

TRANSPORT FOR LONDON

BRIEFING NOTE

Subject: Weekly Mayoral update on Crossrail / Elizabeth line

Date: 5 June 2018

Manifesto commitment(s)

Not applicable

Mayor's Transport Strategy (MTS)

A good public transport experience

Proposal 57: The Mayor, through TfL, will work with the DfT to open the Elizabeth line in 2019, with services initially providing 24 trains per hour through central London and increasing in frequency during the 2020s as demand requires.

1 Purpose

- 1.1 Weekly update to the Mayor outlining progress and challenges ahead of the launch of the Elizabeth line.
- 1.2 The Mayor is asked to **NOTE** this briefing.

2 Headlines

- 2.1 TfL Rail services between Paddington and Heathrow and Hayes & Harlington have been running without major incident since 20 May.
- 2.2 Tunnel fit-out activities are continuing in advance of the next train testing window on 8 June. Station fit-out and testing activities remain ongoing. The "power on" of the western tunnel section (Paddington to Whitechapel) remains on schedule for the start of testing from 11 June.
- 2.3 A revised delivery plan has been developed by Crossrail Ltd (CRL), with input from its contractors, London Underground, Rail for London and MTR. The plan enables increased time for fit-out and testing activity and maintains a workable but compressed period from 1 October 2018 for trial running and operational readiness prior to the start of Elizabeth line services in December 2018.
- 2.4 A number of challenges remain in completing some critical activities including ensuring sufficient time for testing against the volume of testing required; completing installation and testing of remaining critical systems; and securing possession periods from Network Rail in the autumn for testing signalling transitions to the east and west of the tunnel sections. CRL is actively managing these with its contractors including a high-level visit to Siemens in Germany this week to focus on the critical path to completing their signalling, communications and controls activities. The Network Rail possession issue is being escalated with DfT.



- 2.5 The provision of asset data, operation and maintenance manuals and training materials by contractors remains challenging. This is needed to support the handover and bringing into use of the railway for Paddington to Abbey Wood services. CRL continues to apply pressure on contractors at senior level to provide materials to meet training and handover plans, and to work with TfL to prioritise the production schedule.
- 2.6 There remains a significant volume of safety assurance and approvals required in order to support increasingly complex aspects of dynamic testing and ultimately bring the railway into safe operation. The rate of submissions to the safety assurance bodies needs to increase and CRL has secured additional resource to assist with this as well as establishing new weekly metrics, a daily focus on required deliverables and escalation with contractors at a senior level.

3 Costs

- 3.1 CRL's costs are reported on a periodic basis and are available up to the end of Period 1 (up to 26 May 2018). The forecast for the delivery of the central section has remained at £12,723m at the end of Period 1.
- 3.2 At the end of Period 1, the forecast cost to complete the Crossrail works exceeds the £600m TfL contingency by £211m. A breach in funding has been reported formally in the Crossrail semi-annual construction report issued to TfL and DfT officials (Sponsors) following the CRL Board meeting on 24 May.
- 3.3 The forecast cost for Network Rail's (NR) delivery of the On Network Works (ONW) remains unchanged at £2,530m, against the original budget of £2,300m. Under the Crossrail agreements, this cost overrun is a DfT held risk. NR has indicated further risks in the range of [REDACTED], with a funding request of [REDACTED] to be funded from NR contingency.
- 3.4 We are continuing to work with the DfT to agree how to jointly resolve the funding shortfall. The Sponsors anticipate the increase in costs above the currently agreed funding will be made public in the annual Written Ministerial Statement (WMS) that is being prepared for Parliament for publication before the end of June.
- 3.5 In addition, TfL, DfT, and CRL will coordinate the release of press statements to accompany the WMS. This is an opportunity to explain the context of the cost increase, promote the successes of the project and share the challenges remaining ahead of opening the central section in December 2018.

4 Programme and Schedule

- 4.1 The key commitments and dates in Crossrail's Master Operational Handover Schedule (MOHS) 2018 with key issues are provided in the appendix A.

5 Appendix

- **Appendix A:** Key milestones from MOHS 2018 schedule with key issues



- **Appendix B:** List of Acronyms
- **Appendix C:** Joint TfL and Bombardier Weekly Report



Appendix A: Key milestones from MOHS 2018 schedule by Stage and key issues including change since last period. The latest available dates are from Period 02 (up to 26 May 2018).

Key: On track ●
 Behind target but not impacting on critical path to Stage 3 ●
 Behind target and at risk of impacting critical path to Stage 3 services ●

Elizabeth Line Readiness Key Milestones	Target	Forecast	Variance	Critical path RAG	Periodic Trend
Stage 2 Phase 2 - Paddington to Heathrow					
ETCS Ready for Formal Heathrow Testing	24-Aug-18	24-Aug-18	0		↔
ETCS Approval to Operate for Driver Training	24-Aug-18	12-Oct-18	-49	Bombardier's software file is late. This has delayed approval to start driver training and ORR authorisation. This means the start of Phase 2 (when all the C345s will go in the Heathrow tunnels) services has been delayed.	↔
ORR Authorisation for On-board Signalling	28-Sep-18	19-Nov-18	-52		
Commence Stage 2 Phase 2 with ETCS functionality	28-Oct-18	TBC	<i>(Dependent on Unit Availability for Driver Training).</i>		
Stage 3 - Paddington to Abbey Wood					
Dynamic Testing					
PSD Ready for Dynamic Testing in Zone 1	09-Apr-18	05 Jun-18	-57	All units physically installed. Electrical installation ongoing. Recovery programme continues to be discussed	*↔
Provide all Trains to Systemwide for Dynamic Testing (3rd & 4th FLUs)	07 Jun-18	07-Jun-18	0	Train delivery re-scheduled "just in time" for test window 4 (multiple trains). Date change managed through BT Deed of amendment	↔
Linewide SCADA available in Zones 3 & 4	30-May-18	30-May-18	0		*↔
Signalling infrastructure ready for DT in Zones 3 & 4	07-Jun-18	19-Jul-18	-42	Availability now forecast for Testing Window 7 commencing 19 July. Some risk to forecast date with mitigation required.	*↓
GSM-R infrastructure ready for DT in Zones 1 to 4	30 July-18	25-Jul-18	5	Medium risk based on update from Siemens	*↔
Permanently energise OHLE Zones 3 & 4	10-Jun-18	08-Jun-18	2		*↔
Start Dynamic Testing (Zones 3 & 4)	11-Jun-18	11-Jun-18	0		↔



Start Dynamic Testing (Zones 1,2,3 & 4)	30-Jun-18	06-Aug-18	-37	Knock on impact from delay in signalling infrastructure readiness in Z3&4	*↓
Trial Running					
All 11 kV S,S&P locations energized	15-Apr-18	02-Jun-18	-48	Consequences of delayed permanent power to stations, shafts and portals are being mitigated.	*↓
Commence Transition Testing @ GEML	30-Jun-18	11-Aug-18	-42	Confirmation of NR possessions required. DfT support has been requested.	*↓
All 22 kV S,S&P locations energized	30-Jun-18	29-Jul-18	--29	Fault with voltage transformers has led to further delay. New programme issued	*↓
Commence Transition Testing @ GWML	14-Jul-18	09-Sep-18	-57	Securing NR possessions not yet achieved. Discussions continuing to finalise. DfT support has been requested.	*↓
Delivery Yellow Plant (RPM, ET01, ET02)	27-Jul-18	04-Aug-18	-8		↓
CBTC Authorised for FLU for Trial Running	26-Jun-18	02-Jul-18	-6		*↓
Commencement of Trial Running under CCRRB (Construction Rule Book)	05-Aug-18	11-Sep-18	-37	Revised milestone description and date based on extended durations for construction and dynamic testing. MOHS milestone date yet to be formally revised	*↓
22no. CI.345 FLUs Available for Trial Running	13-Aug-18	10-Aug-18	3		*↓
Stage 3 - Paddington to Abbey Wood					
Trial Operations					
ORR Issue Safety Authorisation to RfLI	07-Jun-18	23-May-18	15	COMPLETE	*↔
Training completed for RfL in support of Handover of Routeway	05-Jul-18	14-Sep-18	-71	Production of training materials is being prioritised to ensure RfL can train the maintenance and station staff first as they are the most urgent people	↓
Sufficient RfLI Ops & Maintenance. Staff Trained and Competent as IM	03-Aug-18	10-Sep-18	-38	Production of training materials is being prioritised to ensure RfL can train the maintenance and station staff	↓



				first as they are the most urgent people	
Training Delivered to allow the Introduction of the RFLI Rule Book	03-Aug-18	03-Aug-18	0		↔
Final COS safety case updated and submitted to RABC	31-Aug-18	31-Aug-18	0		↔
Handover of routeway to RfLI	05-Aug-18	1-Oct-18	-57	Reflects revised plan for handovers, trial running and trial operations. MOHS milestone date yet to be formally revised	↓
Commence combined Elizabeth line trials (trial operation)	09-Sep-18	01-Oct-18	-22	Reflects revised plan for handovers, trial running and trial operations. MOHS milestone date yet to be formally revised	↔
Passenger Service					
Submit Technical File to ORR	17-Sep-18	17-Sep-18	0		↔
CBTC Authorised for Passenger Service	10-Oct-18	02-Aug-18	69		↔
PML ATS Re-energised including NR feed	15-Oct-18	09-Oct-18	6		↑
Temporary services recovery complete	09-Nov-18	30-Sep-18	40	Mitigated programme from C610 received.	*↑
Opening of Stage 3 - Central Section Paddington L/L to Abbey Wood	09-Dec-18	09-Dec-18	0		↔
Substantial Completion of Stage 3					
Plumstead Maintenance Facility Completion (Initial IM access)	21-Nov-18	21-Nov-18	0		↓
Final Handover of all Stations, Shafts and Portals	28-Nov-18	28-Nov-18	0		↔
Plumstead Stabling Sidings Completion	29-Mar-19	29-Mar-19	0		↔
Stage 3 - Paddington to Abbey Wood					
LU Stations 'Staged Completion' - for LU Familiarisation and Trial Ops.					



Whitechapel Station	16-Aug-18*	16-Aug-18	0	Handover to IM 8-Oct-18	↔
Bond Street Station	31-Oct-18*	31-Oct-18	0	Handover to IM 28-Nov-18	↔
Liverpool Street Station	02-Sep-18*	02-Sep-18	0	Handover to IM 24-Oct-18	↔
Tottenham Court Road Station	02-Aug-18	02-Aug-18	0	Handover to IM 12-Oct-18	↔
Farringdon Station	17-Aug-18	17-Aug-18	0	Handover to IM 29-Oct-18	↔
RFLI Stations 'Staged Completion' - for RFLI/MTR Familiarisation and Trial Ops.					
Paddington Station	29-Jul-18*	29-Jul-18*	0	Handover to IM 15-Oct-18	↔
Custom House Station	28-Jul-18	28-Jul-18	0	Handover to IM 27-Jul-18	↔
Woolwich Station	09-Sep-18*	09-Sep-18*	0	Handover to IM 31-Oct-18	↔
Canary Wharf Station	05-Jul-18*	05-Jul-18	0	Handover to IM 29-Sep-18	↔
Date with * = Dates are drawn from first draft of handover execution plans					
Stage 4 - Paddington to Abbey Wood & Shenfield					
Required no. units available for Stage 4 (55 FLU & 5 RLU)	17-May-19	8-May-19	9		↔
Opening of Stage 4 - Paddington L/L to Abbey Wood and Shenfield	19-May-19	19-May-19	0		↔
Stage 5 - Full Crossrail Service					
70 Trains Delivered for Stage 5. (Including RLU to FLU Reconfiguration)	13-Dec-19	16-Oct-19	58		↔
Opening of Stage 5 - Reading & Heathrow to Abbey Wood and Shenfield	15-Dec-19	15-Dec-19	0		↔



Appendix B: List of Acronyms

Acronym	Description
APIS	Authorisation for Placing Into Service
ATC	Alstom, TSO, Costain joint venture
ATFS	Auto Transformer Feeder Station
BT	Bombardier Transportation
CBTC	Communications Based Train Control
CRL	Crossrail Limited
DfT	Department for Transport
ET01/02	Engineering Train
ETCS	European Train Control System
FLU	Full Length Unit
GEML	Great Eastern Mainline
GSM-R	Global System for Mobile Communications – Railway
GWML	Great Western Mainline
LU	London Underground
MNO	Mobile Network Operators
MOHS	Master Operating Handover Schedule
MTRC	Mass Transit Railway - Crossrail
MTS	Mayor's Transport Strategy
ORR	Office of Rail & Road
PML	Pudding Mill Lane
PSD	Platform Screen Door
RAB (C)	RfL Assurance Board for Crossrail
RfL	Rail for London
RPM	Railway Profiling Machine
S, S&P	Station Shafts and Portals
TBC	to be confirmed
TCMS	Train Control Management System
TfL	Transport for London
TPH	Trains per hour
WBP	Westbourne Park



Appendix C: Joint TfL and Bombardier Weekly Report
Elizabeth line - Bombardier Weekly Report 4 June 2018

Note No: 13

Key Activities and Issues

- 49 trains have been completed in Derby by Bombardier, which is in line with the plan.
- Five 7-Car trains are based at Old Oak Common Depot and are being used on TfL Rail services between Paddington and Hayes & Harlington from this week. The existing Heathrow Connect rolling stock continues to be used for service from Paddington to the Heathrow with the to the Class 345 trains operating between Paddington and Hayes & Harlington. The remaining 10 7-Car trains remain at Ilford Depot and are available for passenger service on the Liverpool Street to Shenfield line. Availability and reliability has been good.
- Good progress continues to be made in bringing Old Oak Common Depot in to full use. The next stage of signal commissioning, took place successfully on the 17 May.
- Bombardier is focused on delivering its reliability growth plan. This targets a mean distance between service affecting failures (the standard industry measure) of 10,000 miles by 26 June 2018. It is based on 15 modifications and software updates that will reduce or eliminate current faults. Reliability continues to improve, in the 4 weeks leading up to 26 May, it was just over 4,000 miles between service affecting failures, up from 2,000 miles the previous four weeks and 1,000 in the four weeks before that but it is not yet clear if the target figure will be achieved by 26 June.
- Three 9-Car trains are being used for driver training on the Great Western route (between Paddington and Heathrow / Reading) and three 9-Car trains are being used for testing, two in the Elizabeth line central tunnel section between Whitechapel and Abbey Wood (Dynamic Testing) and one for pre-testing in the Heathrow tunnels.
- The next dynamic testing in the tunnels between Canary Wharf and Abbey Wood will take place from 8 June and will include train and signalling testing using new software updates (Release 7.2) from Bombardier and also from Siemens (Release 3.0.10) as well as platform door testing.
- Release 7.2 of the train control management software has been tested on the rigs at Derby and is currently undergoing testing at Melton test track. This is 3 weeks behind the original plan. If the remaining Melton tests are completed successfully this week, this delay will not affect the schedule for testing in the tunnels. Bombardier is assessing the potential implications for the start of work on the subsequent Release 7.3.
- Bombardier will confirm this week any functions with Release 7.2 that have not successfully completed testing and propose how they will be included or enabled in future releases. The timing of these future releases will depend on the significance and urgency of the functions involved.



- Bombardier has produced a plan and programme for assurance activities. With a large amount of testing and the number of releases ahead, this is a key area of focus. There was a successful meeting with the safety regulator (the Office of Rail and Road) on 21 May at which the ORR were briefed on Bombardier's approach to securing the necessary approvals. Bombardier continues to review the resources assigned to this crucial activity.
- Going forward, testing schedules will depend on the software releases from Siemens, who supply the signalling system that is fitted to the tunnels. Weekly meetings continue between Bombardier, Siemens, Crossrail and TfL, to improve joint testing, coordination of software release programmes and bug fixing. These meetings are productive and time devoted to them has been increased. A senior CRL/TfL/Siemens meeting is taking place in Germany on 5 June to review the Siemens programme, including its interface with Bombardier.
- Further pre-testing of the European Train Control System ('ETCS') in the Heathrow has been deferred as the latest software (Release 7.2) has some ETCS functions switched off, to simplify approvals for the central section testing and testing using the previous software version (Release 6.1) has been completed).



Key Programme Milestones

Stage 2	P80 Programme (V3_5_1) 11 th Jan	Current Forecast
Approval for driver training on Great Western routes excluding European Train Control System	27 Feb	Completed - submitted 5 March
Commence build of TCMS release 7.3 (the Stage 2 passenger service software)	26 June	26 June
Independent Safety Assessment body ('ISA') approval for European Train Control System MR3 software necessary for Stage 2	6 August	6 August
Independent Safety Assessment body ('ISA') approval for TCMS release 7.3	18 September	18 September
Approval for European Train Control System driver training on Great Western	24 Aug	12 Oct
Approvals for European Train Control System Passenger Service	28 Sept	19 Nov
Stage 3		
Completion of Transition testing at Melton ready for Central Operating Section Dynamic Testing	29 Jan	Completed
Commence build of TCMS release 7.2 (the Stage 3 passenger service software)	24 April	Completed
Independent Safety Assessment body ('ISA') approval for European Train Control System MR2 software necessary for Stage 3	22 May	11 June
Approval of CBTC signalling for Central Operating Section Trial Operations	22 Jun	26 Jun
Availability of 22 trains for Trial Running in the Central Operating Section	13 Aug	13 Aug
Approval of Class 345 for Stage 3 Passenger Service	10 Oct	10 Oct
Start of Stage 3 Passenger Service	9 Dec	9 Dec
Old Oak Common Depot		
Section A Brought into Use	1 Mar	Completed
Section B1 Brought into Use	11 Apr	Completed
Section C Brought into Use	30 May	11 June

