the annual rate for each socket.

	Recorded Movement (mm)			Rate (mm/year)
	12/06/2013	10/07/2013	09/08/2013	
C305-LB040301	-3.70	-3.40	-3.30	2.519
C305-LB040302	-12.50	-12.00	-12.60	-0.694
C305-LB040303	-17.00	-16.80	-17.20	-1.314
C305-LB040304	-16.30	-16.40	-16.80	-3.176
	Rate less than -2.5 mm/year		% less 2 mm/ year	75.00%
	Rate greater than -3.5 mm/year		% less 3 mm/ year	100.00%

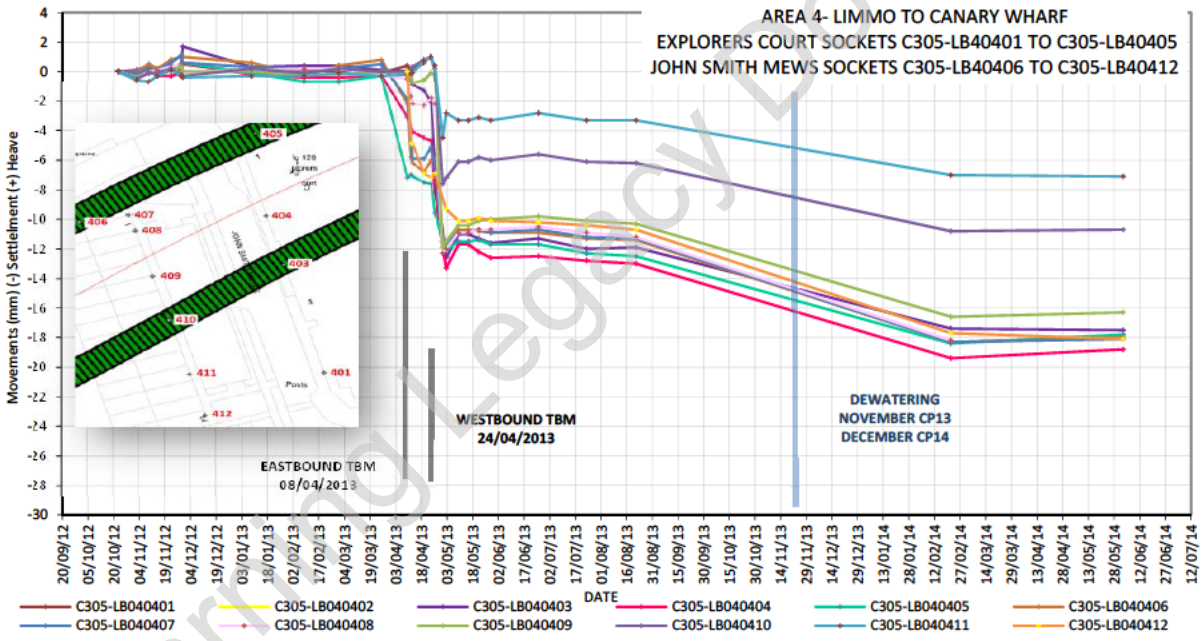
Note: All the movements are in mm. (-) Settlement / (+) Heave
#N/A : No readings

The percentage of the sockets with a settlement rate less than 2 mm/year is 75%, whereas a 100% is less than 3 mm/year. See section 8 Summary of movements related to dewatering activities.

The next plot shows the Excel trend line adjustment for each socket.



C305-LB040401 - C305-LB040412



The socket C305-LB040405 recorded a maximum settlement of -7 mm during the Eastbound TBM transit and -5 mm during the Westbound TBM transit.

The effect of the dewatering in the Cross Passage 13 and 14 can be observed in the graphic above. In order to differentiate the movement due to the TBM transit from the dewatering and analyse whether the rate of change in the data has reached an acceptably small rate, the four readings before the dewatering were used to calculate the annual projection.

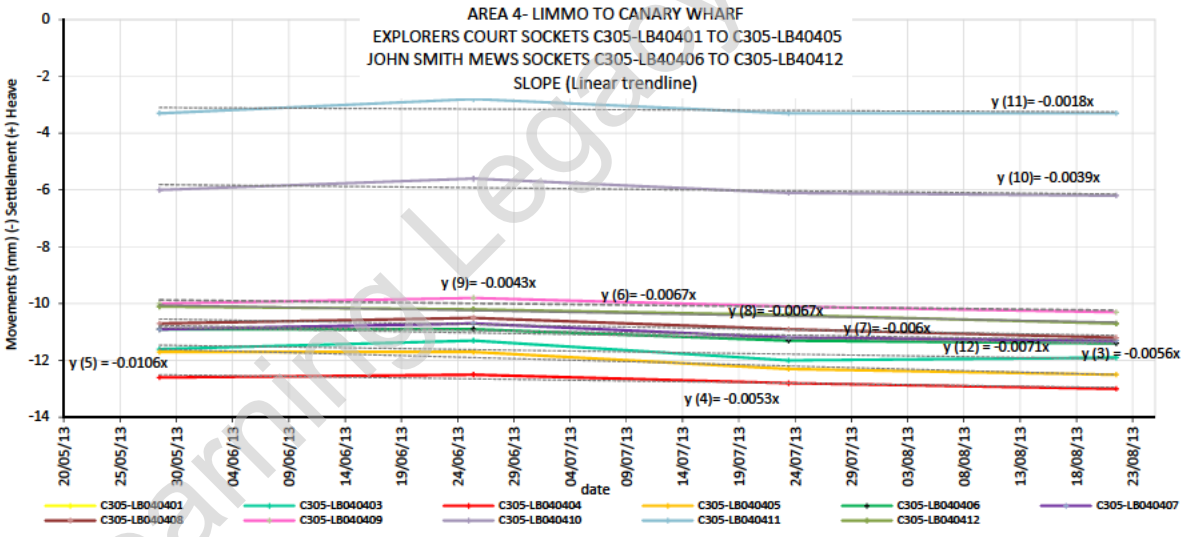
The table below shows the annual rate for each socket.

	Recorded Movement (mm)				Rate (mm/year)
	28/05/2013	25/06/2013	23/07/2013	21/08/2013	
C305-LB040401	#N/A	#N/A	#N/A	#N/A	-
C305-LB040403	-11.60	-11.30	-12.00	-11.90	-2.044
C305-LB040404	-12.60	-12.50	-12.80	-13.00	-1.935
C305-LB040405	-11.70	-11.70	-12.30	-12.50	-3.869
C305-LB040406	-10.90	-10.90	-11.30	-11.40	-2.446
C305-LB040407	-10.90	-10.70	-11.20	-11.30	-2.190
C305-LB040408	-10.70	-10.50	-10.90	-11.20	-2.446
C305-LB040409	-10.00	-9.80	-10.10	-10.30	-1.570
C305-LB040410	-6.00	-5.60	-6.10	-6.20	-1.424
C305-LB040411	-3.30	-2.80	-3.30	-3.30	-0.657
C305-LB040412	-10.10	-10.20	-10.40	-10.70	-2.592
	Rate less than -2.5 mm/year		% less 2 mm/ year		80.00%
	Rate greater than -3.5 mm/year		% less 3 mm/ year		90.00%

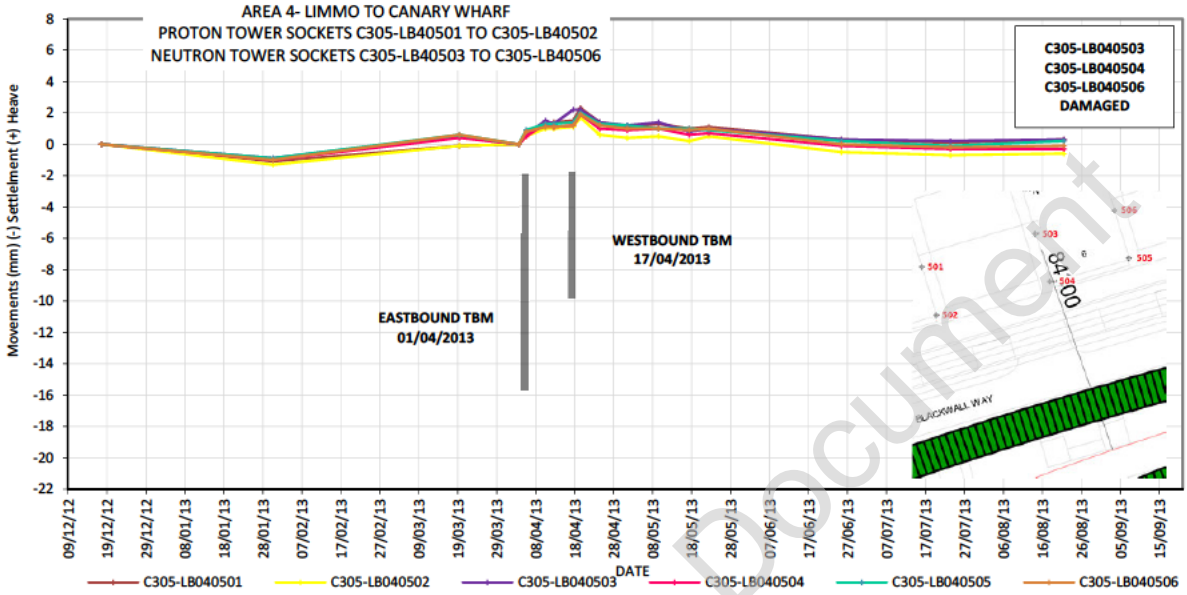
Note: All the movements are in mm. (-) Settlement / (+) Heave
#N/A : No readings

The percentage of the sockets with a settlement rate less than 2 mm/year is 80%, whereas a 90% is less than 3 mm/year. See section 8 Summary of movements related to dewatering activities.

The next plot shows the Excel trend line adjustment for each socket.



C305-LB040501 - C305-LB040506



The sockets recorded a heave of +2 mm during the Eastbound and Westbound TBM transit.

Sockets C305-LB040503, C305-LB040504 and C305-LB040506 were damaged in May 2014.

To analyse whether the rate of change in the data has reached an acceptably small rate, the last three readings were used to calculate the annual projection.

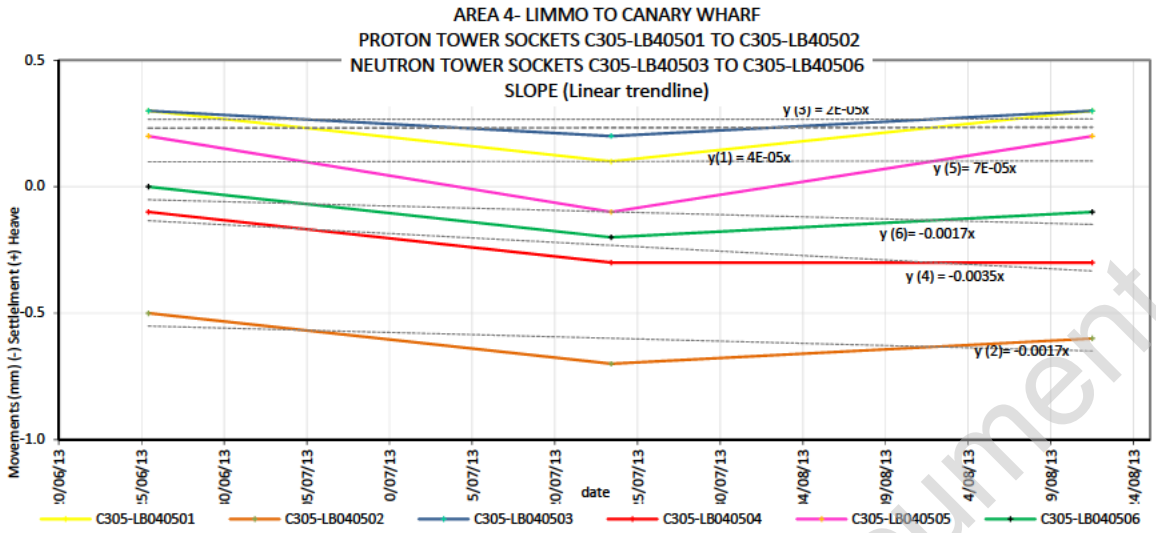
The table below shows the annual rate for each socket.

	Recorded Movement (mm)			Rate (mm/year)
	25/06/2013	23/07/2013	21/08/2013	
C305-LB040501	0.30	0.10	0.30	0.015
C305-LB040502	-0.50	-0.70	-0.60	-0.621
C305-LB040503	0.30	0.20	0.30	0.007
C305-LB040504	-0.10	-0.30	-0.30	-1.278
C305-LB040505	0.20	-0.10	0.20	0.026
C305-LB040506	0.00	-0.20	-0.10	-0.621
	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 Excel trend line adjustment for each socket.



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 below:

- The transect 4D (C305-LP040001-C305-LP040030) is not covered by this close out report. It is included in the Specific Action Plan Y023 – Cross Passage 14 Ground Movement (C305-DSJ-C2-STP-CRG03-50021) and their data will be summarise in their relevant Close out report (I&M Close out report for Cross Passages: Phase I - C305-DSJ-C2-RGN-CRG03-50374).

- The transect 4I (C305-LP047107-C305-LP047115 and C305-LP040723-C305-LP040734) is not covered by this close out report. It is included in the Specific Action Plan Y015 – Cross Passage 13 Ground Movement (C305-DSJ-C2-STP-CRG03-50043) and their data will be summarise in their relevant Close out report (I&M Close out report for Cross Passages: Phase I - C305-DSJ-C2-RGN-CRG03-50374).

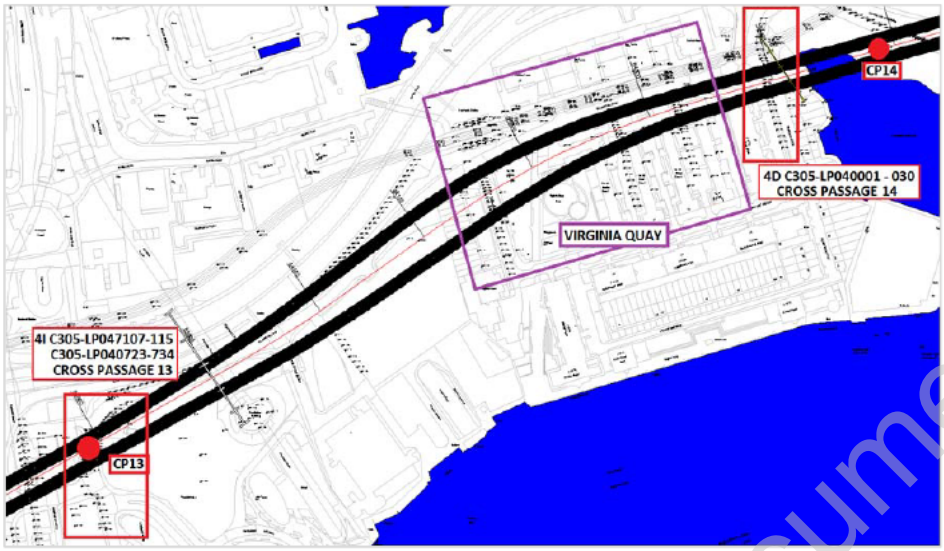
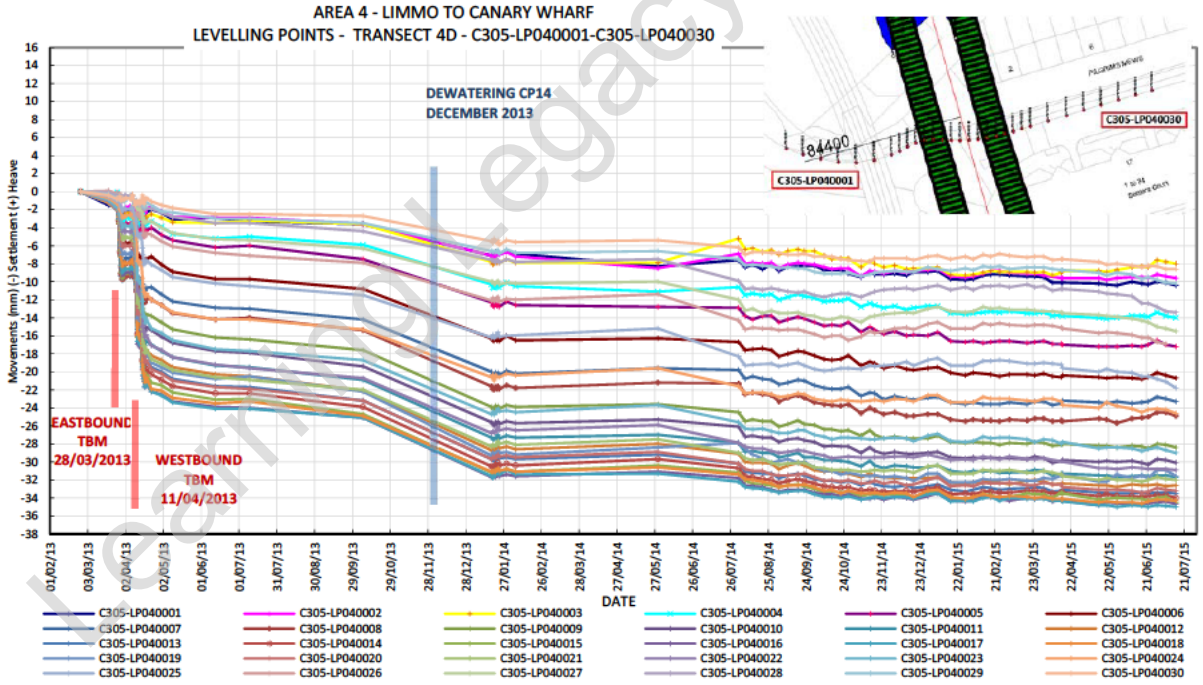


Figure 1: Sockets Virginia Quay and Cross Passages sections 4D and 4I

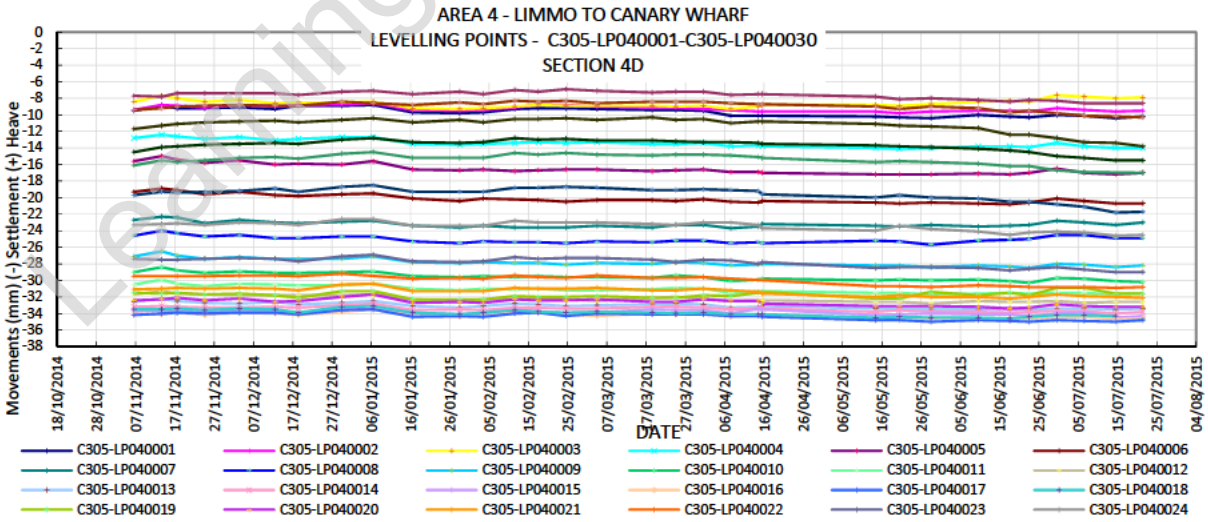
TRANSECT 4D C305-LP040001 to C305-LP040030 (CROSS PASSAGE 14)



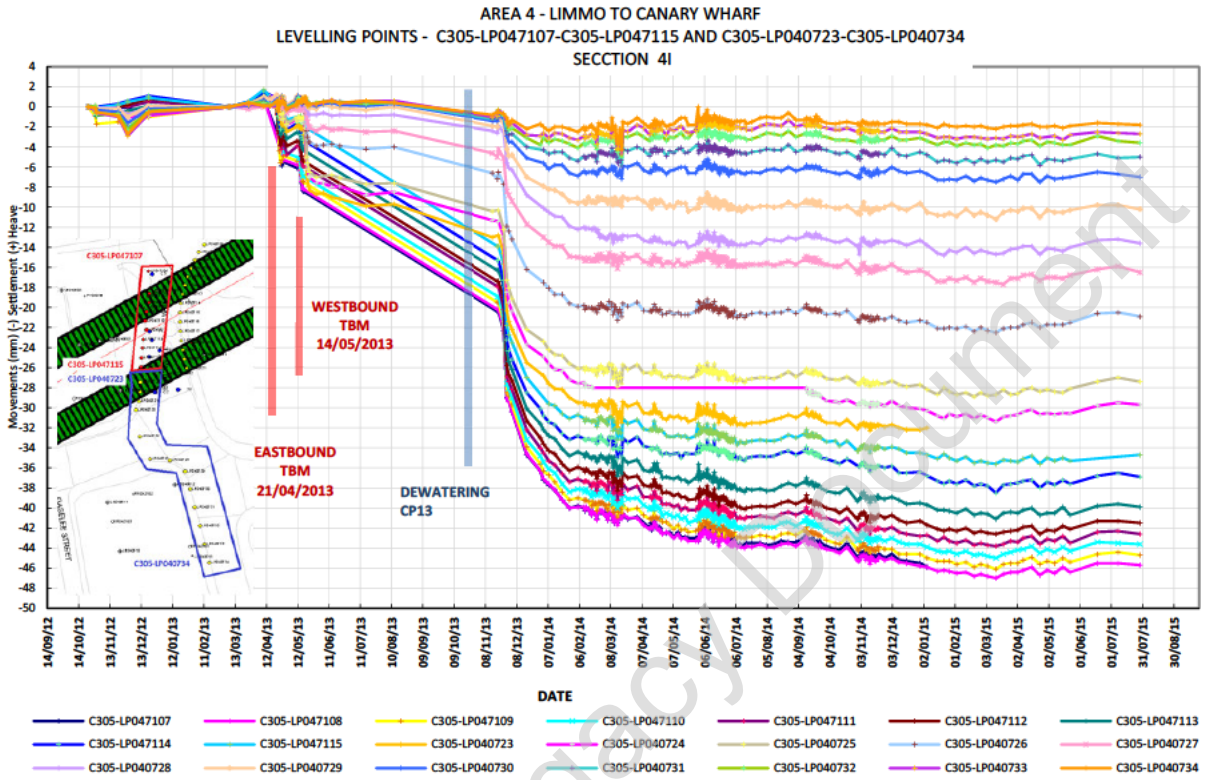
These levelling points close to the area of Virginia Quay, where the sockets included in this Close Out Report are located, reach an annual rate less than 2mm/year for the 100%.

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	READINGS FROM 06/11/2014 TO 14/07/2015 WERE TAKEN FROM THE GRAPH ILLUSTRATED BELOW		-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
	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%



TRANSECT 4I (C305-LP047107-C305-LP047115 AND C305-LP040723-C305-LP040734) (CROSS PASSAGE 13)

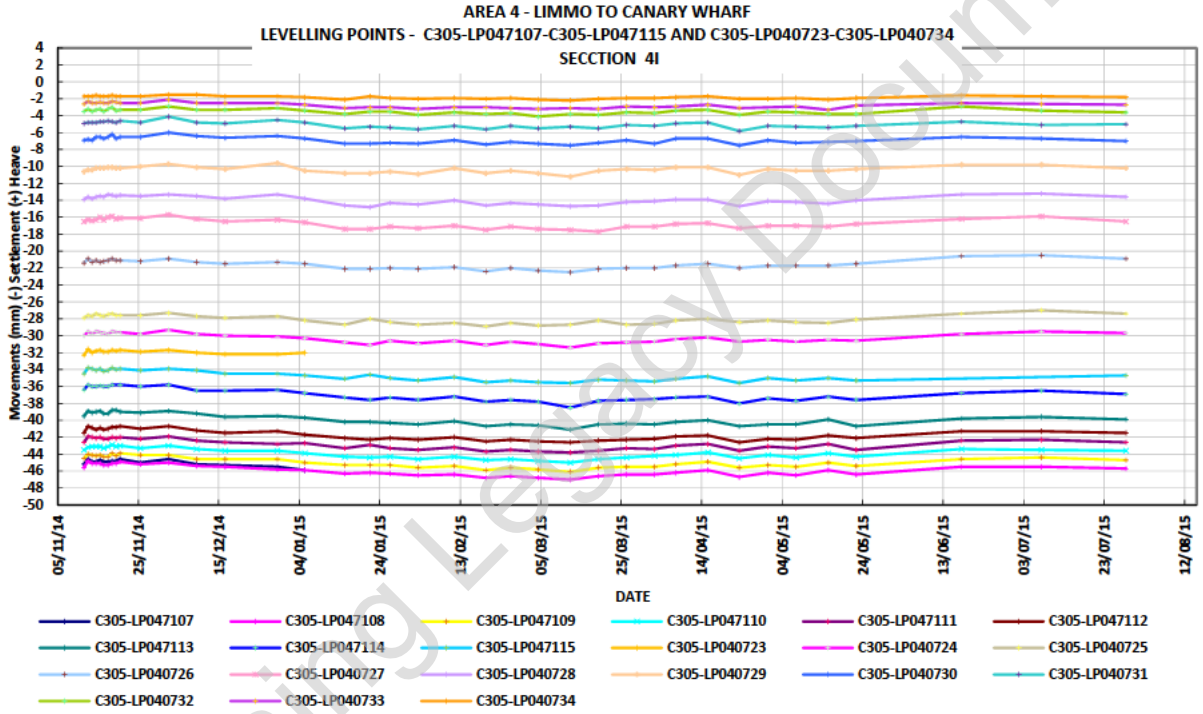


These levelling points close to the area of Virginia Quay, where the sockets included in this Close Out Report are located, reach an annual rate less than 2mm/year for the 100%.

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-LP047107	READINGS FROM 11/11/2014 TO 28/07/2015 WERE TAKEN FROM THE GRAPH ILLUSTRATED BELOW	-
C305-LP047108		-1.7
C305-LP047109		-1.7
C305-LP047110		-1.5
C305-LP047111		-1.5
C305-LP047112		-1.7
C305-LP047113		-2.2
C305-LP047114		-2.3
C305-LP047115		-2.4
C305-LP040723		-
C305-LP040724		-1.1
C305-LP040725		-0.6

C305-LP040726	READINGS FROM 11/11/2014 TO 28/07/2015 WERE TAKEN FROM THE GRAPH ILLUSTRATED BELOW		-0.4
C305-LP040727			-1.1
C305-LP040728			-0.7
C305-LP040729			-0.1
C305-LP040730			-0.8
C305-LP040731			-0.8
C305-LP040732			-0.5
C305-LP040733			-0.8
C305-LP040734			-0.4
	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%**



The graphs and tables of settlement rate for both transects show that settlement rate due to dewatering works is less than 2 mm/year. As the instruments in this report are located between these two transects 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.

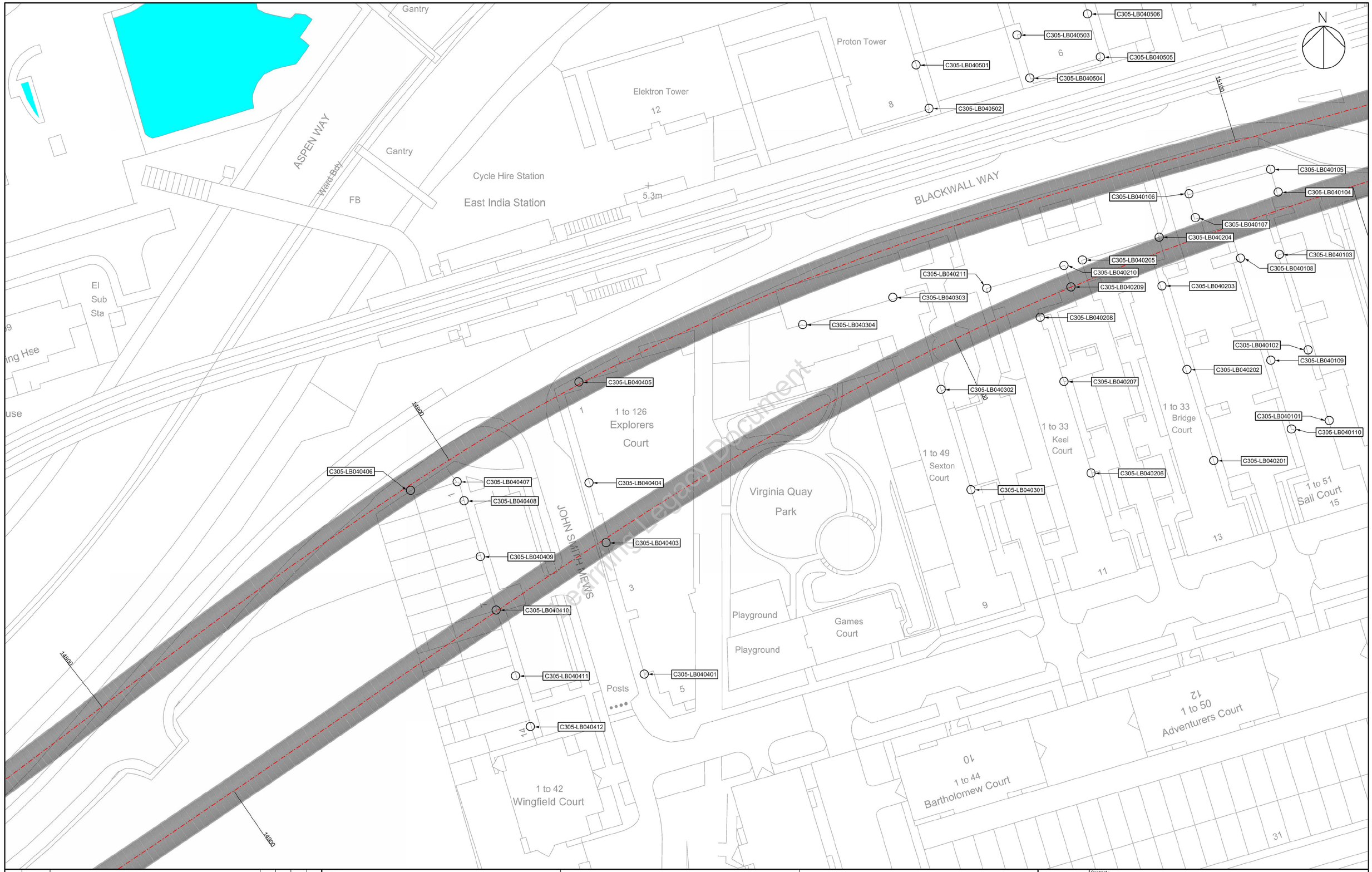
9. SUMMARY STATEMENT

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 and 13, 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.

APPENDIX A: INSTRUMENT LOCATION



Rev.	Date	Description	By	Chkd	App	Auth
P01	06/03/2015	First Issue	MD	AH	RC	-
P02	10/03/2015	---	MD	AH	RC	-
P03	18/03/2015	---	MD	AH	RC	-

Notes

Levelling Socket

8m 0 8m 16m 24m 32m 40m

1:400 @ A1

Crossrail Limited
25 Canada Square
Canary Wharf
London
E14 5LQ

www.crossrail.co.uk

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 Stn)

Title: Instrumentation & Monitoring
Installation Report for I&M MS
Sockets Virginia Quay (84350-84100)
C305-DSJ-C2-GMS-CRG03-50018

By: M.DAVIS
Chk: A.HAWES
App: R.CULLEN
Auth: ---

Scale: Various@ A1

Drawing and CAD file No: C305-DSJ-C2-DDA-CRT00_ST006_Z-08106

Rev: P03

Suitability: S4

Fit for: authorisation

RESTRICTED

S:\gds

C305-DSJ-C2-DDA-CRT00_ST006_Z-08106.dgn 18/03/2015 15:38:44

APPENDIX B: SUMMARY OF INSTRUMENTATION INSTALLED ON SITE

IRS Installation Record Sheets - Sockets

Sensor Type	Sensor ID	Sub-Area	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
					Eastings X	Northings Y	Elevation Z (mATD)				
								AVERAGE	08/10/2012	09/10/2012	09/10/2012
Socket	C305-LB040101	Sail Court	19/09/2012	INSTALLED	89252.233	35337.924	110.016	109.3717	109.3718	109.3716	109.3716
Socket	C305-LB040102	Sail Court	19/09/2012	INSTALLED	89247.286	35354.511	109.569	108.9229	108.9230	108.9228	108.9230
Socket	C305-LB040103	Sail Court	19/09/2012	INSTALLED	89240.599	35376.908	108.895	108.2513	108.2513	108.2512	108.2515
Socket	C305-LB040104	Sail Court	19/09/2012	INSTALLED	89240.312	35391.498	108.426	107.7819	107.7821	107.7818	107.7819
Socket	C305-LB040105	Sail Court	19/09/2012	INSTALLED	89238.561	35396.821	108.419	107.7743	107.7742	107.7743	107.7745
Socket	C305-LB040106	Sail Court	19/09/2012	INSTALLED	89219.364	35391.104	108.437	107.7918	107.7918	107.7918	107.7917
Socket	C305-LB040107	Sail Court	19/09/2012	INSTALLED	89220.851	35385.571	108.443	107.7990	107.7989	107.7991	107.7991
Socket	C305-LB040108	Sail Court	19/09/2012	INSTALLED	89231.485	35376.059	109.032	108.3909	108.3907	108.3910	108.3909
Socket	C305-LB040109	Sail Court	19/09/2012	INSTALLED	89238.606	35352.045	109.638	108.9944	108.9945	108.9943	108.9945
Socket	C305-LB040110	Sail Court	19/09/2012	INSTALLED	89243.43	35335.922	110.083	109.4398	109.4396	109.4397	109.4401
								AVERAGE	11/10/2012	12/10/2012	15/10/2012
Socket	C305-LB040201	Bridge Court	19/09/2012	INSTALLED	89225.195	35328.564	110.003	109.3614	109.3615	109.3611	109.3616
Socket	C305-LB040202	Bridge Court	19/09/2012	INSTALLED	89218.886	35349.892	109.765	109.1217	109.1219	109.1217	109.1215
Socket	C305-LB040203	Bridge Court	19/09/2012	INSTALLED	89213.036	35369.535	109.239	108.5989	108.5992	108.5988	108.5986
Socket	C305-LB040204	Bridge Court	19/09/2012	INSTALLED	89212.356	35380.97	110.242	109.5840	109.5840	109.5839	109.5841
Socket	C305-LB040205	Bridge Court	19/09/2012	INSTALLED	89194.318	35375.626	110.382	109.7236	109.7236	109.7239	109.7232
Socket	C305-LB040206	Keel Court	19/09/2012	INSTALLED	89196.37	35325.629	110.325	109.6711	109.6710	109.6709	109.6714
Socket	C305-LB040207	Keel Court	19/09/2012	INSTALLED	89190.01	35347.07	110.307	109.6544	109.6544	109.6547	109.6541
Socket	C305-LB040208	Keel Court	19/09/2012	INSTALLED	89184.463	35362.143	110.31	109.6534	109.6536	109.6537	109.6530
Socket	C305-LB040209	Keel Court	19/09/2012	INSTALLED	89191.664	35369.296	110.297	109.6440	109.6441	109.6437	109.6442
Socket	C305-LB040210	Keel Court	19/09/2012	INSTALLED	89190.01	35374.335	110.386	109.7299	109.7298	109.7302	109.7297
Socket	C305-LB040211	Keel Court	19/09/2012	INSTALLED	89171.95	35368.979	110.383	109.7289	109.7291	109.7289	109.7287
								AVERAGE	11/10/2012	12/10/2012	15/10/2012

Sensor Type	Sensor ID	Sub-Area	Date Installation	Status	SENSOR Location - GPS reading (m)			Commissioning Readings (m)			
					Eastings X	Northings Y	Elevation Z (mATD)				
Socket	C305-LB040301	Sexton Court	20/09/2012	INSTALLED	89168.186	35321.722	110.383	109.7263	109.7267	109.7263	109.7260
Socket	C305-LB040302	Sexton Court	20/09/2012	INSTALLED	89161.189	35345.208	110.384	109.7270	109.7273	109.7260	109.7276
Socket	C305-LB040303	Sexton Court	20/09/2012	INSTALLED	89149.832	35366.822	110.387	109.7316	109.7314	109.7314	109.7319
Socket	C305-LB040304	Sexton Court	20/09/2012	INSTALLED	89128.656	35360.429	110.373	109.7171	109.7173	109.7163	109.7176
								AVERAGE	18/10/2012	19/10/2012	22/10/2012
Socket	C305-LB040401	Explorers Court	20/09/2012	INSTALLED	89091.508	35278.432	107.949	107.3606	107.3606	107.3604	107.3609
Socket	C305-LB040403	Explorers Court	20/09/2012	INSTALLED	89082.538	35309.281	107.08	106.4920	106.4923	106.4920	106.4918
Socket	C305-LB040404	Explorers Court	20/09/2012	INSTALLED	89078.524	35323.353	106.849	106.2595	106.2597	106.2597	106.2592
Socket	C305-LB040405	Explorers Court	20/09/2012	INSTALLED	89076.175	35346.945	107.156	106.5683	106.5683	106.5681	106.5686
Socket	C305-LB040406	John Smith Mews	20/09/2012	INSTALLED	89036.678	35321.587	107.167	106.7887	106.7886	106.7885	106.7890
Socket	C305-LB040407	John Smith Mews	20/09/2012	INSTALLED	89047.594	35323.593	107.373	106.7078	106.7077	106.7077	106.7081
Socket	C305-LB040408	John Smith Mews	20/09/2012	INSTALLED	89049.222	35319.114	107.29	107.1457	107.1455	107.1458	107.1459
Socket	C305-LB040409	John Smith Mews	20/09/2012	INSTALLED	89053.084	35306.017	107.73	107.1428	107.1425	107.1429	107.1430
Socket	C305-LB040410	John Smith Mews	20/09/2012	INSTALLED	89056.781	35293.466	107.725	107.6655	107.6657	107.6652	107.6657
Socket	C305-LB040411	John Smith Mews	20/09/2012	INSTALLED	89061.339	35278.012	108.247	107.6571	107.6574	107.6567	107.6571
								AVERAGE	09/04/2013	11/04/2013	12/04/2013
Socket	C305-LB040412	John Smith Mews	20/09/2012	INSTALLED	89064.826	35266.142	108.239	106.5832	106.5832	106.5825	106.584
								AVERAGE	14/12/2012	14/12/2012	17/12/2012
Socket	C305-LB040501	Proton Tower	13/12/2012	INSTALLED	89155.324	35421.423	107.441	106.8505	106.8509	106.8499	106.8506
Socket	C305-LB040502	Proton Tower	13/12/2012	INSTALLED	89158.358	35411.209	107.447	106.8554	106.8551	106.8554	106.8557
Socket	C305-LB040503	Neutron Tower	13/12/2012	INSTALLED	89179.034	35428.472	107.432	106.8402	106.8406	106.8405	106.8396
Socket	C305-LB040504	Neutron Tower	13/12/2012	INSTALLED	89182.05	35418.345	107.424	106.8340	106.8342	106.8337	106.8341
Socket	C305-LB040505	Neutron Tower	13/12/2012	INSTALLED	89198.552	35423.289	107.422	106.8299	106.8301	106.8290	106.8305
Socket	C305-LB040506	Neutron Tower	13/12/2012	INSTALLED	89195.531	35433.412	107.419	106.8251	106.8254	106.8245	106.8255

Note: The difference between Commissioning readings and Location sensor (elevation Z) is due to the use of GPS for the installation and the manual levelling to take the commissioning reading.

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

APPENDIX C: MINUTES OF THE CLOSE OUT MEETING

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 stoppage.	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 LP045201-LP045212	Area 4 - Orchard Place (4B)	52% at 2mm/year 59% at 3mm/year	Yes	Yes *

LP041241-LP041249	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

-Cells in yellow indicate data review needs amending. to included for rounding.

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

* - include CP13/CP14 data to demonstrate area is stable after last TBM readings in close out reports affected by dewatering works. Next meeting tomorrow after CTC.

Sign off

DSJV	Geocisa	Crossrail	C122
[redacted]	[redacted]	[redacted]	[redacted]

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:

[redacted]

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 to 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	Crossrail	C122
[redacted]	[redacted]	[redacted]	[redacted]