



## **Crossrail Project Representative**

Crossrail Joint Sponsor Team

**Project Status Report 106**

**Period 09 FY2017-18**

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Jacobs U.K. Limited  
 226 Tower Bridge Road  
 London SW1 2UP  
 United Kingdom  
 T +44 (0)20 7403 3330  
 F +44 (0)20 7939 1418  
[www.jacobs.com](http://www.jacobs.com)

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1	4 January 2018	PSR 106 Period 09 FY 2017-18 v1.13.docx ~ Draft	PRep Core Team		
2	10 January 2018	PSR 106 Period 09 FY 2017-18 v1.19.docx ~ Final	PRep Core Team	[REDACTED]	[REDACTED]

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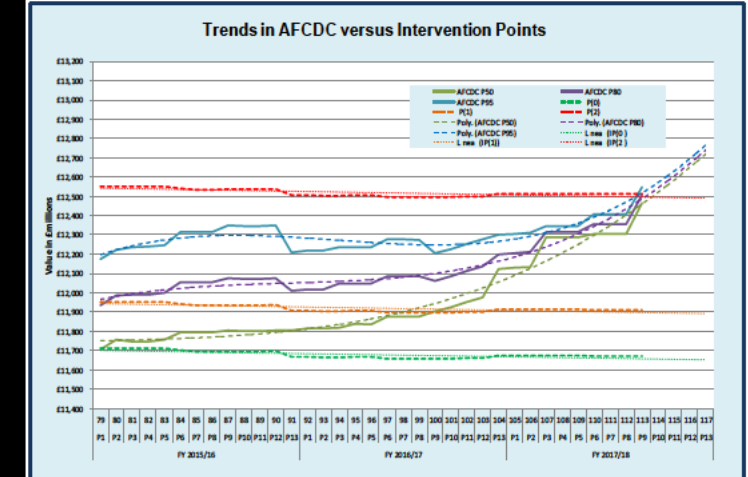
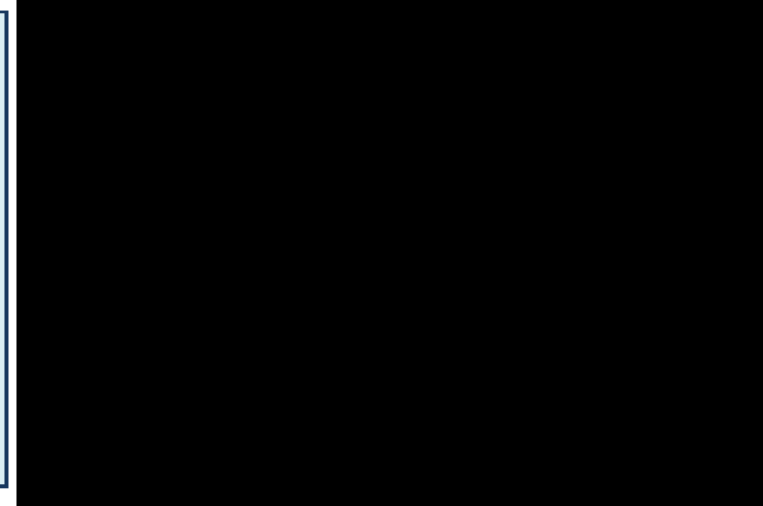
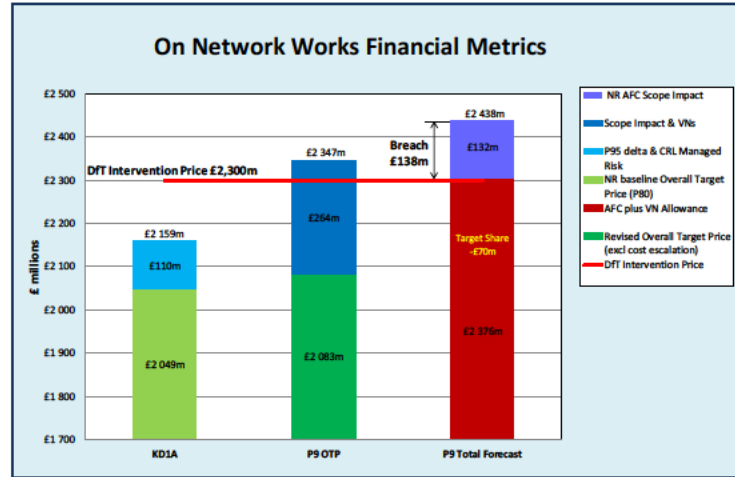
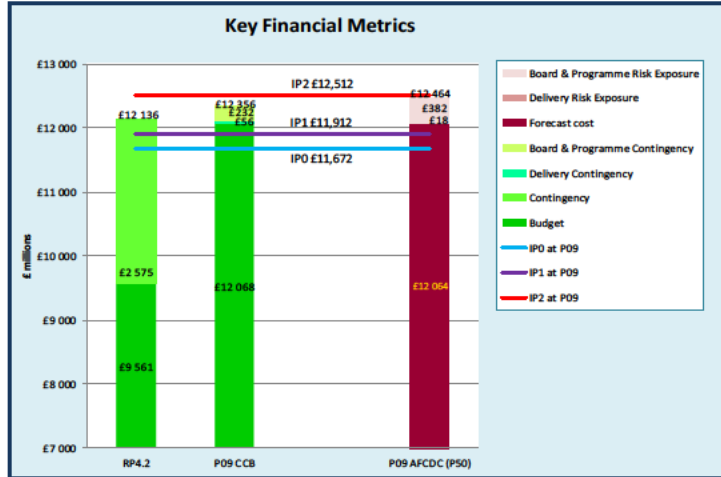
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### Cost and Schedule Dashboard (Period 09 FY2017/18)

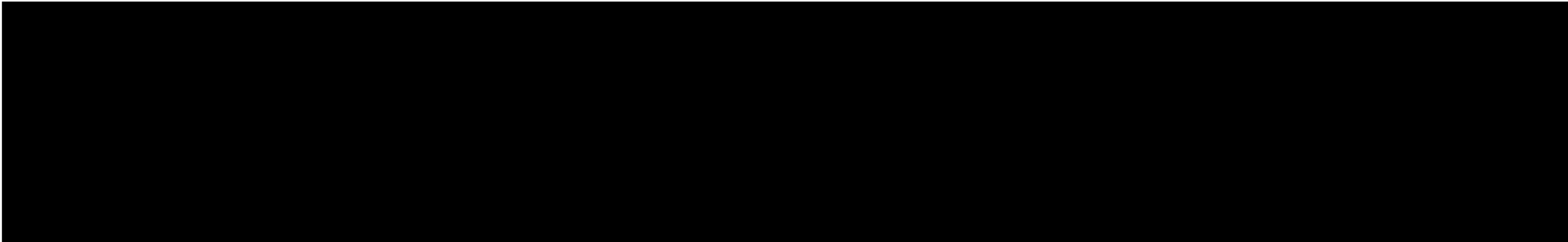
CRL SACR18 QSRA gives confidence level of finishing on time at Stage 3 = 71%

SACR18:  
 AFCDC (P50) ~ £12.303bn. AFCDC (P80) ~ £12.356bn  
 AFC: (£12.303bn AFCDC (P50) + £2.482bn ONW etc) = £14.785bn

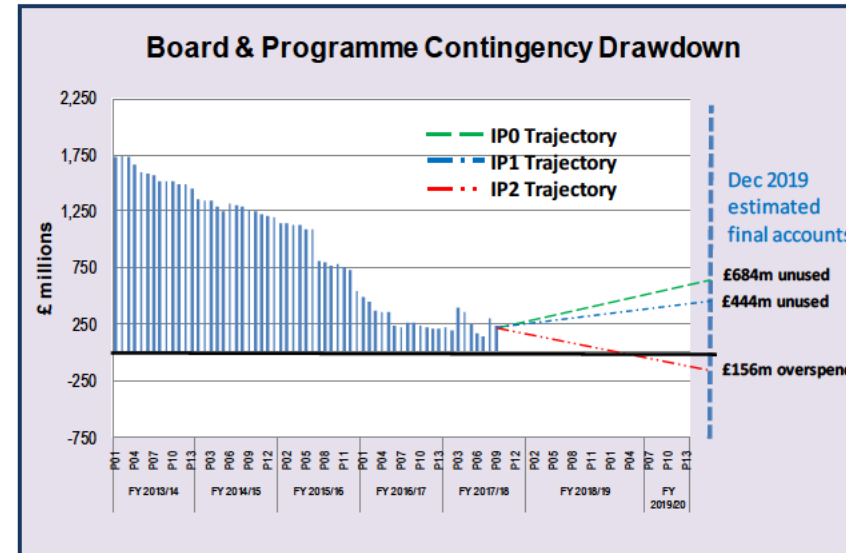
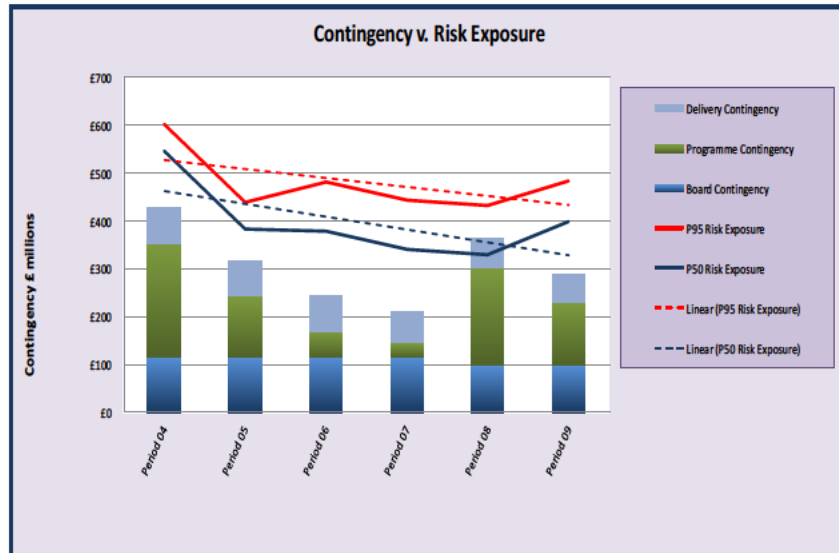
#### Cost:



#### Schedule:



#### Risk, Contingency & Change:



#### Project Representative's Summary:

**Cost:** IPO, IP1 and IP2 have not changed in Period 9. The AFCDC (P50) has significantly increased by £161m in Period 9 to £12,464; exceeding IP1 by £552m and only £48m headroom to IP2. The Finance Current Control Budget remains at £12,356m; The AFCDC (P50) exceeds the reported financial budget by £108m and is in excess of the RP4.2 Baseline funding of £12,136m by £328m. The AFCDC (P80) has increased by £151m in Period 9 to £12,507m which is £595m above IP1 and only £5m under IP2. The AFCDC (P95) exceeds IP2 by £35m. The CRL ONW AFC remains at £2,376m in Period 9. The Period 9 CRL estimated FFOC has reduced by £22m to £2,508m which exceeds the DfT Intervention Price by £208m.

**Schedule & Progress:** Zones 1 & 2 energisation has been re-scheduled to allow EDT to start on 29 January 2018; Zones 3 & 4 Dynamic Testing has been pushed back to 23 April 2018. There remains a significant risk to formal Handover on 5 July 2018 and possibly Stage 3 Opening in December 2018. CRL continues to prepare a revised MOHS to demonstrate how Crossrail completion can be achieved.

**Risk, Contingency & Change:** The P9 QCRA has contributed a £149m increase to the AFCDC (P50) with another £12m added following approval of the Business Plan. The overall contingency budget of £288m is insufficient to cover the P50 risk exposure of £399m by £112m (£147m deterioration from Period 8). The centrally controlled Delivery contingency has reduced in Period 9 by £6m to £56m.

# Cost and Schedule Dashboard

(Quick Reference Guide)

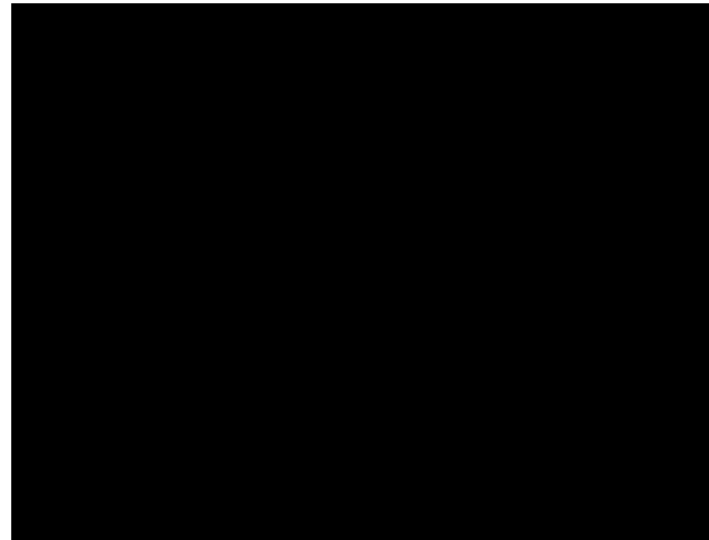
## Cost

### Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFCDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

### On Network Works Financial Metrics

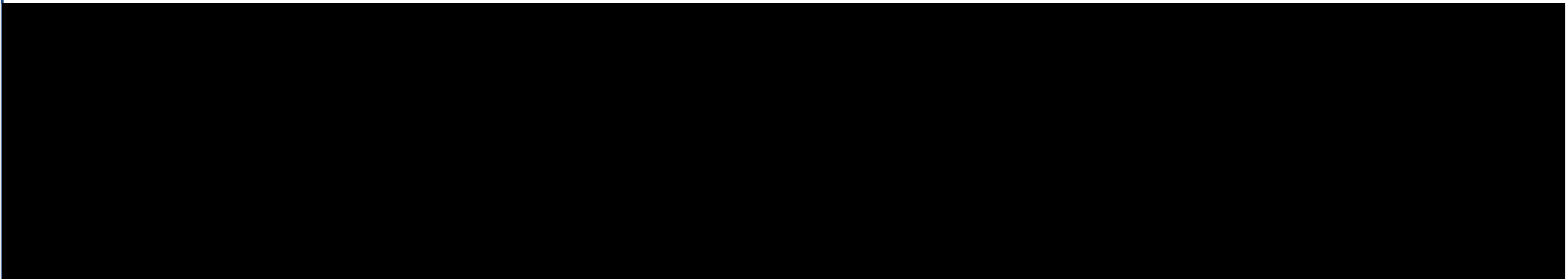
Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.



### Trends in AFCDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFCDC at P50, P80 and P95 and forecasts the respective conservative future AFCDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2.

## Schedule & Float



## Risk, Contingency & Change

### Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

### Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

### Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:

## Introduction, Health & Safety, and Headlines

### Introduction

This report relies on the information set out in CRL's Period 9 reports supplemented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 9 December 2018. Note that information emerging after the close of Period 9 is subject to formal confirmation by CRL in its Period 10 reports.

Overall, in Period 9 cost performance has worsened, driven by a revised view of risk exposure and in-direct costs, and there remains considerable uncertainty in the schedule, principally due to the lack of a programme that integrates the works of all parties concerned with opening.

We draw to the Sponsors attention the following headlines:

### Headlines

**Health and Safety:** The rolling RIDDOR LTC AFR reduced to 0.07 and the LTC AFR remained at 0.17. We are pleased that CRL and its contractors have maintained excellent AFR results this period.

**Financial:** The AFCDC at P50 has increased by £161m (£149m for risk and £12m for Business Plan) to £12,464m following the QCRA. This is only £48m below IP2 and in excess of the previous P80, against which the drawdown of £444m of TfL contingency was agreed in December 2017. The AFCDC at P80 is now just £5m less than IP2. [REDACTED]

[REDACTED] We have recently received details of the QCRA and will comment in our Period 10 report. CRL's estimate for the ONW FFOC has reduced by £22m to £2,508m, due to funding by CRL, but there remain a number of savings in the NR forecast for which CRL is seeking further justification from NR.

**Schedule and Progress:** Zones 1 & 2 energisation has been re-scheduled to allow EDT to start on 29 January 2018; Zones 3 & 4 Dynamic Testing has been pushed back to 23 April 2018. There is also a risk that the train software will not be sufficiently advanced to support EDT by the end of February 2018. As a result there is a significant risk to formal Handover. CRL continues to prepare a revised MOHS, expected in February 2018, to demonstrate how Crossrail completion can be achieved. The majority of works planned for the Christmas period on the ONW were carried out successfully by NR, including the critical Stage M signalling data change.

**Stage 2 Opening:** Stage 2 Opening as described by Sponsors Requirements remains unlikely because of continuing delays to train software development, testing and assurance. There has been no testing carried out on the Heathrow spur, which was originally planned to start at the end of October 2017. A BT schedule was rejected in December 2017 and a revised schedule is currently being reviewed by CRL. Early indications are that the revised schedule is not a material improvement upon the earlier version. If necessary, a commitment to an alternative opening plan is likely to be made by 12 January 2018.

**Stage 3 Opening:** Delivery performance on most station and systemwide projects has been behind plan in the period. Development and testing of the train's CBTC functionality continues in delay. Early indications from the BT schedule currently under review are that there are issues with supporting CRL's dynamic testing programme. The IMs remain concerned at



the slow rate of progress in providing training, O&M manuals, and other documentation. There remains a significant risk that one or more stations will not be operational by December 2018, and that Stage 3 Opening will not be achieved on the planned date.

**Assurance:** Significant concerns remain at the slow progress in developing supporting evidence for Stage 2 and Stage 3 Regulatory Approvals, and at the poor progress in developing Agreements. See Section 6.3 for details.

**Rolling Stock and Depot:** TCMS software development to support ETCS testing on the Heathrow Spur (for Stage 2 Opening) and TCMS v6.1.1.9 (to support EDT in the Central Section) continues to run behind BT's schedule. Ongoing delays and limited visibility of software development continue to impose uncertainty on the Crossrail schedule. The OOC Depot signalling interface was successfully commissioned as part of NR's Stage M works at Christmas 2017.

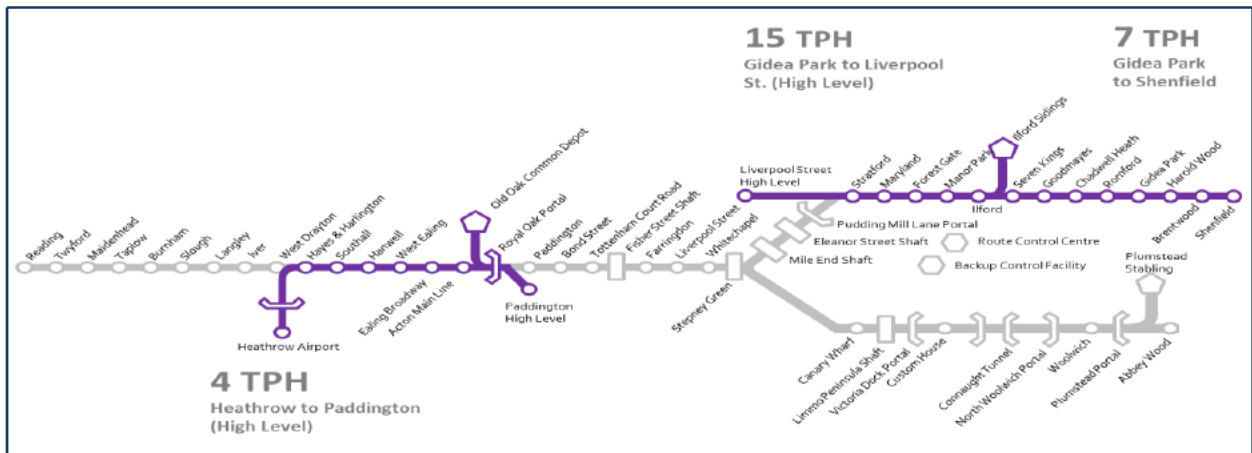
## 1 Stage 1a: Introduction of RLU Fleet

### 1.1 Outstanding Issues

In our last report, [REDACTED]

The imminent completion of the purchase of the RLU fleet, planned by February 2018, means Stage 1a<sup>1</sup> is almost complete. As a result there will not be 'Stage 1a: Introduction of RLU Fleet' Section in our Period 10 report. Our final comment upon Stage 1a is that the drive to increase the MTIN of the fleet, whilst completely necessary, is likely to impact both BT and RSD resources. This impact will take place during crucial periods for BT works in preparation for Stages 2 and 3.

**2 Stage 2: Paddington to Heathrow; 20 May 2018.**



*Achieving Stage 2 by 20 May 2018 is increasingly unlikely, necessitating an Affirmation. BT has not been able to carry out planned testing in the Heathrow tunnel. BT's programme was not accepted. The revision is being reviewed by CRL. Elements of cab simulator not available to support driver training. Delays to Depot internal signalling and Section B readiness could impact Stage 3. NR is working to bring completion of the Hayes & Harlington bay platform forward from May to April 2018.*

We believe it is highly unlikely that Stage 2 (as described in Sponsors Requirements 3.1.6.5, subject to Affirmation 027) will open on time due to the issues set out below. CRL is likely to implement a contingency plan for the planned Stage 2 date, the scope of which will be based on its confidence in the new BT schedule and NR programme for works at Hayes & Harlington.

**2.1 Operational Readiness Assessment**

Eleven Readiness Tasks have been given a "Red" status by the ORSG<sup>2</sup>. This is one less than the total from the last period, but does not represent material progress.

Each of the eleven Tasks can be attributed to five categories:

- Rolling Stock software development;
- Depot Readiness, principally its signalling and availability of stabling;
- Delayed completion of DOO CCTV installation, testing and commissioning;
- Risks to starting driver training;
- Risks to completing NR infrastructure (GSM-R voice and Hayes & Harlington turnback).

All of the Tasks are rated as 'high impact'.

The delays, primarily to the readiness of the train, mean that we do not expect Stage 2 to be achievable by 20 May 2018. We understand CRL is considering whether it needs to submit an affirmation<sup>3</sup> to that effect to Sponsors.

Our belief is that the affirmation should be completed once CRL has completed its analysis of BT’s programme (described in Section 2.3). We believe any submitted affirmation should describe:

- What service pattern will be in place for 20 May 2018, the risks to delivering that service and how they have been mitigated;
- The programme, including cost and risks, for migrating to the Stage 2 service pattern described in the Sponsors Requirements;
- How the current situation will impact upon the train’s readiness to support Stage 3 opening, and what steps are being taken to mitigate any adverse impacts.

	Readiness Task	Issue
Start of classic & ETCS testing	ETCS - Site acceptance tests for system integration 2-0044	The test plan is complete, but the train has not received an ISV so BT is unable to book access paths. BT has tried to mitigate the situation by dead-hauling the train to Heathrow, but has not gained access.
	Integration testing between ETCS (Alstom) and Train (BT) 2-0039	Delays continuing in the development of train software and joint laboratory testing. See Section 2.3.
	C345 route tested Maidenhead – Pad and HTR – HTR Jn 2-0404	BT needs to prove the train’s TPWS signalling is working to receive a Statement of Compatibility (SOC) so that the train can access the network. This testing continues to experience delays.
	Access approved by HAL and NR for train compatibility testing and station systems / interface 2-0122	This Task is linked to both 2-0044 and 2-0404, and is therefore delayed.
Depot	Completion and handover of OOC Depot Section A (stabling for 8 units) 2-0080	See Section 2.4. We would also expect the element concerning Depot Section B to have been red.
	<b>NEW</b> Stage M Readiness. 2-0410	Stage M works were successfully carried out. This Task will be removed in Period 10.
Driver training & Ops Proving	DOO CCTV and associated systems commissioned on GW 2-0060	The SATs are forecast to be completed end January 2018, and full commissioning by end March 2018. See Section 2.2.1.
	DOO CCTV Integration tests prior to driver training 2-0401	There has been a decrease in the time available to carry out testing due to the delays to the train.
	Driver simulator upgraded with ETCS 2-0403	Key dates and content for simulator software releases are now recognised by all parties, but the end date of the final submission does not support driver training.
	ORR issue APIS GSM-R HTR to NR 2-0374	The APIS must be in place to support driver training. See Section 6.3.1.

	Readiness Task	Issue
	HALARP consent to operate GSM-R 2-0375	This Task is linked to 2-0374.
Ops	Turnback availability for FLUs in perturbation 2-0408	Although the turnback is in place, the NR schedule indicates the works to the bay platform completing in May 2018, although CRL/NR are working to bring this forward to April 2018. MTR-C must also complete driver training and Operational Proving activities before the bay can be used in service. See Section 2.2.1.
	BT submit updated technical file for on-board signalling to ORR 2-0368	See Section 6.3.1.

Note: Definition of Red - no information / no owner / no schedule visibility or confidence / fundamental issues exist.

**Figure 2 - 1 ~ Readiness Task with "Red" Status**

## 2.2 Network Rail Works

### 2.2.1 Platforms and Stations

NR report that full installation of the DOO CCTV for ONW West was completed in Period 9. Interim assurance packs have been issued on 30 November 2017 demonstrating installation and test status on each platform. The first issue SAT document page turn exercise was carried out on 7 December 2017 to jointly review content and quality by NR/CRL/RfL/MTR. Progressive delivery of the SAT document continued through December 2017 and will continue further into January 2018 where the final submission is due on 19 January 2018.

DOO CCTV testing and commissioning was completed in Period 9 at West Ealing and Hayes & Harlington and all SAT commissioning completed and benchmark images captured during the Christmas 2017 possessions. CRL/RfL will receive the various corresponding reports during Period 10.

The turnback at Hayes & Harlington is in place. NR has forecast completion of the bay platform in May 2018, subject to confirmed access and the usual possession planning constraints. However, CRL has advised that NR are working to bring completion forward to April 2018.

### 2.2.2 OLE Stockley to Maidenhead

NR has reported that all ONW infrastructure, including OLE, GSM-R and TPS, to enable access to OOC has been delivered in accordance with the requirements of Key Date 12 (30 September 2017), with the exception of the following, which are expected to be delivered on time:

- The Secondary Power feed from the OLE is forecast for completion by February 2018;
- The interface activity Signalling to CRL OOC Depot is commissioned but awaiting depot safety case approval due by 10 January 2018.

The Stage M signalling data change was completed during the Christmas 2017 blockade and is reported to be functioning reliably. Additionally, new track has been installed and connected at WBP and OOC, the OLE installed and energised to Paddington, and the high voltage cable installed and ready for energisation between Kensal Green and WBP.

### 2.3 Rolling Stock

The three key themes in this period concern testing at Heathrow, BT's programme and the cab simulator.

BT planned to dead haul the train to Heathrow so that it could carry out classic testing exercises, a necessary preliminary to the trainborne / trackside signalling integration tests planned by CRL. [REDACTED]

[REDACTED] This is being reported as starting on 19 February 2018, a delay of 2 weeks from the previous period. The non availability of the lab could negatively affect the programme, as discovering and fixing faults (and subsequently proving at Heathrow) can be carried out far more efficiently in a lab than on site.

At the beginning of December 2017 BT submitted a programme to CRL that was subsequently rejected. CRL's position was that the programme did not support the Stage 2 and Stage 3 programmes, and that it lacked the evidence to be considered robust. BT submitted a revised draft on 3 January 2018, which is being reviewed by CRL. We are aware that the dates have not significantly improved upon the dates provided in December, but have more supportive information. This means that [REDACTED]

As a result of the above, we think that Stage 2, as described in Sponsors Requirements, is unlikely to be achieved by 20 May 2018.

### 2.4 Old Oak Common Depot (OOC)

The signalling integration works planned during the Stage M works were carried out successfully. The signalling interface between the Depot and the mainline is expected to be commissioned during mid-January 2018.

Energisation of the depot was planned to be carried out on 3 January 2018. Unfortunately inclement weather contributed to causing a delay. It is now planned for 10 January. This is likely to result in a delay to BIU of Section A to end of January. We believe this length of delay can be mitigated.

We continue our theme from our last period report that the commissioning of the signalling of depot Section A represents a technical challenge. It is scheduled for end of March 2018, and RfL has identified procedures to manage train movements until that point. These procedures can no doubt continue for a period after March if required, but there must come a point when an un-signalled depot becomes unwieldy. This should be identified and mitigated. We believe that point would be at the start of Trial Running (beginning of July 2018).

The other issue to emerge in this period has been the need to split the BIU of Section B into two. This is because of design issues with emergency walkways and cable routes. Previously Section B was due to be BIU on 31 January 2018. Section B1 will now be BIU on 22 February and Section B2 on 25 May 2018. As currently forecast, there will be stabling issues from mid-April to the end of May as planned train delivery exceeds capacity. RfL is identifying mitigation options.

We believe that these issues should be fully debated and assessed through the OCC ORAT to ensure mitigating actions can be identified and implemented in good time.

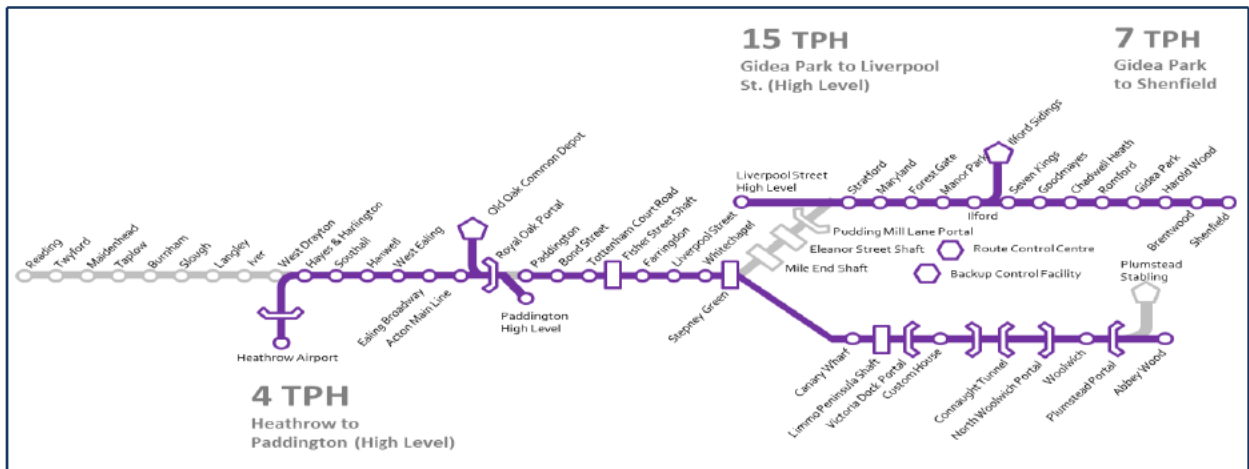
## 2.5 Operations

[Redacted]

[Redacted]

[Redacted] The RLUs would need to be taken from the Shenfield service (six in total), and their diagrams in the east be undertaken by C315s. This is possible, as the C315 fleet remain under the control of MTR-C. The RLUs would need to carry out route gauging etc, but these are known, relatively low level, risks. Some of these tests will need to be repeated with a FLU.

**3 Stage 3: Paddington to Abbey Wood; 9 December 2018<sup>4</sup>.**



Significant risk that [redacted] station will not be ready for Opening.

Energisation and Dynamic Testing dates have been reset but these are subject to significant schedule challenges.

Continued difficulties with the delivery of [redacted].

Readiness of train software likely to negatively impact Dynamic Testing programme.

IM's are not receiving Handover information to their required standard and timing, affecting training, maintenance plans and assurance reviews.

Further delays have occurred to a number of key activities and milestones this period. There remains significant work (including the 'paper railway') to be completed before key NR possessions in March and May, Handover in July, and Stage 3 Opening in December 2018. We are very concerned that there is now insufficient time to complete these works as planned. CRL is currently preparing its refreshed MOHS which we expect to be published in February. This should include details of activities required to achieve these key dates, and the planned dates for Handover of each Element to the IM's which are likely to be spread over several weeks. We will provide our commentary on this final schedule upon receipt.

**3.1 Operational Readiness Assessment**

There are now twenty-three Readiness Tasks that have been given a "Red" by the ORSG<sup>5</sup>, an increase of three from the previous report. The causes for the increase are the delays to training programmes and Handover materials.

Seven of the tasks are rated as 'medium' impact, but have a cumulative impact upon RfL-I maintenance and LU staff being trained and competent, which is rated as 'high' impact. The twenty-three Readiness Tasks can be attributed to four categories:

- COS infrastructure not being in a position to support EDT;
- Train software not being in a position to support EDT;

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- CRL not receiving data, or it being below the necessary quality, from the Tier 1 contractors. This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway;
- Delays to the progressive assurance programme agreed with the ORR.

Readiness Task	Issue
<b>Dynamic Testing Zones 1-2</b>	
Infrastructure available and ready for Dynamic testing	The key concern continues to be the readiness of the Traction Power Energisation schedule. See Section 3.4.
Delivery of FLU with functioning CBTC	The continued slow development of the train's TCMS CBTC functionality presents a high risk that a train is not available for dynamic testing. See Section 3.6.
MAID deliverables uploaded in Livelink <i>Medium impact</i>	Handover material is in delay. See Section 3.8.
Implement RCA's (update processes and procedures) <i>Medium impact</i>	LU has continued concerns that the delay to receiving Handover material will affect implementation of its Risk Control Actions.
RfL-I acceptance of FDO (for interfacing assets) <i>Medium impact</i>	We discuss the issues affecting the delays to FDO in Section 6.3. LU is also impacted, in some cases, by the close out of the programme.
Systemwide approvals and agreements in place for DT	Related to traction power readiness. Uncertainty over conclusions to LoNo's, approvals etc. See Section 6.3.
<b>Dynamic Testing All Zones</b>	
RfL maintenance training facility at TUCA available. <i>High impact</i>	Progress has been made aligning TUCA's programme with the RFL-I training requirements. Classrooms are now expected to be available by end of January 2018. This is welcome, but we are cautious due to the number of occasions that the TUCA programme has met, then not met, the Training programme requirements. RFL-I has stated that its maintenance plan can proceed without TUCA being available.
<b>NEW</b> Interfaces commissioned & operational for Trial Running	The delay to the IM training schedule raises the risk that RfL-I and NR operatives will not be able to facilitate testing and commissioning activities.
LU Elizabeth line asset data in Ellipse/ Maximo <i>Medium impact</i>	Handover material is in delay. See Section 3.8.
Compliance Achieved (FDO signed without caveat)	FDO certificate dates are continuously moving back, delaying Asset Information transfer and impacting upon Interim Acceptance. See Section 6.3.
O&M manuals in place for 5 LU stations <i>Medium impact</i>	O&M manuals are not being provided to the necessary quality in the required timescale.
<b>NEW</b> QRA data issued to LU	This Task is related to Handover, see Section 3.8.

Readiness Task	Issue
LU maintenance in place for Handover	The lack of O&M manuals and asset data described above risks LU staff being inadequately prepared.
All tech training delivery to IM trainers	The IM trainers will in general not receive the expected training by the Contractors. See Section 3.8.
O&M manuals for RfL-I completed.	Delivery of O&M manuals continue to be behind programme, affecting IM readiness. See Section 3.8.
System information delivery (asset data, O&M manuals, training plans, MAXIMO) <i>Medium impact</i>	IMs not receiving the level of information required. This Readiness Task is similar to the 'O&M manuals completed' Task.
RfL maintenance staff train the trainer complete	The training plan is being changed to reflect the fact that in some cases this will not be achieved. See Section 3.8.
Systemwide approvals and agreements in place for DT	The same issue as 'Systemwide Approvals' for Zones 1&2 noted above.
<b><i>Trial Running</i></b>	
<b>NEW</b> LU Comms DLO staff training familiarisation complete	The lack of Handover material is affecting the ability to train LU comms staff.
<b>NEW</b> LU Handover achieved	This task is red due to the items listed above.
RfL-I maintenance staff trained and competent	Red due to contractor training plans and asset availability. See Section 3.8.
RFLI Ops & RCC staff trained, licenced & competent	The delays to the [REDACTED] has affected the Traffic Manager training programmes. Some will not be trained until after Handover.
<b><i>Stage Three Service</i></b>	
LU Staff Ready to Open for Revenue Service	This task is red due to the items listed above.
ORR issue APIS for COS assets	Tier 1 Contractors and CRL may not be producing assurance evidence at the required rate. See Section 6.3.1.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

**Figure 3 - 1 ~ Readiness Tasks with "Red" Status**

### 3.2 Tunnels

The tunnelling contractor remains on plan for contract completion by mid-February 2018. The CRL site team is being demobilised in line with the assumption that the final settlement and project close-out will be achieved by the end of Period 3 (2018/2019). There is a risk that the project's close-out may not be completed in line with CRL policies and procedures, if key resources cannot be retained. See Appendices F.1 and F.2.

**3.3 Stations, Portals and Shafts**

Schedule performance, across most of the stations, has remained less than planned during the period. The actual/forecast performance curves reflect continued delays and are generally either on, have continued to drift closer to or in some cases beyond, the respective Baseline [redacted] date profiles. This places increasing pressure on the existing MOHS schedule and an increasing risk of further delays, to station completions, unless mitigation measures can be applied. It is not yet clear whether the 2018 MOHS refresh will reflect an improvement in this situation.

We note that the percentage progress achieved at the stations since our last report, with the exception of [redacted] and [redacted], has been less than planned. [redacted] station has achieved some measure of recovery and [redacted] station has held its percentage completion without further slippage. We are concerned that this deterioration, as reported, has occurred so soon after a schedule re-baselining (Period 8) in anticipation of the MOHS 2018 refresh that had generally brought reported progress in line with plan.

High level discussions with [redacted] stations, and the Intermediate Shafts, are expected to conclude in Period 10. [redacted]  
 [redacted]  
 [redacted]  
 [redacted]  
 [redacted]

CRL continues to report a MOHS forecast “recovery target” completion date for [redacted] station in mid-December 2018 against a contractor’s planned completion date of 7 March 2019. We are concerned that an updated/amended Period 10 schedule to completion for [redacted] expected from the contractor by 11 December 2017, was not submitted as planned. There remains a risk that the station’s completion date could be delayed beyond the planned Stage 3 opening date in December 2018, unless CRL can secure an improved schedule from the contractor.

[redacted] and [redacted] stations have each reported 25 days delay to their forecast MOHS completion dates. [redacted] station reports a further delay of 56 days to station completion, to the 65 day slippage reported in Period 8. This has pushed forecast completion beyond the MOHS target of 3 August 2018. We are currently investigating what has caused this further substantial delay and will report on status in Period 10. The remaining stations have either held, or very slightly improved on their forecast dates, during the period.

Further detail on the stations can be found in Appendix F.2.

Room and route handover performance still continues at a level less than plan. All of the stations report continued delays and are behind plan with their room and route handovers to Systemwide. The gap in delivery (percentage variance against plan) has remained unchanged during the period. CRL has achieved almost 77% of room and route handovers, against a planned 99%. There is little evidence of any sustained effort towards recovery of the handover schedule; implying an increasing risk that station contractors will not be able to meet Systemwide handover date expectations, and that target dates for Dynamic Testing in Zones 3 & 4 will as a consequence be impacted. Refer to Appendix F.3.

### 3.4 Railway Systems for EDT

CRL has finalised plans for the correction of the wiring errors at PML ATFS which led to the catastrophic failure on 11 November 2017, and for the replacement of the damaged VTs. These plans, in turn, have allowed the preparation of a revised schedule for Railway Systems delivery, in order to achieve energisation and signalling testing across all Zones. “Plan Delta” as the schedule has become known, remains under development, and the latest thinking was presented by CRL at the MOHS Review in December 2017<sup>6</sup>. The dates set out below are subject to confirmation.

The repairs at PML are fundamental pre-requisites for Zones 1 & 2 traction power energisation. The latest declared planned date for the energisation of PML ATFS is 19 January 2018<sup>7</sup> with energisation of the OLE to follow. In the time up to energisation CRL will be focussed upon the completion of installation, clearance of snags, correction of defects and certification, in order to eliminate any future re-work. Thereafter EDT is targeted to start on 29 January 2018 and run for approximately 8 weeks, which is down from the 16 weeks originally planned. Up to that date no dynamic testing will have been carried out; however, this is also due to the software capability of the train falling well short of what was expected at the time the MOHS milestones were developed.

A key objective within the EDT period is the completion of signalling testing at the NR GEML interface during possessions booked in early March 2018. This will require the prior completion of CBTC equipment installation on NR GE assets and, critically, the availability of a suitably equipped and proven Class 345 test train. CRL recognises the threat and is investigating alternative dates. We return to the latter issue in Section 3.7 below.

The significant reduction in time now being made available for EDT might impact the achievement of the early testing benefits, which were presented to justify the original strategic commitment. Possible concerns at the lack of return on the investment made to prioritise Zones 1 & 2 delivery will be eased once dynamic testing has been successfully completed, an outcome which relies heavily upon the error-free completion of planned tests.

### 3.5 Railway Systems for Completion

Despite the loss of approximately 12 weeks of EDT, CRL continues to target substantial completion of delivery of Railway Systems, and dynamic testing in all Zones in time for Handover on 5 July 2018. This includes the recovery of installation not previously achieved in Zones 3 & 4 because of prioritisation in Zones 1 & 2.

Zones 1 & 2 will be de-energised and EDT terminated in early April 2018. This is to allow integration of SCADA systems across all Zones and for re-configuration of the traction power supply system ahead of Zones 3 & 4 energisation.

Our concerns last period that the original MOHS dates for Zones 3 & 4 Dynamic Testing had become unrealistic are reflected in CRL’s latest forecast dates, with energisation now planned for 7 April 2018 and dynamic testing on 23 April 2018. These targets are already extremely challenging, requiring the completion of all energisation-critical installations (e.g. OLE, earthing and bonding and SCADA), and of trackside signalling systems. With planned reviews to integrate [REDACTED] and [REDACTED] schedules still to take place, planned delivery of all the necessary fixed infrastructure has yet to be satisfactorily demonstrated.

The reduction in time available ahead of Handover is making CRL’s proof of correct CBTC / Rolling Stock operation through dynamic testing increasingly difficult to achieve; it might also

impact the signalling testing at the NR GWML interface in early May 2018. The potential loss of the interface possessions is a particular concern because of the long lead times associated with re-booking. CRL recognises the threat and is investigating alternative dates.

Handover is at risk because of difficulties with the delivery of HV Power and Tunnel Ventilation systems. Both systems must be transitioned from temporary to permanent configurations, with direct dependencies upon the completion of Stations power, earthing and bonding, systems, and upon [REDACTED] the situation is compounded still further because of delays in [REDACTED]. This is a complicated systems integration issue for CRL to resolve, alongside the more obvious challenges of Railway Systems completion and dynamic testing. We will report further on this next period.

We remain concerned that successful completion relies upon installation, testing and commissioning proceeding to plan. There is little obvious opportunity for mitigation, and the risk of significant impact upon Handover and Stage 3 Opening, as currently conceived, is increasing. We summarise our concerns with schedule in Section 3.7.

### 3.6 Rolling Stock

[REDACTED]

In previous reports we have described the linkage of the development of the train's software for both Stages 2 and 3. Therefore the situation concerning BT's programme, described in Section 2.3, will have an impact upon Stage 3. [REDACTED]

### 3.7 Integrated Railway

Difficulties in properly integrating fixed infrastructure and rolling stock delivery continue to present a significant risk to the success of Crossrail. Historical delays from [REDACTED] [REDACTED] have left the Crossrail Programme with huge challenges in 2018.

CRL has enjoyed some success in the past in the implementation of a range of mitigations in order to effect schedule recovery, and the philosophy of continuing to set challenging schedule targets in order to maintain delivery pressure is supportable. However, given the amount of work remaining in the Central Section, the criticality of the energisation and signalling milestones to be delivered, and the lack of a reliable schedule from [REDACTED]; CRL's ability to effect formal Handovers in July 2018 remains open to question.

We reiterate that the production of a fully integrated plan for Crossrail completion is fundamental to providing a clear understanding of what is and is not possible in the time remaining, and whether or not the Handover and Staged Opening dates are still achievable.

### 3.8 Operations and Handover

Progress has been made in this period, but not at a pace to reduce the risks to Handover described in our last report. This increases the risk of RfL-I not being able to receive assets as planned. There will also be a need in the near future to formally recognise that Handover as originally planned (all assets accepted by IMs on 5 July 2018) will not happen. This is understood at a working level, but LU for instance would like formal confirmation that it is not going to receive all 5 stations on the planned Handover date. This will allow it to formally adjust its planning schedule. This is likely to occur once MOHS is refreshed.

#### Training

In our last report we described how the training programme was being adjusted so that instead of Tier 1 contractors ‘training the RFL-I trainer’ they would now ‘train the end user’. The training schedule reflecting this has now been completed, and can provide the minimum levels of competent personnel for Handover. However there is no flexibility to the schedule, so contractors and RFL-I staff must adhere to the specified training dates. The revised nature of the training programme now also means that there is an increased risk to performance during the Trial Running and Trial Operations periods.

[REDACTED]

Overlaying all of the above is the variable quality of the training materials that constitute a key element of the programme. Poor quality materials means that IM staff will not be as prepared as they should be, impacting upon testing and operational performance. A case in point are the materials for the RCC staff, which are not deemed adequate by the IM. CRL is currently issuing instructions to the contractors with regard to what ‘good’ training materials looks like, but based upon past performance we are cautious as to whether this will result in a quick improvement.

#### Asset Information

The key concern for the IMs is that the planned progressive nature of Handover is not taking place. The consequence of this is that large volumes of data are now likely to be transferred to the IMs in a 2 to 3 month period before the planned Handover date, overwhelming the available IM resources and consequently affecting Handover. The late delivery of data also means that the IMs cannot finalise their maintenance plans. Particular points to highlight are:

- [REDACTED] has the largest quantum of asset information to transfer, and is under resourced to deliver it. CRL has instructed the contractor to increase its resources, but it is likely that this particular element will remain critical up to Handover;
- MAID has received 1,500 docs from a total of 87,000. Half of that number are now expected in April and May. LU would like CRL to focus upon the quantum of data to be released as well as upon release dates;
- CRL is of the opinion that RfL’s review of data being transferred into CARE is taking too long, exacerbating the initial delays caused by the Tier 1 contractors;
- The contractors have generally provided sufficient information about Spares to the IMs. The exception is [REDACTED] which has not completed its list. This delays finalisation of the RFL-I maintenance plan.

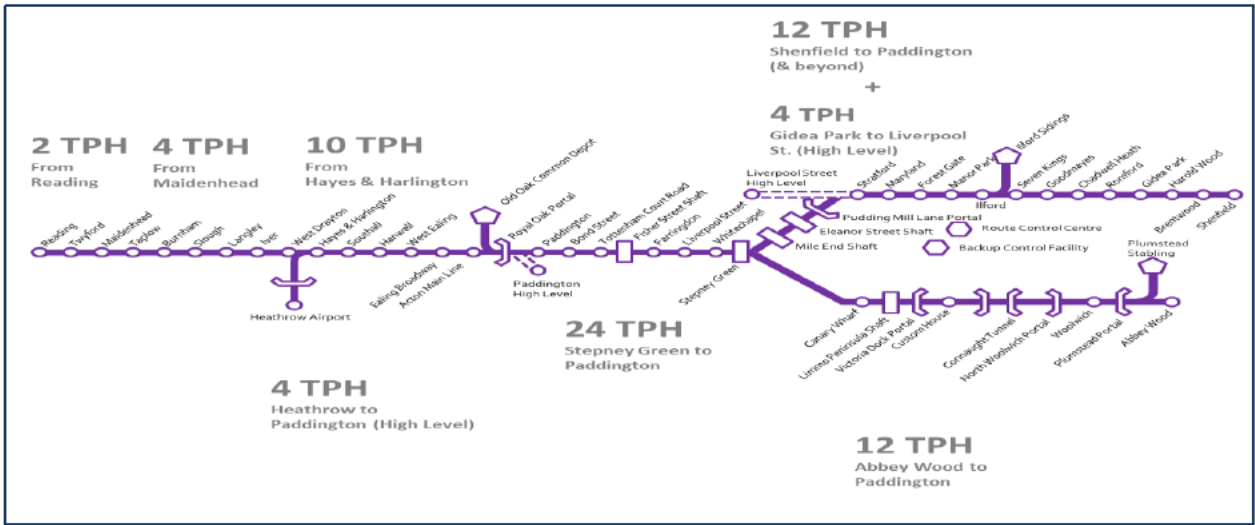
#### Operations & Maintenance Manuals

O&M manuals are important as they are needed to finalise maintenance plans and assist in demonstrating confidence to the Regulatory bodies that RFL-I is prepared for passenger service. At the moment, few O&M manuals have been accepted by the IMs, and the IMs report

that significant work needs to be carried out on the manuals to bring them to a satisfactory standard.

CRL has issued clarification notices to contractors concerning O&M manuals content, submission and review.

**4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.**



*Negotiations continue regarding alternative solution for Ilford Depot line speed enhancement. Programme required for Rolling Stock software change to allow reliable transition between GEML and COS.*

**4.1 Operational Readiness Assessment**

There are four Readiness Tasks that have been given a “Red” status by the ORSG<sup>9</sup>.

Readiness Task	Issue
Wire height alignment corrected to standard in Ilford Depot	MTR-C wants to stable FLUs at Ilford Depot from December 2018. This would provide additional resilience to Stage 3 operations and maintain regular use of the PML transition. This timescale could prove problematic for CRL. If this was mitigated the works would need to be complete by early April 2018.
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The works have little contingency. Full ATS is not required until March 2019.
Ilford Depot exit speeds increased to support Stage 4 Timetable frequencies	The GA proposal to implement operational changes rather than change depot exit speeds is now the preferred option. See Section 4.2.
Ilford Station Redevelopment	Programme for Ilford Station implementation is yet to be agreed.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

**Figure 4 - 1 ~ Readiness Tasks with "Red" Status**



## 4.2 Ilford Depot Line Speed Enhancement and Wire Heights

CRL has advanced negotiations with GA, TfL and MTR-C regarding an alternative proposal to revise stock movements from Ilford Depot, instead of carrying out infrastructure works to enable a 15 mph departure at the London End. CRL wrote to DfT on 15 December 2017 seeking confirmation that DfT and NR were content with the details of the proposal, and its impact on the current and future franchise arrangements.

Discussions continue between CRL and NR regarding proposals for the wire heights project. We continue to expect an outline plan from CRL by the end of January 2018.

## 4.3 Rolling Stock

The train and infrastructure designs have resulted in a performance risk to the Stage 4 timetable.

There is a neutral (non-energised) section of the railway between the COS and the GEML. If the train is held at the last signal before leaving the COS, it will straddle the section and lose power completely. It would then have to roll backwards so that it could regain power, and then not proceed until it was certain it could pass the signal without stopping. Although this is not shown as red task, it is an issue we believe Sponsors should be aware of. There are operating procedures that mitigate that disruption for infrequent use (e.g. ECS during Stage 3) but these are not adequate for the Stage 4 timetable. The solution is a software change by BT, known as 'Packet 44'. There is currently no programme for this. Packet 44 will need to be implemented by early April 2018 for driver training purposes.

**5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.**

*Clarity needed as to what mitigating actions exist, and when they need to be deployed, if ETCS is not available for Stage 5.*

*All West Enhanced stations are on schedule for December 2019 completion.*

**5.1 Operational Readiness Assessment**

There are five Stage 5 Readiness Tasks that have been given a “Red” status by the ORSG<sup>10</sup>.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	NR’s programme has little contingency, and is yet to be funded. Nevertheless NR state that its internal tracker considers this Task to be green.  A number of issues arise if ETCS is NOT installed by NR. <ul style="list-style-type: none"> <li>• The Stage 5 timetable assumes that ETCS is installed. If it is not then trains will transit onto TPWS, which will necessitate a lower speed than ETCS. This degrades the Stage 5 timetable performance, but to what extent is not yet known. We are not yet aware on what the timescales are for resolving the impact of any delay to ETCS.</li> <li>• The CBTC design assumes it will connect to ETCS. If it is required to connect to TPWS it will require a design change.</li> </ul>
Dynamic testing of CBTC to ETCS interface at Westbourne Park	CRL and NR believe each other should lead this work stream. Siemens is contracted to install the ETCS balises that interface with the CBTC system.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019, with little float available. See Section 5.2.1.
Maidenhead Sidings complete for C345 FLU stabling inc staff accommodation	The issue concerns staff accommodation. A mitigation is likely. See Section 5.2.1.
Distribution from Kensal Green to W Ealing, Hayes Slough and Maidenhead ATS sites	NR believes there is sufficient power to operate the timetable, and time to complete any necessary works. A formal report will be submitted to CRL.
ORR issue APIS for ETCS (stage B & C)	Linked to ‘ETCS available and tested airport Jn’ task.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

**Figure 4 - 2 ~ Readiness Tasks with "Red" Status**

## 5.2 Network Rail Works

### 5.2.1 Platforms and Stations

NR has confirmed that funding for the West Enhanced stations from DfT is in place. NR report that West Enhanced stations advance works progressed in accordance with schedule during the Christmas 2017 blockade. NR further report that the West Enhanced stations detailed design for Hayes & Harlington, Southall and West Drayton will be available by end of January 2018 and detailed design for Acton, West Ealing and Ealing Broadway by mid-February 2018. NR continue to state that all West Enhanced stations are on schedule for December 2019 completion.

The GRIP 4 design for the Staff Accommodation at Maidenhead Sidings continues to progress. The accommodation is needed for Stage 5; forecast delivery is by September 2018. The staff accommodation at Maidenhead sidings is still under discussion between NR and CRL to investigate alternative delivery options that may offer more sustainable and affordable benefits.

### 5.2.2 ETCS Delivery on the GWML

#### **Stage A (Heathrow):**

NR has received the Alstom Safety Justification Report and progress is on course for SRP acceptance in January 2018. An instruction requiring the application of a Common Safety Method process to the Operational Rules Development has been received and is being assessed by NR regarding any impact to the Network Rail Safety Justification Report.

#### **Stages B & C (Stockley-Acton & Acton-Paddington):**

The GRIP 4 Stage Gate Review was held on 14 December 2017 and the project is able to progress with its investment authority submission to support the corresponding January 2018 contract award. Following the conclusion of the ergonomics report, NR will review the options for Integrated Electronic Control Centre (IECC) integration as part of its GRIP 5-8 scope. The GSM-R significance test for CSM-RA has been approved as “non-significant” by NR’s Western, Wales and Crossrail Safety Review Panel (SRP) ETCS sub-group.

NR continues to state that Stages A and B & C are on target for being delivered within budget and to programme. Whilst we concur that programme milestones continue to be achieved as planned, we will continue to monitor that cost performance is in line with budget and funding constraints.

## 6 Generic Issues

*The Intervention Points have not changed in Period 9.*

*The AFDCD at P50 has increased by £161m to £12,464m following the QCRA.*

*The AFDCD at P80 has increased by £151m to £12,507m which is only £5m under IP2.*

*The AFDCD at P95 exceeds IP2 by £35m.*

████████████████████████████████████████████████████████████████████████████████

██████████

*CRL estimate for the ONW FFOC has reduced by £22m to £2,508m.*

*The final version of MOHS is expected in February 2018.*

*CRL is currently forecasting all remaining Stage Openings will be on time – we believe this is unlikely for Stage 2 and is at risk for Stage 3.*

*Regulatory Approvals for Stages 2 and 3 continue to be listed as ‘red’ by CRL.*

### 6.1 Financial Analysis

#### 6.1.1 AFDCD and Intervention Points

IP0, IP1 and IP2 have not changed in Period 9. The AFDCD (P50) has significantly increased by £161m in Period 9 to £12,464; exceeding IP1 by £552m and £48m below IP2, see Figure 6 - 1. This increase is predominantly due to CRL undertaking its Q3 (Period 9) QCRA, resulting in additional Programme and Delivery risk allowances of £149.2m and increasing Indirect Costs by £12.2m following the approval of the CRL 2018/19 Business Plan.

The Finance Current Control Budget remains at £12,356m. The AFDCD (P50) exceeds the reported financial budget by £108m and is in excess of the RP4.2 Baseline funding of £12,136m by £328m. The AFDCD (P80) has increased by £151m in Period 9 to £12,507m which is £595m above IP1 and only £5m under IP2. The AFDCD (P95) exceeds IP2 by £35m.

(£ millions)	Period 8	Period 9	Delta	Movement
<b>Forecast</b>	11,974	12,064	90	up
Delivery Risk	64	18	-46	down
<b>Subtotal</b>	12,038	12,082	44	up
Programme Risk	261	378	117	up
Board Risk	4	4	0	same
<b>AFDCD total</b>	12,303	12,464	161	up
IP0	11,672	11,672	0	same
<b>IP0 Headroom</b>	-631	-792	-161	down
IP1	11,912	11,912	0	same
<b>IP1 Headroom</b>	-391	-552	-161	down
IP2	12,512	12,512	0	same
<b>IP2 Headroom</b>	209	48	-161	down

Figure 6 - 1 ~ AFDCD (P50) headroom to Intervention Points

The principal contributions to the AFCDC (P50) increase from the QCRA are:

- £111.4m in respect of additional Programme Risk allowances;
- £37.8m in respect of additional Delivery Risk allowances;
- An additional sum of £12.2m for the CRL approved 2018/2019 Business Plan.

CRL report that the cost pressures, as anticipated in our Period 8 report, on [REDACTED] at [REDACTED] and [REDACTED] contracts have been included in the QCRA and further allowances have been made for [REDACTED] Station. CRL also reports that it has incorporated £204m for Period 9 URTs in Programme commercial risk, but this does not represent the full value and the detail of allowances included in the QCRA will require review to understand CRL’s risk strategy. We received a copy of the CRL Q3 (Period 9) QCRA model on 5 January 2018 and will express our views in our Period 10 report following the conclusion of our review and analysis. We have requested a copy the CRL approved 2018/2019 Business Plan. We will provide commentary following receipt and review of this document in the appropriate period report.

£213m of the £399m P50 risk exposure is URTs, a decrease of £25m from Period 8 (£238m). Pure risk, excluding URTs, has increased in Period 9 by £95m to £186m, (Pure risk at Period 8 was £91m). The percentage of pure risk as a proportion of cost to go (including URTs) for Period 9 increased from 10% to 21%.

CRL is reporting £116m of potential URT drawdown from a Delivery Risk allowance of £18m. However, in contrast, the potential URT drawdown from the £360m Programme Risk allocation is only £95m. CRL has stated that almost the full value of URTs is included in the QRA, but the valuation and settlement of URTs is critical to the expenditure of risk. We will analyse the allowances for URTs as a function of our review and analysis of the QCRA.

CRL is continuing with its efforts to remain within funding but we note the following:

- The AFCDC (P50) exceeds the reported financial budget by £108m;
- The headroom to IP2 for the AFCDC (P50) is £48m. The AFCDC (P95) exceeds IP2 by £35m;
- Although CRL continues to focus on cost reviews to challenge contractor data and identify cost saving opportunities, the analysis of defined cost and target cost continues to indicate an increasing trend in both. See Appendix B, Section B.1.1;
- The programme is at an advanced stage of the works and continues to experience a background of cost escalation, and increasing risk allowances. Realistic opportunities for major cost savings from reviewing remaining scope and revisiting VERP initiatives are highly unlikely.

Further details are shown in Appendix B, Section B.1.1.

**6.1.2 Cost: Central Operating Section (COS)**

CRL report that its discussions with [REDACTED] on programme and costs are expected to conclude in Period 10 and that allowances are included under commercial risks in the CRL Q3 QCRA.

[REDACTED]

[REDACTED]

**6.1.3 Cost: On Network Works (ONW)**

The CRL ONW AFC, excluding VN's, remains at £2,376m in Period 9. The Period 9 CRL estimated FFOC has reduced by £22m to £2,508m which exceeds the DfT Intervention Price by £208m. The reduction to the Forecast Final Outturn Cost (FFOC) reflects the £22m funded via the Additional Funding Agreement between CRL and NR. This is shown as a cost in the CRL AFCDC and is deducted from the FFOC to avoid double counting. The FFOC is subject to an estimated pain share adjustment of £70.2m, which results in a Forecast to the RAB of £2,437.8m, which exceeds the DfT Invention Price of £2.3bn by £137.8m.

The remaining efficiencies and stretch savings are regarded by CRL as challenging and unlikely targets given the advanced stage of works and potential cost risks associated with access delays and prolongation. Additionally, a number of contracts, particularly [REDACTED] are reporting further cost pressures on their respective AFCs, and NR is reporting access risk may affect its anticipated final cost.

CRL and NR are restructuring the ONW financial forecasting and project oversight reporting to align with the requirements of DfT. The adjusted form of reporting will have a clear and timely understanding of the out-turn cost of the ONW, which will also include the underlying residual commercial risks or savings targets, their likelihood and their implementation. CRL presented the proposed draft reporting structure and template to DfT sponsor representatives and PRep on 12 December 2017. A follow up presentation is arranged to be carried out in Period 10.

Figure 6 - 2 tabulates the reported CRL figures inclusive of pain share.

Description	Period 8 AFC £m	Period 9 AFC £m
CRL AFC plus VN Allowance	2,376	2,376
Pain/gain share	-70	-70
Scope Impacts & VNs	154	132
Potential Grant Payments	0	0
Overall Cost	2,460	2,438
DfT Intervention Price	2,300	2,300
Headroom to DfT Intervention Price	-160	-138

*Figure 6 - 2 ~ Headroom to the DfT Intervention Price*

CRL and NR continue to seek resolution of the few remaining identified outstanding VNs. CRL and NR are still reviewing scope and procurement for three VNs totalling £3m that are included in the original £110m funding authority. CRL is still reviewing scope and pricing for £44.6m for two VNs included in the additional £154m funding authority, the bulk of which is associated with [REDACTED] for Ilford Station.

**6.1.4 Contingency**

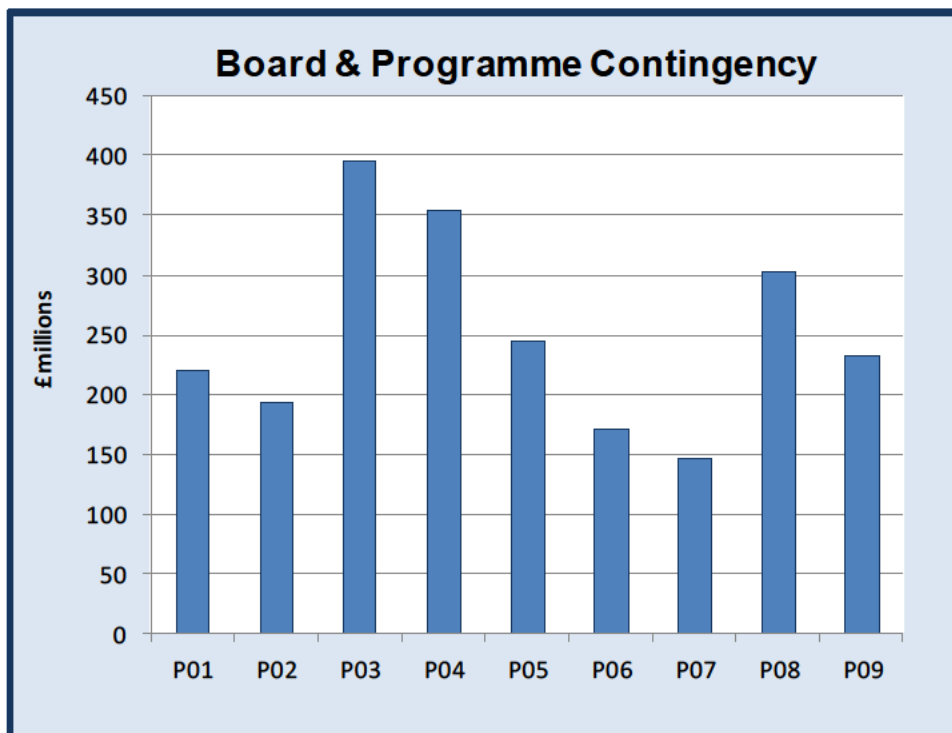
The Period 9 FCCB is £12,356m. The FCCB was aligned in Period 8 with the P80 AFCDC forecast, £12,356m. The Period 9 P80 AFCDC is £12,507m.

There was a £76m decrease in the overall contingency budget in Period 9; this was due to:

- changes to the masterplan shaft sequence, additional design resources and associated programme impacts at ██████████ Station (£38m);
- design delays and associated prolongation at ██████████ Station (£24m);
- design cost increases at ██████████ Station (£8m);
- and other net changes (£6m).

The overall contingency budget of £288m is insufficient to cover the P50 risk exposure of £399m by £112m, a £147m deterioration from Period 8. The centrally controlled Delivery contingency has reduced in Period 9 by £6m to £56m.

The impact of the decrease in the Board and Programme Contingency is shown in Figure 6 - 3.



*Figure 6 - 3 ~ Level of Board and Programme Contingency*

**6.2 Schedule and Progress**

Detailed progress of activities and CRL forecasts leading up to Stage Openings are shown on charts in Appendix D.2. Although CRL’s forecasts indicate all remaining Stages will be opened on time, we remain sceptical, especially regarding Stage 2 Opening. In addition, delays to energisation and Dynamic Testing bring further risks to Stage 3 Opening.

**6.2.1 Central Section**

Figure 6 - 4 shows the CRL forecast and actual cumulative progress of Anchor Milestones set against the MOHS baselines. This indicates that CRL’s contractors have slipped further behind many milestones, and will now continue in a period of no float until Period 1 (April 2018). The current forecasts are now substantially behind MOHS to such an extent that it no longer serves its purpose as a baseline schedule. The [REDACTED] and [REDACTED] dates will be reset once the new MOHS is agreed in February 2018.

At Period 9, CRL is forecasting delays (forecast later than [REDACTED] to 41 Anchor Milestones (previously 33); see Figure D - 2 in Appendix D.1. These affect almost every part of the Programme; they will be re-set as part of the MOHS refresh.

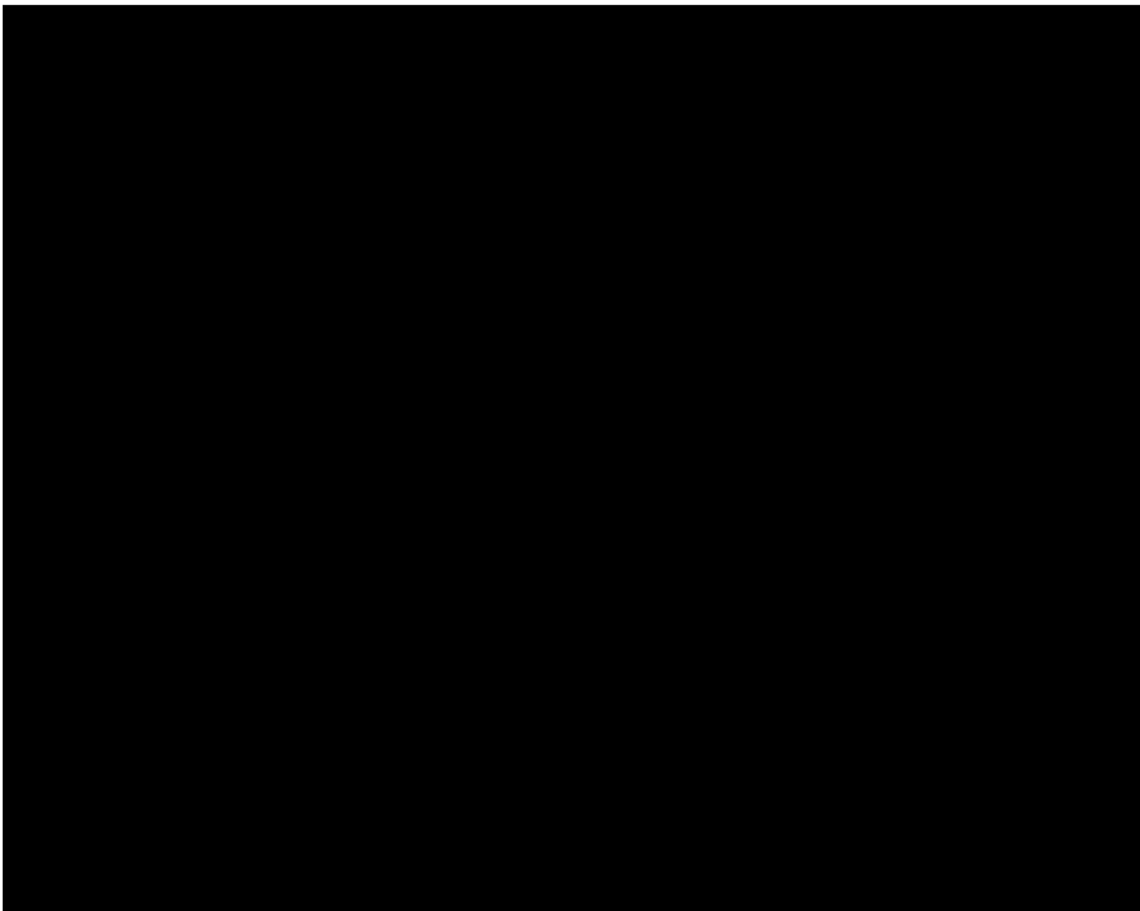


Figure 6 - 4 sets out the Corporate Key Milestones selected by the CRL Board as part of its KPI incentive scheme for the CRL Executive, shown with the MOHS [REDACTED] and the CRL Period 9 forecasts.

The latest date recently declared by CRL for the start of energisation sequence Traction Power (Energisation Z1&2 ATFS) is 19 January 2018 with EDT starting on 29 January 2018. Commentary regarding the delays in Zones 1 & 2 Energisation and EDT is included in Section 3.4. The track connection at Westbourne Park was delivered as part of the NR works at Christmas. We understand that commissioning of the link is not scheduled until late January 2018, but this is ahead of its requirement to support Zones 3 & 4 dynamic testing.



Corporate Key Milestone	Description		Period 8 Actual / Forecast	Period 9 Actual / Forecast
1	Stage 1		22-Jun-17	22-Jun-17
2	All Track Complete (excl WHI EB)		10-Jun-17	10-Jun-17
3	FDO's held (excl PLU)		28-Sep-17	28-Sep-17
4	Commence Traction Power (Z1&2)		15-Nov-17	15-Jan-18
5	Commence Dynamic Testing (Z1&2)		01-Dec-17	29-Jan-18
6	Track connection at Westbourne Park		02-Jan-18	02-Jan-18

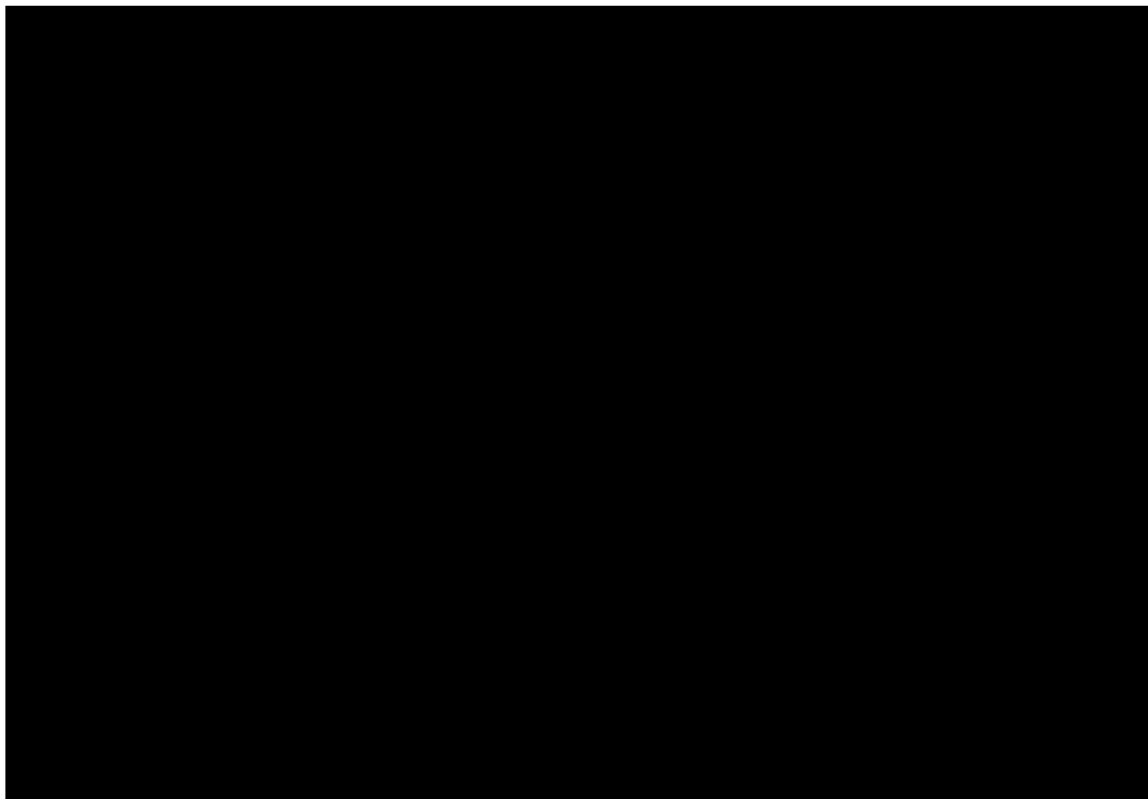
Figure 6 - 5 ~ Corporate Key Milestones

**6.2.2 NR ONW**

Figure 6 - 6 shows the forecast and actual cumulative performance of ONW activities against the MOHS baselines. This information is shown at Period 8 as NR reports lag those of CRL.

CRL and NR report that the ONW is 90% complete (previous 89%) based on forecast cost, rather than actual physical progress.

Feedback from CRL and NR indicates that the majority of works planned for the Christmas period were carried out successfully. In particular the critical Stage M signalling data change works, and the new track at WBP and OOC were completed as planned. Specific areas of concern are discussed in Appendix D and Appendix E.



### 6.3 Approvals and Assurance

#### 6.3.1 Regulatory Approvals

The status of the Regulatory Approvals<sup>11</sup> for each Stage Opening is as follows:

Stage	Status	Comment
2	↔	<p>There are two primary concerns:</p> <ul style="list-style-type: none"> <li>• <u>“APIS for On-Board signalling”</u>. There has been no change since our last report. BT needs to complete its Technical File for submission to the ORR. That is reliant upon the test results being generated at Melton, but the testing programme is delayed, see Section 2.3.</li> <li>• <u>MTR SMS updated for Driver Training and ECS movements</u>. This is now red due to the late delivery (for start of driver training) of all elements of the cab simulator, see Section 2.3.</li> </ul>
3	↔	<p>The ‘red’ rating is caused by the APIS for Central Section assets. Key points to note are:</p> <ul style="list-style-type: none"> <li>• There continues to be progress by CRL in completing the safety deliverables required for its design element, and CRL’s regulatory approvals team believe that this trend, and a proposed re-baselining of the programme to provide a later APIS submission date will make this item amber. We remain concerned that the safety deliverables will be problematic to complete.</li> <li>• There remains a lack of visibility as to what the quantum and schedule is for the safety deliverables required for the Testing and Commissioning stage.</li> </ul>
4	↔	No comment.
5	↔	The amber rating is due to uncertainty concerning NR’s programme to deliver ETCS, and CRL’s role in managing the transition between ETCS and CBTC at WBP.

Figure 6 - 7 ~ Status of Regulatory Approvals

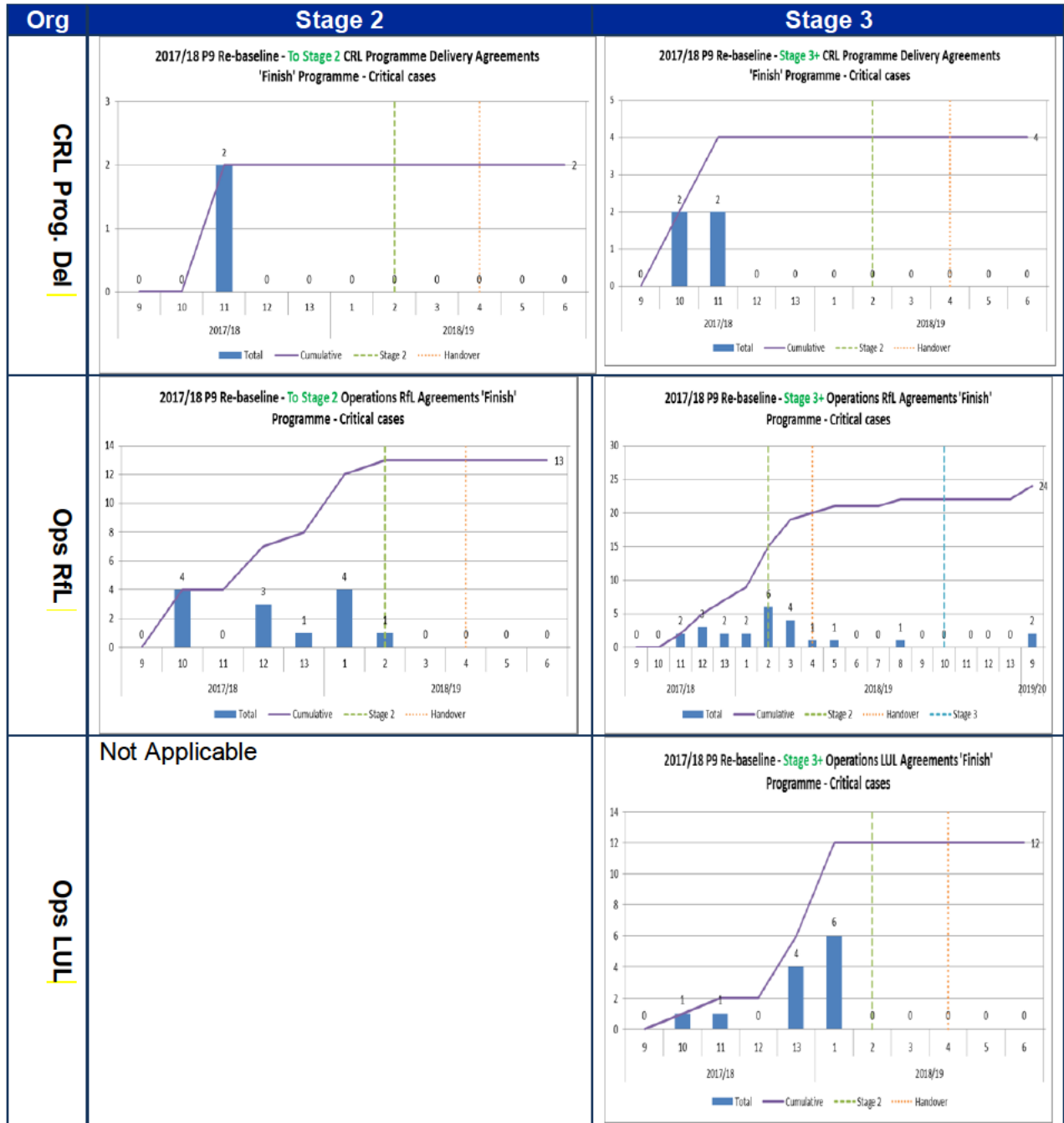
CRL’s rate of addressing long outstanding issues and concerns, reported by Ricardo Rail (RR) in its role as the NoBo/AsBo, is too slow. RR continues to draw CRL’s attention to a number of major concerns that have yet to be fully addressed by CRL. See Appendix F.4 for details.

CRL’s target for the sign-off of FDO certificates is now March 2018. FDO certification has been issued for Mile End shaft, but no other FDO certificates have yet been issued due to outstanding issues or deliverables flagged at the review meetings. The “Red” issue count for stations, shafts and portals has been reduced from a total of 425 (Period 8), down to 377 in Period 9<sup>12</sup>. These issues have to be resolved before the necessary FDO certificates can be issued. See Appendix F.5 for further details.

6.3.2 Agreements

The slippage in completion of the critical agreements, described in our last report, led to a re-baseline exercise. The result of this is shown below in Figure 6 - 8.

We have some concerns, based upon past performance, as to whether the Agreements will be completed on time. Whether mitigations are possible will need to be identified at an early stage. CRL is now intending to discuss the progress of these agreements within the PDB meetings, as well as C&CSC. This is to be welcomed as it raises the awareness of the subject.



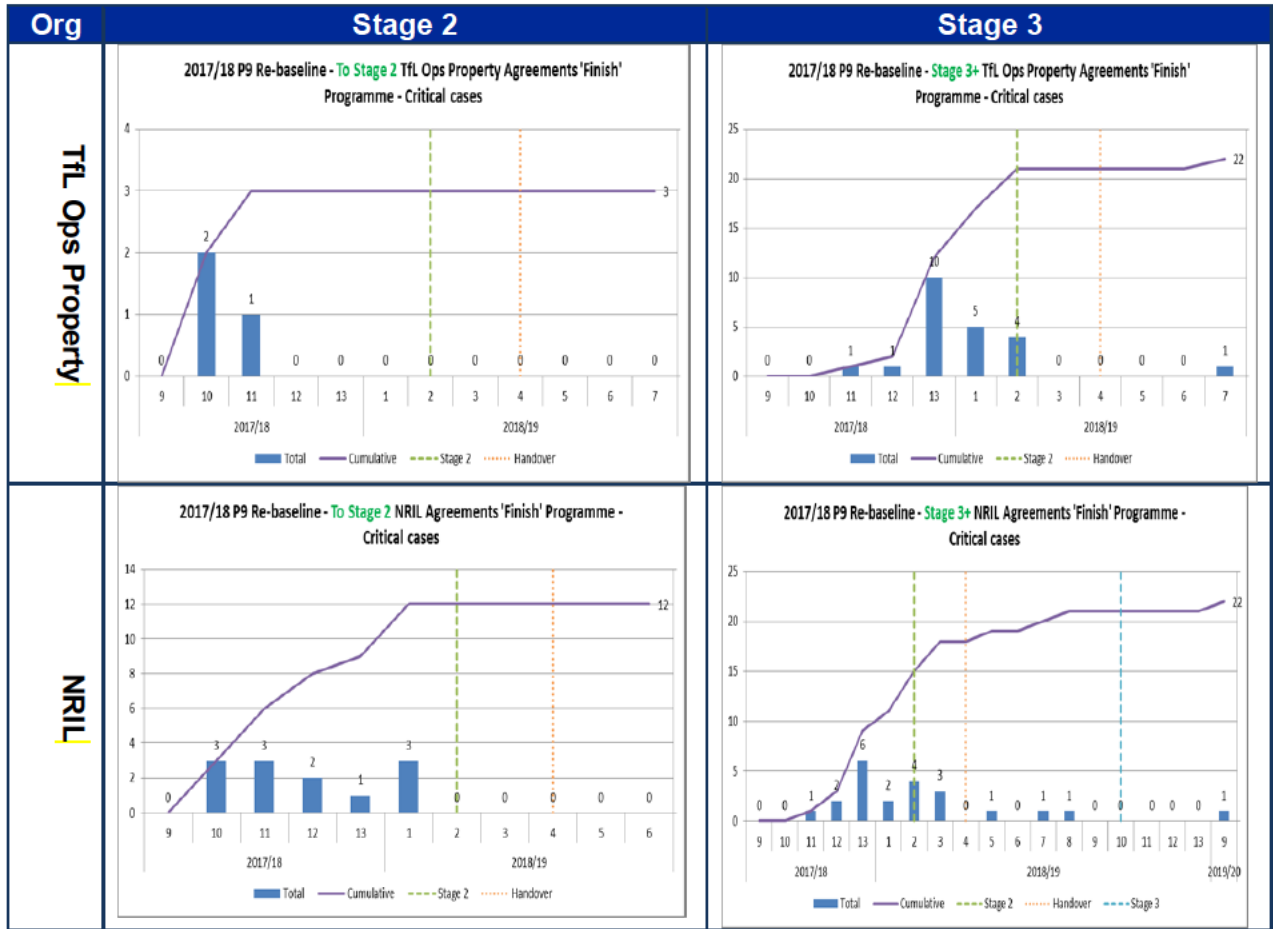


Figure 6 - 8 ~ 'Finish' Curves – Critical Cases

# Appendices

## Appendix A Health & Safety

### A.1 Health & Safety Performance

The rolling RIDDOR LTC AFR reduced from 0.08 to 0.07 (target 0.15), and the LTC AFR remained at 0.17 (target 0.23). Although we had concerns last period regarding a potential trend of worsening results, we are pleased that CRL and its contractors have actually maintained excellent AFR results this period. The next major threat is the industry wide annual cycle of poor results following the Christmas/NYE break which might appear in Period 10 results. Last year CRL and the Principal Contractors did well to deal with this threat so we expect this year to be the same.

Two contractors continue with over 1 million hours without a lost time incident, and another three contractors continue with over ½ million hours. Three contractors have achieved over 700 days elapsed time without an LTC. The HSPI score increased to another record at 2.58 with 100% of contractors achieving over 2.20. CRL is currently reviewing the format of the HSPI to ensure it remains appropriate for the next financial year.

The further delay in the commencement of energisation has created another gap in CRL's preparation for the increased H&S risks. CRL and the Principal Contractors are aware of the need to re-focus on the particular hazards and the change in risk profile when the trace in Zones 1 & 2 is energised during mid-January 2018.

CRL continues its fire safety assurance process to ensure all sites are prepared in case of fire. The Crossrail embedded LFB officer has spoken to all Principal Contractors to make sure that all emergency 'Grab Packs' are kept up to date, and contain maps of falling mains and HV cabling plans.

**Appendix B Cost, Contingency & Risk Exposure**

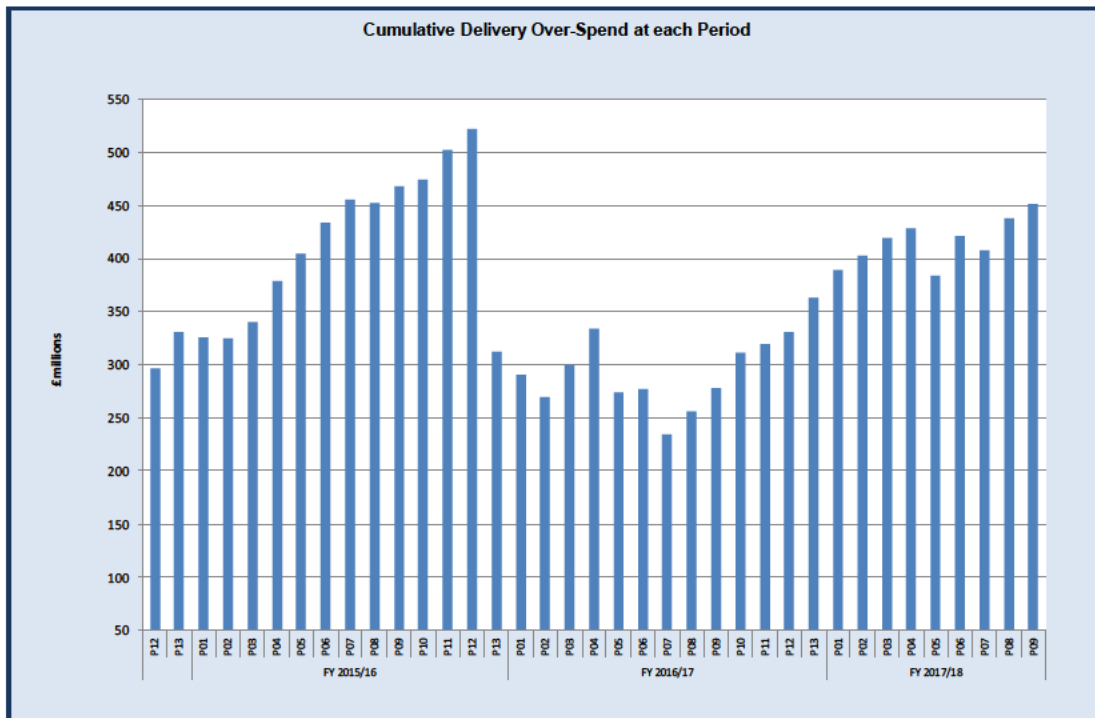
**B.1 Central Section**

**B.1.1 Cost Analysis**

Figure B - 1 indicates the cumulative delivery overspend at each period.

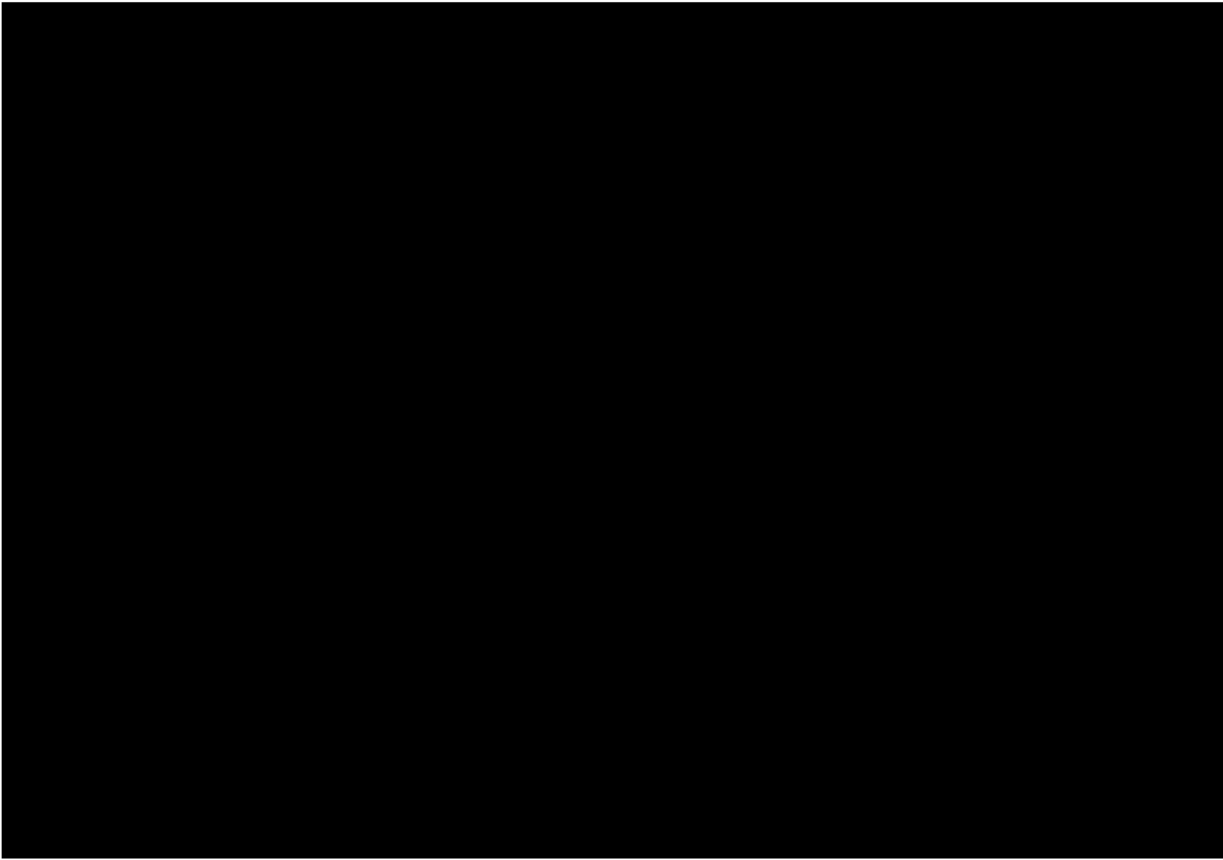
The cumulative delivery overspend has increased in Period 9 by £13m to £451m (Period 8 £438m). CRL reports that spend and performance in Period 9 is dominated by Stations and Systemwide, which together accounted for 89% of Delivery’s Cost of Work Done in Period 9. CRL reports that the AFDCD P50 is £108m above the reported financial budget (P8 £53m below), but remains within the available funding (IP2).

CRL reports that, in Period 9, it spent £40.4m above the 2017/18 Business Plan. This is mainly due to £12.8m for lower than planned productivity and prolongation at Systemwide Main Works, £10.4m spent for prolongation and scope changes at Portals and Shafts, £8.9m for prolongation and delays at [REDACTED], £8.3m for delays and prolongation at [REDACTED] Station and other net overspends of £10.8m. This expenditure was offset by £10.8m of apparent unspent Programme risk due to cost being reported in the Sectors.



**Figure B - 1 ~ Cumulative Delivery Overspend at each Period**

Figure B - 2 illustrates the comparisons of CRL and Contractors Forecast Defined Costs and Target Costs.



[Redacted text block]

[Redacted text block]

[Redacted text block]



**B.1.2 Contingency & Risk**

Figure B - 3 compares the Risk Exposure at P50 and P95 with the remaining contingency. This is discussed in Section 6.1.4.

CRL has carried out its QCRA for Q3 in Period 9. We will carry out a review of CRL’s risk provisions across all Stages upon receipt of the details.

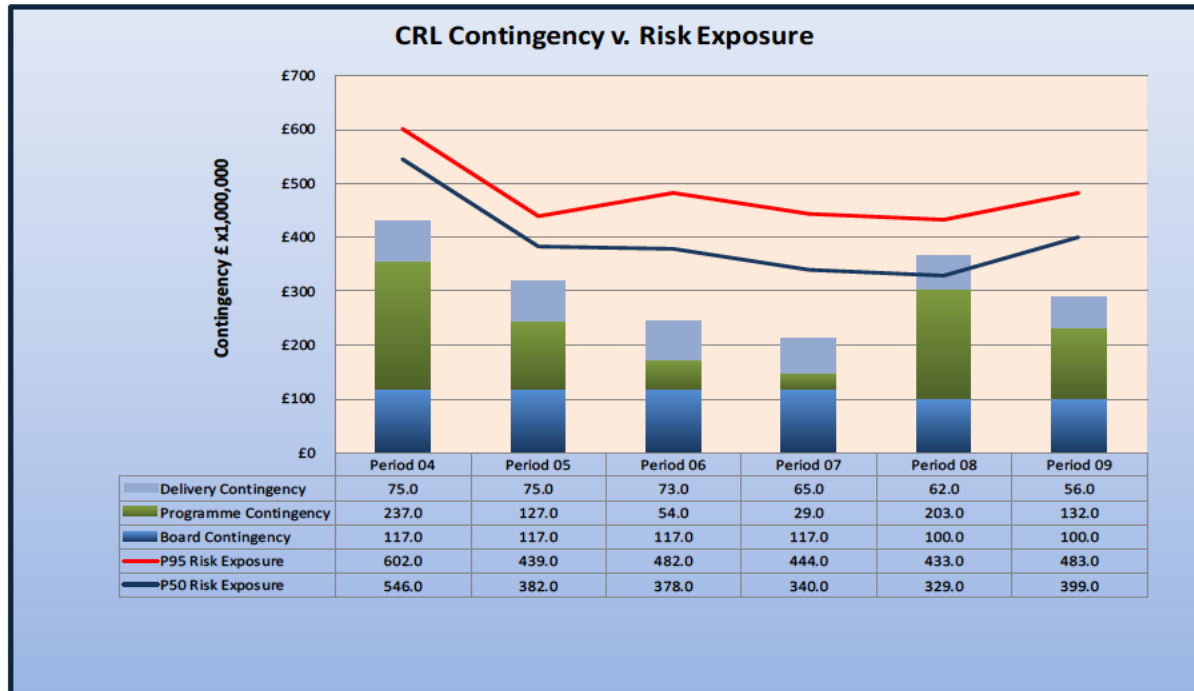


Figure B - 3 ~ Risk Exposure versus Contingency

**B.2 Surface Section**

**B.2.1 Costs: On Network Works (ONW)**

NR has reported an overall increase of £2.8m in recoveries, opportunities and efficiencies. The allowances for this Period are shown in Figure B - 4.

This increase is the result of the NR increasing its stretch opportunities target and securing recoveries from VNs and other NR projects.

Description	Period 8 AFC £m	Period 9 AFC £m	Period Variance £m
Recoveries for VNs or other NR Projects	189.8	183.5	-6.3
Recoveries (Realised)	23.0	29.7	6.7
Efficiencies	21.3	21.3	0.0
Opportunities	0.0	0.0	0.0
P80 & Programme Reserve ('Stretch Opportunities')	8.0	10.4	2.4
<b>Total Allowances</b>	<b>242.1</b>	<b>244.9</b>	<b>2.8</b>

Figure B - 4 ~ NR’s Opportunities, Efficiencies and Recoveries

**Appendix C Contract Administration**

**C.1 General**

Figure C - 1, Figure C - 2, and Figure C - 3 illustrate the status of Notified Compensation Events (NCEs).

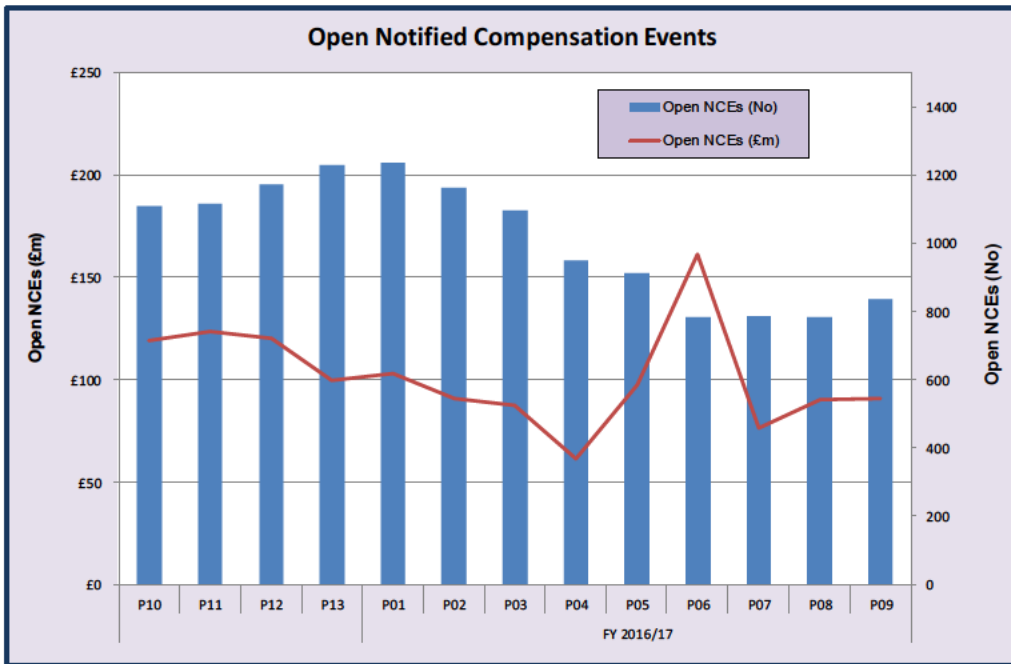


Figure C - 1 ~ Open Notified Compensation Events

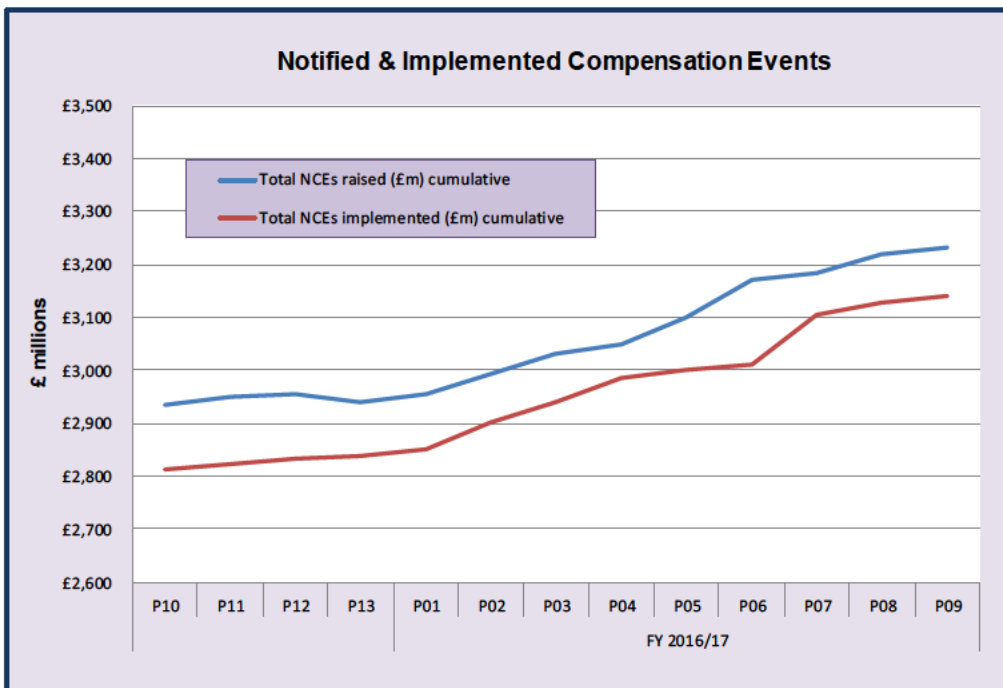


Figure C - 2 ~ Notified Compensation Events

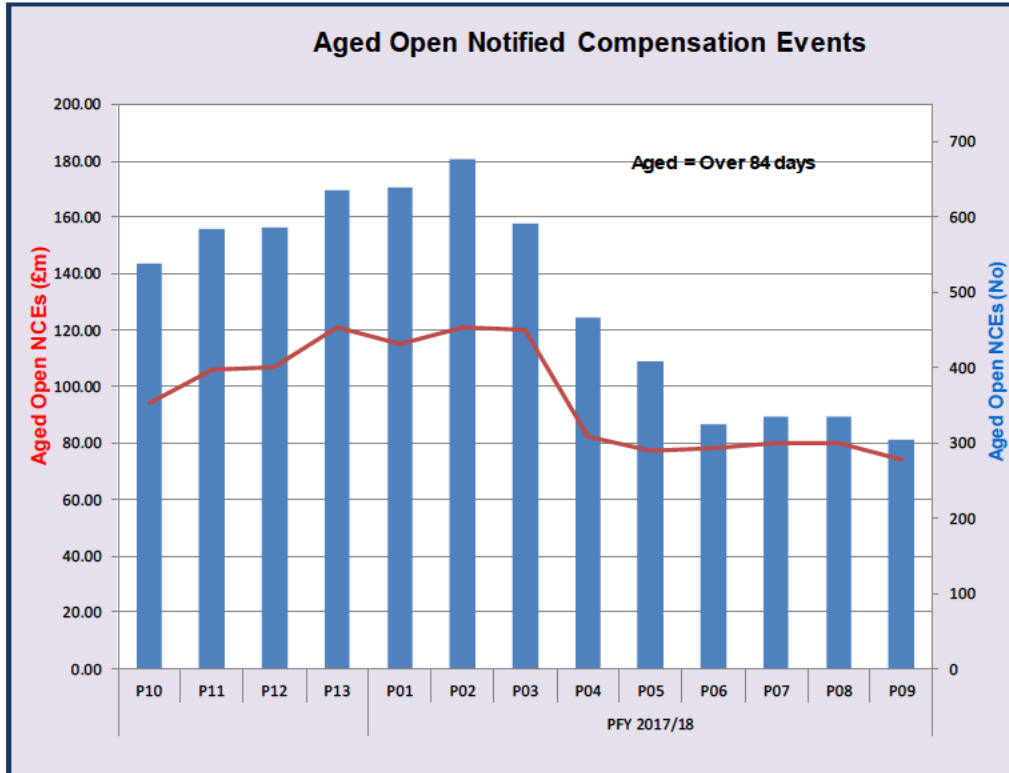


Figure C - 3 ~ Aged Open Notified Compensation Events

In Period 9, the total number of open NCEs increased by 53 to 837. However, the value of open NCEs increased marginally by £1m to £91m.

Contractors notified a further 339 Compensation Events in Period 9; 286 were processed in Period 9 with 231 implemented and 55 either rejected or withdrawn. Aged open NCEs decreased in Period 9 by 30 to 304, the percentage of aged open NCEs reducing to 36% in Period 9.

## Appendix D Schedule & Performance

### D.1 Period Progress measured against MOHS

Figure D - 1 shows the actual and CRL forecast cumulative progress for Anchor Milestones in the MOHS compared with [REDACTED] and [REDACTED]. The chart indicates that the forecast line has dropped even further behind the [REDACTED] following the events at PML during late 2017.

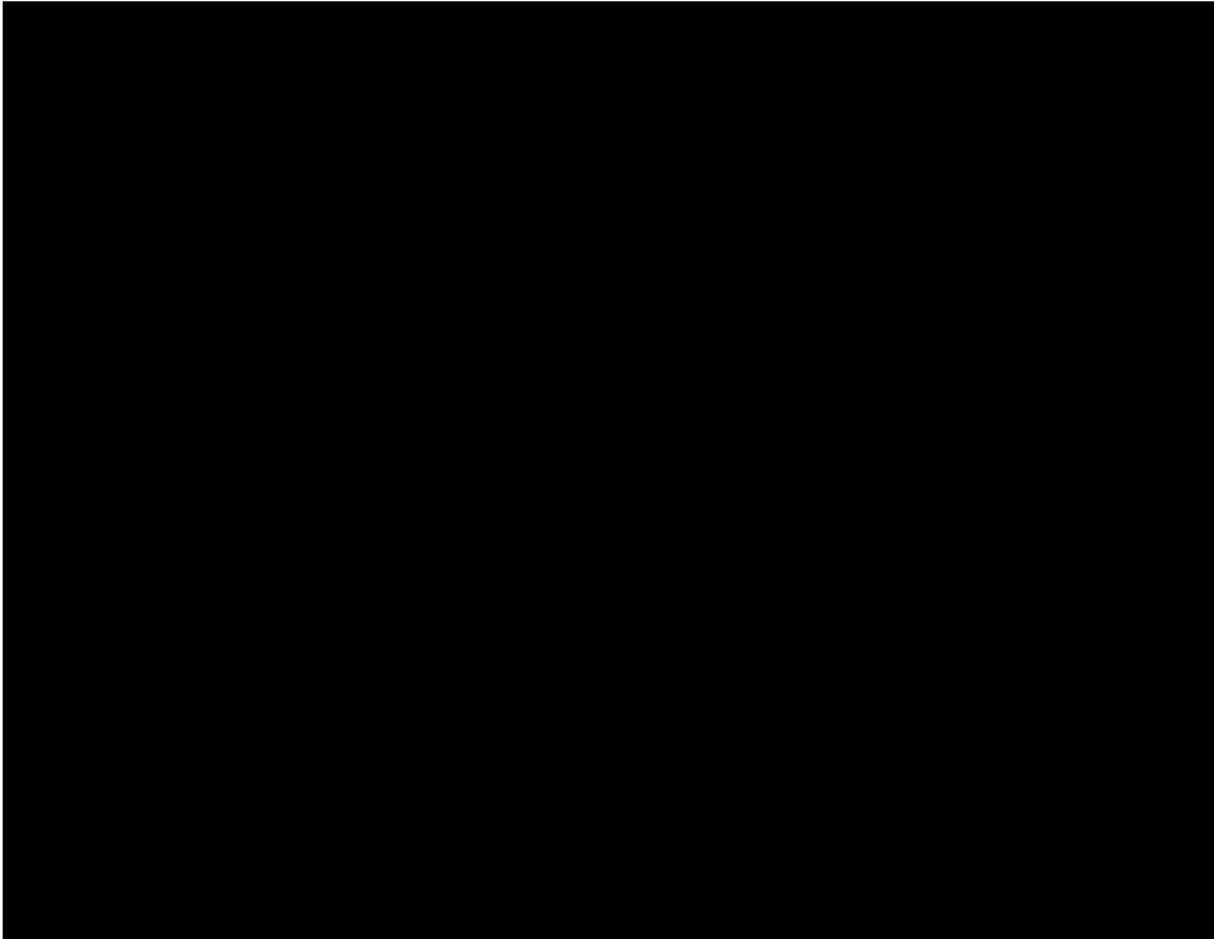
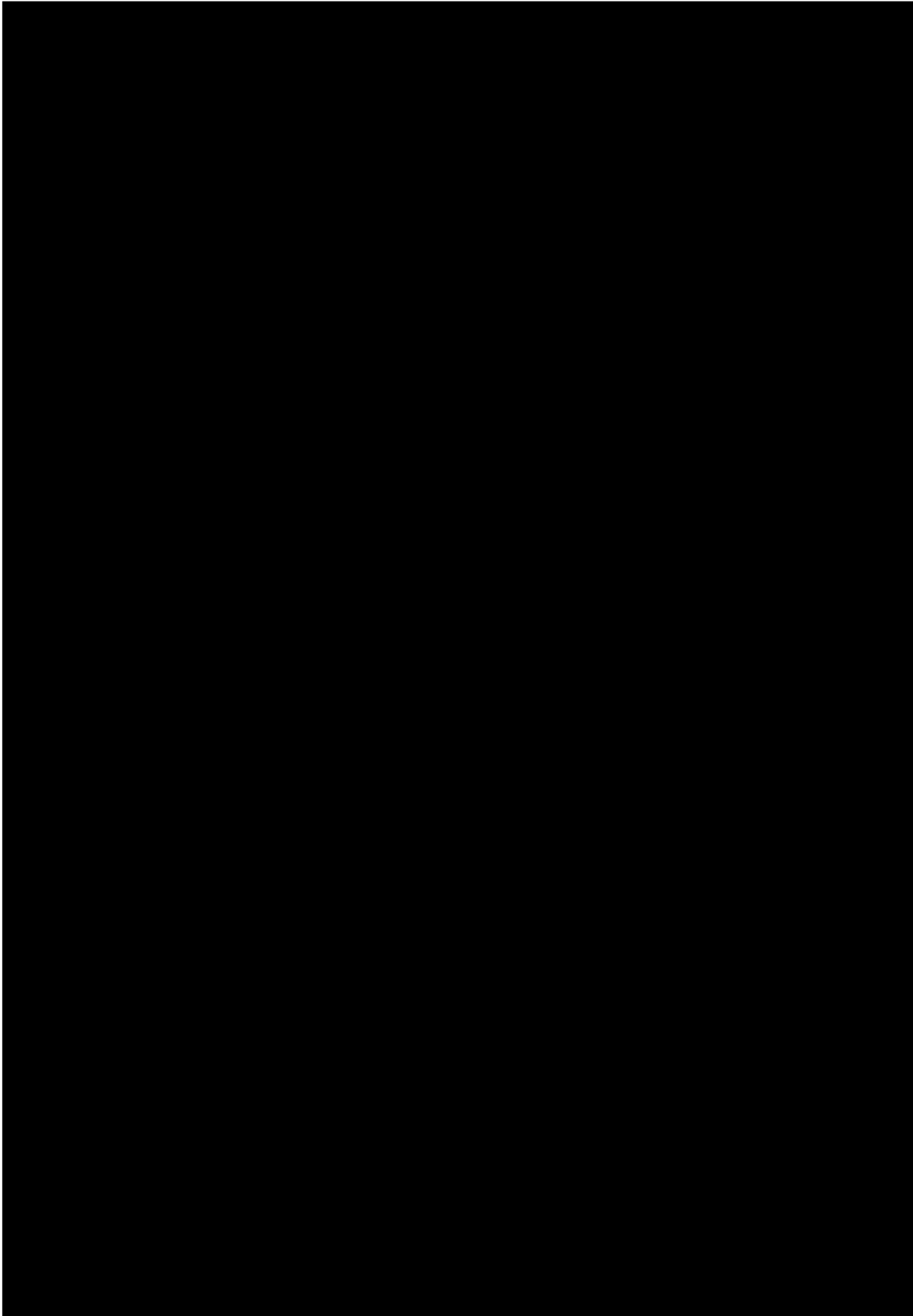
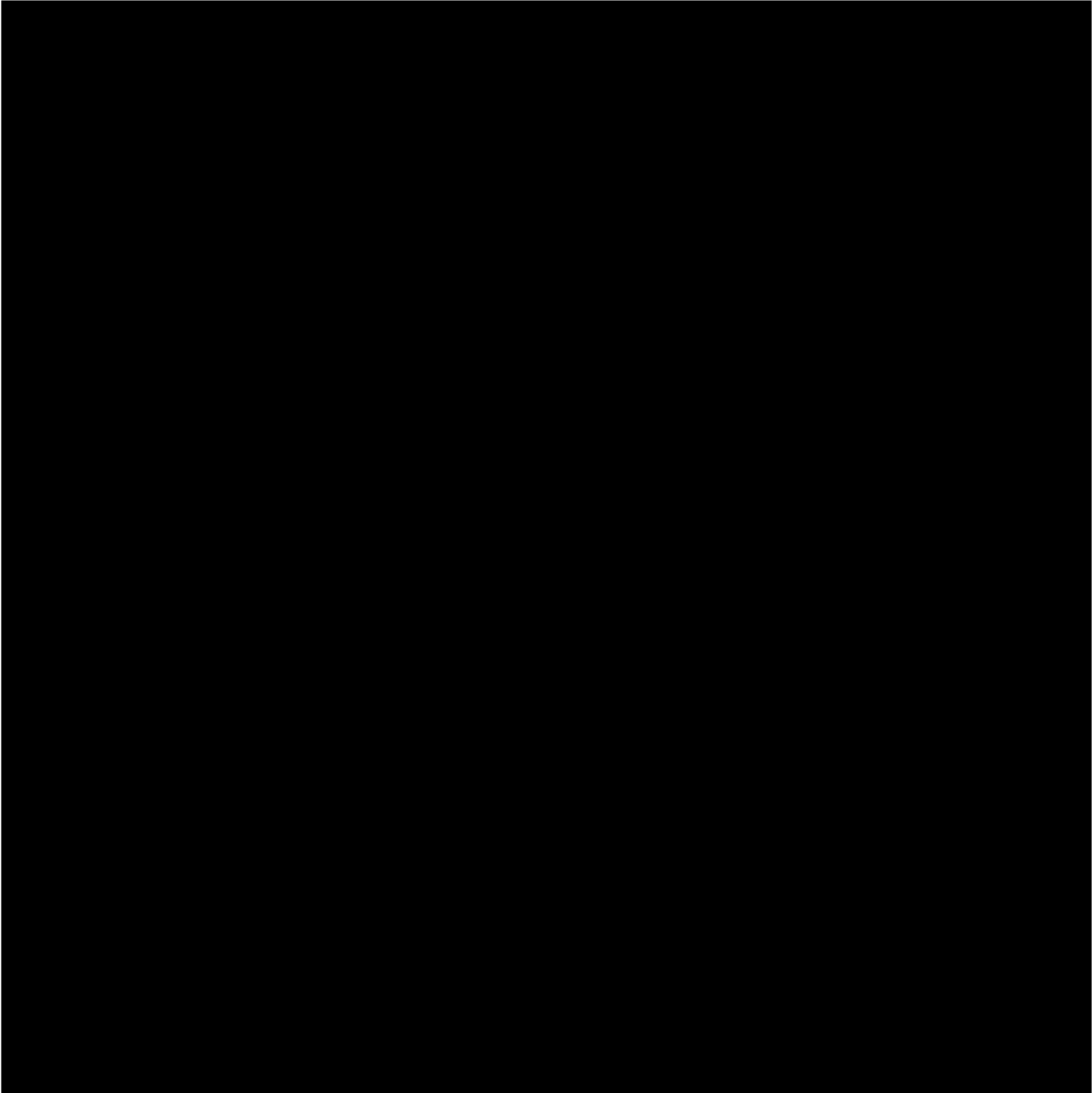


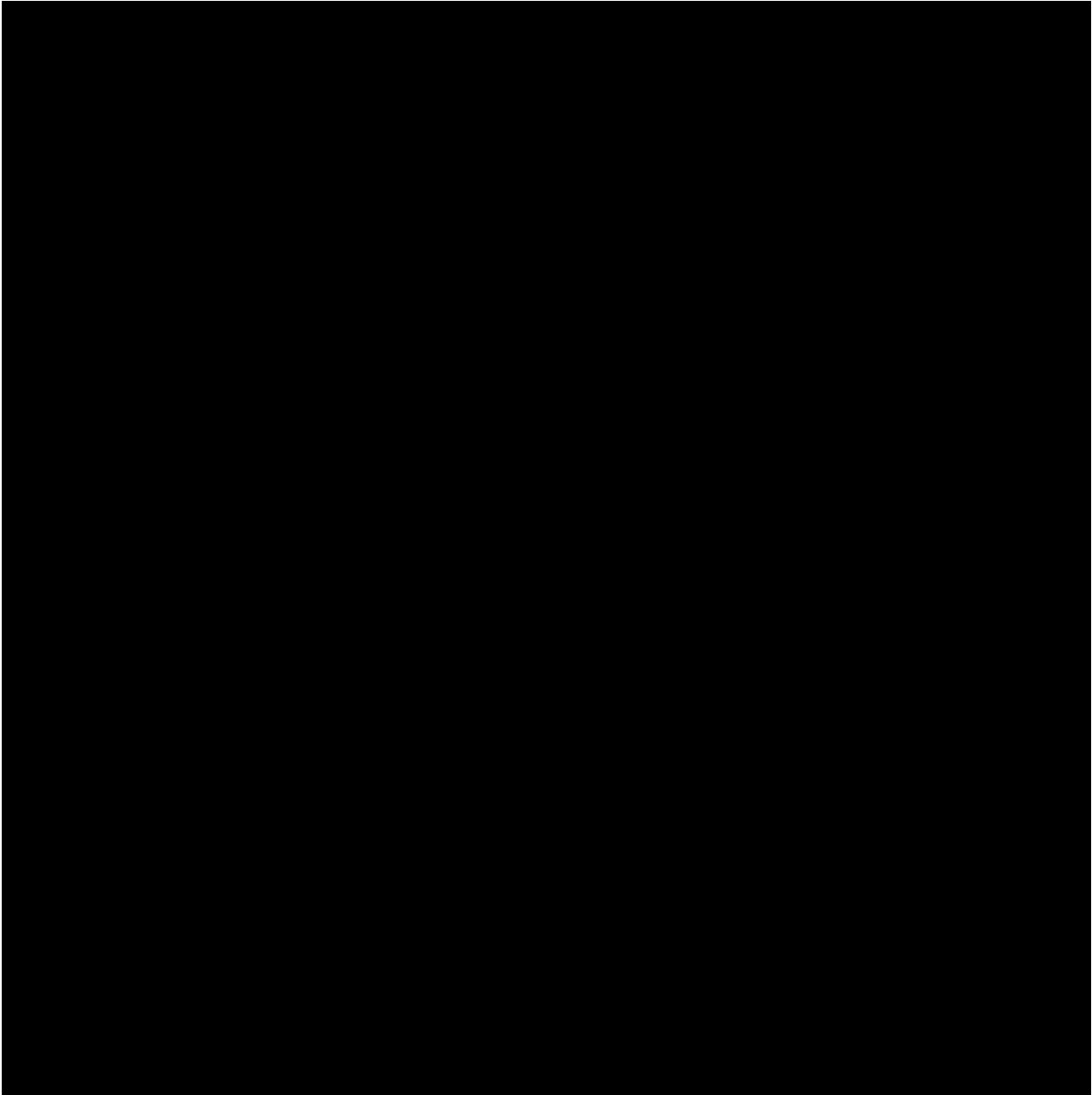
Figure D - 2 indicates that CRL forecast 41 Anchor Milestones to be later than the [REDACTED] which is 8 more than the previous period. This is further evidence of the schedule pressures noted elsewhere in this report. Commentary on these is included in Section 6.2.1.



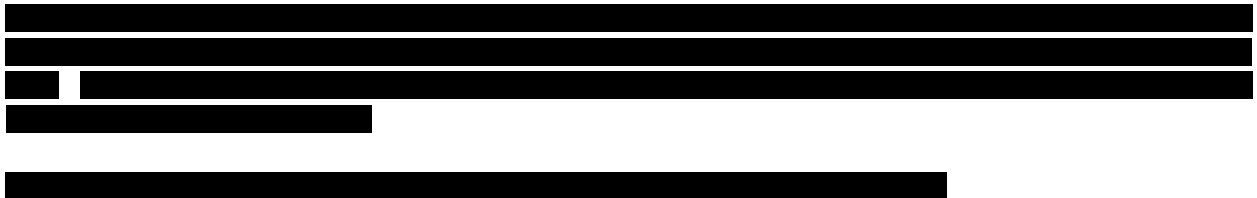
*Figure D - 2 ~ CRL [redacted] Anchor Milestones*

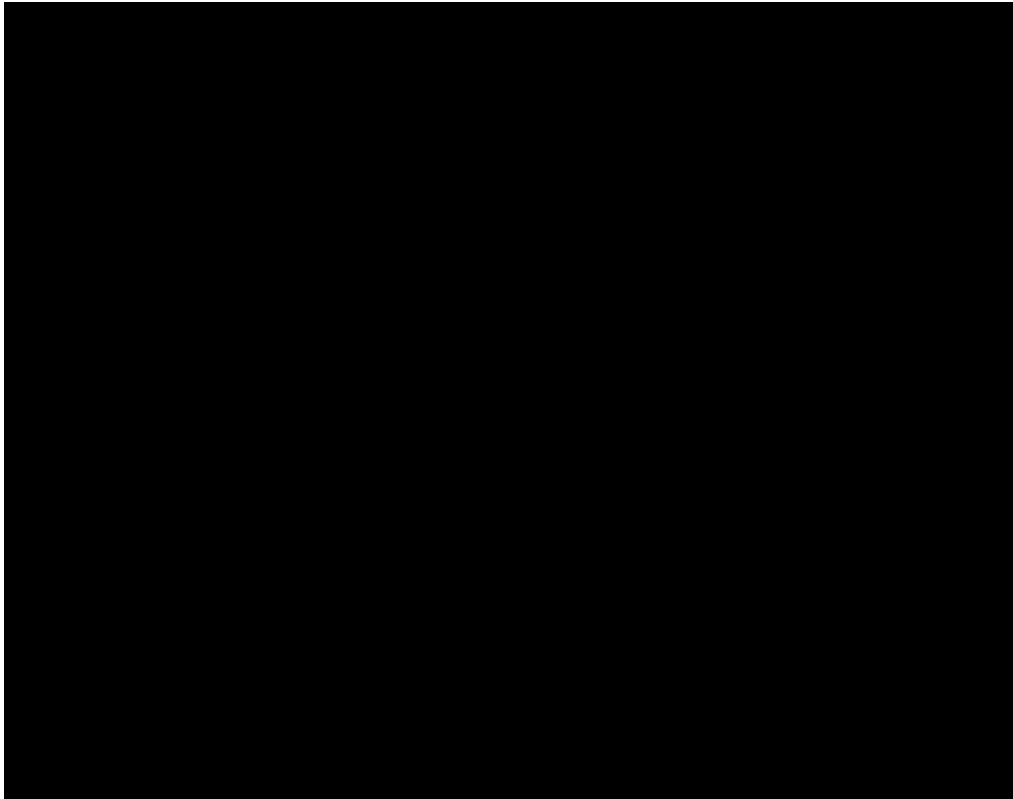
**D.2 Progress towards Stage Completion**





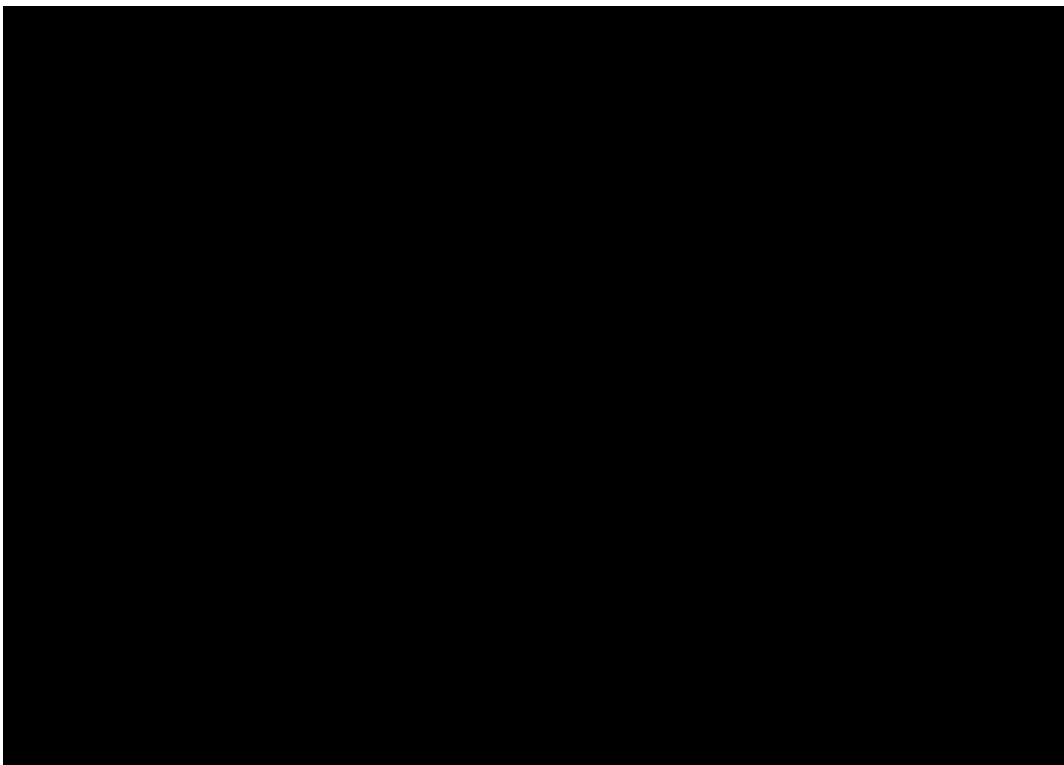
**D.3 Surface Section (incl. ONW)**





**D.4 Systemwide Schedule Progress**

[Redacted]	[Redacted]
[Redacted]	[Redacted]
[Redacted]	[Redacted]
[Redacted]	[Redacted]





[REDACTED]

[REDACTED]

The [REDACTED] contract schedule and Time-Chainage undergoes continuous analysis by CRL and ATC, to accommodate actual progress on site. The long-held MOHS dates for Zones 1 & 2 Energisation and EDT slipped from late 2017 because of the catastrophic equipment failure at PML ATFS. The latest recently declared planned date for the energisation of PML ATFS is 19 January 2018<sup>14</sup> with energisation of the OLE to follow. Despite this further slippage EDT is still planned to start on 29 January 2018.

█ remains critical to Zone 3 & 4 completion, and particularly to meet the possessions for signalling testing at the NR GWML interface in early May 2018. CRL has substantially completed a schedule for Zones 3 & 4 delivery, in order to demonstrate achievability and to understand the impacts of the delays upon key Handover and Stage 3 Opening dates. We provide further details in Section 3.5.

The completion of the Tunnel Ventilation System is recognised by CRL as a critical workstream, with a key dependency upon Stations completion and access for the removal of temporary and installation of permanent works; there is a further dependency upon the availability of HV Power Supplies to support testing and commissioning. There is still no plan which demonstrates how this can be achieved before Handover on 5 July 2018, and this is emerging as a significant risk.

Poor progress in Zones 1 & 2 demonstrated the need to prioritise █ in Zones 3 & 4. This requirement has become even more critical with the significant reduction in available dynamic testing time and the correct operation of trackside / trainborne signalling interface remains one of the biggest risks to the Programme. Against many other competing systems, CRL is making as much schedule provision as possible for █ works.

The █ Period 8 schedule was not MOHS compliant; the Period 9 schedule is under review by CRL. PSD module installation is substantially complete at Canary Wharf and Bond Street westbound platforms, works are in progress at Farringdon and Liverpool Street.

█ These must be completed in time to allow re-planned energisation of the ATFS on 19 January 2018. See also Section 3.4.

█ completion remains dependent upon delivery of works by other contractors. The availability of several temporary power sources continues to offer mitigation, but final cut-over to permanent supplies are progressively being integrated into CRL's revised plans for Rail Systems delivery, which are still under development. Management of the transition from temporary to permanent supplies must be carefully planned to support the completion of █ works, with a significant dependency upon Stations delivery.

█ delivery fundamentally influences the schedule for Zones 3 & 4 completion, with Stations systems integration forming a much more substantial scope element than on Zones 1 & 2. Late cable handover in Zones 3 & 4 by █ remains a significant risk to █ delivery and wider Central Section completion. Delays to Railway and Stations Systems installations at Stations will have a downstream impact upon the completion of █ Phase 3 Static Integration tests, and pose a significant threat to Handover on 5 July 2018.

Zone 1 & 2 EDT Key Dates	MOHS [REDACTED]	P8 Actual / Forecast	Expected at P8	P9 Actual / Forecast
Limmo BSP commissioned	[REDACTED]	09-Jul-17	Achieved	09-Jul-17
Fibre Available	[REDACTED]	04-Jul-17	Achieved	04-Jul-17
Lineside signalling equipment	[REDACTED]	06-Nov-17	Dec-17	25-Jan-18
Linewide SCADA Available	[REDACTED]	28-Aug-17	Achieved	28-Aug-17
PML BSP commissioned	[REDACTED]	06-Nov-17	Achieved	04-Dec-17
Stations signalling equipment	[REDACTED]	24-Oct-17	Achieved	24-Oct-17
PML ATFS commissioned	[REDACTED]	11-Jan-18	Jan-18	10-Jan-18
SG Traction Power SATS	[REDACTED]	18-Sep-17	Achieved	18-Sep-17
Plumstead Traction Power ATS	[REDACTED]	30-Oct-17	Achieved	30-Oct-17
HV Traction Power to OLE	[REDACTED]	15-Nov-17	Jan-18	15-Jan-18
1st train accepted and available	[REDACTED]	29-Oct-17	Achieved	29-Oct-17
Commence Dynamic Testing	[REDACTED]	01-Dec-17	Feb-18	29-Jan-18

Figure D - 8 ~ Zone 1 & 2 EDT Key Dates

Figure D - 8 lists the key dates leading up to Dynamic Testing in Zones 1 & 2 (South East and North East legs) as baselined in the MOHS. The Period 9 Actual / Forecast entries for incomplete activities take account of the remedial works necessary at PML ATFS, and the planned energisation dates thereafter.

[REDACTED] progress to recover trackside signalling installation delays in late 2017 caused by safety stand-downs, incomplete E&B works at Abbey Wood and poor site access, was not sufficient to allow completion in December 2017. Outstanding works have been re-scheduled to be completed just ahead of the latest EDT start date of 29 January 2018.

All Zones 1 - 4 DT Key Dates	MOHS [REDACTED]	P8 Forecast	Expected at P8	P9 Actual / Forecast
Fibre Available	[REDACTED]	28-Feb-18	Mar-18	19-Mar-18
Traction Power to WBP ATS	[REDACTED]	18-Jan-18	Apr-18	18-Jan-18
Linewide SCADA Available	[REDACTED]	20-Apr-18	Apr-18	16-May-18
Stations signalling equipment	[REDACTED]	05-Mar-18	Mar-18	17-Apr-18
Lineside signalling equipment	[REDACTED]	05-Feb-18	Feb-18	16-Apr-18
ONW Track connection at WBP	[REDACTED]	02-Jan-18	Jan-18	02-Jan-18
WBP ATS commissioned	[REDACTED]	20-Apr-18	Apr-18	16-May-18
HV Non Traction Power	[REDACTED]	05-May-18	May-18	31-May-18
HV Traction Power to OLE	[REDACTED]	26-Feb-18	Apr-18	07-Apr-18
Commence Dynamic Testing	[REDACTED]	26-Feb-18	Apr-18	23-Apr-18

Figure D - 9 ~ All Zones 1 – 4 Dynamic Testing Key Dates

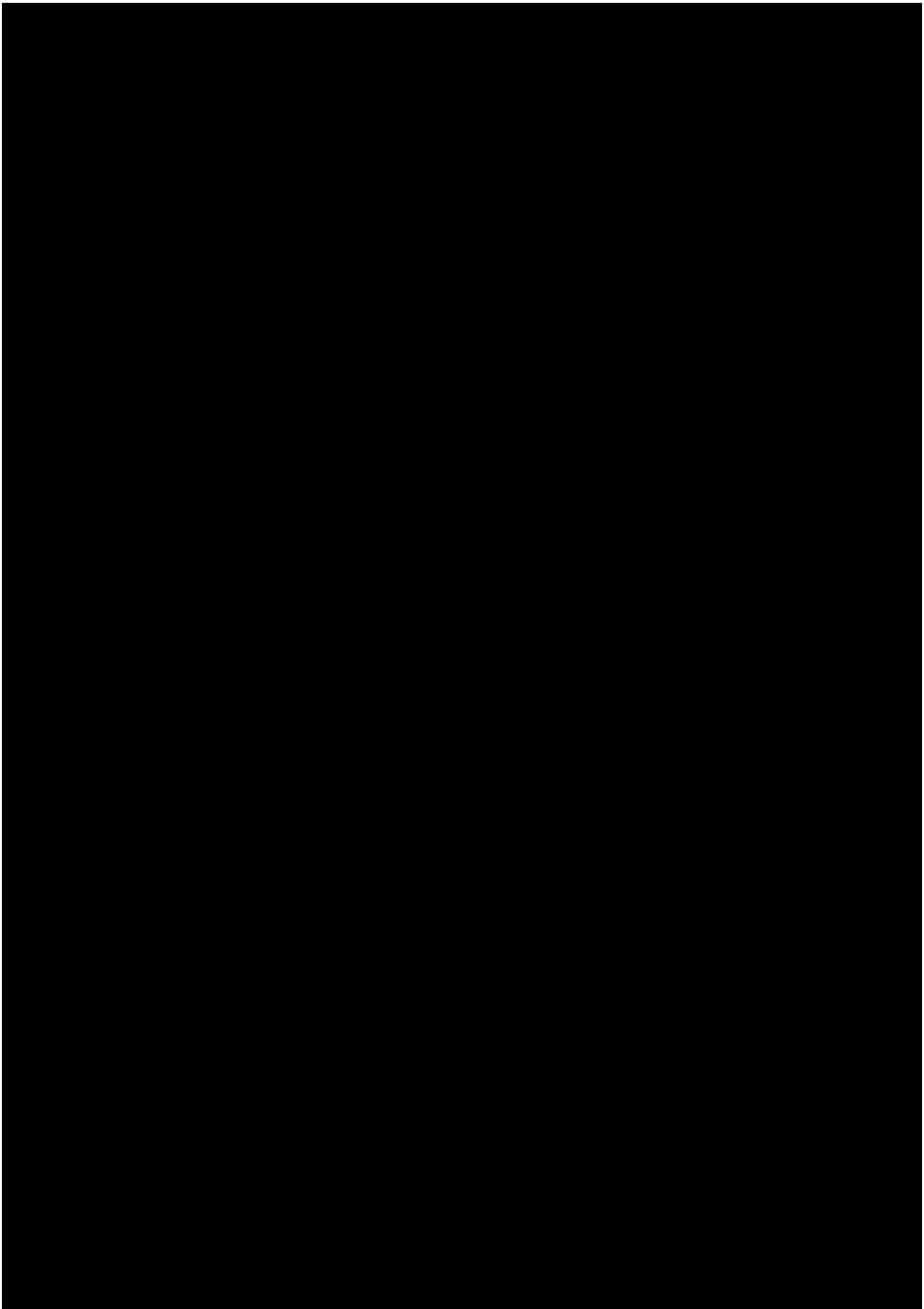
Figure D - 9 lists the key dates leading up to Dynamic Testing in Zones 1 to 4 as baselined in the MOHS. In general, the later dates than previously forecast arise from the need to complete installation of energisation-critical infrastructure to allow a minimum amount of dynamic testing ahead of NR interface testing. We are concerned with the amount of schedule compression indicated by these milestones, while the Handover date remains unchanged. Further information is provided in Section 3.5.

**D.5 Depots**

Figure D - 10 shows the progress of ██████████ Depot and ██████████ Depot as extracted from the MOHS.

Resolution of ██████████ is nearing completion and commercial negotiations continue with ██████ regarding the remainder of the ██████ scope.

Information regarding OOC Depot is provided in Section 2.4.



## Appendix E Network Rail Works

### E.1 NR Programme Delivery Board (PDB) Report

The NR Period 9 PDB Report and Appendices were received on 20 December 2017 and distributed to JST.

### E.2 Key points from the PDB Report

During Period 9, NR continued to focus on the next major milestone; Key Output 4 (Infrastructure Capability in accordance with the ONFR from Heathrow Spur to Paddington Station including depot access lines at Old Oak Common) and the upcoming Christmas works across the Programme.

On Crossrail West, NR completed a significant amount works at the six stations on the western spur to support Key Output 4 (at Acton, Ealing Broadway, West Ealing, Hanwell, Southall and Hayes and Harlington).

On Crossrail East, the Gidea Park Sidings 10 week possession commenced on 27 November 2017, installation of 2241 points and signalling Stage A were successfully completed as was stepping and gauging at Stratford station. Also on Crossrail East, the town planning submission for the Shenfield Traction Power Supply facility was submitted to Brentwood Borough Council for its determination in January 2018. At Abbey Wood the temporary ticket office and interim bridge have been removed and, following opening of the new station on 22 October 2017, the remaining works are progressing well for completion and handover.

### E.3 Safety & Environment

NR continues to see a reduction in the number of injuries relative to the hours worked. Consequently, NR's rolling 13 period all injury rate has fallen from 1.03 to 0.93 for every 100,000hrs worked in Period 9.

NR had two minor injuries and one RIDDOR incident in the period as a direct result of worksite activities.

One major environment incident was recorded for Period 9. This was a breach regarding contaminated land under the haul road at Officer's Meadow on Crossrail East. Four minor environment incidents were recorded (three on Crossrail West and one on Crossrail East) – all were minor spills of less than 5 litres. There were 11 environmental complaints in Period 9 relating to noise, vibration and light.

### E.4 NR Key Dates

The NR reported Key Dates are:

**West: Key Date 12** – 30 September 2017 to enable access to OOC Depot, for Stage 2

The full Stage M data commissioning was completed during the Christmas 2017 blockade.

**West: Key Output 4** – 30 November 2017 infrastructure capability for Stage 2:

NR reports completing a significant amount of works at the six stations on the western spur to support Key Output 4 (at Acton, Ealing Broadway, West Ealing, Hanwell, Southall and Hayes and Harlington). The remaining works will be monitored and reported on by NR as “KO4 residual works” and are scheduled to be fulfilled between December 2017 and March 2018.

NR is reporting DOO CCTV status at Period 9 for west inner stations:

- Leaky Feeder brackets – 98% (on target);
- Leaky feeder cable – 86% (recovering lost productivity);
- Camera installation – 88% (on target);
- Test & commission – 21% (behind plan – losing working time due to rail access issues – plan to recover over Christmas).

NR’s forecast shows testing complete by 5 January, and assurance documentation submitted to CRL by 20 January.

**Anglia: Key Date 29b** – 5 February 2018 track commissioning for connection at PML to support Stage 3 trial running:

NR are on target for the full signalling commissioning of the junction at Pudding Mill Lane on week ending 3/4 February 2018.

**West: Key Date 33** – 31 December 2017 Kensal Green traction power supply energisation for Central Section, Stage 3:

Key Date moved to facilitate an integrated approach to installation and commissioning. No current risk to CRL Zones 3 & 4 energisation.

**West: Key Output 5b** – 10 September 2018 for Stage 5 (December 2019):

The NR schedule for the six west enhanced stations shows a phased completion from September 2019 to December 2019. NR continues to maintain progress to the milestones identified in its indicative timetable.

## E.5 Christmas 2017 Works

During the 10 day Christmas 2017 blockade, CRL reported that NR completed 100% of critical work and 97% overall. Of the work not completed, all was classified as ‘opportunity works’ and included some traction power bonding at WBP, piling at Acton Station (piling rig failure), Ealing Broadway stair removal (structural issues with location of crane on road overbridge), and some OLE snagging at Maidenhead (weather curtailed early).

NR managed to complete the final possession handbacks, including vast volumes of paperwork, early for both Anglia and West. There were no overruns nor any reliability issues.

Over the whole 10 day blockade there was 1 possession overrun. This was by a non-Crossrail ONW project resulting in a 45 minute overrun at Southall by the NR track alliance renewals team on the 27 December 2017.

During the total of 230,000 job-hours worked over the blockade, there was one RIDDOR incident where an Alstom operative slipped on ballast at WBP and fractured his wrist and three lost-time incidents involving two slips and one side injury from access gate catching in the wind.

## Appendix F Engineering

### F.1 Tunnels, Portals, and Shafts

The tunnelling contractor’s (C510) forecast contract completion of works has been held at 17 February 2018, without further slippage. The CRL site team is being demobilised in line with the assumption that the final settlement and project close-out will be achieved by the end of Period 3 (2018/2019). There remains a risk that the project’s close-out may not be completed in line with CRL policies and procedures, if key resources are not retained.

CRL continues to consult with London Metropolitan University (LMU) regarding the internal ceiling repairs in Electra House. Quotes for repairs to the London Wall building have been received and are being reviewed by CRL.

Progress on the Intermediate shafts remains on plan at 89%, having been re-baselined against the Period 8 (2017/18) programme.

### F.2 Stations in the Central Section

In Period 8 all of the stations, with the exception of [REDACTED] and [REDACTED] stations, reported that their percentage progress was generally in line with plan. We note, in Period 9, that the progress achieved since our last report, with the exception of [REDACTED] and [REDACTED] stations, has been less than planned. [REDACTED] station has achieved some measure of recovery and [REDACTED] station has held its percentage completion without further slippage.

The gap between planned and actual percentage completion has already started to widen; particularly at [REDACTED] and [REDACTED] stations. Refer to Figure F - 1. This may be due to the binary nature of reporting progress towards completion against milestones and the impact that just missing milestones will have on the assessed level of completion. The missed milestones can be recovered in the subsequent period, increasing the actual percentage completion reported. However, we are concerned that this deterioration, as reported, has occurred so soon after what was a schedule re-baselining in anticipation of the MOHS 2018 refresh.

[REDACTED]

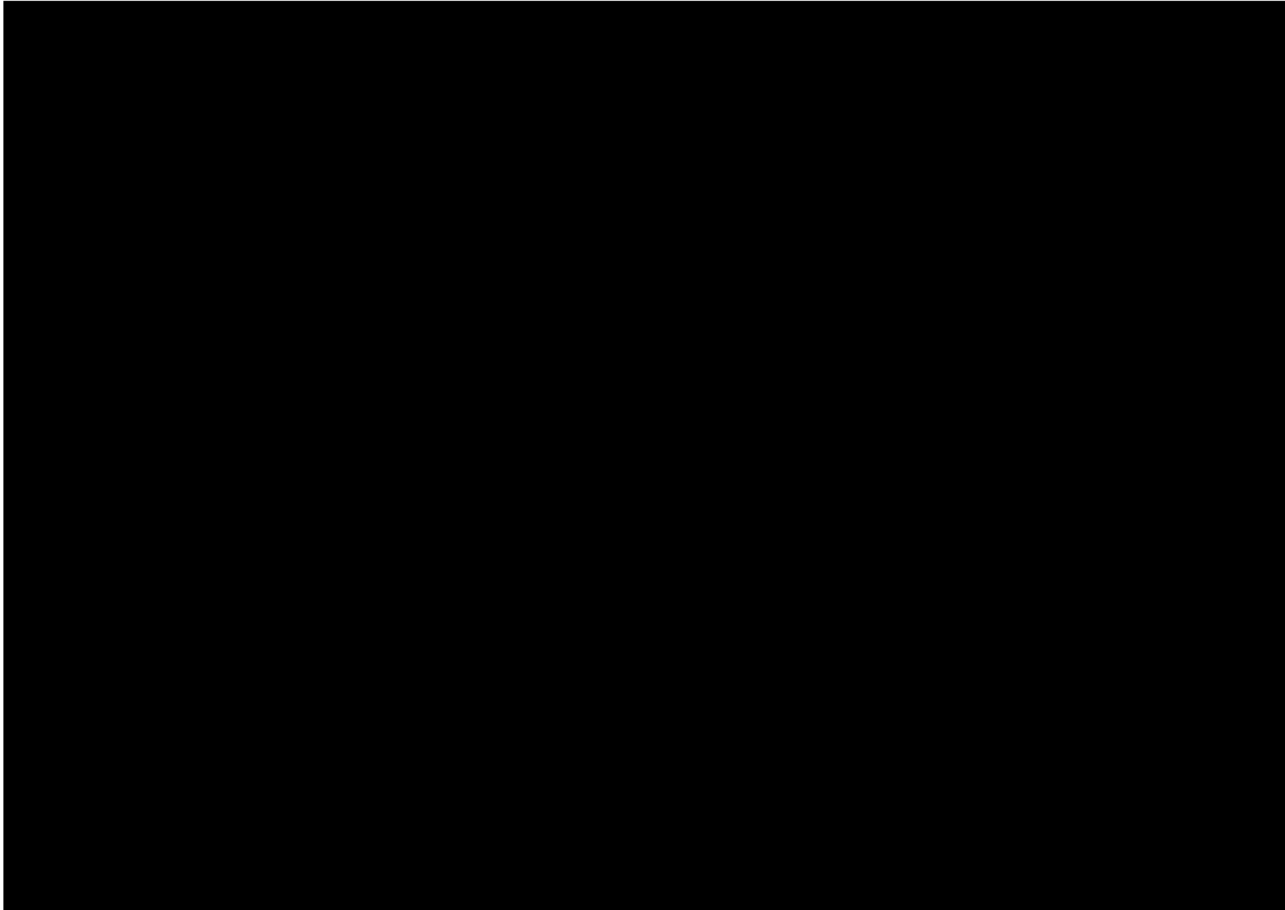
Cumulative plan and actual percentage completions<sup>15</sup> for each of the stations are summarised in Figure F - 1.

While the percentage progress figures show a relative alignment against plan, the station’s performance curves still appear to suggest a different picture. We continue to see a drift closer to, or in some cases beyond, the forecast [REDACTED] curve.





█ date profiles. The forecast performance curve for █ remains beyond the █ curve; but does not appear to have drifted further during the period. █ and █ stations appear to be following the █ curve. Recovery back to the █ curve is forecast by Period 4 2018 and Period 13 2017/18 respectively. This places increasing pressure on the existing MOHS schedule and an increasing risk of further delays, unless mitigation measures can be applied. It is not yet clear whether the 2018 MOHS refresh will reflect an improvement in this situation.



CRL is working very closely with the IMs to ensure that any physical overruns at the stations do not affect trial operations. CRL aims to have the tunnel ready for trial running in Zones 3 & 4 as planned; but there will be some residual works, such as the installation of walkways which cannot be installed while engineering trains are still working.

**Paddington station:** █  
█  
█  
█

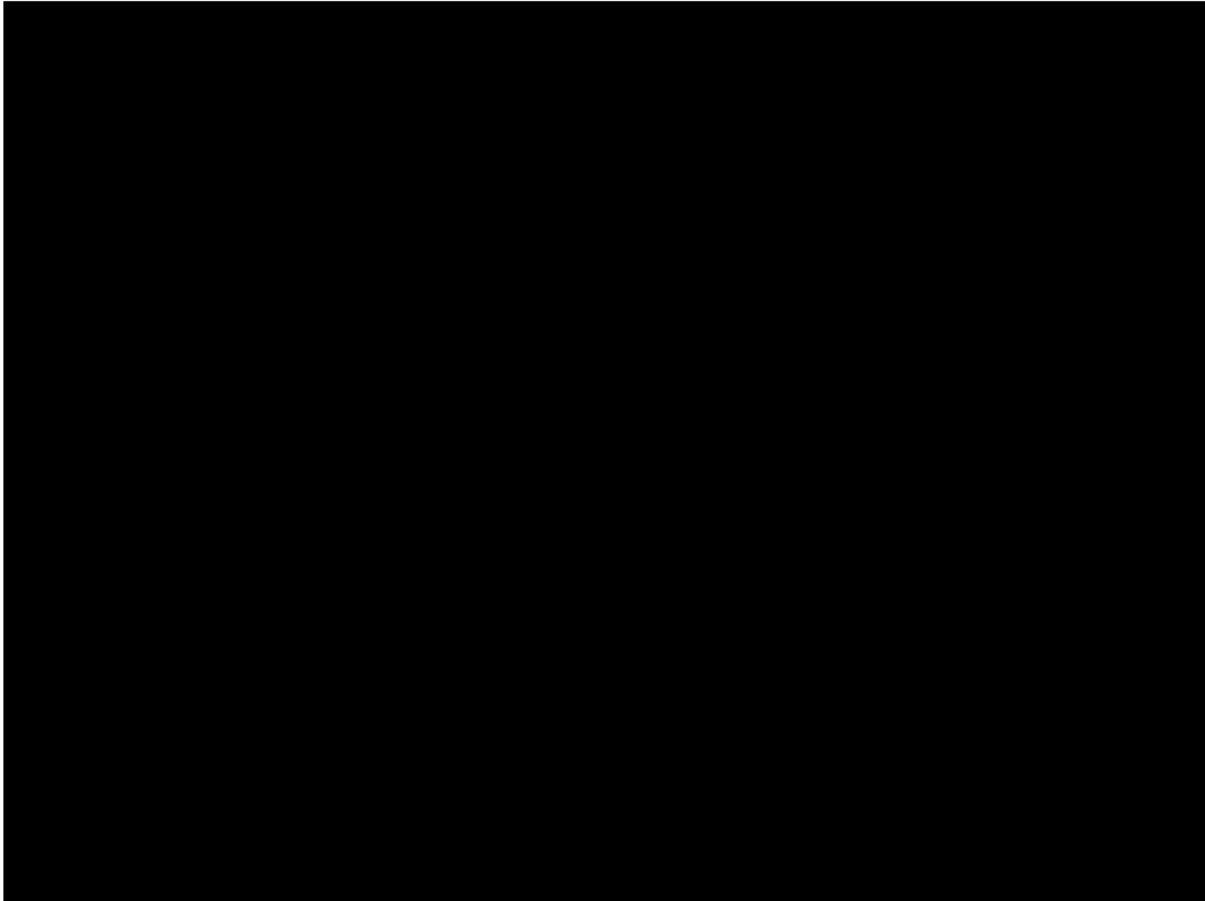
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[Redacted text block]

**Bond Street station:** [Redacted]  
[Redacted] A further milestone was achieved ahead of plan, helping to offset some of the progress delay. The reported (aspirational) MOHS forecast station completion date, has been maintained as 14 December 2018, (refer to Figure F - 1 and Figure F - 4.) [Redacted]

[Redacted text block]



[Redacted text block]

CRL continues to focus on the remaining design works, detailed planning to support dynamic testing and key subcontractor programmes from [Redacted] and [Redacted]. [Redacted] has confirmed its proposed delivery plan for Crossrail works in 2018; which includes the installation of escalators at [Redacted] station. CRL is seeking to make further adjustments to the plan, in order improve on critical path durations and to support an earlier completion of the installation works.

[Redacted text block]

[Redacted text block]

**Tottenham Court Road station:** [Redacted]

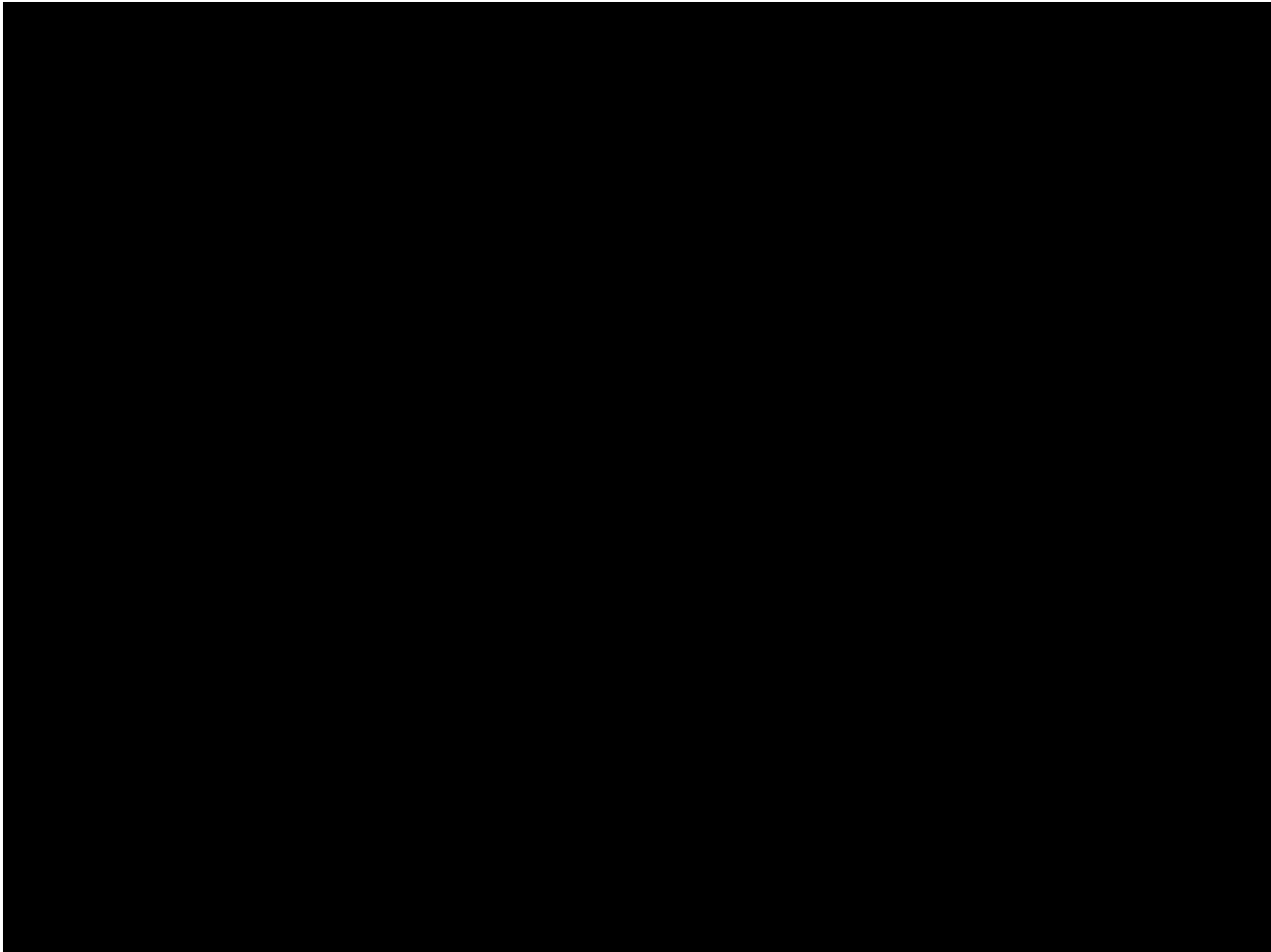
[Redacted text block]

[Redacted text block]

[Large redacted text block]

[Redacted text block]

**Farringdon station:** [Redacted text block]



[Redacted text block consisting of multiple lines of blacked-out content]

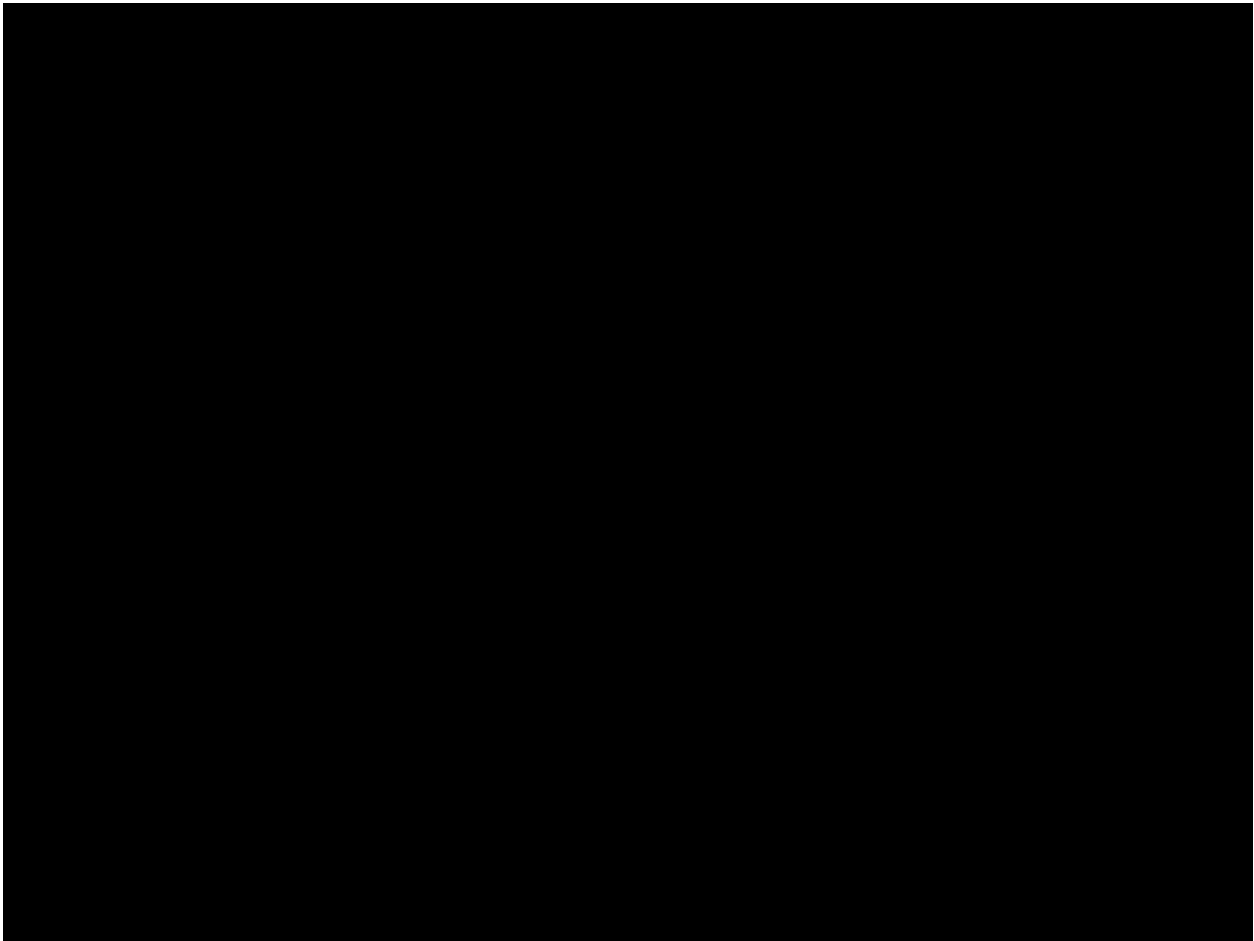
**Liverpool Street station:** [Redacted text block]



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**Whitechapel station:**

[Redacted text block consisting of approximately 5 lines of blacked-out content]

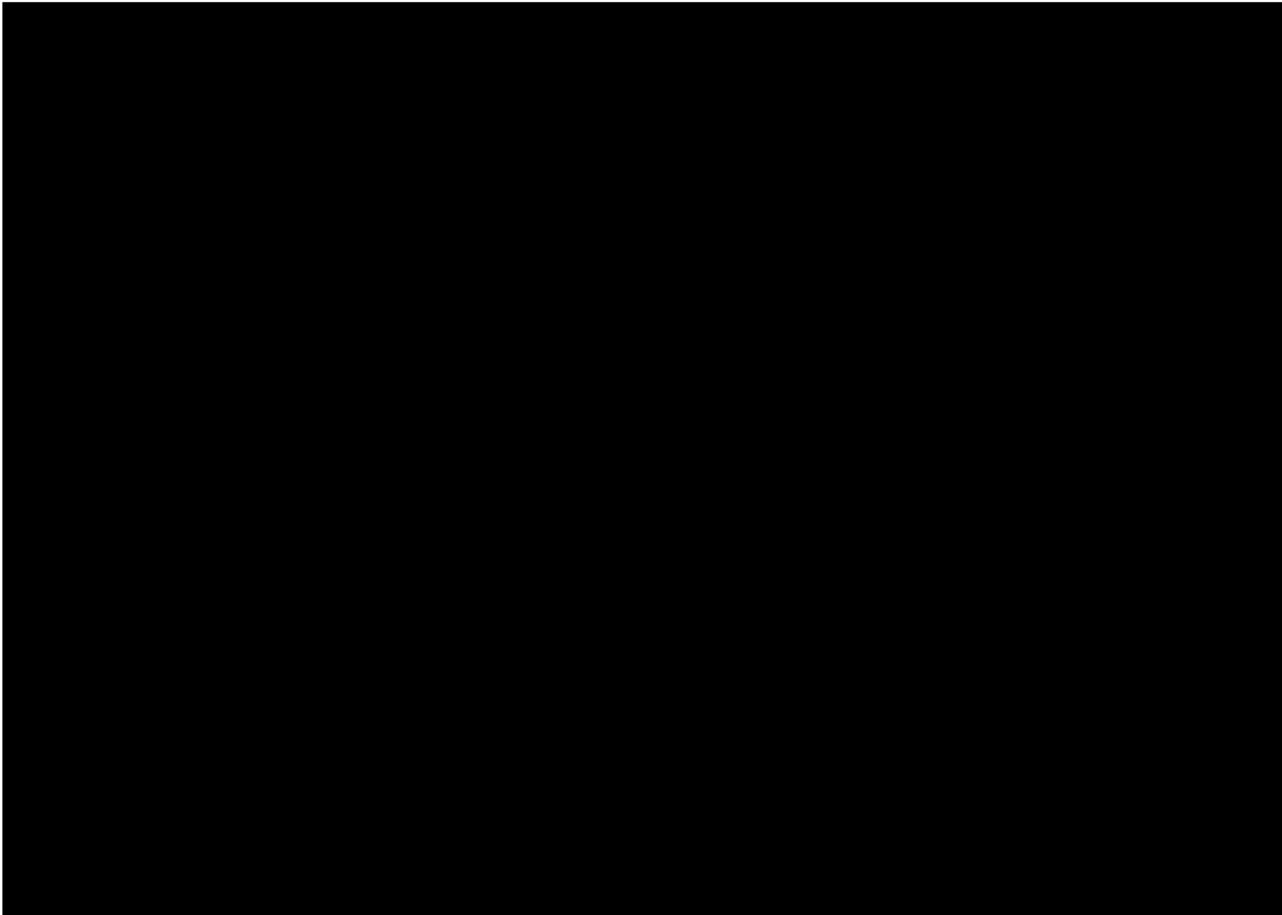


[Redacted text block]

**Custom House station:** Works on the repair of the cracked movement joints, within the station's structure, have been completed.

**Woolwich station:** [Redacted text block]

[Redacted text block]



### F.3 Interface Works and Handovers

Room and route handover performance continues at a level less than plan. Planned and actual progress of accepted room and route handovers, as reported by CRL in Period 9, are summarised in Figure F - 10, Figure F - 11, and Figure F - 12.

All of the stations report continued delays and are behind plan with their room and route handovers to Systemwide. Figure F - 10 shows the status of the Systemwide room/route handovers by each station. The main contributors to the delay are still [REDACTED] (-65%), [REDACTED] (-43%) and [REDACTED] (-34%) stations. [REDACTED] and [REDACTED] report increased variances, during the period, of -7% and -95 respectively. [REDACTED] and [REDACTED] have achieved a slight reduction in their negative variances and the remaining stations have maintained their handovers without further deterioration against plan.



Contract	Location	Rooms & Routes					
		Total per Site	Accepted (No.)		Cum Handovers		Variance (%)
			Actual	Plan	Actual	Plan	
C405	Paddington	116	41	116	35%	100%	-65%
C412	Bond Street	92	41	81	45%	88%	-43%
C422	Tottenham Court Road	139	114	137	82%	99%	-17%
C435	Farringdon	98	85	96	87%	98%	-11%
C502	Liverpool Street	137	112	134	82%	98%	-16%
C512	Whitechapel	122	75	116	61%	95%	-34%
C530	Woolwich (CON, NWP, PLU)	110	103	110	94%	100%	-6%
C350	Pudding Mill Lane	60	60	60	100%	100%	0%
C360	Shafts	161	160	161	99%	100%	-1%
<b>Totals</b>		<b>1035</b>	<b>791</b>	<b>1011</b>	<b>76.4%</b>		

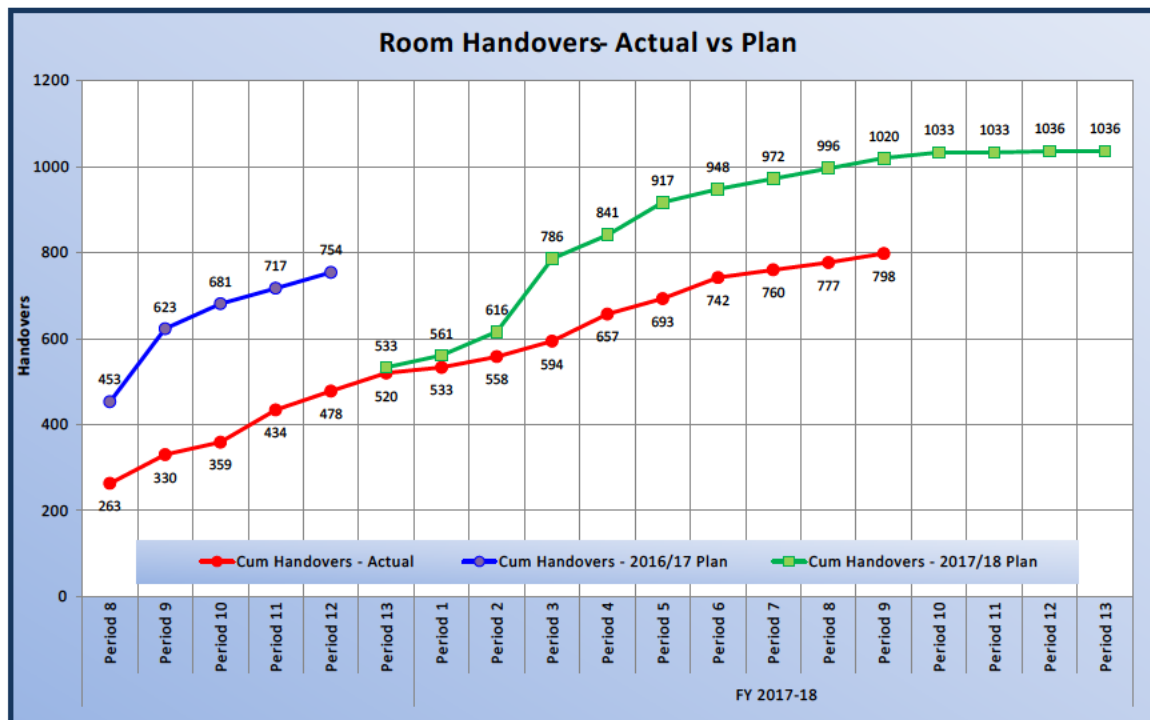
*Figure F - 10 ~ Summary of Systemwide accepted rooms/routes by location*

CRL has achieved almost 77% (75% in Period 8) of the room and route handovers, against a planned 99% (96% in Period 8). The gap in delivery (percentage variance against plan) has remained unchanged during the period. The percentage variance figures and the continued gap between the 'actual' and planned cumulative handover curves can be seen in Figure F - 12.

We note that there are, however, 40 rooms that have been completed pending handover to Systemwide; these are not recognised in CRL's reported figures. Handover has not been achieved, due to incomplete paperwork. If these are taken into consideration, CRL will have achieved 80% against the 96% planned.

Year	Period	Handovers/Period		Cum Handovers - Baseline		Percentages		Variance
		Actual	Plan	Actual	Plan	Actual	Plan	
FY 2017-18	Period 1	27	41	533	561	52%	54%	-3%
	Period 2	25	55	558	616	54%	59%	-5%
	Period 3	36	170	594	786	57%	76%	-18%
	Period 4	63	55	657	841	64%	81%	-17%
	Period 5	36	76	693	917	67%	89%	-22%
	Period 6	49	31	742	948	71%	91%	-20%
	Period 7	18	24	760	972	73%	94%	-21%
	Period 8	17	24	777	996	75%	96%	-21%
	Period 9	21	24	798	1020	77%	99%	-21%
	Period 10		13		1033			
	Period 11		0		1033			
	Period 12		3		1036			
	Period 13		0		1036			

*Figure F - 11 ~ Summary of Actual and Planned Station Room Handovers*



**Note:** Based on data abstracted from CRL's SLD Bi-Weekly Progress Report dated December 2017. (Period 9 - Week 3). Graph adjusted to reflect reported handovers based on number of rooms/routes accepted by Systemwide. Planned handovers ( 2017/18 Plan) re-baselined as a part of 2017 MOHS Refresh.

**Figure F - 12 ~ Schedule of Numbers of rooms to be handed over to Systemwide<sup>17</sup>**

CRL achieved only 21 of the 24 planned rooms/routes in Period 9. The drift away from the handover baseline, however, remained unchanged at a variance of 21% against the plan. The current trend line for cumulative handovers achieved each period to date, suggests that recovery of the handover schedule will not be achieved by early 2018 as planned. Unfortunately, there is little evidence of any sustained effort towards recovery. This implies a continued risk of further delay to Systemwide’s handover date expectations and their installation works.

Equipment Room & route access remains an ongoing challenge that CRL will have to closely manage with both the station and Systemwide contractors.

#### F.4 Interoperability

CRL’s rate of addressing long outstanding issues and concerns, reported by Ricardo Rail (RR) in its role as the NoBo/AsBo, is too slow. RR continues to draw CRL’s attention to a number of major concerns that have yet to be fully addressed by CRL.

RR remains unable to secure an information release plan, for the outstanding documentation, from CRL. CRL’s ability to hold to the information release dates is key to a successful submission of the Technical File, anticipated in August 2018.

The NoBo still reports that a small number of TSI requirements are known to be potentially noncompliant. These issues have been unresolved for some time. The delay in their closure will hamper the NoBo’s efforts to complete its compliance assessment. To mitigate the potential

delay in closing out these issues, the NoBo has continued its work on the basis of currently available documentation.

The AsBo's continues to express concerns regarding CRL's control over the release of information to RR for assessment. These concerns are summarised as:

- Continuing slippage in supply of Design stage evidence to support a substantially complete design stage Safety Assessment Report (SAR);
- CRL is not addressing long outstanding deficiencies and concerns, reported by the AsBo, undermining evidence provided in response to the first two bullet points above;
- Final stage delivery of the main dependencies from CRL may be too late to enable assessment, resolution and compilation of the final SAR;
- The programme for completion of the Railway Level Hazard Management, consistent with the main project milestones, is still awaited;
- There remains insufficient detail of the structure of the CRL argument for safety and compliance;
- The absence of clear and detailed project and contractor plans for the remaining assurance evidence build, is undermining the ability of the AsBo to plan its SAR-Final build.
- The recent substantial change (staff loss) in the System Safety Team.

The AsBo acknowledges awareness of substantial initiatives that should address most of the points above; but the time to implement these is now running out. The date for a substantially complete SAR has now moved into second quarter 2018. The AsBo remains concerned that its ability to delivery a supportive SAR is now at significant risk. This could delay bringing the new railway into use.

## F.5 FDOs

CRL's target for the sign-off of FDO certificates is now March 2018. FDO certification has been issued for Mile End shaft; but no other FDO certificates have yet been issued, due to outstanding issues or deliverables flagged at the review meetings.

The "Red" issue count for stations, shafts and portals has been reduced from a total of 425 (Period 8), down to 377 in Period 9<sup>18</sup>. These issues have to be resolved before the necessary FDO certificates can be issued. The number of "Amber" issues has reduced from 614, down to 531 in the period. The targeted closure of all Red issues by Christmas has not been achieved and the number of "Red" issues remains stubbornly high. FDO sign-offs and subsequent certification dates are rolling back. This will impact on Interim Acceptance (IA) and the subsequent transfer of Assurance documentation to the IMs.

Fire strategy workshops are being held with the site and CRL's CEG teams, to unlock and progress the closure of fire related "Red" issues that block the issue of certification at a number of the sites. In addition, CRL continues to hold regular review meetings with the IMs (LUL and RfL) to review the status of and progress the agreement and closure of outstanding FDO issues.

## Appendix G Systems, Integration and Operations

### G.1 MOHS and Railway Systems Delivery

#### G.1.1 Plan Delta

“Plan Delta” is an interim “working” incarnation of the MOHS, which is being developed to support substantial completion of delivery ahead of Handover on 5 July 2018. It is effectively a recovery plan which seeks to mitigate the schedule delays caused by the catastrophic and unforeseen equipment failures which occurred during the energisation process of PML ATFS on 11 November 2017.

The critical interim objectives of Plan Delta are: to achieve traction power energisation; and to ensure that sufficient rolling stock / fixed infrastructure integration has taken place to support NR signalling interface testing in booked possessions in March 2018 (GEML) and May 2018 (GWML).

Given the delays to EDT and the loss of dynamic testing time that has already occurred, we have serious concerns with how much of the original scope can realistically be achieved ahead of Handover. There is a limit to how much “learning”, “improvement” and “efficiencies” can be implemented in the short time available, and Plan Delta is likely to confirm that there is insufficient time available to meet the original infrastructure handover objectives. In the circumstances we expect CRL to agree a plan with RfL for partial staged handovers from 5 July 2018 onwards, which will support both CRL delivery and RfL practical acceptance.

# Appendix H Compliance and Assurance

## H.1 Quality

### H.1.1 Right First Time (RFT) and World Class (WC) Metrics

The results for 5 of the quality metrics, shown below, remain generally good. The acceptance graph, shown in Figure H - 1 shows that 248 packages were accepted in Period 9. The Period 8 planned number for Period 9 was 514. This performance is similar to Period 8, and is contributing to the issues described in Section 3.8. Delayed submission of packages could impact upon the IMs assurance activities.

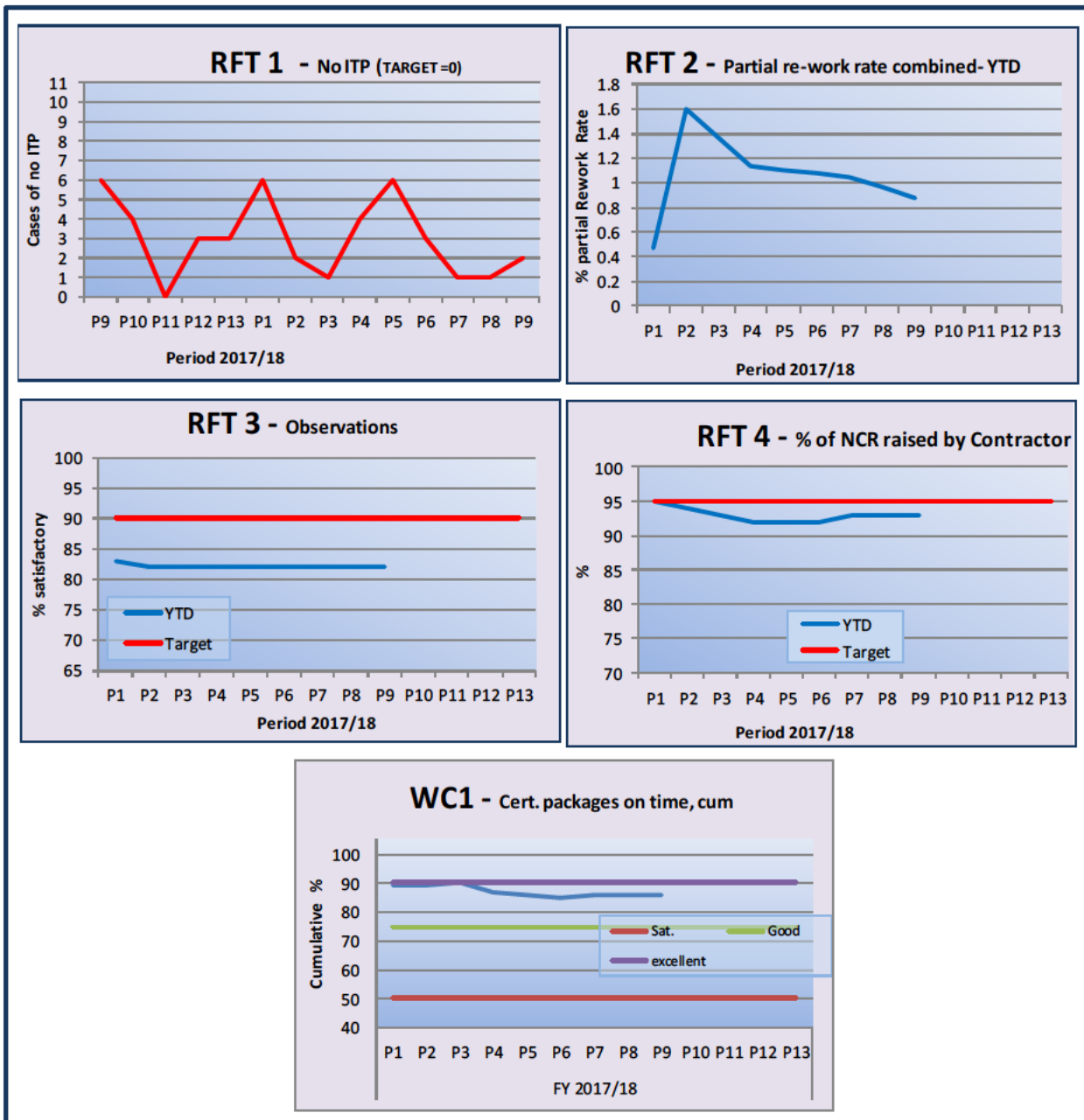


Figure H - 1 ~ Quality KPIs

**H.1.2 Quality Performance Index**

No contractors received a ‘red’ status for their quality performance in Period 9. The overall index for the period was 2.06. CRL’s target is to be above 2.00.

**H.1.3 Quality Issues**

[Redacted content]

**H.1.4 Audit Monitoring**

No audits were adjudged to be ‘poorly controlled’ in this period.

**H.2 Affirmations**

CRL has prepared a ‘close-out report’ in response to Sponsors requirement 4.1.10:

*Prior to the Final Delivery Date, CRL shall provide the Sponsors with a close-out report which shall include, without limitation, outline designs, construction methodology and programmes and budget estimates for works and services which shall be required to be procured by others after the end of the Project in order to increase the capacity of the Crossrail Network to 30 TPH utilising 200m Trains in the Normal State of Operation.*

It also references SR 3.1.4.2 to 3.1.4.4. JST and PRep have met with CRL<sup>20</sup> and provided their comments. CRL is now revising the paper prior to formal submission to Sponsors.

CRL has also stated a position<sup>21</sup> with regard to Affirmation 026 ‘Supporting Communication or Utility Distribution’ that does not appear to be aligned to the agreed actions. We have sought clarification from CRL’s chief of staff, and will update Sponsors once that has been received.

An opening strategy affirmation for Stage 2, described in Section 2.1, may be submitted in early January.

**H.3 Land & Property (L&P)**

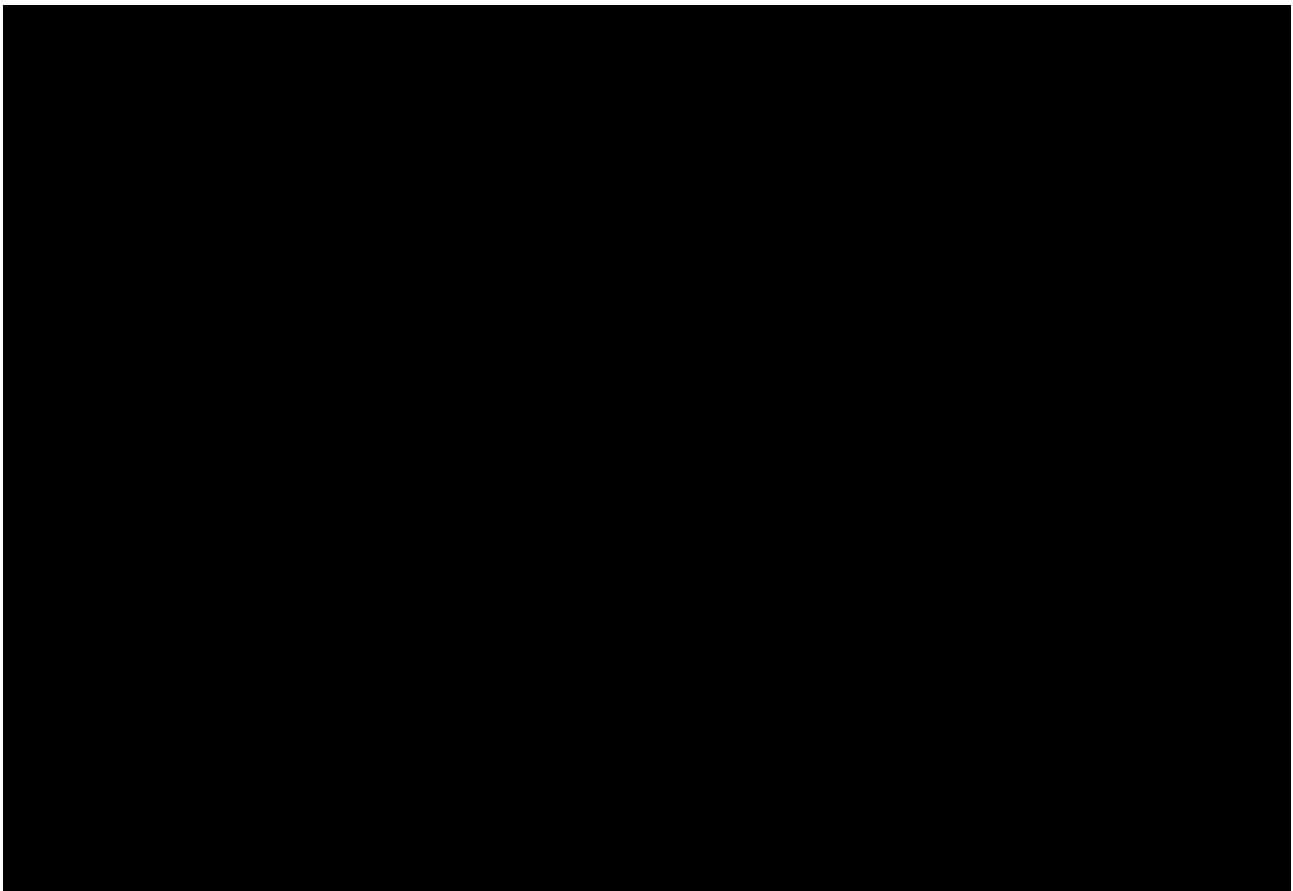
The total L&P Programme AFC (including P50 risk) in the period has increased by £0.2m to £860.9m. This is due to extended occupation at Paddington Station car park and additional disturbance costs at Whitechapel.

CRL has settled 830 out of 1,607 anticipated claims, representing 82.7% of the AFC by value. At period end 5 cases were referred to Land Tribunal. The total claimed figure is £33.2m across all of these cases, compared to CRL’s AFC allowance of £4.3m.

#### H.4 Over Site Development (OSD) and Urban Realm (UR)

CRL still has one further OSD planning application to make at Liverpool Street East. Legal Agreements with Development Partners are being finalised, pending TfL approval.

Figure H - 2 provides a summary<sup>22</sup> of the current forecast Key Dates for Completion and handover<sup>23</sup> of the CRL deck slabs at each station to the OSD contractors<sup>24</sup>, as well as the OSD forecast start, duration and completion dates<sup>25</sup>.



There have been few changes in CRL's forecast MOHS handover and OSD developer start dates (shown bold text in Figure H - 3) during the Period.

Paddington (PIP Triangle) risk concerns, in relation to the joint NR/TfL regime have now been resolved. TfL reviewing the new lease provisions and, subject to TfL approval and NR LC7 consent, CRL/TFL plan to market site by early 2018.

The Developer for the OSD at Bond Street (East) has requested that CRL investigate mitigation measures to reduce noise in the colonnade seating area; particularly from the louvre venting the Chiller Exhaust Room. The developer has also produced a report, from their acoustic consultants, indicating that the noise level in the office area above the station's fan rooms is too high for cellular office space. The report has been reviewed by CRL and meetings are being held with the developer to discuss the noise and vibration concerns.

TfL's investment committee has approved the Development Agreement and lease for the OSD at Bond Street (West), for execution in early 2018. Agreement of the target handover date for the OSD is proving difficult as a result of continued station schedule delays.

A deed of variation to the Development Agreement, for the OSD at Tottenham Court Road (East), now has TfL Commissioner sign-off. The variation allows for changes owing to noise and vibration from the tunnel vent shaft, associated revised planning consent and for site handover in early January 2018.

TfL has concluded that the OSD at Tottenham Court Road (West) should be sold in the open market. This is due to the temporary site accommodation currently installed on the ticket hall roof slab. The OSD development will not be able to start until 2019. Marketing the OSD is now planned for early 2018, subject to TfL sign off.

The Development Agreement for the Fisher Street OSD has been signed. The Planning Committee decision date has, however, yet to be set. CRL has approved the removal of the reinstatement of the rear of 8 -10 Southampton Row, from its contractor's scope and has set aside the associated budget for future delivery. Discussions regarding potential ground settlement, due to OSD loading, are being progressed so that appropriate trigger levels can be determined.

CRL has secured all Urban Realm (UR) central section planning consents and the focus has now moved to their delivery. CRL's transferred responsibility for the management and the associated budget for the delivery of the UR works from the centralised L&P team to the site delivery teams, as of 1 December 2017. Joint work with Westminster, the City, LB Islington and Tower Hamlets continues towards a conclusion on the urban realm delivery agreements in early January 2018.

## **H.5 Undertakings & Assurances (U&A) and Commitments Central Section**

Six of the live contracts for the Central Section planned to uploaded compliance evidence into Commitments Delivery Tracker (CDT) in Period 9, in accordance with their Commitments Compliance Plans (CCP). CRL achieved 100% of the planned upload of evidence during the period.

Refer to our previous reports for further detail in respect of the Potential Incident Reports (PIRs) noted below.

### **H.5.1 C660/C520 Custom House PA/VA (D25) Assurance 465**

Technical work has continued; but the final meeting to present the outcome and resultant noise criteria to London Borough of Newham (LBN), that was planned for before Christmas, has again been postponed. A meeting with LBN, to present the final noise criteria, is now planned for January/February 2018. CRL will then be required to demonstrate to LBN that the noise criteria has been achieved in a final noise demonstration report anticipated in February/March 2018.

## **H.6 Undertakings & Assurances (U&A) and Commitments - Surface Section**

Nine surface section contracts planned and successfully uploaded compliance evidence into the CDT during Period 9, in accordance with their Compliance Matrices.

In Period 8, WOT1C West Outer Track Infrastructure (GRIP5-8), WSK1F Stockley Main Civils (GRIP 5-8) and SAA3A South East (GRIP 5-8) have not met their targets. The detail for each is as follows:

- WOT1C remains pending. The D25 assessments for Maidenhead sidings are still under review.



- WSK1F remains pending. The D26 assessments are still outstanding. Consultation evidence with Thames Water should be available next period.
- SAA3A remains pending. The D25 assessments are complete; but two reports need to be closed out on NR's "eB" system, before uploading into the CDT.

In Period 7, it was reported that NAA1E (North East Stations and Signalling) and SAA3A (NR - South East (GRIP 5-8) had not met their targets due to outstanding D25 assessments. Both contracts have now caught up.

In Period 6, both WSK1F (Stockley Main Civils) and WLG4A (OOCPA) had not met their targets due to outstanding D25 and D26 assessments.

- WSK1F remains pending. The D26 assessment is complete; but needs to be closed out on NR's eB system before uploading into the CDT.
- WLG4A remains pending. Closeout of the OOCPA substation D25 assessment has yet to be agreed with the local authority, following an update from the manufacturer regarding sound power levels. CRL expects this to be closed out in Period 10. The D26 assessment is to be completed by end of January 2018.

In Period 4, both WIT1A (West Inner Track Infrastructure) and WLG4A (OOCPA) had not met their targets, due to outstanding D25 and D26 assessments. In the past such issues have almost always been closed out the following period. This is now becoming a concern. The detail for each is as follows:

- WLG4A (OOPCA) – The U&A is the carrying out of a fixed noise source (D25) assessment. The D25 assessment has been held up because the local authority has asked for baseline monitoring at the substation to be undertaken to inform the report. However, this would be very difficult to arrange as NR would need a possession because it is surrounded by tracks. NR is investigating whether it would be appropriate to conduct baseline monitoring at other similar substations on the route that would not require a possession. This issue is ongoing so the report remains overdue. OOCPA substation D25 assessment; agreeing closeout with the local authority following an update from manufacturer regarding sound power levels. Expected to be closed out by mid-December in period 10
- WLG4A (OOCPA) and WIT1A – The U&A is the carrying out of surface railway noise (D26) assessments – the contractors have started the modelling for the assessments, but there are some data issues which are delaying the reports which are therefore progressing very slowly. Initial assessment for part of the area has been submitted in order to prove the method is correct. This is subject to review which will be carried out in period 9. The entire report is expected to be completed and accepted by end of January 2018 (Period 11).

### **H.6.1 Shenfield Sidings – D25 Assurances 461, 462, 463, 464 & 518**

A level 1 PIR was raised on 24 August 2017 for failure to comply with the D25 fixed noise assurances at Shenfield siding. No D25 assessment has been produced, but the sidings have nevertheless been designed and constructed.

NR reported that a D25 assessment had been carried out and confirmed that the construction of a fence (which has already been approved under Schedule by the local planning authority) would achieve a rating of -5 dB at the nearest sensitive receptor. Brentwood Borough Council has raised no objections to the content of the assessment or the barrier design. The process for closing this PIR can now begin.

## Project Representative Team

### H.7 Project Team

██████████: Project Representative, Safety, Progress, Risk, Governance;  
██████████: Signalling, Railway Systems, Integration, T&C;  
██████████: Engineering, Stations, OSD, U&As, Assurance;  
██████████: Compliance & Change, Operations, RSD;  
██████████: Commercial, Cost Control, Financial, ONW;  
██████████: Administration Manager.

## Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
ABB	ASEA Brown Boveri	LoNo	Letter of No Objection
ACJV	Alstom Costain Joint Venture	LoR	Line of Route
ACWP	Actual Cost of Work Performed	LTC	Lost Time Case
AEA	Abellio East Anglia	LTIFR	Lost Time Incident Frequency Rate
AFC	Anticipated Final Cost	LU	London Underground
AFCDC	Anticipated Final Cost Direct Costs	LUL	London Underground Limited
AFR	Accident Frequency Rate	LV	Low Voltage
AGA	Abellio Greater Anglia (now known as 'GA')	M&E	Mechanical & Electrical
AIP	Approved in Principle	MAID	Mandatory Asset Information Deliverables
AIP	Approval in Principal	MCR	Material Control Requirement
AMS	Agreements Management System	MCS	Master Control Schedule
APIS	Authorisation to Place into Service	MENTOR	Mobile Electrical Network Testing, Observation and Recording
ARS	Automatic Route Setting	MEP	Mechanical Electrical & Public Health
AsBo	Assurance Body - Ricardo Rail	MEPA	Mechanical, Electrical, Public Health, Architecture
ASLEF	Associated Society of Locomotive Engineers and Firemen	MES	Mile End Shaft
ATC	Automatic Train Control	MIRP	Maintenance Integration Review Panel
ATFS	Autotransformer Feeder System	MML	Mott MacDonald Ltd
ATO	Automatic Train Operation	MOHS	Master Operational Handover Schedule
ATP	Automatic Train Protection	MOS	Member of Staff
ATS	Automatic Train Supervision	MPS	Master Plan Shaft
AWS	Automatic Warning System	MTIN	Miles Technical Incident Number
B&PC	Board & Programme Contingency	MTR SMS	MTR Safety Management System.
BBMV	Balfour Beatty Morgan Vinci	MTR-C	Mass Transit Railway - Crossrail
BCA	Bilateral Connection Agreement	MV	Medium Voltage
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCE	Notified Compensation Event
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NCR	Non Conformance Report
BFK	Bam Ferrovial Kier	NG	National Grid
BH	Berkeley Homes	NGET	National Grid Electricity Transmission
BIU	Bringing Into Use	NKL	North Kent Line
BLL	Bakerloo Line Link	NoBo	Notified Body
BOS	Bond Street Station	NOW	North Woolwich
BP	Business Plan	NR	Network Rail
BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems
BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC building	Operations Maintenance Centre
BTH	Blomfield Ticket Hall	OME	Order of Magnitude Estimate
BUF	Bottom Up Forecast	ONFR	On Network Functional Requirements
C&CSC	Commercial and Change Sub-committee	ONSIP	On Network Station Improvements Programme
CAR	Corrective Action Report	ONW	On Network Works
CARE	Crossrail Assurance Reporting Environment	OOC	Old Oak Common
CBTC	Communications Based Train Control	OOCPA	Old Oak Common Paddington Approaches
CCB	Current Control Budget	OPEX	Operational Expenditure
CCP	Commitments Compliance Plans	Ops	Operations
CCRB	Construction and Commissioning Rulebook	ORAT	Operational Readiness & Transfer Group

CCSA	Contract Commercial Status Analysis	ORR	Office of Rail & Road
CCSC	Commercial & Change Sub-Committee	ORSG	Operational Readiness Steering Group
CCTV	Closed Circuit Television	OSD	Over Site Development
CD/RA	Closed Door / Right Away	OTIS	OTIS escalators (company)
CDG	Competence Design Group	OTP	Overall Target Price
CDM	Construction Design & Management Regulations	PAD	Paddington station
CDN	Crossrail Data Network	PDA	Project Development Agreement
CDT	Commitments Delivery Tracker	PDB	Network Rail Programme Delivery Board
CE	Compensation Events	PES	Platform Edge Screen
CEC	Chief Engineer's Communications	PIP	Paddington Integration Project
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PIR	Potential Incident Report
CEG	Central Engineering Group	PLU	Plumstead
CEO	Chief Executive Officer	PM	Project Manager
CFCCB	Contingency Finance Current Control Budget	PMI	Project Manager Instruction
CIF	Crossrail Integration Facility	PML	Pudding Mill Lane
CMR	Crossrail Managed Risk	PMO	Project Management Office NR
CMS	Crossrail Management System	PNY	Paddington New Yard
CoL	City of London	PPE	Personal Protective Equipment
COS	Central Operating Section	PPM	Passenger Performance Measurement
CPFR	Crossrail Programme Functional Requirements	PRep	Project Representative
CPI	Cost Performance Index	PRISM	Cost Management Software
CPO	Compulsory Purchase Order	PSD	Platform Screen Door
CRL	Crossrail Limited	PSG	Performance Steering Group
CRV	Crossrail Requirements Variation	PSR	Project Status Report
CSCS	Construction Skills Certification Scheme	PTYSC	Property Sub-Committee
CSJV	Costain Skanska Joint Venture	PWay	Permanent Way
CSM	Construction Safety Management	QBR	Quarterly Baseline Review
CSM-RA	Common Safety Method – Risk Assessment	QCRA	Quantified Cost Risk Assessment
CT	Computerized Tomography	QRA	Quantified Risk Assessment
CTOC	Crossrail Train Operating Concession	QSRA	Quantified Schedule Risk Assessment
CUH / CHS	Custom House Station	RAB	Regulatory Asset Base
CW	Canary Wharf	RAB (C)	RfL Assurance Board for Crossrail
CWG	Canary Wharf Group	RAG	Red, Amber, Green Matrix
CWS	Canary Wharf Station	RAM	Route Asset Manage.
D&A	Drugs and Alcohol	RBC	Remote Block Computer
DeBo	Designated body	RCA	Risk Control Actions
DfT	Department for Transport	RCC	Route Control Centre
DLO	Direct Labour Organisation	RfL	Rail for London
DLR	Docklands Light Railway	RfL-I	Rail for London - Infrastructure
DOO	Driver Only Operation	RFT	Right First Time
DPS	Depot Protection System	RIA	Railway Integration Authority
DT	Dynamic Testing	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
Dwall	Diaphragm wall	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DWWP	Delivery of Works Within Possession	RIRP	Railway Integration Review Point
E&B	Earthing & Bonding	RLU	Restricted Length Unit
EA	Environment Agency	ROC	Rigid Overhead Conductor
EAC	Estimate at Completion	ROC	Regional Operational Centre
EB	Eastbound	ROP	Royal Oak Portal
ECP	Employers Completion Process	RP4.2	Review Point 4.2
ECS	Empty Coach Stock	RRV	Road / Rail Vehicles
████	████████████████	RS	Rolling Stock
EDT	Early Dynamic Testing	RSD	Rolling Stock & Depot
EED	Emergency Exit Door	RSSB	Rail Safety & Standards Board

EFC	Estimated Final Cost	RTU	Remote Telemetry Unit
EMU	Electrical Multiple Unit	S&C	Switches & Crossings
ERTMS	European Rail Traffic Management Systems	SA	Supplementary Agreement
ESJ	Engineering Safety Justification	SACR	Semi Annual Construction Report
ESM	Engineering Safety Management	SAP	System Applications Products
ETCS	European Train Control System	SAR	Safety Assessment Report
ETH	Eastern Ticket Hall	SAT	Site Acceptance Test
EVM	Earned Value Management	SCADA	Supervisory Control and Data Acquisition
FAR	Farringdon	SCL	Sprayed Concrete Lining
FCCB	Finance Current Control Budget	SCN	Sponsor Change Notice
FDC	Framework Design Consultant	SDG	Signalling Design Group
FDO	Final Design Overview	SDS	Scheme Design Specification
FDS	Final Design Statements	SER	Signalling Equipment Room
FFOC	Final Forecast Outturn Cost	SES	South East Service
FGW	First Great Western	SESR	South East Signalling Room
FIS	Fisher Street Shaft	SFA	Sponsor Funding Account
FLU	Full Length Unit	SHELT	Safety and Health Leadership Team
Fol	Freedom of Information	SIRP	Systems Integration Review Panel
FRAG	Fraud Risk Assurance Group	SISS	Station Information and Security System
FTS	Floating Track Slab	SLD	Single Line Diagrams
GAF	Greater Anglia Franchisee	SMTA	Smithfield Market Traders Association
GE	Great Eastern	SOC	Statement of Compatibility
GEFF	Great Eastern Furrer & Frey	SONIA	Sterling Overnight Index Average
GEML	Great Eastern Main Line	SOR	Systems Operation Room
GFRC	Glassfibre Reinforced Concrete	SORBA	Shaping Architecture Company (sub cladding contractor)
GLA	Greater London Authority	SPI	Schedule Performance Index
GPE	Great Portland Estates	SPS	Secondary Part Steel
GRC	Glass Reinforced Concrete	SR	Sponsors Requirement
GRIP	Governance for Railway Investment Projects	SRP	Safety Review Panel
GSM-R	Global System for Mobile Communication - Railway	SSE	Scottish & Southern Electricity
GW	Great Western	SSP	Stations, Shafts, Portals
GWML	Great Western Main Line	STG	Stepney Green
GWR	Great Western Railway	STS	Standard Track Slab
H&S	Health & Safety	SVP	Safety Verification Panel
HAL	Heathrow Airport Limited	T&C	Testing & Commissioning
HALARP	Heathrow Airport Limited Assurance Review Panel	TAP	Technical Assurance Plan
HAS	High Attenuation Sleeper	TBM	Tunnel Boring Machine
HAVS	Hand Arm Vibration Syndrome	TC&HSG	Testing, Commissioning and Handover Steering Group
HIA	Heathrow Implementation Agreement	TCMS	Train Control Management System
HM	Her Majesty	TCR	Tottenham Court Road
HMDL	Handover Master Deliverable List	TCRW	Tottenham Court Road West
HRW	Heathrow Airport	TDY	Tunnel Drive Y
HSPI	Health & Safety Performance Indicator	TfL	Transport for London
HV	High Voltage	TOC	Train Operating Company
HVAC	Heating Ventilation & Air Conditioning	TPH	Trains Per Hour
IA	Interim Acceptance	TPS	Train Protection System
ICD	Interface Control Document	TPWS	Train Protection & Warning System
IECC	Integrated Electronic Control Centre	TRAIL	Transport Reliability Availability Integrated Logistics
IEP	Intercity Express Programme	TRH	Temporary Rehousing
IFC	Issued For Construction	TSI	Technical Standard for Interoperability
IFD	Ilford Yard	TTVS	Temporary Tunnel Ventilation System
IM	Infrastructure Manager	TUCA	Tunnelling & Underground Construction Academy

IOSH	Institution of Occupational Safety and Health	TWAO	Transport & Works Act Order
IP	Intervention Point (0, 1, & 2)	TXM	TXM Plant
IR35	Inland Revenue Taxation Regulation 35	U&A	Undertakings & Assurances
IRN	Installation Release Note	UKPN	UK Power Networks
ISJ	Interim Safety Justification	UR	Urban Realm
ISV	Intermediate Statements of Verification	URT	Unresolved Trends
ITP	Inspection & Test Plan	VDP	Victoria Dock Portal
ITT	Invitation to Tender	VERP	Value Engineering Review Panel
JST	Joint Sponsor Team	VFL	Volker Fitz Patrick
KBR	Knorr-Bremse Rail	VN	Variation Notice
KD	Key Deliverable	VT	Voltage Transformer
KE	Kinematic Envelope	WAD	Works Authorisation Document
KG	Kensal Green	WBP	Westbourne Park
KO	Key Output	WBS	Work Breakdown Structure
KPI	Key Performance Indicator	WC	World Class
L&P	Land and Property	WHI	Whitechapel
LB	London Borough	WITI	Western Inner Track Infrastructure
LBTH	London Borough of Tower Hamlets	WOE	Western Outer Electrification
█	█	WOO	Woolwich Station
LFB	London Fire Brigade	WOTI	Western Outer Track Infrastructure
LIV	Liverpool Street	WTH	Western Ticket Hall
LMU	London Metropolitan University	YC	Yard Control
LO	London Over ground		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Pilling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



## End Notes

- <sup>1</sup> Full complement of C345 Rolling Stock (160m long trains) on existing GE services from Shenfield to Liv St.
- <sup>2</sup> Meeting held 5 December 2017.
- <sup>3</sup> Email from CRL Chief of Staff to PRep15 December 2017 describing intention to amend Affirmation 027 'Opening Strategy' if necessary.
- <sup>4</sup> Stage 3 Completion of Trial Running is 9 September 2018; Stage 3 Opening is 9 December 2018.
- <sup>5</sup> Meeting held 15 December 2017.
- <sup>6</sup> MOHS Review held on 14 December 2017.
- <sup>7</sup> CRL Period 9 Board Report (Board Version).
- <sup>8</sup> 15 December 2017.
- <sup>9</sup> 4 December 2017.
- <sup>10</sup> 5 December 2017.
- <sup>11</sup> Status is reported in the CRL Regulatory Approvals Periodic Dashboard.
- <sup>12</sup> A total of 377 Red issues remain open, as of the close of Period 9. These comprise 257 SSP issues and 120 Systemwide issues.
- <sup>13</sup> See also Section 5.2.2 for progress based on all NR activities.
- <sup>14</sup> CRL Period 9 Board Report (Board Version).
- <sup>15</sup> Data has been abstracted from the CRL Period 9 (2017/18) station dashboards.
- <sup>16</sup> Refer to Paddington Station's Period 9 dashboard.
- <sup>17</sup> The graph is based on data abstracted from CRL's SLD Weekly Progress Report dated 8 September 2017 (Period 9 Week 3). The graph has been adjusted to reflect reporting based on the number of rooms/routes accepted by Systemwide.
- <sup>18</sup> A total of 377 Red issues remain open, as of the close of Period 9. These comprise 257 SSP issues and 120 Systemwide issues.
- <sup>19</sup> Described in Section 3.4 of our Period 6 report.
- <sup>20</sup> 12 December 2017 – L Findlay, G Overall, B Long, H Brown.
- <sup>21</sup> Technical Dashboard and report, Period 9.
- <sup>22</sup> Summary of OSD dates has been abstracted from the CRL Period 9 Board Report, the MOHS and Key Dates progress summary.
- <sup>23</sup> The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.
- <sup>24</sup> The developers' start dates, durations and forecast completion dates have been abstracted from the OSD Progress Section of the CRL Board Report and CRL's Anchor Milestone summary.
- <sup>25</sup> The estimated shell & core completion dates will be validated when the OSD contractors' schedules become available.



## **Crossrail Project Representative**

Crossrail Joint Sponsor Team

**Project Status Report 107**

**Period 10 FY2017-18**

**10 December 2017 – 06 January 2018**

Document No. B2111500/107/1.21

1 February 2018



**Official ~ Sensitive Commercial**

**Project Status Report 107**

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Jacobs U.K. Limited  
 226 Tower Bridge Road  
 London SW1 2UP  
 United Kingdom  
 T +44 (0)20 7403 3330  
 F +44 (0)20 7939 1418  
[www.jacobs.com](http://www.jacobs.com)

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Note: This report relies on the information set out in CRL's Period 10 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 6 January 2018. Note that information emerging after the close of Period 10 is subject to formal confirmation by CRL in its Period 11 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff.

**Document history and status**

Revision	Date	Description	By	Review	Approved
1	25 January 2018	PSR 107 Period 10 FY 2017-18 v1.15.docx ~ Draft	PRep Core Team		
2	1 February 2018	PSR 107 Period 10 FY 2017-18 v1.21.docx ~ Final	PRep Core Team	<span style="background-color: black; color: black;">[REDACTED]</span>	<span style="background-color: black; color: black;">[REDACTED]</span>

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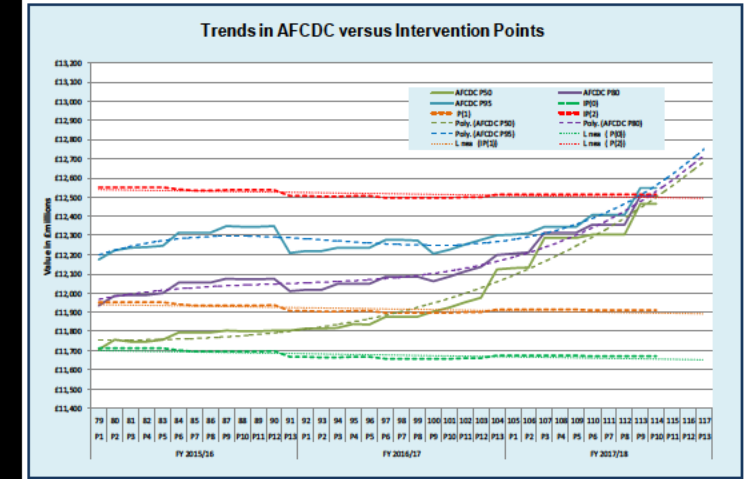
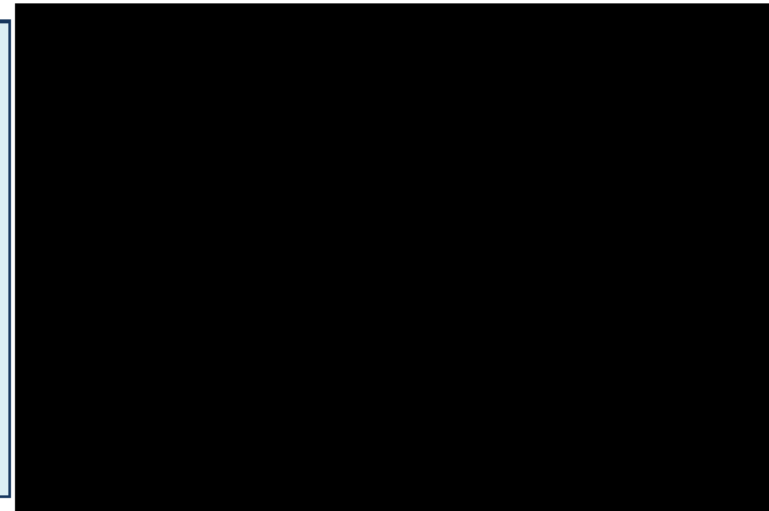
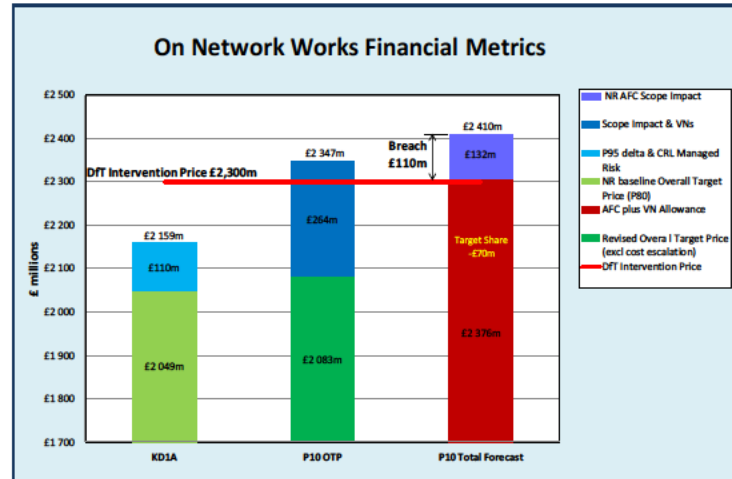
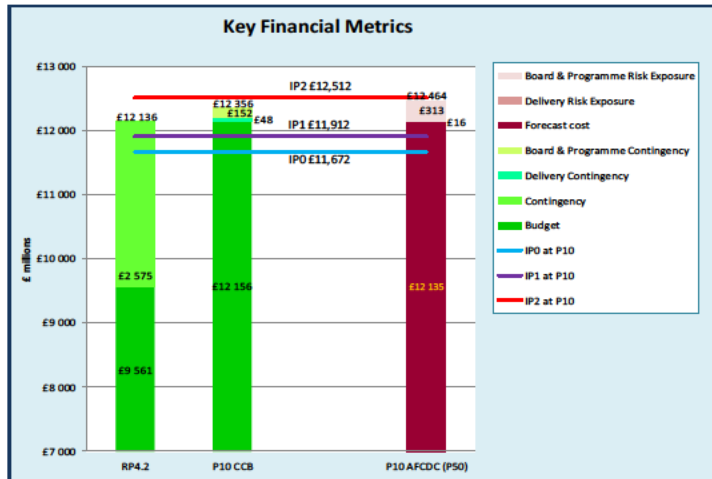
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### Cost and Schedule Dashboard (Period 10 FY2017/18)

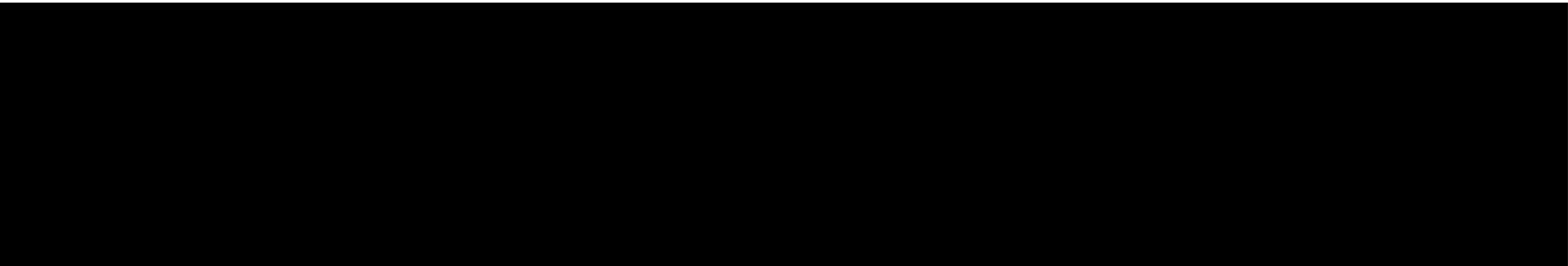
CRL SACR18 QSRA gives confidence level of finishing on time at Stage 3 = 71%

SACR18:  
 AFCDC (P50) ~ £12.303bn. AFCDC (P80) ~ £12.356bn  
 AFC: (£12.303bn AFCDC (P50) + £2.482bn ONW etc) = £14.785bn

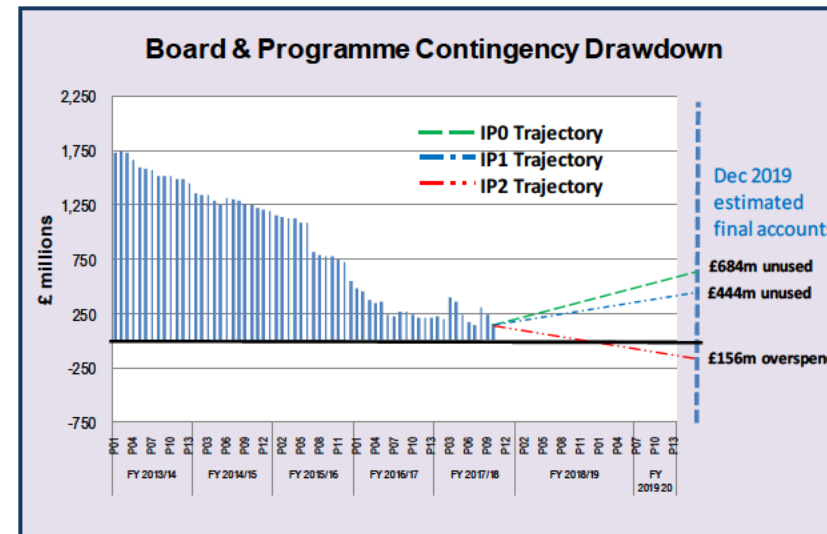
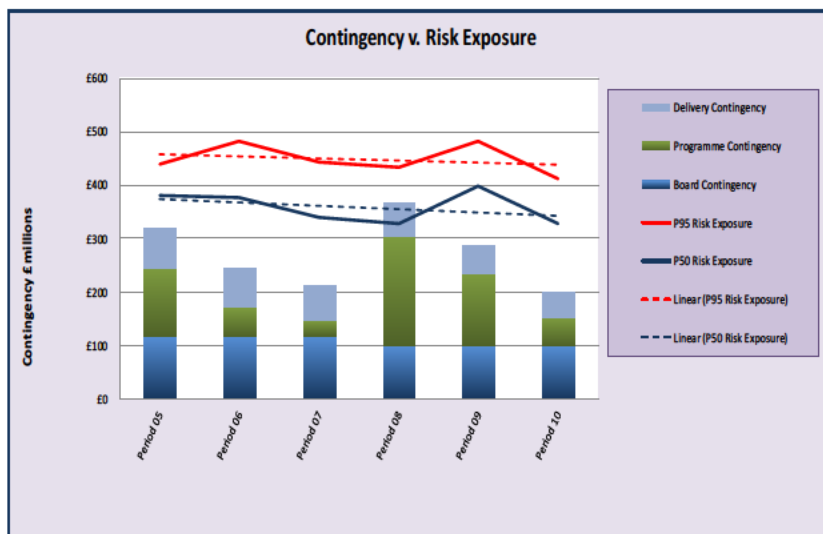
#### Cost:



#### Schedule:



#### Risk, Contingency & Change:



#### Project Representative's Summary:

**Cost:** IP0, IP1 and IP2 have not changed in Period 10. The AFCDC (P50) has not changed from Period 9 and remains at £12,464 for Period 10. This exceeds IP1 by £552m with only £48m headroom to IP2. The Finance Current Control Budget remains at £12,356m; The AFCDC (P50) exceeds the reported financial budget by £108m and is in excess of the RP4.2 Baseline funding of £12,136m by £328m. The AFCDC (P80) is also unchanged at £12,507m which is £595m above IP1 and only £5m under IP2. The AFCDC (P95) exceeds IP2 by £35m. The CRL ONW AFC remains at £2,376m in Period 10. The Period 10 CRL estimated FFOC has reduced by £28m to £2,480m which exceeds the DfT Intervention Price by £180m.

**Schedule & Progress:** Zones 1 & 2 energisation has slipped further in the period with EDT planned to start on 25 February 2018; Zones 3 & 4 Dynamic Testing has been pushed back to 11 June 2018. CRL continues to prepare a revised MOHS for issue in February 2018 which is expected to confirm CRL's plan for completion. In the meantime, current measured progress suggests that formal Handover and Stage 3 Opening are at serious risk.

**Risk, Contingency & Change:** The Period 10 risk exposure has reduced by £71m to £328m due to a drawdown of risk to fund Delivery level cost increases. The overall contingency budget of £199m is insufficient to cover the P50 risk exposure of £328m by £129m (£17m deterioration from Period 9). The centrally controlled Delivery contingency has reduced in Period 10 by £8m to £48m.

# Cost and Schedule Dashboard

(Quick Reference Guide)

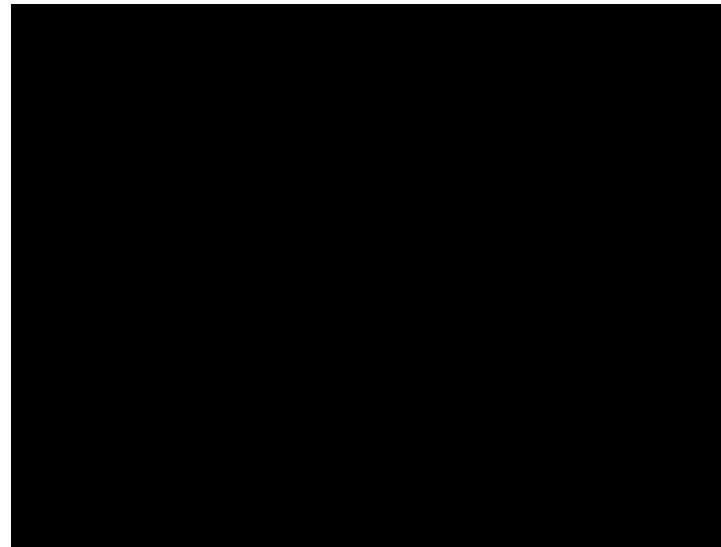
## Cost

### Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFCDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

### On Network Works Financial Metrics

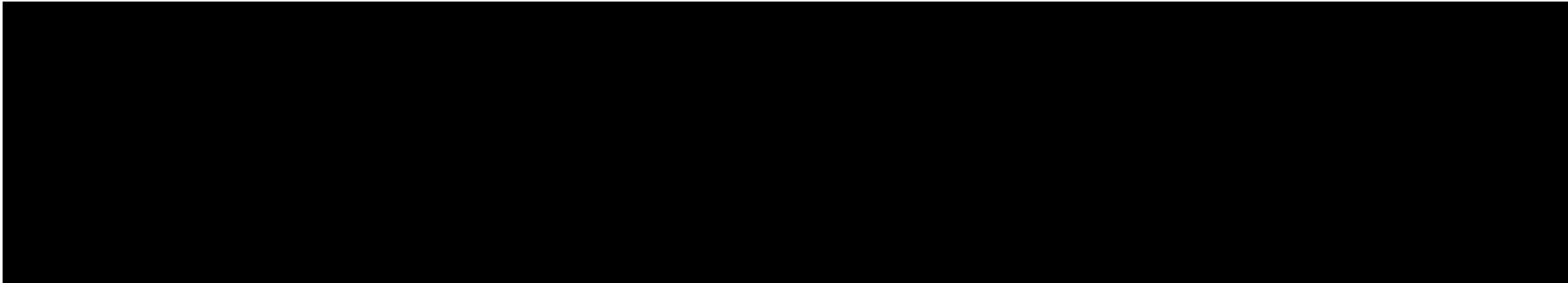
Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.



### Trends in AFCDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFCDC at P50, P80 and P95 and forecasts the respective future AFCDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2.

## Schedule & Float



## Risk, Contingency & Change

### Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

### Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

### Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:

## Executive Summary

### Summary

Key points are:

- Health and Safety performance remains good;
- CRL and its stakeholders have opted for a contingency plan for Stage 2;
- Significant delays have occurred during Period 10 such that risks to Stage 3 Opening have increased;
- A new Master Operational Handover Schedule (MOHS) is due to be issued in February;
- Costs continue to rise and we expect the forecast for the Central Section (AFCDC) to breach Intervention Point 2 (IP2) at SACR19, if not before.

### Health and Safety:

Health and Safety performance indicators remain good and are ahead of CRL targets.

### Financial:

The Intervention Points have not changed since Period 9. The AFCDC at P50 has not changed from Period 9 and remains at £12,464m. The AFCDC at P80 is also unchanged at £12,507m, which is only £5m under IP2. The AFCDC at P95 exceeds IP2 by £35m. During Period 10, the risk allowance reduced by £71m to £328m, including Unresolved Trends, but the allocation is not identified. [REDACTED]

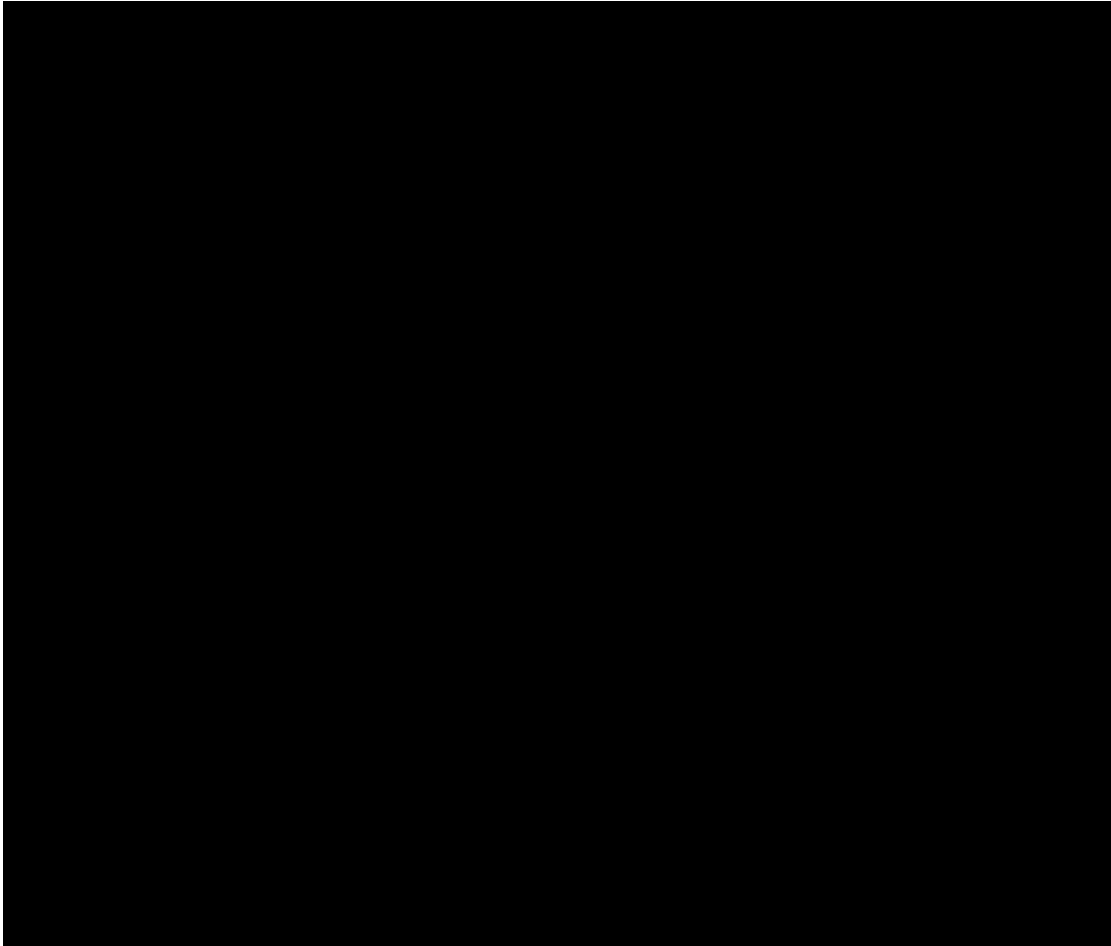
[REDACTED] There is a risk that further schedule delays, the need to implement possible mitigations, and any consequent inefficient working, will result in additional costs. There is a significant risk that increasing costs will result in a breach of IP2 at SACR19, if not before. The CRL reported On Network Works (ONW) Anticipated Final Cost, excluding VNs, remains at £2,376m and the estimated Final Forecast Outturn Cost is reduced to £2,480m to reflect the £28m cash funding.

### Schedule and Progress:

Zones 1 & 2 energisation has slipped further in the period with Early Dynamic Testing (EDT) planned to start on 25 February 2018. Zones 3 & 4 Dynamic Testing has been pushed back to commence on 11 June 2018. The chart at Figure ES - 1 below illustrates the impact of these, and previous delays, on the actual/forecast progress compared to baseline dates.

CRL has developed a detailed schedule which contains the functional scope of the dynamic test sequence and the necessary train software functionality. Schedule development has been supported by progressive discussions which are taking place between CRL and RfL/LU, to agree handover arrangements on completion of dynamic testing. These discussions point towards a staged transfer of assets which will take place around the current formal Handover date of 5 July 2018. While agreement in principle has been reached to target the start of Trial Running on 5 August 2018, the schedule is ambitious and commitment from all CRL contractors and the Infrastructure Managers (IMs) has not yet been secured.





CRL continues to prepare a revised MOHS for issue in February 2018 which will set out a schedule framework for the completion of the Crossrail Programme. MOHS will contain assumptions for activities and deliverables outside CRL control, such as train availability and IM readiness, so it will not provide guarantees. Planning for activities to the end of dynamic testing is reasonably robust, but arrangements for the post-Handover period are less clear and will be subject to further discussion and agreement after the MOHS has been formally issued. However, significant challenges remain with timely completion of fixed infrastructure and there is a high risk that train software development will not keep pace with project requirements. Success relies increasingly heavily on right-first-time delivery. Precise asset handover dates are uncertain, and current start dates for Trial Running, Trial Operations and Stage 3 Opening are at serious risk.

### **Stage 2 Opening:**

Stage 2 Opening as described by Sponsors Requirements will not be achieved because of continuing delays to BT train software development, testing and assurance. An alternative plan is now in place in which Class 360 rolling stock is retained for Heathrow services, with Class 345 Reduced Length Unit's secured from the Great Eastern operating services between Paddington and Hayes & Harlington. These arrangements are temporary, awaiting the delayed completion of the original Stage 2 BT programme. CRL should formally convey this information, plans for migrating back to its original plan, and the impact upon dynamic testing to Sponsors. Initial testing in the Heathrow spur, originally planned to start at the end of October 2017, has taken place; arrangements for further testing are being made by BT.

**Stage 3 Opening:**

Significant challenges remain with the completion of Stations and Rail Systems installation and integration, to support both dynamic testing and subsequent staged handover of assets to RfL and LU. The development and testing of rolling stock Communications Based Train Control (CBTC) functionality remains in significant delay, and plans to make better use of off-site testing facilities, such as the Crossrail Integration Facility, are being promoted within CRL in order to provide technical support and facilitate some schedule recovery. The IMs are extremely concerned at the delays and ongoing slow rates of progress in CRL's provision of training, Operation & Maintenance manuals, and other documentation. As an illustration, only 12 training courses of the 72 planned have been completed which is indicative of delays being experienced more widely in handover deliverables production. There remains a significant risk that one or more stations will not be fully operational by December 2018 (██████████), and that Stage 3 Opening will not be achieved on the planned date.

**Stage 4 and 5 Opening:**

Procurement arrangements for the construction of the stabling sidings at Plumstead Depot which are required to support Stage 4 services, have yet to be resolved by CRL. Concern remains at the signalling system that will be in place on the Great Western Main Line at the time of Stage 5 Opening, despite the expiry of the Office of Rail & Road Train Protection & Warning System (TPWS) derogation, due at the end of December 2019.

**Assurance:**

Significant concerns remain at the slow progress in the preparation of supporting evidence for Safety Approvals and Regulatory Approvals for Stages 2 and 3. Progress is behind plan in resolving critical Agreements.

**Old Oak Common Depot:**

Old Oak Common Depot energisation has been achieved, but resolution of residual issues will delay Bringing Into Use (BIU) of Section A. Construction difficulties will introduce further delay to BIU of Sections B1, B2 and C. There are consequential impacts upon the planned build-up of the rolling stock fleet and the provision of support to testing on the Heathrow Spur, which BT is seeking to address.

## 1 Schedule and Progress

### 1.1 Summary

A new Master Operational Handover Schedule (MOHS), which should take into account all stakeholders and partners detailed schedules, is due to be presented to the CRL Board meeting on 1 February 2018. Upon receipt, we will carry out a review for our next report. Due to the various delays set out below, there is an increased risk that Stage 3 will not open on time.

### 1.2 Progress

Progress in Period 10 has been poor. There have been a number of delays to significant activities in the Central Section since Period 9, such as Zone 1 & 2 energisation (16 days) and Early Dynamic Testing (27 days), and Zone 3 & 4 energisation (33 days) and Dynamic Testing (49 days), which have delayed commencement of Trial Running (31 days) and Trial Operations (34 days). These delays are in parallel to delays in train software development and testing. Although CRL's forecasts indicate all remaining Stages will be opened on time, we remain sceptical. The details set out in this report describe the large amounts of work to be completed by CRL, in ever decreasing amounts of time.

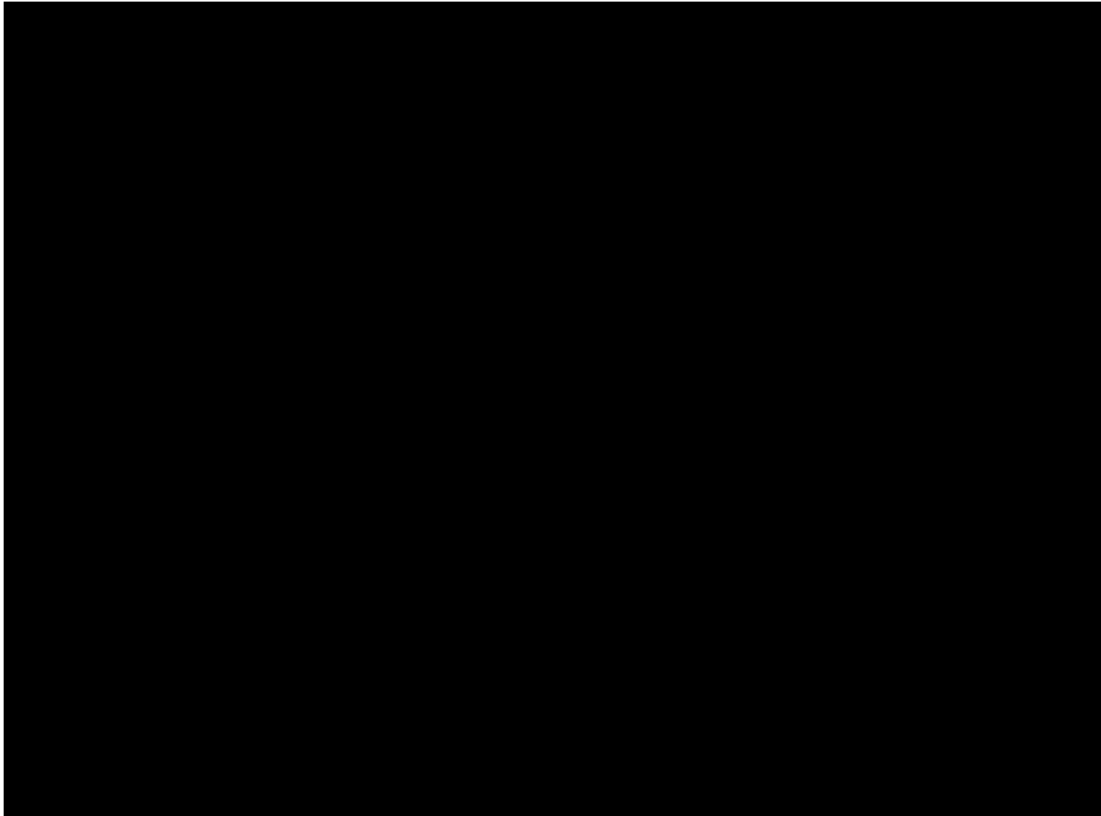
Sponsors will be aware of the Carillion receivership. This has had minimal impact on CRL's work in the Central Section, and minor impact on the NR ONW. Further details are described in Sections 2.3.1, 5.3.1, and 7.4.

#### 1.2.1 Central Section

Figure ES - 1 in the Executive Summary shows the CRL forecast and actual cumulative progress of Anchor Milestones set against the MOHS baselines. This indicates that CRL's contractors have slipped further behind many milestones (46 forecast to be later than [REDACTED] previous 41), with minimal progress in Period 10; and will continue in a period of no float until Period 2 (May 2018). The current forecasts are now substantially behind MOHS to such an extent that it does not serve its purpose as a baseline schedule. The [REDACTED] dates will be reset once the new MOHS is issued in February 2018. The CRL Board Report continues to give details<sup>1</sup> of its QSRA at the end of SACR18 with a confidence level of 71%. This is no longer relevant and we would expect this to be much lower if a QSRA was repeated.

Progress charts for the Systemwide projects [REDACTED] indicate the continuing delays across most projects. [REDACTED] the substantial delays across all Systemwide projects, but we expect these will all be shown as 'on time' once the MOHS dates are re-set. An important feature of the forecasts across most projects is that a variety of work needs to be completed after formal Handover, in some cases during Trial Running and Trail Operations.

<sup>1</sup> CRL Board Report for Period 10 page 9 'Schedule Risk'.



The main progress issues and schedule challenges across the COS are:

- Completion and integration of Rail Systems for Dynamic Testing;
- Energisation, Dynamic Testing and Handover;
- Test Train availability;
- Completion of Stations;
- Integration of Stations Systems;
- Assurance and Agreements documentation;
- Safety authorisations.

Figure 1 - 2 sets out the Corporate Key Milestones selected by the CRL Board as part of its KPI incentive scheme for the CRL Executive, shown with the MOHS [REDACTED] and the CRL Period 10 forecasts. The latest date recently declared by CRL for the start of energisation sequence Traction Power (Energisation Z1&2 ATFS) is 31 January 2018, with EDT starting on 25 February 2018. Commentary regarding the delays in Zones 1 & 2 Energisation and EDT is included in Section 3.5. We understand that new Corporate Milestones for FY2018/19 will be agreed at the March 2018 Board meeting.

Corporate Key Milestone	Description	[REDACTED]	Period 9 Actual / Forecast	Period 10 Actual / Forecast
1	Stage 1	[REDACTED]	22-Jun-17	22-Jun-17
2	All Track Complete (excl WHI EB)	[REDACTED]	10-Jun-17	10-Jun-17
3	FDO's held (excl PLU)	[REDACTED]	28-Sep-17	28-Sep-17
4	Commence Traction Power (Z1&2)	[REDACTED]	15-Jan-18	29-Jan-18
5	Commence Dynamic Testing (Z1&2)	[REDACTED]	29-Jan-18	25-Feb-18
6	Track connection at Westbourne Park	[REDACTED]	02-Jan-18	02-Jan-18

Figure 1 - 2 ~ Corporate Key Milestones

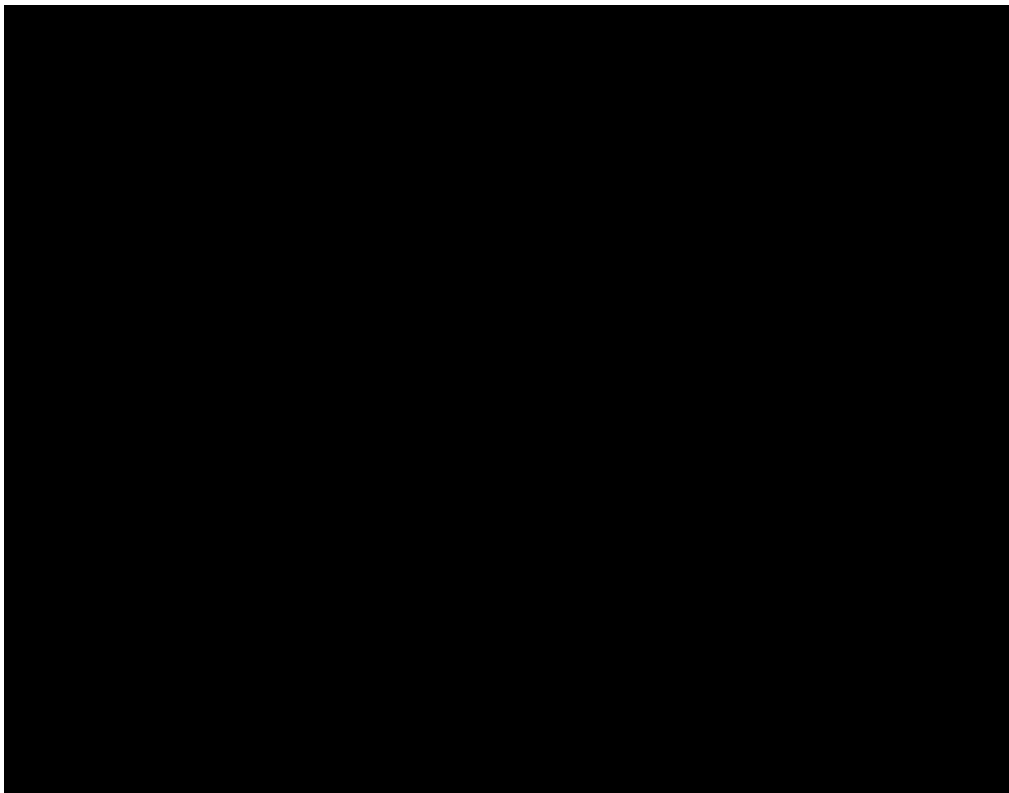
At the Risk Sub-committee on 12 January 2018, CRL advised the following:

- CRL Risk Team will demobilise by end of May 2018;
- Final QCRA will be March/April 2018 to inform SACR19;
- Risk and Cost format in Board Report to be revised post Period 13;
- No risk modelling will be carried out post March 2018, but period risk review will continue;
- P50 reporting will be provided post SACR19, but without risk 'S' curve modelling with P80 and P95 data;
- ARM will close down 1 May 2018;
- Active risks will be managed by Sectors via shared spreadsheet database;
- CRL will continue to provide central oversight to collect and co-ordinate Sector risk reporting and manage via bimonthly ExCom reviews;
- This was the last Risk Sub-committee.

CRL intend to write to Sponsors on these issues as some relate to obligations in the PDA. We are concerned that CRL may lose focus on risk management after May 2018, so will review these proposals upon receipt.

**1.2.2 NR ONW**

CRL and NR report that the ONW is 92% complete (previous 90%) based on expenditure of forecast cost, rather than actual physical progress. Figure 1 - 3 shows the forecast and actual cumulative performance of ONW key dates and milestones against the MOHS baselines. This information is shown at Period 9, as NR reports lag those of CRL.



In Period 10, NR reported over 550,000 hours were worked over the Christmas 2017 possession period across the ONW Programme, delivering major elements of ONW works critical to the opening of the railway. The key achievements are:

- Completion and reliable operation of Stage M signalling data change at OOCPA. The largest signalling data enhancement undertaken on Britain's railways;
- Delivery of PWay – the points at Ladbroke Grove and Royal Oak plus all associated infrastructure;
- Piling works for the new west enhanced station buildings;
- Commissioning the DOO cameras on Crossrail West, a greater quantity than had been planned and almost a week ahead of schedule;
- Undertaking significant electrification works including the High Voltage cable pull at Westbourne Park which completes the physical works required for KD33;
- Electrification of Platform 2 at Paddington station - the last platform at this station to be electrified;
- Installation of 14 Switching and Crossing units at Gidea Park Sidings;
- 10 wire runs and 8 de-wired runs at Shenfield;
- Significant progression of drainage and signalling at Pudding Mill Lane.

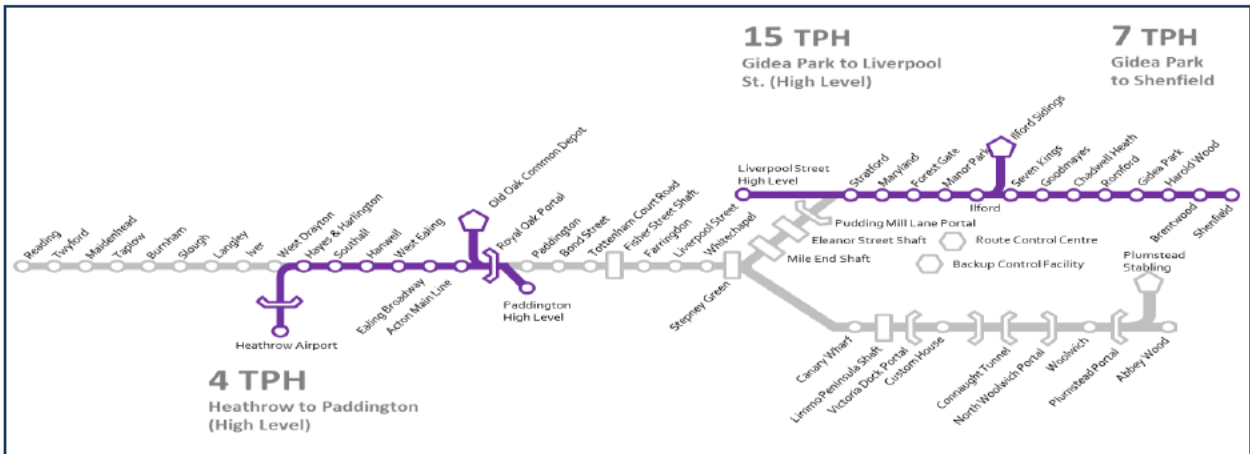
NR reports it is on target for the full signalling commissioning of the Pudding Mill Lane junction on the weekend of 3/4 February 2018 in support of Key Date 29b (5 February 2018 track commissioning for connection at PML to support Stage 3 trial running). This involves Signalling Final Commissioning of Pudding Mill Lane, Channelsea, Ilford and Gidea Park.

NR is reporting that Abbey Wood Station is planned to be substantially complete by the end of March 2018 in support of Key Output 2 (30 June 2018 SE Infrastructure complete, for Stage 3). However, there exists a key risk in respect of local community concerns in relation to drainage which NR is currently assessing and considering options. Additionally, the two forecourt lifts have been delayed due to commissioning issues.

At Goodmayes station, the installation of the new lifts is delayed due to works prohibition notices in respect of the existing overbridge which presently remains unresolved. NR is still reporting forecast completion to meet Key Date 20, 31 August 2018.

Refer to Sections 2, 4 and 5 for further information regarding NR works required for each Stage completion.

**2 Stage 2: Paddington to Heathrow; 20 May 2018.**



**2.1 Summary**

As predicted, Stage 2<sup>2</sup> as originally planned will not open on 20 May 2018. A contingency plan will be implemented instead.

*In May 2018 2TPH C345 RLU's will operate Paddington to Hayes & Harlington, 2TPH C360's will operate Heathrow to Paddington.*

*CRL and RfL are currently identifying a plan to migrate to the original Stage 2 plan, and assessing the implications for Stage 3 EDT.*

*Delays to Depot BIU programme will affect stabling capacity required for fleet build up.*

**2.2 Operational Readiness Assessment**

In our last report, we stated that we did not expect Stage 2 to be achievable by 20 May 2018. CRL has now confirmed that this is the case. It will proceed with its alternative plan to operate 2TPH of C360 stock Paddington to Heathrow, and 2TPH of C345 RLU stock Paddington to Hayes & Harlington. The RLUs will be taken from those currently in service on the East leg. CRL's current estimate for when the original plan could be implemented is late October 2018.

This is a practical decision to make under the circumstances. CRL and RfL's analysis of BT's programme<sup>3</sup> concluded that continuing with the original plan was not feasible. The other decision to make was whether a C345 FLU should be used for the Paddington to Hayes service.

The decision to not proceed with the FLU, whilst regrettable, does allow the most robust contingency plan to be implemented. CRL was going to submit an affirmation<sup>4</sup> to that

<sup>2</sup> As described in Sponsors Requirements 3.1.6.5, subject to Affirmation 027.  
<sup>3</sup> Submitted in w/c 8 January 2018.  
<sup>4</sup> Action 88b/2: CRL to prepare the affirmation on Stage 2 Plan B - Sponsor Board 11 December 2017.

effect to Sponsors, but we understand that it was agreed at the last Sponsor Board<sup>5</sup> that CRL would instead send a letter.

We believe the letter should describe:

- What service pattern (now known) will be in place for 20 May 2018, the risks to delivering that service and how they have been mitigated;
- The programme, including cost and risks, for migrating to the Stage 2 original service pattern;
- How the current situation will impact upon the train's readiness to support Stage 3 opening, and what steps are being taken to mitigate any adverse impacts.

It is likely that the information described above will not become clear until early February.

In this Section we report upon CRL's Stage 2 readiness tracker, but it has not been completed at time of writing. Since Period 8, CRL has not included the tracker in its Period report, but has instead used the Stage 2 Integrated Programme Dashboard. This is a useful reporting tool, but does raise the following questions:

- The format of the Stage 2 Readiness Tracker was agreed<sup>6</sup> as the method by which CRL would report progress to Sponsors. CRL only need to do this in its SACR reports, but if it has discontinued doing it for its periodic reports, is its worth devalued?
- We have assessed the Tracker and Dashboard red items, and there is alignment. However there were some other items on the Tracker which are not on the Dashboard, how are they being reported?
- The introduction of an alternative Stage 2 plan requires some form of reporting structure. Will it be part of the existing Stage 2 Integrated Programme Dashboard?

JST and PRep will discuss the above with CRL before the Period 12 reporting cycle to ensure Sponsors have sufficient oversight, and that the recommendations of the Project Assessment Review<sup>7</sup> are integrated into the process. We do not at this stage foresee any major concerns, as CRL is addressing the key issues no matter which format of reporting is being used.

## **2.3 Network Rail Works**

### **2.3.1 West Platforms and Stations**

NR report that the DOO/CCTV for Crossrail west is fully installed and tested. Over the Christmas 2017 possession period, NR reports it has commissioned a greater quantity of DOO cameras than had been planned, almost a week ahead of schedule.

Assurance packs for all platforms (incl. SAT documents) have been reviewed and are currently CAT1. The SAT documents contain Outstanding Works List, generated during the review (e.g. where temporary lighting was used to capture image, a re-visit is planned to capture final 'clean' shot). NR is intending to issue a handover deliverables list for agreement by CRL/RFL which is regarded to be consistent for both East and West sections.

NR reports that it has received a schedule that supports the forecast completion of the Hayes and Harlington bay platform in May 2018. NR has stated that it was working on bringing the

<sup>5</sup> 26 January 2018.

<sup>6</sup> As part of the 24 month notice process, May 2016.

<sup>7</sup> Issued by the Infrastructure and Projects Authority, 6 November 2017.



programme back to 4 April 2018. However, although the contractor, Carillion, has entered into voluntary receivership, NR has responded positively and has implemented a remedial plan that maintains delivery prior to CRL test and commissioning in April 2018.

### 2.3.2 Stockley to Maidenhead OLE

NR report that Key Date 12 residual works are complete:

- The NR connection of the Secondary Power Feed from OLE which allows the OOC Depot connection and manual operation of secondary supply;
- NR Stage M signalling to OOC Depot, although CRL require further commissioning stages that may require NR support.

The conversion of the OLE to AT power is forecast by NR to be completed by May 2018 in line with CRL schedule, but this is subject to traction power modelling verification presently in progress.

## 2.4 Rolling Stock

Testing of the train in the Heathrow tunnel has been carried out on two weekends<sup>8</sup>, with this now expected to be a common occurrence. The initial test trips have identified many issues, as was expected.

The schedule for the development of the train simulator remains the same as last period, with completion expected by the end of March 2018. The laboratory facility to be used by BT and Alstom remains forecast to be available from 19 February 2018. We are pleased that there is no further slippage to this item, but note that it was expected to be available in August 2017.

## 2.5 Old Oak Common Depot (OOC)

Energisation was achieved on 9 January 2018, which has allowed testing of Section A to begin. This has identified a number of issues that have contributed to its BIU date being delayed to mid-February 2018 (originally end November 2017). Construction difficulties in this period have also resulted in the BIU dates for Sections B1, B2 and C being further delayed. This results in the following:

- The depot is not currently available to support train testing in the Heathrow tunnel, which if it were would relieve the logistical pressures of dead hauling the train from Derby;
- There is a misalignment between the train delivery schedule and the stabling capacity at the depot. The trains may be able to be stored elsewhere, but they will be required to carry out fault-free running and mileage accumulation utilising the Elizabeth Line infrastructure. This could present a delay in having the requisite number of vehicles ready for some of the Trial Running tests.

A key concern to resolving the above is the commercial relationship that BT has with its sub-contractor. The management of the relationship is important in ensuring the depot can support the Crossrail programme as required.

The main works for signalling Section A of the depot is planned for 10 March 2018. We reiterate that this is a difficult activity, but if this date slips there are other periods available before Trial Running starts.

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<sup>8</sup> 12-14 and 19-21 January 2018.

## 2.6 Operations

MTR-C is generally well positioned to start progressing the alternative Stage 2 plan.

There is an issue with Selective Door Operation (SDO), in that it cannot operate on the RLU trains. This is being mitigated by skip stopping Hanwell station (no detriment to its current service) and implementing operating plans with NR to avoid platform 12 at Paddington station.

## 2.7 Agreements and Approvals

### Agreements

The three key agreements which are critical for Stage 2 cannot be finalised until the ORR publishes its determination of the matters in issue between TfL and HAL regarding the Framework Access Agreement. That determination was due by the end of January. RfL's assessment of the risk of delay remains at 'amber'.

There has been some slippage of the recently re-baselined critical Agreements programme across most areas during Period 10. The various disciplines responsible for the agreements report their confidence in the situation, but we reiterate our concerns stated in our last report regarding progress. See Appendix D.

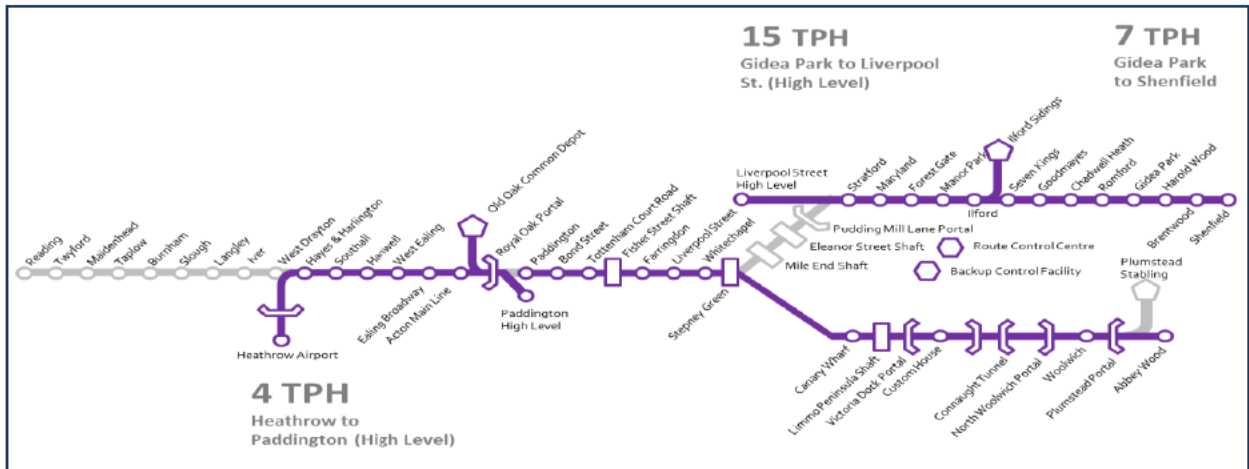
### Regulatory Approvals

CRL has rated the status of achieving regulatory approval for Stage 2 as 'red'. This is due to:

- "APIS for On-Board signalling". There has been no change since our last report. BT needs to complete its Technical File for submission to the ORR. That is reliant upon the test results being generated at Melton, but the testing programme is delayed; see Section 2.4.
- MTR SMS updated for Driver Training and ECS movements. This is red due to the late delivery (for start of driver training) of all elements of the cab simulator; see Section 2.4.
- MTR SMS updated for Passenger services. This is red due to the necessary information expected to be late, due to the circumstances described in this Section of the report.

We should point out that these evaluations are based upon achieving the original Stage 2 plan by May 2018. We would expect a reassessment at some point when the migration strategy to the original plan is identified.

**3 Stage 3: Paddington to Abbey Wood; 9 December 2018<sup>9</sup>.**



**3.1 Summary**

CRL is grappling with a range of issues, risks, and delays which threaten to delay Stage 3 Opening. There remains a significant risk that one or more stations will not be fully operational by December 2018 (██████████), and that Stage 3 Opening will not be achieved on the planned date.

*Continuing risk that some stations will not be ready for Opening on time.*

*Most Systemwide key dates have been delayed.*

*Commencement of Trial Running and Trial Operations has been delayed.*

*Rising risk that delays producing adequate Handover material will affect Handover to the IMs.*

*Delays to train software development likely to impact EDT.*

*CRL rate achieving the requisite regulatory approvals as 'red'.*

**3.2 Operational Readiness Assessment**

There are now twenty-five Readiness Tasks that have been given a “Red” by the Elizabeth Line Readiness Steering Group (ELRSG)<sup>10</sup>, an increase of two from the previous report. The causes for the increase are the delays to training programmes and delays to station Handover dates.

Eight of the tasks are rated as ‘medium’ impact, but have a cumulative impact upon RfL-I maintenance and LU staff being trained and competent, which is rated as ‘high’ impact. The twenty-five Readiness Tasks can be attributed to four categories:

- COS infrastructure not being in a position to support EDT;
- Train software not being in a position to support EDT;
- CRL not receiving data, or it being below the necessary quality, from the Tier 1 contractors. This impacts upon IM training courses for both operations and

<sup>9</sup> Stage 3 Completion of Trial Running is 9 September 2018; Stage 3 Opening is 9 December 2018.

<sup>10</sup> Meeting held 12 January 2018. This group was formally known as the ORSG.

maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway. The current rate of progress means it is likely that significant parts of the assurance necessary for Handover (July 2018) will be incomplete;

- Delays to the progressive assurance programme agreed with the ORR.

Taking into account the above, it is clear that assets will be ready for Trial Running activities at different times, with differing levels of Handover material available to support them. We believe that this situation will require a different approach to the current one. This would entail the IMs and CRL establishing:

- A staggered Handover that seeks to bring assets into use when they can be used as a cohesive part of Trail Running and Trail Operations activities.
- Prioritise Handover material where possible to facilitate Handover. This could result in a more extended asset Handover process between CRL and the IMs, but it might result in the asset being brought into use earlier than otherwise.

	Readiness Task	Issue
<b>Dynamic Testing Zones 1-2</b>		
	Infrastructure available and ready for Dynamic testing	The key concern continues to be the readiness of the Traction Power Energisation schedule. See Section 3.5.
	Delivery of FLU with functioning CBTC	The continued slow development of the train's TCMS CBTC functionality presents a high risk that a train is not available for dynamic testing during March 2018. See Section 3.9.
	MAID deliverables uploaded in Livelink <i>Medium impact</i>	Handover material is in delay. See Section 3.10.
	Implement RCA's (update processes and procedures) <i>Medium impact</i>	LU has continued concerns that the delay to receiving Handover material will affect implementation of its Risk Control Actions.
	RfL-I acceptance of FDO (for interfacing assets) <i>Medium impact</i>	FDO certificate dates are continuously moving back, (now February / March 2018) delaying parts of Handover material and impacting upon Interim Acceptance. We discuss the issues in Section 3.8.2.
	<b>NEW</b> Training of RFLI staff on CCRRB (Crossrail Construction Railway Rule Book)	This relates to the general delay in training. Without this knowledge necessary works to be carried out post-Handover will be impeded or suspended.
	Systemwide approvals and agreements in place for DT	Related to traction power readiness. Uncertainty over conclusions to LoNo's, approvals etc. See Section 3.8.
<b>Dynamic Testing All Zones</b>		
	Interfaces commissioned & operational for Trial Running	The delay to the IM training schedule raises the risk that RfL-I and NR operatives will not be able to facilitate testing and commissioning activities. This risk is being superseded by the lack of asset readiness.
	<b>NEW</b> MTR-C station Handover	The IM raises uncertainty concerning Handover dates and material.

	Readiness Task	Issue
	LU Elizabeth line asset data in Ellipse/ Maximo <i>Medium impact</i>	Handover material is in delay. See Section 3.10.
	Compliance Achieved (FDO signed without caveat)	Issue raised in 'RfL-I acceptance of FDO (for interfacing assets). See Section 3.8.2.
	O&M manuals in place for 5 LU stations <i>Medium impact</i>	O&M manuals are not being provided to the necessary quality in the required timescale.
	QRA data issued to LU	This Task is related to Handover, see Section 3.10.
	LU maintenance in place for Handover	The lack of O&M manuals and asset data described above risks LU staff being inadequately prepared.
	All tech training delivery to IM trainers	The IM trainers will in general not receive the expected training by the Contractors. The current programme is under intense pressure. See Section 3.10.
	O&M manuals for RfL-I completed.	Delivery of O&M manuals continue to be behind programme, affecting IM readiness. See Section 3.10.
	System information delivery (asset data, O&M manuals, training plans, MAXIMO) <i>Medium impact</i>	IMs not receiving the level of information required. This Readiness Task is similar to the 'O&M manuals completed' Task.
	RfL maintenance staff train the trainer complete	The training plan has changed to reflect the fact that in some cases this will not be achieved. See Section 3.10.
	Systemwide approvals and agreements in place for DT	The same issue as 'Systemwide Approvals' for Zones 1&2 noted above.
<b>Trial Running</b>		
	LU Comms DLO staff training familiarisation complete	The lack of Handover material continues to affect the ability to train LU comms staff.
	LU Handover achieved	This task is red due to the items listed above.
	RfL-I maintenance staff trained and competent	Red due to contractor training plans and asset availability. See Section 3.10.
	RFLI Ops & RCC staff trained, licenced & competent	The delays to the [REDACTED] 'drops' at the RCC has affected the Traffic Manager training programmes. Some will not be trained until after Handover.
<b>Stage Three Service</b>		
	LU Staff Ready to Open for Revenue Service	This task is red due to the items listed above.
	ORR issue APIS for COS assets	Tier 1 Contractors and CRL may not be producing assurance evidence at the required rate. See Section 3.8.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 3 - 1 ~ Readiness Tasks with "Red" Status

CRL has not listed it as a 'red' item, as it does not impact upon opening, but 4G and WiFi provision is listed as red within its Board report<sup>11</sup> as a number of risks have been identified. It intends to begin procurement in March 2018 for an interim solution for on-train WiFi for the start of Elizabeth Line services. This project will need to be in place at the start of operational service to avoid the Elizabeth Line incurring reputational risk.

### 3.3 Tunnels

The tunnelling contractor remains on plan for contract completion by mid-February 2018. The CRL site team is being demobilised in line with the assumption that the final settlement and project close-out will be achieved by the end of Period 3 (2018/2019). There is a risk that the project's close-out process may not be completed in line with CRL policies and procedures, if key resources cannot be retained.

### 3.4 Stations, Portals and Shafts

Percentage progress achieved at all stations in Period 10, with the exception of [REDACTED] is now broadly in line with plan. Refer to Appendix C, Figure C - 1 for details.

In the Period:

- Planned percentage completion for [REDACTED] has been re-baselined to 87%, coinciding with actual reported percentage completion;
- [REDACTED] each report a slight recovery in their percentage progress;
- The delta between planned and actual percentage completion at [REDACTED] has increased to -6% and that for [REDACTED] -2%;
- Schedule performance and forecast station completion dates have been held in the period, with the exception of [REDACTED] (2 weeks slippage) and [REDACTED] (a further 4 week delay).

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<sup>11</sup> Period 10, 'Operations Performance'.

[Redacted]

[Redacted]

[Redacted]

The suite of commercial agreements [Redacted] were signed by all parties just after the close of Period 10.

- [Redacted]
- [Redacted]
- [Redacted]

**Paddington Station**

[Redacted]

12 [Redacted]

- [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]

**Bond Street Station**

- [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]

- [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]

**Tottenham Court Road Station**

- [Redacted]
- [Redacted]
- [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]



- [Redacted]

**Farringdon Station**

[Redacted]

[Redacted]

**Liverpool Street Station**

[Redacted]

[Redacted]

**Whitechapel Station**

[Redacted]

[Redacted]

[Redacted]

**Canary Wharf Station**

[Redacted]

**Custom House Station**

[Redacted]

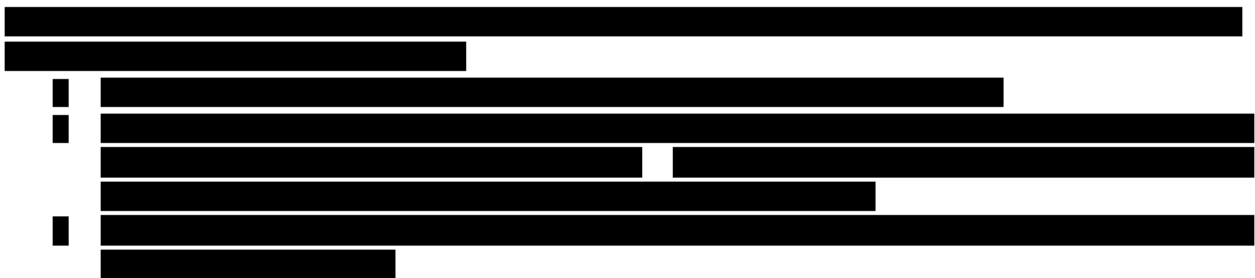
**Woolwich Station**

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

Intermediate Shafts



3.5 Railway Systems for EDT

Key dates leading up to EDT are shown in Figure 3 - 3. The table indicates the Period 10 forecasts plus any more recent updates. These will be updated and confirmed in the new MOHS.

Zone 1 & 2 EDT Key Dates	MOHS [REDACTED]	P9 Actual / Forecast	P10 Actual / Forecast	Revised Forecast
Limmo BSP commissioned	[REDACTED]	09-Jul-17	09-Jul-17	
Fibre Available	[REDACTED]	04-Jul-17	04-Jul-17	
Lineside signalling equipment	[REDACTED]	25-Jan-18	25-Jan-18	
Linewide SCADA Available	[REDACTED]	28-Aug-17	28-Aug-17	
PML BSP commissioned	[REDACTED]	04-Dec-17	04-Dec-17	
Stations signalling equipment	[REDACTED]	24-Oct-17	24-Oct-17	
PML ATFS commissioned	[REDACTED]	10-Jan-18	10-Jan-18	31-Jan-18
SG Traction Power SATS	[REDACTED]	18-Sep-17	18-Sep-17	
Plumstead Traction Power ATS	[REDACTED]	30-Oct-17	30-Oct-17	
HV Traction Power to OLE	[REDACTED]	15-Jan-18	19-Jan-18	31-Jan-18
1st train accepted and available	[REDACTED]	29-Oct-17	29-Oct-17	
Commence Dynamic Testing	[REDACTED]	29-Jan-18	19-Feb-18	25-Feb-18

Figure 3 - 3 ~ Zone 1 & 2 EDT Key Dates

CRL has continued preparations for energising PML ATFS, following the catastrophic equipment failure that occurred there on 11 November 2017. Progress has fallen behind the schedule set out in the [REDACTED] "Plan Delta", and the current target is now 31 January 2018<sup>13</sup>. Traction power will be progressively applied to the OLE for short-circuit testing and section proving, allowing EDT to start on 25 February 2018. Thereafter, dynamic testing will take place until 10 June 2018, with the exception of non-test periods specifically set aside for infrastructure completion. Significant completion activities include the integration of the current separate Zones 1 & 2 and Zones 3 & 4 elements of the SCADA and Traction Power supply systems.

CRL is now providing for a nominal period of 15 weeks for dynamic testing in Zones 1 & 2, although there might be some scope for adjustment through the adoption of different train paths and working patterns. This schedule is predicated on energisation progressing without setback and the prior completion of all dynamic testing dependent works; it also assumes the delivery by BT of a reliable test train with appropriate functionality and that dynamic testing proceeds

<sup>13</sup> Discussed at the RAB(C) meeting held on 31 January 2018.

without significant issues. While all of these activities carry risk, we particularly struggle to accept the credibility of the rolling stock assumption. Further details are provided in Section 3.7. The long-booked interface possessions in March 2018 for signalling testing across the NR GEML interface will not now be used for dynamic testing, but will be retained for the delayed installation of CBTC equipment by [REDACTED] on NR infrastructure. Additional possessions have been secured in April 2018 by CRL, to accommodate the late start to EDT.

Broken rail baseplates in Connaught Tunnel have emerged as an unforeseen risk to the completion of dynamic testing in Zones 1 & 2; the cause is under investigation; see Appendix D.2.3. Until the baseplates are replaced, the emergency speed restriction that has been imposed as a safety measure will prevent dynamic testing at higher trains speeds. CRL is developing plans for replacement and it is anticipated that impact upon the testing schedule will be avoided.

### 3.6 Railway Systems for Completion

Key dates leading up to full Dynamic testing are shown in Figure 3 - 4. The table indicates the Period 10 forecasts plus any more recent updates. These will be updated and confirmed in the new MOHS.

All Zones 1 - 4 DT Key Dates	MOHS [REDACTED]	P9 Actual / Forecast	P10 Actual / Forecast	Revised Forecast
Fibre Available	[REDACTED]	19-Mar-18	19-Mar-18	30-Mar-18
Traction Power to WBP ATS	[REDACTED]	18-Jan-18	18-Jan-18	28-Feb-18
Linewide SCADA Available	[REDACTED]	16-May-18	29-May-18	29-May-18
Stations signalling equipment	[REDACTED]	17-Apr-18	26-Apr-18	
Lineside signalling equipment	[REDACTED]	16-Apr-18	09-Apr-18	
ONW Track connection at WBP	[REDACTED]	02-Jan-18	02-Jan-18	02-Jan-18
WBP ATS commissioned	[REDACTED]	16-May-18	29-May-18	10-Jun-18
HV Non Traction Power	[REDACTED]	31-May-18	13-Jun-18	01-Jul-18
HV Traction Power to OLE	[REDACTED]	07-Apr-18	27-Mar-18	10-May-18
Commence Dynamic Testing	[REDACTED]	23-Apr-18	23-Apr-18	11-Jun-18

Figure 3 - 4 ~ All Zones 1 – 4 Dynamic Testing Key Dates

Dynamic testing in Zones 3 & 4 is now planned to start on 11 June 2018, following the completion of the OLE energisation sequence between 10 May and 10 June 2018, but there is no schedule provision for unforeseen failures. Slippages since last period are largely due to the need to complete a range of energisation-critical installation activities highlighted in our last report (e.g. OLE, earthing and bonding, SCADA and trackside signalling systems). Productivity improvements are under investigation by [REDACTED] to recover recent poor schedule progress with OLE installation.

CRL is now providing for a nominal period of 6 weeks for dynamic testing in Zones 3 & 4, followed by 3 weeks testing in all Zones starting in July 2018, in order to demonstrate integrated signalling functionality. Once again, the schedule is predicated on energisation from WBP ATFS progressing without setback and the prior completion of all dynamic testing dependent works; it also assumes the delivery by BT of a reliable test train with appropriate functionality and that dynamic testing proceeds without significant issues. Further details are provided in Section 3.7.

The long-booked possessions at the NR GWML interface in May 2018 will not be used for signalling testing as originally intended, and CRL is looking to secure further dates in June and July 2018.

A range of activities will not be completed in time for formal Handover, restricted to those which are not required to support dynamic testing with signalling. The full scope of outstanding activities, along with arrangements for completion, have yet to be agreed between CRL and RfL. See Section 3.7.

### **3.7 Integrated Railway**

Improved clarity of the Class 345 test train dynamic testing scope has allowed the development by CRL of a detailed schedule containing the functional scope of the dynamic testing sequence up to Trial Running. While this falls short of the fully integrated plan for Crossrail completion that we have been calling for in past reports, the publication of a schedule which contains all principal dynamic testing activities prior to Trial Running across the whole of the Central Section is a positive step. It is anticipated that the dynamic testing sequence will form the core critical path in the forthcoming 2018 MOHS.

The schedule has been produced following discussions between CRL and RfL. A revised target date for the start of Trial Running of 5 August 2018 has been agreed in principle between the parties, which represents a slippage of 4 weeks. However, CRL acknowledges that the schedule is highly ambitious, and subject to the usual assumptions of flawless execution and test train provision by BT with appropriate and proven functionality. It also relies upon an increase in the number of planned signalling testing resources, an approach which [REDACTED] has yet to agree with or commit to. Recognising that the schedule is still under development, and despite the positive engagement between CRL and RfL, we remain unconvinced as to how, and exactly when, Handover and Stage 3 Opening will be achieved.

Working arrangements are being developed between CRL and RfL which will allow the completion of late activities from the time of Handover and into the Trial Running period. CRL has forecast that a wide range of activities will remain:

- [REDACTED] non-dynamic testing critical works (e.g. lighting, LV cabling);
- [REDACTED] removal of temporary works (e.g. lighting, fire main, radio);
- [REDACTED] permanent ventilation system testing;
- [REDACTED] completion of testing;
- [REDACTED] completion of integration testing with Rail Systems;
- [REDACTED] completion of integration testing with Stations.

Although now forecast by CRL to be completed beforehand, significant risk remains with the final delivery of HV Power and Tunnel Ventilation systems. Both of these systems must be transitioned from temporary to permanent configurations, with complex and direct dependencies upon the completion of Stations power, earthing and bonding, systems, and upon [REDACTED]

Refer to Systemwide progress charts in Appendix B.

## 3.8 Approvals, Assurance and Agreements

### 3.8.1 Final Design Overview (FDO) Performance

Most of the progress has been on the Portals (24 Reds closed) with only limited progress made on the stations. 50 Red Issues were closed or downgraded to Amber during Period 10 and 83 Amber issues were closed, leaving a total of 327 Red issues open; comprising 210 Stations, Shafts and Portals issues and 117 Systemwide issues.

- All CRL Red comments have now been closed on Limmo shaft, North Woolwich Portal and Victoria Dock Portal.
- All remaining RfL “Red” issues are proposed as closed by CRL.
- Liaisons with RfL to confirm their agreement to the closure of the remaining issues to allow the FDO Certificates to be fully signed off continues.
- CRL and RfL continue to meet regularly to progress the agreement of closure of remaining issues.

Completion of █████ assurance deliverables remains a focus for █████ in order to support and facilitate FDO close-out.

### 3.8.2 Interoperability

The Interoperability liaison meeting was held on 18 January 2018. Key points as follows:

- CRL’s Authorisation Strategy document to be submitted to ORR by the end of January 2018;
- The CSM document is forecast for submission to ORR by April 2018;
- CRL’s Technical File, including all systems, to be submitted to ORR early in September 2018.

### 3.8.3 Regulatory Approvals

CRL has rated the status of achieving regulatory approval for Stage 3 as ‘red’. This is caused by its assessment of receiving an APIS from the ORR for Central Section assets. We are concerned that the safety deliverables will be problematic to complete due to:

- Design: Slow progression through RAB-C and concerns voiced by the AsBo that it is not receiving material in sufficient time.
- Testing and Commissioning: There continues to be a lack of visibility as to what the quantum and schedule is for the safety deliverables required for this stage. This is also a concern to the AsBo.

CRL has proposed key dates<sup>14</sup> for the Safety Case development; these will be confirmed in the new MOHS. Finalisation of safety documentation relies upon documented outputs from site testing, so further delays to dynamic testing are very likely to impact Safety Case completion and downstream securing of Regulatory Approvals.

### 3.8.4 Agreements

TfL has not finalised its commercial strategy regarding a potential recovery from NR of the capital cost of the Kensal Green and Pudding Mill Lane bulk supply points. It is therefore possible that the current informal interim arrangements could be in place during the testing and commissioning phase and, potentially, for the start of commercial operation.

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<sup>14</sup> As presented at CRL MOHS review meeting 19 January 2018.

There has been some slippage of the recently re-baselined critical Agreements programme across most areas at Period 10. The various disciplines responsible for the agreements report their confidence in the situation, but we reiterate our concerns stated in our last report. See Appendix D.1.

### 3.9 Rolling Stock

The continuing delays described in Section 2.4 affect the ability of the train to be ready to support Early Dynamic Testing once an initial series of tests, that do not require signalling, are completed. These are expected to take circa 2 to 3 weeks, requiring a train with some level of signalling functionality by early to mid March.

The decision to operate a Plan 'B' for Stage 2 means that there may be some flexibility in prioritising the CBTC testing element of the programme. This could facilitate the provision of a train with some level of signalling functionality earlier than may have been the case. However we urge caution, based upon previous software development performance.

We would also add that the train's software architecture is configured so that the version of TCMS (v7) required for passenger service will need to incorporate ETCS and CBTC functionality. So the technical issues affecting Stage 2 will need to be resolved, if Stage 3 is to enter into passenger service.

### 3.10 Handover

Handover is now at a critical point. There appears to be a fundamental misalignment between when the IMs will receive the agreed materials, and what CRL is able to provide. This affects the key areas of Asset Information, Training, O&M manuals and, in some cases, Spares.

There are a number of reasons why the situation has arisen. A key one is that CRL's programme originally planned for completion of the assets well in advance of Handover. For example, ██████████ was expected to be approved for Initial Acceptance in October 2017, with another 19 assets following between then and May 2018. The delays to the programme have meant that designs remain uncompleted, which affects asset information, O&M manuals and training. This does not explain all the delays affecting Handover, with Tier one contractor performance and concerns of a slow review process by CRL and IMs contributing to the situation.

Systemwide ██████████ performance has been identified as a specific issue. It contributes a significant proportion of the Handover materials due to the number of systems it is providing, but appears to be substantially under resourced to deliver it. CRL has instructed it to provide additional resource.

To illustrate the issue, a recent presentation of MOHS<sup>15</sup> showed that IMs had currently accepted 25 of an estimated 600 O&M manuals, and 12 training courses from an expected 72 have been completed.

We believe there will need to be a fundamental review of the programme that will be more bespoke to each asset, depending upon when it is ready, and what are the priority items that must be in place for the IMs to put it into use.

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<sup>15</sup> MOHS review 19 January 2018.

### 3.11 Trial Running and Trial Operations

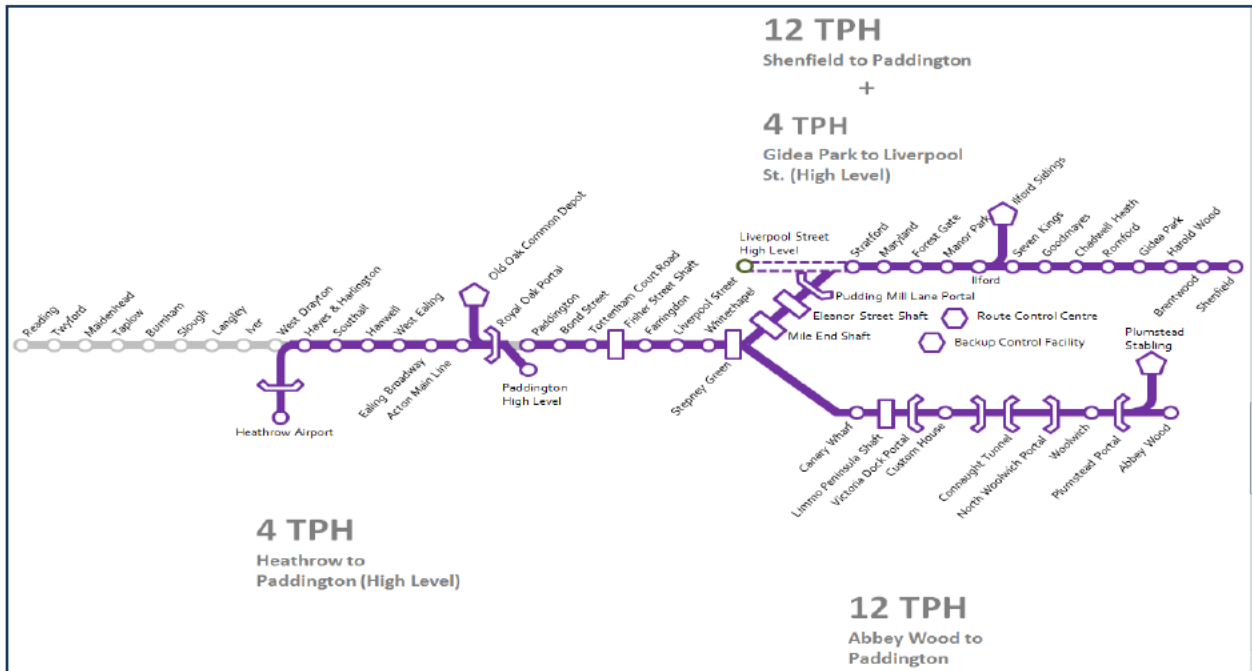
As we explained in Section 3.2, we would expect the plan for Trial Running and Trial Operations to change to reflect the realities of the overall programme. This will require the IMs to be flexible, and could necessitate a blurring between the two modes depending upon what and when a configuration of assets is available to the IM in question.

We will develop this theme as the programme is clarified during the MOHS process. We are aware<sup>16</sup> that Trial Running is now forecast to start a month later than previously planned, and Trial Operations by 5 weeks.

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<sup>16</sup> MOHS review 19 January 2018.

**4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.**



**4.1 Summary**

At this time all issues for Stage 4 are being dealt with, although there is an emerging risk at Plumstead Depot.

*Negotiations continue regarding revised stock movements from Ilford Depot.*  
*Risk that Ilford wire height programme will not support Stage 3 service planning, or Stage 4 driver training.*  
*NR is forecasting Ilford Station to be open by December 2019.*

**4.2 Operational Readiness Assessment**

There are four Readiness Tasks that have been given a “Red” status by the ORSG<sup>17</sup>. Those that were red in Period 9 and have now improved are shaded grey.

Readiness Task	Issue
Wire height alignment corrected to standard in Ilford Depot	The scope is being reviewed by CRL, but as yet no construction or access plans to carry out the works have been agreed. The timing of the works is important. MTR-C wants to stable FLUs at Ilford Depot from December 2018. The next important date is Driver training starting in February 2019.

<sup>17</sup> 8 January 2018.



	Readiness Task	Issue
	KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The works have little schedule float. Full ATS is required by March 2019.
	<b>NEW</b> PML Eastbound Neutral Section Transition (incl Packet 44 data)	This issue was explained in Section 4.3 ‘Rolling Stock’ of our last report. BT and CRL Systemwide need to develop programmes to complement Stage 4.
	Ilford Depot exit speeds increased to support Stage 4 Timetable frequencies	Awaiting formal acceptance of the GA proposal to implement operational changes. See Section 4.3.
	Ilford Station Redevelopment	The design contract is expected to be let by the end of January 2018. NR is forecasting Ilford station to be open by December 2019. See Section 4.5.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with "Red" Status

### 4.3 Ilford Depot Line Speed Enhancement and Wire Heights

CRL and NR have agreed<sup>18</sup> the alternative proposal to revise stock movements from Ilford Depot, instead of carrying out infrastructure works to enable a 15 mph departure at the London End. CRL is currently waiting for DfT confirmation in response to CRL’s proposals issued to DfT on 15 December 2017 seeking confirmation that DfT are content with the details of the proposal, and its impact on the current and future franchise arrangements.

CRL has received and is currently assessing<sup>19</sup> the constructability report and general layout drawing proposals for the wire heights project from NR. We expect an outline plan from CRL to report progress in Period 11.

### 4.4 Plumstead Depot

CRL continues to negotiate with [REDACTED] [REDACTED] for construction of [REDACTED] Plumstead stabling sidings. CRL is considering other options in case these negotiations fail.

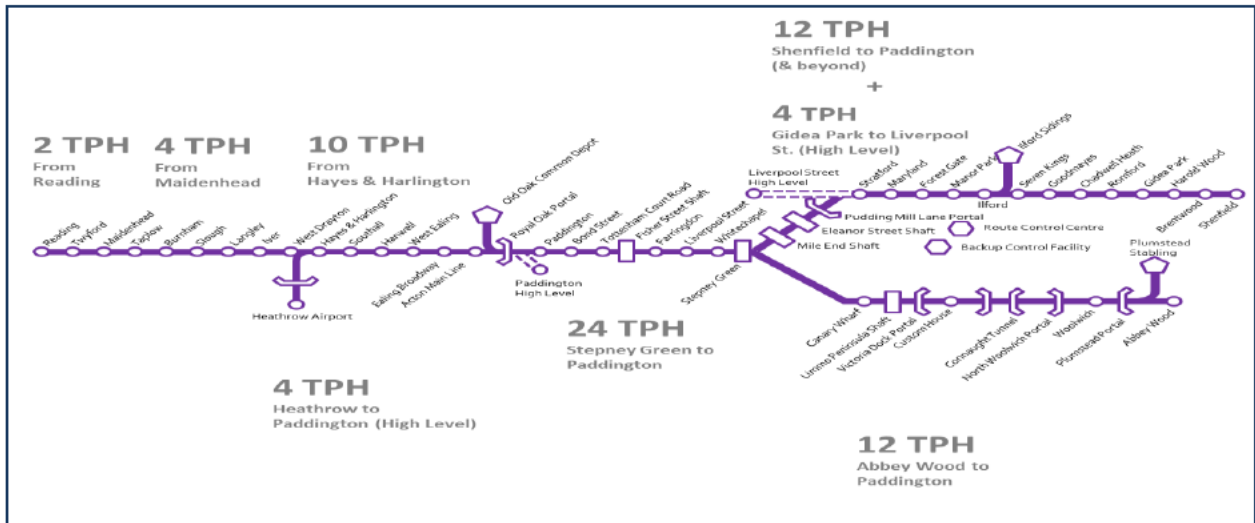
### 4.5 Ilford Station

NR is reporting that progress is on schedule for the enhanced station works at Ilford. The design contract was due to be let by the end of January 2018 and NR internal governance is progressing to award delivery contracts. NR is forecasting Ilford Station to be open by December 2019.

<sup>18</sup> Confirmed at NR PDB 23 January 2018.

<sup>19</sup> Confirmed at NR PDB 23 January 2018.

**5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.**



**5.1 Summary**

Although the ORSG has raised five Readiness Tasks to red RAG status, most issues are being mitigated. The key issues being monitored are ETCS and the West Enhanced Stations.

**5.2 Operational Readiness Assessment**

There are five Stage 5 Readiness Tasks that have been given a “Red” status by the ORSG<sup>20</sup>.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	NR’s programme has little schedule float. There will not be enough time to complete driver training as currently programmed. See Section 5.3.2.  In our last report, we reported that there was a concern that if ETCS was not installed by NR then there was a risk that trains could not transition between CBTC and TPWS at line speed. There is now an emerging consensus within CRL that, with some modifications, this will be possible.
Dynamic testing of CBTC to ETCS interface at Westbourne Park	There has been some progress, with CRL and NR agreeing to develop dynamic and lab testing requirements. Nevertheless, the Task remains red until these are agreed.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019, with little float available. Carillion also had a level of involvement. See Section 7.5.

<sup>20</sup> 2 January 2018.

	Readiness Task	Issue
	Maidenhead Sidings complete for C345 FLU stabling inc staff accommodation	The issue concerns staff accommodation. A mitigation is likely. See Section 5.3.1.
	ORR issue APIS for ETCS (stage B & C)	Linked to 'ETCS available and tested airport Jn' task.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

*Figure 5 - 1 ~ Readiness Tasks with "Red" Status*

### 5.3 Network Rail Works

#### 5.3.1 Platforms and Stations

NR reconfirmed at the Period 10 NR PDB that funding for the West Enhanced stations from DfT is in place. NR further report that the West Enhanced stations detailed design for Hayes & Harlington, Southall and West Drayton is on course to be available by end of January 2018 and detailed design for Acton, West Ealing and Ealing Broadway by mid-February 2018.

NR report that the advanced works for the West Enhanced Stations remains on schedule and has undertaken mitigation measures in respect of the voluntary receivership of Carillion; further detail is provided in Section 7.5. NR also report that the Main Works ITTs have been issued, mid-tender reviews held and GRIP 5 completion expected by 8 February 2018 to allow NR award recommendation by end of April 2018. Current progress reporting by NR supports its affirmation that all West Enhanced stations are on schedule for December 2019 completion.

At the P10 NR PDB, CRL expressed concern with NR in respect of visibility of the progress for the GRIP 4 design for the Staff Accommodation at Maidenhead Sidings. NR confirmed that the design is linked to the station and Greater West stakeholder requirements. The accommodation is needed for Stage 5; forecast delivery is by September 2018. Discussions are ongoing for alternative delivery options that may offer more sustainable and affordable benefits, with CRL proposing that delivery may be transferred to MTR-C.

#### 5.3.2 ETCS Delivery on the GWML

##### Stage A (Heathrow):

The Alstom Safety Justification Report remains on course for SRP acceptance by the end of January 2018. NR continues to assess the impact to the Network Rail Safety Justification Report due to the application of the Common Safety Method process to the Operational Rules Development. NR has reported that this may impact on the start of driver training. We will continue to monitor and report progress and any issues as they arise.

##### Stages B & C (Stockley-Acton & Acton-Paddington):

During Period 10, NR has undertaken a technical and schedule review of ETCS key risks, principally:

- CBTC interface may require further design integration and definition of specific dynamic testing requirements;
- Co-ordination of Configuration and management of conventional signalling changes and ETCS scheme design;
- Interface with other projects, for example HS2.

NR reported progress indicates that Stages A and B & C are on target for being delivered within budget and to programme. Whilst we concur that programme milestones continue to be achieved as planned, we will continue to monitor that cost performance is in line with budget and funding constraints.

## 6 Health & Safety

### 6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. Although the HSPI has dropped this period due to late and missing reports over the Christmas holidays, especially at [REDACTED] we expect this will be resolved for Period 11.

Again, CRL and its Principal Contractors (PCs) prepared well for the Christmas/NYE break so, as predicted, the lagging lost time incident frequency rates were not impacted by the usual industry wide annual cycle of poor results over the holiday period.

H&S KPI	Target	Period 9	Period 10
HSPI	2.20	2.58	2.48
PCs scoring over 2.20	11	11	10
RIDDOR AFR	0.15	0.07	0.07
LTC AFR	0.23	0.17	0.16

Figure 6 - 1 ~ Health and Safety Performance COS

Two contractors continue with over 1 million hours without a lost time incident, and another three contractors continue with over ½ million hours.

A further delay in the commencement of energisation has created another gap in CRL's preparation for the increased H&S risks. CRL and the PC's are aware of the need to re-focus on the particular hazards and the change in risk profile when the trace in Zones 1 & 2 is energised during late January 2018.

CRL continues its fire safety assurance process to ensure all sites are prepared in case of fire. As well as updating of 'Grab Packs', the Crossrail embedded LFB officer has spoken to all PCs to make sure that temporary or permanent falling mains are adequate for any emergency.

For several months now, we have been concerned about the status of the Construction Phase H&S Plan for Canary Wharf Station works. We understand that the Plan is being updated by [REDACTED], and should be complete during Period 11.

We note that most of CRL H&S staff are due to complete their time on Crossrail by June 2018, even though some construction works are planned to continue to December 2018. Also, CRL's duties as Client under the CDM Regulations continue until works are complete and H&S Files are issued by the PCs. We have raised this issue with the CRL H&S Director, who has advised that some roles described in the approved Business Plan for 2018/19 may be extended.

### 6.2 Health & Safety Performance ONW (NR)

During Period 10, NR undertook a comprehensive programme of works over the Christmas 2018 period. The major focus throughout the 10 day possession period was on close calls, with over 2,300 raised with the trends being good practice, housekeeping, slips, trips and falls and plant and equipment. However, despite this continued focus, there were eleven safety incidents and also eight work related accidents. NR is currently investigating all incidents and accidents.

## 7 Cost

### 7.1 Summary

The Intervention Points and AFCDC have not changed in Period 10, although we expect costs to increase before SACR19 (Period 13), if not before. The ONW AFC, excluding VNs, remains at £2,376m, and the estimate for the ONW FFOC has reduced by £28m to £2,480m.

*IP0, IP1 and IP2 have not changed in Period 10.*

*The AFCDC (P50) has not changed from Period 9 and remains at £12,464m.*

*The AFCDC (P80) is also unchanged at £12,507m which is only £5m under IP2.*

*The AFCDC (P95) exceeds IP2 by £35m.*

*During Period 10, the QRA reduced by £71m to £328m.*

*The AFCDC (P50) exceeds the reported financial budget by £108m.*

*The CRL ONW AFC, excluding VN's, remains at £2,376m.*

*The estimated FFOC is reduced to £2,480m to reflect the £28m cash funding.*

### 7.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 10. The AFCDC (P50) has not changed from Period 9 and remains at £12,464m. This exceeds IP1 by £552m with only £48m headroom to IP2. The AFCDC (P50) exceeds the reported financial budget by £108m and is in excess of the RP4.2 Baseline funding of £12,136m by £328m. The AFCDC (P80) is also unchanged at £12,507m, which is £595m above IP1 and only £5m under IP2. The AFCDC (P95) exceeds IP2 by £35m.

(£ millions)	Period 9	Period 10	Delta	Movement
<b>Forecast</b>	<b>12,064</b>	<b>12,135</b>	<b>71</b>	up
Delivery Risk	18	16	-2	down
<b>Subtotal</b>	<b>12,082</b>	<b>12,151</b>	<b>69</b>	up
Programme Risk	378	309	-69	down
Board Risk	4	4	0	same
<b>AFCDC total</b>	<b>12,464</b>	<b>12,464</b>	<b>0</b>	same
IP0	11,672	11,672	0	same
<b>IP0 Headroom</b>	<b>-792</b>	<b>-792</b>	<b>0</b>	same
IP1	11,912	11,912	0	same
<b>IP1 Headroom</b>	<b>-552</b>	<b>-552</b>	<b>0</b>	same
IP2	12,512	12,512	0	same
<b>IP2 Headroom</b>	<b>48</b>	<b>48</b>	<b>0</b>	same

Figure 7 - 1 ~ AFCDC (P50) headroom to Intervention Points

During Period 10, the QRA reduced by £71m to £328m. CRL has provided an outline description of the main areas of risk drawdown to fund Delivery level cost increases, but it has not provided the links to the specific risk allowances within the QCRA. The overall CRL reported Delivery risk allowance at Period 9 was £18m which is inadequate on its own to fund the Period 10 risk drawdown. It is therefore unclear where the £71m is specifically drawn from.

£157m of the £328m P50 risk exposure is URTs, a decrease of £56m from Period 9 (£213m). Pure risk, excluding URTs, has decreased in Period 10 by £15m to £171m, (Pure risk at Period 9 was £186m). The percentage of pure risk as a proportion of cost to go (including URTs) for Period 10 remains at 21%.

CRL continues to repeat the same proposals with respect to its efforts to remain within funding but we continue to note the following:

- The AFCDC (P50) exceeds the reported financial budget by £108m;
- The headroom to IP2 for the AFCDC (P50) is £48m. The AFCDC (P95) exceeds IP2 by £35m;
- Although CRL continues to focus on cost reviews to challenge contractor data and identify cost saving opportunities, the analysis of defined cost and target cost continues to indicate an increasing trend in both. See Section 7.4;
- Realistic opportunities for major cost savings from reviewing remaining scope and revisiting VERP initiatives at such a late stage of the programme are highly improbable.

Figure 7 - 2 indicates the cumulative delivery overspend at each period.

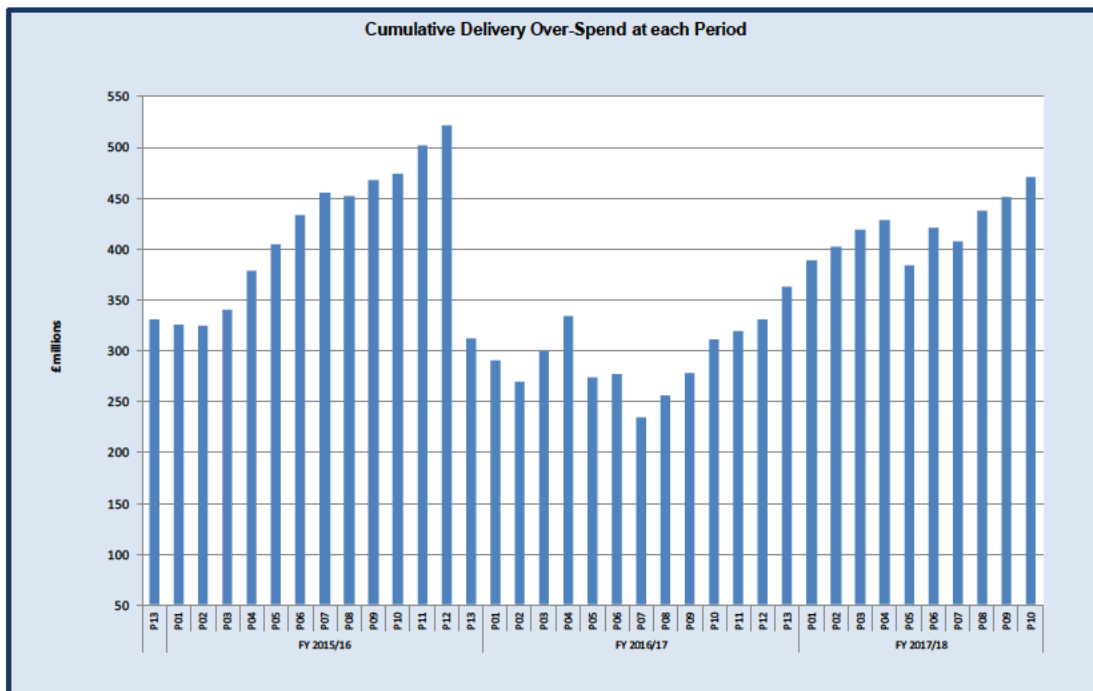


Figure 7 - 2 ~ Cumulative Delivery Overspend at each Period

Over the past three Periods, delivery overspend has been steadily increasing (£63m). The cumulative delivery overspend has increased in Period 10 by £20m to £471m (Period 9 £451m). CRL reports that spend and performance in Period 10 continues to be dominated by Stations and Systemwide, which together accounted for 83% of Delivery’s Cost of Work Done in Period 10.

CRL reports that, in Period 10, it spent £18.3 above the 2017/18 Business Plan. This is mainly due to:

- Lower than planned productivity, access delays and prolongation at [REDACTED] (£11.1m);
- Prolongation and delays at [REDACTED] (£4.3m);
- Prolongation and delays at [REDACTED] (£4.0m);
- Prolongation, scope changes and design cost increases at [REDACTED] (£2.7m);
- Delays arising from changes to the master plan shaft sequence at [REDACTED] (£2.7m);
- Other net overspends (£4.3m).

This expenditure was offset by £10.8m of apparent unspent Programme risk due to cost being reported in the Sectors.

### 7.3 Q3 QCRA review

As we reported in Period 9, the P50 AFCDC increased by £161m to £12,464m. CRL stated that this increase was a consequence of the refresh of Programme and Delivery risk following the Q3 QCRA (£149.2m) and an increase in Indirect Costs following the approval of the 2018/19 Business Plan (£12.2m). We received a copy of the Q3 QCRA modelling on 5 January 2018 which provides detail of the QCRA contribution to the Period 9 AFCDC increase. CRL provided a copy of the 2018/2019 Business Plan on 16 January 2018 and a full review is presently being carried out to report in Period 11.

The CRL QCRA is the collation of Programme Unallocated Risks, Programme Non-Delivery Risks and Delivery Risks. The Q3 QCRA is reported by CRL as £399m, comprising:

- £359.5m Programme Unallocated Risk;
- £22m Programme Non-Delivery Risk;
- £17.5m Delivery Risk.

The URTs modelled within the Q3 QCRA amount to £204m. A further £7m of URTs is included in technical, operations and surface sectors, but these have not been modelled by CRL. The total sum of £211m for URTs that is included in the £399m P50 risk exposure represents a decrease of £27m from Period 8 (£238m). Consequently, pure risk, excluding URTs, increased in Period 9 by £98m to £188m<sup>21</sup>.

Commercial Risks contribute £310.6m to Programme Unallocated Risk, comprising:

- £204m URTs;
- £72.4m Prolongation schedule risk;
- 34.2m for potential AFC increases.

Previous QCRAs factored a probability value for URTs. Due recognition has been given at Period 9 that URTs have certainty of implementation, but not necessarily in value. Consequently, the URT value included in Programme Commercial Risk is for the full mean value of Period 9 URTs.

Unallocated risks have reduced by £3.1m from Period 8 to Period 9.

<sup>21</sup> Rounding error CRL Board Report states £96m and £186m respectively.



CRL has £22m provision at the Q3 Period 9 QCRA for Programme non-delivery risks which principally relate to Land & Property identified risks. This has marginally decreased by £2m from Period 8.

Delivery risk has decreased to £17.5m at the Q3 Period 9 QCRA following the reassessment to 5% of cost to go, exclusive of unresolved trends and the transfer of £20.4m to Programme Unallocated Commercial Risks. The methodology of delivery risk reassessment appears to be arbitrary and appears not to correlate with current risk drawdown. In Period 10, CRL reported cost increases at [REDACTED] (£44.6m), [REDACTED] (£13.2m), [REDACTED] (£4.5m) and other net increases (£8.8m) were funded by a £71.1m drawdown from risk. Additionally, at Period 10 CRL is reporting £76m of potential URT drawdown against a £16m Delivery Risk provision.

The Q3 Period 9 QCRA has not introduced any new risks. CRL has stated<sup>22</sup> that the sum of £149.2m contribution to the Period 9 AFCDC increase has been principally the result of the full value for URT valuation. It is evident that the Commercial Risk reported by CRL under Programme Unallocated Risk, £310.6m of the £399m QCRA, is pivotal with respect to the value and distribution of risk provisions. However, these commercial allowances are more akin to cost rather than risk provisions. There remain known areas of risk reported by CRL without provision such as delays associated with BT train delivery and software interfaces, Ilford Depot line speeds and wire heights, potential cost increases for the new MOHS, potential project cost increases<sup>23</sup> and new potential challenges linked to the Carillion collapse, [REDACTED] electricians disputes and [REDACTED] prolongation disputes, which may impose cost pressure on the reported AFCDC. [REDACTED]

[REDACTED] At this stage, the majority of Commercial Risk may be regarded as live issues to be closed out during the currency of the Crossrail Programme, and consequently the majority of the QCRA sum has already been committed to be spent. The remaining CRL reported risk is 'pure risk', i.e. there is a possibility it may not be spent.

#### 7.4 Cost: Central Operating Section (COS)

CRL is reporting that all commercial agreements with [REDACTED] were signed just after the Period 10 end. [REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

<sup>22</sup> CRL Period 9 Board Report.

<sup>23</sup> For example [REDACTED]

<sup>24</sup> Discussion with Commercial Director and Head of Risk 22 January 2018.

[Redacted text block]

[Large redacted text block]

[Redacted text block]

- [Redacted list item]
- [Redacted list item]
- [Redacted list item]
- [Redacted list item]

### 7.5 Cost: On Network Works (ONW)

The CRL ONW AFC, excluding VNs, remains at £2,376m in Period 10. However, the Period 10 CRL estimated FFOC is reduced to £2,480m to reflect the £28m cash funding NR secured via the DfT Grant Funded Agreement. The £28m is separate cash funding that CRL advise does not qualify as NR Programme Costs. The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,409.6m, which exceeds the DfT Invention Price of £2.3bn by £109.6m.

Figure 7 - 4 tabulates the reported CRL figures inclusive of pain share.

Description	Period 9 AFC £m	Period 10 AFC £m
CRL AFC plus VN Allowance	2,376	2,376
Pain/gain share	-70	-70
Scope Impacts & VNs	132	104
Potential Grant Payments	0	0
Overall Cost	2,438	2,410
DfT Intervention Price	2,300	2,300
Headroom to DfT Intervention Price	-138	-110

*Figure 7 - 4 ~ Headroom to the DfT Intervention Price*

The collapse of Carillion on 15 January 2018 has had an impact on the ONW. Carillion has delivered and completed works for ONW and its works at OOCPA are near completion. NR has reported that the loss of Carillion may cause a significant impact to the ONW schedule completion dates for Key Output 5b, 10 September 2018 for Stage 5 (December 2019), but less of an impact on the overall Crossrail timescales.

The ongoing activities that were to be delivered for the ONW by Carillion are as follows:

- West Outer stations works (West Drayton to Twyford) comprising of platform extensions, DOO CCTV installation and stations Communications installations. The work was currently in progress for delivery by September 2018. The consequences of a delay arising from Carillion going into receivership threatens the Key Output 5b date. NR is reporting that costs could be impacted in terms of both finding a new contractor and also extensions of time on the NR programme, which is currently due to complete by September 2018.
- West enhanced stations preparatory and advance works; in order to meet critical key programme delivery dates, NR separated out the ground work and advance works from the main GRIP 6-8 contract tenders and varied it to Carillion. The consequence of delay could be potential time and access opportunities lost against a challenging programme to complete these works by December 2019.

NR has advised CRL that it is reviewing options to deal with the Carillion position.

The remaining efficiencies and stretch savings are regarded by CRL as challenging and unlikely targets, given the advanced stage of works and potential cost risks associated with access delays and prolongation. However, NR is reporting a £15.6m improvement for recoveries in Period 10. NR has reported an overall increase of £12.9m in recoveries, opportunities and efficiencies. This increase is principally the result of NR increasing recoveries from VNs and other NR projects. The allowances for this Period are shown in Figure 7 - 5.

Description	Period 9 AFC £m	Period 10 AFC £m	Period Variance £m
Recoveries for VNs or other NR Projects	183.5	199.1	15.6
Recoveries (Realised)	29.7	29.7	0.0
Efficiencies	21.3	21.3	0.0
Opportunities	0.0	0.0	0.0
P80 & Programme Reserve ('Stretch Opportunities')	10.4	7.7	-2.7
Total Allowances	244.9	257.8	12.9

Figure 7 - 5 ~ NR's Opportunities, Efficiencies and Recoveries

A number of contracts, particularly [REDACTED] continue to report cost pressures on their respective AFCs. In addition to NR reporting that access risk may affect its anticipated final cost, we anticipate that further costs may be forthcoming in respect of mitigation measures to preserve key dates as a consequence of Carillion going into receivership.

CRL is reporting positive progress with the enhanced monitoring of cost and schedule performance, including commercial status of 'live' contracts, that it is continuing to be developed with NR.

CRL and NR still continue to seek resolution of the few remaining identified outstanding VNs as reported at Period 9.

## 7.6 Contingency

The Period 10 FCCB remains as £12,356m. The FCCB was aligned in Period 8 with the P80 AFDCD forecast, £12,356m. The Period 10 P80 AFDCD of £12,507m exceeds the FCCB by £151m.

There was a £89m decrease in the overall contingency budget in Period 10; this was due to:

- Increased construction support, logistics, prelims, tunnel ventilation, track installation and OHLE at Systemwide Main Works (£43m);
- Increased design costs, Systemwide changes and other scope changes at [REDACTED] Station (£17m);
- Indirect costs following the implementation of the 2018/19 business plan: driven by prolongation of roles, IT and accommodation costs (£12m);
- Cost increases at Intermediate Shafts (£6m);
- Changes to the design of the Crossrail Arch and associated programme mitigation measures at [REDACTED] Station (£5m);
- Other net changes (£6m).

The overall contingency budget of £199m is insufficient to cover the P50 risk exposure of £328m by £129m, a £17m deterioration from Period 9. The centrally controlled Delivery contingency has reduced in Period 9 by £8m to £48m. Although the risk exposure at Period 10 is back to Period 8 levels, the overall contingency budget is comparably 50% less.

The impact of the decrease in the Board and Programme Contingency is shown in Figure 7 - 6.

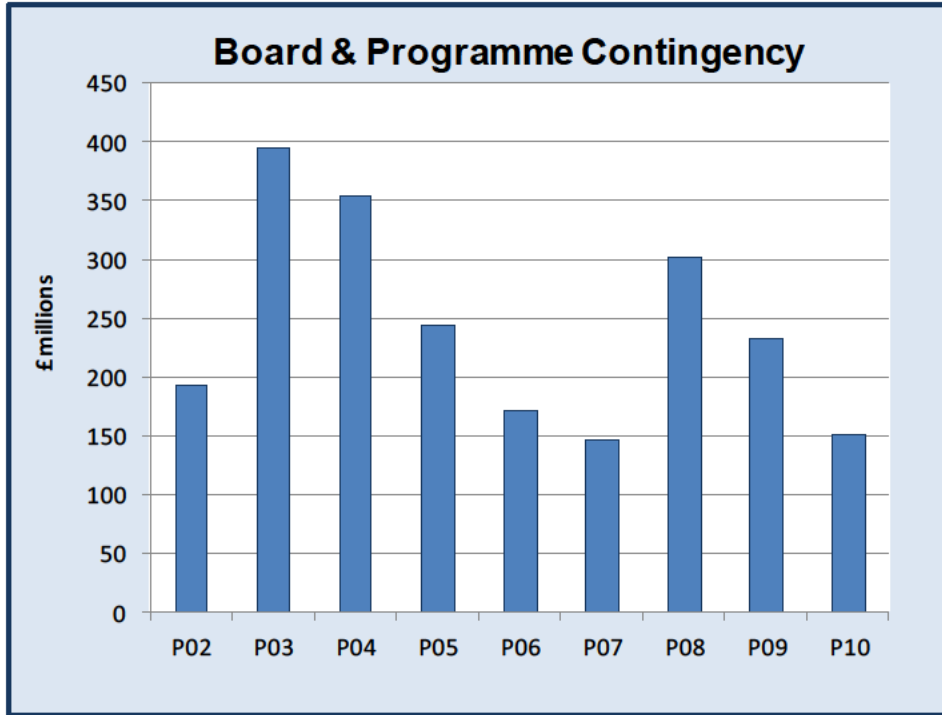


Figure 7 - 6 ~ Level of Board and Programme Contingency

Figure 7 - 7 compares the Risk Exposure at P50 and P95 with the remaining contingency.

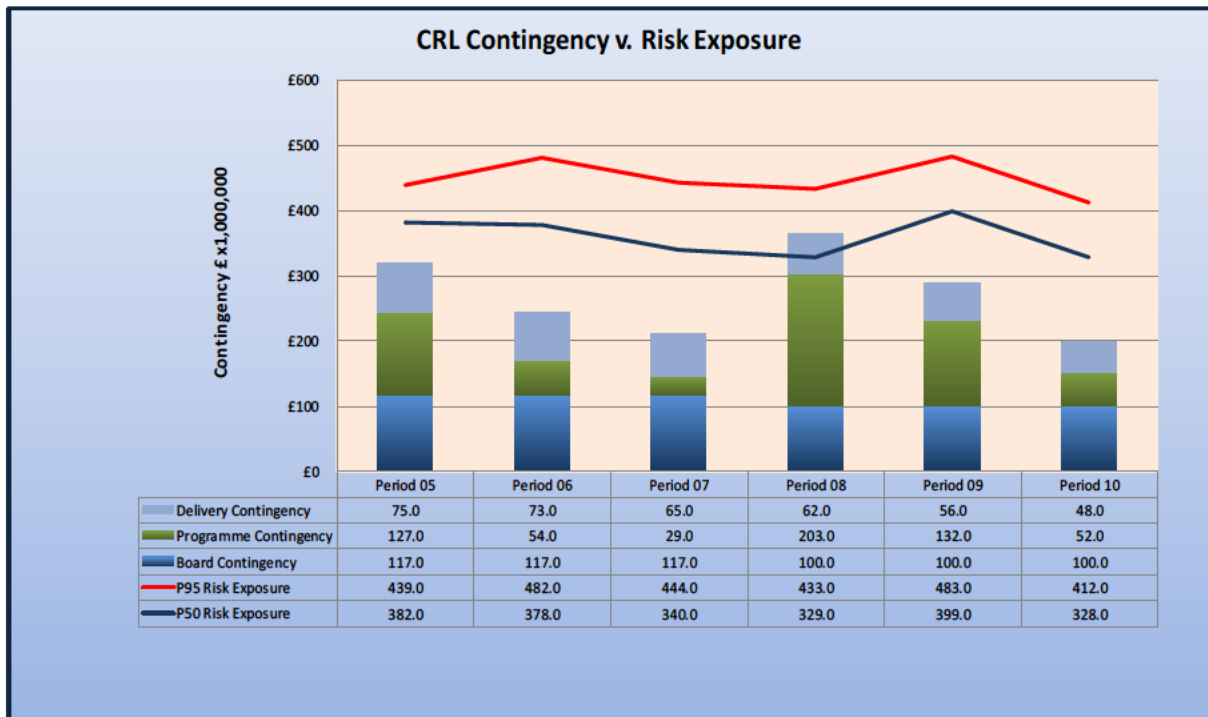
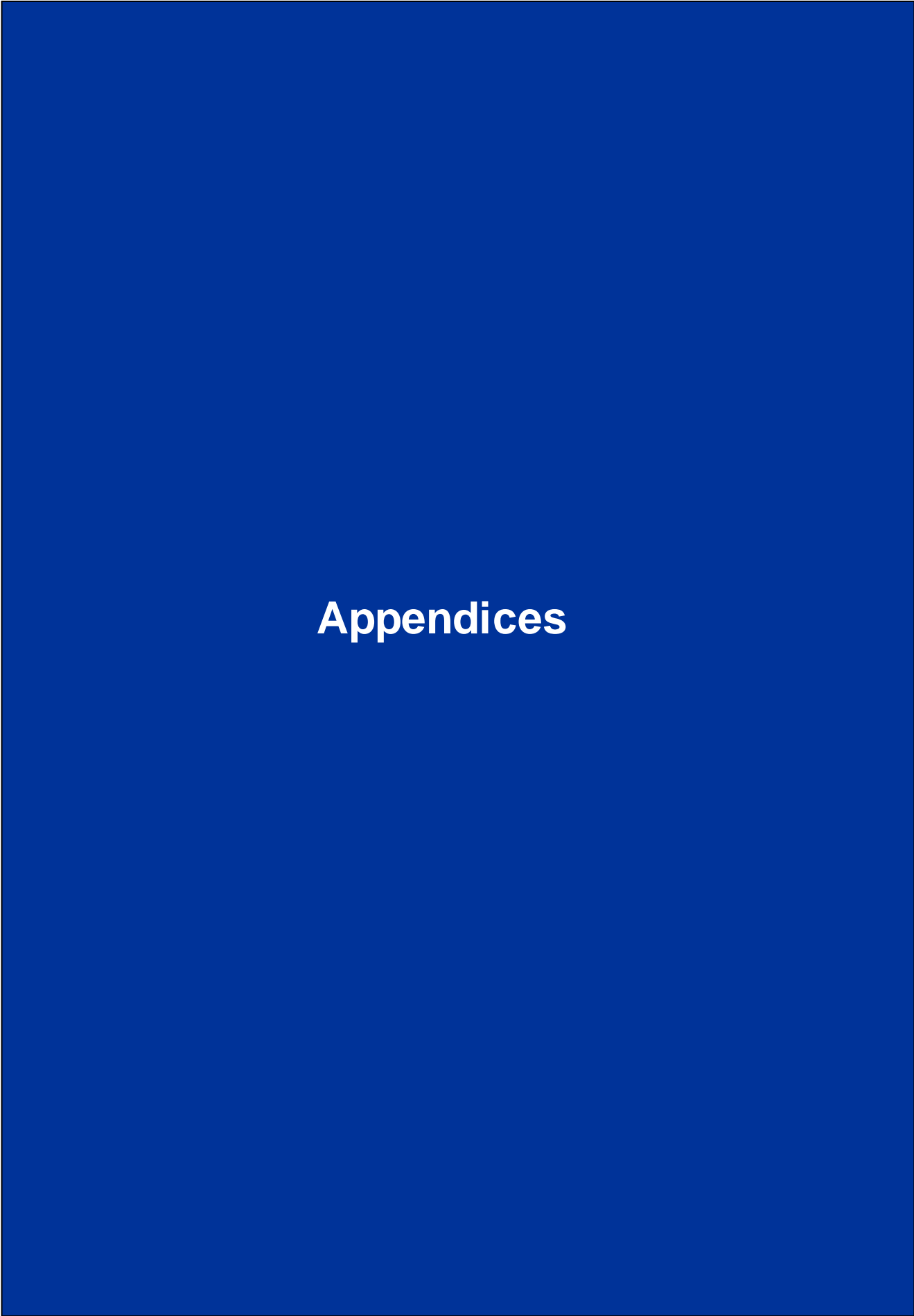


Figure 7 - 7 ~ Risk Exposure versus Contingency



**Appendices**

Appendix A Contract Administration

A.1 General

Figure A - 1, Figure A - 2 and Figure A - 3 illustrate the status of Notified Compensation Events (NCEs).

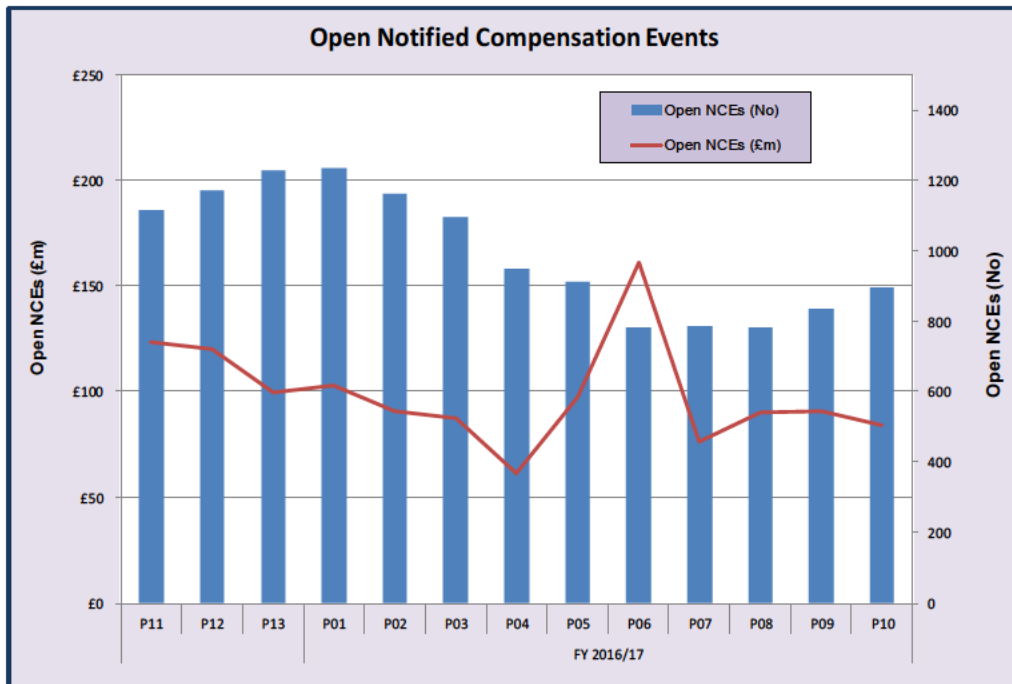


Figure A - 1 ~ Open Notified Compensation Events

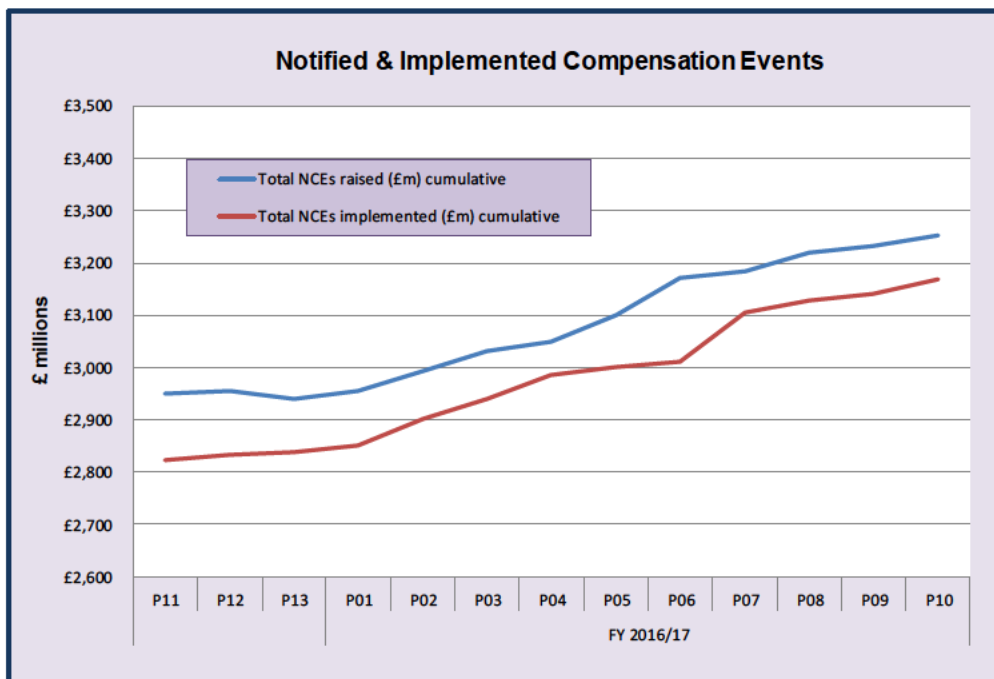


Figure A - 2 ~ Notified Compensation Events

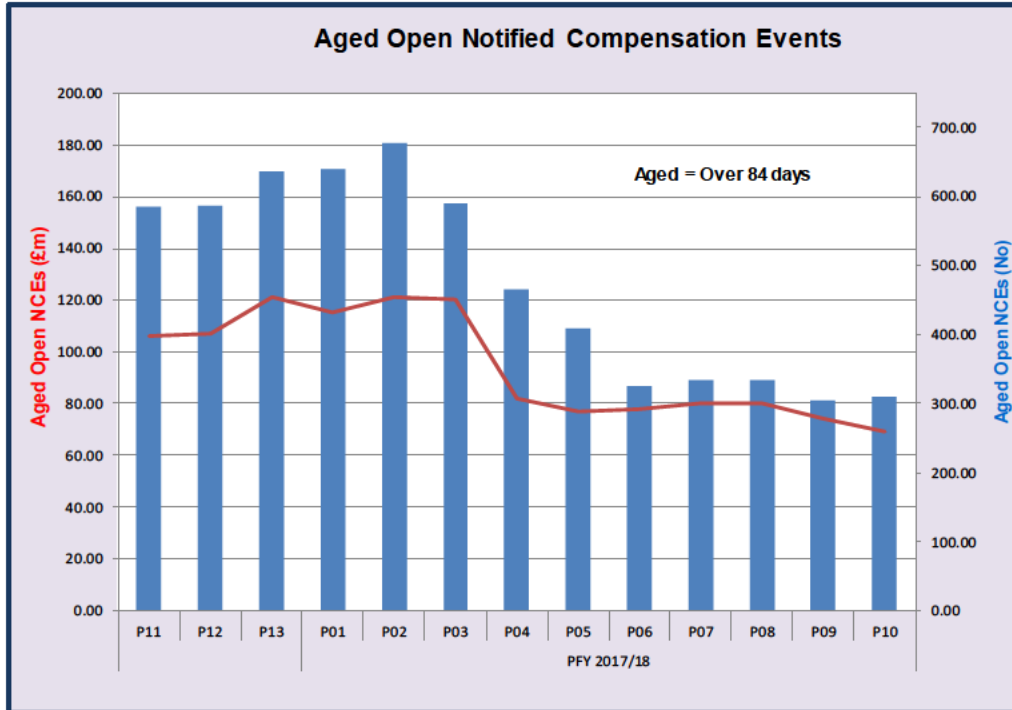


Figure A - 3 ~ Aged Open Notified Compensation Events

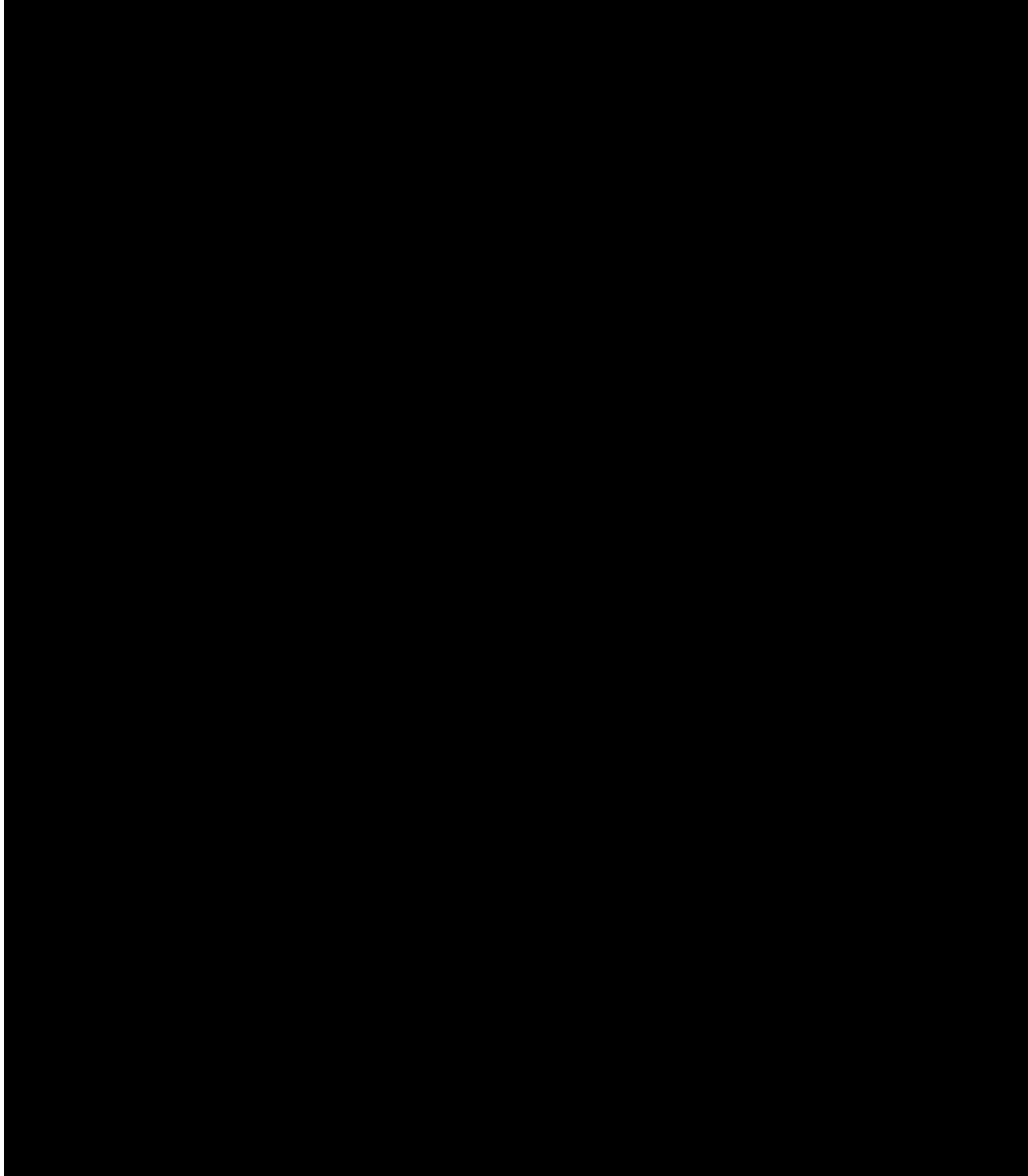
In Period 10, the total number of open NCEs increased by 60 to 897. However, the value of open NCEs decreased by £7m to £84m.

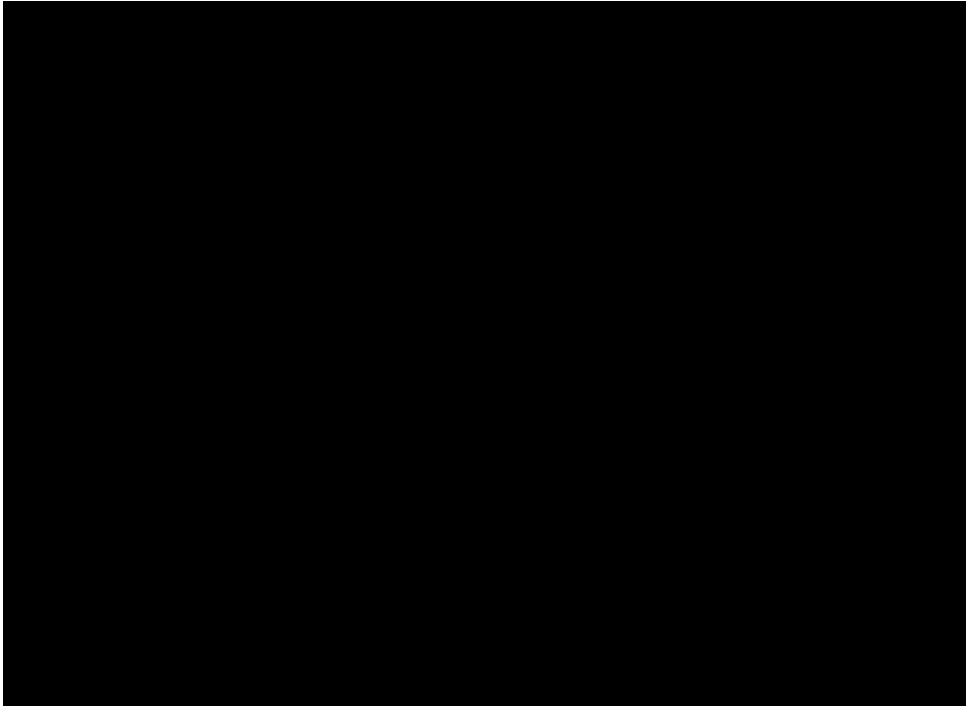
Contractors notified a further 338 Compensation Events in Period 10; 278 were processed in Period 10, with 202 implemented and 76 either rejected or withdrawn. Aged open NCEs increased marginally in Period 10 by 5 to 309, the percentage of aged open NCEs increasing to 34% in Period 10.



**Appendix B Schedule & Performance**

These charts indicate progress of each Systemwide project based on data received from CRL. This data will be substantially changed when the new MOHS is issued.





## Appendix C Stations

### C.1 Stations in the Central Section

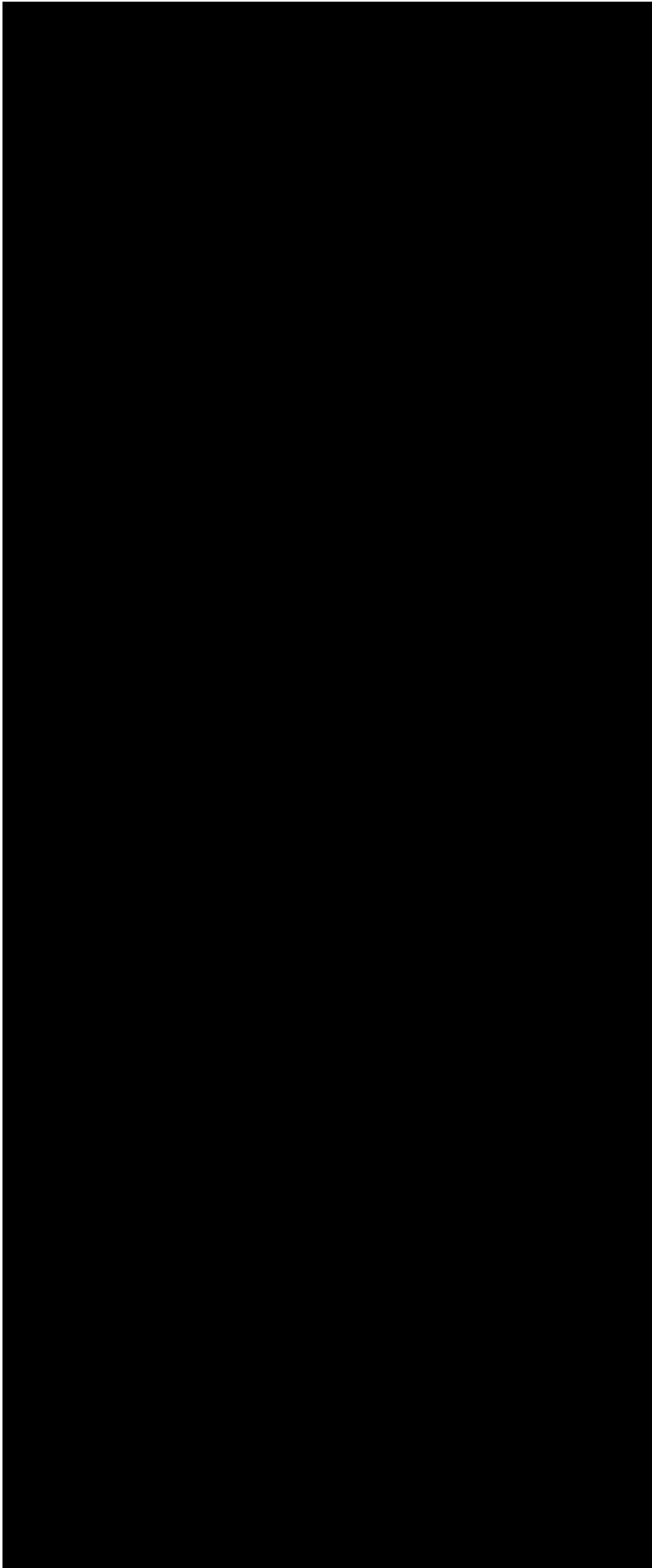
[Redacted]

[Redacted]

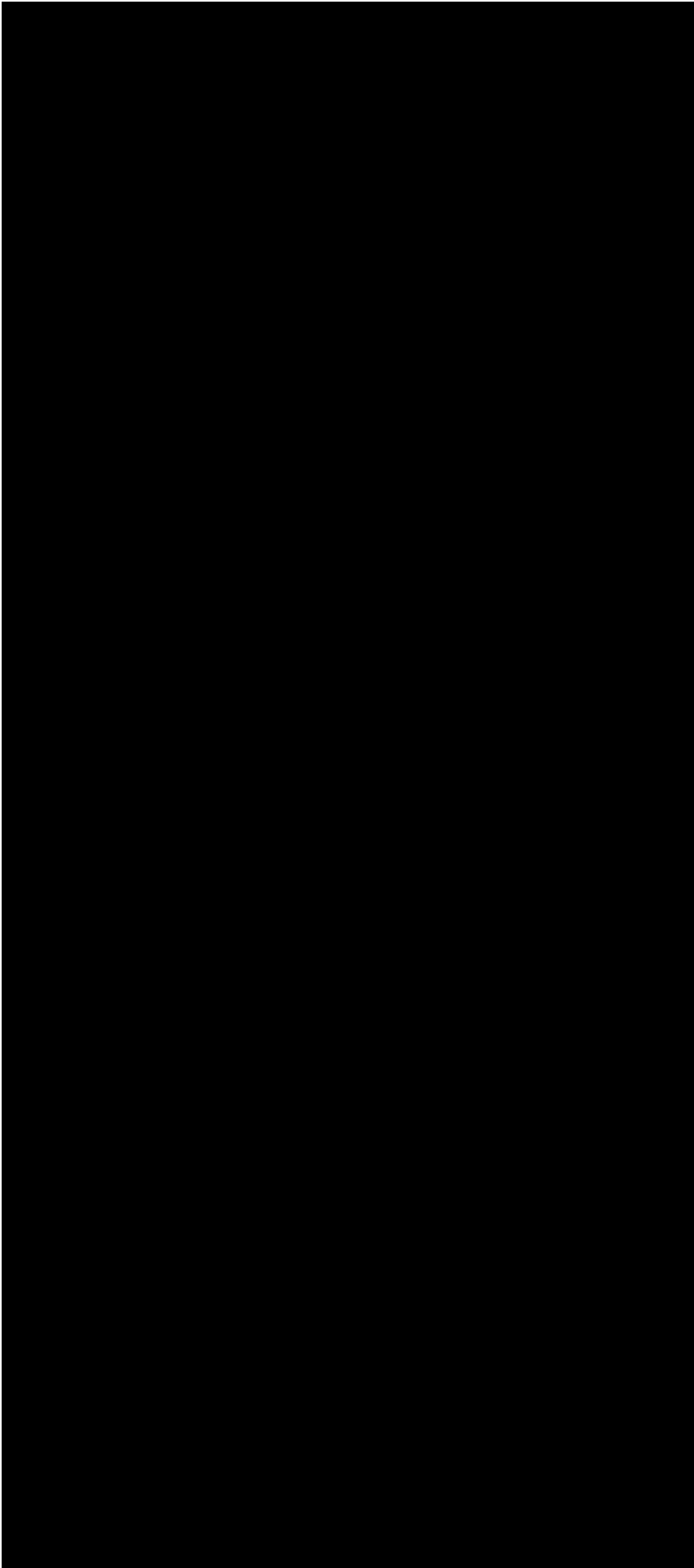
[Redacted]

[Redacted]

<sup>25</sup> Data has been abstracted from the CRL Period 10 (2017/18) station dashboards.



*ance*



**C.2 Interface Works and Handovers**

Room and route handover performance continues at a level less than plan. Planned and actual progress of accepted room and route handovers, as reported by CRL in Period 10 (Period 11, week 1), are summarised in Figure C - 9 to Figure C - 11.

Status as follows:

- CRL report Systemwide has received 201 out of 284 Red rooms and routes;
- All Priority 1 Rooms & Routes were handed over in Zones 1 & 2 and six Rooms & Routes are outstanding in Zones 3 & 4;
- CRL has achieved 834 handovers against a planned 1024 in the period, representing almost 81% of the total required;
- Key areas of concern remain [REDACTED] stations.

Contract	Location	Rooms & Routes					
		Total per Site	Accepted (No.)		Cum Handovers		Variance (%)
			Actual	Plan	Actual	Plan	
C405	Paddington	116	60	116	52%	100%	-48%
C412	Bond Street	92	50	85	54%	92%	-38%
C422	Tottenham Court Road	139	114	137	82%	99%	-17%
C435	Farringdon	98	85	96	87%	98%	-11%
C502	Liverpool Street	137	112	137	82%	100%	-18%
C512	Whitechapel	122	89	122	73%	100%	-27%
C530	Woolwich (CON, NWP, PLU)	110	104	110	95%	100%	-5%
C350	Pudding Mill Lane	60	60	60	100%	100%	0%
C360	Shafts	161	160	161	99%	100%	-1%
<b>Totals</b>		<b>1035</b>	<b>834</b>	<b>1024</b>	<b>80.6%</b>		

Figure C - 9 ~ Summary of Systemwide accepted rooms/routes by location

Year	Period	Handovers/Period		Cum Handovers - Baseline		Percentages		Variance
		Actual	Plan	Actual	Plan	Actual	Plan	
FY 2017-18	Period 1	27	41	533	561	52%	54%	-3%
	Period 2	26	55	559	616	54%	59%	-5%
	Period 3	36	170	595	786	57%	76%	-18%
	Period 4	63	55	658	841	64%	81%	-17%
	Period 5	36	76	694	917	67%	89%	-22%
	Period 6	48	31	742	948	71%	91%	-20%
	Period 7	18	24	760	972	73%	94%	-21%
	Period 8	17	24	777	996	75%	96%	-21%
	Period 9	37	24	814	1020	77%	99%	-21%
	Period 10	15	13	829	1033	80%	100%	-20%
	Period 11		0		1033			
	Period 12		3		1036			
	Period 13		0		1036			

Figure C - 10 ~ Summary of Actual and Planned Station Room Handovers

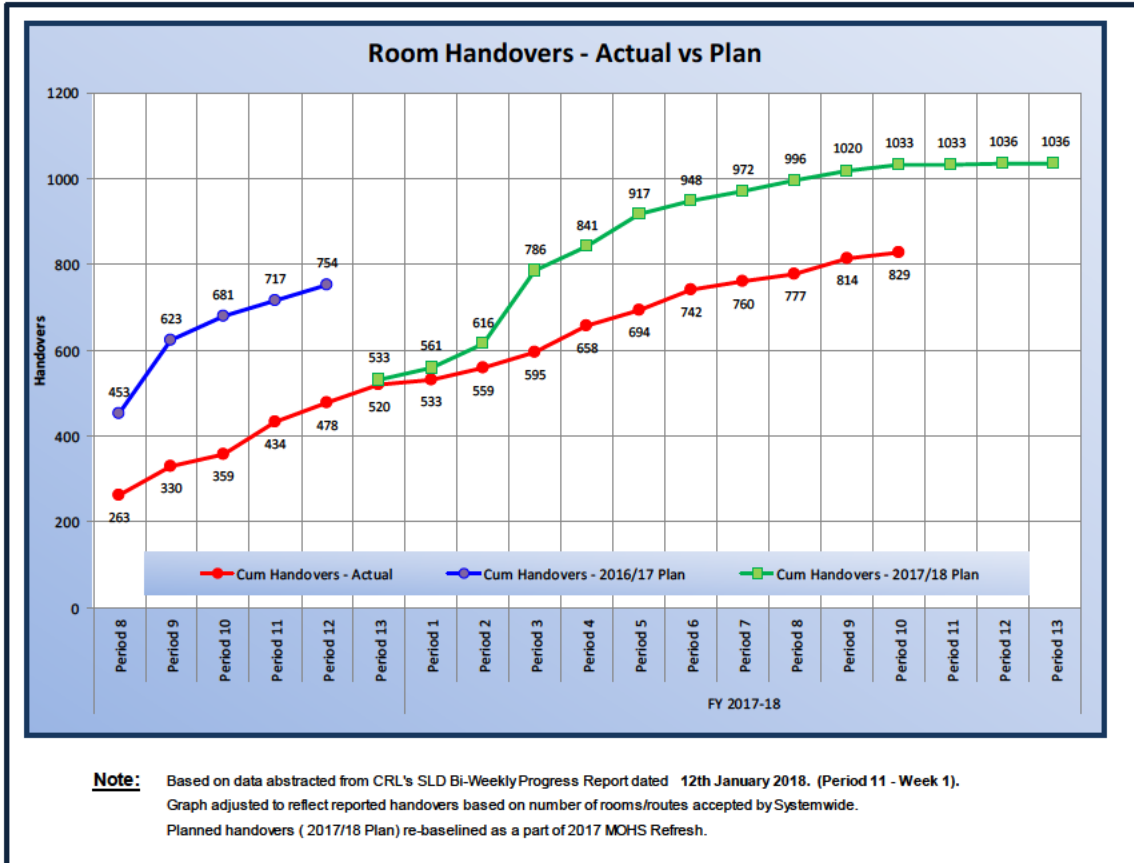


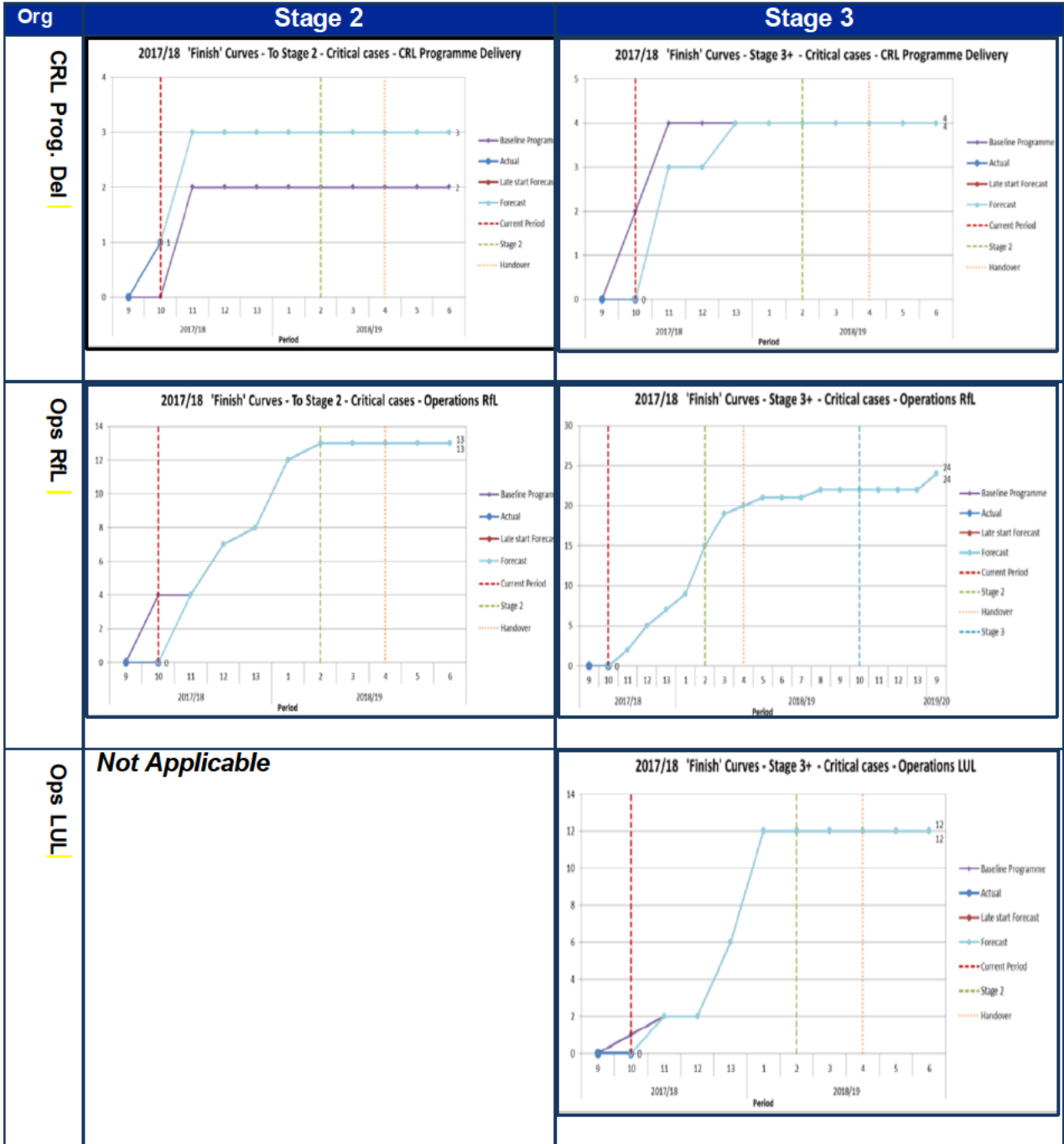
Figure C - 11 ~ Schedule of Numbers of rooms to be handed over to Systemwide<sup>26</sup>

<sup>26</sup> The graph is based on data abstracted from CRL's SLD Weekly Progress Report dated 8 September 2017 (Period 9 Week 3). The graph has been adjusted to reflect reporting based on the number of rooms/routes accepted by Systemwide.

Appendix D Compliance and Assurance

D.1 Agreements

These graphs show how the different disciplines have performed in Period 10.





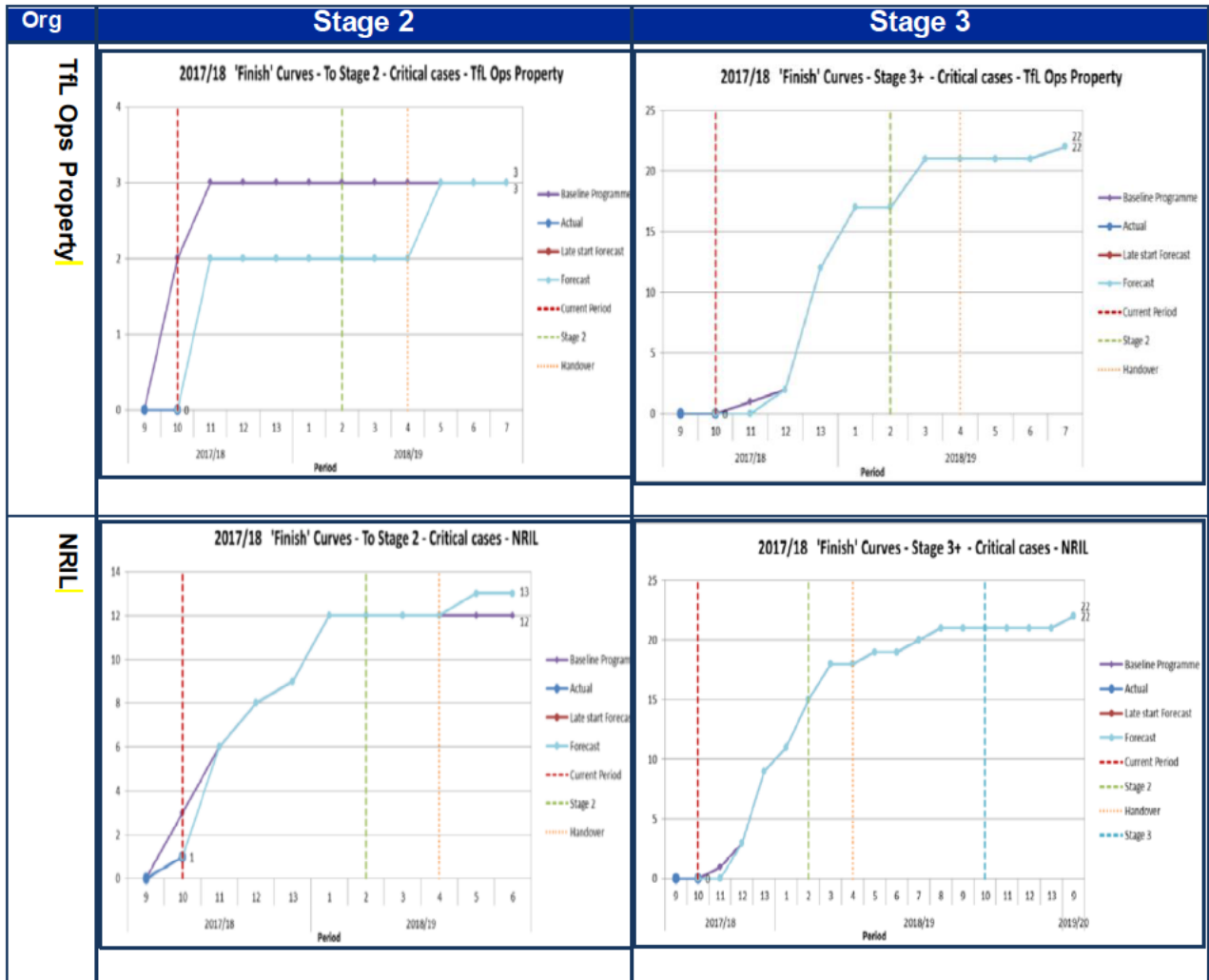


Figure D - 1 ~ 'Finish' Curves – Critical Cases

D.2 Quality

D.2.1 Right First Time (RFT) and World Class (WC) Metrics

The results for 5 of the quality metrics, shown below, remain generally good. The Acceptance graph, shown in Figure D - 2 shows that 86 packages were accepted in Period 10. The Period 9 planned number for Period 10 was 263. This performance is similar to the previous periods, and is contributing to the issues described in Section 3.10. Delayed submission of packages could impact upon the IMs assurance activities.

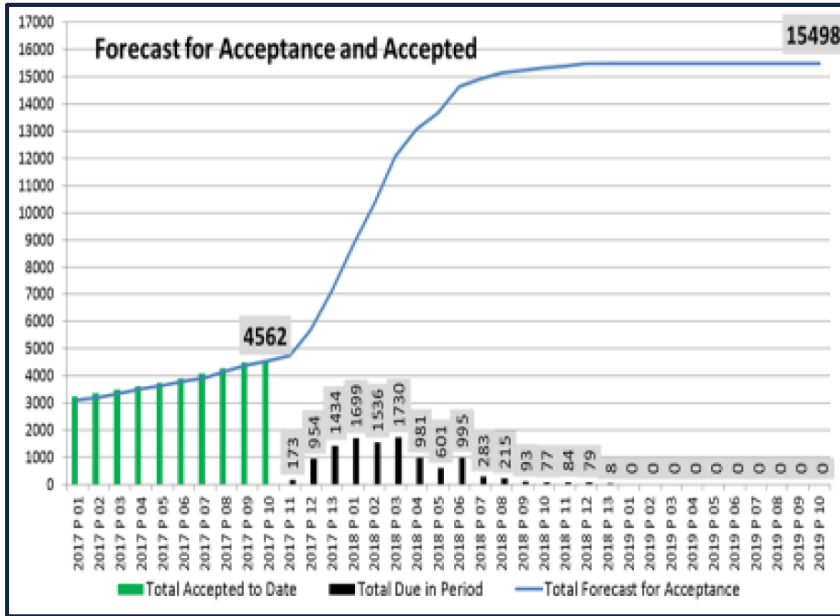


Figure D - 2 ~ P10 Acceptance Graph

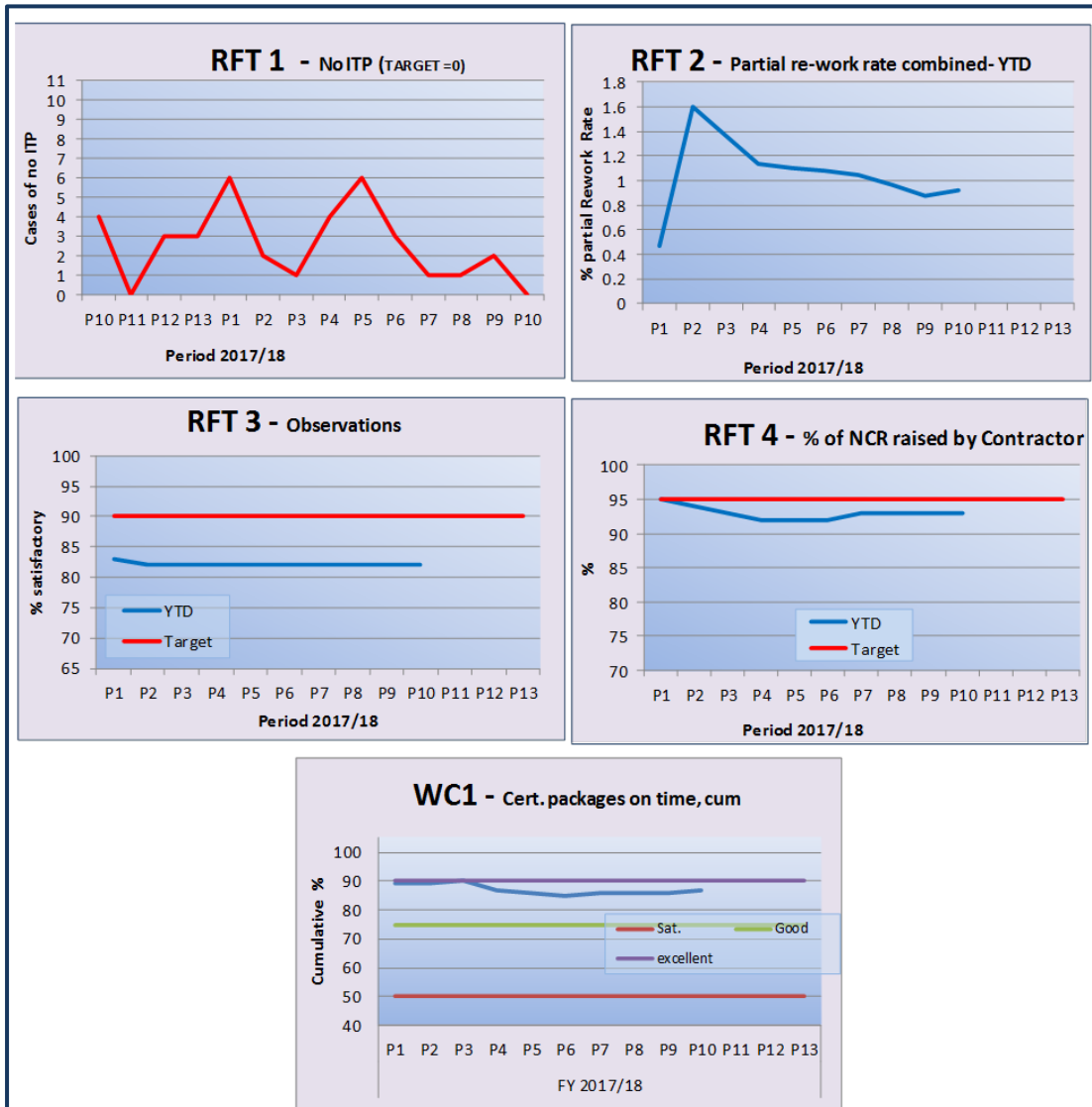


Figure D - 3 ~ Quality KPIs

PSR 107 Period 10 FY 2017-18 v 1.21.docx

**D.2.2 Quality Performance Index**

No contractors received a ‘red’ status for their quality performance in Period 10. The overall index for the period was 2.22. CRL’s target is to be above 2.00.

**D.2.3 Quality Issues**

There have been two Category 1 NCRs reported in this period:

- [REDACTED]
- [REDACTED]

**D.2.4 Audit Monitoring**

No audits were adjudged to be ‘poorly controlled’ in this period.

**D.3 Affirmations**

We are waiting to review the final draft of CRL’s ‘close out report’ relating to Sponsors requirement 4.1.10 that requested information concerning a 30 TPH service.

CRL has also continued to state a position<sup>27</sup> with regard to Affirmation 026 ‘Supporting Communication or Utility Distribution’ that does not appear to be aligned to the agreed actions. We are continuing to seek clarification from CRL’s chief of staff, and will update Sponsors once that has been received.

**D.4 Land & Property (L&P)**

The total L&P Programme AFC (including P50 risk) in the period has decreased by £0.1m to £860.8m. This is due to the North Pole worksite no longer being required, which was offset by additional costs for GWS at [REDACTED]

CRL has settled 831 out of 1,608 anticipated claims, representing 82.7% of the AFC by value. At period end, 5 cases were referred to Land Tribunal. The total claimed figure is £33.2m across all of these cases, compared to CRL’s AFC allowance of £4.7m.

**D.5 Over Site Development (OSD) and Urban Realm (UR)**

There have been few changes in CRL’s forecast MOHS handover and OSD developer start dates (shown bold text in Figure D - 4) during the Period. This reflects the apparent relative stability in CRL’s forecast station handover dates to the OSD developers.

<sup>27</sup> CRL Technical Dashboard and report, Period 10.

Figure D - 4 provides a summary<sup>28</sup> of the current forecast Key Dates for Completion and handover<sup>29</sup> of the CRL deck slabs at each station to the OSD contractors<sup>30</sup>, as well as the OSD forecast start, duration and completion dates<sup>31</sup>.

CRL still has one further OSD planning application to make at Liverpool Street East. Legal Agreements with Development Partners are being finalised, pending TfL approval.

OSD Sites linked to CRL Stations - Key Dates							
Station	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast MOHS Station Handover Date	Forecast Developer Start Date on Site**	Construction Duration (m)	Est. Shell & Core Completion
Bond Street	West - Davies Street	A275	10	27-Aug-18	Feb-19	20	Oct-20
	East - Hanover	A276	11	11-Jun-18	Jun-18	20	Feb-20
Tottenham Court Road	West - Dean Street	A279	15	06-Aug-18	Jan-19	21	Oct-20
	East - Astoria	A277	12	06-Sep-17	Jan-18	30	Jul-20
	East - Goslett Yard	N/A	N/A	06-Sep-17	Apr-18	13	May-19
Farringdon	West - Cardinal House	A278	13	30-May-18	Jan-19	18	Jun-20
	East - Lindsey Street	A280	16	30-May-18	May-18	21	Jan-20
Liverpool Street	West - 101 Moorgate	A288	19	22-Feb-18	Apr-19	21	Jan-21
	East - Blomfield Street	A284	18	09-Jan-18	Nov-18	24	Dec-20
OSD Sites NOT linked to CRL Stations - Key Dates							
Station / Site	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast Sectional Completion Date	Forecast Developer Start Date on Site	Construction Duration (m)	Shell & Core Completion
Paddington	PIP Triangle	N/A	N/A	Available	TBC	TBC	TBC
	Fisher Street	N/A	N/A	Jul-18	Jul-18	16	Nov-19
	Limmo Peninsula	N/A	N/A	Aug-18	Jan-20	TBC	TBC
	Woolwich	N/A	N/A	Apr-18	Sep-18	45	Jun-22
<b>Notes</b> <ol style="list-style-type: none"> <li>** Proposed OSD start dates will be confirmed as the Developers programme evolves</li> <li>CRL Forecast Sectional Completion Dates are abstracted from The CRL MOHS Baseline schedule</li> <li>TBC = To be confirmed</li> <li>Dates abstracted from L&amp;P OSD Project Dashboard and Anchor Milestones are shaded thus: <span style="background-color: #f2f2f2; border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span></li> <li>Forecast dates that have now been achieved (with actual dates shown) are shaded thus: <span style="background-color: #90ee90; border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span></li> <li>Developer start dates at Bond Street precede station forecast handover dates, due to earlier phased handovers.</li> </ol>							

Figure D - 4 ~ Summary of OSD forecast Key Dates

Paddington (PIP Triangle) risk concerns, in relation to the joint NR/TfL regime have now been resolved. TfL reviewing the new lease provisions and, subject to TfL approval and NR LC7 consent, CRL/TfL plan to market site by early 2018.

Programme delays have impacted the “light-well” and vent shaft handovers to the Developer for the OSD at Bond Street (East). Handover ( ) of the light-well was achieved on 10 January 2018 (target was 21 November 2017). Handover of the vent shaft area is forecast on 29 January 2018 (target was 2 January 2018). Extended working hours for OSD “muck-away” have been agreed with WCC and CSJV.

<sup>28</sup> Summary of OSD dates has been abstracted from the CRL Board Report, the MOHS and Key Dates progress summary.

<sup>29</sup> The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.

<sup>30</sup> The developers’ start dates, durations and forecast completion dates have been abstracted from the OSD Progress Section of the CRL Board Report and CRL’s Anchor Milestone summary.

<sup>31</sup> The estimated shell & core completion dates will be validated when the OSD contractors’ schedules become available.

Variation of the existing OSD agreement for Great Portland Estates (GPE) Bond Street (East) Office consent was approved by TfL and phased handover of the site has been instructed by CRL. Work to resolve the noise and vibration concerns continue, with further information provided to GPE for review. The handover date for the vent shaft remains a risk and is being monitored closely by both teams. The June 2018 target date for land receipts is not expected to be impacted.

TfL's Investment Committee has approved the Development Agreement (DA) and lease for the OSD at [REDACTED] for execution in early 2018. Agreement of the target handover date for the OSD is proving difficult, as a result of continued station schedule delays. The target handover date to the OSD developer is now 28 November 2018.

Negotiations are concluded and the DA for the OSD at Tottenham Court Road (East) is complete, enabling handover and the development to commence. The Deed of Variation has been agreed and will be completed with site handover planned for w/c 15 January 2018.

CRL handed over the Tottenham Court Road (East) OSD site at Goslett Yard to Derwent (OSD Developer) on 17 January 2018. This is the first OSD site to be handed over in full to an OSD developer. Enabling works have started and the appointment of a main contractor is expected later in the year. This is CRL's highest value commercial site.

TfL has concluded that the OSD for residential development at Tottenham Court Road (West) should be offered to the open market in early 2018. The OSD development will not be able to start until 2019. The retail areas will be retained for in-house (TfL) management. The site is now being used for site office accommodation by the CRL delivery team until November 2018.

The DA for the Fisher Street OSD has been signed. The Developer has submitted additional information, supporting project viability, to Camden. The Planning Committee decision date has, however, still not been set.

Progress has been made on the remaining issues with the Developer for the Farringdon (West) OSD (HB Reavis). Settlement monitoring, cycle super highway, definition of interface works and long stop dates and being addressed by CRL and the Developer, prior to signing the DA. London Borough of Islington has granted Schedule 7 consent for the use of "Elefant grill" mesh on the station's Farringdon Road elevation. The negotiation of the DA for the Farringdon West (Cardinal Lysander) Office consent is near conclusion, awaiting resolution of final outstanding issues with HB Reavis. CRL still awaits TfL CFO & Commissioner approval. This has been delayed, pending greater certainty on payment date.

Agreement has been reached for the handover of the Farringdon (East) OSD site on 23 March 2018. The DA is on track to complete by the end of January 2018. Terms have been agreed for the DA and lease for the office development. The DA is awaiting TfL CDIC approval. Site handover has been agreed with the station team for end of March 2018.

The DA for Liverpool Street (West) office consent has been approved by TfL and Commissioner and is being finalised for execution. The DA and Lease for the Liverpool Street (East) Office and Retail OSD application has been agreed. Further TfL (CFO) approval is currently being sought.

The Limmo masterplan has yet to be agreed with London Borough of Newham. CDIC approval has been obtained to market the site through the TfL Property Partnership Framework (PPF). A JV partner selection process will be launched via the PPF in Q1 2018.

TfL wish to delay marketing of the Woolwich residential site, in order to review potential for an alternative private rented sector disposal structure to increase long term income.

Joint work with Westminster, the City, LB Islington and Tower Hamlets continues towards a conclusion of the UR delivery agreements, anticipated in January/February 2018. CRL's transferred responsibility for the management and the associated budget for the delivery of the UR works from the centralised L&P team to the site delivery teams, as of 1 December 2017.

CRL has instructed CSJV to revise the schedule 7 consents for the East and West Ticket Halls at Bond Street station. The transfer of the UR works for the ETH to WCC has been agreed. CRL is finalising legal terms and conditions for the transfer. WCC comments on the WTH UR proposals and a revised bollard line are being fully implemented by CRL.

## **D.6 Undertakings & Assurances and Commitments - Central Section**

Eight of the live contracts for the Central Section planned to upload compliance evidence into Commitments Delivery Tracker (CDT) in Period 10, in accordance with their Commitments Compliance Plans (CCP). Contract [REDACTED] has pending evidence, but this is expected to be completed in Period 11.

Refer to our previous reports for further detail in respect of the Potential Incident Reports (PIRs) noted below.

### **D.6.1 C660/C520 Custom House PAVA (D25) Assurance 465**

Assurance 465 is drawn from Information Paper D25 and requires Crossrail to agree criteria for the performance of the public address (PA) system with a local authority prior to specifying and carrying out the detailed design of that system. The C660 PA design at Custom House station is essentially complete (Custom House station FDO was held in May 2017) but subsequently, following an email communication from the local authority, the London Borough of Newham, on 21 June 2016, agreement on appropriate criteria has not been reached.

Technical work has continued; but the final meeting to present the outcome and resultant noise criteria to London Borough of Newham (LBN), that was planned for before Christmas, has again been postponed. A meeting with LBN, to present the final noise criteria, is now planned for January/February 2018. CRL will then be required to demonstrate to LBN that the noise criteria have been achieved in a final noise demonstration report anticipated in February/March 2018.

### **D.6.2 Farringdon Station (East Ticket Hall) D25 Assurances.**

It was noted that the current combination of modelling and mitigation predicted that -2dB would be achieved at the east ticket hall (ETH). A line of mitigation involving operational control (the reduced operation of the fans during a key hour of the morning when background noise levels are low) was being sought from RfL. If that was agreed the modelling predicts that -4dB will be achieved for the ETH and that, while this is not the required -5dB, this would represent the exercise of reasonable endeavours and a report setting out that case will need to be submitted to the local authority (City of London).

In the event that noise levels associated with tunnel ventilation, draught relief and operation of plant and equipment at a particular location are expected to be above the -5 dB level, IP D25 requires that CRL will, prior to commencement of procurement of equipment, provide the local planning authority with the following information:

- Calculated rating levels at the most sensitive receivers under the range of operational modes anticipated, including noise from the mechanical fan operation and draught relief;
- For tunnel ventilation, the frequency and duration of use of the fans expected as a result of possible congestion and train headway simulations;

- Details of the performance of noise mitigation incorporated into the deep level station, ventilation shaft and head-house structures; and
- A description of the limitations to any or further mitigation being practicable.

There is no further definition around the timing of when this is to be provided, but logically the reference to ‘procurement of equipment’ is intended to refer to any equipment which contributes to, or potentially mitigates, the overall noise level, such that the local authority has a chance to comment on the proposed equipment prior to the commitment to purchase being made by CRL.

The risk was, that if the equipment is procured before the decision is made by RfL, and if the RfL decision is to accept the operation control, then this will technically put CRL in breach of the commitment.

RfL accepted the operational constraint toward the end of October 2017. The C&CSC meeting on 23 January 2018 noted that the requisite “reasonable endeavours” report had not been issued to the City. The fans responsible for the -4dB rating prediction were procured two years ago and are due to be installed in February this year. A PIR has been raised accordingly.

## **D.7 Undertakings & Assurances and Commitments - Surface Section**

Nine surface section contracts planned and successfully uploaded compliance evidence into the CDT during Period 10, in accordance with their Compliance Matrices.

In Period 4, it was reported that both WIT1A (West Inner Track Infrastructure) and WLG4A (OOCPA) had not met their planned uploads of evidence to CDT due to outstanding D25 and D26 assessments.

In Period 6, it was reported that both WSK1F (Stockley Main Civils) and WLG4A (OOCPA) had not met their planned uploads of evidence to CDT due to outstanding D25 and D26 assessments.

- WSK1F remains pending. The D26 assessment is complete; but needs to be closed out on NR’s eB system before uploading into the CDT.
- WLG4A remains pending. Closeout of the OOCPA substation D25 assessment has yet to be agreed with the local authority, following an update from the manufacturer regarding sound power levels. CRL expects this to be closed out in Period 10. The D26 assessment is to be completed by end of January 2018.

In Period 8, it was reported that WOT1C West Outer Track Infrastructure (GRIP5-8), WSK1F Stockley Main Civils (GRIP 5-8) and SAA3A South East (GRIP 5-8) had not met their planned upload of evidence to CDT. The detail for each is as follows:

- WOT1C remains pending. The D25 assessments for Maidenhead sidings are still under review.
- WSK1F remains pending. The D26 assessments are still outstanding. Consultation evidence with Thames Water should be available next period.
- SAA3A remains pending. The D25 assessments are complete; but two reports need to be closed out on NR’s “eB” system, before uploading into the CDT.

As at Period 10:

- SAA3A has uploaded the outstanding D25 assessment in CDT.
- WOT1C upload to CDT remains outstanding.
- WSK1F has now uploaded the outstanding D26 assessment in CDT. However, consultation evidence with Thames Water remains outstanding in period 10.
- WLG4A has still not completed the D25 and D26 tasks.

- WIT1A has still not completed its D25 tasks. Completion and upload to CDT is now planned for Period 11 (January 2018).

Whilst these outstanding actions are a concern, progress is being made by the relevant contracts, albeit slowly, and at this stage no early warnings regarding potential non-compliance with the Undertakings & Assurances are considered necessary.

#### **D.7.1 Shenfield Sidings – D25 Assurances 461, 462, 463, 464 & 518**

A level 1 PIR was raised on 24 August 2017 for failure to comply with the D25 fixed noise assurances at Shenfield siding. Under assurance 464, NR was required to provide details to the local authority of the measures undertaken to ensure that, under all reasonably foreseeable circumstances, the design process and procurement process for fixed installations is adequate to achieve compliance with the design criterion set out in IPD25 and to take the local authority's comments into account. However, no D25 assessment had been produced, but the sidings had been designed and constructed.

Assurance 518 requires that, if -5dB cannot be met, then a report setting out the reasons why must be sent to the local authority before procurement of the equipment. Without a D25 assessment done, this is not known. This, and the position on assurance 464, is further compounded by the fact that NR had submitted and had approved by Brentwood the Schedule 7 "Bringing into Use" (BiU) for the sidings. The submission of a BiU is a statement that the nominated undertaker has 'taken all reasonably practicable permanent measures for the mitigation of the effects of the work'. This cannot be known, because the D25 report had not been done.

A D25 assessment has been carried out and it confirms that, with the construction of a fence (which has already been approved under Schedule by the local planning authority), a rating of -5dB at the nearest sensitive receptor can be achieved. Brentwood Borough Council has raised no objections to the content of the assessment or the barrier design. This PIR is now closed.



## Project Representative Team

### D.8 Project Team

██████████:  
██████████  
██████████  
██████████:  
██████████  
██████████

Project Representative, Safety, Progress, Risk, Governance;  
Signalling, Railway Systems, Integration, T&C;  
Engineering, Stations, OSD, U&As, Assurance;  
Compliance & Change, Operations, RSD;  
Commercial, Cost Control, Financial, ONW;  
Administration Manager.

## Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
ABB	ASEA Brown Boverly	LoR	Line of Route
ACJV	Alstom Costain Joint Venture	LTC	Lost Time Case
ACWP	Actual Cost of Work Performed	LTIFR	Lost Time Incident Frequency Rate
AEA	Abellio East Anglia	LU	London Underground
AFC	Anticipated Final Cost	LUL	London Underground Limited
AFDCD	Anticipated Final Cost Direct Costs	LV	Low Voltage
AFR	Accident Frequency Rate	M&E	Mechanical & Electrical
AGA	Abellio Greater Anglia (now known as 'GA')	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AMS	Agreements Management System	MENTOR	Mobile Electrical Network Testing, Observation and Recording
APIS	Authorisation to Place into Service	MEP	Mechanical Electrical & Public Health
ARS	Automatic Route Setting	MEPA	Mechanical, Electrical, Public Health, Architecture
AsBo	Assurance Body - Ricardo Rail	MES	Mid End Shaft
ASLEF	Associated Society of Locomotive Engineers and Firemen	MIRP	Maintenance Integration Review Panel
ATC	Automatic Train Control	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
AWS	Automatic Warning System	MTIN	Miles Technical Incident Number
B&PC	Board & Programme Contingency	MTR SMS	MTR Safety Management System
BBM	Balfour Beatty Morgan Vinci	MTR-C	Mass Transit Railway - Crossrail
BCA	Bilateral Connection Agreement	MV	Medium Voltage
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCE	Notified Compensation Event
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NCR	Non Conformance Report
BFK	Bam Ferrovial Kier	NG	National Grid
BH	Berkeley Homes	NGET	National Grid Electricity Transmission
BIU	Bringing Into Use	NKL	North Kent Line
BLL	Bakerloo Line Link	NoBo	Notified Body
BOS	Bond Street Station	NOW	North Woolwich
BP	Business Plan	NR	Network Rail
BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems
BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC building	Operations Maintenance Centre
BTH	Blomfield Ticket Hall	OME	Order of Magnitude Estimate
BUF	Bottom Up Forecast	ONFR	On Network Functional Requirements
C&CSC	Commercial and Change Sub-committee	ONSIP	On Network Station Improvements Programme
CAR	Corrective Action Report	ONW	On Network Works
CARE	Crossrail Assurance Reporting Environment	OOC	Old Oak Common
CBTC	Communications Based Train Control	OOCPA	Old Oak Common Paddington Approaches
CCB	Current Control Budget	OPEX	Operational Expenditure
CCP	Commitments Compliance Plans	Ops	Operations
CCRB	Construction and Commissioning Rulebook	ORAT	Operational Readiness & Transfer Group

CCRRB	Crossrail Construction Railway Rule Book	ORR	Office of Rail & Road
CCSA	Contract Commercial Status Analysis	ORSG	Operational Readiness Steering Group
CCSC	Commercial & Change Sub-Committee	OSD	Over Site Development
CCTV	Closed Circuit Television	OTIS	OTIS escalators (company)
CD/RA	Closed Door / Right Away	OTP	Overall Target Price
CDG	Competence Design Group	PAD	Paddington station
CDM	Construction Design & Management Regulations	PCs	Principal Contractors
CDN	Crossrail Data Network	PDA	Project Development Agreement
CDT	Commitments Delivery Tracker	PDB	Network Rail Programme Delivery Board
CE	Compensation Events	PES	Platform Edge Screen
CEC	Chief Engineer's Communications	PIP	Paddington Integration Project
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PIR	Potential Incident Report
CEG	Central Engineering Group	PLU	Plumstead
CEO	Chief Executive Officer	PM	Project Manager
CFCCB	Contingency Finance Current Control Budget	PMI	Project Manager Instruction
CIF	Crossrail Integration Facility	PML	Pudding Mill Lane
CMR	Crossrail Managed Risk	PMO	Project Management Office NR
CMS	Crossrail Management System	PNY	Paddington New Yard
CoL	City of London	PPE	Personal Protective Equipment
COS	Central Operating Section	PPF	Property Partnership Framework
CPFR	Crossrail Programme Functional Requirements	PPM	Passenger Performance Measurement
CPI	Cost Performance Index	Prep	Project Representative
CPO	Compulsory Purchase Order	PRISM	Cost Management Software
CRL	Crossrail Limited	PSD	Platform Screen Door
CRV	Crossrail Requirements Variation	PSG	Performance Steering Group
CSCS	Construction Skills Certification Scheme	PSR	Project Status Report
CSJV	Costain Skanska Joint Venture	PTYSC	Property Sub-Committee
CSM	Construction Safety Management	PWay	Permanent Way
CSM-RA	Common Safety Method – Risk Assessment	QBR	Quarterly Baseline Review
CT	Computerized Tomography	QCRA	Quantified Cost Risk Assessment
CTOC	Crossrail Train Operating Concession	QRA	Quantified Risk Assessment
CUH / CHS	Custom House Station	QSRA	Quantified Schedule Risk Assessment
CW	Canary Wharf	RAB	Regulatory Asset Base
CWG	Canary Wharf Group	RAB (C)	RfL Assurance Board for Crossrail
CWS	Canary Wharf Station	RAG	Red, Amber, Green Matrix
D&A	Drugs and Alcohol	RAM	Route Asset Manage.
DA	Development Agreement	RBC	Remote Block Computer
DeBo	Designated body	RCA	Risk Control Actions
DfT	Department for Transport	RCC	Route Control Centre
DLO	Direct Labour Organisation	RfL	Rail for London
DLR	Docklands Light Railway	RfL-I	Rail for London - Infrastructure
DOO	Driver Only Operation	RFT	Right First Time
DPS	Depot Protection System	RIA	Railway Integration Authority
DT	Dynamic Testing	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
Dwall	Diaphragm wall	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DWWP	Delivery of Works Within Possession	RIRP	Railway Integration Review Point
E&B	Earthing & Bonding	RLU	Restricted Length Unit
EA	Environment Agency	ROC	Rigid Overhead Conductor
EAC	Estimate at Completion	ROC	Regional Operational Centre
EB	Eastbound	ROP	Royal Oak Portal
ECP	Employers Completion Process	RP4.2	Review Point 4.2
ECS	Empty Coach Stock	RRV	Road / Rail Vehicles

		RS	Rolling Stock
EDT	Early Dynamic Testing	RSD	Rolling Stock & Depot
EED	Emergency Exit Door	RSSB	Rail Safety & Standards Board
EFC	Estimated Final Cost	RTU	Remote Telemetry Unit
ELRSG	Elizabeth Line Readiness Steering Group	S&C	Sw itches & Crossings
EMU	Electrical Multiple Unit	SA	Supplementary Agreement
ERTMS	European Rail Traffic Management Systems	SACR	Semi Annual Construction Report
ESJ	Engineering Safety Justification	SAP	System Applications Products
ESM	Engineering Safety Management	SAR	Safety Assessment Report
ETCS	European Train Control System	SAT	Site Acceptance Test
ETH	Eastern Ticket Hall	SCADA	Supervisory Control and Data Acquisition
EVM	Earned Value Management	SCL	Sprayed Concrete Lining
FAR	Farringdon	SCN	Sponsor Change Notice
FCCB	Finance Current Control Budget	SDG	Signalling Design Group
FDC	Framework Design Consultant	SDO	Selective Door Operation
FDO	Final Design Overview	SDS	Scheme Design Specification
FDS	Final Design Statements	SER	Signalling Equipment Room
FFOC	Final Forecast Outturn Cost	SES	South East Service
FGW	First Great Western	SESR	South East Signalling Room
FIS	Fisher Street Shaft	SFA	Sponsor Funding Account
FLU	Full Length Unit	SHELT	Safety and Health Leadership Team
FoI	Freedom of Information	SIRP	Systems Integration Review Panel
FRAG	Fraud Risk Assurance Group	SISS	Station Information and Security System
FTS	Floating Track Slab	SLD	Single Line Diagrams
GAF	Greater Anglia Franchisee	SMTA	Smithfield Market Traders Association
GE	Great Eastern	SOC	Statement of Compatibility
GEFF	Great Eastern Furrer & Frey	SONIA	Sterling Overnight Index Average
GEML	Great Eastern Main Line	SOR	Systems Operation Room
GFRC	Glassfibre Reinforced Concrete	SORBA	Shaping Architecture Company (sub cladding contractor)
GLA	Greater London Authority	SPI	Schedule Performance Index
GPE	Great Portland Estates	SPS	Secondary Part Steel
GRC	Glass Reinforced Concrete	SR	Sponsors Requirement
GRIP	Governance for Railway Investment Projects	SRP	Safety Review Panel
GSM-R	Global System for Mobile Communication - Railway	SSE	Scottish & Southern Electricity
GW	Great Western	SSP	Stations, Shafts, Portals
GWML	Great Western Main Line	STG	Stepney Green
GWR	Great Western Railway	STS	Standard Track Slab
H&S	Health & Safety	SVP	Safety Verification Panel
HAL	Heathrow Airport Limited	T&C	Testing & Commissioning
HALARP	Heathrow Airport Limited Assurance Review Panel	TAP	Technical Assurance Plan
HAS	High Attenuation Sleeper	TBM	Tunnel Boring Machine
HA VS	Hand Arm Vibration Syndrome	TC&HSG	Testing, Commissioning and Handover Steering Group
HIA	Heathrow Implementation Agreement	TCMS	Train Control Management System
HM	Her Majesty	TCR	Tottenham Court Road
HMDL	Handover Master Deliverable List	TCRW	Tottenham Court Road West
HRW	Heathrow Airport	TDY	Tunnel Drive Y
HSPI	Health & Safety Performance Indicator	TfL	Transport for London
HV	High Voltage	TOC	Train Operating Company
HVAC	Heating Ventilation & Air Conditioning	TPH	Trains Per Hour
IA	Interim Acceptance	TPS	Train Protection System
ICD	Interface Control Document	TPWS	Train Protection & Warning System
IECC	Integrated Electronic Control Centre	TRAIL	Transport Reliability Availability Integrated Logistics
IEP	Intercity Express Programme	TRH	Temporary Rehousing

IFC	Issued For Construction	TSI	Technical Standard for Interoperability
IFD	Iford Yard	TTVS	Temporary Tunnel Ventilation System
IM	Infrastructure Manager	TUCA	Tunnelling & Underground Construction Academy
IOSH	Institution of Occupational Safety and Health	TWAO	Transport & Works Act Order
IP	Intervention Point (0, 1, & 2)	TXM	TXM Plant
IR35	Inland Revenue Taxation Regulation 35	U&A	Undertakings & Assurances
IRN	Installation Release Note	UKPN	UK Power Networks
ISJ	Interim Safety Justification	UR	Urban Realm
ISV	Intermediate Statements of Verification	URT	Unresolved Trends
ITP	Inspection & Test Plan	VDP	Victoria Dock Portal
ITT	Invitation to Tender	VERP	Value Engineering Review Panel
JST	Joint Sponsor Team	VFL	Voker Fitz Patrick
KBR	Knorr-Bremse Rail	VN	Variation Notice
KD	Key Deliverable	VT	Voltage Transformer
KE	Kinematic Envelope	WAD	Works Authorisation Document
KG	Kensal Green	WBP	Westbourne Park
KO	Key Output	WBS	Work Breakdown Structure
KPI	Key Performance Indicator	WC	World Class
L&P	Land and Property	WHI	Whitechapel
LB	London Borough	WTI	Western Inner Track Infrastructure
LBTH	London Borough of Tower Hamlets	WOE	Western Outer Electrification
		WOO	Woolwich Station
LFB	London Fire Brigade	WOTI	Western Outer Track Infrastructure
LIV	Liverpool Street	WTH	Western Ticket Hall
LMU	London Metropolitan University	YC	Yard Control
LO	London Overground		
LoNo	Letter of No Objection		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU - Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU - White Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	MD04	General Paddington
C340	Victoria Dock Portal Civil Works	MD05	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	MD11	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	MD19	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	MD20	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	MD22	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



## **Crossrail Project Representative**

Crossrail Joint Sponsor Team

**Project Status Report 108**

**Period 11 FY2017-18**

**07 January 2018 – 03 February 2018**

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**Official ~ Sensitive Commercial**



**Project Status Report 108**

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Jacobs U.K. Limited  
 226 Tower Bridge Road  
 London SW1 2UP  
 United Kingdom  
 T +44 (0)20 7403 3330  
 F +44 (0)20 7939 1418  
[www.jacobs.com](http://www.jacobs.com)

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Note: This report relies on the information set out in CRL's Period 11 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 3 February 2018. Note that information emerging after the close of Period 11 is subject to formal confirmation by CRL in its Period 12 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff.

**Document history and status**

Revision	Date	Description	By	Review	Approved
1	22 February 2018	PSR 108 Period 11 FY 2017-18 v1.16.docx ~ Draft	PRep Core Team		
2	1 March 2018	PSR 108 Period 11 FY 2017-18 v1.23.docx	PRep Core Team	<span style="background-color: black; color: black;">[REDACTED]</span>	<span style="background-color: black; color: black;">[REDACTED]</span>

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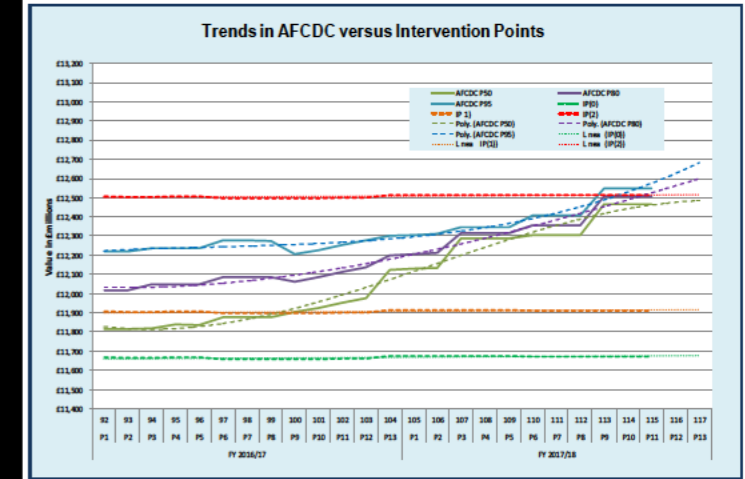
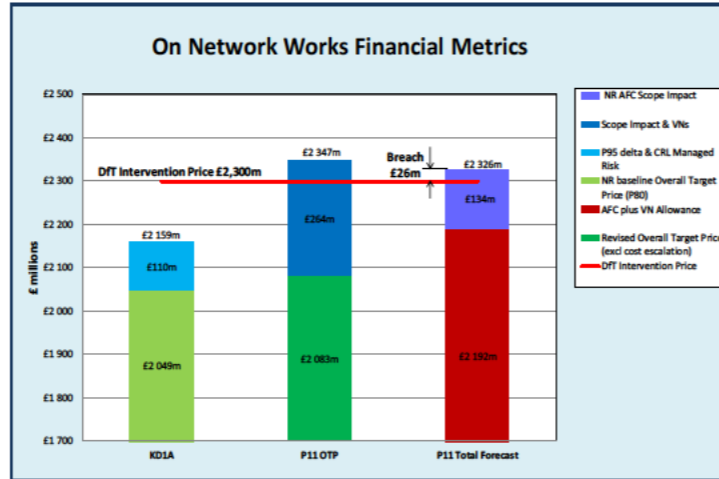
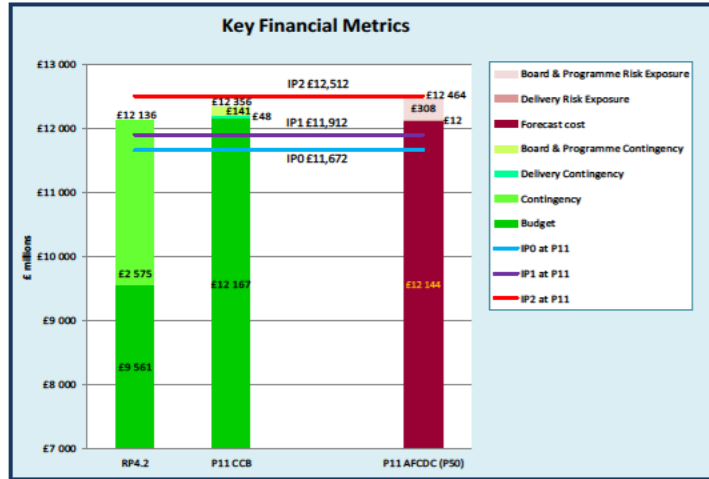
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Cost and Schedule Dashboard (Period 11 FY2017/18)

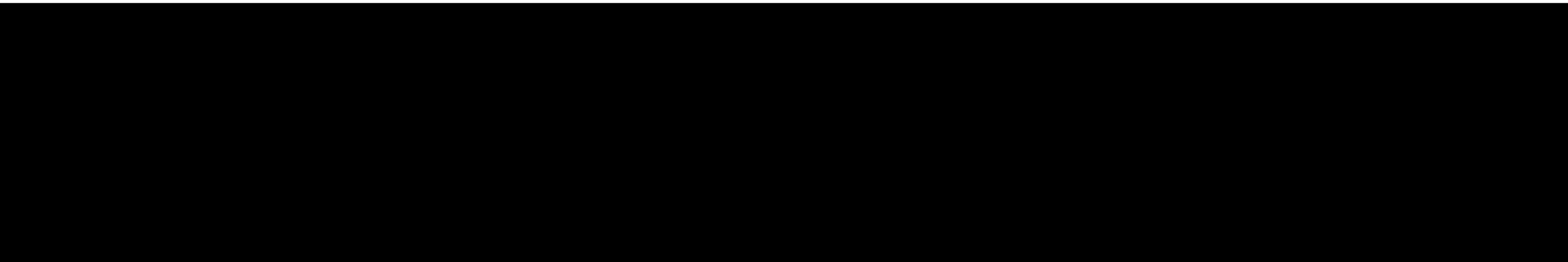
CRL SACR18 QSRA gave confidence level of finishing on time at Stage 3 = 71%. (This is now out of date.)

SACR18 (as at April 2017):  
 AFCDC (P50) ~ £12.303bn. AFCDC (P80) ~ £12.356bn  
 AFC: (£12.303bn AFCDC (P50) + £2.482bn ONW etc) = £14.785bn

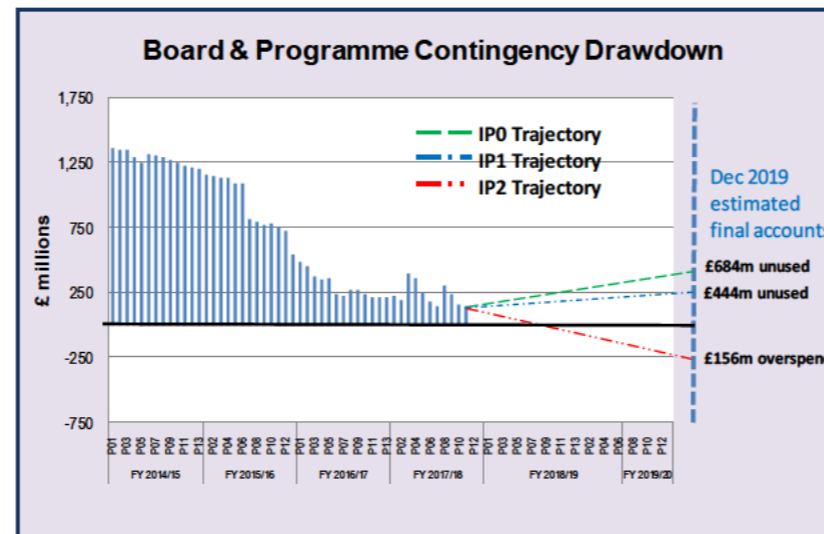
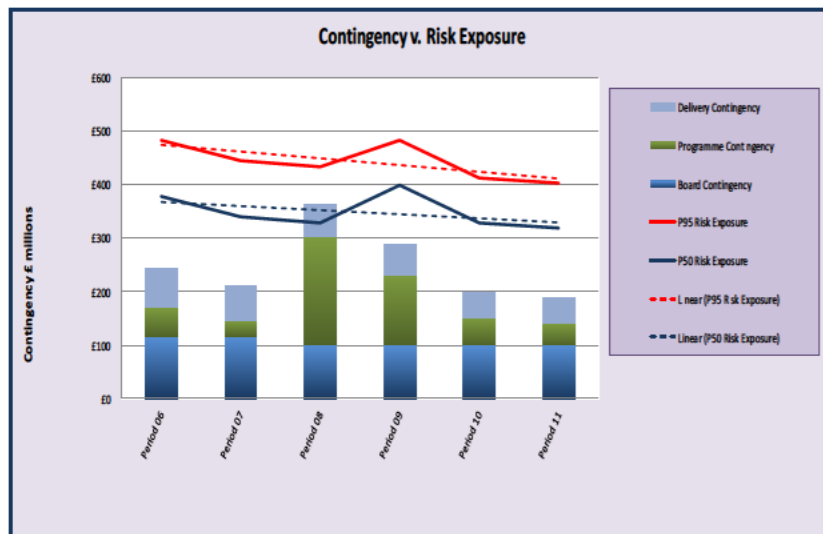
Cost:



Schedule:



Risk, Contingency & Change:



Project Representative's Summary:

**Cost:** IP0, IP1 and IP2 have not changed in Period 11. Although the AFCDC (P50) has marginally reduced by £0.1m, the reported AFCDC remains at £12,464 for Period 11. This exceeds IP1 by £552m with only £48m headroom to IP2. The Finance Current Control Budget remains at £12,356m; The AFCDC (P50) continues to exceed the reported financial budget by £108m and remains in excess of the RP4.2 Baseline funding of £12,136m by £328m. The AFCDC (P80) is also unchanged at £12,507m which is £595m above IP1 and only £5m under IP2. The AFCDC (P95) exceeds IP2 by £35m. The CRL ONW AFC remains at £2,376m in Period 11. The Period 11 CRL estimated FFOC has reduced by £84m to £2,396m which exceeds the DfT Intervention Price by £96m. We expect costs to increase.

**Schedule & Progress:** MOHS 2018 has been formally "launched", providing the baseline and schedule framework for the completion of the Crossrail Programme. It identifies the key critical milestones for energisation, testing, handover and RfL post-handover testing, leading to delivery of Stage 3 Opening on 9 December 2018. While MOHS has the support of all stakeholders, it is ambitious, contains virtually no float and relies upon right-first-time delivery at rates that have not been sustained in the past. There is therefore a high risk that the start dates for Trial Running, Trial Operations and Stage 3 Opening will not be achieved.

**Risk, Contingency & Change:** The Period 11 risk exposure has reduced by £9m to £319m due to approved changes for a supplemental agreement for cost increases at Bond Street Station and additional resources to complete electromagnetic capability and earthing and bonding testing. The overall contingency budget of £189m is insufficient to cover the P50 risk exposure of £319m by £130m (£1m deterioration from Period 10). The centrally controlled Delivery contingency is unchanged and remains at £48m in Period 11.

# Cost and Schedule Dashboard

(Quick Reference Guide)

## Cost

### Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

### On Network Works Financial Metrics

Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.

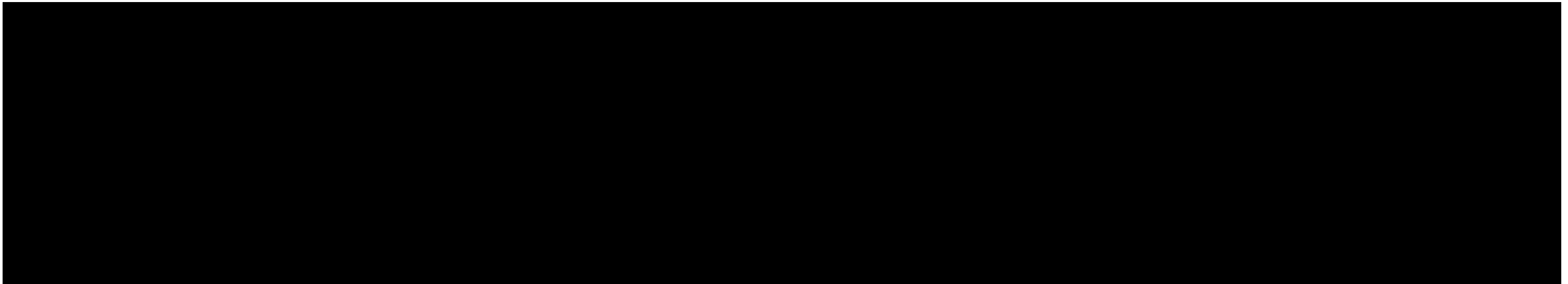
### Forecast Defined Cost and Target

Indicates and profiles the comparison between CRL and Contractors Defined Cost Forecast and the comparison between CRL and Contractors Target Cost.

### Trends in AFDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFDC at P50, P80 and P95 and forecasts the respective future AFDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2.

## Schedule & Float



## Risk, Contingency & Change

### Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

### Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

### Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:

## Executive Summary

### Health and Safety:

Health and Safety performance indicators remain good and ahead of CRL targets.

### Financial:

The Intervention Points have not changed during Period 11, and the AFCDC at P50 remains at £12,464m. The AFCDC at P80 is also unchanged at £12,507m, which is only £5m under IP2. The AFCDC at P95 exceeds IP2 by £35m. During Period 11, the cost risk assessment reduced by £9m to £319m and the AFCDC at P50 continues to exceed the reported financial budget by £108m.

We expect costs to increase when the full impact of Master Operational Handover Schedule (MOHS) 2018 is assessed. There is a significant risk that IP2 will be breached at SACR19, if not before.

The On Network Works (ONW) forecast cost (AFC plus variations) remains at £2,530m (including £22m charged to the AFCDC). CRL is also now reporting on NR's total funding and costs (including funding from other programmes) which is currently £2,818m.

### Schedule and Progress:

MOHS 2018 has been formally "launched", providing the baseline and schedule framework for the completion of the Crossrail Programme. It identifies the key critical milestones for energisation, testing, handover and RfL post-handover testing, leading to delivery of Stage 3 Opening on 9 December 2018. While the MOHS has the support of all stakeholders, it is ambitious, contains virtually no float, and relies upon right-first-time delivery at productivity rates that have not been sustained in the past. There is therefore a high risk that the start dates for Stage 3 Opening, Trial Running and Trial Operations will not be achieved.

The principal critical path within MOHS is the Rolling Stock/Signalling dynamic testing sequence. This sequence is extremely tightly scheduled and offers very little scope for failure, without impact upon Trial Running and Trial Operations. The sequence relies upon the provision by BT of Rolling Stock with proven and reliable software functionality, but a high risk remains that train software development will not keep pace with project requirements.

We have completed our review of the CRL 2018/19 Business Plan which is based upon the previous version of MOHS; details are contained in this report. We expect some staff will need to be retained longer and Indirect Costs to increase when the full impact of MOHS 2018 is assessed by CRL.

### Stage 2 Opening:

CRL has confirmed to Sponsors its commitment to an alternative plan for Stage 2 Opening, which it has prepared in order to mitigate the effects of continuing delays to BT train software development, testing and assurance. The alternative plan constitutes two phases. Phase 1 retains the existing Class 360 rolling stock for Heathrow services (2TPH), and the introduction of Class 345 Reduced Length Units (RLUs), secured from the Great Eastern, on services between Paddington and Hayes & Harlington (2TPH); the due date for service start is 20 May 2018. Phase 2 is the introduction of Class 345 Full Length Units (FLUs) operating from Paddington to

Heathrow (4TPH). This was the original Stage 2 plan. CRL is targeting the end of October 2018 for the start of Phase 2.

[REDACTED]

### **Stage 3 Opening:**

There remains a significant risk that one or more stations will not be fully operational, and that Stage 3 Opening will not be achieved on the planned date of 9 December 2018. The energisation sequence for Zones 1 & 2 started at Pudding Mill Lane autotransformer on 31 January 2018, and overhead line equipment section proving and short circuit testing are in progress. A Class 345 test train has been delivered to Plumstead and early dynamic testing started on 25 February 2018. Thereafter, dynamic testing will be carried out until 5 August 2018, deliberately phased to allow as much concurrent installation and integration testing as possible.

The development and testing of Rolling Stock communications based train control (CBTC) functionality remains in delay and poses a serious threat to the successful completion of the dynamic testing. We expect feedback from the first few weeks of testing with signalling protection, due to start 9 March 2018, to provide an indication of the robustness of train borne software and the likely future dynamic testing workload.

Schedule compression due to ongoing delays and adherence to the Stage 3 Opening date, has progressively increased demand for access to, and occupancy of, the Tunnels and Stations. These difficulties are compounded by the need to apply additional safety controls following energisation. Despite careful scheduling, significant challenges remain with the timely completion and integration of fixed infrastructure and the production of associated assurance documentation. There is insufficient time for the delivery of all assets prior to Trial Running and Trial Operations, and MOHS reflects the prioritisation of those critical to dynamic testing. Challenges remain with the completion of non-dynamic testing critical systems (e.g. walkways, lighting, LV cabling), removal of temporary services and the integration of stations. While formal arrangements have yet to be agreed, collaborative discussions are already taking place between CRL and RfL/LU, in anticipation of the need to stagger asset handover.

The Infrastructure Managers (IM) remain extremely concerned at the delays and ongoing slow rates of progress in CRL's provision of training, asset information, operations & maintenance manuals, and other documentation. Across all CRL contracts, training remains significantly behind schedule, although there have been isolated cases of good performance. RfL-I has confirmed its minimum handover requirements which would allow it to 'stand up' as IM, and CRL has incorporated the production of handover deliverables into MOHS.

### **Stage 4 and 5 Opening:**

CRL negotiations continue with [REDACTED] over the construction of the stabling sidings at [REDACTED] [REDACTED] which are required to support Stage 4 services. Management plans remain to be developed for CRL to support NR's future migration of TPWS to ERTMS on the GWML, currently scheduled for late 2019.

**Assurance:**

Preparation of supporting evidence for Safety Approvals and Regulatory Approvals for Stages 2 and 3 remains slow. Progress is behind plan in resolving critical Agreements.

**Old Oak Common Depot:**

The Bringing Into Use (BIU) of Section A of Old Oak Common (OOC) Depot is now scheduled for 1 March 2018, although residual issues associated with signal interface testing and with general testing of other systems might introduce some further delay. MTR-C has warned of possible impact upon driver training and Stage 2 Phase 1 service start on 20 May 2018, should further slippage occur. Access to OOC Depot is critical to support the planned build-up of the rolling stock fleet, testing on the Heathrow Spur and Stage 2 operational services.



# 1 Schedule and Progress

## 1.1 Summary

The new Master Operation Handover Schedule (MOHS 2018) was signed off by CRL and its partners on 16 February 2018, presented to JST and PRep on 19 February 2018, and presented to Sponsor Board on 22 February 2018. Although Stage 3, 4 and 5 Opening dates have been retained, most activities and milestones have been re-baselined. It also includes the latest plans regarding Stage 2 Opening in two phases. Figure 1 - 1 gives examples of some key dates which have been reset in the new MOHS, as well as the relevant delay in weeks.

CRL has advised that the new MOHS is ‘fully integrated’ and includes NR ONW key dates, BT delivery dates<sup>1</sup>; and that it is supported by RfL-I and LUL. However, the MOHS is a ‘top down’ schedule i.e. it sets out CRL’s strategic vision for delivery of Crossrail. In many cases activity durations and milestone dates have not been agreed with its Tier 1 Contractors.

Key Dates	MOHS 2017	MOHS 2018	Weeks
Traction Power Energisation Z1&2	01-Oct-17	01-Feb-18	18
Commence DT in Z1&2	01-Nov-17	25-Feb-18	17
Traction Power KG ATFS to WBP	02-Jan-18	28-Feb-18	8
ATS at WBP energised	10-Jan-18	07-Apr-18	12
Traction Power on Z3&4	04-Feb-18	10-May-18	14
Linewide SCADA available	30-Nov-17	30-May-18	26
Commence DT in Z3&4	26-Feb-18	11-Jun-18	15
HV Non Traction Power on	26-Jan-18	01-Jul-18	22
Commence Trial Running	05-Jul-18	05-Aug-18	4
Commence Trial Operations	06-Aug-18	09-Sep-18	5

*Figure 1 - 1 ~ Example comparisons between MOHS 2017 and MOHS 2018*

We believe the schedule is very optimistic and extremely challenging, with many problems needing to be resolved. In addition, there is almost no schedule float to allow for any errors or mistakes. Key features of this MOHS are delays to a number of significant key dates, as well as the compression of almost all activities. There is also a significant amount of construction work to be completed during late 2018, when Trial Operations are being executed; see Section 3.7. We are aware that CRL is attempting to mitigate these issues in order to achieve Stage 3 Opening in December but we are concerned that this may not be possible in all cases.

## 1.2 Progress

Progress in Period 11 has been mixed.

NR progressed most of its works on schedule in support of Stage 2. BT continue to have problems with OOC readiness, driver training, train software development, and reliability of the C345 trains. Further details are set out in Section 2.

<sup>1</sup> In some cases moderated by RfL.

Traction power energisation of Zones 1 & 2 was achieved on 1 February 2018, which is a major milestone for Stage 3. There was also good progress in support of the new MOHS across a number of station and Systemwide projects. However, permanent tunnel ventilation works fell behind plan, as well as [REDACTED]. CRL's contractors continue to have problems producing paperwork on time; e.g. asset data, handover materials, O&M manuals, Installation Release Notes, and Final Design Overview certificates. Amongst other things, this results in delays to the training of IM's ready for Handover. There are also concerns with the availability of trains required for Stage 3 testing. Further details are set out in Section 3.

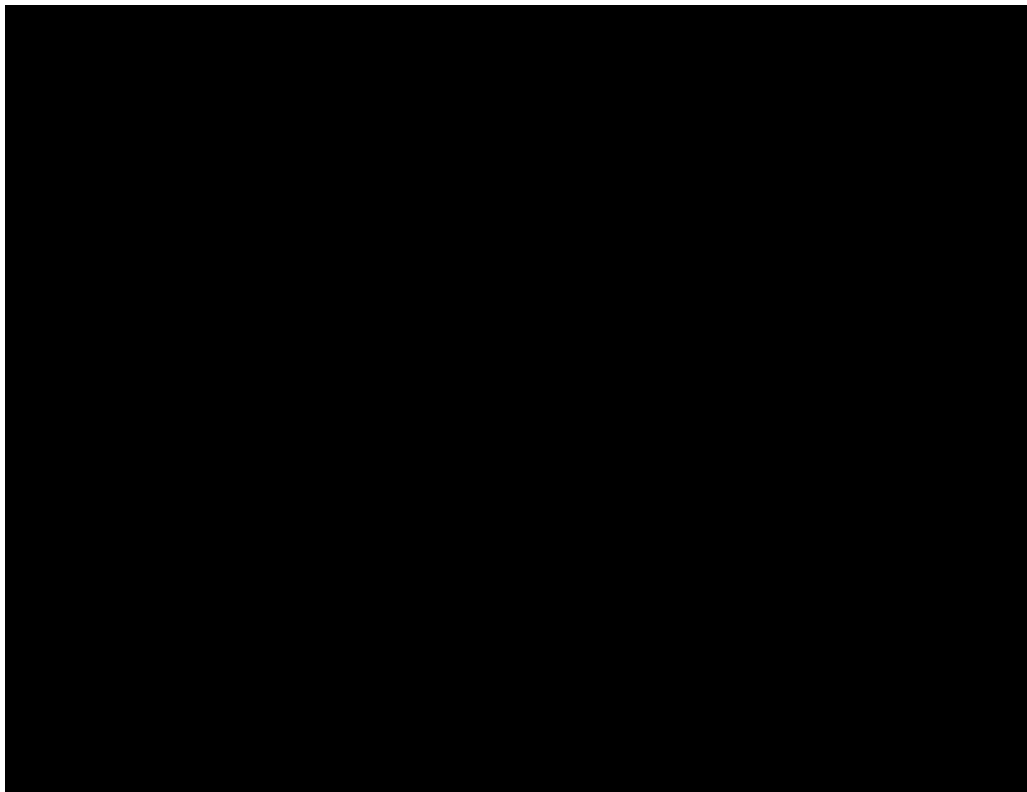
Key risks on Stages 4 and 5 and set out in Sections 4 and 5.

### 1.2.1 Central Section

The number of Anchor Milestones has increased significantly; mainly to include all the Handover to IM dates, as well as new targets for training and safety case production. Figure B - 1 in Appendix B indicates the status of Anchor Milestones at Period 10 and Figure B - 2 indicates the status of Anchor Milestones at Period 11 following the implementation of the new MOHS.

At this time, the forecast dates sit over the [REDACTED] [REDACTED] dates; i.e. they are on schedule. We will monitor status in future reports. It should be noted that the forecast curve for delivery of Anchor Milestones over the next 6 months is much steeper than the previous 6 months. This aspiration to increase productivity, resulting in steepening of the forecast curve, is also prevalent across most systems and stations projects as shown in the individual project charts in Appendix B and Appendix C. We are sceptical that this can be achieved.

Figure 1 - 2 indicates the Systemwide progress against the new MOHS 2018 at Period 11. The overlap of forecast dates with the MOHS 2018 [REDACTED] and the steepening of the forecast productivity curve can be seen in this chart.



The new MOHS contains a large number of assumptions and therefore risks. The key risks are:

- [REDACTED]
- [REDACTED]
- Installation and testing of ventilation systems cannot be accelerated, see Section 3.6;
- [REDACTED]
- Some stations may not be ready for scheduled non traction power-on dates, see Section 3.6;
- Phase 3 integration testing is delayed by slippages to preceding works, see Section 3.6;
- Handover Execution Plans are not agreed with IMs in time, see Sections 3.10 and 3.11;
- Training materials, asset data and training sessions are not delivered in time, see Sections 3.2 and 3.10;
- The production of IRNs cannot be accelerated back to the original forecast, see Section 3.6;
- CRL and the IMs are not able to agree Staged Completions in some locations, see Section 3.11;
- [REDACTED]
- Access to the Trace is insufficient to enable works to be completed, see Section 3.6;
- Tunnel walkways etc cannot be installed before Trial Operations, see Section 3.6;
- CRL and NR are not able to agree transition testing dates on GEML and GWML, see Section 3.6;
- [REDACTED]
- IMs are not satisfied with the Handover verification process, see Section 3.8;
- Critical works after Handover cannot be completed in time under the RfL-I Rulebook, see Sections 3.2 and 3.6;
- Sufficient documentation cannot be submitted to ORR in time, see Section 3.8.

These key risks are due to assumptions built into the MOHS. Any of these has the potential to impact on the Stage 3 Opening date. This list is not exhaustive and there are many more minor risks; see Section 3 for more details. In light of these risks, we recommend that Sponsors consider preparations in case of a delay to Stage 3 Opening. We understand CRL is reviewing all risks across Systemwide activities and other critical paths as part of its SACR19 review.

Figure 1 - 3 sets out the Corporate Key Milestones selected by the CRL Board as part of its KPI incentive scheme for the CRL Executive, shown with the MOHS 2017 [REDACTED] and the CRL Period 11 actuals. All have been achieved. New Corporate Milestones are due to be agreed in March 2018.

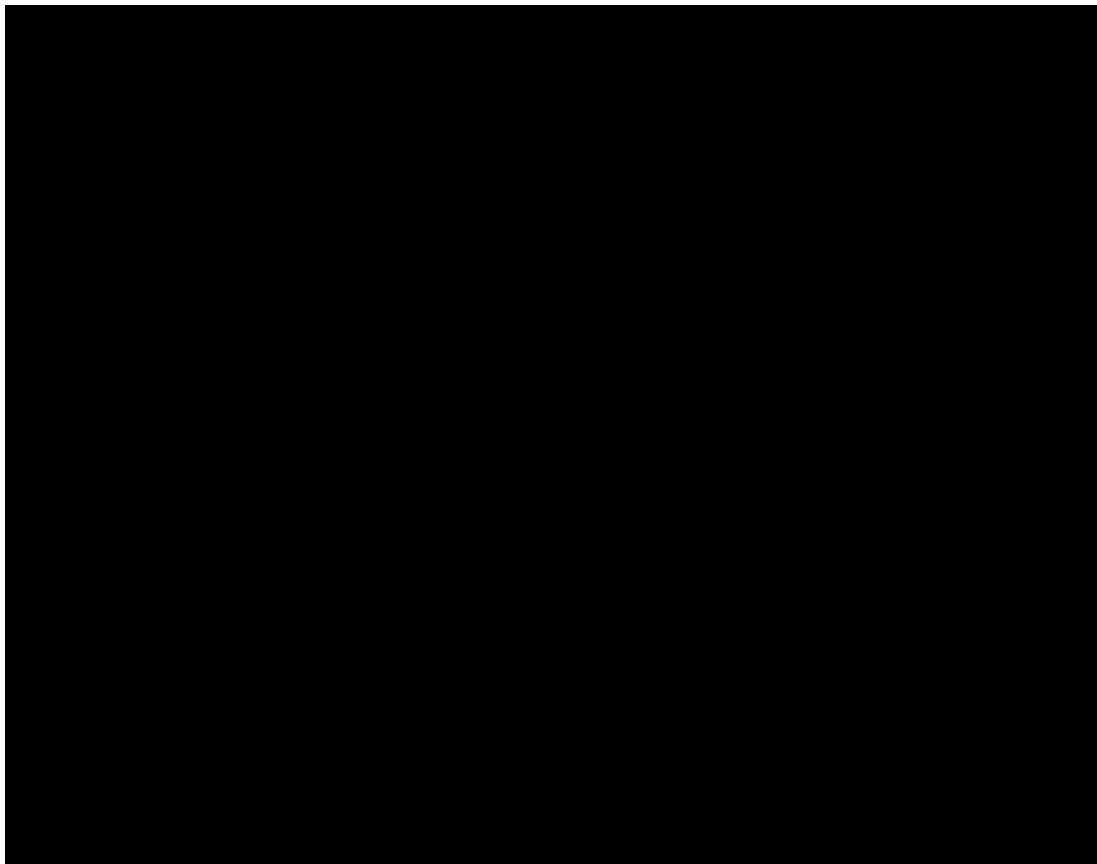
Corporate Key Milestone	Description	MOHS 2017 [REDACTED]	Period 10 Actual / Forecast	Period 11 Actual / Forecast
1	Stage 1	[REDACTED]	22-Jun-17	22-Jun-17
2	All Track Complete (excl WHI EB)	[REDACTED]	10-Jun-17	10-Jun-17
3	FDO's held (excl PLU)	[REDACTED]	28-Sep-17	28-Sep-17
4	Commence Traction Power (Z1&2)	[REDACTED]	29-Jan-18	01-Feb-18
5	Commence Dynamic Testing (Z1&2)	[REDACTED]	25-Feb-18	25-Feb-18
6	Track connection at Westbourne Park	[REDACTED]	02-Jan-18	02-Jan-18

**Figure 1 - 3 ~ Corporate Key Milestones**

PSR 108 Period 11 FY 2017-18 v1.23 docx

**1.2.2 NR ONW**

CRL and NR report that the ONW is 93% complete (previous 92%) based on expenditure of forecast cost, rather than actual physical progress. Figure 1 - 4 shows the forecast and actual cumulative performance of ONW key dates and milestones against the MOHS baselines. The forecast information is shown at Period 10, as NR reports lag those of CRL. Although the [REDACTED] and [REDACTED] dates have been adjusted in accordance with the new MOHS, the forecast curve is almost exactly the same as before. The large increase in milestone completion in Period 6 (10 September 2018) is due to substantial completion of west station works (excluding enhancements), K05B (Full Infrastructure Capability - Maidenhead to Central Core Area at Westbourne Park to Support Operation of New Trains) and KD24 (Infrastructure complete to support Stage 5 Dynamic Testing).



During Period 11, NR achieved the following Programme milestones;

- Key Date 20 (31 August 2018) - Signalling updated and selective door opening commissioned on the GE route to support Stage 4 EMC testing;
- Key Date 21 (31 August 2018) - Update of GE Control Centre at Liverpool Street complete to support Stage 4 Dynamic Testing;
- Key Date 29B (5 February 2018) NR track and civil engineering infrastructure complete, including turnouts between the Electric lines and the Crossrail Central Tunnel Section, ready to receive signalling systems overlay installation by Crossrail on the NE Spur. The delivery of Key Date 29B also included the first Crossrail train to pass through the transition portal at Pudding Mill Lane.

On Crossrail Anglia, the 10 week Gidea Park Sidings possession was completed.

At Abbey Wood station, the interim station training room has been dismantled and removed from site, the link footbridge has been removed and works continue towards final completion and formal station opening.

On Crossrail West, Schedule 7 approval was obtained from the London Borough of Ealing for the final two west enhanced stations at Ealing Broadway and Southall. All west enhanced stations now benefit from having Schedule 7 consent.

CRL is currently forecasting that KD33 (Traction Power - Kensal Green to Westbourne Park) will be achieved on 28 February 2018, however NR is planning for this to be achieved in April 2018. We have raised this with CRL and expect to receive its explanation for the anomaly soon, as well as any potential impact on the energisation of the Westbourne Park ATS.

Refer to Sections 2, 4 and 5 for further information regarding NR works required for each Stage completion.

**1.3 CRL 2018/2019 Business Plan review**

The CRL 2018-2019 Business Plan was approved by the CRL Board on 7 December 2017 and issued to PRep on 16 January 2018. CRL has assumed that the Business Plan staff structures and plans are predicated on the MOHS 2017 “Business Plan” Refresh and that Staff demobilise according to the role end dates in the Business Plan.

However, the MOHS 2017 is regarded to be out of date and hence the proposed resourcing is not properly aligned with Programme delivery as we now see it. There is no evidence to suggest that the approved plan has been reviewed and aligned to the 2018 MOHS refresh nor provision or allowance included in the current QCRA to accommodate for such known risks. For instance, the MOHS 2018 indicates delays to Trial Running and Trial Operations which may require extending key roles, and resources are planned to de-mobilise too early due to schedule slippage. Delivery resources, too, are departing mid-2018 prior to when most of the works are due to be complete and before some Handover dates, notably at [REDACTED] and [REDACTED] stations.

The Business Plan does include for key roles that are currently vacant, but is expecting to recruit at salaries consistent with current averages for each grade. This is regarded to be an optimistic proposition; it is our opinion that [REDACTED]

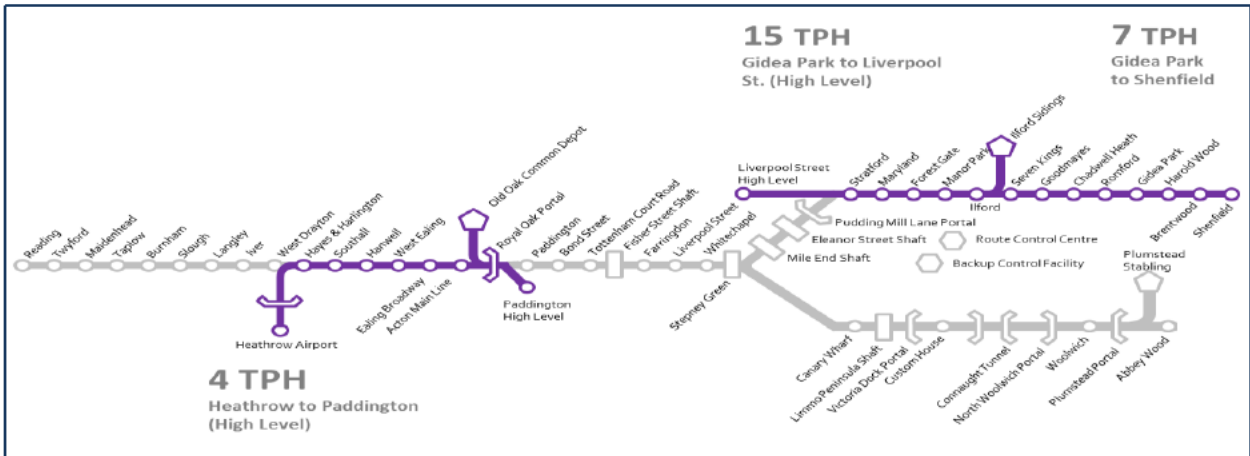
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

CRL has assumed that certain operational and functional activities will be completed “by others”. The 2018/2019 Business Plan does not make it clear who the “others” are, and whether or not they have agreed with the activity transfer and that adequate funding is available.

CRL reported that the 2018/2019 Business Plan contributed £12m increase to the Period 9 AFCDC. This increase can be evidenced by the extension of appointments from the previous business plan due to programme delays, the concentration and compression of interfacing activities and disciplines and the consequential effects to ongoing assurance and maintenance documentation. We expect Indirect Costs to increase when the full impact of MOHS 2018 is assessed.

Further commentary on each section in the Business Plan is included in Appendix E.

**2 Stage 2: Phase 1; 20 May 2018. Phase 2; [28 October 2018]**



**2.1 Summary**

CRL CEO has written to the Sponsor Board chairman with its plans for Stage 2, which will be implemented in two phases. Both phases contain risks, as set out below.

*Achieving Regulatory Approvals for Phase 2 adjudged to be 'Red' by CRL approvals team.*

**2.2 Operational Readiness Assessment**

We are now reporting upon Stage 2 Phase 1 and Stage 2 Phase 2 within this Section of the report, and CRL has provided a letter<sup>2</sup> to Sponsors to inform them of the situation. In our last report, we explained how the letter should, in our opinion, address three issues. These were:

- What service pattern (now known) will be in place for 20 May 2018, the risks to delivering that service and how they have been mitigated;
- The programme, including cost and risks, for migrating to the Stage 2 original service pattern;
- How the current situation will impact upon the train's readiness to support Stage 3 Opening, and what steps are being taken to mitigate any adverse impacts.

These have been partially addressed and, if required, we will work with Sponsors in formulating any response to the letter.

<sup>2</sup> A Wolstenholme to D Hughes – 20 February 2018.

As described in our last report, CRL is now reporting its Stage 2 Phases 1 & 2<sup>3</sup> through its dashboard reporting format, rather than its Readiness Tracker. We believe the dashboard is a more concise reporting tool, but the Readiness Tracker is the formal reporting vehicle for SACR. This was agreed between Sponsors and CRL when CRL gave 24 month notice of Stage 2 Opening. CRL and JST are due<sup>4</sup> to discuss the content of the SACR19 report, and we will raise the matter there.

## 2.3 Network Rail Works

### 2.3.1 West Platforms and Stations

NR has confirmed<sup>5</sup> that the works for West Inner stations for KO4<sup>6</sup>, which includes DOO CCTV, are substantially complete. NR has also reported that the Hayes and Harlington bay platform extension remains on schedule for completion for 8 April 2018.

### 2.3.2 Stockley to Maidenhead OLE

The NR Stage M signalling is complete to OOC Depot, but further commissioning by CRL may require NR support. NR is currently awaiting CRL confirmation and will require an Investment Authority remit to progress.

NR is reporting that key deliverables for Stage 2 Opening remain on schedule:

- Electrification of 8066 points is scheduled for completion on 7 May 2018, over the early May Day Bank Holiday;
- All outstanding gauging work at Paddington including track and coper moves will be completed by 7 May 2018, over the early May Day Bank Holiday;
- Completion of the diverse telecoms north and south routes is forecast for April 2018, but is dependant on the BT Depot completion.

NR continues to forecast the conversion of the OLE to AT power to be completed by May 2018 in line with CRL schedule. Separately, and not under CRL ONW, NR has confirmed<sup>7</sup> that investment authority has been granted for the 12kA upgrade to the power distribution system. This provides assurance for power capacity for electric trains on the NR system from Paddington.

## 2.4 Phase 1

The key issues affecting Phase 1 are as follows:

### OOO

The depot is forecast to be Brought Into Use (BIU) on 1 March 2018. MTR-C's Class 345 (C345) driver training programme, which will require the depot to be operational, is scheduled to start on 5 March 2018. If driver training is delayed then MTR-C's position is that, as there is no float in the programme, there will be a consequential impact upon passenger services in May

<sup>3</sup> Tracker replaced by dashboard from CRL's Period 7, 2017/18 Board report.

<sup>4</sup> 1 March 2018.

<sup>5</sup> NR PDB 20 February 2018.

<sup>6</sup> KO4 = Key Output 4 (30 November 2017) – Infrastructure capability from Heathrow Spur to Paddington (High Level) including new up and down lines providing access to Old Oak Common depot.

<sup>7</sup> NR PDB 20 February 2018.

2018. This could mean the cancellation of some off-peak services until sufficient numbers of drivers were trained.

The risks to BIU are as follows:

- The section of the depot that interfaces with the mainline (Section A0) remains route barred, waiting for [REDACTED] contractor to complete testing logs for the agreement of NR. This was expected to be achieved in early/mid-January. It is possible for MTR-C drivers to exit/enter the depot in its current state, but these movements would be difficult.
- The testing and commissioning of Section A has encountered issues, and the programme has now been adjusted to carry out the minimum of tests that are critical for BIU. We note that Section A was originally scheduled for BIU on 24 November 2017, so the current delay (14 weeks) indicates the problems that the depot is facing.

There is no realistic mitigation for the driver training programme if the depot is not available, as the trains need access to maintenance facilities.

**Rolling Stock**

The C345 has received its Statement of Compatibility from NR to operate on the GW, and one FLU<sup>8</sup> is planned to be available for driver training from 5 March 2018, followed by two more by 19 March 2018. [REDACTED]

The issue of platform gaps at Paddington could be resolved by train software development. The facility is available on TCMS v4.2, but had not been proven because it was not envisaged that TCMS v4.2 would be required in the west. [REDACTED]

[REDACTED] We do not consider this situation as a major risk to Phase 1.

**Regulatory Approvals**

There are three approvals (ORR issue Amended Safety Certificate for GWML, SMS updated for Empty Coach Stock & Driver Training, SMS updated for Passenger Service) to obtain for Phase 1, and these are all 'green'. This is to be expected, as the C345 FLU and RLU using the existing signalling system are known quantities.

**2.5 Phase 2**

The issues affecting Phase 2 are as follows:

**OOC**

Depot works will be continuing during Phase 1 passenger service, Phase 2 testing and service plus Stage 3 testing. Therefore, problems arising could affect any of these three activities so CRL should consider a contingency plan.

In our last report, we stated that the signalling of Section A was forecast for March 2018 (originally October 2017). It is now forecast for 5 May 2018. The delay can be managed, but represents another erosion of schedule float.

<sup>8</sup> FLUs are being used for driver training and testing activities, RLUs for passenger service.



Depot Section B1, which provides 6 more stabling sidings, has a new BIU date of 11 April, which was 22 February in Period 10. The train delivery schedule has been adapted to incorporate the delay, but there is a risk that testing activities could be curtailed if any more delay affects capacity. Depot Section B2 is scheduled for BIU by 23 May, and this is also on the critical path for stabling. A further point is that signalling of Section B and C is not scheduled until 26 August. There will be movements to and from these sidings from the start of Trial Running, and this will require resources and procedural controls from BT if all requirements are going to be satisfied.

**Rolling Stock**

The train carried out further testing in the Heathrow tunnel on 23 February, and this provided some areas of comfort. Stage 3 (CBTC) testing in Melton has lately been prioritised over Phase 2 (ETCS) testing.

[Redacted text block]

**Regulatory Approvals**

There are a number of issues affecting Regulatory Approvals for Phase 2:

- [Redacted] forecast of when it is expected to achieve On-board signalling ETCS APIS from the ORR is the end of September 2018, which it considers to be ‘amber’;
- [Redacted];
- We also note that NR is forecasting receiving its APIS for ETCS and GSM-R data trackside by mid-April 2018. This was originally forecast for the end of December 2017, and the current date would have conflicted with the Stage 2 driver training schedule as planned before the implementation of a Stage 2 phased opening. NR state the submission is finished, so we would encourage it to be submitted.

**2.6 Agreements**

The three key agreements which are critical for Stage 2 cannot be finalised until the ORR publishes its determination of the matters in issue between TfL and HAL regarding the Framework Access Agreement. It was expected that determination would be due by the end of January 2018, but it is now expected that MTR-C and HAL will conclude the agreements by mid-March 2018. RfL’s assessment of the risk of delay remains at ‘amber’.

There are six other agreements that are on the critical path for Stage 2 Phase 1, and these are classified as ‘green’ by RfL.

See Appendix D.1 for progress charts.



Eight of the tasks are rated as ‘medium’ impact, but have a cumulative impact upon RfL-I maintenance and LU staff being trained and competent, which is rated as ‘high’ impact. The twenty-three Readiness Tasks can be attributed to three categories:

- COS infrastructure not being in a position to support EDT;
- Train software not being in a position to support EDT;
- CRL not receiving data, or it being below the necessary quality, from the Tier 1 contractors. This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway.

	Readiness Task	Issue
<b>Dynamic Testing Zones 1-2</b>		
	Infrastructure available and ready for Dynamic testing	The original start date of 1 November 2017 was delayed until 25 February 2018. See Section 3.5.
	Delivery of FLU with functioning CBTC	There has been some progress in the development of the train’s TCMS CBTC functionality, but it continues to presents a high risk that a train is not available to fully support dynamic testing. See Section 3.9.
	<b>NEW</b> Drivers trained on CBTC, CCRRB, T3 and OSP briefed and familiar with zones	Process of obtaining the necessary access accreditation from Tier 1 contractors proving arduous.
	MAID deliverables uploaded in Livelink <i>Medium impact</i>	Handover material is in delay. See Section 3.10.
	Implement RCA’s (update processes and procedures) <i>Medium impact</i>	LU has instigated mitigating actions that has reduced this issue to amber.
	RfL-I acceptance of FDO (for interfacing assets) <i>Medium impact</i>	FDO certificate dates are continuously moving back, (now end of February / March 2018) delaying parts of Handover material and impacting upon Interim Acceptance. We discuss the issues in Section 3.8.2.
	Training of RfL-I staff on CCRRB (Crossrail Construction Railway Rule Book)	This relates to the general delay in training. Without this knowledge necessary works to be carried out post-Handover will be impeded or suspended.
	<b>NEW</b> Training of RfL staff for operation of RCC equipment during Dynamic Testing	The training simulators are not functioning as planned. This activity may be mitigated by the Contractor carrying out the tasks.
	Systemwide approvals and agreements in place for DT	Sufficient progress has been made with the energisation programme to alleviate this issue.
<b>Dynamic Testing All Zones</b>		
	Interfaces commissioned & operational for Trial Running	The delay to the IM training schedule raises the risk that RfL-I and NR operatives will not be able to facilitate testing and commissioning activities. This risk is being compounded by the lack of asset readiness.

	Readiness Task	Issue
	MTR-C station Handover	The IM (RfL-I) cites continuing uncertainty concerning Handover dates and material.
	LU Elizabeth line asset data in Ellipse/ Maximo <i>Medium impact</i>	Handover material continues to be in delay. See Section 3.10.
	Compliance Achieved (FDO signed without caveat)	Issue raised in 'RfL-I acceptance of FDO (for interfacing assets). See Section 3.8.1.
	O&M manuals in place for 5 LU stations <i>Medium impact</i>	O&M manuals continue to not be provided to the necessary quality in the required timescale.
	QRA data issued to LU	This Task is related to 'Implement RCA's (update processes and procedures)'
	LU maintenance in place for Handover	The lack of O&M manuals and asset data described above risks LU staff being inadequately prepared.
	All tech training delivery to IM trainers	The IM trainers will not receive the expected training by the Contractors. The current programme is under intense pressure. See Section 3.10.
	O&M manuals for RfL-I completed.	Delivery of O&M manuals continue to be behind programme, affecting IM readiness. See Section 3.10.
	System information delivery (asset data, O&M manuals, training plans, MAXIMO) <i>Medium impact</i>	IMs not receiving the level of information required. This Readiness Task is similar to the 'O&M manuals completed' Task.
	RfL maintenance staff train the trainer complete	The training plan has changed to reflect the fact that this will not be achieved. See Section 3.10.
	Systemwide approvals and agreements in place for DT	This reflects the delay associated with Zones 3 & 4 readiness.
<b>Trial Running</b>		
	<b>NEW</b> Sufficient 345 units available to support 24tph tests	FLU's have been manufactured, but there are issues with sufficient numbers meeting the acceptance criteria for the start of Trial Running.
	LU Comms DLO staff training familiarisation complete	The lack of Handover material affected the ability to train LU comms staff, but assumptions have been made to mitigate the situation.
	LU Handover achieved	This task is Red due to the items listed above.
	RfL-I maintenance staff trained and competent	Red due to contractor training plans and asset availability. See Section 3.10.
	RfL-I Ops & RCC staff trained, licenced & competent	The delays to the [REDACTED] at the RCC has affected the Traffic Manager training programmes. Some will not be trained until after Handover.

	Readiness Task	Issue
<b>Stage Three Service</b>		
	LU Staff Ready to Open for Revenue Service	This task is Red due to the items listed above.
	ORR issue APIS for COS assets	Tier 1 Contractors and CRL have made progress in producing assurance evidence at the required rate. See Section 3.8.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 3 - 1 ~ Readiness Tasks with "Red" Status

### 3.3 Tunnels

The tunnelling contractor forecasts contract (██████) completion by 27 April 2018. This date has slipped due to continued access for Liverpool Street station fit-out works, through the shaft. Backfilling of access shaft AS1 is due to start<sup>11</sup> in June 2018.

The CRL site team continues with its demobilisation in accordance with the current CRL Business Plan, and on the assumption that the final settlement and project close-out will be achieved by the end of Period 3 (2018/2019). There is a risk that the project's close-out process may not be completed in line with CRL policies and procedures, if the contractor experiences further delays in achieving contract completion and/or key resources cannot be retained until all Assurance/Handover documentation has been accepted.

### 3.4 Stations, Portals and Shafts

The cumulative plan and actual percentage completions, reported for all stations, have been re-baselined in Period 11. Refer to Appendix C, Figure C - 1 for a summary of the re-baselined percentage completion against plan. The re-baselining exercise, a part of the MOHS 2018 refresh, has suppressed the planned level of progress at most of the stations; but most markedly at ████████ (plan adjusted from 92% in Period 10 to 87% in Period 11). All stations achieved their planned milestones in the Period.

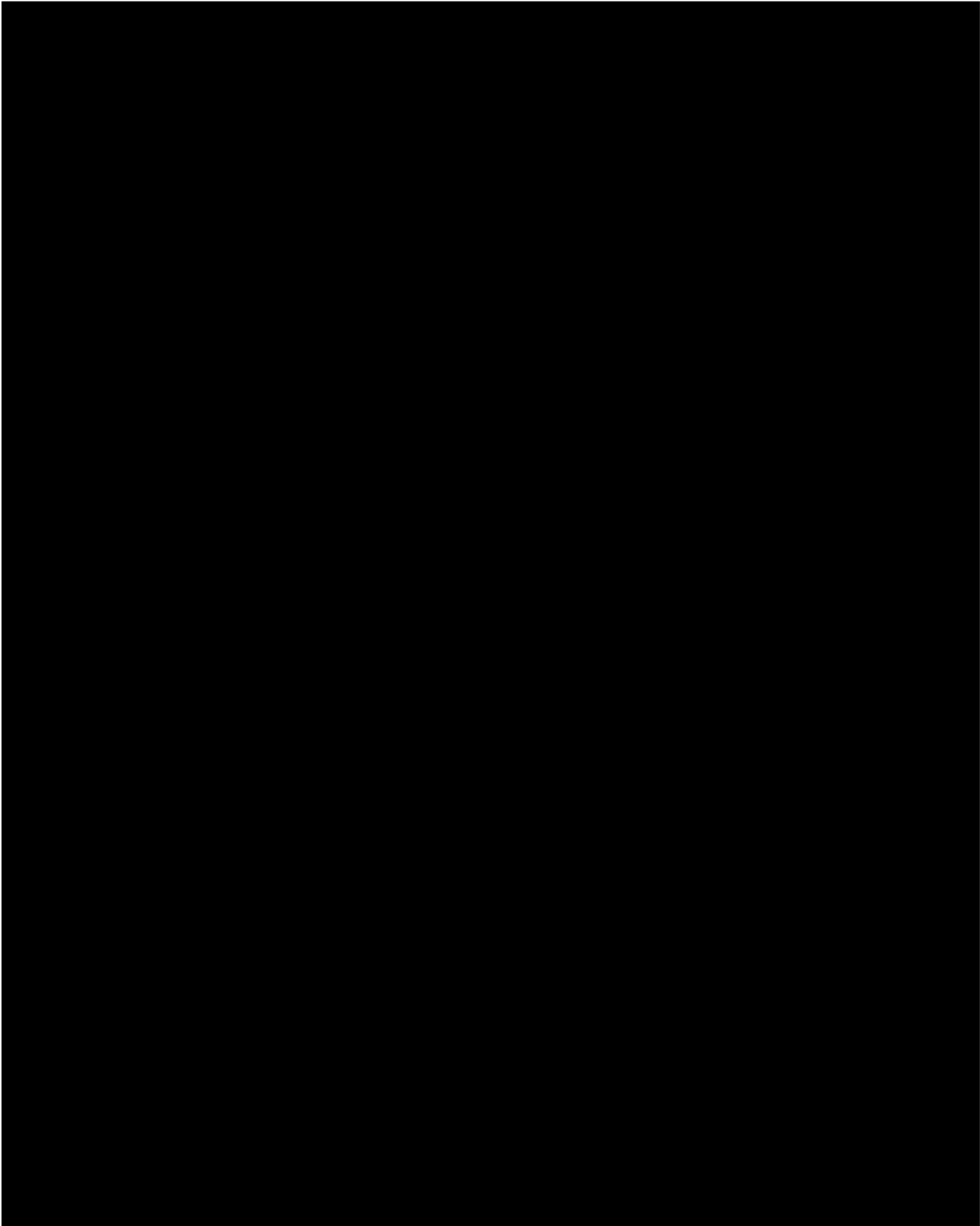
The schedule performance curves, for each of the stations, have been re-baselined to reflect CRL's 2018 MOHS refresh. The curves for each station are, as a result of the MOHS 2018 refresh, coincident with plan. We note that this has resulted in a steep increase in the gradient of the forecast performance curves over the coming months. We are concerned that this may reflect a possible "optimism bias", on the part of CRL, in the assumed rates of production that can be achieved by their respective contractors. Historically, CRL's contractors have found it difficult to achieve and sustain such high rates of production.

To illustrate the basis for this concern, and the challenge presented to CRL, we have included the Period 10 (MOHS 2017) schedule performance curves for comparison against the refreshed MOHS 2018 forecast performance curves for Period 11; see Appendix C, Figure C - 2 to Figure C - 8 inclusive.

A summary of the forecast Central Section station completion dates can be seen in Figure 3 - 2 below. This table has been expanded, for this report, to reflect the forecast key dates and

<sup>11</sup> Activity A157600 – Backfill AS1, Finsbury Circus shaft Start 24/06/18. Forecast finish 24/09/18.

milestones at Period 11, against both the MOHS 2017 and refreshed MOHS 2018. The MOHS 2018 has also introduced forecast dates for “Handover to IMs”.



The suite of commercial agreements with [REDACTED], covering the contracts for [REDACTED] [REDACTED] stations, and the Intermediate Shafts, were signed by all parties just after the close

of Period 10. CRL now has to focus on achieving the required level of production and the target milestone dates as each contract progresses towards IM handover and target completion dates. Maintaining pressure on the Tier I contractor will be challenging; but Tier II contractors have yet to commit to achieving the MOHS 2018 schedule.

**Paddington Station**

[Redacted text block for Paddington Station]

**Bakerloo Line Link (BLL)**

[Redacted text block for Bakerloo Line Link (BLL)]

[Redacted]

**Tottenham Court Road Station**

[Redacted]

[Redacted]

[Redacted]

[Redacted]

**Farringdon Station**

[Redacted]

[Redacted]

[Redacted]

**Liverpool Street Station**

[Redacted]

[Redacted]



**Whitechapel Station**

[REDACTED]

**Woolwich Station**

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

- | [REDACTED]
- | [REDACTED]
- | [REDACTED]
- | [REDACTED]
- | [REDACTED]
- | [REDACTED]
- | [REDACTED]

**Canary Wharf Station**

[REDACTED]

- | [REDACTED]
- | [REDACTED]
- | [REDACTED]
- | [REDACTED]
- | [REDACTED]

[REDACTED]

[REDACTED]

**Custom House Station**

[REDACTED]

Intermediate Shafts

[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]

[REDACTED]

3.5 Railway Systems for EDT

CRL successfully energised PML ATFS on 31 January 2018, following the catastrophic equipment failure that occurred there on 11 November 2017. [REDACTED]

[REDACTED]

[REDACTED] We provide further commentary on MOHS 2018 in Section 1.

Zones 1 & 2 progressive OLE energisation and section proving, followed by short circuit testing during possessions has successfully taken place since PML ATFS energisation; this allowed EDT to start on 25 February 2018, [REDACTED]. The purpose of these tests was to demonstrate by measurement that the exported electrical effects upon neighbouring railways (i.e. LU, LO, DLR, NR) are as designed and within specified safety parameters. The assurance provided by these tests will allow the OLE to be energised at any time (rather than just during “non-traffic” times) and remove constraints on future dynamic testing.

[REDACTED]

[REDACTED] Another potential schedule impact was avoided when very late management intervention resolved a staff access issue through a Crossrail station, which would otherwise have caused a planned critical OLE section proving activity to be lost. These examples illustrate the range of unforeseen issues, from apparently trivial to potentially serious, which might emerge to frustrate future timely delivery.

Successful energisation will provide the foundation for EDT and for future dynamic testing across the whole of the Central Section. Class 345 test train 345021 has already been delivered to Plumstead carrying TCMS v.6.1.1.11, having undergone testing at Melton Test Track. This software version is understood to contain sufficient functionality for some, but not all, of the CBTC “dynamic testing with signalling protection”; this phase of testing is due to start on 9 March 2018 following the initial period of “non-protected” running from 25 February 2018. Dynamic testing in Zones 1 & 2 is scheduled to be completed on 11 June 2018, although if it proves impossible to complete the planned testing scope, there will be opportunity to do so once dynamic testing is extended to cover all Zones, from 2 July 2018.

Some C620 equipment testing remains outstanding, with track turnouts at Plumstead (necessary to support the start of EDT) and at Whitechapel (necessary to support testing with signalling protection). Both workstreams are scheduled to be completed in time.

We reported last period on the need for CRL to replace broken rail baseplates discovered in Connaught Tunnel, in order to avoid speed restrictions which would prevent dynamic testing at higher trains speeds in Zones 1 & 2. The replacement works are now incorporated into the MOHS.

**3.6 Completion and Handover of Integrated Systems**

Key dates in the dynamic testing phase through to Trial Operations are shown in Figure 3 - 3. These dates have remained largely unchanged during the last period while MOHS 2018 has been finalised<sup>12</sup>. While this might be read as indication of plan stability, it must be stressed that the MOHS as now cast contains virtually no schedule float. Aside from right-first-time execution, management of access to the Tunnels and Stations for completion and maximisation of productive work time will have the greatest influence upon success. Across Systemwide, limits have been reached for the efficient utilisation of plant and manpower, and (with the notable exception of C660 fibre splicing and testing) increases in resources will have no significant effect upon productivity. If the plan is not adhered to, some recovery might be possible by “trading” schedule opportunities for dynamic testing activities against installation activities, thus avoiding impact upon the current dates for Trial Running and Trial Operations. However, there is no spare time for significant rework should something go wrong, and past experience strongly suggests that completion will not be incident-free.

Key Dates	MOHS 2018	P11 Actual / Forecast
Traction Power Energisation	01-Feb-18	01-Feb-18
Commence DT in Z1&2	25-Feb-18	25-Feb-18
ONW KD33 Power from KG	28-Feb-18	28-Feb-18
4 Trains ready for DT Z3&4	23-Mar-18	23-Mar-18
Fibre Backbone complete	27-Mar-18	27-Mar-18
ATS at WBP energised	07-Apr-18	07-Apr-18
Traction Power on Z3&4	10-May-18	10-May-18
Linewide SCADA available	30-May-18	30-May-18
Commence DT in Z3&4	11-Jun-18	11-Jun-18
HV Non Traction Power on	01-Jul-18	01-Jul-18
DT All Zones	02-Jul-18	02-Jul-18
Commence Trial Running	05-Aug-18	05-Aug-18
Commence Trial Operations	09-Sep-18	09-Sep-18

*Figure 3 - 3 ~ Key Dates to Trial Operations*

Zone 3 & 4 energisation, and thereafter the achievement of the final Traction Power supply configuration for the Central Section, is a complex and critical workstream. OLE to the west of the Zones 1 & 2 limit of energisation (located between Stepney Green and Whitechapel) will be progressively energised using PML ATFS, and will include short circuit testing. Supply of traction power will then be switched from PML ATFS to WBP ATS (planned to be already energised on 7 April 2018) to start an eastward OLE energisation sequence up to Pudding Mill Lane and Abbey Wood. Once completed, dynamic testing in Zones 3 & 4 will start on 11 June 2018. Critical pre-requisites to energisation are the completion of OLE, earthing and bonding

<sup>12</sup> Key dates are mainly as originally presented at MOHS Period Review Meeting held on 19 January 2018.

and [REDACTED] systems installation ([REDACTED]), which in turn are dependent upon efficient works train management and installation productivity improvements by [REDACTED]. As with Zones 1 & 2, the timely preparation of the associated IRNs in order to support safety submissions and to allow Phase 3 testing will be challenging.

In the meantime, withdrawal of PML ATFS as a supply point will allow planned completion and re-configuration of the sub-station facility to its final state, which is as a permanent traction power supply for both Crossrail and NR.

CRL will start the process of permanent HV non-traction power energisation across the Central Section on 11 March 2018. With railway systems able to be supported by temporary power supplies this process is not strictly necessary for dynamic testing, but is a critical enabler to Station Systems Phase 3 integration testing. The sequence has been designed primarily to support the completion of the permanent Tunnel Ventilation System and comprises a pre-determined “daisy-chain” of HV sub-station energisations (i.e. both 11kV and 22kV) on 12 consecutive weekends. This is the first work stream to bring together the various Stations and Rail Systems deliverables as an integrated power distribution system, and success on an extremely tight schedule relies upon close co-ordination and readiness of Stations installations. The introduction of permanent power will also bring with it changed safety risks, managed through carefully controlled access and restricted methods of working. Imposition of these controls will inevitably mean that activities will take longer, and be less efficient to complete than at present.

Following completion in Zones 3 & 4, dynamic testing will be carried out across all Zones from 2 July 2018, in order to demonstrate end-to-end integrated signalling functionality. This testing period will include two weekends of signalling transition testing at each of the NR GE and GWML interfaces, possessions for which have been provisionally booked for June, July and August 2018, but which have yet to be confirmed by NR. As before, progress in line with MOHS requires the delivery by BT of a reliable test train with appropriate functionality and that dynamic testing proceeds without significant issues. Further details are provided in Section 3.7.

MOHS provides opportunities for installation completion wherever this does not conflict with dynamic testing. For example while dynamic testing takes place in Zones 1 & 2, installation will continue in Zones 3 & 4; the reverse applies when dynamic testing takes place in Zones 3 & 4, with completion activities planned for Zones 1 & 2.

Until Trial Running, the Central Section must function as both an electrified test track and as a construction railway, and C610’s Construction and Commissioning Railway Rule Book provides for this. At a practical level, competing construction and testing requirements, driven by an extremely tight schedule, will place increasing demands upon site management and train operations and the railway will be at its most vulnerable from a safety perspective. Safety is paramount, and as we approach this critical phase of Crossrail Programme delivery, CRL must ensure that processes and procedures are trained-out, properly understood and well-practised before rail operations intensify.

While much focus continues to be placed upon proving the Rolling Stock / Signalling functionality, Phase 3 integration testing at other critical interfaces must be completed before Crossrail can be shown to be fit for operation as a passenger railway. As reported last period, working arrangements are being developed between CRL and RfL which will allow the completion of late activities from the time of Handover and into the Trial Running period. CRL has forecast that a wide range of activities will remain:

- [REDACTED] non-dynamic testing critical works (e.g. walkways, lighting, LV cabling);
- [REDACTED] removal of temporary works (e.g. lighting, fire main, radio);
- [REDACTED] permanent ventilation system testing;

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- [REDACTED] completion of testing;
- [REDACTED] completion of integration testing with Rail Systems;
- [REDACTED] completion of integration testing with Stations.

We are aware that, and it is extremely encouraging that, RfL is showing a willingness to enter into discussion upon all completion issues and remains open-minded on how those that do not compromise safety or reliability might jointly be concluded.

The Systemwide progress charts in Appendix B illustrate the significant increases in productivity that are necessary over the next few months, in order to achieve Stage 3 Opening on 9 December 2018. [REDACTED]

### 3.7 Dynamic Testing

MOHS 2018 contains the latest and best available information from BT on Class 345 test train dynamic testing scope and progress. Collaboration and information sharing between BT and CRL has improved significantly over recent months, and lack of openness appears to have receded as an obstacle to achieving railway integration. Nevertheless, given past performance, serious concerns remain with [REDACTED] to match CRL's schedule requirements.

The dynamic testing sequence forms the core critical path and MOHS shows that it is split into three distinct phases:

- Zones 1 & 2 (EDT);
- Zones 3 & 4;
- All Zones.

Dynamic testing now runs between 25 February 2018 and 5 August 2018, over a total period of 23 weeks; this compares with the period of 35 weeks provided for in MOHS 2017. The reduction in dynamic testing time illustrates the schedule compression that has been incorporated into the MOHS in order to maintain the Stage 3 Opening date and highlights the critical reliance upon progress strictly in line with plan. CRL is seeking to maximise the use of the available off-site testing facilities to complement and support dynamic testing, and [REDACTED] are focussing their integration efforts on the CIF at Chippenham, as well as at Melton. Ultimately, the ability to make best use of all of these facilities will come down to the availability of scarce resources, something that both contractors are seeking to address.

### 3.8 Approvals, Assurance and Agreements

#### 3.8.1 Final Design Overview (FDO) Performance

There has been an improvement in the rate of FDO Red issue closures during the Period; but the rate must increase dramatically, if CRL is to achieve its target for concluding the FDO process by the end of March 2018:

- 72 Reds have been closed/downgraded (50 in Period 10);
- 35 Ambers were closed in Period 11 (4 in Period 10);
- A total of 255 Red issues remain open (327 in Period 10); comprising 163 for Stations, Shafts and Portals (210 in Period 10) and 92 for Systemwide (117 in Period 10);
- All remaining RfL Red issues are proposed as closed by CRL. A further 133 (111 in Period 10) issues have been proposed closed to RfL.

Limmo Shaft and Victoria Dock Portal each have only 1 remaining Red issue to resolve. Both relate to the Interim Safety Justification and, on resolution, will allow the FDO report to be released and FDO certification to be issued.

North Woolwich Portal has only 1 Red issue relating to the A&M strategy.

**3.8.2 Interoperability**

Ricardo Rail (RR), acting as CRL’s NoBo, reports that design assurance is progressing in line with the agreed programme.

Planning of the outstanding work content is still a major concern to RR. All parties involved need to fully understand the work left to be delivered by August 2018. RR sees this planning exercise as being critical to the success of overall project delivery.

[Redacted content]

The time to address these issues is running out.

**3.8.3 Regulatory Approvals**

CRL has rated the status of achieving regulatory approval for Stage 3 as ‘amber’.

This is as a result of the MOHS review and reviewed ORR guidelines, leading to a revision of the submission date of the CRL application for APIS of the Central Section to 17 September (previously 3 July). CRL believes the target date aligns with the improved programme of safety and interoperability deliverables. We remain concerned that the safety deliverables will be problematic to complete due to:

- Design: Slow progression through RAB-C;

- Testing and Commissioning: There is more visibility as to what the quantum is for the safety deliverables required for this stage, but the schedule is challenging. This is also a concern to the AsBo.

CRL has proposed key dates for the Safety Case development which are set out in Figure 3 - 4; these have been confirmed in the new MOHS. Finalisation of safety documentation relies upon documented outputs from site testing, so any further delays to dynamic testing are likely to impact Safety Case completion and downstream securing of Regulatory Approvals.

No	Key Dates	MOHS 2018
1	Contractors submit draft ESJs to CRL	31-Mar-18
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18
4	Contractors submit final ESJs to CRL	30-May-18
5	CRL submit Safety Justifications to RAB-C	07-Jun-18
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18
7	Final COS Safety Case updated and submitted to RAB-C	31-Aug-18
8	Submit Technical File to ORR	17-Sep-18

Figure 3 - 4 ~ Engineering Safety Management Submissions for Stage 3 Safety Case

### 3.8.4 Agreements

The slippage of the recently re-baselined critical Agreements programme has continued in Period 11. Internally, CRL reports<sup>13</sup> that there are no ‘Red’ items in the Industry Agreements necessary for Stage 3, however we are monitoring the following areas where progress is problematic:

- Infrastructure Interface Agreements between NR and RfL for Plumstead Portal & South East spur, Pudding Mill Lane and Westbourne Park;
- Umbrella property agreement between TfL and NR;
- Other communication agreements within TfL’s framework (e.g. LFB, LUL, etc).

See charts in Appendix D.1

### 3.9 Rolling Stock

The decision to open Stage 2 inphases has meant that there has been some flexibility in bringing forward the CBTC testing element of the programme. CBTC Automatic Mode/ Protected Mode has been completed, giving some confidence that the initial dynamic testing activities can be undertaken. There have been delays to the software associated with full CBTC functionality, and we remain cautious that software development will progress at a rate to support testing. The key dates<sup>14</sup> that BT has said that its train software will be ready to deliver by are shown in Figure 3 - 5.

<sup>13</sup> Industry Agreements report – PDB 13 February 2018.

<sup>14</sup> BT dates - reference “BT Stage 3 prioritised programme QSRA P80 dates”.

Mode	Dates
Staff Accountable mode. Protected Manual mode.	18-Feb-18
CBTC AWS/TPWS Transitions.	18-Feb-18
CBTC stopping accuracy. PSD synchronisation.	20-Feb-18
All CBTC functionality complete	02-Mar-18
Autoreverse. Isolated ETCS. Remaining Door functions. Passenger Info System.	05-Apr-18

**Figure 3 - 5 ~ Train Software Dates**

The delays to the software and FLU programme (none have so far been accepted) has resulted in a possible shortfall of accepted trains expected at the start of Trial Running. Twenty-two trains are required to operate a 24 TPH in the COS, which will be required at some point during the Trial Running Period. At the moment, 22 trains are forecast to be available by 13 August 2018, which is manageable if there is no further slippage, but this is at risk.

### 3.10 Handover

In our last report, we said that Handover was at a critical point. The situation has become more accentuated during Period 11.

#### Training

The overall quality of the courses from the Tier 1 contractors has been cited by the IMs as inadequate, leading to the rejection of a significant number of proposed courses. This factor has been compounded by the delays to the training programme, discussed in our previous reports.

#### O&M manuals

There has been some improvement with regard to quality, but not in the necessary pace of development.

#### Spares

This issue had been receding due to the identification of strategic spares, but the IMs now believe that the lack of information on other categories of spares (e.g. those with 3 month lead time to buy) could become critical if they are not informed in time as to what and how many are required.

#### Asset Information

This area continues to be problematic, with the IMs believing they will receive the information late and in large indigestible amounts. For the purpose of Handover, it will be necessary to identify the critical data and expedite them, but retrieving those from the overall system that has been created may not be easy.

In summary, the issues described above are becoming a key impediment to Handover, and hence Passenger Service.

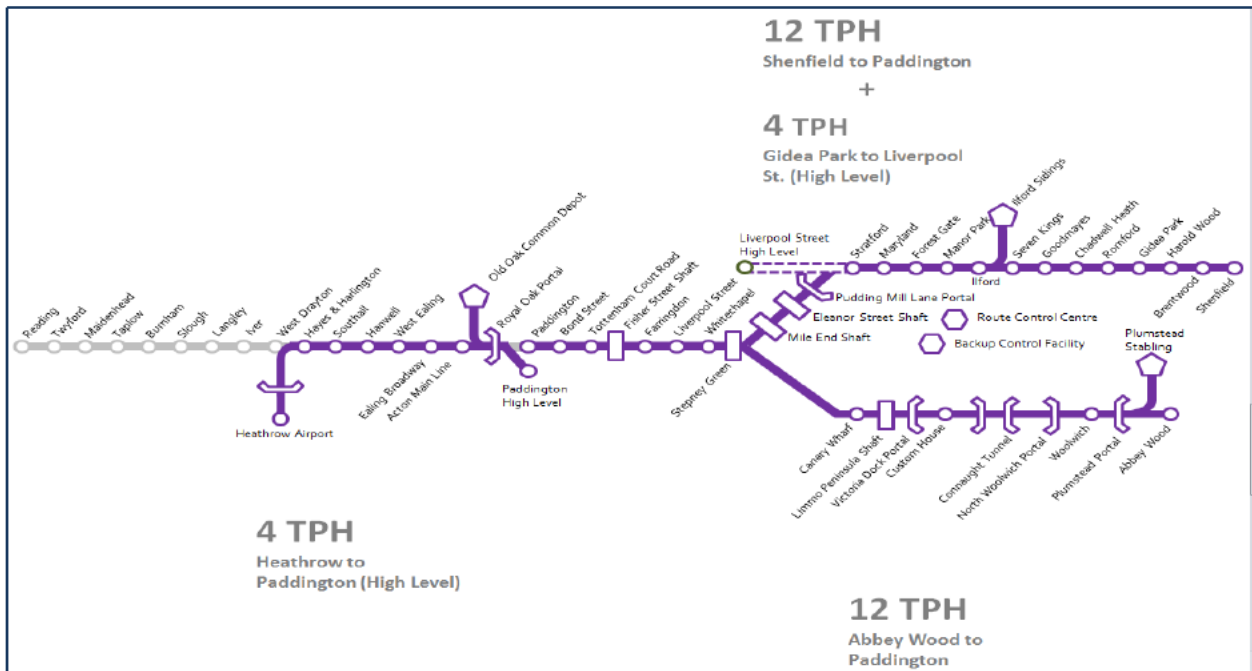
### 3.11 Trial Running and Trial Operations

The current MOSH shows an acceptance by CRL and the IMs that the Handover of an asset will be carried out in phases. There are possibly 8 assets that have been identified by CRL as requiring 'Staged Completion' plans. These plans will bridge the gap between the asset being partially made available to the IM to use, and final Handover. At each of these locations there



will need to be detailed discussion between CRL and the IM that considers what is logical to be made available and by when. CRL and the IMs have agreed to complete Handover Execution Plans for each asset by mid-March 2018.

**4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.**



**4.1 Summary**

Negotiations and planning continue regarding works required at Ilford Depot. CRL is reviewing emerging issues at Plumstead Depot.

**4.2 Operational Readiness Assessment**

There are four Readiness Tasks that have been given a “Red” status by the ORSG<sup>15</sup>.

Readiness Task	Issue
Wire height alignment corrected to standard in Ilford Depot	The scope is being reviewed by CRL, but as yet no construction or access plans to carry out the works have been agreed.
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The works have little schedule float. Full ATS is required by March 2019.
PML Eastbound Neutral Section Transition (incl Packet 44 data)	This issue was explained in Section 4.3 ‘Rolling Stock’ of our Period 9 report. RfL and BT have reported some progress and BT now needs to provide a programme for installing the software.

<sup>15</sup> 29 January 2018.

	Readiness Task	Issue
	Ilford Station Redevelopment	Contract award is scheduled by mid-March 2018. NR is forecasting Ilford Station to be open by December 2019. See Section 4.5.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

**Figure 4 - 1 ~ Readiness Tasks with "Red" Status**

### 4.3 Ilford Depot Line Speed Enhancement and Wire Heights

Negotiations between GA, CRL, and DfT are almost complete regarding the revised stock movements which will preclude the need for further track works at Ilford Depot. CRL continues to review the options regarding wire heights and we expect a plan to be submitted to C&CSC for approval soon.

### 4.4 Plumstead Depot

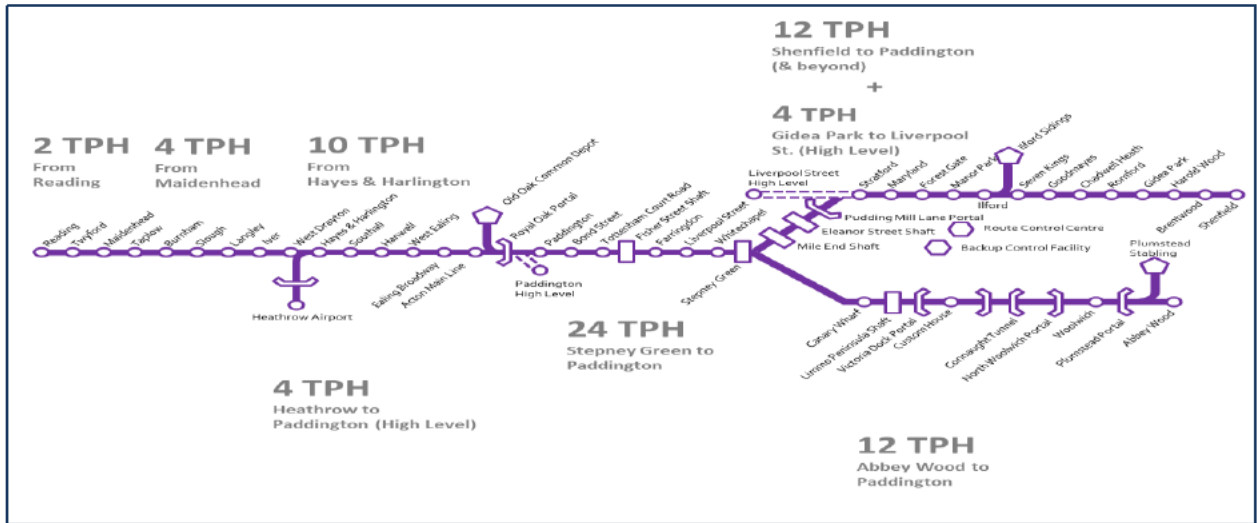
The new MOHS indicates that the Plumstead Maintenance Facility (C695) is due to be handed over to the IM on 2 August 2018 with full contract completion by November 2018 ready for Stage 3. There are some issues regarding handover of land from [REDACTED] to enable Depot works to proceed but these are being mitigated by CRL.

Plumstead Sidings (C696) will need to be complete in March 2019 so they are available for Stage 4 in May 2019. CRL continues to negotiate with ATC [REDACTED] regarding these works and a paper is expected at C&CSC soon setting out the agreed procurement plan for these works. Design and site investigation works have already been commissioned, and full site commencement is expected in August 2018.

### 4.5 Ilford Station

NR reports that it has received returned tender submission for the Crossrail East Enhanced Stations (Ilford & Romford) GRIP 5 Design which are currently under evaluation. Contract award is scheduled by mid-March 2018. NR is currently undertaking internal governance with regard to awarding the delivery contracts and remains on target for station opening for December 2019.

**5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.**



**5.1 Summary**

Although the ORSG has concerns, most issues are being mitigated.

**5.2 Operational Readiness Assessment**

There are four Stage 5 Readiness Tasks that have been given a “Red” status by the ORSG<sup>16</sup>. Those that were red in Period 9 and have now improved are shaded grey.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	NR’s programme has little schedule float. There is unlikely to be enough time to complete driver training as currently programmed. See Section 5.3.2.
Dynamic testing of CBTC to ETCS interface at Westbourne Park	Agreed that Siemens will be installing the balises within the tunnel portal.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019, with little float available. See Section 5.3.1.
Maidenhead Sidings complete for C345 FLU stabling inc staff accommodation	The issue concerns staff accommodation. See Section 5.3.1.
ORR issue APIS for ETCS (Stage B & C)	Linked to ‘ETCS available and tested airport Jn’ task.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with "Red" Status

<sup>16</sup> 5 February 2018.

**5.3 Network Rail Works**

**5.3.1 Platforms and Stations**

[REDACTED]

[REDACTED]

Due to the liquidation of the Phase 1 advanced works contractor, Carillion, the second phase of advanced works at Ealing Broadway will revert to the successful Enhanced Stations Work Package 2 Contractor. We expect this to maintain continuity and momentum to the ongoing progress of works.

NR continue to report to be on schedule for all stations to be open by December 2019.

NR has reported at Period 11 that it has developed and provided the remit for the design of the Staff Accommodation at Maidenhead Sidings. The GRIP 4 design is forecast to be delivered by the NR Design contractor, Arcadis, at the end of April 2018. The accommodation is needed for Stage 5, NR corresponding KD24 (10 September 2018), and delivery continues to be forecast for September 2018. Discussions continue between CRL and NR in respect of agreeing the implementation strategy.

**5.3.2 ETCS Delivery on the GWML**

**Stage A (Heathrow):**

NR has reported that training courses have commenced. The Balise/LEU training facility is installed and is on target to be completed by May 2018. The Alstom Safety Justification Report (SJR) was not accepted by NR due to outstanding comments on the verification process. Presently, the NoBo is reviewing the final evidence and compliance arguments. NR is forecasting to complete the Technical File submission in March 2018 in order to maintain the APIS date for April 2018.

**Stages B & C (Stockley-Acton & Acton-Paddington):**

NR reports that it received Investment Authority for GRIP 5-8 and the Contract awarded to Alstom in January 2018, to deliver the ETCS solution. NR reports that is has provided warranted infrastructure data for the Stage B area and design works remain on schedule.

Management plans remain to be developed for CRL to support NR's future migration of TPWS to ERTMS on the GWML, currently scheduled for late 2019.

## 6 Health & Safety

### 6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. As predicted, the HSPI improved during Period 11, to its highest score achieved to date.

The RIDDOR increased slightly due to incidents at [REDACTED] and [REDACTED], and the lost time case AFR also increased slightly. Both measures remain well within target.

H&S KPI	Target	Period 10	Period 11
HSPI	2.20	2.48	2.60
PCs scoring over 2.20	11	10	11
RIDDOR AFR	0.15	0.07	0.08
LTC AFR	0.23	0.16	0.17

Figure 6 - 1 ~ Health and Safety Performance COS

The trace in Zones 1 & 2 is now energised, so operatives in this area are now working under revised Rules. CRL and its Principal Contractors (PCs) continue to focus on this issue and prepare for energisation of the rest of the trace; due in May 2018.

We continue to be concerned about the status of the Construction Phase H&S Plan for [REDACTED] Station works. We understand that the Plan has been updated by [REDACTED] and [REDACTED], and it should be signed off by CRL soon.

In our last report, we noted that most of the CRL H&S staff are due to complete their time on Crossrail by June 2018, according to the approved Business Plan for 2018/19, even though some construction works are planned to continue to December 2018. The CRL H&S Director has advised that some roles described in the Business Plan are to be extended so the situation will be resolved. See Section 1.3 for further details.

CRL Head of Integration gave a presentation to SHELTON on 18 January 2018 regarding the safety documentation required for Stage 3. Further details on this are included in Section 3.8.3.

### 6.2 Health & Safety Performance ONW (NR)

During Period 11, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) has increased slightly to 0.2284. This is due to recording a lost time injury during the period. However, the NR overall All Injury Rate has reduced and is currently 0.91 injuries per 100,000 hours worked.

During Period 11, NR reported one lost time injury, where an operative slipped into a trial hole and twisted their left leg while undertaking surveys, and four no lost time incidents. Three other safety incidents and significant close calls were reported in Period 11 including an allegation of a possession irregularity which is undergoing a Level 2 investigation.

## 7 Cost

### 7.1 Summary

The Intervention Points and the AFCDC have not changed during Period 11, although there is a significant risk that IP2 will be breached at SACR19, if not before.

*IP0, IP1 and IP2 have not changed in Period 11.*

*The AFCDC (P50) has not changed from Period 10 and remains at £12,464m.*

*The AFCDC (P80) is also unchanged at £12,507m, which is only £5m under IP2.*

*The AFCDC (P95) is also unchanged and exceeds IP2 by £35m.*

*During Period 11, the QRA reduced by £9m to £319m.*

*The AFCDC (P50) continues to exceed the reported financial budget by £108m.*

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████████████████████████████████████████████████████████████████████████████████

*Potential threat to breach IP2 at or before SACR19.*

*The ONW forecast cost (AFC plus variations) remains at £2,530m (including £22m charged to the AFCDC).*

*CRL is now reporting on NR's total funding and costs (including funding from other programmes) which is currently £2,818m.*

████████████████████████████████████████████████████████████████████████████████

### 7.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 11. CRL has reported a marginal reduction of £0.1m for Period 11, but the CRL declared AFCDC (P50) has not changed from Period 10 and remains at £12,464m. This exceeds IP1 by £552m with only £48m headroom to IP2. The AFCDC (P80) is also unchanged at £12,507m, which is £595m above IP1 and only £5m under IP2. The AFCDC (P95) exceeds IP2 by £35m.

(£ millions)	Period 10	Period 11	Delta	Movement
<b>Forecast</b>	<b>12,135</b>	<b>12,144</b>	<b>9</b>	<b>up</b>
Delivery Risk	16	12	-4	down
Programme Risk	309	304	-5	down
Board Risk	4	4	0	same
<b>AFCDC total</b>	<b>12,464</b>	<b>12,464</b>	<b>0</b>	<b>same</b>
IP0	11,672	11,672	0	same
<b>IP0 Headroom</b>	<b>-792</b>	<b>-792</b>	<b>0</b>	<b>same</b>
IP1	11,912	11,912	0	same
<b>IP1 Headroom</b>	<b>-552</b>	<b>-552</b>	<b>0</b>	<b>same</b>
IP2	12,512	12,512	0	same
<b>IP2 Headroom</b>	<b>48</b>	<b>48</b>	<b>0</b>	<b>same</b>

Figure 7 - 1 ~ AFCDC (P50) Headroom to Intervention Points

PSR 108 Period 11 FY 2017-18 v1.23 docx

During Period 11, the QRA reduced by £9m to £319m due to:

- The movement of risk into delivery cost to offset increased costs at ██████████ ██████████ for additional testing & commissioning resources, additional installation resources and CIS enhancements (£1.7m);
- The extension of resources for C100 to support earthing & bonding testing (£3.0m) and other net increases (0.5m);
- ██████████ 0 Portals & Shafts additional costs for ██████████ support, drainage outfall and mitigation measures to meet Limmo key dates (£1.5m);
- The provision of fire rated soffit cladding to platform and concourse level and other increases at ██████████ Station (£0.8m) another net increases in the Sector (£0.8m);
- the extension of the Delivery Team at ██████████ Station as a result of schedule extensions and the requirement for the existing team to manage additional scope (£0.5m); and other net increases (£0.1m);
- Other net Delivery increases (£0.2m).

£181m of the £319m P50 risk exposure is URTs, an increase of £24m from Period 10 (£157m). Pure risk, excluding URTs, has decreased in Period 11 by £33m to £138m (Pure risk at Period 10 was £171m). The percentage of pure risk as a proportion of cost to go (including URTs) for Period 11 has fallen by 1% in the period to 20%.

CRL continues to seek cost efficiencies and to challenge contractors costs in its attempt to remain within funding, but we continue to note the following:

- The AFCDC (P50) continues to exceed the reported financial budget by £108m;
- The headroom to IP2 for the AFCDC (P50) is £48m. The AFCDC (P95) exceeds IP2 by £35m;
- The analysis of defined cost and target cost continues to indicate an increasing trend in both with CRL assessments rising towards the contractors estimates. See Section 7.3;
- Realistic prospects for major cost savings is highly improbable by reviewing the remaining scope at such a late stage of a constrained programme with many complex interactive interfaces.

Figure 7 - 2 indicates the cumulative delivery overspend at each period.

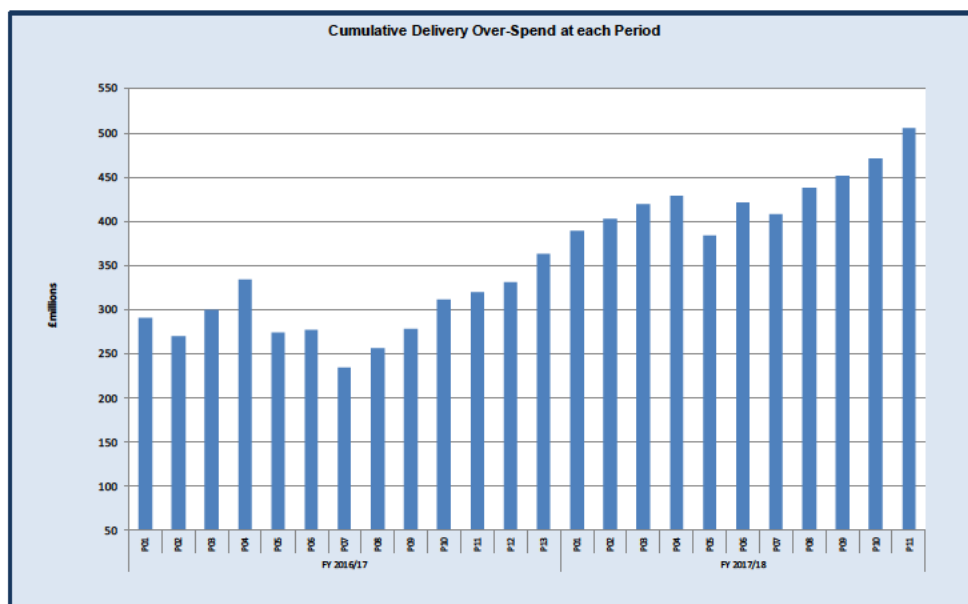


Figure 7 - 2 ~ Cumulative Delivery Overspend at each Period



The cumulative delivery overspend has increased in Period 11 by £34m to £505m (Period 10, £471m). CRL reports that spend and performance in Period 11 continues to be dominated by Stations and Systemwide Sectors, together accounting for 81% of Delivery's Cost of Work Done in Period 11.

CRL reports that, in Period 11, it spent £60.7 above the 2017/18 Business Plan. This is mainly due to:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

This expenditure was offset by £10.8m of apparent unspent Programme risk due to cost being reported in the Sectors.

### 7.3 Cost: Central Operating Section (COS)

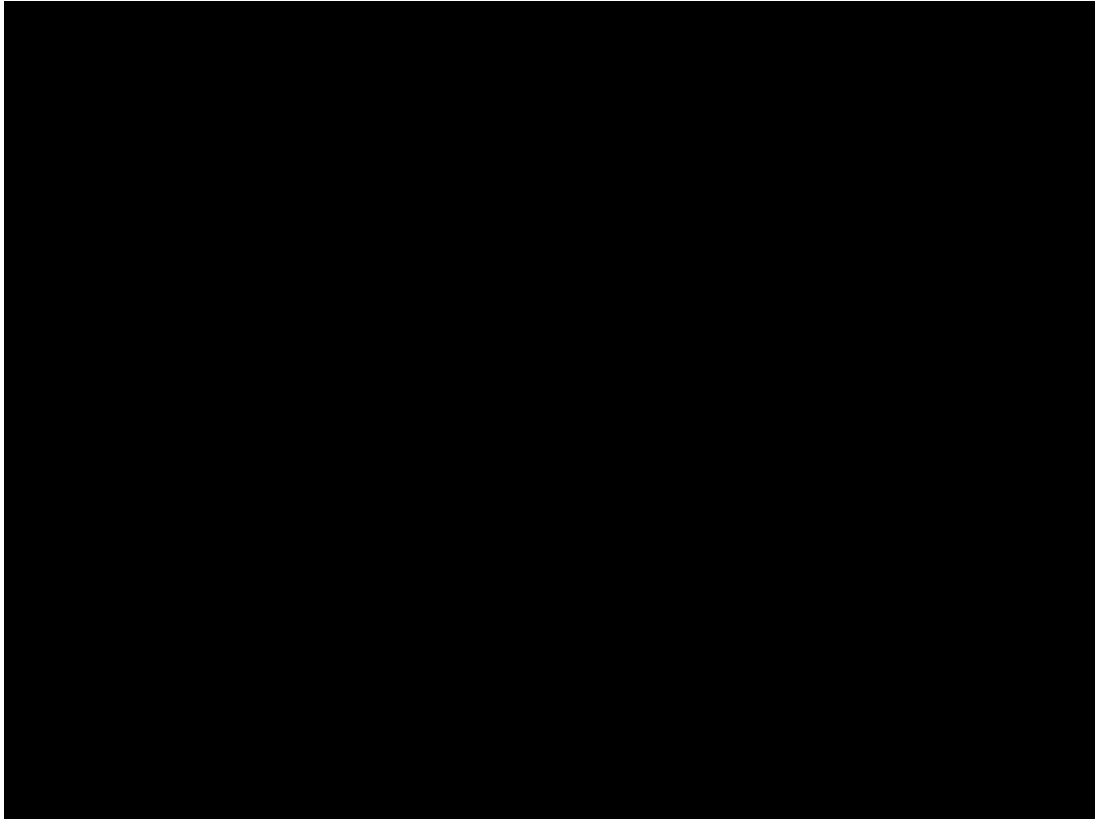
CRL has carried out its cost and risk assessment review following its disclosure regarding the potential threats to exceeding IP2 and meeting MOHS 2018 completion dates. CRL has presented its high level findings to JST, but PRep has not been formally informed of the detail of the review due to its sensitivity. CRL has advised that access to the review will be granted following its Board approval, on 1 March 2018.

[REDACTED]

- [REDACTED]
- [REDACTED]

[REDACTED]

[REDACTED]



[Redacted text block]

- [Redacted list item]
- [Redacted list item]
- [Redacted list item]

[Redacted text block]

[Redacted text block]

#### 7.4 Cost: On Network Works (ONW)

CRL and NR issued the enhanced reporting and cost monitoring in Period 11, and CRL has reported that an interim final account for ONW with NR has been initiated. Consequently, the format of CRL and NR ONW cost reporting has been restructured to satisfy the requirements of DfT to show clarity for funding, cost sensitivity and risk.

In Period 10, the CRL estimated FFOC was £2,480m. In Period 11, the FFOC estimate was reduced by £84m to £2,396m to reflect the cash funding NR secured via the DfT Grant Funded

Agreement. The CRL ONW AFC, excluding VNs, remains at £2,376m in Period 11<sup>17</sup>. The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,325.6m, which exceeds the DfT Invention Price of £2.3bn by £25.6m.

Figure 7 - 4 indicates the relevant breakdown.

Description	Period 11 £m
CRL AFC Excluding VNs	2,376
VN Funding	154
CRL AFC Including VN's	2,530
Cash Funding:	
CRL Funding Agreement between CRL and NR	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84
Total Cash Funding	134
<b>FFOC</b>	<b>2,396</b>
Pain/gain share	-70
<b>Forecast to RAB</b>	<b>2,326</b>

*Figure 7 - 4 ~ Breakdown and Formulation of the NR ONW FFOC and RAB*

### 7.4.1 ONW Funding

CRL has reported that the total AFC and Variations funding for NR ONW is £2,530m. This is in line with confirmed funding arrangements with Sponsors. NR is also reporting Total Secured Funding for NR ONW as £2,818.1m that includes confirmed CRL and NR sourced recoveries, efficiencies and opportunities, as shown in Figure 7 - 5.

<sup>17</sup> Email CRL ONW Commercial Manager 16 February 2018.

Description	Source of Funding			
	DfT £m	CRL £m	NR £m	Total £m
KD1A - OTP	2,049.0			2,049.0
CRL Managed Risk	110.0			110.0
Portfolio Board Funding	217.0			217.0
<b>NR Current Funding</b>	<b>2,376.0</b>	<b>-</b>	<b>-</b>	<b>2,376.0</b>
Remaining £154m VNs	112.0	22.0	20.0	154.0
<b>AFC and Variations Funding</b>	<b>2,488.0</b>	<b>22.0</b>	<b>20.0</b>	<b>2,530.0</b>
<b>Recoveries:</b>				
[REDACTED]				
[REDACTED]				
[REDACTED]				
[REDACTED]				
[REDACTED]				
[REDACTED]				
<b>Recoveries Sub Total</b>	<b>-</b>	<b>118.9</b>	<b>169.2</b>	<b>288.1</b>
<b>TOTAL SECURED FUNDING</b>	<b>2,488.0</b>	<b>140.9</b>	<b>189.2</b>	<b>2,818.1</b>

Figure 7 - 5 ~ NR ONW Secured Funding

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

7.4.2 ONW Cost

CRL further reports that the Grand Total Cost is £2,818.1m with a mid-point sensitivity of plus £51.8m, as shown in Figure 7 - 6

Description	Cost Sensitivity			
	Period 11 £m	Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,894.3	2,863.3	2,922.7	3,019.4
Risk	14.4	7.2	10.1	14.4
Efficiencies	-30.1	-27.1	-15.1	0.0
Recoveries (Residual)	-55.0	-50.0	-45.0	-27.5
Targeted Savings	-5.6	-5.1	-2.8	0.0
<b>Cost Grand Total</b>	<b>2,818.0</b>	<b>2,788.3</b>	<b>2,869.9</b>	<b>3,006.3</b>
Total Secured Funding	2,818.1	2,818.1	2,818.1	2,818.1
Funding Gap	-0.1	-29.8	51.8	188.2

Figure 7 - 6 ~ NR ONW Cost Summary

[REDACTED]

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]

**7.5 Contingency**

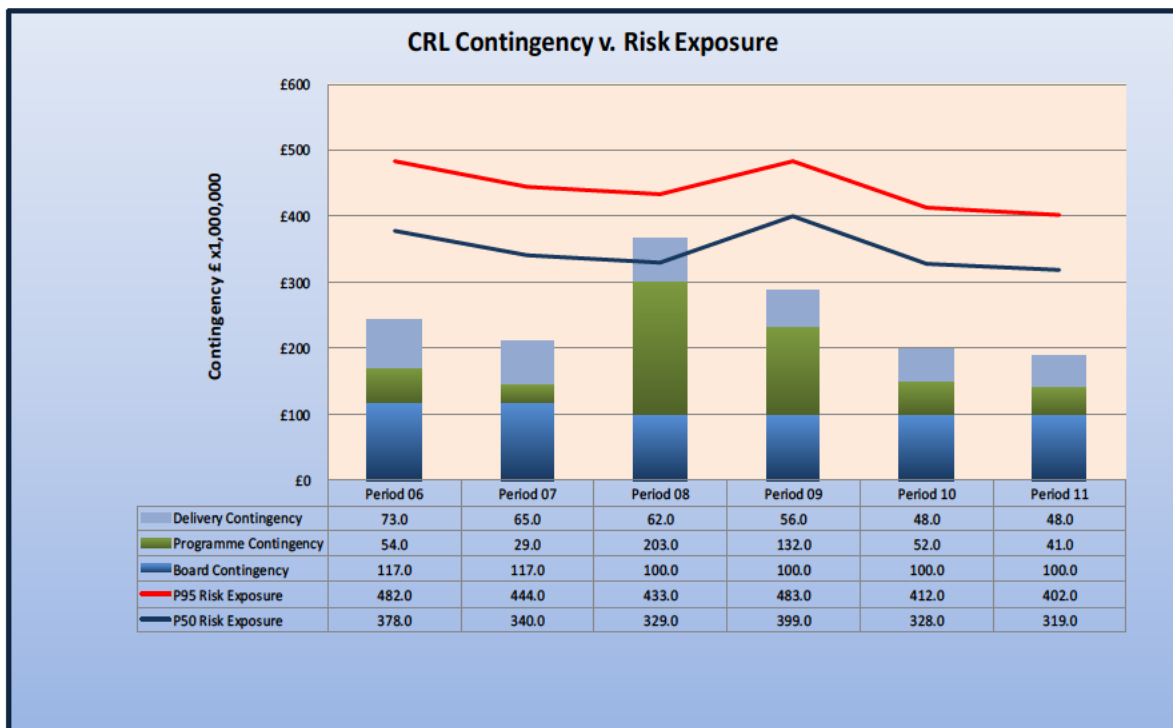
The Period 11 FCCB remains as £12,356m. The £12,464m AF CDC (P50) exceeds the reported financial budget by £108m and is in excess of the RP4.2 Baseline funding of £12,136m by £328m. The Period 11 P80 AF CDC of £12,507m exceeds the FCCB by £151m.

There was a £10m decrease in the overall contingency budget in Period 11; this was due to:

- Approved changes for: a supplemental agreement for cost increases at [REDACTED] Station (£8m);
- Additional resources to complete electromagnetic capability and earthing and bonding testing (£2m).

The overall contingency budget of £189m is insufficient to cover the P50 risk exposure of £319m by £130m, a £2m deterioration from Period 10. The centrally controlled Delivery contingency at Period 11 remains at £48m.

Figure 7 - 7 shows the trend of the decrease in the Board and Programme Contingency and compares the Risk Exposure at P50 and P95 with the remaining contingency.



**Figure 7 - 7 ~ Risk Exposure versus Contingency**

# Appendices

**Appendix A Contract Administration**

**A.1 General**

Figure A - 1, Figure A - 2 and Figure A - 3 illustrate the status of Notified Compensation Events (NCEs).

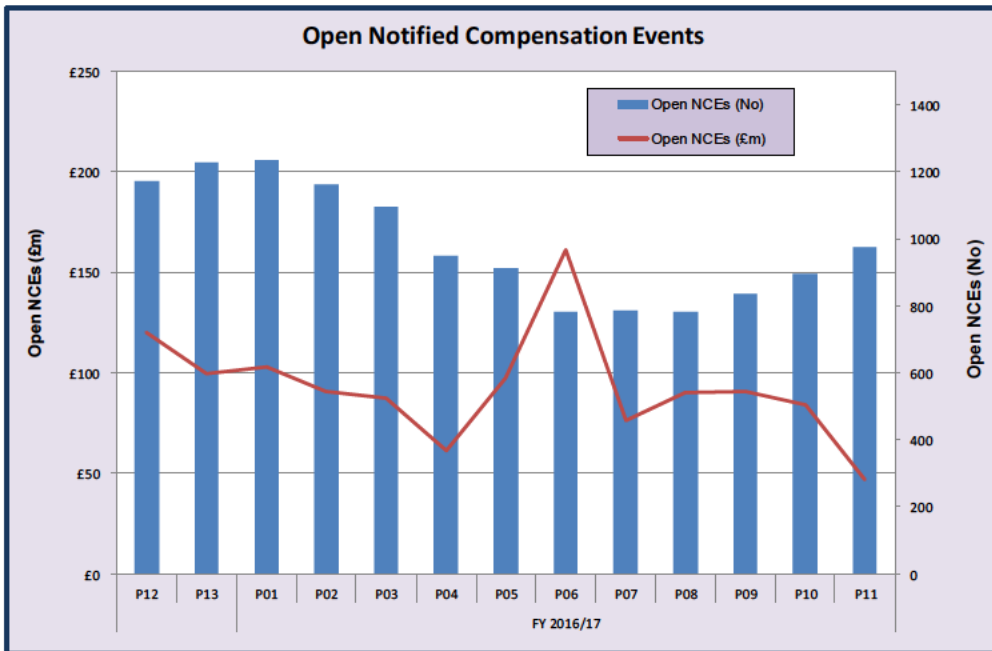


Figure A - 1 ~ Open Notified Compensation Events

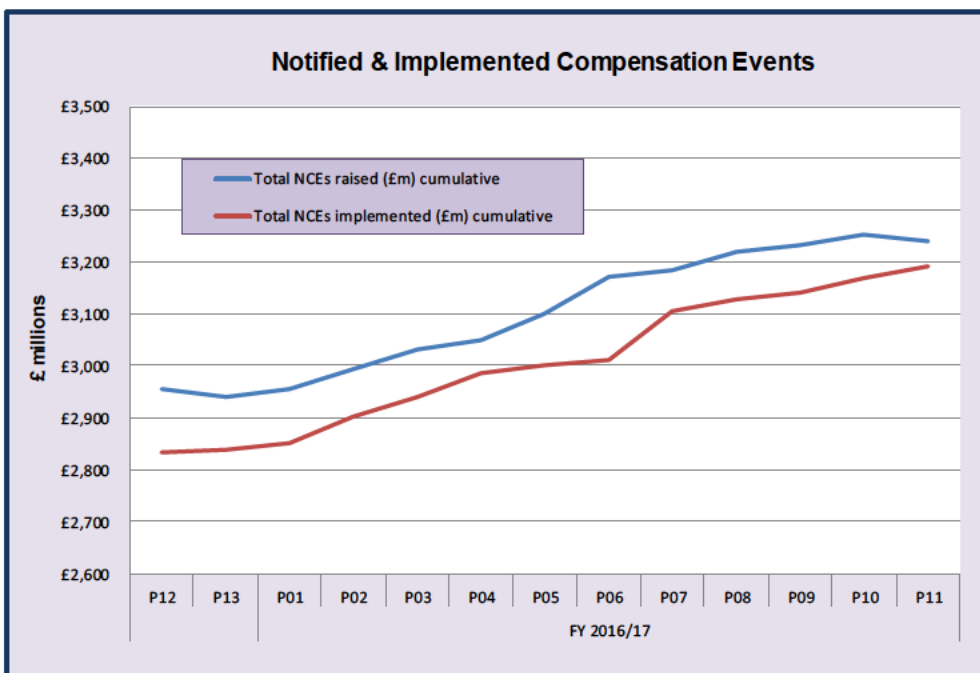


Figure A - 2 ~ Notified Compensation Events

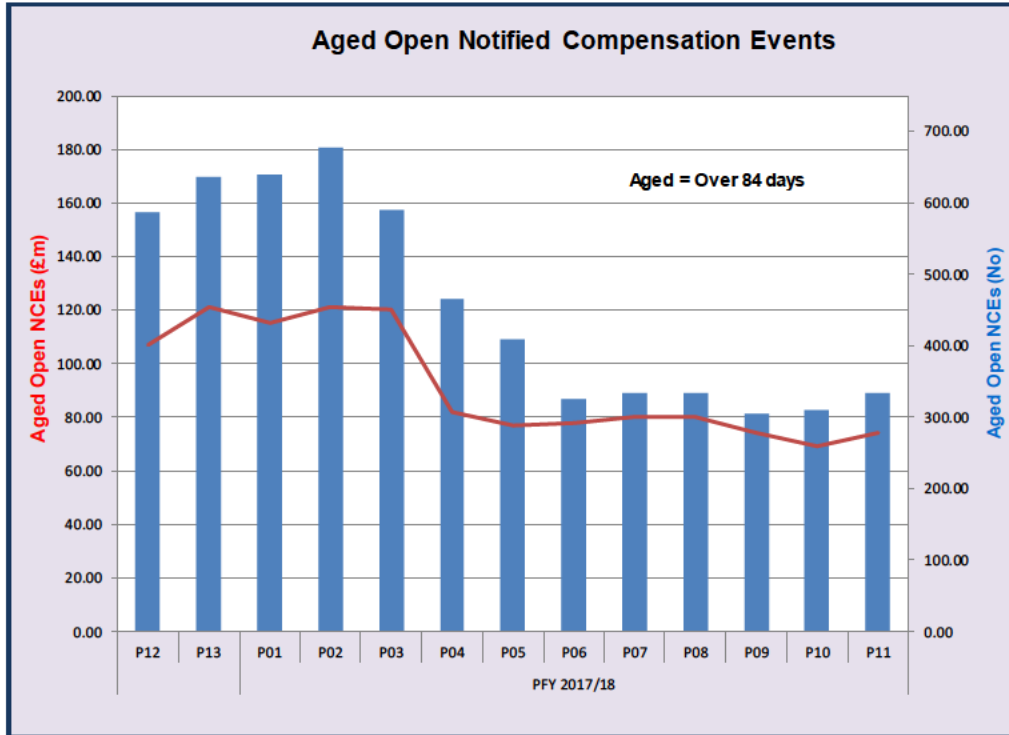


Figure A - 3 ~ Aged Open Notified Compensation Events

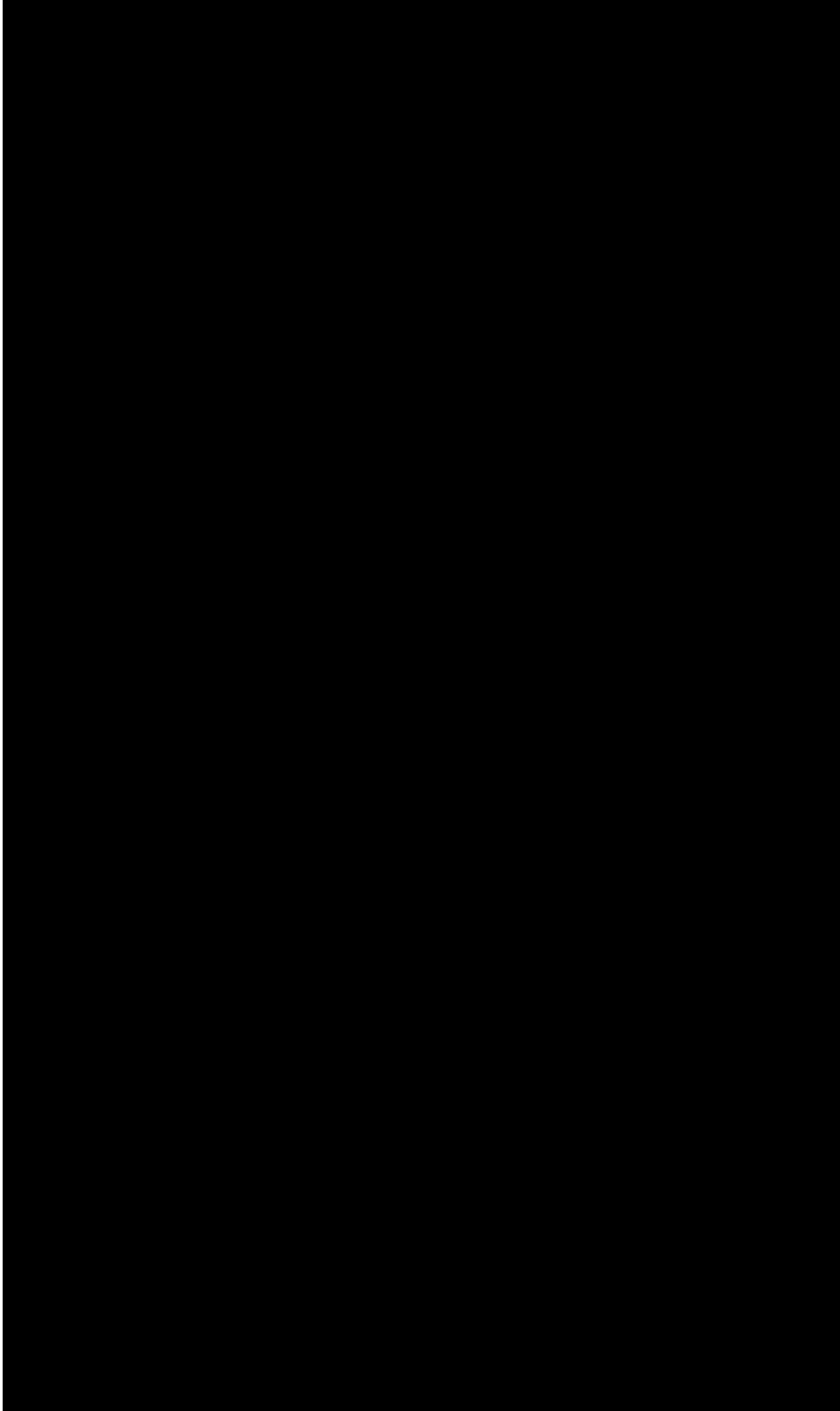
In Period 11, the total number of open NCEs increased by 80 to 977. However, the value of open NCEs decreased by £37m to £47m.

Contractors notified a further 232 Compensation Events in Period 11; 152 were processed in Period 11, with 114 implemented and 38 either rejected or withdrawn. Aged open NCEs increased in Period 11 by 25 to 334, the percentage of aged open NCEs remaining at 34% in Period 11.

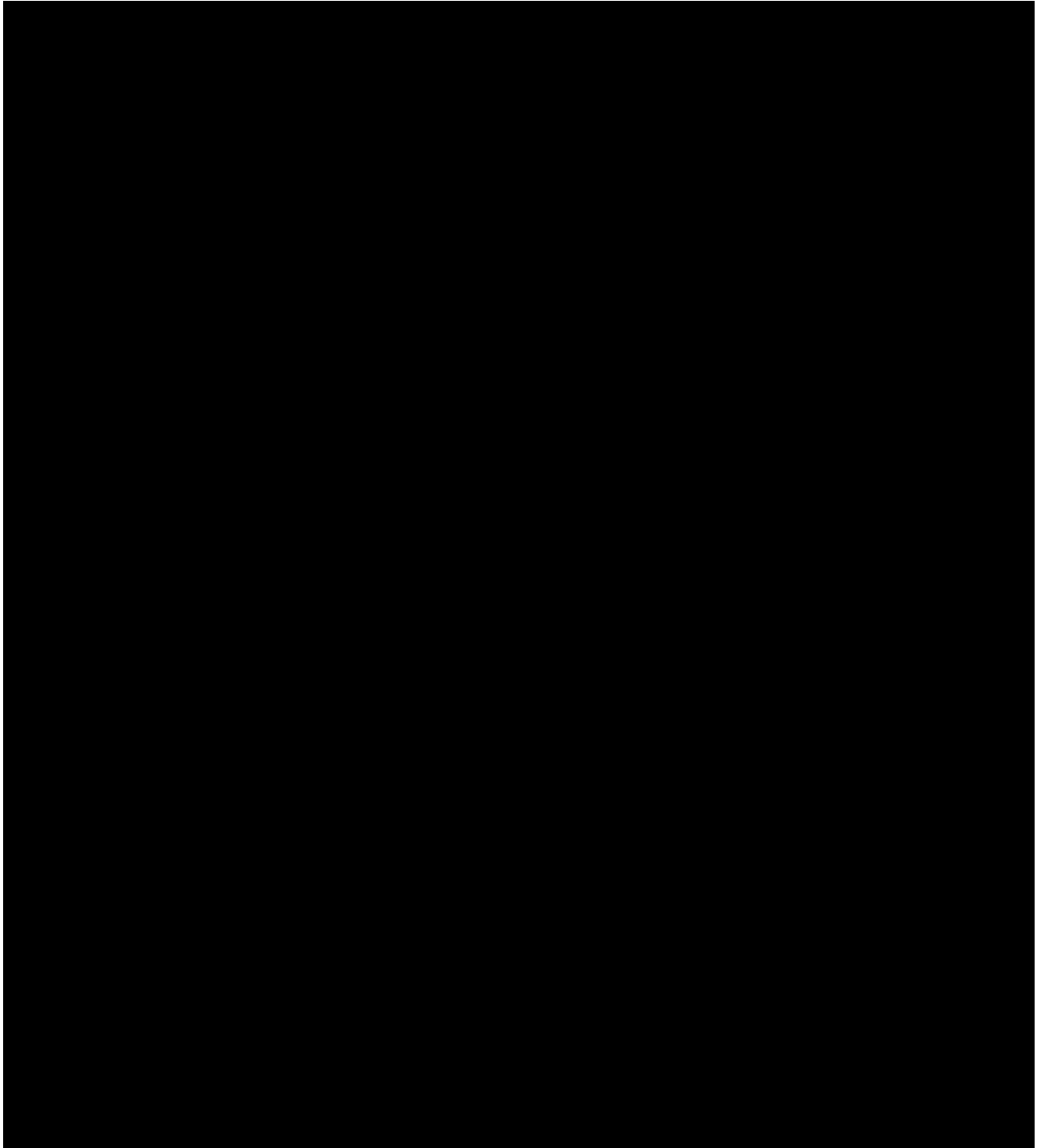


**Appendix B Schedule & Performance**

Figure B - 1 indicates the status of Anchor Milestones at Period 10 and Figure B - 2 indicates the status of Anchor Milestones at Period 11 following the implementation of the new MOHS.



The charts at Figure B - 3 indicate progress of each Systemwide contract based on data received from CRL. The [REDACTED] have now been revised in accordance with MOHS 2018.



## Appendix C Stations

### C.1 Stations in the Central Section

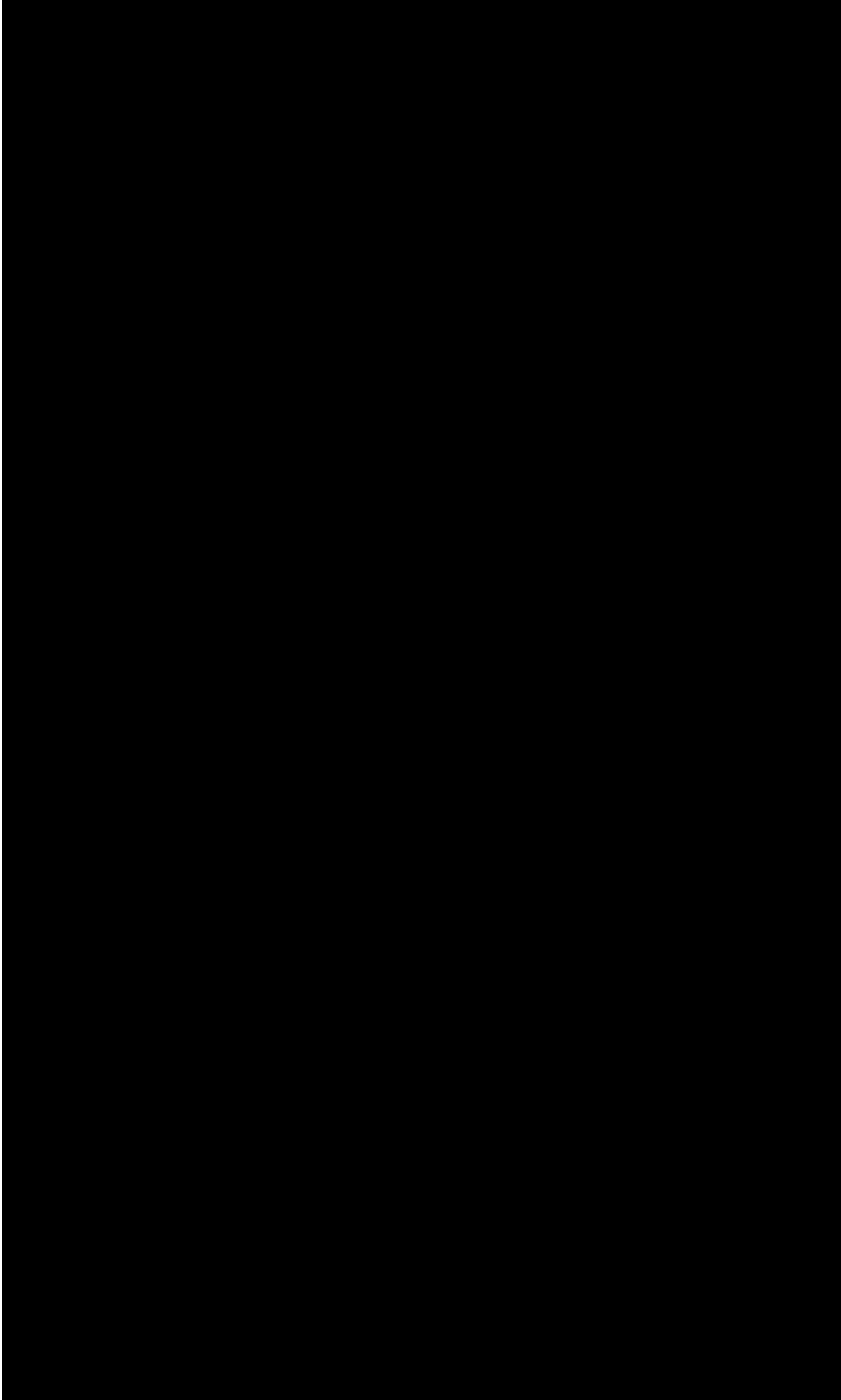
[Redacted text block]

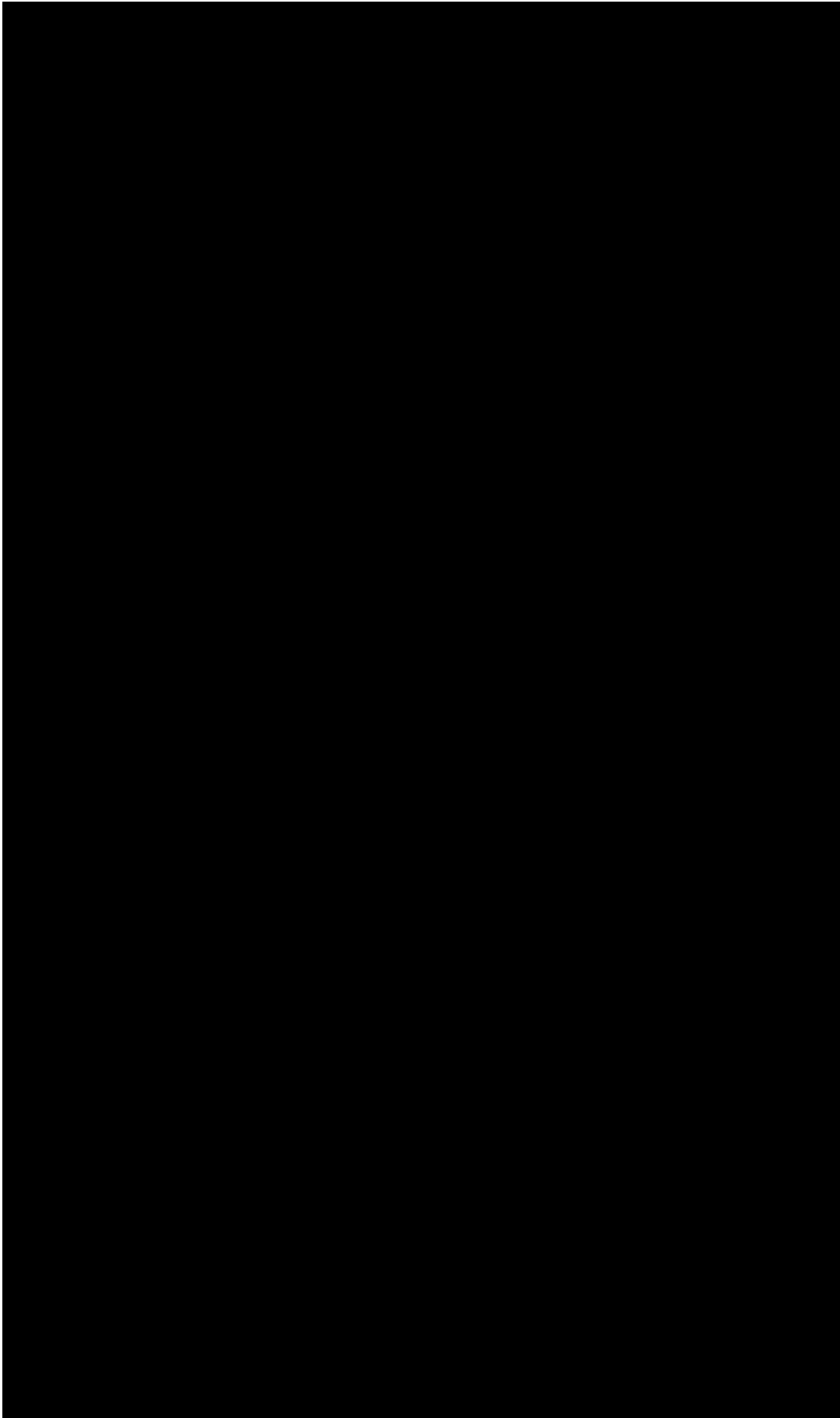
[Redacted text block]

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<sup>18</sup> Data has been abstracted from the CRL Period 11 (2017/18) station dashboards.





## C.2 Interface Works and Handovers

Room and route handover performance continues at a level less than plan; but without further apparent deterioration. Planned and actual progress of accepted room and route handovers, as reported by CRL in Period 11 (Period 11, week 3), are summarised in Figure C - 9 and Figure C - 10.

Status as follows:

- CRL has achieved 835 handovers against a planned 1,024 in the period, representing 81% of the total required; but we note that there has been very little movement in respect of handovers during the period.
- Key areas of concern are [REDACTED]

Contract	Location	Rooms & Routes					Variance (%)
		Total per Site	Accepted (No.)		Cum Handovers		
			Actual	Plan	Actual	Plan	
C405	Paddington	116	61	116	53%	100%	-47%
C412	Bond Street	92	50	85	54%	92%	-38%
C422	Tottenham Court Road	139	114	137	82%	99%	-17%
C435	Farringdon	98	85	96	87%	98%	-11%
C502	Liverpool Street	137	112	137	82%	100%	-18%
C512	Whitechapel	122	89	122	73%	100%	-27%
C530	Woolwich (CON, NWP, PLU)	110	104	110	95%	100%	-5%
C350	Pudding Mill Lane	60	60	60	100%	100%	0%
C360	Shafts	161	160	161	99%	100%	-1%
<b>Totals</b>		<b>1035</b>	<b>835</b>	<b>1024</b>	<b>80.7%</b>		

Figure C - 9 ~ Summary of Systemwide accepted rooms/routes by location

Year	Period	Handovers/Period		Cum Handovers - Baseline		Percentages		Variance
		Actual	Plan	Actual	Plan	Actual	Plan	
FY 2017-18	Period 1	27	41	533	561	52%	54%	-3%
	Period 2	26	55	559	616	54%	59%	-5%
	Period 3	36	170	595	786	57%	76%	-18%
	Period 4	63	55	658	841	64%	81%	-17%
	Period 5	36	76	694	917	67%	89%	-22%
	Period 6	48	31	742	948	71%	91%	-20%
	Period 7	18	24	760	972	73%	94%	-21%
	Period 8	17	24	777	996	75%	96%	-21%
	Period 9	38	24	815	1020	77%	99%	-21%
	Period 10	15	13	830	1033	80%	100%	-20%
	Period 11	5	0	835	1033	80%	100%	-20%
	Period 12				1035			
	Period 13				1035			

Figure C - 10 ~ Summary of Actual and Planned Station Room Handovers<sup>19</sup>

<sup>19</sup> The graph is based on data abstracted from CRL's SLD Weekly Progress Report dated 26 January 2018 (Period 11 Week 3). The graph has been adjusted to reflect reporting based on the number of rooms/routes accepted by Systemwide.

Appendix D Compliance and Assurance

D.1 Agreements

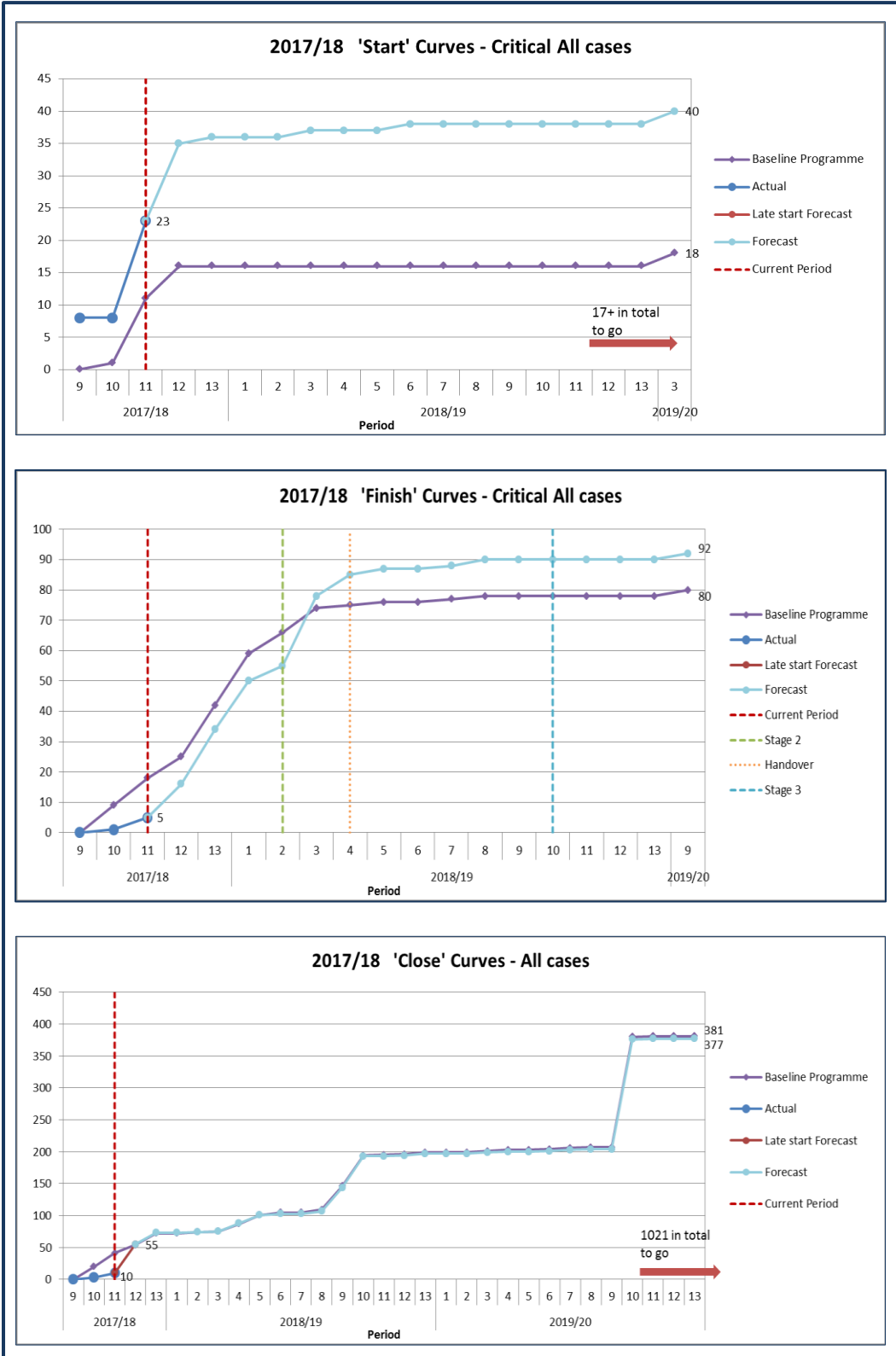


Figure D - 1 ~ 2017/18 Start, Finish & Close Curves

D.2 Quality

D.2.1 Right First Time (RFT) and World Class (WC) Metrics

The results for 5 of the quality metrics, shown below, remain generally good. The Acceptance graph, shown in Figure D - 3, shows that 208 packages were accepted in Period 11. The Period 10 planned number for Period 11 was 173. This is welcome, but the number of submissions per period going forward is of a different magnitude.

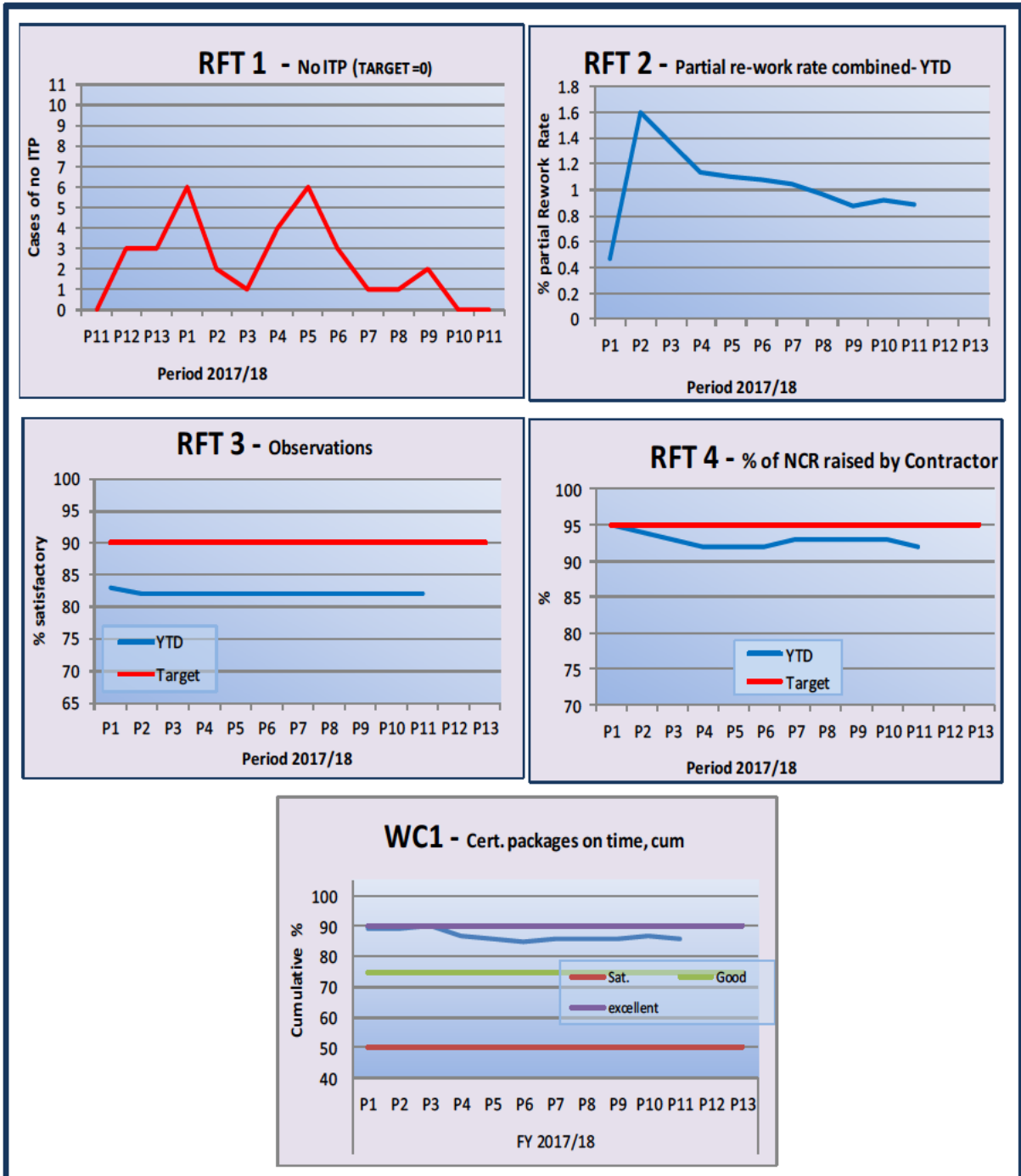


Figure D - 2 ~ Quality KPIs



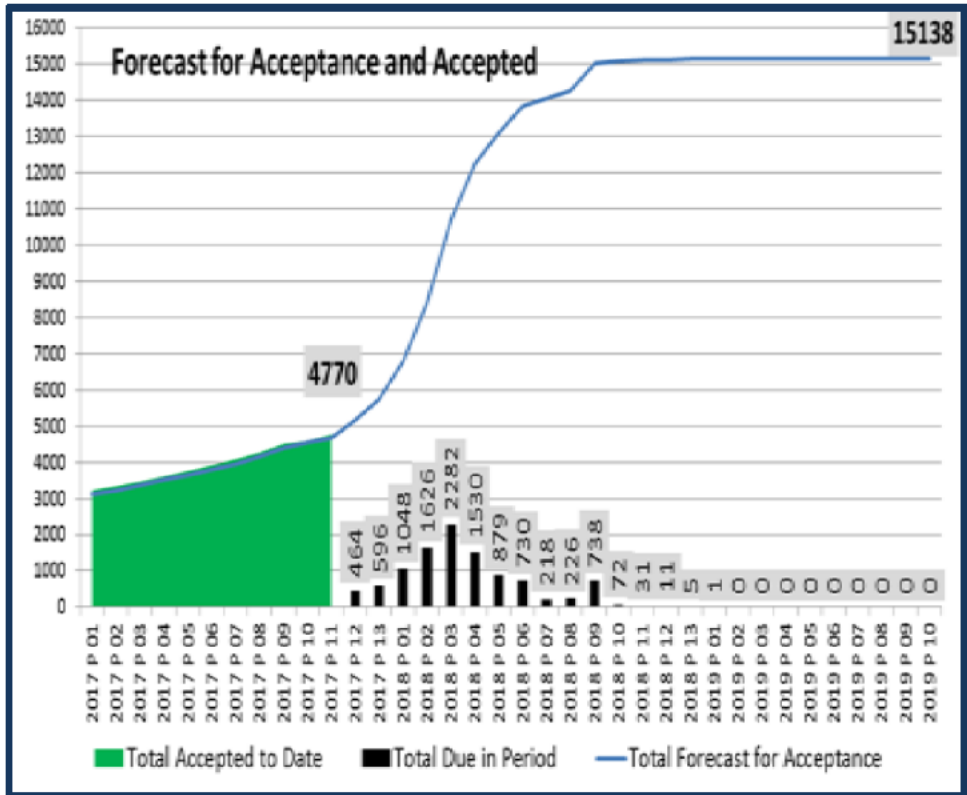


Figure D - 3 ~ P11 Acceptance Graph

**D.2.2 Quality Performance Index**

No contractors received a “Red” status for their quality performance in Period 11. The overall index for the period was 2.06. CRL’s target is to be above 2.00.

**D.2.3 Quality Issues**

There were no Category 1 NCRs reported in this period.

**D.2.4 Audit Monitoring**

No audits were adjudged to be ‘poorly controlled’ in this period

**D.3 Affirmations**

We have described a position with regard to Affirmation 026 ‘Supporting Communication or Utility Distribution’ in our previous reports. CRL’s chief of staff is carrying out further investigations with CRL’s Delivery team, and will report once that has been completed.

A report has been written by RfL that addresses an outstanding action from Affirmation 005a ‘Recommendations for a Crossrail Performance and Management Regime’. The action was to report upon how the recommendations had been implemented. We expect to see this submitted to Sponsors in the near future.

## D.4 Land & Property (L&P)

L&P CAPEX remains at £841.2m; all Urban Realm Central Section planning consents have been obtained and the focus moves to delivery.

The total L&P Programme AFC (including P50 risk) in the period remains unchanged at £860.8m. CRL has settled 835 out of 1,609 anticipated claims, representing 83.2% of the AFC by value. At period end, 4 cases were referred to Land Tribunal. The total claimed figure is £27.6m across all of these cases, compared to CRL's AFC allowance of £2.5m.

## D.5 Over Site Development (OSD) and Urban Realm (UR)

There have been some changes to CRL's forecast MOHS handover and OSD developer start dates (shown bold text in Figure D - 4) during the Period. The revised dates are a result of the 2018 MOHS refresh and the impact that this has had on CRL's forecast dates for station handover to the OSD developers.

Figure D - 4 provides a summary<sup>20</sup> of the current forecast Key Dates for Completion and handover<sup>21</sup> of the CRL deck slabs at each station to the OSD contractors<sup>22</sup>, as well as the OSD forecast start, duration and completion dates<sup>23</sup>.

CRL still has one further OSD planning application to make at Liverpool Street East. Legal Agreements with Development Partners are being finalised, pending TfL approval.

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<sup>20</sup> Summary of OSD dates has been abstracted from the CRL Board Report, the MOHS and Key Dates progress summary.

<sup>21</sup> The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.

<sup>22</sup> The developers' start dates, durations and forecast completion dates have been abstracted from the OSD Progress Section of the CRL Board Report and CRL's Anchor Milestone summary.

<sup>23</sup> The estimated shell & core completion dates will be validated when the OSD contractors' schedules become available.

OSD Sites linked to CRL Stations - Key Dates							
Station	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast MOHS Station Handover Date	Forecast Developer Start Date on Site**	Construction Duration (m)	Est. Shell & Core Completion
Bond Street	West - Davies Street	A275	10	31-Oct-18	Feb-19	20	Oct-20
	East - Hanover	A276	11	11-Jun-18	Jun-18	14	Aug-19
Tottenham Court Road	West - Dean Street	A279	15	30-Nov-18	Jan-19	21	Oct-20
	East - Astoria	A277	12	06-Sep-17	Jan-18	37	Jan-21
	East - Goslett Yard	N/A	N/A	06-Sep-17	May-18	14	Jul-20
Farringdon	West - Cardinal House	A278	13	30-Jun-18	Jan-19	18	Jun-20
	East - Lindsey Street	A280	16	29-Mar-18	Jun-18	20	Feb-20
Liverpool Street	West - 101 Moorgate	A288	19	22-Feb-18	Apr-19	21	Jan-21
	East - Blomfield Street	A284	18	28-Feb-18	Jun-19	28	Oct-21
OSD Sites <u>NOT</u> linked to CRL Stations - Key Dates							
Station / Site	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast Sectional Completion Date	Forecast Developer Start Date on Site	Construction Duration (m)	Shell & Core Completion
Paddington	PIP Triangle	N/A	N/A	Available	TBC	TBC	TBC
	Fisher Street	N/A	N/A	Jun-18	Jun-18	16	Oct-19
	Limmo Peninsula	N/A	N/A	Aug-18	Jan-20	TBC	TBC
	Woolwich	N/A	N/A	Apr-18	Sep-18	45	Jun-22
<p><b>Notes</b></p> <ol style="list-style-type: none"> <li>** Proposed OSD start dates will be confirmed as the Developers programme evolves</li> <li>CRL Forecast Sectional Completion Dates are abstracted from The CRL MOHS Baseline Early schedule</li> <li>TBC = To be confirmed</li> <li>Dates abstracted from L&amp;P OSD Project Dashboard and Anchor Milestones are shaded thus: <span style="background-color: #f2f2f2; border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span></li> <li>Forecast dates that have now been achieved (with actual dates shown) are shaded thus: <span style="background-color: #90ee90; border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span></li> <li>Developer start dates at Bond Street precede station forecast handover dates, due to earlier phased handovers.</li> </ol>							

Figure D - 4 ~ Summary of OSD forecast Key Dates

**Paddington (PIP Triangle)** risk concerns, in relation to the joint NR/TfL regime, have been resolved. TfL is reviewing the new lease provisions and, subject to TfL approval and NR LC7 consent, CRL/TfL plan to market the site early in 2018.

Variation of the existing OSD agreement for Great Portland Estates (GPE) **Bond Street (East)** Office consent was approved by TfL and phased handover of the site has been instructed by CRL. Programme delays have impacted the light-well and vent shaft handovers. The light-well ( ) was handed over on 23 January 2018. Work to resolve the noise and vibration concerns continues, with further information provided to GPE for review. The handover date for the vent shaft remains a risk and is being monitored closely by both teams. The June 2018 target date for land receipts is not expected to be impacted. The OSD works are progressing well and the basement excavation is complete.

TfL's Investment Committee has approved the Development Agreement (DA) and lease for the OSD at **Bond Street (West)**, for execution in early 2018. TfL CFO & Commissioner approval received. Agreement of the target handover date for the OSD has proved difficult, as a result of continued station schedule delays. CRL's current target handover date to the OSD developer is now 31 October 2018.

Negotiations are concluded and the DA for the OSD at **Tottenham Court Road (East)** is complete, enabling handover and the development to commence. The Deed of Variation has been agreed and CRL handed over the Tottenham Court Road (East) OSD site at Goslett Yard to Derwent (OSD Developer) on 17 January 2018. This is the first OSD site to be handed over in full to an OSD developer. Enabling works have started and the appointment of a main contractor is expected later in the year. This is CRL's highest value commercial site.

The OSD for residential development at **Tottenham Court Road (West)** should be offered to the open market in early 2018. The retail areas will be retained for in-house (TfL) management. The site is now being used for site office accommodation by CRL's delivery team until November 2018. The OSD development will not, therefore, be able to start until 2019. The final account for OSD interface work (C423), to date, is being agreed with TfL.

The DA for the **Fisher Street** OSD has been signed with extensions to June 2018. The Developer has submitted additional information, supporting project viability, to Camden. The Planning Committee decision date has, however, still not been set.

The negotiation of the DA for the **Farringdon West** office consent is near conclusion, awaiting resolution of final outstanding issues with HB Reavis. TfL CFO & Commissioner approval has been delayed, pending greater certainty on the payment date.

The handover of the **Farringdon (East)** OSD site is forecast on 29 March 2018. Terms have been agreed for the DA and lease for the office development. The DA is still awaiting TfL CDIC approval.

The DA for **Liverpool Street (West)** office consent has been approved by TfL and Commissioner and is being finalised for execution.

The DA and Lease for the **Liverpool Street (East)** Office and Retail OSD application has been agreed. Further TfL (CFO) approval is currently being sought.

The **Limmo** masterplan has yet to be agreed with London Borough of Newham. CDIC approval has been obtained to market the site through the TfL Property Partnership Framework (PPF). A JV partner selection process will be launched via the PPF in Q1 2018.

TfL wish to delay marketing of the **Woolwich** residential site, in order to review potential for an alternative private rented sector disposal structure to increase long term income.

## D.6 Undertakings & Assurances and Commitments - Central Section

Nine of the live contracts for the Central Section planned to upload compliance evidence into Commitments Delivery Tracker (CDT) in Period 11, in accordance with their Commitments Compliance Plans (CCP). Contract C660 (Communication and Controls) has caught up on the evidence reported as pending in Period 10 while C530 (Woolwich Box and Portal Fit-out) has one outstanding piece of evidence to upload in CDT this period. Refer to our previous reports for further detail in respect of the Potential Incident Reports (PIRs) noted below.

### D.6.1 C660/C520 Custom House PA/VA (D25) Assurance 465

Assurance 465 is drawn from Information Paper D25 and requires CRL to agree criteria for the performance of the public address (PA) system with a local authority prior to specifying and carrying out the detailed design of that system. The C660 PA design at Custom House station is essentially complete (Custom House station FDO was held in May 2017) but subsequently, following an email communication from the local authority, the London Borough of Newham, on 21 June 2016, agreement on appropriate criteria has not been reached.

The report of the noise survey carried out in December 2017 was issued to CRL on 30 January 2018 for review. Comments have been returned and a final revised report is expected by 9 February 2018. A meeting with LB Newham has been scheduled for 20 February, where the findings of the noise survey and criteria will be presented for agreement. It will then be

necessary to demonstrate to Newham that the criteria have been achieved by issuing a final noise demonstration report currently scheduled for March.

## **D.7 Undertakings & Assurances and Commitments - Surface Section**

Nine of the live surface section contracts planned to upload compliance evidence into the Commitments Delivery Tracker (CDT) in Period 11, in accordance with their Compliance Matrices. The nine contracts have not met their targets; but are expected to have uploaded the outstanding evidence in Period 12.

The nine contracts are:

1. NAA1E- North East Stations and Signalling (GRIP 5-8);
2. SAA3A - South East (GRIP 5-8);
3. WIT1A - West Inner Track Infrastructure (GRIP5);
4. WLG4A - Old Oak Common and Paddington Approaches - OOCPA(GRIP 5);
5. WOT1A - West Outer Track Infrastructure - Bridges (GRIP5-8);
6. WOT1C - West Outer Track Infrastructure (GRIP5-8);
7. WSK1F- Stockley - Main Civils (GRIP 5-8);
8. WSN3C- Stations West Inner and West Outer (GRIP 5); and
9. WVN1F- Over Head Line Equipment (Outer).

There has been no other change, with regard to what was previously reported in Period 10. This means that:

- WOT1C West Outer Track Infrastructure (GRIP5-8) has not uploaded any evidence into CDT since Period 8
- The D25 report that WSK1F (Stockley Main Civils) was due to upload in Period 6 remains outstanding. Also, the planned upload of evidence of consultation with Thames Water remains outstanding since Period 10.
- WLG4A (OOCPA) has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4.
- WIT1A (West Inner Track Infrastructure) has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4.

No Surface Section PIRs were raised in Period 11.

## Appendix E CRL 2018/2019 Business Plan Review

### Programme Director

The Programme Director's office is planned to effectively close down on 31 August 2018, with minimal 10% oversight allocation from a single Transcend Contract Manager until 17 December 2018. Although it is understood that CRL is setting up a close out delivery structure, this is believed to be principally geared to finalising the necessary compliance and operation and maintenance manuals to achieve final handover. We are not comfortable that this date supports the current Programme delivery needs.

### Central Delivery

CRL has rationalised the Delivery resources towards the December 2018 Stage 3 completion date based on the MOHS 2017 milestones and critical paths. This presents a concentration of resources active across many delayed work fronts and interfaces that require extension from the previous business plan to many roles. Consequently, the majority of roles disappear from the end of August 2018 and CRL is setting up a separate follow on CRL Close-out organisation. The CRL business plan assumptions under central Delivery refer to this close out function under the Org5 business plan. CRL has advised that the Org5 will start from 1 September 2018 and is planned to cease on 28 February 2019, with Chris Sexton appointed as the Programme Close-Out Director. CRL is currently developing the resources for the high level organisation chart and scope and any revisions to the 2018/19 Business Plan will be done in the usual way under IRSG.

The planned end date for the Deputy Delivery Director for Stages 2, 4 and 5 is 31 August 2018, which is before Stage 2 and has no indication of a succession plan through to Stage 5. Integration and T&C resources would seem to be released too early. CRL will need to extend some staff to cover delayed Dynamic Testing and Trial Running, and to manage and co-ordinate the resolution of errors and test logs as they emerge. Similarly, Systemwide delivery resources are being reduced early when compared with current completion requirements.

The CRL business plan is based on Stages 2, 3, 4 and 5 being delivered to dates projected in the MOHS 2017. Stage 2 is now delayed from 20 May 2018 and is now planned to be delivered in two phases, but there may not be an impact upon business plan. The RSD team and the greater Operations team will have the primary involvement, and these personnel will be present for at least the next two years. The surface team has an involvement, but the inner surface works will have been proved prior to May 2018.

As we have previously reported, the Tier 1 contractors have struggled to provide the necessary O&M documentation, in the correct format and in a timely manner to support handover and training. CRL has stated that contractors' staff will not be retained to complete outstanding assurance documentation. It is not clear whether CRL assumes that the contractors will provide such staff at their own expense or what provisions has CRL made to ensure that the Tier 1 contractors fulfil their obligations in this respect.

CRL has advised that the delivery organisation demobilises upon asset handover and completion of the Employers Completion Process. Some contracts will be more straightforward to close-out than others and so the Employer's Completion Process could extend for some considerable time into the future. To date, the close out process has been slow and has taken longer than envisaged. The assumed 3 month period after "final completion" may be insufficient especially if the appropriate resource is not retained and knowledge and information is lost.

CRL is assuming that the Contractors' warranty periods and management of outstanding works will be managed by others, but does not go on to state who exactly the others are. CRL has advised that the Close-Out organisation will assume delivery responsibilities post August 2018, but significant elements of delivery will continue beyond "Handover" in mid-2018 and clarification is required from CRL whether these fall under the Close-Out organisation or are handed over to RfL or some other named party.

Although the business plan recognises that PMs may demobilise before contract completion and that someone from within the project team will be nominated to lead the remaining team, CRL has not identified that the resource is available and suitable candidates have been identified in advance of the possible requirement.

### **Technical**

The CRL 2018/2019 Business Plan shows notable extension of technical resources to the previous business plan and has made future provision of selected technical resources into 2019 to cover the Staged Openings. However, the timely completion of assurance processes in late 2018 is assumed against a background performance of delivery forecasts that indicate otherwise. The materials necessary for handover to the IMs, for example training, O&M manuals, etc., is proving problematic and is causing delays which are compounded by the departure of the Handover Manager on 16 April 2018 and the remainder of the team departing between June and November 2018. CRL's assumptions for the outstanding assurance documentation are unlikely to be met and further assumptions for the completion of the works contracts are similarly challenging. The forecast handover date over-runs need to be identified and accommodated in the business plan.

### **Surface**

Commercial support is maintained until March 2019 and key delivery roles have been extended to August/September 2018 to provide delivery supervision for NR ONW activities through to Stage 5. There is no apparent CRL management allowance for ongoing ONW associated with the West Enhanced Stations and Ilford Station all targeted for completion by December 2019.

### **Health and Safety**

CRL has extended the engagement of a number of its health and safety advisors and assurance specialists from the previous 2017/2018 Business Plan. The 2018/2019 Business Plan is indicating that the majority of H&S roles will now terminate in June 2018. Given that the known pressures on delivery are driving site activity beyond mid-2018 where CDM responsibilities will remain under CRL control, it appears that, despite these extensions, CRL is curtailing its H&S management roles prematurely.

### **CEO**

The 2018/2019 Business Plan suggests a generally earlier CEO office demobilisation than the previous business plan but provides no indication for the continuation of the incumbent CEO. Extensions have been allowed for the CRL Chairman and Chief of Staff and CRL has since advised that the CEO indicative end date is currently 31 March 2018.

The CRL Chief of Staff, the PRep CRL principal point of contact, now has a planned end date of 31 July 2018 but there is no indication of a succession plan for ongoing communications.

## External Affairs

Resources have been restructured to provide an earlier demobilisation compared to the previous business plan with a substantive team until 17 July 2018 but thereafter a residual core of function heads until December 2018.

CRL's current plan is that the helpdesk will cease operating at the end March 2018 and transfer to TfL. Confirmation will need to be sought from TfL that it will assume responsibilities and will be mobilised for dealing with public enquiries including property and utility search enquiries, claims handling and complaints. Confirmation is similarly sought in regard of TfL taking over responsibility from July 2018 of the maintenance for all hoardings.

Similarly, confirmation is required that NR will continue to deal with enquiries, complaints and claims relating to the surface section and will cover the costs for hoardings and communication on ONW routes.

## Talent and Resources

The HR function of CRL appears to be rationalised in the 2018/2019 Business Plan and co-ordinated with MOHS 2017 and supporting the overall demobilisation plan. However, MOHS 2018 is indicating slippage that may require extension of key roles and HR support.

## Legal and Agreements

CRL appears to have undertaken a lean management approach with the restructuring of the Legal and Agreements team with a balance of early departures principally for part time roles and extended terms for key roles until March 2019. CRL has noted that the Company Secretary departs in May 2018 but has not offered how it complies with its corporate legal responsibilities. CRL also suggest that Sponsors are to make adequate provision within their separate Business Plans to negotiate, manage and close agreements.

## Finance

CRL is planning to shut down all its Finance resources by the end of May 2018, save for the Finance Director and Senior PA to the Finance Director, who remain until mid to end August 2018. Confirmation will need to be sought from TfL that it is acceptable to and prepared for the transfer of the residual finance activities after 31 May 2018.

## IT

Under the previous business plan, the CRL IT resource was due to close down on 31 August 2018. In its 2018/2019 Business Plan, CRL has extended and restructured its IT resource to 17 January 2019. CRL offices at 25 Canada Square is due to close in December 2018 with only the CRL offices at Westferry Circus remaining as an active Crossrail site beyond December 2018. The CIF is established on Westferry Circus 8<sup>h</sup> floor and is intended to support the Programme Test and commissioning. Unless dismantled and re-established elsewhere, ongoing schedule delays may prolong the need for limited access to and for the use of the Westferry Circus office beyond the end of 2018.

CRL will be maintaining the IT Systems for eB to continue to the end of the defects period. CRL is to confirm that priority is shown to ensure that all necessary information is transferred to the IMs before systems are shut down.



## Land and Property

The head count for Land & Property has been substantially reduced by around two thirds from the previous Business Plan. However, the residual resource has been extended over a longer period to March 2019. This would appear to offer a leaner property team focusing on close out matters.

## Programme Controls

Most of Programme Controls are due to depart by end May 2018 and the rest by August 2018. However, programme resources have been extended from the previous business plan and complemented with additional planners up to 17 May 2018. The residual planning resource thereafter reduces to just a Sector Planner until 17 August 2018 and Controls Transition Manager until 17 December 2018. The risk analysis team effectively shuts down from the end of August 2018 with the Risk Manager departing at the end of May 2018. CRL has already advised that P13/SACR19 will be last time it will carry out a QCRA and will be streamlining its cost reporting as a consequence. The dates within the CRL business plan assumptions for Dynamic Testing and Handover for Trial Operations have already slipped by a month for each and CRL has publically announced critical pressures on both schedule and cost that threaten completion dates and exceed budgets. We therefore regard it premature for CRL to plan to reduce such programme management functions at such a critical and important phase of the programme which is already facing delivery risks.

## Commercial

The restructure of commercial resources appears to be driving towards 17 August 2018 conclusion. The commercial resources have been extended from the previous business plan and bolstered with additional quantity surveyors to mid-June 2018. A residual commercial function remains linearly decreasing until December 2018 with a single oversight resource available to 17 March 2019.

CRL has assumed that the commercial resources will be able to deal with all commercial settlements in support of the schedule progress to plan and also assume that a minimal number of disputes will become elevated to adjudication or court proceedings.

Although the CRL assumptions are regarded to be optimistic and supported by contract performance indicators, the MOHS 2018 has slipped against the business plan referenced MOHS 2017 which may inspire delay and disruption changes in excess of those anticipated under the 2018/2019 Business Plan.

## Operations

The production of assurance documentation is behind schedule and is challenging. CRL assumption that sufficient infrastructure works, testing and assurance documentation are completed in time to enable RfL to develop/populate the relevant procedures, training and systems for commencement of Trial Running on 5 July 2018 (5 August 2018 in new MOHS) and RfL Trial Operations from 6 August 2018 (9 September 2018 in new MOHS) to 8 December 2018.

Delays are also straining the CRL assumption that training materials, simulators and the equipped TUCA facility are provided to schedule.

██████████ with Rolling Stock software, which in turn impact upon the ability to test the NR interfaces, detract from the credibility of the assumption that Key dependent milestones, particularly those with Network Rail, are achieved to schedule.

CRL has assumed that TfL will not charge for personnel involved in activities impacted by works, testing & commissioning and Handover and assurance activities that lag after 5 July 2018 where it is assumed that the TfL business plan provides funding for the role from that date. CRL has not provided evidence or reference that TfL has agreed to this nor declared who will be responsible for the transition, management reporting, governance and other support functions.

## Project Representative Team

### E.1 Project Team

██████████: Project Representative, Safety, Progress, Risk, Governance;  
██████████: Signalling, Railway Systems, Integration, T&C;  
██████████s: Engineering, Stations, OSD, U&As, Assurance;  
██████████ Compliance & Change, Operations, RSD;  
██████████ Commercial, Cost Control, Financial, ONW;  
██████████ Administration Manager.

## Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LoNo	Letter of No Objection
ABB	ASEA Brown Boverly	LoR	Line of Route
ACJV	Alstom Costain Joint Venture	LTC	Lost Time Case
ACWP	Actual Cost of Work Performed	LTIFR	Lost Time Incident Frequency Rate
AEA	Abellio East Anglia	LU	London Underground
AFC	Anticipated Final Cost	LUL	London Underground Limited
AFDCDC	Anticipated Final Cost Direct Costs	LV	Low Voltage
AFR	Accident Frequency Rate	M&E	Mechanical & Electrical
AGA	Abellio Greater Anglia (now known as 'GA')	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AMS	Agreements Management System	MENTOR	Mobile Electrical Network Testing, Observation and Recording
APIS	Authorisation to Place into Service	MEP	Mechanical Electrical & Public Health
ARS	Automatic Route Setting	MEPA	Mechanical, Electrical, Public Health, Architecture
AsBo	Assurance Body - Ricardo Rail	MES	Mile End Shaft
ASLEF	Associated Society of Locomotive Engineers and Firemen	MIRP	Maintenance Integration Review Panel
ATC	Automatic Train Control	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
AWS	Automatic Warning System	MTIN	Miles Technical Incident Number
B&PC	Board & Programme Contingency	MTR SMS	MTR Safety Management System.
BBMV	Balfour Beatty Morgan Vinci	MTR-C	Mass Transit Railway - Crossrail
BCA	Bilateral Connection Agreement	MV	Medium Voltage
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCE	Notified Compensation Event
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NCR	Non Conformance Report
BFK	Bam Ferrovial Kier	NG	National Grid
BH	Berkeley Homes	NGET	National Grid Electricity Transmission
BIU	Bringing Into Use	NKL	North Kent Line
BLL	Bakerloo Line Link	NoBo	Notified Body
BOS	Bond Street Station	NOW	North Woolwich
BP	Business Plan	NR	Network Rail
BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems
BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC building	Operations Maintenance Centre
BTH	Blomfield Ticket Hall	OME	Order of Magnitude Estimate
BUF	Bottom Up Forecast	ONFR	On Network Functional Requirements
C&CSC	Commercial and Change Sub-committee	ONSIP	On Network Station Improvements Programme
CAR	Corrective Action Report	ONW	On Network Works
CARE	Crossrail Assurance Reporting Environment	OOC	Old Oak Common
CBTC	Communications Based Train Control	OOCPA	Old Oak Common Paddington Approaches
CCB	Current Control Budget	OPEX	Operational Expenditure
CCP	Commitments Compliance Plans	Ops	Operations
CCRB	Construction and Commissioning Rulebook	ORAT	Operational Readiness & Transfer Group

CCRRB	Crossrail Construction Railway Rule Book	ORR	Office of Rail & Road
CCSA	Contract Commercial Status Analysis	ORSG	Operational Readiness Steering Group
CCSC	Commercial & Change Sub-Committee	OSD	Over Site Development
CCTV	Closed Circuit Television	OSP	Operations Safety Procedures
CD/RA	Closed Door / Right Away	OTIS	OTIS escalators (company)
CDG	Competence Design Group	OTP	Overall Target Price
CDM	Construction Design & Management Regulations	PAD	Paddington station
CDN	Crossrail Data Network	PCs	Principal Contractors
CDT	Commitments Delivery Tracker	PDA	Project Development Agreement
CE	Compensation Events	PDB	Network Rail Programme Delivery Board
CEC	Chief Engineer's Communications	PES	Platform Edge Screen
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PIP	Paddington Integration Project
CEG	Central Engineering Group	PIR	Potential Incident Report
CEO	Chief Executive Officer	PLU	Plumstead
CFCCB	Contingency Finance Current Control Budget	PM	Project Manager
CFO	Chief Financial Officer	PMI	Project Manager Instruction
CIF	Crossrail Integration Facility	PML	Pudding Mill Lane
CIS	Customer Information System	PMO	Project Management Office NR
CMR	Crossrail Managed Risk	PNY	Paddington New Yard
CMS	Crossrail Management System	PPE	Personal Protective Equipment
CoL	City of London	PPF	Property Partnership Framework
COS	Central Operating Section	PPM	Passenger Performance Measurement
CPFR	Crossrail Programme Functional Requirements	PRep	Project Representative
CPI	Cost Performance Index	PRISM	Cost Management Software
CPO	Compulsory Purchase Order	PSD	Platform Screen Door
CRL	Crossrail Limited	PSG	Performance Steering Group
CRV	Crossrail Requirements Variation	PSR	Project Status Report
CSCS	Construction Skills Certification Scheme	PTYSC	Property Sub-Committee
CSJV	Costain Skanska Joint Venture	PWay	Permanent Way
CSM	Construction Safety Management	QBR	Quarterly Baseline Review
CSM-RA	Common Safety Method – Risk Assessment	QCRA	Quantified Cost Risk Assessment
CT	Computerized Tomography	QRA	Quantified Risk Assessment
CTOC	Crossrail Train Operating Concession	QSRA	Quantified Schedule Risk Assessment
CUH / CHS	Custom House Station	RAB	Regulatory Asset Base
CW	Canary Wharf	RAB (C)	RfL Assurance Board for Crossrail
CWG	Canary Wharf Group	RAG	Red, Amber, Green Matrix
CWS	Canary Wharf Station	RAM	Route Asset Manage.
D&A	Drugs and Alcohol	RBC	Remote Block Computer
DA	Development Agreement	RCA	Risk Control Actions
DeBo	Designated body	RCC	Route Control Centre
DfT	Department for Transport	RfL	Rail for London
DLO	Direct Labour Organisation	RfL-I	Rail for London - Infrastructure
DLR	Docklands Light Railway	RFT	Right First Time
DOO	Driver Only Operation	RIA	Railway Integration Authority
DPS	Depot Protection System	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DT	Dynamic Testing	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
Dwall	Diaphragm wall	RIRP	Railway Integration Review Point
DWWP	Delivery of Works Within Possession	RLU	Restricted Length Unit
E&B	Earthing & Bonding	ROC	Rigid Overhead Conductor
EA	Environment Agency	ROC	Regional Operational Centre
EAC	Estimate at Completion	ROP	Royal Oak Portal
EB	Eastbound	RP4.2	Review Point 4.2
ECP	Employers Completion Process	RR	Ricardo Rail

ECS	Empty Coach Stock	RRV	Road / Rail Vehicles
		RS	Rolling Stock
EDT	Early Dynamic Testing	RSD	Rolling Stock & Depot
EED	Emergency Exit Door	RSSB	Rail Safety & Standards Board
EFC	Estimated Final Cost	RTU	Remote Telemetry Unit
ELRSG	Elizabeth Line Readiness Steering Group	S&C	Switches & Crossings
EMC	Electromagnetic compatibility	SA	Supplementary Agreement
EMU	Electrical Multiple Unit	SACR	Semi Annual Construction Report
ERTMS	European Rail Traffic Management Systems	SAP	System Applications Products
ESJ	Engineering Safety Justification	SAR	Safety Assessment Report
ESM	Engineering Safety Management	SAT	Site Acceptance Test
ETCS	European Train Control System	SCADA	Supervisory Control and Data Acquisition
ETH	Eastern Ticket Hall	SCL	Sprayed Concrete Lining
EVM	Earned Value Management	SCN	Sponsor Change Notice
FAR	Farringdon	SDG	Signalling Design Group
FCCB	Finance Current Control Budget	SDO	Selective Door Operation
FDC	Framework Design Consultant	SDS	Scheme Design Specification
FDO	Final Design Overview	SER	Signalling Equipment Room
FDS	Final Design Statements	SES	South East Service
FFOC	Final Forecast Outturn Cost	SESR	South East Signalling Room
FGW	First Great Western	SFA	Sponsor Funding Account
FIS	Fisher Street Shaft	SHELT	Safety and Health Leadership Team
FLU	Full Length Unit	SIRP	Systems Integration Review Panel
FoI	Freedom of Information	SISS	Station Information and Security System
FRAG	Fraud Risk Assurance Group	SJR	Safety Justification Report
FTS	Floating Track Slab	SLD	Single Line Diagrams
GAF	Greater Anglia Franchisee	SMTA	Smithfield Market Traders Association
GE	Great Eastern	SOC	Statement of Compatibility
GEFF	Great Eastern Furrer & Frey	SONIA	Sterling Overnight Index Average
GEML	Great Eastern Main Line	SOR	Systems Operation Room
		SORBA	Shaping Architecture Company (sub cladding contractor)
GFRC	Glassfibre Reinforced Concrete	SPI	Schedule Performance Index
GLA	Greater London Authority	SPS	Secondary Part Steel
GPE	Great Portland Estates	SR	Sponsors Requirement
GPE	Great Portland Estates	SRP	Safety Review Panel
GRC	Glass Reinforced Concrete	SSE	Scottish & Southern Electricity
GRIP	Governance for Railway Investment Projects	SSP	Stations, Shafts, Portals
GSM-R	Global System for Mobile Communication - Railway	STG	Stepney Green
GW	Great Western	STS	Standard Track Slab
GWML	Great Western Main Line	SVP	Safety Verification Panel
GWR	Great Western Railway	T&C	Testing & Commissioning
H&S	Health & Safety	TAP	Technical Assurance Plan
HAL	Heathrow Airport Limited	TBM	Tunnel Boring Machine
HALARP	Heathrow Airport Limited Assurance Review Panel	TC&HSG	Testing, Commissioning and Handover Steering Group
HAS	High Attenuation Sleeper	TCMS	Train Control Management System
HAVS	Hand Arm Vibration Syndrome	TCR	Tottenham Court Road
HIA	Heathrow Implementation Agreement	TCRW	Tottenham Court Road West
HM	Her Majesty	TDY	Tunnel Drive Y
HMDL	Handover Master Deliverable List	TfL	Transport for London
HRW	Heathrow Airport	TOC	Train Operating Company
HSPI	Health & Safety Performance Indicator	TPH	Trains Per Hour
HV	High Voltage	TPS	Train Protection System
HVAC	Heating Ventilation & Air Conditioning	TPWS	Train Protection & Warning System
IA	Interim Acceptance	TRAIL	Transport Reliability Availability Integrated Logistics
ICD	Interface Control Document	TRH	Temporary Rehousing
IECC	Integrated Electronic Control Centre		

IEP	Intercity Express Programme	TSI	Technical Standard for Interoperability
IFC	Issued For Construction	TTVS	Temporary Tunnel Ventilation System
IFD	Ilford Yard	TUCA	Tunnelling & Underground Construction Academy
IM	Infrastructure Manager	TWAO	Transport & Works Act Order
IOSH	Institution of Occupational Safety and Health	TXM	TXM Plant
IP	Intervention Point (0, 1, & 2)	U&A	Undertakings & Assurances
IR35	Inland Revenue Taxation Regulation 35	UKPN	UK Power Networks
IRN	Installation Release Note	UR	Urban Realm
IRSG	International Regulatory Strategy Group	URT	Unresolved Trends
ISJ	Interim Safety Justification	VDP	Victoria Dock Portal
ISV	Intermediate Statements of Verification	VERP	Value Engineering Review Panel
ITP	Inspection & Test Plan	VFL	Vo ker Fitz Patrick
ITT	Invitation to Tender	VN	Variation Notice
JST	Joint Sponsor Team	VT	Voltage Transformer
KBR	Knorr-Bremse Rail	WAD	Works Authorisation Document
KD	Key Deliverable	WBP	Westbourne Park
KE	Kinematic Envelope	WBS	Work Breakdown Structure
KG	Kensal Green	WC	World Class
KO	Key Output	WCCC	Whole Contract Construction Certificate
KPI	Key Performance Indicator	WHI	Whitechapel
L&P	Land and Property	WITI	Western Inner Track Infrastructure
LB	London Borough	WOE	Western Outer Electrification
LBTH	London Borough of Tower Hamlets	WOO	Woolwich Station
		WOTI	Western Outer Track Infrastructure
LFB	London Fire Brigade	WTH	Western Ticket Hall
LIV	Liverpool Street	YC	Yard Control
LMU	London Metropolitan University		
LO	London Over ground		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to PML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU – Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU – WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	M004	General Paddington
C340	Victoria Dock Portal Civil Works	M005	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	M011	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	M019	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	M020	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	M022	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA PML
C411	Bond Street Station (Pilling & Dwall)	NR01	Network Rail Interface Works



C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



## **Crossrail Project Representative**

Crossrail Joint Sponsor Team

**Project Status Report 109**

**Period 12 FY2017-18**

**4 February 2018 – 3 March 2018**

Document No. B2111500/109/1.18

29 March 2018



**Official ~ Sensitive Commercial**

**Project Status Report 109**

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Jacobs U.K. Limited  
 226 Tower Bridge Road  
 London SW1 2UP  
 United Kingdom  
 T +44 (0)20 7403 3330  
 F +44 (0)20 7939 1418  
[www.jacobs.com](http://www.jacobs.com)

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Note: This report relies on the information set out in CRL's Period 12 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 3 March 2018. Note that information emerging after the close of Period 12 is subject to formal confirmation by CRL in its Period 13 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff.

**Document history and status**

Revision	Date	Description	By	Review	Approved
1	23 March 2018	PSR 109 Period 12 FY 2017-18 v1.12.docx ~ Draft	PRep Core Team		
2	29 March 2018	PSR 109 Period 12 FY 2017-18 v1.18.docx ~ Final	PRep Core Team	<span style="background-color: black; color: black;">[REDACTED]</span>	<span style="background-color: black; color: black;">[REDACTED]</span>

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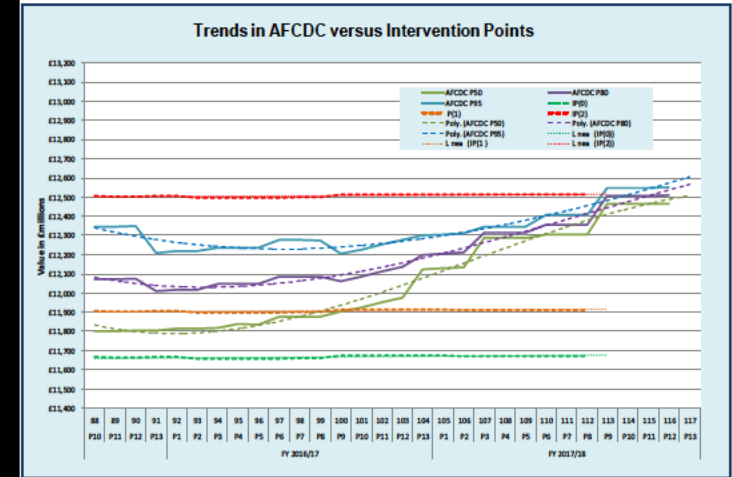
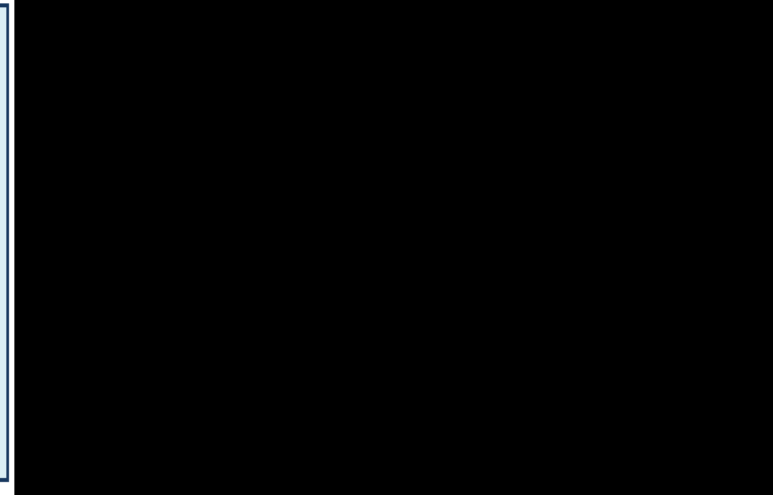
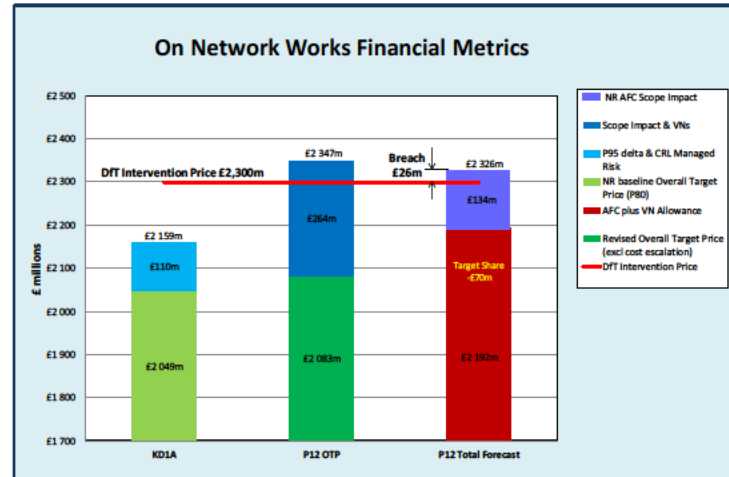
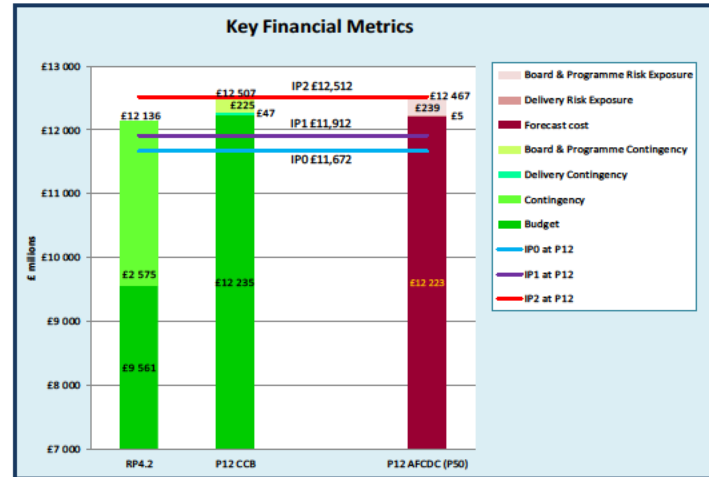
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SACR18 (as at April 2017):  
 AFCDC (P50) ~ £12.303bn. AFCDC (P80) ~ £12.356bn  
 AFC: (£12.303bn AFCDC (P50) + £2.482bn ONW etc) = £14.785bn

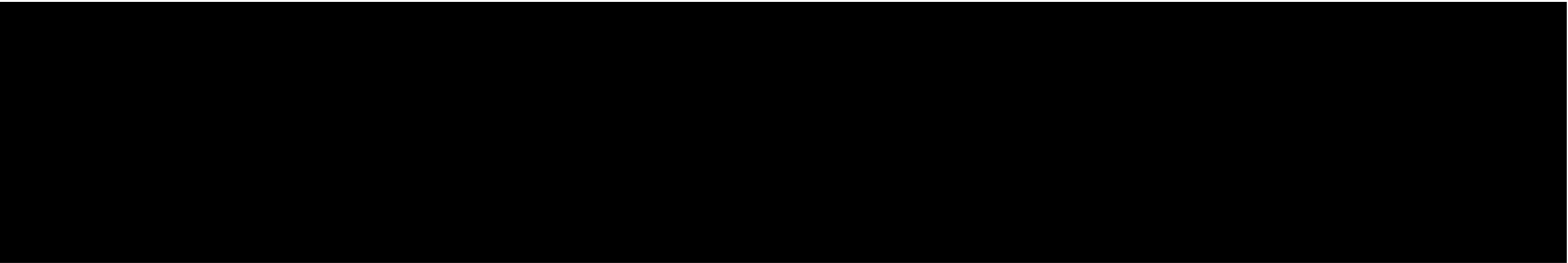
Cost and Schedule Dashboard (Period 12 FY2017/18)

CRL SACR18 QSRA gave confidence level of finishing on time at Stage 3 = 71%. (This is now out of date.)

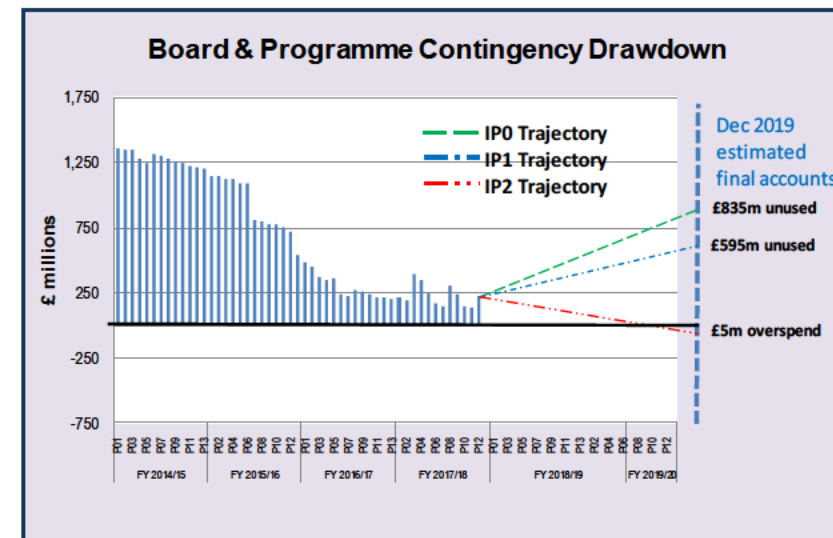
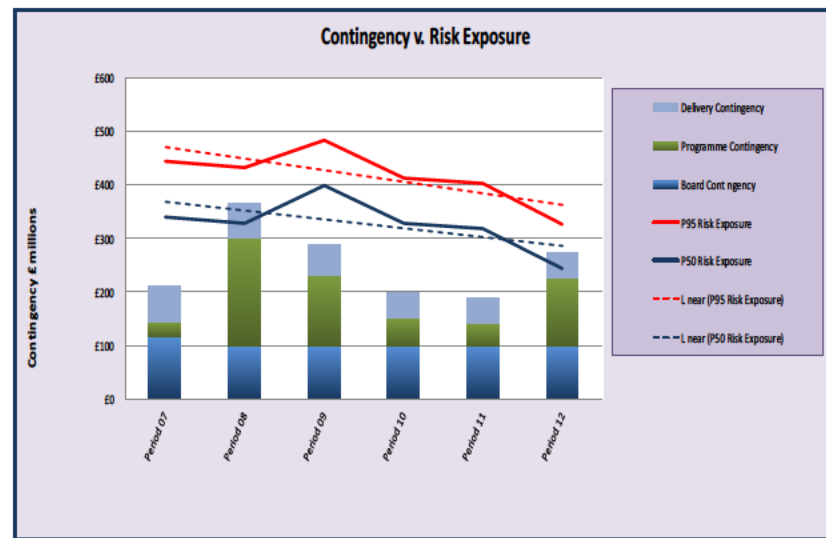
Cost:



Schedule:



Risk, Contingency & Change:



**Project Representative's Summary:**

**Cost:** IP0, IP1 and IP2 have not changed in Period 12. The AFCDC (P50) has increased by £3.1m in Period 12 to £12,467m with only £45m headroom to IP2. The Finance Current Control Budget has been increased to £12,507m due to a £151m increase in programme contingency to align with the P11 P80 AFCDC. The AFCDC (P50) is consequently below the reported financial budget by £40m but exceeds the RP4.2 Baseline funding of £12,136m by £331m. The AFCDC (P80) has also increased by £3m to £12,510m which is only £2m under IP2. The AFCDC (P95) exceeds IP2 by £38m. The CRL ONW AFC remains at £2,376m excluding VNs in Period 12. The Period 12 CRL estimated FFOC remains at £2,396m which exceeds the DfT Intervention Price by £96m.

**Schedule & Progress:** The Master Operational Handover Schedule (MOHS) remains highly ambitious, contains minimal schedule float, and relies upon right-first-time delivery at productivity rates that have not been sustained in the past. There have been no significant performance breakthroughs in the period to reduce the significant risk that the start dates for Trial Running and Trial Operations will not be achieved. The systemwide contractor (ATC C610) has yet to produce a delivery schedule aligned with the MOHS. There remains a high risk that one or more stations will not be fully operational, and that Stage 3 Opening will not be achieved on the planned date of 9 December 2018.

**Risk, Contingency & Change:** In Period 12, there was a £75m reduction in P50 risk to £244m predominantly due to funding changes at Whitechapel and Canary Wharf Stations, Systemwide and Intermediate Shafts. The overall revised contingency budget of £271m is currently sufficient to cover the P50 risk exposure of £244m by £27m (a £158m improvement from Period 11). The centrally controlled Delivery contingency has reduced slightly by £1m to £47m in Period 12.

# Cost and Schedule Dashboard

(Quick Reference Guide)

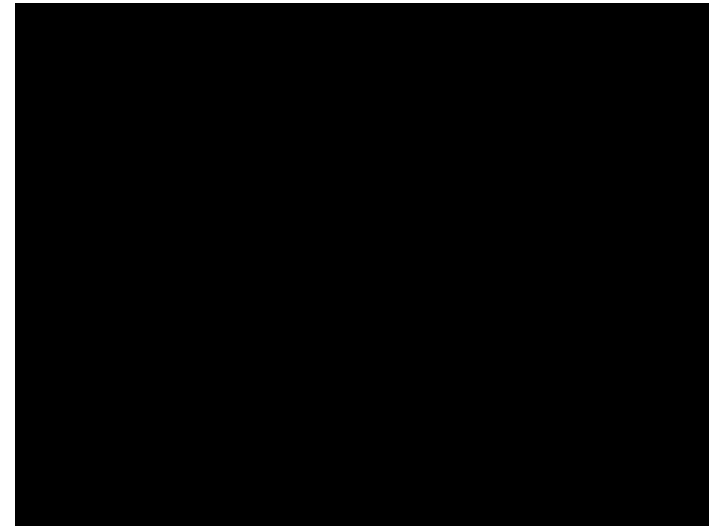
## Cost

### Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

### On Network Works Financial Metrics

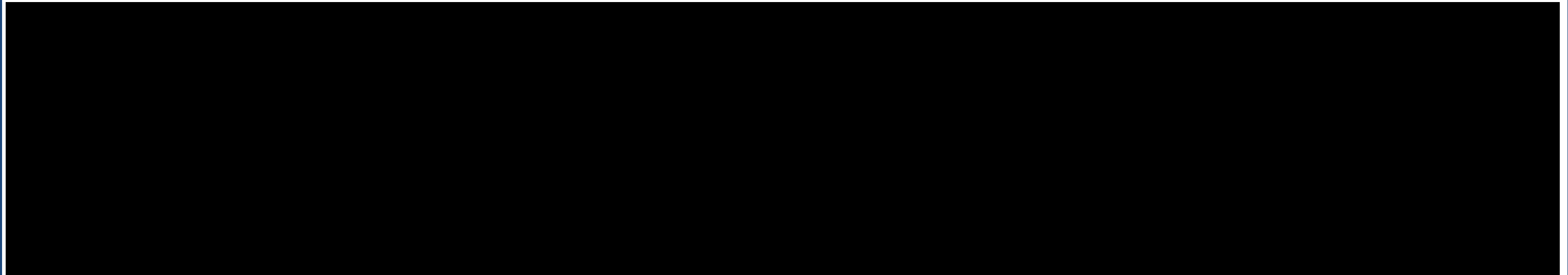
Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.



### Trends in AFDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFDC at P50, P80 and P95 and forecasts the respective future AFDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2.

## Schedule & Float



## Risk, Contingency & Change

### Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

### Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

### Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:





capacity, then consideration should be given to postponing Stage 2 Phase 2 opening so it does not impact Stage 3 opening. This could mean opening at some point from March 2019.

### **Stage 3 Opening:**

Dynamic Testing in Zones 1 & 2 started on 25 February 2018 and is planned to continue until 5 August 2018. Initial train testing progress has been intermittent because of gauging issues and problems with grease on the overhead line equipment, and this has caused intermediate dates for signalling testing to slip. The resulting delays have been mitigated in part by re-packaging the dynamic testing content under a new interim safety argument, now approved by the RfL Assurance Board for Crossrail (RAB(C)), allowing dynamic testing with full signalling protection to slip to 10 April 2018. However, achievement of key dates relies upon good progress and test results. Off-site development by BT of the Rolling Stock Communications Based Train Control (CBTC) functionality at Melton Test Track remains in delay and threatens the successful completion of the dynamic testing on the Central Section.

With significant amounts of construction still outstanding, CRL struggles to find the optimum balance between dynamic testing and installation, which best serves the Crossrail Programme. Schedule compression due to ongoing delays and adherence to the Stage 3 Opening date has progressively increased demand for access to, and occupancy of, the Tunnels and Stations. CRL continues to work closely with C610 to pursue productivity improvements.

Recent delays to the power supply energisation sequence and the installation of permanent tunnel ventilation may have consequences for the final integration and testing of Station systems, if not successfully mitigated. Concerns continue regarding completion of [REDACTED].

The Infrastructure Managers (IMs) remain extremely concerned at the delays and ongoing slow rates of progress in CRL's provision of training materials, asset information, operations & maintenance manuals, and other documentation. Across all CRL contracts, training remains significantly behind schedule. RfL-I has confirmed its minimum handover requirements which would allow it to 'stand up' as IM. These are under review by CRL.

There remains a high risk that one or more stations will not be fully operational, and that Stage 3 Opening will not be achieved on the planned date of 9 December 2018. We recommend that CRL commences contingency planning in case Stage 3 cannot be opened as planned.

### **Stage 4 and 5 Opening:**

During this period, the key concern for Stage 4 has been the potential slippage in completing the power upgrade on the Great Eastern (GE), which is necessary to operate the planned timetable. CRL and NR are currently reviewing mitigations. The principal issue for Stage 5 is the possibility of delay to NR's ETCS installation programme, and what that might entail if the existing derogation is not extended.

### **Assurance:**

Timely production of assurance documentation is being frustrated by delays to the infrastructure and most stages of the progressive assurance process are indicating delay. With final approvals relying upon outputs from late-running integration, testing and commissioning, it is possible that these impacts are not recoverable. Preparation of supporting evidence by Tier 1 contractors and BT for Safety and Regulatory Approvals for Stages 2 and 3 remains delayed.

This is bringing schedule and workload challenges to CRL, NR, LU, RfL, MTR-C, and HAL in their ability to deliver the necessary documentation to the various safety panels.

**Old Oak Common Depot:**

Old Oak Common Section A was Brought Into Use on 1 March 2018, allowing driver training to start. The immediate issues facing the depot are the signalling of Section A, planned for early May 2018, of which there is some confidence, and the installation of ARS to facilitate the connection between the depot and the mainline. This is important, as the current method requires intervention by an NR signaller, which will not suffice as train movements increase. There is a lack of clarity as to when this will occur. There are also a number of Consents that must be met before the depot can enter into service.

# 1 Schedule and Progress

## 1.1 Summary

Following issue of the new Master Operational Handover Schedule (MOHS) on 16 February 2018, CRL and most its Tier 1 Contractors are now working to new baseline dates, although █████ Systemwide contractor ATC is currently reviewing its schedule against these targets. Figure 1 - 1 gives examples of some key dates which were reset in the new MOHS, as well as the forecasts issued by CRL at Period 12. Although the forecasts match the MOHS dates, we are aware of issues with Westbourne Park traction power and energisation of non-traction power at Limmo, which CRL is currently reviewing. We expect some of the dates in this table may be delayed before Period 13 closes on 31 March 2018; see Section 3.6 for further details.

Key Dates	MOHS 2018	Period 12 Actual / Forecast
Traction Power Energisation Z1&2	01-Feb-18	01-Feb-18
Commence DT in Z1&2	25-Feb-18	25-Feb-18
Traction Power KG ATFS to WBP	28-Feb-18	28-Feb-18
ATS at WBP energised	07-Apr-18	07-Apr-18
Traction Power on Z3&4	10-May-18	10-May-18
Linewide SCADA available	30-May-18	30-May-18
Commence DT in Z3&4	11-Jun-18	11-Jun-18
HV Non Traction Power on	01-Jul-18	01-Jul-18
Commence Trial Running	05-Aug-18	05-Aug-18
Commence Trial Operations	09-Sep-18	09-Sep-18

Completed on time

Forecast to be revised

Forecast under review

**Figure 1 - 1 ~ Key Dates**

As noted in our Period 11 report, we believe the MOHS is very optimistic and extremely challenging. Progress in Period 12 and part of Period 13 reinforces our opinion that there is a high risk that the start dates for Trial Running, Trial Operations and Stage 3 Opening will not be achieved. In light of the risks and issues set out in this report, we recommend that Sponsors consider preparations in case of a delay, or sub-optimal openings, of Stages 2 and 3. We understand a deep dive into Crossrail readiness was held with TfL Board members on 20 March 2018 where funding and schedule were discussed with TfL and CRL leadership teams.

## 1.2 Progress

Progress on Stage 2 Phase 1 indicates that this remains on schedule, although some significant works need to be completed. Stage 2 Phase 2 is likely to be delayed; see Section 2 for further details.

Progress on Stations Shafts and Portals is generally in accordance with the new MOHS, although significant challenges remain.

Dynamic Testing in Zones 1 & 2 commenced on 26 February 2018, which is in accordance with the new MOHS but later than the previous MOHS date of 1 November 2017. However, this is still earlier than the previous Master Schedule, which set this at 11 April 2018. It remains to be seen if CRL can meet its target to commence the rest of Dynamic Testing in Zones 3 & 4 on 11 June 2018; we are aware of a number of risks to this, as described in Sections 3.5 and 3.6.

Delays to tunnel ventilation systems installation, HV non-traction power energisation, TCMS train software development, Handover materials production, and training during Period 12 have increased the risk of sub-optimal or delayed Stage 3 Opening. Further details are set out in Section 3.

Progress and key risks on Stages 4 and 5 and set out in Sections 4 and 5.

**1.2.1 Central Section**

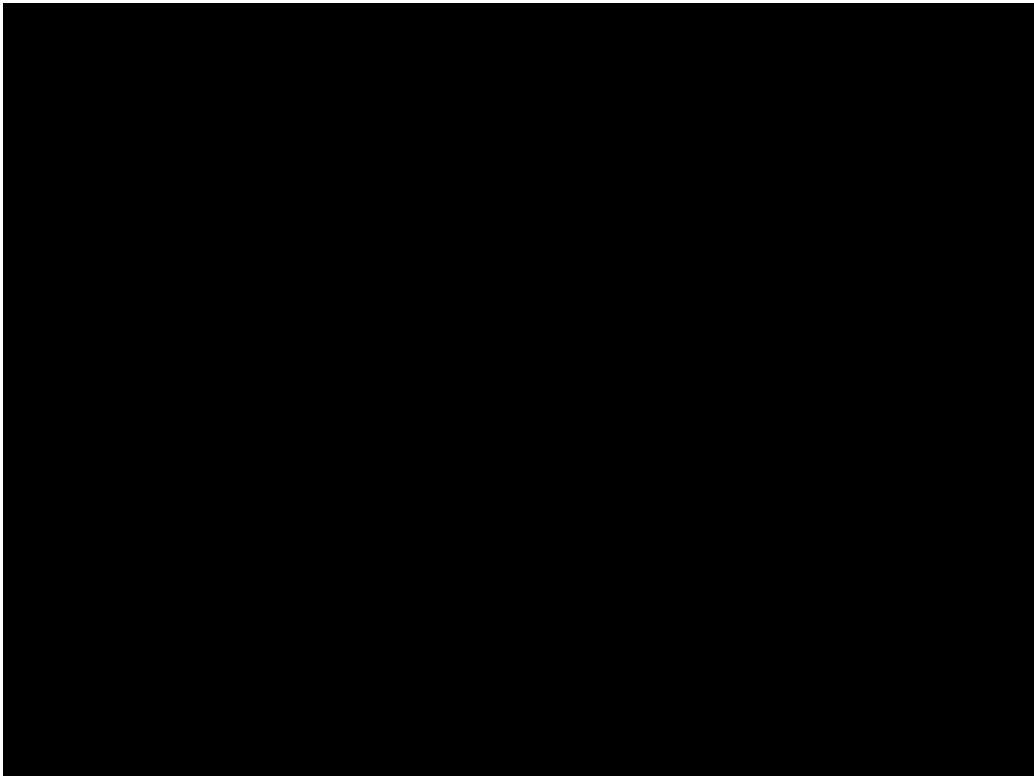
██████████ indicates the overall progress of Anchor Milestones at Period 12 following the implementation of the new MOHS, and ██████████ 10 Anchor Milestones which are already forecast to be delivered later than the new MOHS baseline ██████████ date. In most cases, these delays are minor and not critical but they do reflect the increasing pressures on the schedule. The delay regarding driver training units available for MTR-C has an impact on Stage 2 Phase 2; see Section 2.5.

Anchor Milestone	MOHS Baseline Date	Actual / Forecast
Stage 1a complete progressive Introduction of Class 345 (RLU) into Passenger Service on GE	20-Mar-18	28-Mar-18
C644 -A693 WBP ATFS energised	31-Mar-18	07-Apr-18
C610- A726 Traction E&B complete in Zones 3 & 4	13-Apr-18	25-Apr-18
C631-A711 PSD Ready for Dynamic Testing in Zone 1	09-Apr-18	28-Apr-18
Sys - A698 Start PSD Platform Train Interface Test (DT) in Zone 1	10-Apr-18	04-May-18
Training material submitted in readiness for training delivery	05-May-18	30-May-18
C660- A713 GSM-R infrastructure ready for DT in Zones 1 to 4	08-Jun-18	13-Jun-18
C610 -A723 All walkway installation complete in Zone 1	29-Jun-18	27-Jul-18
2 Driver Training Units Available to MTR for Stage 2 (inc ETCS Functionality)	24-Aug-18	12-Oct-18
C610 -A720 Temporary services recovery complete	09-Nov-18	14-Nov-18

Figure 1 - 2 ~ Anchor Milestones forecast to be later than MOHS ██████████ date

We noted last report that CRL’s aspiration to increase productivity sufficiently to meet the new MOHS may not be achieved. The new data for actuals and forecasts at Period 12 has revealed that some productivity targets have not been met. This is illustrated by the actual/forecast curve not meeting the ██████████ date curves, and moving towards the ██████████ date curves on the individual project charts in Appendix B and Appendix C. This is also shown at Figure 1 - 3, which indicates the Systemwide progress against the new MOHS 2018 at Period 12. Detail regarding progress of individual projects is included later in this report; see Sections 2 and 3.

All of the Corporate Key Milestones, selected by the CRL Board as part of its KPI incentive scheme for the CRL Executive, have been achieved now that Dynamic Testing has commenced. New Corporate Milestones for 2018/19 are due to be agreed in March or April by the CRL Board.



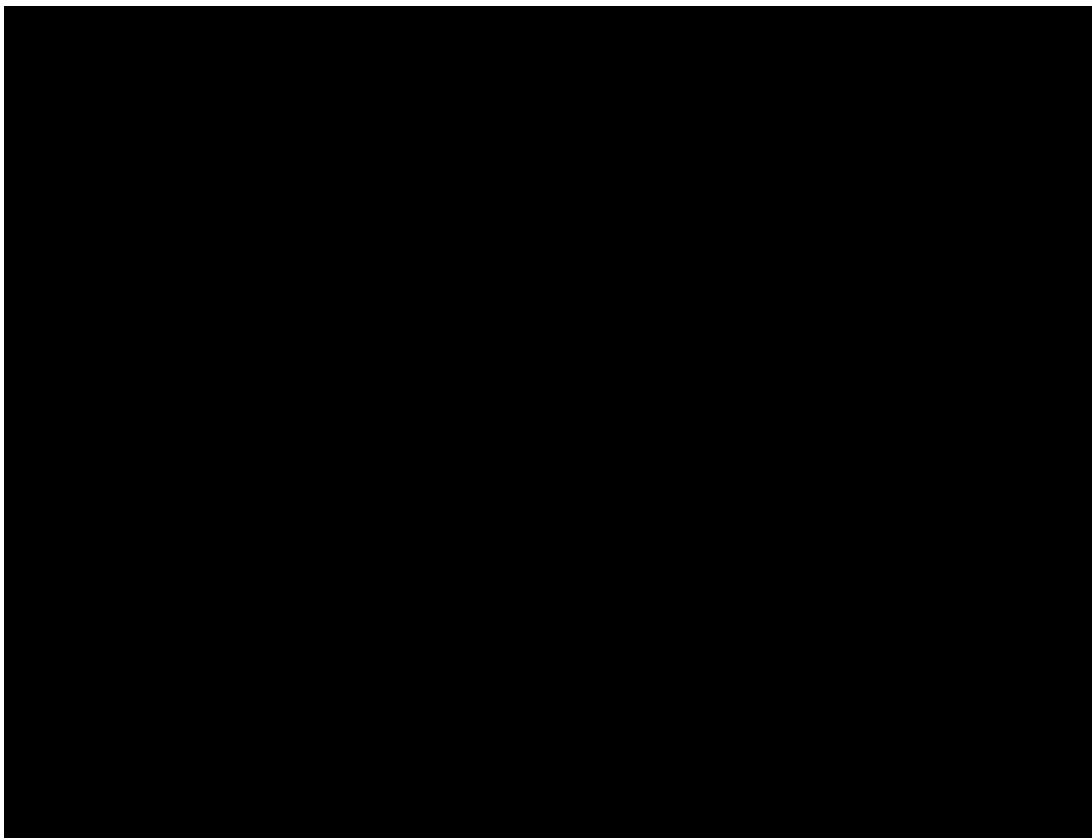
In our last report, we noted that the new MOHS contains a large number of assumptions and therefore risks. Some of these assumptions are already being challenged, such as increased productivity of tunnel ventilation systems installation. The key risks remain as:

- [REDACTED]
- [REDACTED];
- Installation and testing of ventilation systems cannot be accelerated; this is proving to be the case, see Section 3.6;
- [REDACTED]
- Some stations may not be ready for scheduled non-traction power-on dates; energisation has been delayed, see Section 3.6;
- Phase 3 integration testing is delayed by slippages to preceding works, see Section 3.6;
- Handover Execution Plans are not agreed with IMs in time, see Sections 3.4 and 3.9;
- Training materials, asset data and training sessions are not delivered in time; the contractors are struggling to deliver in time, see Sections 3.2 and 3.9;
- The production of IRNs cannot be accelerated back to the original forecast; this is becoming critical as this are needed for assurance processes, see Section 3.4;
- CRL and the IMs are not able to agree Staged Completions in some locations, see Sections 3.4 and 3.10;
- [REDACTED]
- Access to the Trace is insufficient to enable works to be completed, see Section 3.6;
- Tunnel walkways etc. cannot be installed before Trial Operations, see Section 3.6;
- CRL and NR are not able to agree transition testing dates on GEML and GWML, see Sections 3.5 and 3.6;
- [REDACTED]
- IMs are not satisfied with the Handover verification process, see Section 3.7;

- Critical works after Handover cannot be completed in time under the RfL-I Rulebook, see Sections 3.2 and 3.6;
- Sufficient documentation cannot be submitted to ORR in time; see Section 3.7.

### 1.2.2 NR ONW

CRL and NR report that the ONW is 93% complete (previous 93%) based on expenditure of forecast cost, rather than actual physical progress. Figure 1 - 4 shows the forecast and actual cumulative performance of ONW key dates and milestones against the MOHS baselines, excluding completion dates for the west enhanced stations. The forecast information is shown at Period 11, [REDACTED]. The large increase in milestone completion in Period 6 (10 September 2018) is due to substantial completion of west station works (excluding enhancements), K05B (Full Infrastructure Capability - Maidenhead to Central Core Area at Westbourne Park to Support Operation of New Trains) and KD24 (Infrastructure complete to support Stage 5 Dynamic Testing).



During Period 12, on Crossrail East, works commenced at the Gidea Park auto transformer site and, on Crossrail West, the signalling commissioning was successfully completed at Westbourne Park.

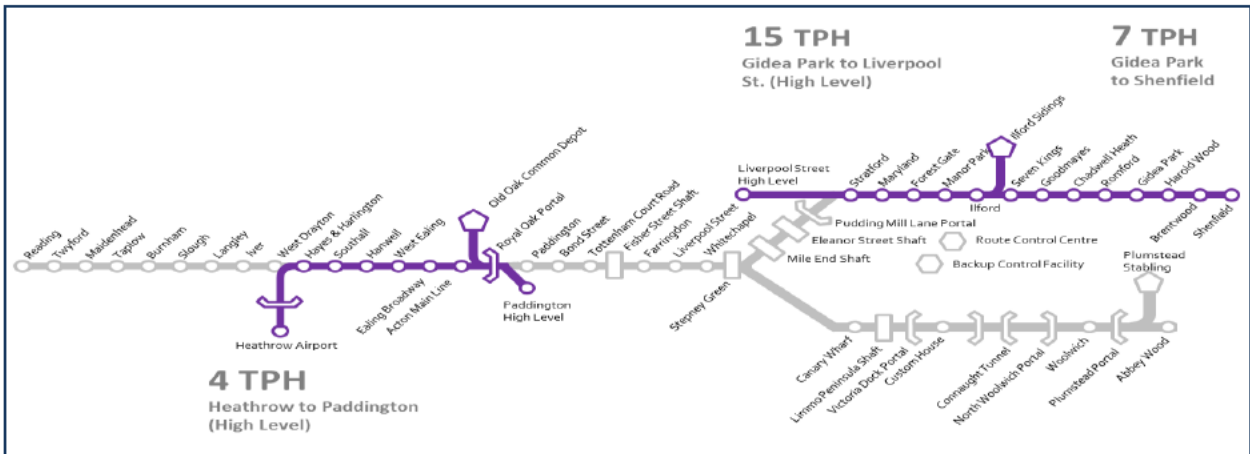
NR reports that all works are on schedule to achieve Key Dates and Key Outputs, with the exception of:

- [REDACTED]
- KD33 (30 March 2018): Westbourne Park commissioning works associated with KD33: Traction power infrastructure, including SCADA control complete from Kensal Green auto transformer feeder station to Westbourne Park ATS were completed during Christmas 2017. Following a request from CRL, the cables will be connected, tested and energised at the end of April 2018. CRL and NR have agreed a revised date for KD33 of 30 March 2018, while an energisation date is still to be confirmed. NR and CRL confirm that they are working collaboratively to manage this Key Date;
- KO5A and KD22 (10 September 2018): [REDACTED] A revised programme has been requested from the concentrator renewal team to reflect re-staging works. An Employers Representative Instruction (ERI) has also been issued following the Electrification System Simulation Analysis (ELSSA) report with the potential to improve the auto transformer programme by six to eight months. Integration workshops between NR and the auto transformer works contractors are being held to mitigate delays to the programme.

At Abbey Wood station, NR reports that the two forecourt lifts have been commissioned and have been put into use. However, CRL reports that substantial completion has been delayed until the end of April 2018 due to extended M&E works.

Refer to Sections 2, 4 and 5 for further information regarding NR works required for each Stage completion.

**2 Stage 2: Phase 1; 20 May 2018. Phase 2; [Date TBC]**



**2.1 Summary**

Stage 2 Phase 1 remains on schedule to open on time, although some significant works remain. CRL is mitigating these and is in consultation with GWR regarding contingency planning. Stage 2 Phase 2 is likely to be further delayed.

*Train software currently struggling to identify its location, affecting DOO CCTV, Passenger Information Systems and Automatic Selective Door Opening.*

*There needs to be an agreed procedure between NR and MTR-C for operating Paddington Station platforms.*

*Installation of ARS at OOC required to manage future increase in train movements, and submissions to Local Authority to satisfy Consents required before passenger services begin.*

**2.2 Operational Readiness Assessment**

CRL's Stage 2 dashboard lists 1 issue categorised as 'red' for Phase 1, and 4 issues for Phase 2. They are:

- Phase 1
  - Requirement for Central Door Locking (CDL) at Paddington.
- Phase 2
  - Train readiness for testing and meeting MOHS;
  - CRL's formal integration tests;
  - Timeliness of Approvals;
  - Time required for driver training and Operational proving.

Further explanation is given in this Section.



**2.3 Network Rail Works**

**2.3.1 West Platforms and Stations**

NR has reported that works for West Inner stations for KO4 are substantially complete and will be fully completed to meet CRL Stage 2. CRL reports that works continue for the installation of permanent platform lighting, station information systems, communication cables, power, PA system, tactile paving, and new customer information screens. Final DOO CCTV commissioning checks are also progressing in conjunction with train testing.

NR has reported<sup>1</sup> that the introduction of recent design changes and the inclusion of MTR-C requirements for the Hayes & Harlington bay platform extension works has resulted in a revised forecast completion date. The design Inter Disciplinary Check (IDC) review took place on 2 March 2018 and Approved For Construction (AFC) was granted on 9 March 2018. NR has confirmed that construction commenced on 12 March 2018 and forecast completion is now 7 May 2018, delayed from 7 April 2018 forecast at Period 11. The CRL MOHS 2018 shows the Hayes & Harlington bay platform required for KO4, as 27 April 2018. However, CRL confirmed at the Period 12 PDB that the revised completion date can be accommodated to meet Stage 2, Phase 1, 20 May 2018. Currently, NR is reporting no cost impact as a consequence of these changes. Separately and not ONW, a new requirement requires RfL to agree with BT to update software to incorporate Selective Door Operation (SDO) at the Hayes & Harlington bay platform.

**2.3.2 Stockley to Maidenhead OLE**

CRL reports that the OOC Depot signalling subcontractor (Atkins) has drafted the scope of the future signalling test and commissioning required to bring the Depot into use in March and May 2018. CRL and NR are currently establishing the resources and additional commercial arrangements to support this approach. [REDACTED]

NR is reporting that key deliverables for Stage 2 Opening remain on schedule:

- Electrification of points (ref: 8066) remains on schedule for completion by 7 May 2018, over the Early May Bank holiday;
- All outstanding gauging work at Paddington including track and coper moves is due to be completed by 7 May 2018, over the early May Day Bank Holiday;
- The NR delivery team is due to complete the fully diverse telecoms fibre routing (North and South of OOC depot) during possession access in April 2018.

CRL reports that the Traction power modelling has been completed and shows that sufficient power is available for Class 345 stock and IEP trains for Stage 2 timetables. The target for the project to achieve conversion to Autotransformer mode in the West is by September 2018<sup>2</sup>.

<sup>1</sup> Confirmed at CRL PDB 13 March 2018.

<sup>2</sup> Confirmed by NR at the ONW PDB 20 March 2018.

**2.4 Phase 1**

The key issues affecting Phase 1 are as follows:

**OOC**

Section A of the depot was BIU on 1 March 2018. This allowed trains to access the depot, and driver training to start on 5 March 2018. This was a positive step for the project and programme. We believe the next major issues facing the depot concern signalling and Consents.

Section A is planned to be signalled by 7 May 2018. There has been some positive pre testing of this section, so we feel that there is a reasonable level of confidence that the date will be met. If it is not, it will increase operational pressures in the approach to Phase 1 opening.

The installation of Automatic Route Setting (ARS) on the fringe, connecting the depot to the mainline, is more of a concern. At present, the NR signaller manually routes the trains into and out of the depot. This is acceptable for the limited number of movements currently occurring, but not when numbers increase through Stage 2 Phase 1 and Trial Running. There is a working assumption that ARS will be installed in June, but there appears to be a lack of certainty to this date. The date needs to be firm, and if possible brought forward to facilitate Phase 1.

The other concern we are highlighting is Consents. The depot is required to fulfil certain requirements to the local authority controlled by Schedule 7 of the Crossrail Act. A key constraint for the depot is noise levels. These Consents need to be in place before the start of operational service in May 2018, and there are issues with gathering the necessary evidence to submit to the Local Authority. RfL is working with BT on the matter.

**Rolling Stock**

The 'red' issue of CDL required at Paddington station is symptomatic of a wider problem that emerged during the period. We understand that the current version of software (TCMS 4.2) is essentially unable to establish its location in relation to stations. This has affected the functionality of PIS, DOO CCTV, SDO and CDL. The critical nature of these systems means that this situation must be rectified before the trains enter passenger service. A software fix is due to be applied by 9 April, with subsequent proving activities to be completed by 30 April. This is obviously not long before passenger service starts on 20 May 2018. CRL is in consultation with GWR regarding contingency planning. We are monitoring the situation.

CDL itself, required to address the gaping (between train door and platform) situation at Paddington, has a number of further issues to address. [REDACTED]

DOO CCTV integration testing has started, and BT is intervening to make the train recognise its location, allowing the images to be displayed in the cab. There have been the expected issues with regard to signal glare, platform lighting and camera angles. However this is not the same situation as for Stage 1; Site Acceptance Tests (SAT) are almost completed, and there is

<sup>3</sup> A question is why bother with CDL if routed into platforms that do not require it? This is because with such a platform restriction there is a performance risk. An upgrade to the train software is expected in the summer that will remove the bug.

agreement amongst all parties as to what is a 'pass'. We expect the issues to be resolved in time for passenger service.

**Regulatory Approvals**

There are three key approvals (ORR issue Amended Safety Certificate for GWML, Safety Management System (SMS) updated for Empty Coach Stock & Driver Training, SMS updated for Passenger Service) to obtain for Phase 1. The first two have been completed. The last one has been assessed by MTR-C as 'red'. This is because it is concerned that BT will not be able to produce the required assurance documentation in time. MTR-C is prepared to adjust the timing and frequency of its SVP to facilitate BT's assurance submissions.

**2.5 Phase 2**

The issues affecting Phase 2 are as follows:

**OOC**

There has been no change to the BIU and signalling commissioning dates during the period from our last report, so we have no further comment from that provided in our Period 11 report. We are aware of a potential risk to energisation of Section B1; we will report on status next period.

**Rolling Stock**

BT's prioritisation of TCMS v7.2 to support Stage 3 over Stage 2 Phase 2 has had an impact upon the programme, which has raised the possibility of Phase 2 opening in Spring 2019.

In MOHS 18 the date that [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

Functional testing in the Alstom laboratory has not begun, but some BT equipment has been sent to the laboratory and Alstom has extended the time available for testing until 30 March. We hope there is some success.

**Regulatory Approvals**

There are a number of issues affecting Regulatory Approvals for Phase 2:

- BT's forecast of when it is expected to achieve On-board signalling ETCS APIS from the ORR is now mid-November 2018, which it considers to be 'amber'. This has moved from end-September 2018 in Period 11, which was also considered 'amber';
- [REDACTED]  
[REDACTED]  
[REDACTED]
- We stated in our last report that NR was forecasting receiving APISs for ETCS and GSM-R data trackside by mid-April 2018. This was originally forecast for the end of December 2017, and is now forecast to be received during May 2018. We continue to advocate for their submission urgently.

## 2.6 Agreements

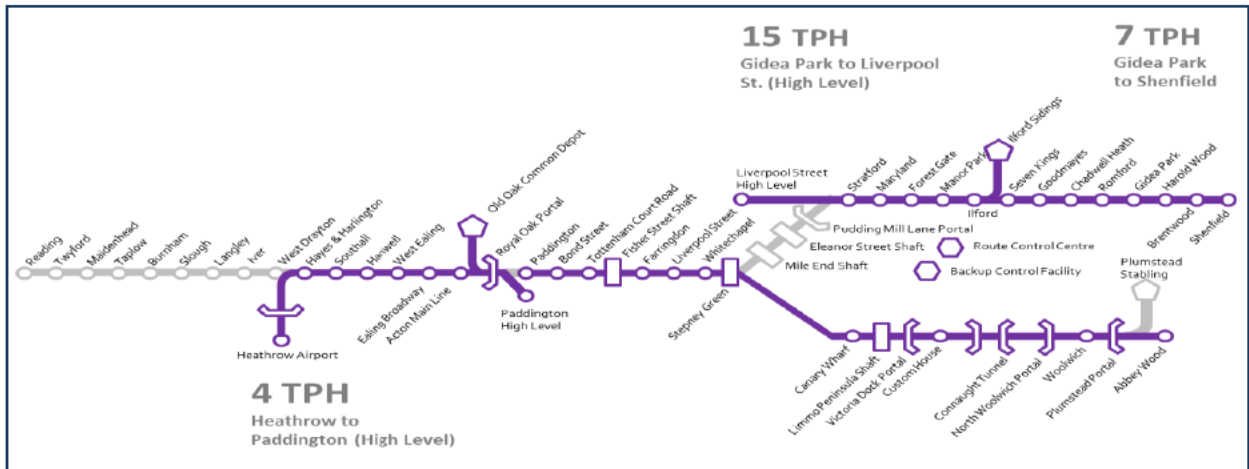
The three key agreements which are critical for Stage 2 remain open. RfL's assessment of the risk of delay remains at 'amber'.

There are six other agreements with HAL that are on the critical path for Stage 2 Phase 1, and these are classified as 'green' by RfL.

One point to note is that the lease agreement for the Class 360 trains used to support Stage 2 expires at the end of December. Considering our commentary in Section 2.5 - Rolling Stock, RfL will need to seek an extension to that lease.

See Appendix D.1 for progress charts.

**3 Stage 3: Paddington to Abbey Wood; 9 December 2018<sup>4</sup>.**



**3.1 Summary**

Although CRL and its contractors are working to the targets set in the new MOHS, there remain significant challenges. There remains a high risk that one or more stations will not be ready, and that Stage 3 Opening will not be achieved on the planned date. We recommend that CRL considers contingency plans in case Stage 3 cannot be opened as planned.

*There are now twenty-two Readiness Tasks that have been given a “Red” by the ELRSG. We remain concerned about a possible “optimism bias” in the forecast rates of production. There have been no movements in the Stations forecast IM handover or completion dates during the period but achieving these dates will remain a challenge. The Installation Release Note process for handovers of work is in delay. [REDACTED] has yet to produce a delivery schedule aligned with the MOHS. HV non-traction power energisation sequence due to start 11 March re-scheduled for 1 April. Productivity rates for Tunnel Ventilation installation are proving inadequate. Closure for all FDO certification by the end of March 2018 is unlikely to be achieved. [REDACTED] A huge residual Assurance workload is accumulating. Problems with train software development meeting some of the MOHS dates. Concerns whether there will be sufficient Rolling Stock to fully operate Trial Running. Continuing schedule pressures with Handover materials and training.*

<sup>4</sup> Stage 3 Completion of Trial Running is 9 September 2018; Stage 3 Opening is 9 December 2018.

### 3.2 Operational Readiness Assessment

There are now twenty-two Readiness Tasks that have been given a “Red” by the Elizabeth Line Readiness Steering Group (ELRSG)<sup>5</sup>, a decrease of one from the previous report. Those Tasks that improved, or have closed, are shaded grey and will be removed in our next report.

Seven of the tasks are rated as ‘medium’ impact, but have a cumulative impact upon RfL-I maintenance and LU staff being trained and competent, which is rated as ‘high’ impact. The twenty-two Readiness Tasks can be attributed to three categories:

- COS infrastructure and interfaces not being in a position to support dynamic testing;
- Train software not being in a position to support dynamic testing;
- CRL not receiving data, or it being below the necessary quality, from the Tier 1 contractors. This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway.

	Readiness Task	Issue
<b>Dynamic Testing Zones 1-2</b>		
	Infrastructure available and ready for Dynamic testing	Dynamic testing started on 25 February 2018. The infrastructure is not as complete at the start of testing as originally planned.
	Delivery of FLU with functioning CBTC	MOHS dates are being exceeded, increasing the pressure upon the more limited time for testing. See Section 3.8.
	Drivers trained on CBTC, CCRRB, T3 and OSP briefed and familiar with zones	MTR-C has been able to circumvent previous difficulties with obtaining the necessary access accreditation from Tier 1 contractors.
	MAID deliverables uploaded in Livelink <i>Medium impact</i>	Handover material is in delay. See Section 3.9.
	RfL-I acceptance of FDO (for interfacing assets) <i>Medium impact</i>	FDO certificate dates were planned to be completed by end of February/early March 2018). See Section 3.7.1.
	Training of RfL-I staff on CCRRB (Crossrail Construction Railway Rule Book) <i>Medium impact</i>	This relates to the continuing delay in the training programme. Without this knowledge necessary works to be carried out post-Handover will be impeded or suspended.
	<b>NEW</b> Possessions & isolations agreed and booked	This has been carried out for the eastern interface, but remains outstanding for the western interface.
	Training of RfL staff for operation of RCC equipment during Dynamic Testing	This activity has been mitigated by the Contractor carrying out the tasks. It allows EDT to continue, but is a missed chance for RfL staff to familiarise themselves with the equipment.
<b>Dynamic Testing All Zones</b>		
	Interfaces commissioned & operational for Trial Running	The delay to the IM training schedule raises the risk that RfL-I and NR operatives will not be able to facilitate testing and commissioning activities. This risk is being compounded by the lack of asset readiness.
	MTR-C station Handover	This Task has been reallocated to Trial Running / Trial Operations.

<sup>5</sup> Meeting held 9 March 2018.

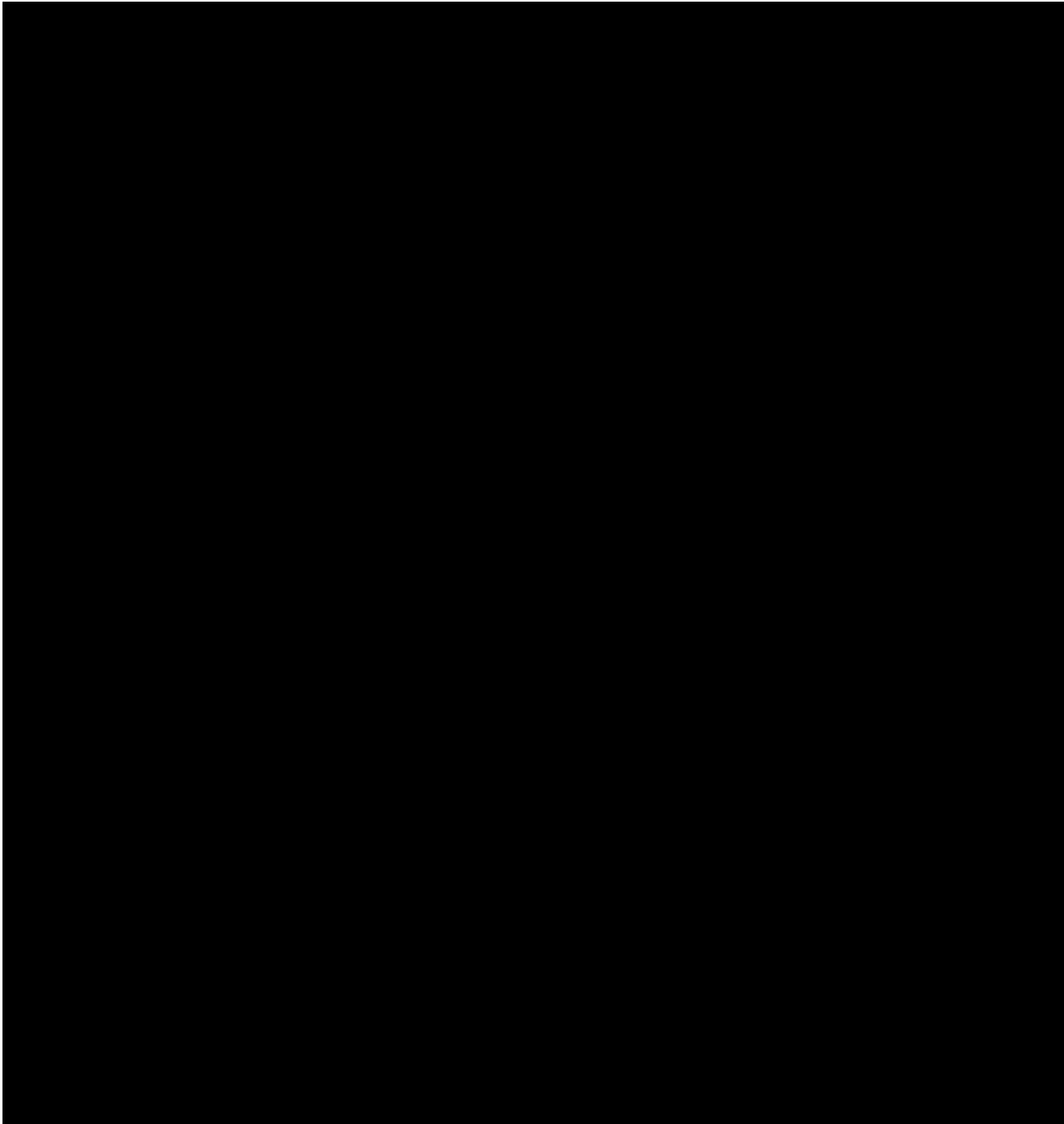
	Readiness Task	Issue
	LU Elizabeth line asset data in Ellipse/ Maximo <i>Medium impact</i>	Handover material continues to be in delay. See Section 3.9.
	Compliance Achieved (FDO signed without caveat)	Issue raised in 'RfL-I acceptance of FDO (for interfacing assets). See Section 3.7.1.
	O&M manuals in place for 5 LU stations <i>Medium impact</i>	O&M manuals continue to not be provided to the necessary quality in the required timescale. See Section. See Section 3.9.
	LU maintenance in place for Handover <i>Medium impact</i>	The lack of O&M manuals and asset data described above risks LU staff being inadequately prepared.
	All tech training delivery to IM trainers	The IM trainers will not receive the expected training by the Contractors. The current programme cannot be fully met. See Section 3.9.
	O&M manuals for RfL-I completed.	Delivery of O&M manuals continue to be behind programme, affecting IM readiness. See Section 3.9.
	System information delivery (asset data, O&M manuals, training plans, MAXIMO) <i>Medium impact</i>	IMs not receiving the level of information required. This Readiness Task is similar to the 'O&M manuals completed' Task.
	RfL maintenance staff train the trainer complete	The training plan has changed to reflect the fact that this will not be achieved, but lack of training courses and material is impeding progress. See Section 3.9.
	Systemwide approvals and agreements in place for DT	This reflects the delay associated with Zones 3 & 4 readiness.
<b>Trial Running</b>		
	Sufficient 345 units available to support 24tph tests	FLU's have been manufactured, but there are issues with sufficient numbers meeting the acceptance criteria for the start of Trial Running. See Section 3.8
	<b>NEW</b> MTR-C Station Handover	This task was previously in DT all zones section. It reflects the late completion of [REDACTED] and [REDACTED] stations.
	<b>NEW</b> Element Completion Handover Certificate signed by LU	The Certificate requires Handover materials to be completed, which are currently red and the stations completed and they are in delay.
	RfL-I maintenance staff trained and competent	Red due to contractor training plans and asset availability. See Section 3.9.
	RfL-I Ops & RCC staff trained, licenced & competent	The delays to the [REDACTED] the RCC has affected the Traffic Manager training programmes. Some will not be trained until after Handover. In addition delays to the start of Trial Running / Trial Operations will reduce the time for the staff to familiarise themselves with the railway.
<b>Trial Operations</b>		
	LU Handover achieved	This task is Red due to the items listed above.
<b>Stage Three Service</b>		
	LU Staff Ready to Open for Revenue Service	This task is Red due to the items listed above.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 3 - 1 ~ Readiness Tasks with "Red" Status







CRL is putting a lot of pressure on its contractors to complete the Installation Release Note (IRN) process for handovers of work and/or rooms/routes to Systemwide contractors. Weekly, and in some cases daily, meetings to review IRN progress are being held with contractors. [REDACTED]

Early acceptance of, and familiarisation with, the new station, portal and shaft assets, by the IMs, will be a key factor in helping CRL to achieve or possibly beat the 2018 MOHS target dates. The re-baselining exercise has helped CRL identify and track forecast station IM handover dates and staged handovers of each separate asset element to the IM; particularly for stations, such as [REDACTED], that are running late. Detailed Handover Execution Plans (HEP) are being developed by CRL and should be in place by the close of Period 13. The HEPs will



[Redacted]

[Redacted]

**Bond Street Station**

[Redacted]

[Redacted]

- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]

[Redacted]

- | [Redacted]
- | [Redacted]

**Tottenham Court Road Station**

[Redacted]

[Redacted]

[Redacted]

[Redacted]

**Farringdon Station**

[Redacted]

[Redacted]

- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]

[Redacted]

**Liverpool Street Station**

[Redacted]

[Redacted]

[Redacted]

**Whitechapel Station**

[Redacted]

- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]
- | [Redacted]

[Redacted]

[REDACTED]

[REDACTED]

**Woolwich Station**

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

**Canary Wharf Station**

[REDACTED]

**Custom House Station**

[REDACTED]

**Intermediate Shafts**

[Redacted content]

**3.5 Dynamic Testing**

**3.5.1 Dynamic Testing Management**

MOHS 2018 contains the latest and best available information from BT on Class 345 test train dynamic testing scope and progress. We now regularly see<sup>8</sup> good levels of collaboration and information sharing at a working level between BT and CRL, and the fact that joint site testing activities are now taking place is generating greater enthusiasm and momentum between the teams, if not agreement.

[Redacted content] The use of these facilities, together with the CIF at Westferry Circus, has still to be optimised under the direction of CRL, as Systems Integrator, and work continues to identify the solution for best use. As before, the extraction of maximum benefit from these facilities will come down to the availability of scarce resources.

The current dynamic testing sequence forms the core critical path. It has three components:

- Zones 1 & 2 (EDT);
- Zones 3 & 4;
- All Zones (including Zones 3 & 4);

Dynamic testing runs between 25 February 2018 and 5 August 2018, over a total period of 23 weeks; this compares with the period of 35 weeks provided for in MOHS 2017. The reduction in

<sup>8</sup> For example at CRL Testing & Configuration Review Panel and RAB(C) meetings.

dynamic testing time illustrates the schedule compression that has been incorporated into the MOHS in order to maintain the Stage 3 Opening date and highlights the critical reliance upon progress being strictly in line with plan. Achievement also depends upon BT's ability to deliver software functionality to match CRL's schedule requirements.

### 3.5.2 Zones 1 & 2 (EDT)

As reported last month CRL started dynamic testing in Zones 1 & 2 on 25 February 2018, almost 17 weeks later than the MOHS 2017 milestone date of 1 November 2017. Meaningful testing with the train has been carried out, and some acceptable evidence for the railway assurance process has been produced. However, progress has been less than planned because of issues with the fixed infrastructure that were discovered during the first test runs. Unexpected gauge infringements (which the initial low-speed "sweep" of the railway was intended to capture) have now largely been addressed and residual OLE construction grease that affected traction current pick-up by the train pantograph has been removed. Dynamic testing resumed on 10 March 2018.

The need to complete planned testing for stray electrical currents and touch potentials has further restricted activity, with opportunities for testing driven by the possession availability and supporting resources of neighbouring railways. CRL is required to demonstrate by measurement that the exported electrical effects upon neighbouring railways (i.e. LUL, LO, DLR, NR) are as designed and within specified safety parameters, before permanent energisation. All testing is due to be completed by the end of March 2018, in principle allowing the OLE to be energised and for trains to be tested at any time (rather than just during "non-traffic" times). That will allow dynamic testing to be carried out during the day, rather than be restricted to nights, offering CRL greater flexibility for adjusting the balance between construction and testing across the Central Section, in order to maintain MOHS progress.

Despite inherent technical and schedule complexity, CRL continues to anticipate issues and deliver solutions that enable at least some progress to be maintained. A recent case in point has been the development by CRL of an interim safety case for dynamic testing "not relying upon signalling protection". This requirement has been driven by the fact that full signalling protection cannot be validated until the most recent test results have been reviewed and endorsed by [REDACTED] – work which is currently in progress. Recent acceptance of the safety case by RAB(C)<sup>9</sup> has avoided further delay to the next phase of dynamic testing, with Route Accessibility testing due to start on 26 March 2018. Further information is provided in Section 3.7.3.

We have written previously of the changing site safety profile as the Central Section moves to an electrically live testing environment. This brings with it a requirement for new safe working methods, and the crucial need to remain vigilant and process-compliant. The risks and the potential consequences of error were highlighted in an incident during dynamic testing on 12 March 2018, in which a test train ran into an electrically "dead" OLE section, causing the traction power supply to be tripped and resulting in some damage to the Rigid Overhead Conductor. Early indications are that the electrical section was planned to have been energised as part of that particular night's test, but had been left isolated. The safety measures in place operated successfully (e.g. the electrical section was earthed, the circuit breakers at PML ATFS operated as designed and the nearest construction staff were several kilometres away, deliberately separated from the incident by an electrically dead and clearly marked "buffer zone"). However, the occurrence is under close scrutiny by CRL and a formal review is underway. Sufficient investigation has already taken place to allow dynamic testing to continue

<sup>9</sup> Safety case accepted at the RAB(C) meeting held on 15 March 2018.

without significant delay. However, the incident once again illustrates the potential schedule and, worse, safety impacts of the types of unplanned and unforeseen events to which MOHS remains susceptible.

It should be noted that [REDACTED] equipment testing remains outstanding, with work at [REDACTED] signalling equipment room necessary to support dynamic testing with signalling protection on target for completion before the required date of 10 April 2018.

Replacement of broken rail baseplates discovered in Connaught Tunnel has been completed on the westbound line and is at 30% on the eastbound; overall completion is on target to avoid impact upon the speed increase tests in Zones 1 & 2 during April 2018.

### **3.5.3 All Zones Dynamic Testing, including Zones 3 & 4**

Dynamic testing in Zones 3 & 4 is due to take place between 11 June and 2 July 2018. We expect that CRL will build on lessons learned from Zones 1 & 2 during this phase.

Thereafter, dynamic testing will be carried out across all Zones until 5 August 2018, in order to demonstrate end-to-end integrated signalling functionality. This testing period will include two weekends of signalling transition testing at each of the NR GE and GWML interfaces, possessions for which have been provisionally booked for July and August 2018, but which have yet to be confirmed by NR. As before, progress in line with MOHS requires the delivery by BT of a reliable test train with appropriate functionality, and that dynamic testing proceeds without significant issues.

Testing will also be subject to the preparation and acceptance of appropriate safety cases.

[REDACTED]  
[REDACTED]  
[REDACTED] We provide further details in Section 3.7.3.

### **3.6 Completion and Handover of Integrated Systems**

The success of MOHS 2018 is highly reliant upon the performance of the [REDACTED] Systemwide main works contractor [REDACTED] as the principal enabler for completion of the Central Section. However, [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

Systemwide delivery remains at its limits for the efficient utilisation of plant and manpower, and maximisation of access and productive work time provides the most likely means of meeting demanding MOHS timescales and extracting localised schedule float. A particular focus is the amount of time necessary for positioning works trains and establishing safe systems of work ahead of working shifts on site. Attention is being given to the possibility of adopting a blockade-based approach, rather than daily shift patterns, to reduce unproductive time. Intuitively, there appear to be a number of benefits, including the potential for improved clarity of working arrangements on site and the creation of arguably a safer working environment. Ultimately, though, this is an extreme form of “trading” of dynamic testing activities against installation activities within a constrained and “finite” working environment. If justified, adoption needs to be swift in order to reap maximum schedule benefit.



In the meantime, CRL and its contractors continue to operate as responsively and flexibly as possible, seeking to maintain progress by quickly addressing failures or poor progress. While CRL and █████ continue to pursue various initiatives, the onerous productivity rates upon which MOHS 2018 is founded are already proving difficult to achieve in practice, as illustrated in the Systemwide progress charts in Appendix B.

Key dates in the dynamic testing phase through to Trial Operations are shown in Figure 3 - 3. These dates have remained largely unchanged during the last period, although there has been some movement in forecast dates for some milestones<sup>10</sup>. This is unsurprising, given that the MOHS contains virtually no schedule float. Due to a number of issues described in this Section, we understand some of these dates are to be revised or are under review.

Key Dates	MOHS 2018	P11 Actual / Forecast	P12 Actual / Forecast
Traction Power Energisation	01-Feb-18	01-Feb-18	01-Feb-18
Commence DT in Z1&2	25-Feb-18	25-Feb-18	25-Feb-18
ONW KD33 Power from KG	28-Feb-18	28-Feb-18	28-Feb-18
4 Trains ready for DT Z3&4	23-Mar-18	23-Mar-18	09-May-18
Fibre Backbone complete	27-Mar-18	27-Mar-18	27-Mar-18
ATS at WBP energised	07-Apr-18	07-Apr-18	07-Apr-18
Traction Power on Z3&4	10-May-18	10-May-18	10-May-18
Linewide SCADA available	30-May-18	30-May-18	30-May-18
Commence DT in Z3&4	11-Jun-18	11-Jun-18	10-Jun-18
HV Non Traction Power on	01-Jul-18	01-Jul-18	01-Jul-18
DT All Zones	02-Jul-18	02-Jul-18	02-Jul-18
Commence Trial Running	05-Aug-18	05-Aug-18	05-Aug-18
Commence Trial Operations	09-Sep-18	09-Sep-18	09-Sep-18

Completed on time

Forecast to be revised

Forecast under review

**Figure 3 - 3 ~ Key Dates to Trial Operations**

Possibly the most significant slippage in the period has been with the provision of permanent HV non-traction power across the Central Section. The energisation sequence was due to start at Limmo on 11 March 2018, but installations were not ready, and the activity has been re-scheduled for 1 April 2018. It had been planned for energisation to take place through a pre-determined “daisy-chain” of HV sub-station energisations (i.e. both 11kV and 22kV) on 12 consecutive weekends, in a sequence designed primarily to support the completion of the permanent Tunnel Ventilation System. CRL is investigating with the █████ HV non-traction power contractor if the rigid sequence of substation energisation at weekends only can be improved upon. As a priority, CRL is seeking to ensure that permanent power is made available in line with MOHS at █████, because this is strategically significant location for Tunnel Ventilation System commissioning. Given that the general productivity rates for Tunnel Ventilation installation are proving less than those necessary for MOHS, it is possible that some form of prioritisation of works at █████ will be required in any event.

<sup>10</sup> CRL MOHS Period Review held on 16 March 2018.

Slightly behind Tunnel Ventilation in priority are the requirements to support Station Systems Phase 3 integration testing. Permanent power delivery brings together the various Stations and Rail Systems deliverables as an integrated power distribution system, and success relies upon close co-ordination and readiness of Stations installations. However, [REDACTED]

[REDACTED]  
[REDACTED] We will report further on this next period.

[REDACTED] These are currently considered non-critical because there is sufficient schedule float before the Zones 3 & 4 traction power requirement.

The completion of Platform Screen Doors has been delayed because of the prioritisation of works which support the early stages of dynamic testing. This delay is not critical, but provides a further illustration of the difficulties of restricted access and reduced productive time on site.

Until Trial Running, the Central Section must function as both an electrified test track and as a construction railway, and C610's Construction and Commissioning Railway Rule Book provides for this. At a practical level, competing construction and testing requirements, driven by an extremely tight schedule, will place increasing demands upon site management and train operations, and the railway will be at its most vulnerable from a safety perspective. This was perhaps illustrated by the incident that took place last period, described above in Section 3.5.2. Safety remains paramount and, as we approach this critical phase of Crossrail Programme delivery, CRL must ensure that processes and procedures are trained-out, properly understood and well-practised before rail operations intensify.

While much focus continues to be placed upon proving the Rolling Stock/Signalling functionality, Phase 3 integration testing at other critical interfaces must be completed before Crossrail can be shown to be fit for operation as a passenger railway. [REDACTED]

[REDACTED] This delay runs concurrently with those occurring in Stations delivery, compounding the difficulties in achieving completion of Phase 3 testing once Trial Running commences.

CRL has forecast that a wide range of activities will remain:

- [REDACTED] non-dynamic testing critical works (e.g. walkways, lighting, LV cabling);
- [REDACTED] removal of temporary works (e.g. lighting, fire main, radio);
- [REDACTED] permanent ventilation system testing;
- [REDACTED] completion of testing;
- [REDACTED] completion of integration testing with Rail Systems;
- [REDACTED] completion of integration testing with Stations.

Working arrangements continue to be developed between CRL and RfL that will allow the completion of these late activities from the time of Handover and into the Trial Running period. Further, RfL has previously indicated its willingness to enter into discussion upon all completion issues and it remains open-minded on how those that do not compromise safety or reliability might jointly be concluded<sup>12</sup>. Given the emergence of issues and the strategic slippage in the period, it is clear that CRL will be forced to rely more heavily upon the IM's co-operation and agreement to allow completion beyond the start of Trial Running. At its most extreme, CRL

<sup>11</sup> Discussed at the Period 12 CRL C650 PDB held on 14 March 2018.

<sup>12</sup> Presented by RfL at the CRL MOHS Period Review held on 16 February 2018.

might find itself in a position where the loss of Stage 3 Opening is unavoidable. It is therefore crucial that open engagement is maintained at all management levels, to allow all opportunities and options to be explored and to avoid late and unwanted “surprises”.

### **3.7 Approvals, Assurance and Agreements**

#### **3.7.1 Final Design Overview (FDO) Performance**

There has been a continued reduction in the number of FDO Red issue closures during the Period; but the closure rate must increase dramatically if CRL is to achieve its target for concluding the FDO process by the end of March 2018.

We believe that the targeted closure for all FDO certification by the end of March 2018 is unlikely to be achieved. Despite an increased rate of close out of FDO issues in Period 12, only 4 FDO Reports/Certificates have been issued to their respective IMs.

At the current rate of closure, the Red FDO issues will not be closed until late April 2018:

- 83 “Red” issues have now been closed or downgraded to “Amber” (72 in Period 11);
- 18 Ambers were closed in Period 12 (35 in Period 11);
- A total of 172 Red issues remain open (255 in Period 11); comprising 108 for Stations, Shafts and Portals (163 in Period 11) and 64 for Systemwide (92 in Period 11);
- Progress on closing red issues raised by RFL-I continues, but the rate of closure is slowing. Of the 420 Red issues raised, only 260 have been closed. Closure of a considerable amount of issues are dependent on evidence being made available that should have been considered during the design process. Without this evidence, it is very difficult to determine if what has been built is sufficiently operable, maintainable or safe. This could potentially add risk to the Crossrail opening date.
- A series of review meetings between CRL’s Technical Director and RfL, held during the period, have helped to significantly reduce the number of Reds that CRL had proposed as closed and were awaiting RfL review. A further 89 (133 in Period 11) issues have been proposed closed to RfL;
- Limmo shaft, Victoria Dock portal and North Woolwich portal have cleared all of their Red issues during the period and FDO reports and certificates were issued to RfL for acceptance;
- Tottenham Court Road and Fisher Street shaft now have zero Red issues and the FDO Reports and Certificates are in the process of being finalised;
- Good progress has been seen on shafts and Systemwide this period, with 22 and 28 reds closed respectively;
- The IA meeting was held for Custom House station. The IA certificate for Victoria Dock portal was signed.

#### **3.7.2 Interoperability**

Ricardo Rail (RR) remain concerned regarding CRL’s programme, however we understand CRL have made some progress on this issue during the period<sup>13</sup>. We will report on this in Period 13.

RR, acting as CRL’s NoBo, reports that design assurance is progressing in line with the agreed programme. However:

<sup>13</sup> As reported by CRL Technical Director at Sponsor Board 22 March 2018.

- There is still a small amount of outstanding evidence to be provided on the completed design stage ISV's;
- There is no indication when Test and Commissioning evidence will start to be provided;
- [REDACTED]

RR, acting as CRL's AsBo, reports major concerns relating to the finalisation of the Safety Assessment Report (SAR) in 5 months. These concerns are summarised as follows:

- System Definition and System Safety Plan have yet to be finalised;
- There is still no clear and agreed submission schedule for the formal supply of all remaining evidence;
- There is no programme for the essential CRL/contractor and AsBo interactions, necessary to achieve a supportive condition;
- Continuity of CRL resource for final evidence delivery to the AsBo.

The AsBo's current summary concludes, in respect of progress to a supportive SAR, that:

- The SAR-P was not supportive;
- The SAR-S is now at significant risk that it will not be supportive;
- There is an increasing risk that the Final SAR will be unable to support APIS.

The AsBo has urged CRL to commit to the required actions identified for each of the concerns summarised above. The time to address these issues is running out.

### 3.7.3 RAB(C)

RAB(C) has a dual role on Crossrail, acting separately as the CRL and as the RfL-I Safety Review Panel. Examples of the types of documents that RAB(C) was established to routinely consider are: permanent works safety submissions (such as Engineering Safety Justifications) on behalf of CRL; and strategic operations and maintenance documents, as part of the organisational development of RfL-I as an Infrastructure Maintainer. RAB(C) meetings have provided a good indication of Crossrail assurance progress, and we have reported in the past on the increasing backlog of planned submissions. Recent panel meetings have prioritised the review and acceptance of safety documentation associated with energisation, testing and commissioning, with the sometimes multiple reviews necessary before acceptance, compounding the workload of the panel.

It is now apparent that the same indications of serious schedule delay that are visible elsewhere in the assurance chain (described throughout Section 3.7) are showing in the RAB(C) submissions schedule. RAB(C) has expressed a willingness in the past to meet more frequently in order to address the backlog, but CRL seems unable to produce the documents at the required rate. To some extent this is understandable, given the dependence upon contractors' inputs and the fact that many key submissions will rely upon evidence from testing and commissioning, which is in obvious delay. However, while it is perhaps easier for the focus to be on the more tangible physical works, a huge residual assurance workload is accumulating.

We will monitor the production of Engineering Safety Management submissions for the Stage 3 Safety Case using Figure 3 - 4. These documents are critical to the achievement of Stage 3 Opening.

No	Key Dates	MOHS 2018	Period 12 actual / forecast
1	Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	31-Mar-18
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	30-Apr-18
4	Contractors submit final ESJs to CRL	30-May-18	30-May-18
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	07-Jun-18
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Jun-18
7	Final COS Safety Case updated and submitted to RAB-C	31-Aug-18	31-Aug-18
8	Submit Technical File to ORR	17-Sep-18	17-Sep-18

**Figure 3 - 4 ~ Engineering Safety Management Submissions for Stage 3 Safety Case**

**3.7.4 Regulatory Approvals**

There are eight approvals that CRL is tracking for Stage 3. All are green with the exception of one, ‘ORR issue APIS for Central Section to CRL’, which is amber. CRL has therefore continued to rate the status of achieving regulatory approval for Stage 3 as ‘amber’ overall.

We remain concerned at this grading, due to the problems described earlier in this section concerning the pace of submissions to RAB(C), and the outlook held by CRL’s AsBo. Their activities contribute to the Technical File that needs to be submitted to the ORR.

CRL is in dialogue with the ORR, and is contemplating a staged submission to try and mitigate any delays. That approach could retain momentum, but does introduce further managerial demands upon the approval process.

**3.7.5 Agreements**

The slippage of the recently re-baselined critical Agreements programme has continued in Period 12. There has been commitment from NR in this period to progress the Umbrella Property Agreement, which will include the South East Spur, Paddington Station and the Portals.

See charts in Appendix D.1.

**3.8 Rolling Stock**

The development of the train software continues, but there have been problems with meeting some of the MOHS dates. The mode ‘All CBTC functionality’ was scheduled to complete on 2 March 2018, but is now forecast for 13 April 2018. This will put pressure upon the Zone 1 and 2 EDT. There has also been slippage in the MOHS activity ‘4 trains ready for DT Z3&4’. It was forecast for 23 March in Period 11, and now 9 May in Period 12. At this stage this is principally due to slippage in the DT Z3&4 forecast, meaning the trains are not required for the March date.

In addition, we have concerns whether there will be sufficient Rolling Stock to fully operate the Trial Running Period. This is not a concern regarding the manufacturing rate, but with the acceptance process. The 15 RLUs were expected to be accepted between April and September 2017; currently 13 have been. RfL is expecting to accept 22 FLUs in a similar period as originally envisaged for the RLU’s, so it must ensure the process between it, BT and MTR-C runs as smooth as possible.

**3.9 Handover**

We reiterate our comments from our Period 11 report, in that all four components of Handover most relevant to the IM O&M functions continue to be critical, with the rate of improvement below what it needs to be to enable IM readiness for Trial Running.

**Training**

The training programme has been hampered by poor quality of training materials, training modules and cancellations, and there is a recognition that it will not be completed on time. For example, in this Period 23 sets of training materials were received from a planned 74, and 11 courses from a planned 36 were given. CRL’s forecast for completion of training materials has now slipped from 5 May to 30 May 2018.

To mitigate this, RfL-I will try to prioritise safety critical courses, predominately in the C600 series of contracts. If this is not, successful then the contractors will need to enter care and custody arrangements. What the implications are for the Trial Running period will need to be addressed.

**O&M manuals**

There has not been any significant progress in this period. It is estimated that circa 800 manuals are required, of which 4 have so far been accepted by IMs. O&M manuals are critical for IMs to demonstrate their ability to operate the railway.

**Spares**

The situation concerning Spares is much as we described in our last report. The IMs now believe that the lack of information on secondary spares (e.g. those with 3 month lead time to buy) is now becoming critical if they are not informed in time as to what and how many are required.

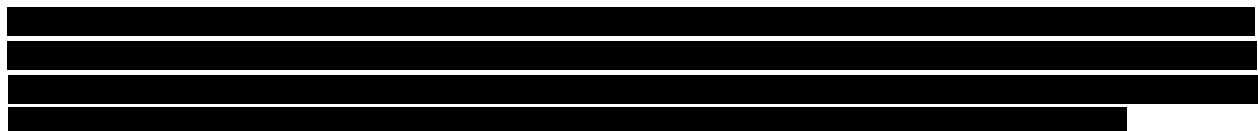
**Asset Information**

The MOHS schedule date for IMs to receive their first of two tranches of information<sup>14</sup> was 1 March 2018. It has now been re-forecast for 30 March 2018. We think this delay will prove longer, which will lessen the time available for the IMs to digest the material.

In summary, the issues described above have become more critical during Period 12, and are likely to now impact upon how IMs prepare for Trial Running.

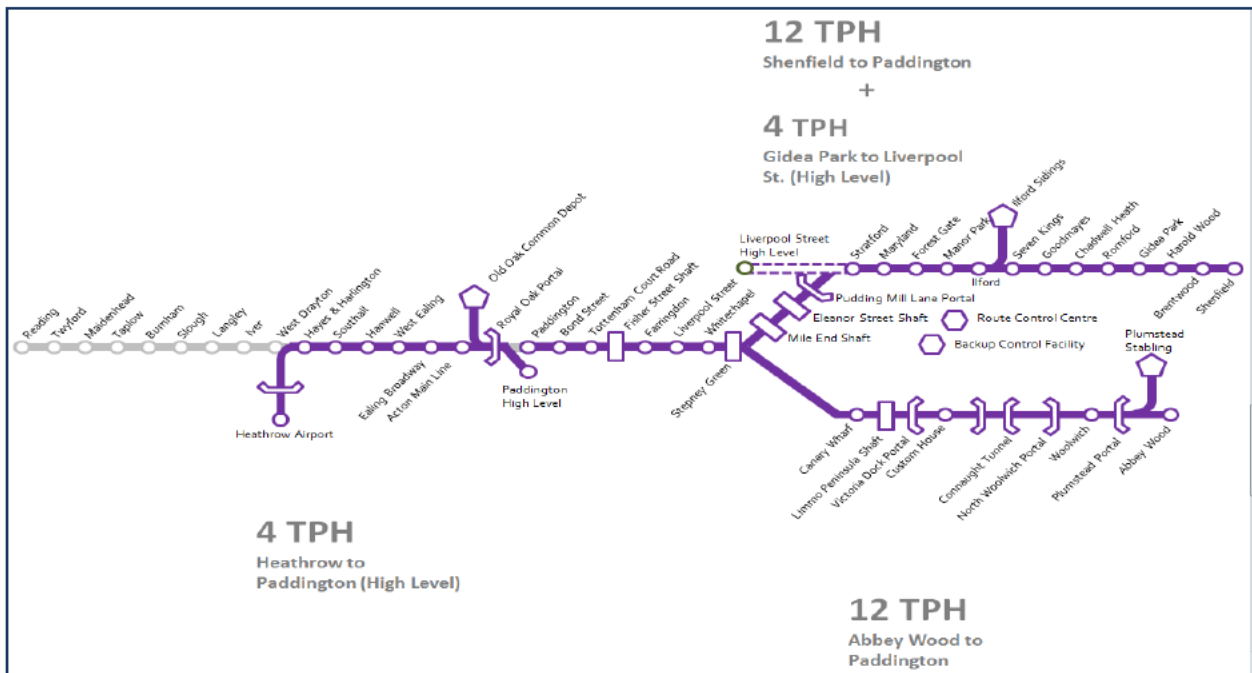
**3.10 Trial Running and Trial Operations**

We have explained in both Sections 3.2 and 3.9 the pressures that are likely to impact upon these phases of the project.



<sup>14</sup> The first tranche to RfL essentially explains how many assets there are, where they are and what they are. The second tranche explains the attributes of the equipment.

**4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.**



**4.1 Summary**

Although there are a number of risks relating to Stage 4, apart from the late completion of Ilford Station redevelopment, they are all being mitigated by CRL and NR.

**4.2 Operational Readiness Assessment**

There are five Readiness Tasks that have been given a “Red” status by the ORSG<sup>15</sup>.

Readiness Task	Issue
Wire height alignment corrected to standard in Ilford Depot	The scope has been approved and funded by CRL. Awaiting a formal programme from NR, which will require engagement with GE. We are concerned at the rate of progress.
KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	The works have little schedule float. Full ATS is required by March 2019, but CRL PDB Stage 4 dashboard indicates this has slipped to May 2019. NR Period 12 reports maintain a March 2019 completion date, but indicate red RAG status. CRL are in discussion with NR to resolve.

<sup>15</sup> 26 February 2018.

	Readiness Task	Issue
	PML Eastbound Neutral Section Transition (incl Packet 44 data)	[REDACTED]
	Ilford Station Redevelopment	NR is forecasting Ilford Station to be open by December 2019. See Section 4.5.
	<b>NEW</b> DOO CCTV installed and operational Stratford and Shenfield stations	There are difficulties with the operation of DOO CCTV at Shenfield due to opposition by GA, and with siting cameras at Stratford

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with "Red" Status

### 4.3 Ilford Depot Line Speed Enhancement and Wire Heights

CRL has described the work<sup>16</sup> associated with Ilford Yard OLE Wire Heights to be split into three phases which are proposed to be delivered under seven packages:

- Phase 1; the critical element of Country end and C828 throat is under Phase 1, comprising three work packages. In total, twelve roads are required to stable Class 345 stock at Ilford. Phase 1 will provide 10 roads dedicated for Class 345 stock. The two additional roads will be provided by the depot from whichever road is available contemporaneously within the depot. Consequently, the OLE wire height will need to be lowered across the whole depot to permit stabling of Class 345 stock;
- Phase 2; London End;
- Phase 3; Main part of the AGA Depot.

Although CRL has favoured the full scope of depot requirements, this has been revised to proceed with Phase 1 only and re-assess Phases 2 and 3 requirements to rationalise the scope with the depot or explore alternate operational performance of a ten road stabling provision with MTR.

CRL regards the wire heights at Ilford Depot to be instructed additional work and confirmed that these are not included in the ONW works, as depots are not considered to be part of the national rail network.

GAF is reporting that it requires more detailed consultation with CRL / NR on the project. We would advise CRL to do this soon, in the light of the issues that arose in preparing Ilford Depot prior to Stage 1.

### 4.4 Plumstead Depot

Issues regarding land handover and the procurement of the Sidings works [REDACTED] continue to be managed by CRL. We expect a paper to be submitted to C&CSC soon regarding the latter.

<sup>16</sup> C&CSC 6 March 2018.



#### 4.5 Ilford Station

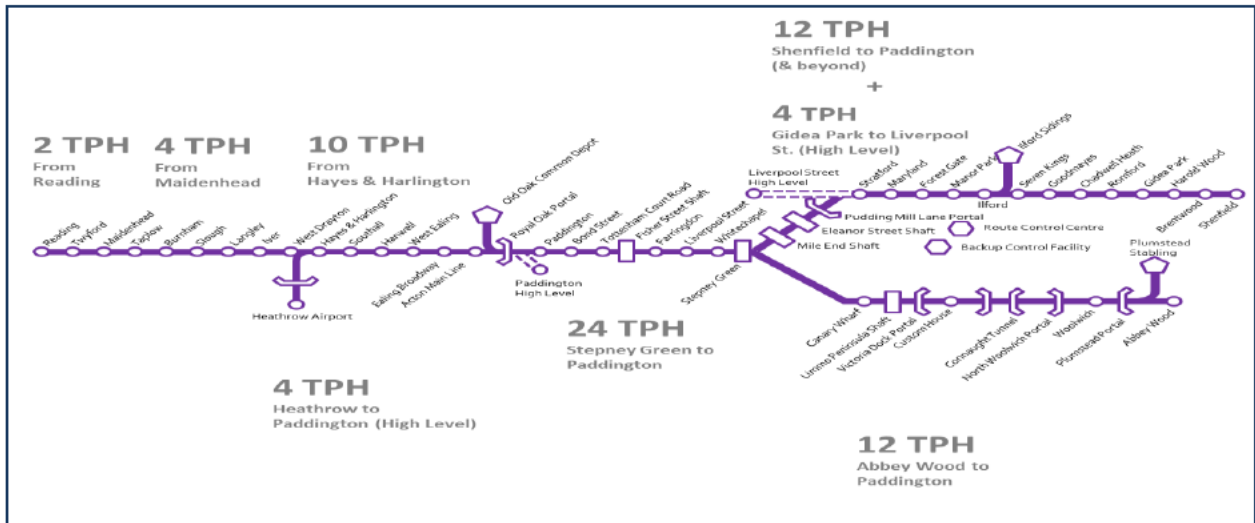
NR reports that it is currently undertaking internal governance with regard to awarding the delivery contracts and remains committed for station opening for December 2019. However, CRL reports that the design [REDACTED]

[REDACTED] NR reports that the GRIP 5 Design contract is due to be let in April 2018<sup>17</sup>.

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<sup>17</sup> April 2018 date confirmed at NR P12 PDB, CRL P12 Board Report incorrectly states January 2018.

**5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.**



**5.1 Summary**

Although there are a number of concerns, these are being mitigated. The principal issue is the possibility of delay to NR’s ETCS installation programme, and what that might entail if the existing derogation is not extended.

**5.2 Operational Readiness Assessment**

There are four Stage 5 Readiness Tasks that have been reported as a “Red” status to the PDB on 13 March 2018.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	NR’s programme has little schedule float. There is unlikely to be enough time to complete driver training as currently programmed. If ETCS is not available then there is a technical solution that will enable CBTC to TPWS transition, but this will require ORR to extend the existing derogation. See Section 5.3.2.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019, with little float available. See Section 5.3.1.
Maidenhead Sidings complete for C345 FLU stabling inc staff accommodation	The issue concerns staff accommodation. We would like to see more progress to ensure an important facility is available on time. See Section 5.3.1.
ORR issue APIS for ETCS (Stage B & C)	Linked to ‘ETCS available and tested airport Jn’ task.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

**Figure 5 - 1 ~ Readiness Tasks with "Red" Status**

## 5.3 Network Rail Works

### 5.3.1 Platforms and Stations

NR reports that the Maidenhead Station GRIP 4 design IDC is scheduled for 28 March 2018, which includes staff accommodation, with GRIP 4 stage gate acceptance expected in April 2018. Following the discussions between CRL and NR in respect of the implementation strategy, the delivery of staff accommodation for Maidenhead, Shenfield and Gidea Park is proposed to be de-scoped from the NR ONW works and carried out by CRL. Final arrangements will be clarified by CRL in Period 13.

NR has reported a further two week delay with the procurement for West Enhanced Stations Main Works Package 3 (Southall, Hayes and Harlington, and West Drayton). Consequently, NR has amended the tender return date to 23 March 2018, with Contract award scheduled for 20 June 2018.

NR also confirms that procurement for West Enhanced Stations Main Works Package 2 (Acton Mainline, Ealing Broadway, and West Ealing) remains on schedule for a tender return date of 16 April 2018 and Contract award for 11 July 2018.

NR has confirmed<sup>18</sup> that the detailed design for Hayes & Harlington, Southall, West Drayton, Acton and West Ealing is expected to achieve Approved for Construction status (AFC) for April 2018.

NR reports that additional Advanced Works are planned at Ealing Broadway, Hayes and Harlington and Acton Mainline to utilise possessions prior to main works Contractors commencing.

NR continues to report to be on schedule for all stations to be open by December 2019.

### 5.3.2 ETCS Delivery on the GWML

#### **Stage A (Heathrow):**

Alstom's Safety Justification Report has been accepted with comments that will be closed out in NR's Safety Justification Report. Presentations will be made to the Safety Review Panel in April 2018, to achieve a May 2018 Authorisation to Place into Service (APIS). An extension request for Heathrow Implementation Agreement 4 (HIA), Dynamic Testing, has been received from CRL and is being reviewed by NR. NR has reported that BT has arrived in Charleroi without the required equipment to undertake laboratory integration testing. Consequently, NR is reporting that BT may not be able to fulfil HIA5 (ETCS Laboratory Testing) within the contracted timescales without impacting the Stage B/C programme. The BT remit for HIA5 is due to expire at the end of March 2018. NR is currently evaluating whether a workable alternative can be accommodated without impacting on Stages B&C testing.

#### **Stages B & C (Stockley-Acton & Acton-Paddington):**

NR reports that Investment Authority was granted on schedule and the delivery Contract let to Alstom. The contract kick-off meeting was held on 28 February 2018 and NR is currently reviewing the programme recently received from Alstom.

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<sup>18</sup> ONW PDB 20 March 2018.

NR has commenced and has briefed the ORR on the further safety assessment required for a short-term extension to the ORR exemption in order to provide a contingency to schedule prolongation. NR has identified the key risks as follows:

- CBTC interface requires further design integration and to define specific dynamic testing requirements;
- Configuration and management of conventional signalling changes and ETCS scheme design need to be co-ordinated;
- Interface with other projects, such as HS2.

Consequently, NR is arranging a risk review with key stakeholders to establish key technical and schedule risks to December 2019 completion.

## 6 Health & Safety

### 6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI reduced slightly during Period 12, to just below its highest ever score.

The RIDDOR did not change, and the lost time case AFR decreased slightly. Both measures remain well within target.

H&S KPI	Target	Period 11	Period 12
HSPI	2.20	2.60	2.57
PCs scoring over 2.20	11	11	11
RIDDOR AFR	0.15	0.08	0.08
LTC AFR	0.23	0.17	0.16

Figure 6 - 1 ~ Health and Safety Performance COS

During Period 12 there were 6 significant incidents including 4 High Potential Near Misses (HPNM). One of these at Whitechapel on 20 February 2018 involved operatives about to cross the track without the necessary paperwork being completed correctly. Fortunately fail safe procedures enabled them to be removed. However, a more serious HPNM occurred on the trace on 12 March 2018, after the Period end. This led to a test train entering an earthed section of the tunnel west of Canary Wharf, resulting in damage to the overhead conductor and delay to Dynamic Testing, but no injuries; see Section 3.5.2. This should not have happened, and the CRL Director of Health & Safety will be carrying out a full investigation.

### 6.2 Health & Safety Performance ONW (NR)

During Period 12, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) has decreased slightly to 0.1794. This is due to no LTIs during Period 12. The Programme's overall All Injury Rate has dropped once again, and is currently 0.83 injuries per 100,000 hours worked.

NR recorded four minor injuries in Period 12 requiring on site first aid. Ten other safety incidents and significant close calls were reported in Period 12, including three disturbances of services and a Mobile Electrical Working Platform (MEWP) exceeding the site speed limit.

## 7 Cost

### 7.1 Summary

The Intervention Points have not changed and the AFCDC has increased by only £3m during Period 12. We expect IP2 to be breached at Period 13 (SACR19) following the QCRA review.

*IP0, IP1 and IP2 have not changed in Period 12.*

*The AFCDC (P50) has increased by £3m to £12,467m.*

*The P80 AFCDC is £12,510m.*

*The P95 AFCDC is £12,550m.*

*The AFCDC (P50) exceeds IP1 by £555m, with only £45m headroom to IP2.*

*We expect IP2 to be formally breached at Period 13 (SACR19) following the QCRA review.*

*The QRA reduced by £75.2m to £244m.*

*£291m of the £244m P50 risk exposure is URTs.*

*Analysis of defined cost and target cost still continues to show an increasing trend in both.*

*The ONW FFOC remains at £2,396m.*

*The CRL ONW AFC, excluding VNs, remains at £2,376m.*

### 7.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 12. CRL has reported a small increase of £3.1m to the AFCDC, mainly due to Systemwide interfaces and additional scope for temporary tunnel ventilation at Portals and Shafts. At Period 12, CRL is reporting the P50 AFCDC as £12,467m, the P80 AFCDC at £12,510m and the P95 AFCDC at £12,550m. We regard the increase to be conservative given the circumstances of known and probable cost increases suggested by CRL, reporting of AFC increases in its Period 12 NSACS report and the over subscribed risk provisions in the event all URTs are resolved. We expect IP2 to be formally breached at Period 13 (SACR19).

The CRL Period 12 AFCDC (P50) exceeds IP1 by £555m, with only £45m headroom to IP2. The AFCDC (P80) is £598m above IP1 and only £2m under IP2. The AFCDC (P95) exceeds IP2 by £38m.

(£ millions)	Period 11	Period 12	Delta	Movement
<b>Forecast</b>	<b>12,144</b>	<b>12,223</b>	<b>79</b>	up
Delivery Risk	12	5	-7	down
Programme Risk	304	235	-69	down
Board Risk	4	4	0	same
<b>AFDC total</b>	<b>12,464</b>	<b>12,467</b>	<b>3</b>	up
IP0	11,672	11,672	0	same
<b>IP0 Headroom</b>	<b>-792</b>	<b>-795</b>	<b>-3</b>	down
IP1	11,912	11,912	0	same
<b>IP1 Headroom</b>	<b>-552</b>	<b>-555</b>	<b>-3</b>	down
IP2	12,512	12,512	0	same
<b>IP2 Headroom</b>	<b>48</b>	<b>45</b>	<b>-3</b>	down

Figure 7 - 1 ~ AFDC (P50) Headroom to Intervention Points

During Period 12, the QRA reduced by £75.2m to £244m to fund the following changes:

- ██████ (£42.1m), ██████ design changes;
- ██████ (£20.2m), ██████ interfaces and prolongation, lower than planned productivity, and delays to installation and Dynamic Testing and ██████ S ██████ due to the amended resources schedule;
- ██████ (£5.4m), for remedial works at ██████ Station;
- ██████ (£3.8m); ██████ interfaces at the Intermediate Shafts and additional scope for temporary tunnel ventilation;
- Other net drawdowns (£3.7m).

The Period 12 QRA includes a provision of £25m for Programme Non-delivery Risk, which leaves £219m to fund URTs. CRL is reporting URT's at £291m for Period 12, leaving a QRA shortfall for URTs alone of £72m. The CRL Period 12 NSACS is showing an AFC increase of £189m. Although not directly linked to the AFDC, this provides an indicator of potential forthcoming order of magnitudes in respect of cost increase exposure. Consequently, we are expecting a considerable step increase in the Period 13 (Q4) QCRA.

CRL is reporting at Period 12 the bizarre circumstance where £291m of the £244m P50 risk exposure is URTs, an increase of £110m from Period 11 (£181m) and £47m in excess of the QCRA provision. Consequently, pure risk, excluding URTs, has decreased in Period 12 from £138m to minus £47m. The percentage of pure risk as a proportion of cost to go (including URTs) for Period 12 has fallen by 26% in the period to minus 6%. The overall effect is that the Period 12 contingency and risk figures lack credibility. We are concerned that the risk allowances provided in Period 12 are erroneous and should be revised by CRL in Period 13 QCRA, especially as CRL intend to disband its risk management team in May 2018 and reduce risk reporting overall.

CRL is completing its Q4 QCRA Risk Review on 9 April 2018 which it intends to include defined cost reviews for ██████. CRL is also undertaking earlier risk reviews in Period 13 for ██████ and ██████. We would recommend that all Contracts and the CRL 'book end' cost review, presented to JST on 20 March 2018, are included in the QCRA review. We have requested attendance at these reviews but CRL wish to conduct this QCRA without Project Representative attendance<sup>19</sup>. We will review the CRL Q4 Period 13 risk modelling and report in due course.

<sup>19</sup> Email dated 27 March 2018 from CRL Programme Controls Director.

CRL continues to seek cost efficiencies and to challenge contractors costs in its attempt to remain within funding, but we continue to note the following:

- The AFCDC (P50) continues to rise and further increases are likely as evident from CRL inadequate risk allowances;
- The headroom to IP2 for the Period 12 AFCDC (P50) is £45m and URTs at Period 12 are £47m in excess of the QRA;
- The analysis of defined cost and target cost still continues to show an increasing trend in both with CRL assessments of defined costs still rising towards the contractors estimates. See Section 7.3;
- CRL is reporting that the programme is over 90% complete and entering the safety critical stages of testing and commissioning. Therefore, realistic prospects for major cost savings by reviewing the remaining scope at such a late stage, without compromising the necessary safety and procedural requirements of many complex interactive interfaces, is highly improbable.

Figure 7 - 2 indicates the cumulative delivery overspend at each period.

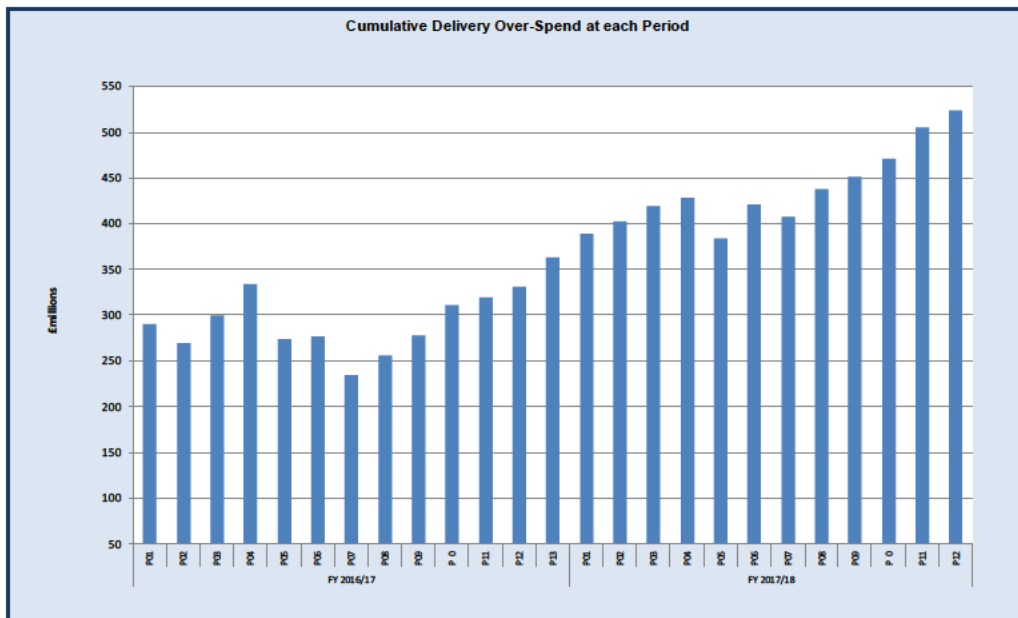


Figure 7 - 2 ~ Cumulative Delivery Overspend at each Period

The cumulative delivery overspend has increased in Period 12 by £19m to £524m (Period 11, £505m). CRL reports that spend and performance in Period 12 continues to be dominated by Stations and Systemwide Sectors, together accounting for 82% of Delivery’s Cost of Work Done in Period 12.

CRL reports that, in Period 12, it spent £67.4m above the 2017/18 Business Plan. This is mainly due to:

- Lower than planned productivity, access delays and prolongation at [REDACTED] (£17.7m);
- Ongoing prolongation and delays at [REDACTED] 12.0m);
- Changes to the Masterplan Shaft sequence and prolongation at [REDACTED] (£8.1m);
- Prolongation, scope changes and design cost increases at [REDACTED] (£7.4m);
- Other net overspends (£33.0m).



This expenditure was offset by £10.8m of apparent unspent Programme risk due to cost being reported in the Sectors.

### 7.3 Cost: Central Operating Section (COS)

Sponsors have commissioned an independent review of the CRL cost and risk assessment following its disclosure regarding the potential threats to exceeding IP2 and meeting MOHS 2018 completion dates. CRL has received Board Approval of its cost and risk assessment and has yet to present the detail of the review and high level findings to PRep.

[Redacted text block]

- [Redacted list item]
- [Redacted list item]

[Redacted text block]

[Redacted text block]

[Large redacted text block]

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]

#### 7.4 Cost: On Network Works (ONW)

There has been no change to the ONW FFOC in Period 12, which remains at £2,396m. The CRL ONW AFC, excluding VNs, remains at £2,376m in Period 12. The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,325.6m, which exceeds the DfT Invention Price of £2.3bn by £25.6m.

Figure 7 - 4 indicates the relevant breakdown.

Description	Period 11 £m	Period 12 £m
CRL AFC Excluding VNs	2,376	2,376
VN Funding	154	154
<b>CRL AFC Including VN's</b>	<b>2,530</b>	<b>2,530</b>
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
Total Cash Funding	134	134
<b>FFOC</b>	<b>2,396</b>	<b>2,396</b>
Pain/gain share	-70	-70
<b>Forecast to RAB</b>	<b>2,326</b>	<b>2,326</b>

Figure 7 - 4 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

##### 7.4.1 ONW Funding

CRL has reported that the total AFC and Variations funding for NR ONW is unchanged from Period 11 and remains at £2,530m for Period 12. This is in line with confirmed funding arrangements with Sponsors. NR is also reporting Total Secured Funding for NR ONW as £2,818.1m that includes confirmed CRL and NR sourced recoveries, efficiencies and opportunities, as shown in Figure 7 - 5. [REDACTED]

Description	P12 Source of Funding			
	DfT £m	CRL £m	NR £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0
CRL Managed Risk	110.0	-	-	110.0
Portfolio Board Funding	217.0	-	-	217.0
Approved £154m VNs	112.0	22.0	20.0	154.0
<b>NR Current Funding</b>	<b>2,488.0</b>	<b>22.0</b>	<b>20.0</b>	<b>2,530.0</b>
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]	[REDACTED]
<b>Sub Total</b>	<b>-</b>	<b>118.9</b>	<b>169.2</b>	<b>288.1</b>
<b>TOTAL SECURED FUNDING</b>	<b>2,488.0</b>	<b>140.9</b>	<b>189.2</b>	<b>2,818.1</b>

Figure 7 - 5 ~ NR ONW Secured Funding

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

These amounts are currently included in the 'Recoveries (Residual)' tabulated in Figure 7-6, NR ONW Cost Summary.

7.4.2 ONW Cost

CRL reports that the Grand Total Cost has not changed from Period 11 and remains at £2,818.1m for Period 12, with a mid-point sensitivity of plus £50.1m. Our analysis of the P12 Surface SDR Final report provides a different mid-value funding gap sum of £49.9m<sup>20</sup> – only a £0.2m difference which may be down to rounding errors, as shown in Figure 7 - 6.

Description	Period 11 £m	Period 12 £m	Delta £m	Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,894.3	2,894.9	0.6	2,865.9	2,916.9	3,004.2
Risk	14.4	0.0	-14.4	0.0	0.0	0.0
Efficiencies	-30.1	-24.3	5.8	-21.9	-12.2	0.0
Recoveries (Residual)	-55.0	-37.2	17.8	-32.2	-29.0	-18.6
Targeted Savings	-5.6	-15.3	-9.7	-13.8	-7.7	0.0
<b>Cost Grand Total</b>	<b>2,818.0</b>	<b>2,818.1</b>	<b>0.1</b>	<b>2,798.0</b>	<b>2,868.0</b>	<b>2,985.6</b>
Total Secured Funding	2,818.1	2,818.1	0.0	2,818.1	2,818.1	2,818.1
Funding Gap	-0.1	0.0	0.1	-20.1	49.9	167.5

Figure 7 - 6 ~ NR ONW Cost Summary

<sup>20</sup> Computational error noted to CRL - email PRep to CRL 14 March 2018.

NR continues to focus on cost control, however, in CRL's view, the most significant cost risks to the ONW are:

- [REDACTED]
- [REDACTED]

CRL is reporting reduction in efficiencies and recoveries and a significant increase in targeted savings for Period 12. As the programme draws to a close, the opportunity to achieve the reduction in efficiencies and recoveries is diminishing and NR is moving to remove them. Targeted Savings has always been an adjustment which CRL has consistently reported will be extremely challenging to achieve on top of other efficiencies. The threefold increase in targeted savings from Period 11 may be regarded to be ambitious.

CRL reports that it has begun implementing an interim final account plan with NR with a view to concluding the exercise in Period 13. CRL is proposing to reassess the ONW final account status in September 2018 when greater certainty of costs in line with the anticipated substantial completion of all ONW works, save for the West enhanced stations, is expected.

**7.5 Contingency**

CRL has reported that the Finance Current Control Budget has been increased in Period 12 to £12,507m due to a £151m increase in programme contingency to align with the P11 P80 AFCDC. The £12,467m AFCDC (P50) is consequently below the reported financial budget by £40m, but exceeds the RP4.2 Baseline funding of £12,136m by £331m. The Period 12 P80 AFCDC of £12,510m exceeds the FCCB by £3m.

CRL is reporting that the overall Period 12 contingency budget of £271m is sufficient to cover the P50 risk exposure of £244m by £27m (a £157m improvement from Period 11). CRL appears to have a contradiction in its reporting, as this does not take into consideration that CRL has reported separately that URTs are exceeding P50 risk provisions. At Period 12, URTs alone are £291m and a further £25m of risk is allocated to Programme Non-delivery Risk. Our assessment of risk exposure equates to £316m, suggesting that the Period 12 contingency budget is inadequate by £45m. The centrally controlled Delivery contingency at Period 12 has reduced by £1m to £47m.

Figure 7 - 7 shows the trend of the decrease in the Board and Programme Contingency and compares the Risk Exposure at P50 and P95 with the remaining contingency.

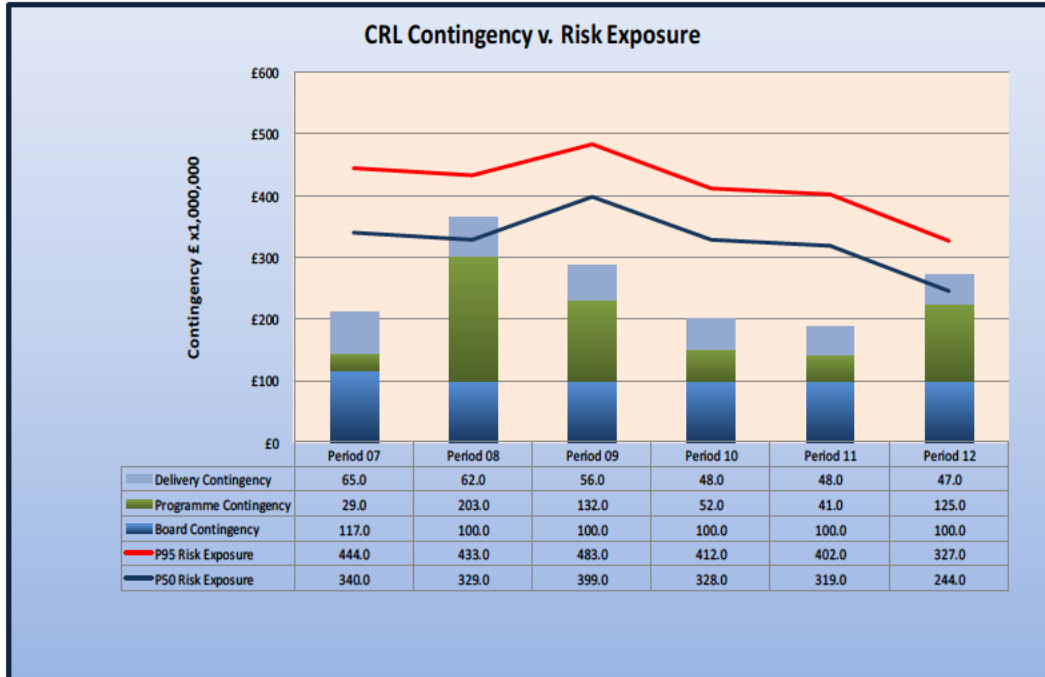
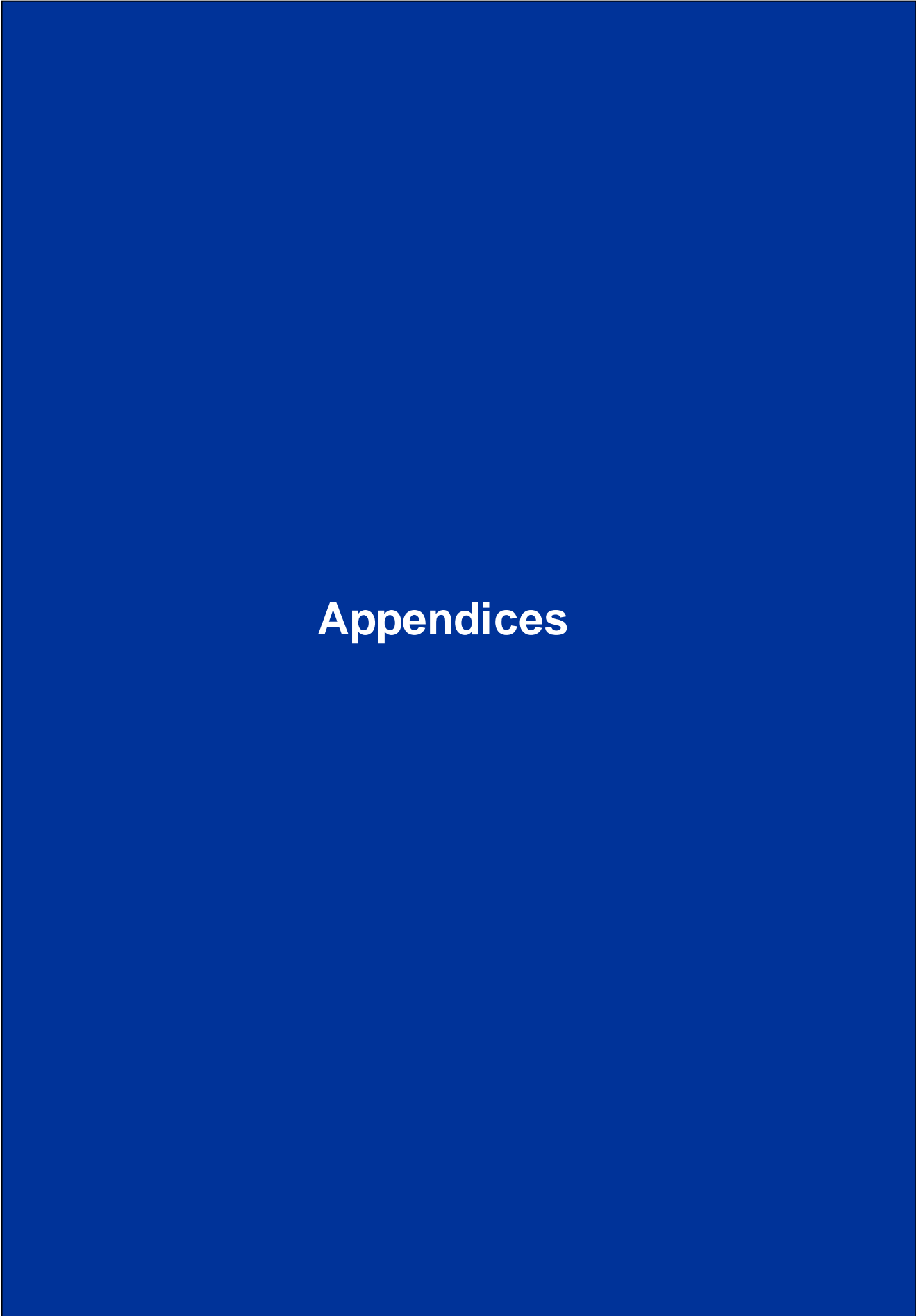


Figure 7 - 7 ~ Risk Exposure versus Contingency



**Appendices**

Appendix A Contract Administration

A.1 General

Figure A - 1, Figure A - 2 and Figure A - 3 illustrate the status of Notified Compensation Events (NCEs).

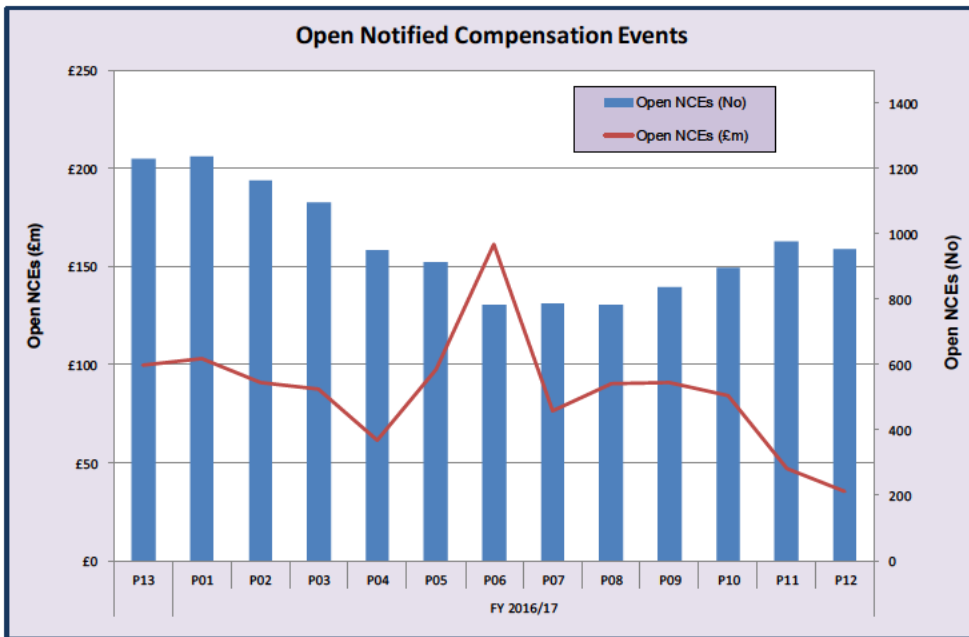


Figure A - 1 ~ Open Notified Compensation Events

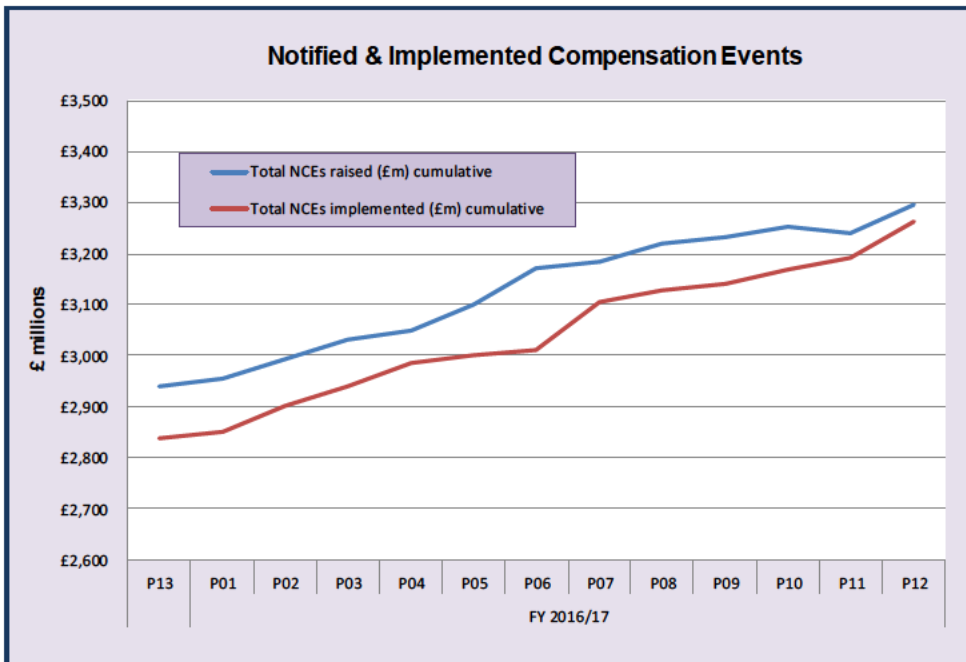


Figure A - 2 ~ Notified Compensation Events

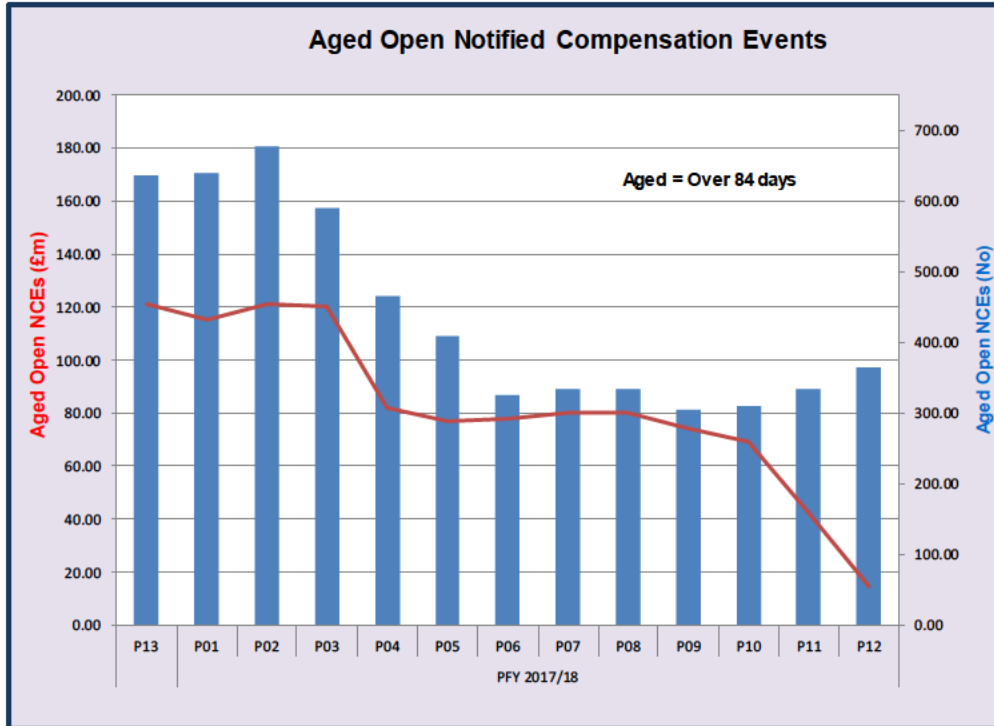


Figure A - 3 ~ Aged Open Notified Compensation Events

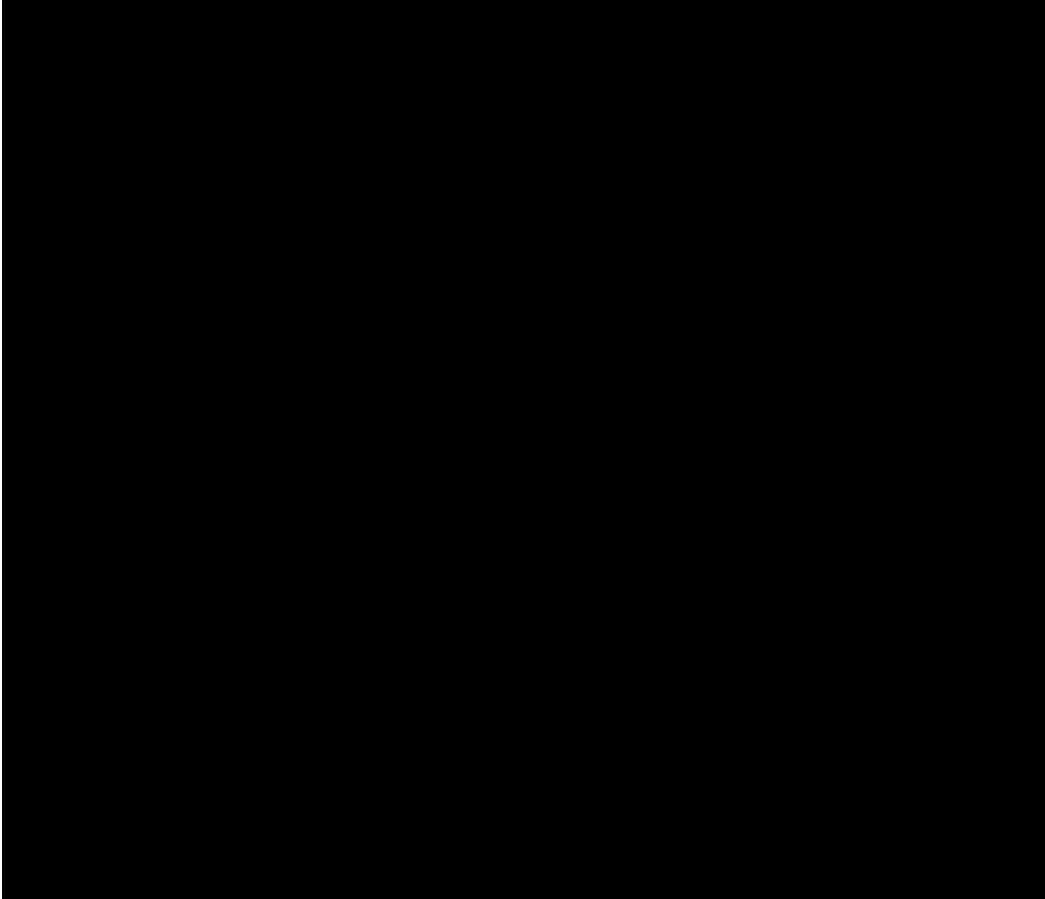
In Period 12, the total number of open NCEs decreased by 24 to 953 and the value of open NCEs also decreased by £12m to £35m.

Contractors notified a further 335 Compensation Events in Period 12; 359 were processed in Period 12, with 282 implemented and 77 either rejected or withdrawn. Aged open NCEs increased in Period 12 by 30 to 364, the percentage of aged open NCEs rising from 34% to 38% in Period 12.

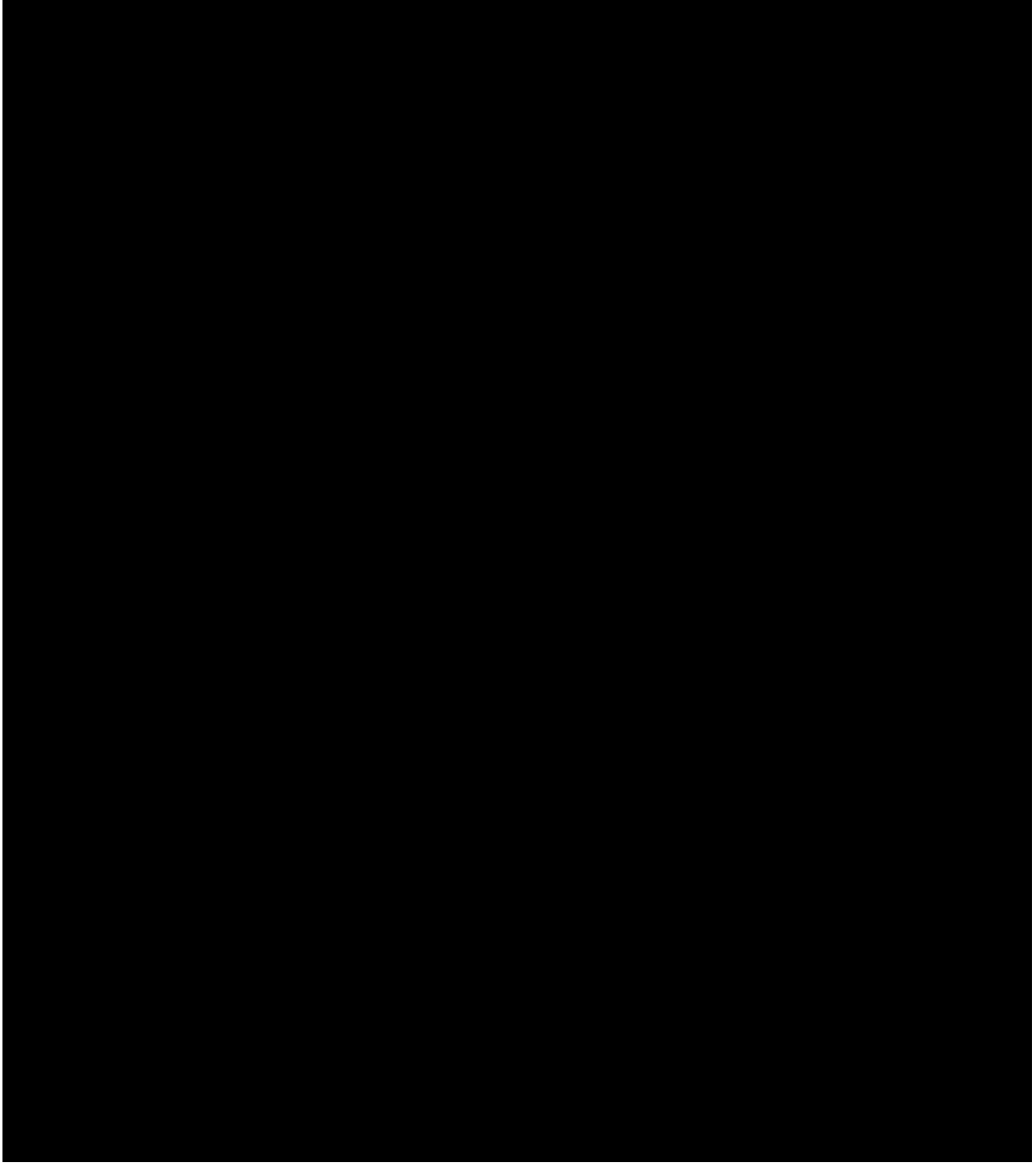


**Appendix B Schedule & Performance**

Figure B - 1 indicates the status of Anchor Milestones at Period 12 following the implementation of the new MOHS.



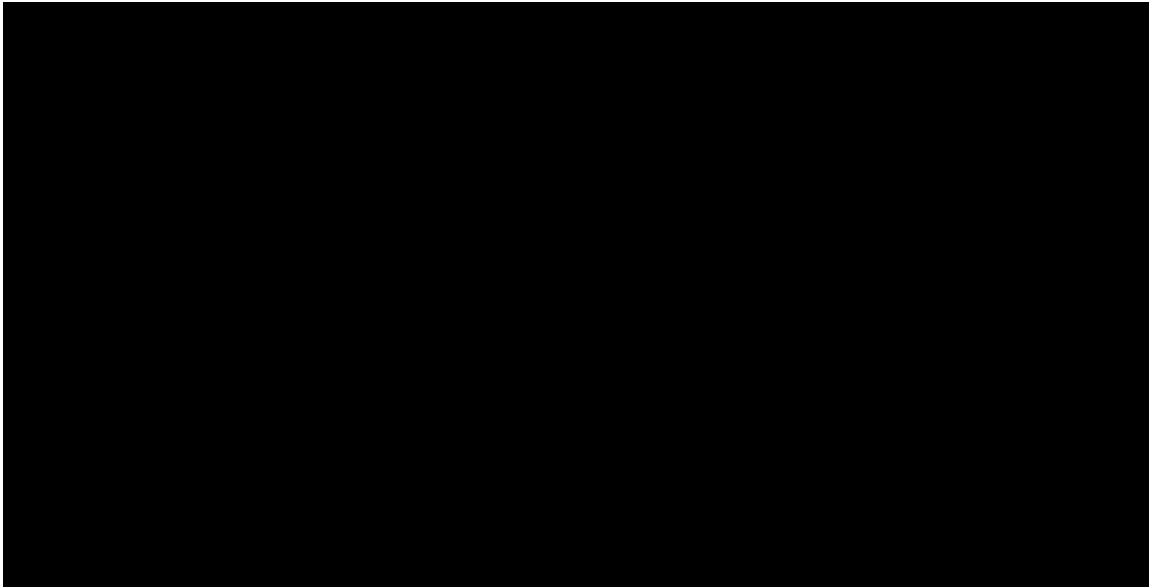
The charts at Figure B - 2 indicate progress of each Systemwide contract based on data received from CRL.



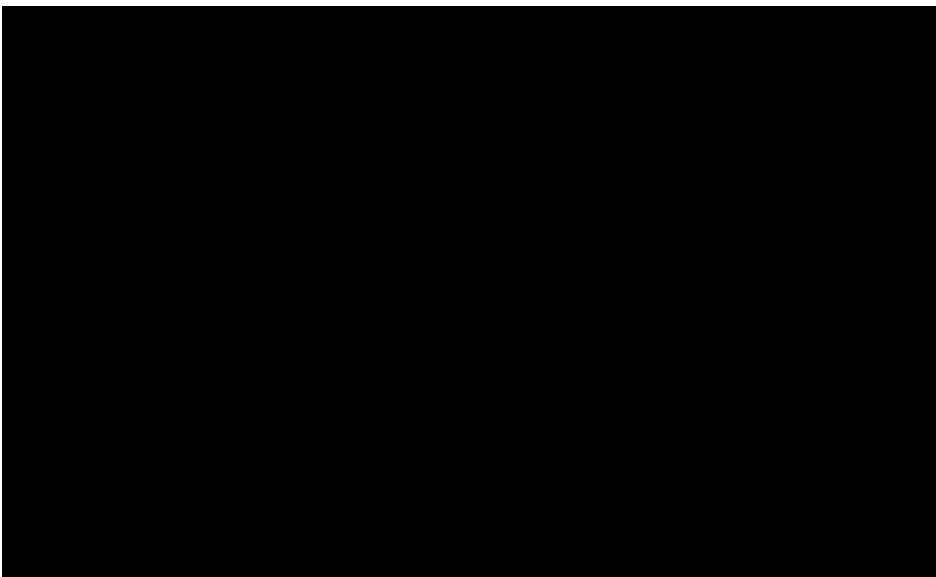
## Appendix C Stations

### C.1 Stations in the Central Section

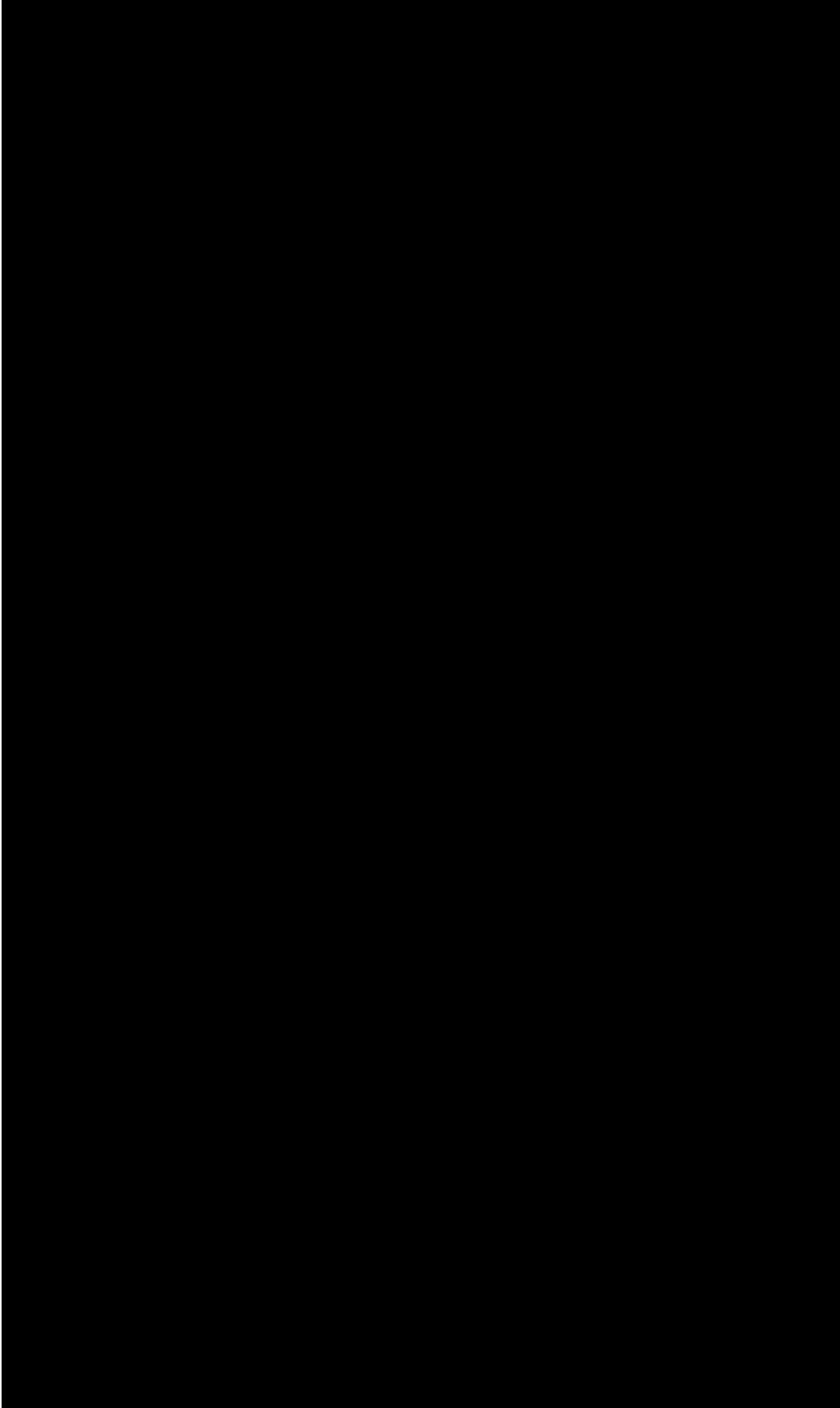
[REDACTED] [REDACTED] [REDACTED] The percentage completions are still closely re-aligned, following the re-baselining exercise for MOHS 2018 in Period 11. There are slight differences between the planned and actual percentage completion at some of the stations, but these are small and are currently absorbed by the rounding up of the reported percentages.

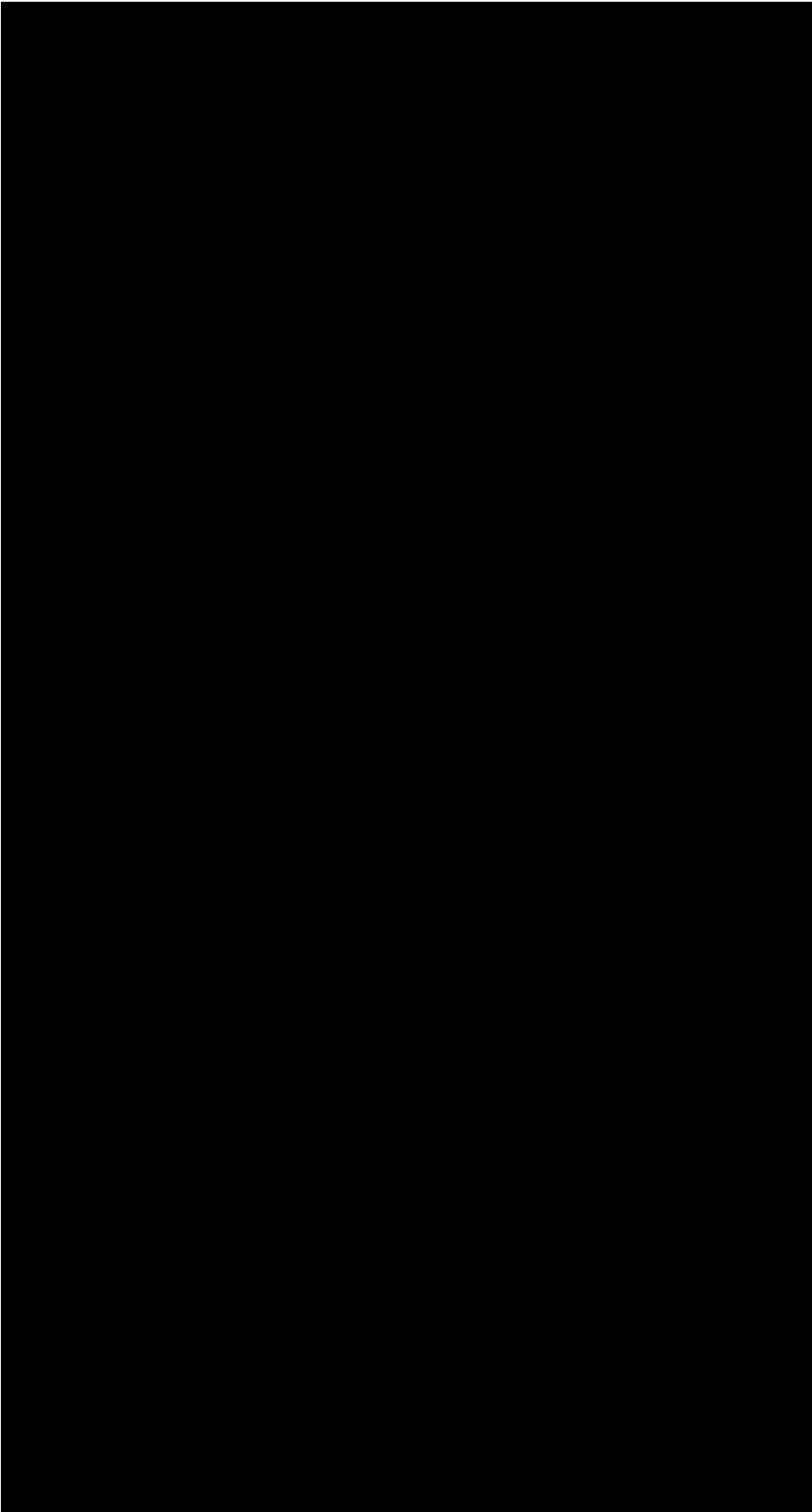


[REDACTED]  
[REDACTED]  
[REDACTED]



<sup>21</sup> Data has been abstracted from the CRL Period 12 (2017/18) station dashboards.





**C.2 Interface Works and Handovers**

CRL has reformatted and re-baselined its room and route handover (SLD) reporting, to focus on the acceptance of the remaining 67 SLD handovers. The resultant “SLDs to go” report, with the planned and actual progress of accepted room and route handovers in Period 12, is summarised in Figure C - 9 below.

The 67 remaining SLD handovers exclude the last of the C660 rooms/routes. These are now monitored separately under CRL’s C660 IRN tracker. The intermediate shafts (C360) SLDs have been added into the “SLD to go” reporting. The resultant total number of SLD handovers, to be achieved, has been reduced from 1035, as previously reported, down to 964 room/routes.

Contract	Location	Rooms & Routes Accepted					
		Total per Site	Accepted (No.)		Cum Handovers		Variance (%)
			Actual	Plan	Actual	Plan	
C405	Paddington	79	65	65	82%	82%	0%
C412	Bond Street	68	51	51	75%	75%	0%
C422	Tottenham Court Road	125	117	117	94%	94%	0%
C435	Farringdon	96	96	96	100%	100%	0%
C502	Liverpool Street	122	115	115	94%	94%	0%
C512	Whitechapel	98	94	94	96%	96%	0%
C530	Woolwich (CON, NWP, PLU)	110	110	110	100%	100%	0%
C350	Pudding Mill Lane	60	60	60	100%	100%	0%
CWS	Canary Wharf	30	28	28	93%	93%	0%
C360	Shafts	176	161	161	91%	91%	0%
<b>Totals</b>		<b>964</b>	<b>897</b>	<b>897</b>	<b>93.0%</b>		

*Figure C - 9 ~ Summary of re-baselined Systemwide accepted rooms/routes by location*

Farringdon and Woolwich stations and Pudding Mill Lane portal have now completed all SLD handovers. The re-baselining of the remaining planned SLDs has brought all of the remaining SLDs in line with plan. CRL has achieved 897 handovers against a planned 964 in the period, against the new baseline, representing 93% of the total required. The remaining room/routes “To Go”, by location, are summarised in Figure C - 10 below.

Contract	Location	Rooms & Routes "To Go"	
		Accepted (No.)	Cum Plan
		Cum Actual	
C405	Paddington	14	14
C412	Bond Street	17	17
C422	Tottenham Court Road	8	8
C435	Farringdon	0	0
C502	Liverpool Street	7	7
C512	Whitechapel	4	4
C530	Woolwich (CON, NWP, PLU)	0	0
C350	Pudding Mill Lane	0	0
CWS	Canary Wharf	2	2
C360	Shafts	15	15
<b>Totals</b>		<b>67</b>	<b>67</b>

*Figure C - 10 ~ Summary of cumulative actual and planned station room/route handovers “To Go”*

Appendix D Compliance and Assurance

D.1 Agreements

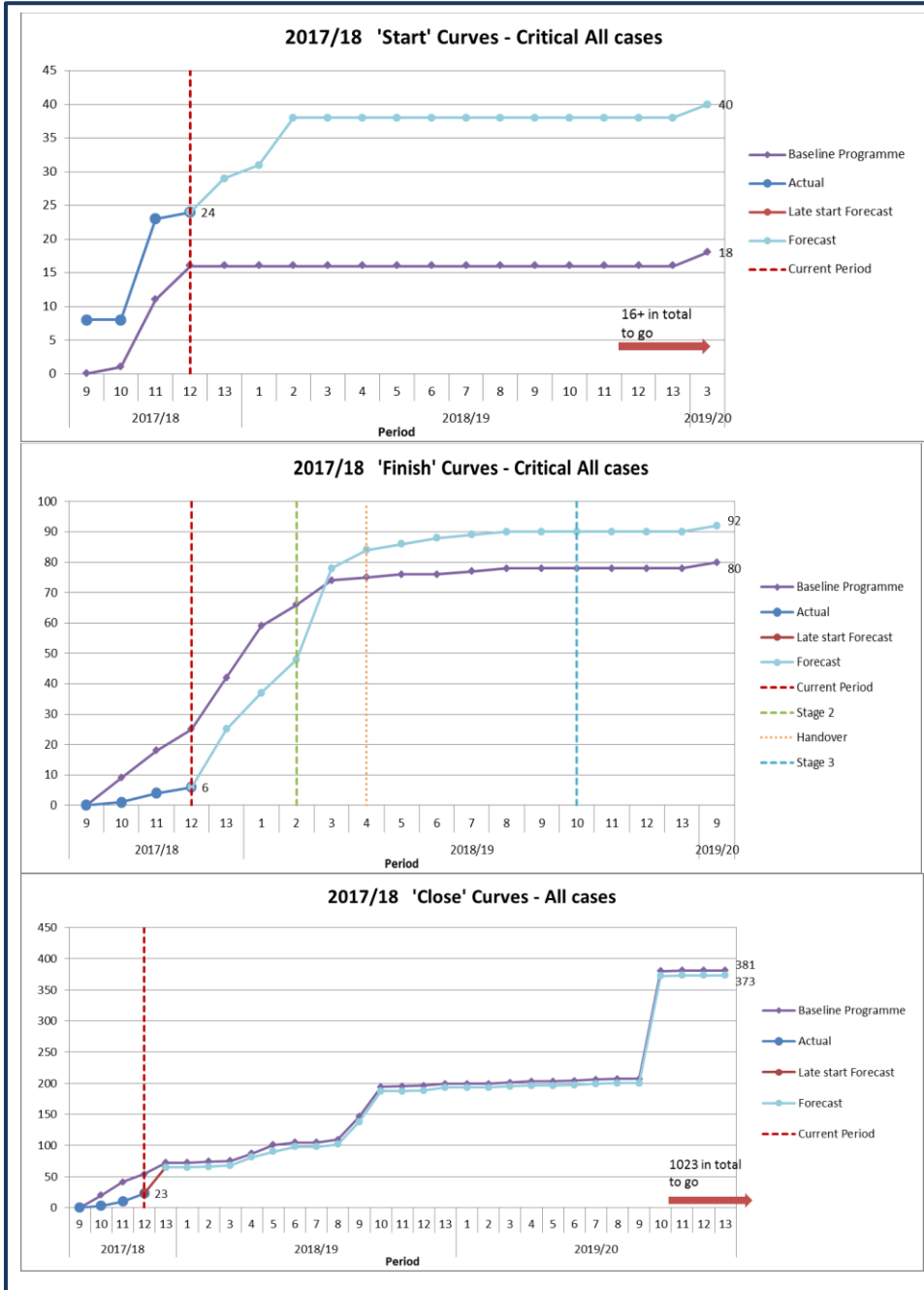


Figure D - 1 ~ 2017/18 Start, Finish & Close Curves

**D.2 Quality**

**D.2.1 Right First Time (RFT) and World Class (WC) Metrics**

The results for the quality metrics, shown below in Figure D - 2 remain generally good. However, there has been a decline for two of the metrics in the individual period. RFT3 registered 77%, and RFT4 82%.

The planned number of packages was behind schedule for the period. The Acceptance graph, shown in Figure D - 3, shows 175 were accepted. The total planned in P11 for P12 was 464. This activity looks likely to extend well into 2019.

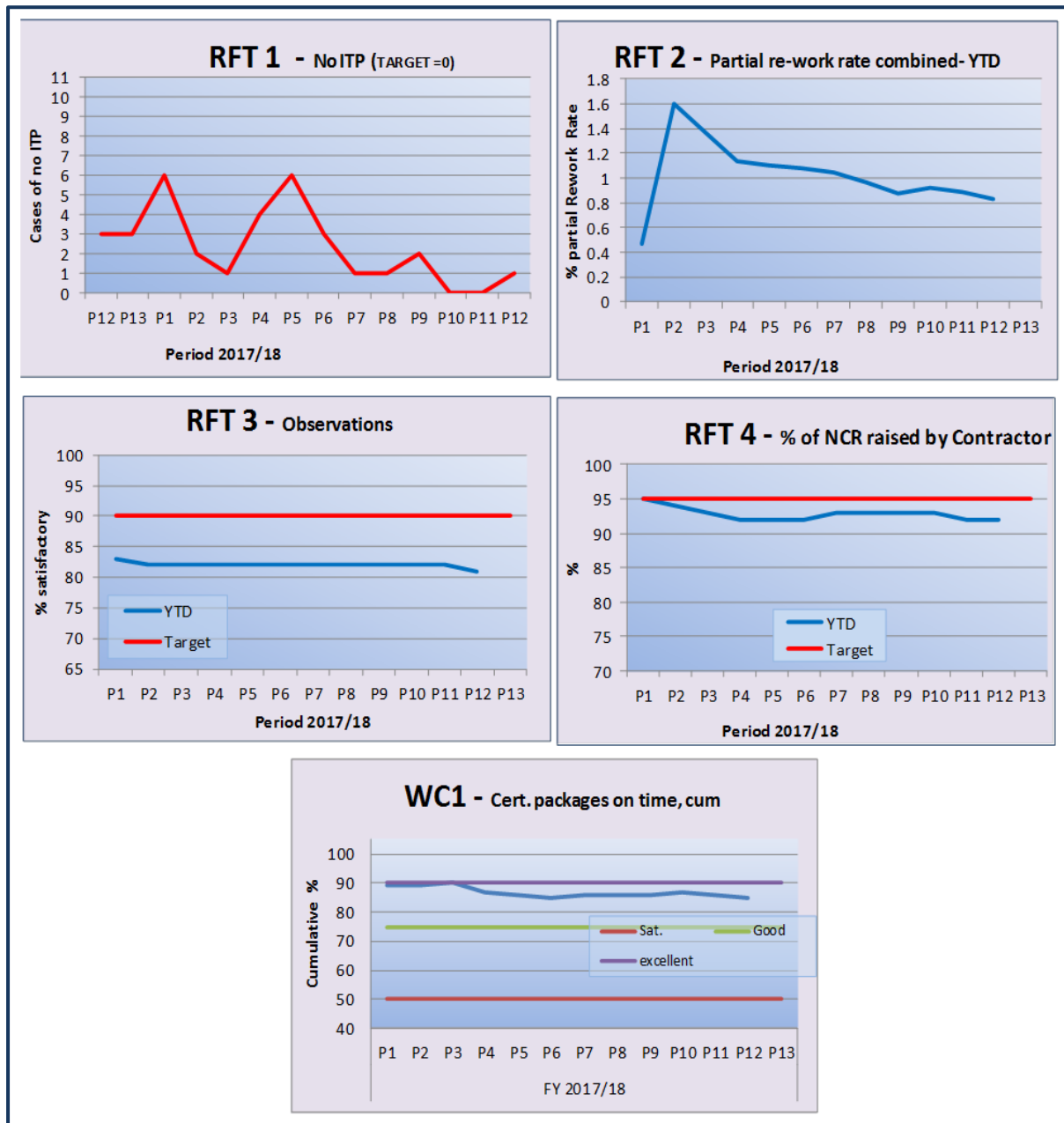


Figure D - 2 ~ Quality KPIs



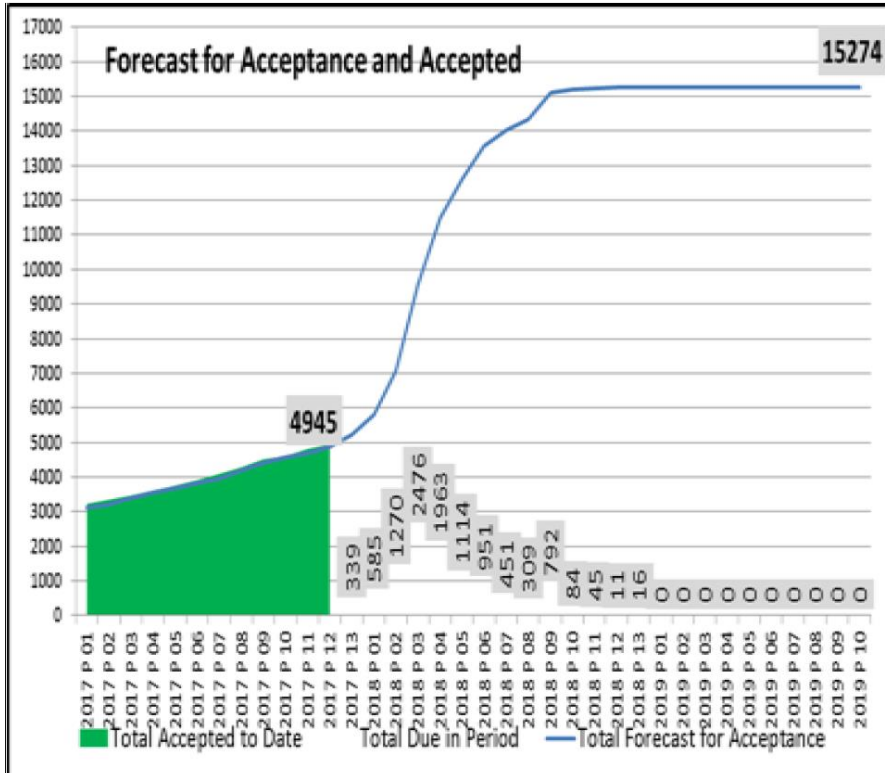


Figure D - 3 ~ P12 Acceptance Graph

### D.2.2 Quality Performance Index

No contractors received a “Red” status for their quality performance in Period 12. The overall index for the period was 2.06. CRL’s target is to be above 2.00.

### D.2.3 Quality Issues

There was one Category 1 NCR reported in this period, relating to [REDACTED]

### D.2.4 Audit Monitoring

No audits were adjudged to be ‘poorly controlled’ in this period.

### D.3 Affirmations

There has been no change from our comments of last period. These are:

- Affirmation 026 Supporting Communication or Utility Distribution – we are waiting for CRL’s chief of staff to conclude investigations with CRL’s Delivery team, and will report once that has been completed;
- A report by RfL that addresses an outstanding action from Affirmation 005a ‘Recommendations for a Crossrail Performance and Management Regime’ is to be submitted to Sponsors. It describes how the Sponsors Requirements for PPM to be in excess of 95% has been met, but that the cancellation and mileage rates of 1% or less have not.

## D.4 Land & Property (L&P)

L&P CAPEX is now £841.1m; all Urban Realm Central Section planning consents have been obtained and the focus moves to delivery. OSD continues to focus on legal agreements, and good progress is being made in finalising development deals/providing TfL with sites to market.

The total L&P Programme AFC (including P50 risk) in the period remains unchanged at £860.7m. CRL has settled 840 out of 1,609 anticipated claims, representing 83.0% of the AFC by value. At period end, 5 cases were referred to Land Tribunal. The total claimed figure is £27.6m across all of these cases, compared to CRL's AFC allowance of £2.5m.

## D.5 Over Site Development (OSD) and Urban Realm (UR)

There have been no changes to CRL's forecast MOHS handover dates, during Period 12. A number of OSD developer start dates (shown bold text in Figure D - 4) have, however, been amended, together with some estimated durations for OSD construction works.

Figure D - 4 provides a summary<sup>22</sup> of the current forecast Key Dates for Completion and handover<sup>23</sup> of the CRL deck slabs at each station to the OSD contractors<sup>24</sup>, as well as the OSD forecast start, duration and completion dates<sup>25</sup>.

CRL still has one further OSD planning application to make at Liverpool Street East. Legal Agreements with Development Partners are being finalised, pending TfL approval.

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<sup>22</sup> Summary of OSD dates has been abstracted from the CRL Board Report, the MOHS and Key Dates progress summary.

<sup>23</sup> The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.

<sup>24</sup> The developers' start dates, durations and forecast completion dates have been abstracted from the OSD Progress Section of the CRL Board Report and CRL's Anchor Milestone summary.

<sup>25</sup> The estimated shell & core completion dates will be validated when the OSD contractors' schedules become available.

OSD Sites linked to CRL Stations - Key Dates							
Station	Location	CRL Anchor Milestone	PDA Milestone	CRL's Forecast (MOHS) Handover Date to Station OSD Developer	Forecast Developer Start Date on Site**	Construction Duration (m)	Est. Shell & Core Completion
Bond Street	West - Davies Street	A275	10	31-Oct-18	Feb-19	20	Oct-20
	East - Hanover	A276	11	11-Jun-18	Jun-18	20	Feb-19
Tottenham Court Road	West - Dean Street	A279	15	30-Nov-18	Jan-19	21	Oct-20
	East - Astoria	A277	12	06-Sep-17	Jan-18	37	Jan-21
	East - Goslett Yard	N/A	N/A	06-Sep-17	May-19	14	Jul-20
Farringdon	West - Cardinal House	A278	13	30-Jun-18	Jan-19	18	Jun-20
	East - Lindsey Street	A280	16	29-Mar-18	Jul-18	21	Mar-20
Liverpool Street	West - 101 Moorgate	A288	19	22-Feb-18	Apr-19	21	Jan-21
	East - Blomfield Street	A284	18	28-Feb-18	Jul-19	21	Apr-21
OSD Sites <u>NOT</u> linked to CRL Stations - Key Dates							
Station / Site	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast Sectional Completion Date	Forecast Developer Start Date on Site	Construction Duration (m)	Shell & Core Completion
Paddington	PIP Triangle	N/A	N/A	Available	TBC	TBC	TBC
	Fisher Street	N/A	N/A	Jun-18	Jun-18	16	Oct-19
	Limmo Peninsula	N/A	N/A	Aug-18	Jan-20	TBC	TBC
	Woolwich	N/A	N/A	Apr-18	Sep-18	45	Jun-22
<p><b>Notes</b></p> <ol style="list-style-type: none"> <li>** Proposed OSD start dates will be confirmed as the Developers programme evolves</li> <li>CRL Forecast Sectional Completion Dates are abstracted from The CRL MOHS Baseline Early schedule</li> <li>TBC = To be confirmed</li> <li>Dates abstracted from L&amp;P OSD Project Dashboard and Anchor Milestones are shaded thus: <span style="background-color: #f2f2f2; border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span></li> <li>Forecast dates that have now been achieved (with actual dates shown) are shaded thus: <span style="background-color: #d9ead3; border: 1px solid black; display: inline-block; width: 20px; height: 10px;"></span></li> <li>Developer start dates at Bond Street precede station forecast handover dates, due to earlier phased handovers.</li> </ol>							

Figure D - 4 ~ Summary of OSD forecast Key Dates

**Paddington (PIP Triangle)** No partner has been identified for the proposed office development. Risk concerns, in relation to the joint NR/TfL regime, have been resolved. TfL is reviewing the new lease provisions and, subject to TfL approval and NR LC7 consent, CRL/TfL plan to market the site early in 2018.

Variation of the existing OSD agreement for Great Portland Estates (GPE) **Bond Street (East)** Office consent was approved by TfL and phased handover of the site has been instructed by CRL. The East Ticket Hall (ETH) vent shaft was handed over (██████████) on 15 February 2018 against a planned handover date of 2 January 2018. Main Handover of the ETH +1 roof slab is forecast for 12 June 2018.

Work to resolve the noise and vibration concerns continues, with further information provided to GPE for review. The handover date for the vent shaft remains a risk and is being monitored closely by both teams. The June 2018 target date for land receipts is not expected to be impacted.

The Development Agreement (DA) for the OSD for **Bond Street (West)**, between Grosvenor and TfL, was signed and exchanged on 23 February 2018. Agreement of the target handover date for the OSD has proved difficult, as a result of continued station schedule delays. CRL's current target handover date to the OSD developer is now 31 October 2018.

The DA for the OSD at **Tottenham Court Road (East)** is complete, enabling handover and the development to commence. The Deed of Variation has been agreed and CRL handed over the Tottenham Court Road (East) OSD site at Goslett Yard to the OSD Developer (Derwent). Enabling works have started and the appointment of a main contractor is expected later in the year.

The OSD for residential development at **Tottenham Court Road (West)** will be offered to the open market in early 2018. Retail areas will be retained for in-house (TfL) management. The site is being used for site office accommodation by CRL's delivery team until November 2018. The OSD development will not, therefore, be able to start until 2019. The final account for OSD interface work (C423), to date, is being agreed with TfL.

The DA for the **Fisher Street** OSD has been signed with extensions to June 2018. The Developer has submitted additional information, supporting project viability, to Camden. The Planning Committee decision date has, however, still not been set. Terms agreed for a deed of variation to the DA to extend the longstop date to at least March-18, with extensions to June 2018 at TfL's absolute discretion.

The negotiation of the DA for the **Farringdon West** office consent is near conclusion, awaiting resolution of final outstanding issues with the developer (HB Reavis). TfL CFO & Commissioner approval has been delayed, pending greater certainty on the payment date.

CRL's handover of the **Farringdon (East)** OSD site is forecast for 29 March 2018. Terms have been agreed for the DA and lease for the office development. The DA is still awaiting TfL Commissioner approval.

The DA for **Liverpool Street (West)** office consent has been approved by TfL and Commissioner. The DA is being finalised for execution.

The DA and Lease for the **Liverpool Street (East)** Office and Retail OSD application has been agreed. Further TfL (CFO) approval is currently being sought. Handover of the Moorgate Shaft site to the developer has been re-scheduled for the end of May 2018, as the DA has not been completed.

The **Limmo** masterplan has yet to be agreed with London Borough of Newham. Approval has been obtained to market the site through the TfL Property Partnership Framework (PPF). A JV partner selection process will be launched via the PPF in Q1 2018.

TfL wish to delay marketing of the **Woolwich** residential site, in order to review the potential for an alternative private rented sector disposal structure, to increase long term income.

## D.6 Undertakings & Assurances and Commitments - Central Section

Five of the live contracts for the Central Section planned to upload compliance evidence into Commitments Delivery Tracker (CDT) in Period 12, in accordance with their Commitments Compliance Plans (CCP). C530 (Woolwich Box and Portal Fit-out) has not caught up on the evidence reported as pending in period 11. C435 (Farringdon Station Main Works Platform Tunnels, Fit out) and C660 (Communication and Controls) have outstanding pieces of evidence to upload in CDT this period. Refer to our previous reports for further detail in respect of the Potential Incident Reports (PIRs) noted below.

### D.6.1 C660/C520 Custom House PAVA (D25) Assurance 465

Assurance 465 is drawn from Information Paper D25 and requires CRL to agree criteria for the performance of the public address (PA) system with a local authority prior to specifying and carrying out the detailed design of that system. The C660 PA design at Custom House station is essentially complete (Custom House station FDO was held in May 2017) but subsequently, following an email communication from the local authority, the London Borough of Newham, on 21 June 2016, agreement on appropriate criteria has not been reached.

The report of the noise survey carried out in December 2017 was issued to CRL on 30 January 2018 for review. Comments have been returned and a final revised report was received in February 2018. The meeting with LB Newham took place on 20 February, where the findings of the noise survey were presented and criteria discussed. Draft criteria have been sent to LB Newham for agreement. CRL anticipates a response from LB Newham before the end of March 2018.

## **D.7 Undertakings & Assurances and Commitments - Surface Section**

Four of the live Surface Section contracts planned to upload compliance evidence into the Commitments Delivery Tracker (CDT) in Period 12, in accordance with their Compliance Matrices. The four contracts are:

- SAA3A (South East (GRIP 5-8));
- WLG4A (Old Oak Common & Paddington Approaches (OOCPA) (GRIP 5));
- WSN3C (Stations West Inner and West Outer (GRIP 5));
- WIT1A (West Inner Track Infrastructure (GRIP5) have not met their targets.

The reason for the evidence not being uploaded this period was due to the NR Commitments Coordinator leaving and no replacement was found until recently. This backlog should be cleared by the time of the Period 13 report.

There has been no other change, with regard to what was previously reported in Period 11. This means that:

- WOT1C West Outer Track Infrastructure (GRIP5-8) has not uploaded any evidence into CDT since Period 8;
- The D25 report that WSK1F (Stockley Main Civils) was due to upload in Period 6 remains outstanding. Also, the planned upload of evidence of consultation with Thames Water remains outstanding since Period 10;
- WLG4A (OOCPA) has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4;
- WIT1A (West Inner Track Infrastructure) has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4.

No Surface Section PIRs were raised in Period 12.

## Project Representative Team

### D.8 Project Team

██████████:	Project Representative, Safety, Progress, Risk, Governance;
██████████:	Signalling, Railway Systems, Integration, T&C;
██████████:	Engineering, Stations, OSD, U&As, Assurance;
██████████:	Compliance & Change, Operations, RSD;
██████████:	Commercial, Cost Control, Financial, ONW;
██████████:	Administration Manager.

## Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LoNo	Letter of No Objection
ABB	ASEA Brown Boverly	LoR	Line of Route
ACJV	Alstom Costain Joint Venture	LTC	Lost Time Case
ACWP	Actual Cost of Work Performed	LTIFR	Lost Time Incident Frequency Rate
AEA	Abellio East Anglia	LU	London Underground
AFC	Anticipated Final Cost	LUL	London Underground Limited
AFDCDC	Anticipated Final Crossrail Direct Cost	LV	Low Voltage
AFR	Accident Frequency Rate	M&E	Mechanical & Electrical
AGA	Abellio Greater Anglia (now known as 'GA')	MAID	Mandatory Asset Information Deliverables
AIP	Approved in Principle	MCR	Material Control Requirement
AIP	Approval in Principal	MCS	Master Control Schedule
AMS	Agreements Management System	MENTOR	Mobile Electrical Network Testing, Observation and Recording
APIS	Authorisation to Place into Service	MEP	Mechanical Electrical & Public Health
ARS	Automatic Route Setting	MEPA	Mechanical, Electrical, Public Health, Architecture
AsBo	Assurance Body - Ricardo Rail	MES	Mile End Shaft
ASLEF	Associated Society of Locomotive Engineers and Firemen	MIRP	Maintenance Integration Review Panel
ATC	Automatic Train Control	MML	Mott MacDonald Ltd
ATFS	Autotransformer Feeder System	MOHS	Master Operational Handover Schedule
ATO	Automatic Train Operation	MOS	Member of Staff
ATP	Automatic Train Protection	MPS	Master Plan Shaft
ATS	Automatic Train Supervision	MTIN	Miles Per Technical Incident Number
ATS	Auto Transformer Station	MTIN	Miles Technical Incident Number
AWS	Automatic Warning System	MTR SMS	MTR Safety Management System
B&PC	Board & Programme Contingency	MTR-C	Mass Transit Railway - Crossrail
BBM	Balfour Beatty Morgan Vinci	MV	Medium Voltage
BCA	Bilateral Connection Agreement	NCE	Notified Compensation Event
BCWP	Budgeted Cost of Work Performed (Earned Value)	NCR	Non Conformance Report
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NG	National Grid
BFK	Bam Ferrovial Kier	NGET	National Grid Electricity Transmission
BH	Berkeley Homes	NKL	North Kent Line
BIU	Bringing Into Use	NoBo	Notified Body
BLL	Bakerloo Line Link	NOW	North Woolwich
BOS	Bond Street Station	NR	Network Rail
BP	Business Plan	NSACS	New Sector Area Cost Summary
BREEAM	Building Research Establishment Environmental Assessment Methodology	O&M	Operations and Maintenance
BSP	Bulk Power Supply Point	OCS	Overhead Catenary Systems
BT	Bombardier Transportation	OLE	Overhead Line Equipment
BT / PC	Bombardier Transportation / Prime Contractor	OMC Building	Operations Maintenance Centre
BTH	Blonfield Ticket Hall	OME	Order of Magnitude Estimate
BUF	Bottom Up Forecast	ONFR	On Network Functional Requirements
C&CSC	Commercial and Change Sub-committee	ONSIP	On Network Station Improvements Programme
CAR	Corrective Action Report	ONW	On Network Works
CARE	Crossrail Assurance Reporting Environment	OOC	Old Oak Common
CBTC	Communications Based Train Control	OOCPA	Old Oak Common Paddington Approaches
CCB	Current Control Budget	OPEX	Operational Expenditure
CCP	Commitments Compliance Plans	Ops	Operations
CCRB	Construction and Commissioning Rulebook	ORAT	Operational Readiness & Transfer Group

CCRRB	Crossrail Construction Railway Rule Book	ORR	Office of Rail & Road
CCSA	Contract Commercial Status Analysis	ORSG	Operational Readiness Steering Group
CCSC	Commercial & Change Sub-Committee	OSD	Over Site Development
CCTV	Closed Circuit Television	OSP	Operations Safety Procedures
CD/RA	Closed Door / Right Away	OTIS	OTIS escalators (company)
CDG	Competence Design Group	OTP	Overall Target Price
CDL	Central Door Locking	PAD	Paddington station
CDM	Construction Design & Management Regulations	PCs	Principal Contractors
CDN	Crossrail Data Network	PDA	Project Development Agreement
CDT	Commitments Delivery Tracker	PDB	Network Rail Programme Delivery Board
CE	Compensation Events	PES	Platform Edge Screen
CEC	Chief Engineer's Communications	PIP	Paddington Integration Project
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PIR	Potential Incident Report
CEG	Central Engineering Group	PLU	Plumstead
CEO	Chief Executive Officer	PM	Project Manager
CFCCB	Contingency Finance Current Control Budget	PMI	Project Manager Instruction
CFO	Chief Financial Officer	PML	Pudding Mill Lane
CIF	Crossrail Integration Facility	PMO	Project Management Office NR
CIS	Customer Information System	PNY	Paddington New Yard
CMR	Crossrail Managed Risk	PPE	Personal Protective Equipment
CMS	Crossrail Management System	PPF	Property Partnership Framework
CoL	City of London	PPM	Passenger Performance Measurement
COS	Central Operating Section	Prep	Project Representative
CPFR	Crossrail Programme Functional Requirements	PRISM	Cost Management Software
CPI	Cost Performance Index	PRM	Persons of Reduced Mobility
CPO	Compulsory Purchase Order	PSD	Platform Screen Door
CRL	Crossrail Limited	PSG	Performance Steering Group
CRV	Crossrail Requirements Variation	PSR	Project Status Report
CSCS	Construction Skills Certification Scheme	PTYSC	Property Sub-Committee
CSJV	Costain Skanska Joint Venture	PWay	Permanent Way
CSM	Construction Safety Management	QBR	Quarterly Baseline Review
CSM-RA	Common Safety Method – Risk Assessment	QCRA	Quantified Cost Risk Assessment
CT	Computerized Tomography	QRA	Quantified Risk Assessment
CTOC	Crossrail Train Operating Concession	QSRA	Quantified Schedule Risk Assessment
CUH / CHS	Custom House Station	RAB	Regulatory Asset Base
CW	Canary Wharf	RAB (C)	RfL Assurance Board for Crossrail
CWG	Canary Wharf Group	RAG	Red, Amber, Green Matrix
CWS	Canary Wharf Station	RAM	Route Asset Manage.
D&A	Drugs and Alcohol	RBC	Remote Block Computer
DA	Development Agreement	RCA	Risk Control Actions
DeBo	Designated body	RCC	Route Control Centre
DfT	Department for Transport	RfL	Rail for London
DLO	Direct Labour Organisation	RfL-I	Rail for London - Infrastructure
DLR	Docklands Light Railway	RFT	Right First Time
DOO	Driver Only Operation	RIA	Railway Integration Authority
DPS	Depot Protection System	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DT	Dynamic Testing	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
Dwall	Diaphragm wall	RIRP	Railway Integration Review Point
DWWP	Delivery of Works Within Possession	RLU	Restricted Length Unit
E&B	Earthing & Bonding	ROC	Rigid Overhead Conductor
EA	Environment Agency	ROC	Regional Operational Centre
EAC	Estimate at Completion	ROP	Royal Oak Portal
EB	Eastbound	RP4.2	Review Point 4.2



ECP	Employers Completion Process	RR	Ricardo Rail
ECS	Empty Coach Stock	RRV	Road / Rail Vehicles
		RS	Rolling Stock
EDT	Early Dynamic Testing	RSD	Rolling Stock & Depot
EED	Emergency Exit Door	RSSB	Rail Safety & Standards Board
EFC	Estimated Final Cost	RTU	Remote Telemetry Unit
ELRSG	Elizabeth Line Readiness Steering Group	S&C	Sw itches & Crossings
EMC	Electromagnetic Comp atibility	SA	Supplementary Agreement
EMU	Electrical Multiple Unit	SACR	Semi Annual Construction Report
ERTMS	European Rail Traffic Management Systems	SAP	System Applications Products
ESJ	Engineering Safety Justification	SAR	Safety Assessment Report
ESM	Engineering Safety Management	SAT	Site Acceptance Test
ETCS	European Train Control System	SCADA	Supervisory Control and Data Acquisition
ETH	Eastern Ticket Hall	SCL	Sprayed Concrete Lining
EVM	Earned Value Management	SCN	Sponsor Change Notice
FAR	Farringdon	SDG	Signalling Design Group
FCCB	Finance Current Control Budget	SDO	Selective Door Operation
FDC	Framework Design Consultant	SDS	Scheme Design Specification
FDO	Final Design Overview	SER	Signalling Equipment Room
FDS	Final Design Statements	SES	South East Service
FFOC	Final Forecast Outturn Cost	SESR	South East Signalling Room
FGW	First Great Western	SFA	Sponsor Funding Account
FIS	Fisher Street Shaft	SHELT	Safety and Health Leadership Team
FLU	Full Length Unit	SIRP	Systems Integration Review Panel
FoI	Freedom of Information	SISS	Station Information and Security System
FRAG	Fraud Risk Assurance Group	SJR	Safety Justification Report
FTS	Floating Track Slab	SLD	Single Line Diagrams
GAF	Greater Anglia Franchisee	SMS	Safety Management System
GE	Great Eastern	SMTA	Smithfield Market Traders Association
GEFF	Great Eastern Furrer & Frey	SOC	Statement of Comp atibility
GEML	Great Eastern Main Line	SONIA	Sterling Overnight Index Average
GFRC	Glassfibre Reinforced Concrete	SOR	Systems Operation Room
GLA	Greater London Authority	SORBA	Shaping Architecture Company (sub cladding contractor)
GPE	Great Portland Estates	SPI	Schedule Performance Index
GRC	Glass Reinforced Concrete	SPS	Secondary Part Steel
GRIP	Governance for Railway Investment Projects	SR	Sponsors Requirement
GSM-R	Global System for Mobile Communication - Railway	SRP	Safety Review Panel
GW	Great Western	SSE	Scottish & Southern Electricity
GWML	Great Western Main Line	SSP	Stations, Shafts, Portals
GWR	Great Western Railway	STG	Stepney Green
H&S	Health & Safety	STS	Standard Track Slab
HAL	Heathrow Airport Limited	SVP	Safety Verification Panel
HALARP	Heathrow Airport Limited Assurance Review Panel	T&C	Testing & Commissioning
HAS	High Attenuation Sleeper	TAP	Technical Assurance Plan
HA VS	Hand Arm V bration Syndrome	TBM	Tunnel Boring Machine
HEP	Handover Execution Plans	TC&HSG	Testing, Commissioning and Handover Steering Group
HIA	Heathrow Implementation Agreement	TCMS	Train Control Management System
HM	Her Majesty	TCR	Tottenham Court Road
HMDL	Handover Master Deliverable List	TCRW	Tottenham Court Road West
HRW	Heathrow Airport	TDY	Tunnel Drive Y
HSPI	Health & Safety Performance Indicator	TiL	Transport for London
HV	High Voltage	TOC	Train Operating Company
HVAC	Heating Ventilation & Air Conditioning	TPA	Tunnel Planning Authority
IA	Interim Acceptance	TPH	Trains Per Hour

ICD	Interface Control Document	TPS	Train Protection System
IECC	Integrated Electronic Control Centre	TPWS	Train Protection & Warning System
IEP	Intercity Express Programme	TRAIL	Transport Reliability Availability Integrated Logistics
IFC	Issued For Construction	TRH	Temporary Rehousing
IFD	Ilford Yard	TSI	Technical Standard for Interoperability
IM	Infrastructure Manager	TTVS	Temporary Tunnel Ventilation System
IOSH	Institution of Occupational Safety and Health	TUCA	Tunnelling & Underground Construction Academy
IP	Intervention Point (0, 1, & 2)	TWAO	Transport & Works Act Order
IR35	Inland Revenue Taxation Regulation 35	TXM	TXM Plant
IRN	Installation Release Note	U&A	Undertakings & Assurances
IRSG	International Regulatory Strategy Group	UKPN	UK Power Networks
ISJ	Interim Safety Justification	UR	Urban Realm
ISV	Intermediate Statements of Verification	URT	Unresolved Trends
ITP	Inspection & Test Plan	VDP	Victoria Dock Portal
ITT	Invitation to Tender	VERP	Value Engineering Review Panel
JST	Joint Sponsor Team	VFL	Volker Fitz Patrick
KBR	Knorr-Bremse Rail	VN	Variation Notice
KD	Key Deliverable	VT	Voltage Transformer
KE	Kinematic Envelope	WAD	Works Authorisation Document
KG	Kensal Green	WBP	Westbourne Park
KO	Key Output	WBS	Work Breakdown Structure
KPI	Key Performance Indicator	WC	World Class
L&P	Land and Property	WCCC	Whole Contract Construction Certificate
LB	London Borough	WHI	Whitechapel
LBTH	London Borough of Tower Hamlets	WITI	Western Inner Track Infrastructure
		WOE	Western Outer Electrification
LFB	London Fire Brigade	WOO	Woolwich Station
LIV	Liverpool Street	WOTI	Western Outer Track Infrastructure
LMU	London Metropolitan University	WTH	Western Ticket Hall
LO	London Overground	YC	Yard Control

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to FML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU - Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU - WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	MD04	General Paddington
C340	Victoria Dock Portal Civil Works	MD05	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	MD11	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	MD19	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	MD20	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	MD22	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA FML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU



## **Crossrail Project Representative**

Crossrail Joint Sponsor Team

**Project Status Report 110**

**Period 13 FY2017-18**

**4 March 2018 – 31 March 2018**

Document No. B2111500/110/1.21

26 April 2018



**Official ~ Sensitive Commercial**

**Project Status Report 110**

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Jacobs U.K. Limited  
 226 Tower Bridge Road  
 London SW1 2UP  
 United Kingdom  
 T +44 (0)20 7403 3330  
 F +44 (0)20 7939 1418  
[www.jacobs.com](http://www.jacobs.com)

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Note: This report relies on the information set out in CRL's Period 13 reports augmented by more current information received by PRep during the course of our routine discussions with CRL since the Period close on 31 March 2018. Note that information emerging after the close of Period 13 is subject to formal confirmation by CRL in its Period 1 reports. This report is supplemented by our weekly reports to JST and regular meetings with JST staff.

**Document history and status**

Revision	Date	Description	By	Review	Approved
1	19 April 2018	PSR 110 Period 13 FY 2017-18 v1.13.docx ~ Draft	PRep Core Team		
2	26 April 2018	PSR 110 Period 13 FY 2017-18 v1.21.docx ~ Final	PRep Core Team	<span style="background-color: black; color: black;">[REDACTED]</span>	<span style="background-color: black; color: black;">[REDACTED]</span>

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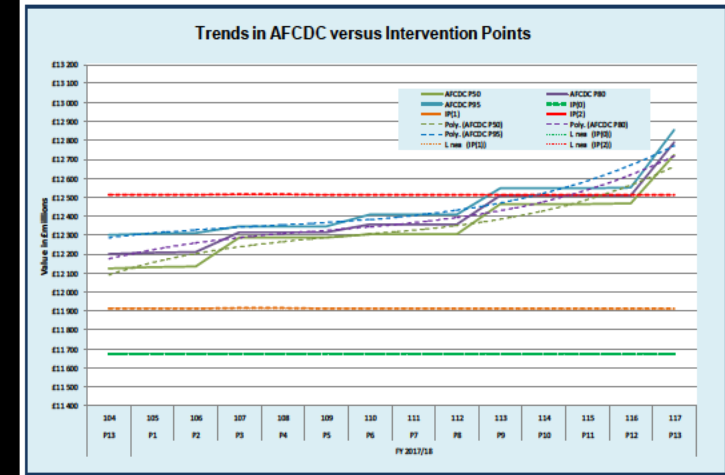
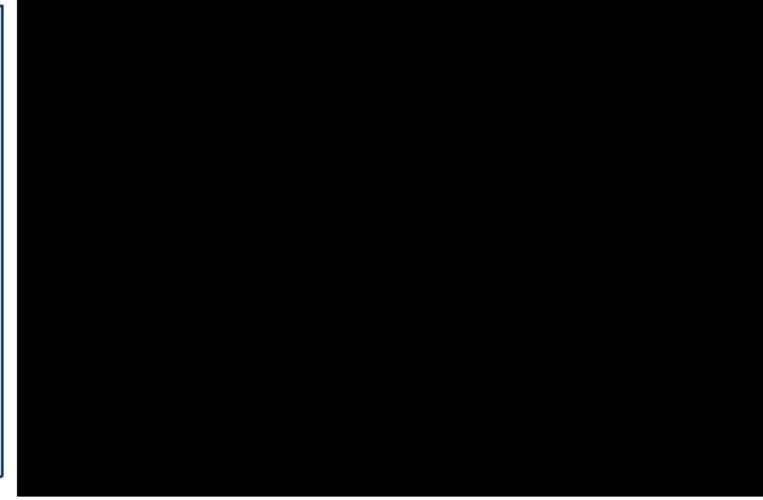
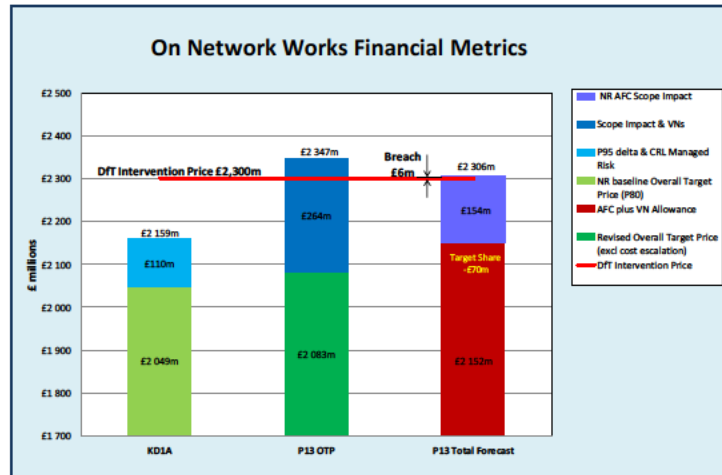
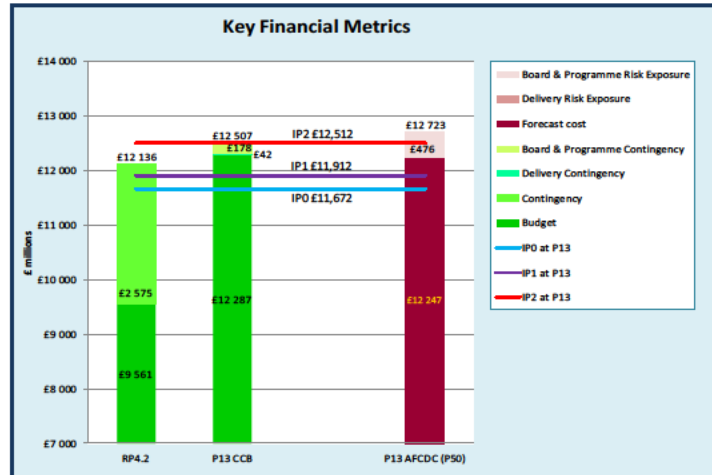


SACR18 (as at April 2017):  
 AFCDC (P50) ~ £12.303bn. AFCDC (P80) ~ £12.356bn  
 AFC: (£12.303bn AFCDC (P50) + £2.482bn ONW etc) = £14.785bn

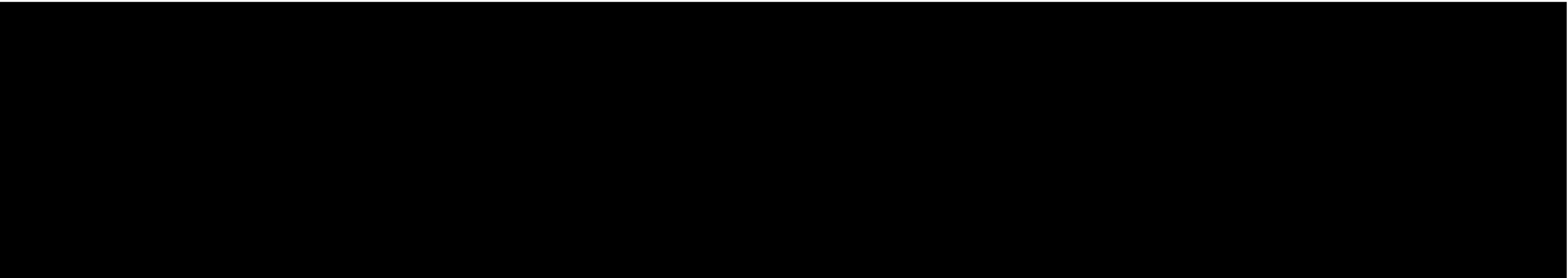
### Cost and Schedule Dashboard (Period 13 FY2017/18)

CRL SACR18 QSRA gave confidence level of finishing on time at Stage 3 = 71%. (This is now out of date.)

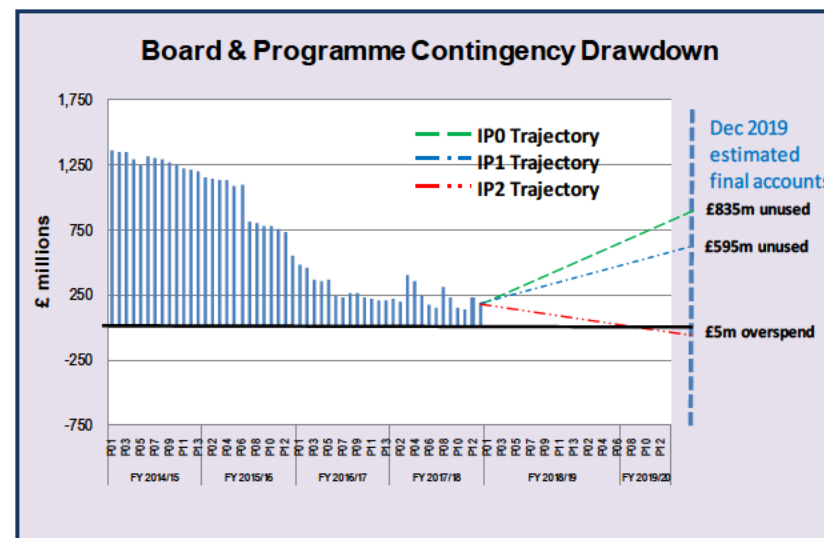
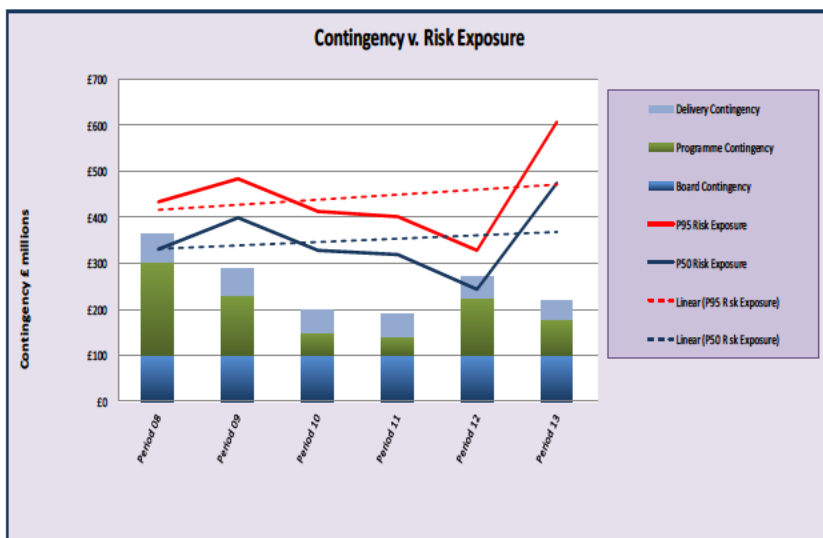
#### Cost:



#### Schedule:



#### Risk, Contingency & Change:



**Project Representative's Summary:**

**Cost:** IP0, IP1 and IP2 have not changed in Period 13. The AFCDC (P50) has increased by £255.6m in Period 13 to £12,723m, exceeding IP2 by £211m. The Period 13 Finance Current Control Budget remains at £12,507m. The AFCDC (P50) consequently exceeds both the reported financial budget by £216m and the RP4.2 Baseline funding of £12,136m by £587m. The AFCDC (P80) has also increased by £278m to £12,790m which exceeds IP2 by £278m. The AFCDC (P95) of £12,855m exceeds IP2 by £343m. The CRL ONW AFC remains at £2,376m excluding VNs in Period 13. The Period 13 CRL estimated FFOC has reduced by £20m to £2,376m, due to confirmation of NR's £20m funding contribution, and exceeds the DfT Intervention Price by £76m.

**Schedule & Progress:** The MOHS remains highly ambitious. Overall period performance has struggled to match that required to deliver MOHS, and there have been notable slippages in key dates for Stations, Shafts and Portals systems, Phase 3 integration testing, completion of NR works to facilitate Zones 3 & 4 energisation and IRN production. There remains a high risk that the start dates for Trial Running, Trial Operations and Stage 3 Opening will not be achieved.

**Risk, Contingency & Change:** In Period 13, there was a £231m increase in P50 risk to £475m predominantly due to increased risk provision following the CRL Q4 QRA. The overall revised contingency budget of £220m is currently insufficient to cover the P50 risk exposure of £475m by £256m (a £283m deterioration from Period 12). The centrally controlled Delivery contingency has reduced by £5m to £42m in Period 13.

# Cost and Schedule Dashboard

(Quick Reference Guide)

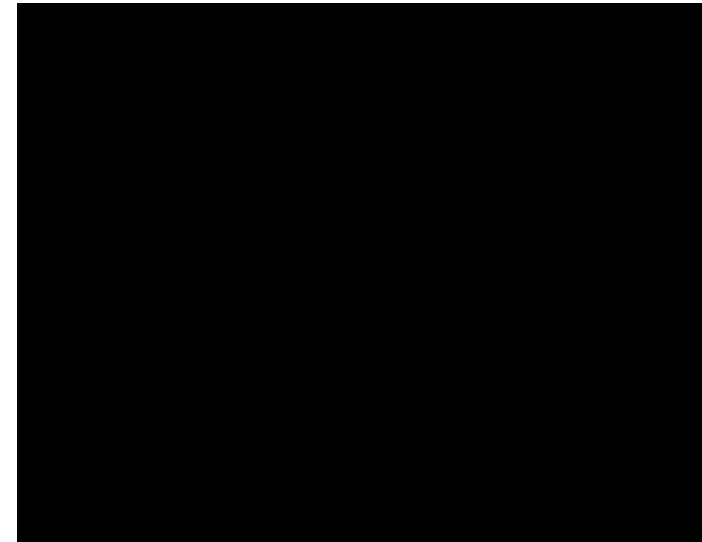
## Cost

### Key Financial Metrics

Indicates constituent parts of RP4.2 baseline, Current Control Budget for this Period including contingency, and AFDC for this Period including risk exposure (at P50). These columns are set against the three Intervention Points.

### On Network Works Financial Metrics

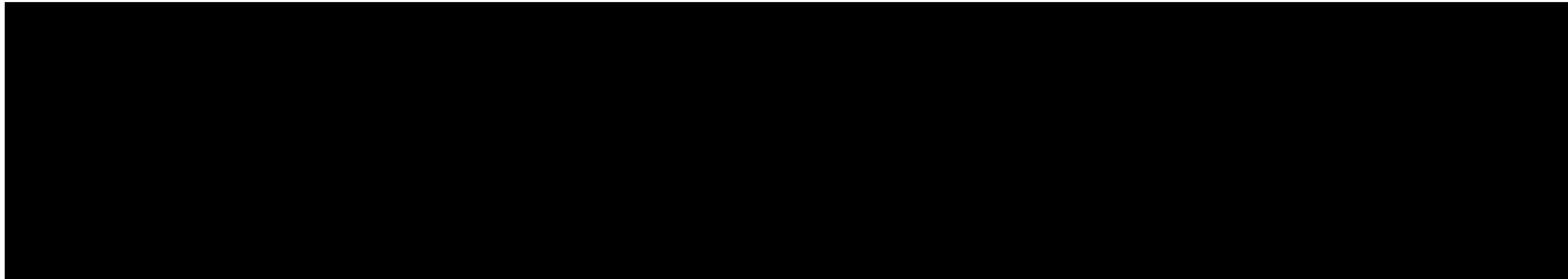
Indicates original NR baseline Overall Target Price (P80) as at Key Date 1A set against revised Overall Target Price including authorised variations. The third column is forecast Anticipated Final Cost (AFC) plus any gain share to NR. To these are added CRL Managed Risk. These are set against the DfT Intervention Price to give the current AFC headroom. Note that due to timing of reports, CRL ONW financial metrics are based on the previous period data.



### Trends in AFDC versus Intervention Points

Indicates and profiles the periodic reported CRL AFDC at P50, P80 and P95 and forecasts the respective future AFDC trends and their relationship with the intervention points as defined in the PDA for IP0, IP1 and IP2.

## Schedule & Float



## Risk, Contingency & Change

### Risk Exposure comparison

Shows levels of Risk Exposure (P50 and P95 confidence levels) compared to contingency available to cover those risks that materialise.

### Board & Programme Contingency Drawdown

Indicates Board & Programme Contingency (B&PC) drawdown since Period 4 2012/13 when contingency was first allocated to Project level as part of CRL's target initiative. Three trajectory lines are then shown from the current level of B&PC to show the rates of drawdown that would be consistent with IP0, IP1, and IP2 outcomes.

### Project Representative's summary comments relating to:

- Cost:
- Schedule & Progress:
- Risk, Contingency & Change:

## Executive Summary

### Health and Safety:

Health and Safety performance indicators remain stable and ahead of CRL targets.

### Financial:

The Intervention Points have not changed in Period 13. The AFCDC at P50 has increased by £256m to £12,723m. The AFCDC at P50 exceeds IP2 by £211m, so we expect CRL to confirm a formal breach of IP2 at SACR19. The P80 AFCDC is now £12,790m and the P95 AFCDC is £12,855m. The new Quantified Cost Risk Assessment at P50 increased to £475m, of which £340m is Unresolved Trends. Although the Target and Defined Cost gaps are showing signs of closing, the convergence is slow and the value for both still shows an increasingly upward trend.

The total On Network Works (ONW) forecast cost (AFC plus VNs) remains at [REDACTED]. The ONW final forecast outturn cost (FFOC) reduced by £20m in Period 13 to £2,376m.

### Schedule and Progress:

The Master Operational Handover Schedule (MOHS) remains highly ambitious. Overall period performance has struggled to match that required to deliver MOHS, and there have been notable slippages in key dates for Phase 3 integration testing of Stations, Shafts and Portals systems with [REDACTED], completion of NR works to facilitate Zones 3 & 4 energisation and Installation Release Note (IRN) production. The current Central Section Zones 1 & 2 installation approach of night time construction and daytime dynamic testing has proved difficult to manage and is unable to make best use of available time. CRL will instead adopt blockade working from 26 April 2018, which it expects will deliver the productivity improvements necessary to allow key MOHS milestones to be met.

[REDACTED] latest Systemwide schedule is now largely aligned with MOHS, with the significant exceptions of walkway installation and tunnel ventilation system completion, which extend into the Trial Running period. Blockade working is assumed, providing probably the last opportunity for a significant change in delivery approach to be implemented and for sustained performance improvements to be realised. There are also challenges with the completion of assurance documentation, and the delivery of other support for formal Handover to the IMs. Given the amount of work remaining and past performance, there remains a high risk that the start dates for Trial Running, Trial Operations and Stage 3 operations will not be achieved.

### Stage 2 Opening:

Several workstreams are in progress to deliver Stage 2 Phase 1 operations, scheduled to start on 20 May 2018. All are being managed, but there is a lot of work to complete in limited time.

The development of Automatic Route Setting (ARS) changes by NR, in order to mitigate a Bombardier Transportation (BT) Train Control Management System (TCMS) issue with Central Door Locking, is on target for implementation before opening. This will ensure that Class 345 trains are routed into Paddington Station Platforms 9 and 11, to manage a stepping distance issue.

[REDACTED]

The schedule for delivery of TCMS v7.3, which is planned to be installed on the Class 345s operating the Phase 2 services, is still under development by BT. Conflicts with TCMS development for Stage 3 must be resolved in order to identify a target date for Phase 2. Should the target date for Phase 2 be too close to December 2018, there is a risk that Stage 3 Opening will be compromised because of the overwhelming workload associated with the delivery of two major operating stages.

### **Stage 3 Opening:**

Dynamic testing in Zones 1 & 2 continues. Restrictions on train testing periods have been lifted because neighbouring railways have been satisfied by CRL that stray electrical currents and touch potentials are compliant. To date, the rate of testing has been slow, with only 6 [REDACTED] test cases completed out of a minimum of 145 to be undertaken in Zones 1 & 2; completion of these is planned to take place at the end of May 2018. [REDACTED]

[REDACTED]

[REDACTED] Safety approvals for energisation and dynamic testing have so far kept pace with site requirements, but CRL's next submissions must address RAB(C) concerns at document timing, quality and clarity.

Current critical installation workstreams include HV Power, permanent Tunnel Ventilation and GSM-R, with delays threatening the start of Trial Operations. Phase 3 testing of station systems will be supported by localised bespoke [REDACTED] released to suit site testing requirements. Concerns remain with general progress at Central Section stations and particularly with the completion of [REDACTED] and [REDACTED].

The Infrastructure Managers (IMs) remain extremely concerned at the delays and ongoing slow rates of progress in CRL's provision of training materials, asset information, operations & maintenance manuals, and other documentation. CRL delivery workstreams have remained schedule critical in the period and continue to pose a significant risk to IM readiness for Trial Running.

It is anticipated that the introduction of blockade working will deliver a more efficient use of time and resources. However there is very little construction or testing schedule float available and a high risk remains that one or more stations will not be fully operational, and that Stage 3 Opening will not be achieved on the planned date of 9 December 2018.

### **Stage 4 and 5 Opening:**

Potential slippage in the Great Eastern power upgrade project, completion of which is necessary to support Stage 4 services, remains a concern; CRL and NR continue to review mitigations. Procurement arrangements for the construction of the stabling sidings at Plumstead Depot, which are required to support Stage 4 services, are nearing conclusion.

[REDACTED] at the time of Stage 5 Opening; the potential implications for Crossrail are not yet understood, should the existing ORR derogation not be extended on expiry at the end of December 2019.

**Old Oak Common Depot:**

Old Oak Common Section B1 was Brought Into Use on 11 April 2018, supporting fleet build-up and providing capacity for Stage 2 Phase 1 Reduced Length Units (RLU's). Section A remains on plan to be signalled by 7 May 2018, but is at risk. The remainder of the Depot will be signalled by the beginning of September 2018. Automatic Route Setting (ARS) is targeted for installation by start of Phase 1, but it is not a pre-requisite. All Consents are in hand, except for the agreement and implementation of noise monitoring procedures for Section A, resolution of which is being prioritised by RfL and BT.

# 1 Schedule and Progress

## 1.1 Summary

Figure 1 - 1 indicates some key dates which were reset in the new MOHS<sup>1</sup>, as well as the forecasts issued by CRL at Period 12 and 13. It is clear from this that a number of important energisation dates have been delayed during the period. Further details are set out in Section 3.

Key Dates	MOHS 2018	Period 12 Actual / Forecast	Period 13 Actual / Forecast
Traction Power Energisation Z1&2	01-Feb-18	01-Feb-18	01-Feb-18
Commence DT in Z1&2	25-Feb-18	25-Feb-18	25-Feb-18
Traction Power KG ATFS to WBP	28-Feb-18	28-Feb-18	21-May-18
ATS at WBP energised	07-Apr-18	07-Apr-18	27-Apr-18
Traction Power on Z3&4	10-May-18	10-May-18	21-May-18
Linewide SCADA available	30-May-18	30-May-18	30-May-18
Commence DT in Z3&4	11-Jun-18	11-Jun-18	11-Jun-18
HV Non Traction Power on	01-Jul-18	01-Jul-18	29-Jul-18
Commence Trial Running	05-Aug-18	05-Aug-18	05-Aug-18
Commence Trial Operations	09-Sep-18	09-Sep-18	09-Sep-18
Completed on time			
Forecast later than MOHS			

Figure 1 - 1 ~ Key Dates

Progress in the periods since MOHS 2018 was issued justifies our view that there is a high risk that the start dates for Trial Running, Trial Operations and Stage 3 Opening will not be achieved. In light of the risks and issues set out in this report, we recommend that Sponsors continue preparations in case of a delay, or sub-optimal openings, of Stages 2 and 3. See details below and in Sections 2 and 3.

## 1.2 Progress

Stage 2 Phase 1 remains on schedule although risks remain. Stage 2 Phase 2 does not yet have a start date; see Section 2 for further details.

Progress on Stations, Shafts and Portals is generally in accordance with MOHS, although significant challenges remain.

Dynamic Testing in Zones 1 & 2 started on 26 February 2018. Many challenges remain for CRL to overcome for Dynamic Testing in Zones 3 & 4 to meet its planned start of 11 June 2018, and we describe these in Sections 3.5 and 3.6.

<sup>1</sup> DT = Dynamic testing, KG = Kensal Green, ATFS = Auto Transformer Feeder Station, WBP = Westbourne Park, ATS = Auto Transformer Substation, SCADA = Supervisory Control and Data Acquisition, HV = High Voltage.

Continuing delays to tunnel ventilation systems installation, HV non-traction power energisation, TCMS train software development, Handover materials production, and training during Period 13 have further increased the risk of sub-optimal or delayed Stage 3 Opening. Further details are set out in Section 3.

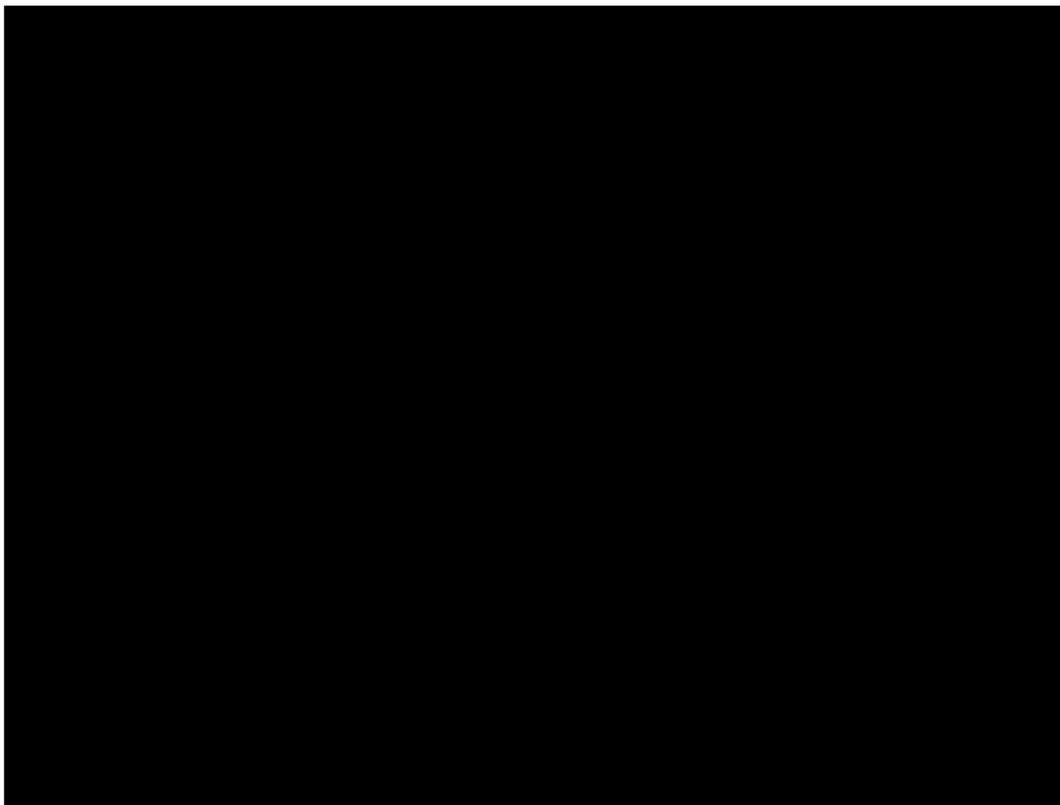
**1.2.1 Central Section**

Figure B - 3 in Appendix B indicates 21 Anchor Milestones (10 in Period 12) which are forecast to be delivered later than the new MOHS baseline late date. In some cases, these delays are minor and not critical, but in others there have been further delays in the period.

Figure B - 1 in Appendix B indicates the overall cumulative progress of Anchor Milestones at Period 13 following the implementation of the new MOHS. The new data for actuals and forecasts has revealed that some productivity and milestone targets have not been met. This is illustrated by the actual/forecast curve moving towards the [REDACTED] date curves on the individual [REDACTED]. This is also shown at [REDACTED] the Systemwide progress against MOHS 2018 at Period 13. Detail regarding progress of individual projects is included later in this report; see Sections 2 and 3.

Most of the Corporate Key Milestones, selected by the CRL Board as part of its KPI incentive scheme for the CRL Executive, have been agreed. We have been advised that these will be reported from Period 1.

We note that CRL still includes its SACR18 QSRA data within its Board report. This indicates a 71% probability that Stage 3 will be opened on time. We re-iterate our comments in previous reports that the data set included a large number of assumptions, and that this calculation is now several months out of date. We have advised CRL to remove the information, as it is no longer relevant. We believe the actual probability of Stage 3 opening on time is substantially lower than 71%.



Our Period 11 and Period 12 reports listed the large number of assumptions, and therefore risks, built in to MOHS 2018, which could impact on delivery of the Central Section. Some of these were becoming issues in Period 12 and more have become challenges during Period 13. The key issues are now:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- Installation and testing of ventilation systems has not been accelerated, and has been further delayed, see Section 3.5;
- Energisation of non traction power systems remains delayed following the missed commissioning at Limmo last period, see Section 3.5;
- Phase 3<sup>2</sup> integration testing is under threat, mainly due to delays to communications software implementation, to installation of permanent ventilation, and to power-on dates, see Section 3.5;
- Delays to the GSM-R system are adding risk to the start of Trial Running, see Section 3.5;
- Draft handover Execution Plans have been submitted but these need to be urgently agreed by the IMs, see Section 3.4;
- Training materials, asset data, O&M manuals and training sessions are not being delivered in time or to the quality required, see Section 3.9;
- The completion of all Final Design Overview certificates and the production of Installation Release Notes is not being accelerated back to the original forecast and further delays are bringing significant risk to the Handover and safety approval process, see Sections 3.4 and 3.7;
- Competing demands for access to the Trace for dynamic testing and completion of installation is now critical, and CRL is now implementing blockade working, see Section 3.5;
- Tunnel walkways etc. cannot be installed before Trial Operations, see Section 3.5;
- CRL may not be able to agree transition testing dates with NR on the GWML, see Section 3.6.3;
- [REDACTED]
- [REDACTED]
- [REDACTED]
- Submission of Engineering Safety Justifications by Tier 1 Contractors is behind schedule, see Section 3.7.3.

There remains a high risk that one or more stations will not be fully operational, and that Stage 3 Opening will not be achieved on the planned date of 9 December 2018.

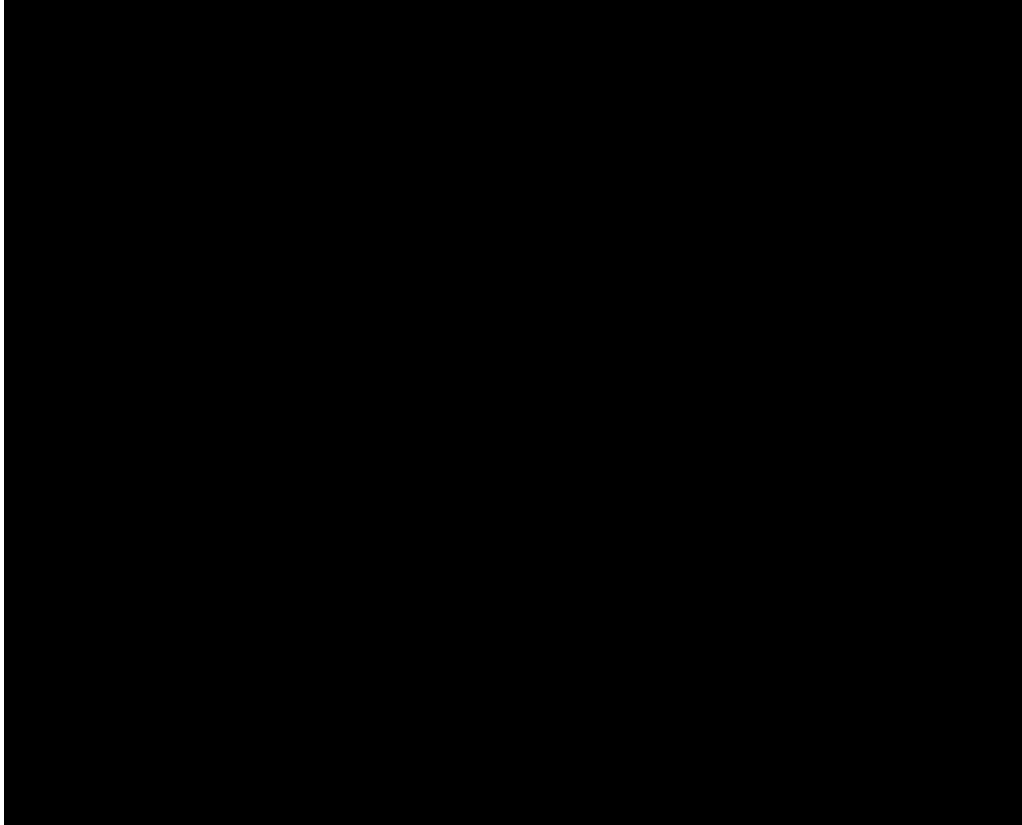
<sup>2</sup> The Crossrail generic testing sequence is as follows: Phase 1 - Factory Acceptance Testing; Phase 2 – Static Testing; Phase 3 – Static Integration Testing; Phase 4 – Dynamic Testing; Phase 5 – Trial Running.



**1.2.2 NR ONW**

CRL and NR report that the ONW is 94% complete (previous 93%) based on expenditure of forecast cost, rather than actual physical progress. Figure 1 - 3 shows the forecast and actual cumulative performance of ONW key dates and milestones against the MOHS baselines, excluding completion dates for the west enhanced stations.

The forecast information is shown at Period 12, as NR reports lag those of CRL. NR has completed a review of its forecasts for the remainder of the project and this is reflected in the revisions to the forecast curve since last period.



At Period 13, NR reports that all works are on schedule to achieve Key Dates and Key Outputs, with the exception of:

Stage 3; KD33 (Enable energisation of COS from Kensal Green as pre-requisite for dynamic testing in advance of Stage 3 introduction of Crossrail services (30 March 2018):

- The traction power infrastructure, including SCADA control from Kensal Green auto transformer feeder station to Westbourne Park ATS, were completed during Christmas 2017. Following a request from CRL, the cables will be connected, tested and energised at the end of April 2018. CRL and NR have agreed a revised date for KD33 of 21 May 2018, although an energisation date is still to be confirmed. NR and CRL are continuing to collaborate to manage this Key Date.

Stage 5; KO5A (Full Infrastructure Capability from Shenfield to the Central Core Area at Pudding Mill Lane) and KD22 (Route clearance & all other infrastructure, including stabling & sidings updates, complete to support Stage 4 Dynamic Testing) (10 September 2018):

- Integration workshops between NR and the auto transformer works contractors are progressing to mitigate delays to KO5A due to the Liverpool Street concentrator renewal on Line of Route Telecoms immunisation works. We will monitor progress and mitigation proposals.

Stage 5; KO5B (Full Infrastructure Capability from Reading to the Central Core Area at Westbourne Park to support the operation of new Crossrail trains across the full Crossrail Network) and KD24 (Infrastructure complete to support Stage 5 Dynamic Testing) (10 September 2018):

- The completion of KD24 remains at risk pending the resolution of the contracting strategy for West Outer Stations. GRIP 5-6 works remains under review following the Carillion liquidation.
- Traction Power Supply construction of the Traction Switching Station at Paddington can only be achieved during the Christmas 2018 works. NR is investigating the available options, but KO5B remains at risk.

None of the above represents any current critical risk and we will continue to track progress.

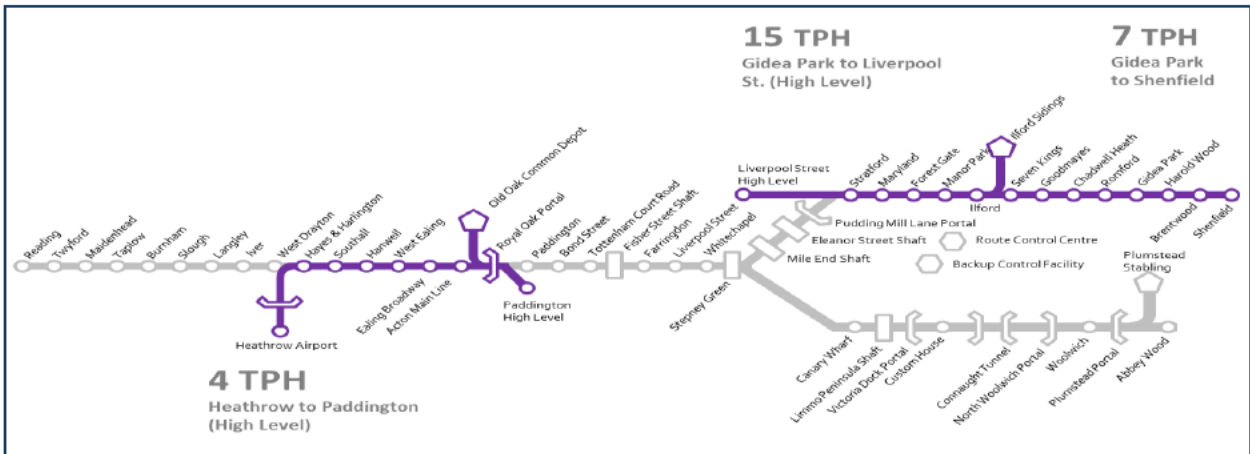
During Period 13, on Crossrail East all under track crossings (UTXs) were completed and handed back to NR Route. Brentwood Borough Council has approved the planning application for the auto transformer site at Shenfield which permits the associated enabling works to commence.

At Abbey Wood station, the works to the six station lifts were completed and all are now in service. CRL is liaising with the local authority and local residents in respect of the local drainage issue at Abbey Wood, where water is ponding in the back gardens of local residents. During Period 13, the 'free form' timber roof over the new Abbey Wood station earned the contractor, Wiehag, the Project of the Year Award at the Construction News Awards 2018.

On Crossrail West, tenders for the Enhanced Stations main works package 3 (at Southall, Hayes and Harlington and West Drayton) were returned and are being evaluated by NR. Additionally, the Paddington platform gauging works were completed for Platforms 1 and 2.

Refer to Sections 2, 4 and 5 for further information regarding NR works required for each Stage completion.

**2 Stage 2: Phase 1; 20 May 2018. Phase 2; [Date TBC]**



**2.1 Summary**

Stage 2 Phase 1 remains on schedule to open on time, although a significant number of medium level risks remain. CRL is managing these. Stage 2 Phase 2 continues to not have a start date.

Phase 1

*Train software fixes to address ASDO and associated location issues affecting DOO CCTV, Passenger Information Systems, and Automatic Selective Door Opening are proceeding to programme.*

*Installation of ARS for operating Paddington Station platforms agreed.*

*Installation of ARS at OOC now programmed.*

*Submissions to Local Authority to satisfy Consents has improved.*

Phase 2

*BT's development of TCMS v7.3 and associated assurance under scrutiny.*

**2.2 Operational Readiness Assessment**

CRL's Stage 2 dashboard categorises two issues as 'red' for Phase 1, and no issues as 'red' for Phase 2. These issues, and the changes from Period 12, are as follows:

**Phase 1**

- Requirement for Central Door Locking (CDL) at Paddington;
- DOO CCTV – *new* .

## Phase 2

The following items were 'red' in Period 12, but are now 'amber' due to RfL and BT agreeing to a revised programme:

- Train readiness for testing and meeting MOHS;
- CRL's formal integration tests;
- Timeliness of Approvals;
- Time required for driver training and Operational proving.

The dates of the revised programme do not comply with MOHS, and a service start date has not been confirmed. Further explanation is given in this Section.

## 2.3 Network Rail Works

### 2.3.1 West Platforms and Stations

NR has reported that works for West Inner stations for KO4 are substantially complete and issues identified during commissioning are planned to be rectified prior to Stage 2 Opening. NR has reported that Entry into Service (EiS) for the West Inner DOO and platform extensions (with handover completed in parallel) is forecast for completion on 20 May 2018.

NR has reported that the Bay Platform extension at Hayes & Harlington is complete and available to accept rolling stock. The bay platform has been extended to 200 metres operational length. The extension to 205 metres will take place in conjunction with the enhanced station delivery.

Additionally, NR has reported that:

- All Outstanding Gauging Work (including track & coper moves) will be complete at Paddington by 7 May 2018;
- Minor gauging modifications at Hanwell will be complete by the end of April 2018;
- OOC Diverse telecoms (North & South) is forecast for completion by the end of April 2018, subject to BT depot completion.

### 2.3.2 Stockley to Maidenhead OLE

NR has reported that the OLE at Royal Oak Sidings was completed and entered into service at the beginning of April 2018 and that the electrification of points (ref: 8066) remains on schedule for completion by 7 May 2018, over the Early May Bank Holiday.

## 2.4 Phase 1

The key issues affecting Phase 1 are as follows:

### **OOO**

Section B1 (Roads 9 to 15) was BIU on 11 April 2018. This provides further capacity for the build-up of the fleet, including for the RLUs operating the service.

Section A remains on plan to be signalled by 7 May 2018. We understand there is reasonable confidence that this will be achieved. The remainder of the depot is forecast to be signalled by the beginning of September 2018. This will mean operational restrictions in place during Stage 2 Phase 1 and Trial Running. However procedures would need to be developed in any

case for times when the depot was un-signalled (planned or unplanned) during future operational service, so the situation is not unique.

In our last report we discussed the importance of installing ARS in the fringe at the earliest opportunity. There is a provisional target to carry that out by the start of Phase 1. This is welcome, not so much as a pre-requisite for Phase 1, but that train movements would be hindered when testing for Stage 3 begins if this functionality was not in place.

All Consents are in hand, with the exception of agreeing and implementing noise monitoring procedures for Section A by 20 May 2018. This is being progressed by RfL and BT.

**Rolling Stock**

The issue of CDL remains ‘red’, as there is little contingency available to resolve any issues that arise. Completion of the software testing was forecast to complete in time for the evidence to be presented at MTRC-SVP, scheduled for 30 April. It will now be presented on 9 May 2018.

Testing of the software has been generally positive, so the need for implementing a mitigation plan<sup>3</sup> has not increased. CRL should state what the latest date is for implementation of the mitigation plan.

[REDACTED]

Following discussions with the contractor, there is now more confidence that this can be achieved by 20 May 2018. [REDACTED]

[REDACTED] The optimum solution at this point is that the CDL testing is sufficiently comprehensive that MTR-C SVP is able to accept less restrictive platform allocations.

[REDACTED]

[REDACTED] and completing the necessary assurance documentation. This situation is not comparable with the position of DOO CCTV in Stage 1, but does need management focus to ensure a manageable situation does not impact Stage 2 Phase 1 opening.

**Regulatory Approvals**

The status of the of the remaining key approval to be completed (‘SMS updated for passenger service’) has changed from ‘red’ to amber. It was ‘red’ due to concerns by MTR-C that BT would not be able to produce the required assurance in time. Confidence has risen due to progress in line with the schedule. We remain cautious, as there is limited time to complete the outstanding works and document accordingly.

**2.5 Phase 2**

The issues affecting Phase 2 are as follows:

**OOC**

There has again been no change to the BIU and signalling commissioning dates during the period from our last report, and we are not aware of any major issues that are likely to affect that situation in the near term.

<sup>3</sup> The mitigation plan is described as Class 387 stock, leased from GW and driven by MTR-C drivers, who will require training.

**Rolling Stock**

The slippages to the MOHS dates have now been formally agreed, so there is no change to the situation that we described in our last report.

We note that Stage 2 Phase 2 requires TCMS v7.3 (full ETCS). [REDACTED]

[REDACTED] The interim activities to measure progress are:

- Software code freeze – 15 May 2018;
- Type testing of software on the train – 23 June 2018.

We will be monitoring progress of these activities.

Functional testing in the Alstom laboratory began in the period, and was granted an extension by NR to allow testing to continue until complete on 20 April 2018. BT and Alstom are scheduled to complete a joint report by 30 April 2018. We will report upon its findings.

**Regulatory Approvals**

There has been little change from our last report. [REDACTED]

**2.6 Agreements**

There are three key agreements which are critical for Stage 2 that RfL has assessed as ‘amber’. These are;

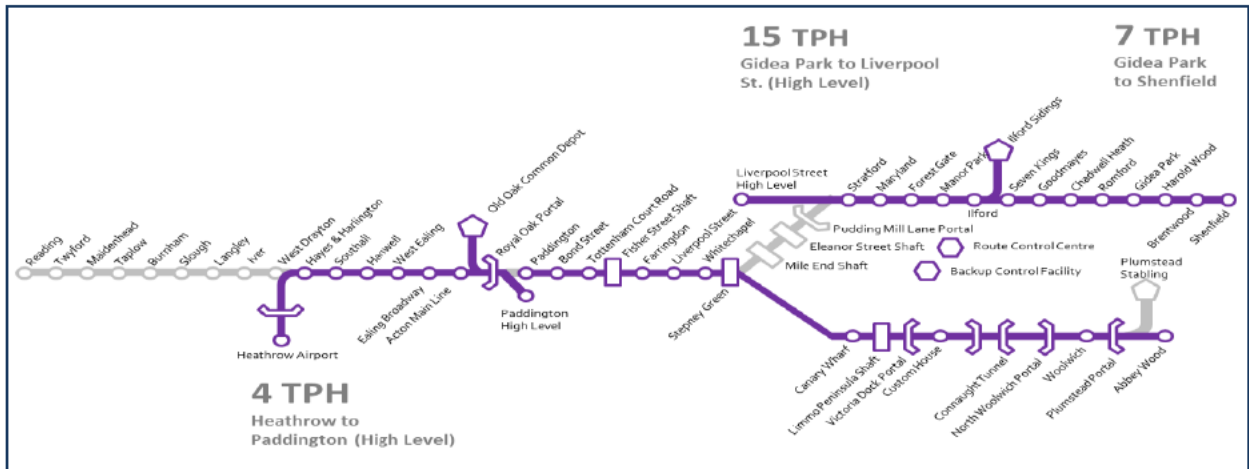
- Framework Access Terms and Conditions – Heathrow Spur;
- Track Access Agreement – Heathrow Spur;
- Station Access Agreements for Heathrow Spur Stations.

RfL reports that the ORR issued a determination in week commencing 23 April 2018. This will now unlock the delivery of these agreements.

There are six other agreements with HAL that are on the critical path for Stage 2 Phase 1, and these are classified as ‘green’ by RfL. We understand RfL intend to extend the lease on the C360 trains to cover the period from December 2018 to start of Stage 2 Phase 2.

See Appendix D.1 for progress charts.

**3 Stage 3: Paddington to Abbey Wood; 9 December 2018<sup>4</sup>.**



**3.1 Summary**

Although CRL and its contractors are working to the targets set in the MOHS, there remain significant challenges on all fronts. There remains a high risk that one or more stations will not be ready, and that Stage 3 Opening will not be achieved on the planned date.

*Twenty Readiness Tasks have been given a “Red” by the ELRSG.*

*There have been positive developments with regard to train software development, but there are still issues in meeting MOHS dates.*

*Further evidence of increasing schedule pressure at the stations.*

*The Stations Phase 3 integration testing schedule is being impacted by delays to [REDACTED]*

*[REDACTED]*

*RAB(C) has raised concerns with the timing, quality and clarity of CRL submissions.*

*Completion of IRNs remains significantly behind the rate required to support MOHS.*

*[REDACTED]*

*[REDACTED]*

*A large residual Assurance workload continues to accumulate.*

*Concerns continue with the provision of sufficient Rolling Stock for Trial Running.*

*Continuing schedule pressures to deliver Handover materials (e.g. training, asset data, O&M Manuals, Spares) a risk to Trial Running.*

<sup>4</sup> Stage 3 Completion of Trial Running is 9 September 2018; Stage 3 Opening is 9 December 2018.

### 3.2 Operational Readiness Assessment

There are twenty Readiness Tasks that have been given a “Red” by the Elizabeth Line Readiness Steering Group (ELRSG)<sup>5</sup>, a decrease of two from the previous report. Those Tasks that improved, or have closed, are shaded grey and will be removed in our next report.

Six of the tasks are rated as ‘medium’ impact, but have a cumulative impact upon RfL-I maintenance and LU staff being trained and competent, which is rated as ‘high’ impact. The twenty Readiness Tasks can be attributed to three categories, and are the same issues as last period:

- CRL not receiving data, or it being below the necessary quality, from the Tier 1 contractors. This impacts upon IM training courses for both operations and maintenance personnel, completion of maintenance plans and finalisation of assurance reviews. These activities need to be completed so that the IMs can prove they are able to accept and operate the railway;
- COS infrastructure and interfaces not being in a position to support dynamic testing;
- Train software not being in a position to support dynamic testing.

	Readiness Task	Issue
<b>Dynamic Testing Zones 1-2</b>		
	Delivery of FLU with functioning CBTC	MOHS dates are being exceeded, increasing the pressure upon the more limited time for testing. See Section 3.8.
	MAID deliverables uploaded in Livelink <i>Medium impact</i>	Handover material is in delay. See Section 3.9.
	RfL-I acceptance of FDO (for interfacing assets) <i>Medium impact</i>	FDO certificate dates continue to be delayed. See Section 3.7.1.
	Training of RfL-I staff on CCRRB (Crossrail Construction Railway Rule Book) <i>Medium impact</i>	RfL-I staff will be using the ATC rule book in the short term, and ATC has trained an RfL-I trainer who will disseminate amongst RfL-I
	Possessions & isolations agreed and booked	Delays to the programme are affecting possession plans. There is also potential delay from a requirement from NR that [REDACTED] provides a maintenance regime prior to installation of the transition assets.
<b>Dynamic Testing All Zones</b>		
	Interfaces commissioned & operational for Trial Running	The continued delays to the IM training schedule increases the risk that RfL-I and NR operatives will not be able to facilitate testing and commissioning activities. This risk is being compounded by the lack of asset readiness.
	LU Elizabeth line asset data in Ellipse/ Maximo <i>Medium impact</i>	Handover material continues to be in delay. See Section 3.9.
	Compliance Achieved (FDO signed without caveat)	Issue raised in ‘RfL-I acceptance of FDO (for interfacing assets)’. See Section 3.7.1.
	O&M manuals in place for 5 LU stations <i>Medium impact</i>	O&M manuals continue to be provided below the necessary quality and in the required timescale. See Section 3.9.

<sup>5</sup> Meeting held 6 April 2018.

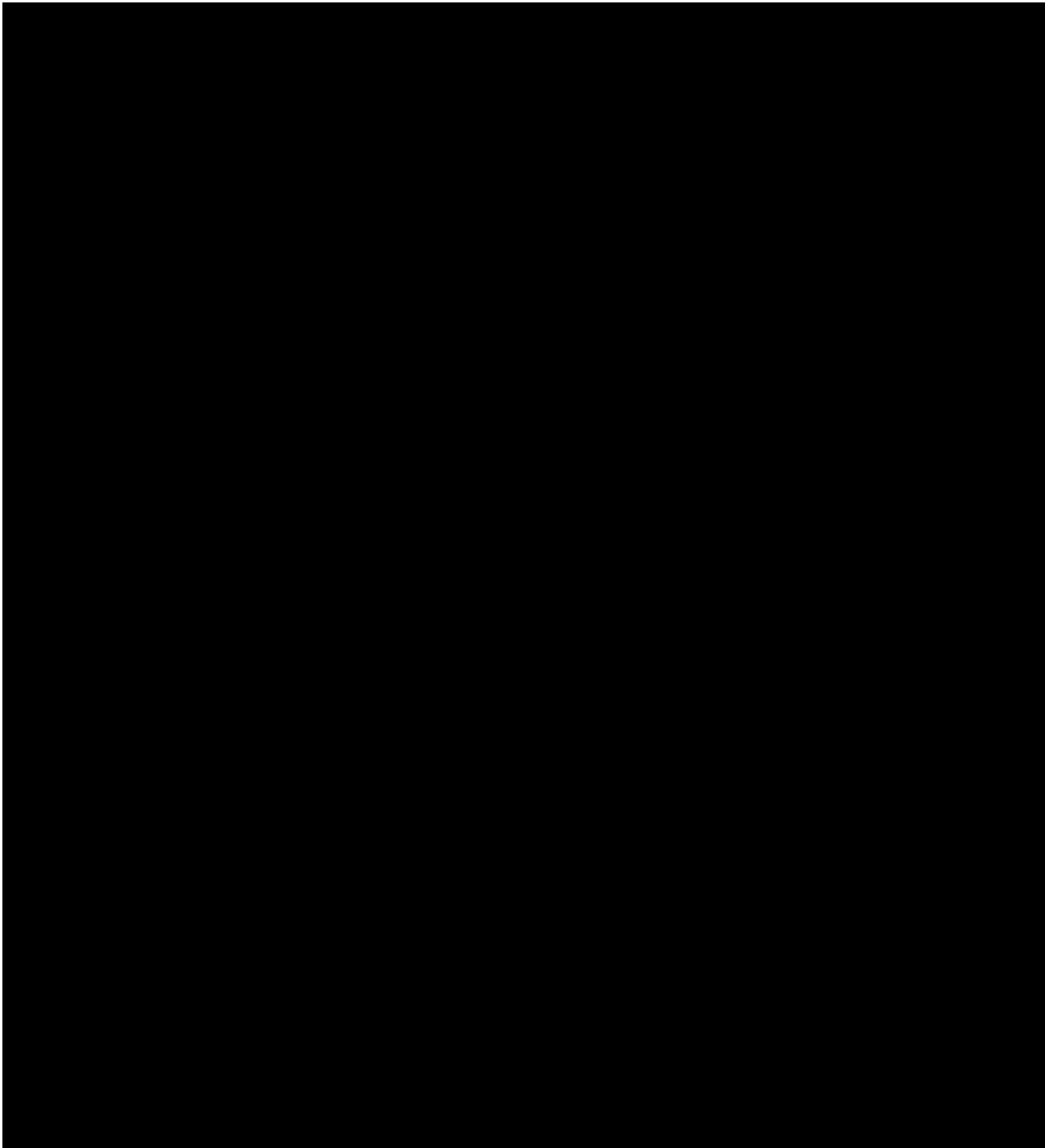


	Readiness Task	Issue
	LU maintenance in place for Handover <i>Medium impact</i>	The lack of O&M manuals and asset data described above risks LU staff being inadequately prepared.
	RfL maintenance staff train the trainer complete <i>Retired</i>	This Task has been retired as the strategy to train the RfL trainers was abandoned due to delays in the programme, to be replaced by direct training to all staff
	All tech training delivery to RfL-I trainers	The IM trainers and staff may not receive the expected training by the Contractors. The current programme cannot be fully met. See Section 3.9.
	O&M manuals for RfL-I completed	Delivery of O&M manuals continue to be behind programme, affecting IM readiness. See Section 3.9.
	System information delivery (asset data, O&M manuals, training plans, MAXIMO) <i>Medium impact</i>	IMs not receiving the level of information required. This Readiness Task is similar to the 'O&M manuals completed' Task.
	Systemwide approvals and agreements in place for DT	This reflects the delay associated with Zones 3 & 4 readiness.
<b>Trial Running</b>		
	Sufficient 345 units available to support 24tph tests	FLU's have been manufactured, but there may be issues with sufficient numbers meeting the acceptance criteria for the start of Trial Running. See Section 3.8
	MTR-C Station Handover	This task was previously in <i>DT all zones</i> section. It reflects the late completion of [REDACTED] and [REDACTED] stations.
	Element Completion Handover Certificate signed by LU	The Certificate requires Handover materials and the Stations to be completed. Handover materials are adjudged to be red, and some stations are delayed.
	RfL-I maintenance staff trained and competent	Red due to contractor training plans and asset availability. See Section 3.9.
	RfL-I Ops & RCC staff trained, licenced & competent	The delays to the [REDACTED] at the RCC have affected the Traffic Manager training programmes. Some will not be trained until after Handover. In addition delays to the start of Trial Running/Trial Operations will reduce the time for the staff to familiarise themselves with the railway.
<b>Trial Operations</b>		
	LU Handover achieved	This task is Red due to the items listed above.
<b>Stage Three Service</b>		
	LU Staff Ready to Open for Revenue Service	This task is Red due to the items listed above.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 3 - 1 ~ Readiness Tasks with "Red" Status





The general progress of the station works, in readiness for testing and commissioning, is being measured by the various Tier 1 contractor's production of Installation Release Notices (IRNs). [REDACTED]. There are an estimated 3,911 IRNs required for the Stations, Shafts and Portals (SSPs). By the close of Period 13, only 1,006 IRNs have been signed-off. This is a negative variance, against plan, of 719 IRNs. The actual rate of completion of IRNs are noted by station in the Sections below.

The rate of IRN submissions is dependent on the physical completion of the works and accruing delays to the schedule. IRN completions are being strongly pursued by CRL and the project teams continue to push the contactors; but some of the stations (e.g. [REDACTED] and [REDACTED]) have raised concerns that the focus on achieving IRNs has detracted from physical

installation works. [REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

The production of Handover Execution Plans (HEPs) has progressed well during the period and all SSP sites have now submitted their HEPs to CRL and their respective IMs (LUL/RfL) for review. The HEPs will allow the IMs to plan and organise their response for Staged Completions, asset handover and the start of their familiarisation/operation processes. Terminology around “staged” and “final” completion, is being harmonised towards the use of LUL terms. LUL has also started to assign staff to embed within each of the CRL station teams. RfL and MTR-C need to follow suit. All three parties will be signatories to the acceptance of the HEPs. LUL has, however, emphasised to CRL that the HEPs are not intended to be a relaxation of the handover process, to what might be regarded as “handover light”.

We note that CRL’s delivery team at [REDACTED] it has resumed scenario planning exercises for a delayed station opening with LUL and RfL. CRL has also started a dialogue with RfL and MTR-C regarding how best to complete external SORBA (GFRC cladding) works at [REDACTED] station, post station opening, in the event that the works over-run. Contingency scenarios are also being investigated to mitigate delays to Tunnel Ventilation Systems at [REDACTED] station.

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED]

[REDACTED] is

[REDACTED] and [REDACTED] stations continue to work on mitigating forecast schedule delays. Delays, ongoing scope changes and prolongation of works at these stations, continue to put pressure on CRL’s budget. Completing these stations as planned by the MOHS dates remains a significant challenge.

The commercial close-out plans for [REDACTED] and [REDACTED] stations were approved by C&CSC on 17 April 2018. Each plan noted that a number of 3<sup>rd</sup> party issues still need to be resolved by the PM. Members of the meeting also discussed the ‘mountain of assurance documentation’, including As-Built drawings, that have to be completed. The anticipated large quantity of documentation will apply across all CRL projects. This will need a considerable number of man hours input from Tier 1 contractors over the next few months, and corresponding CRL/consultant resources to review and accept the documents. All of this work implies additional cost and an increasing risk of delay. CRL has recognised this issue and will have to seek additional budget to cover the required increased resources.

**Paddington Station**

[REDACTED]  
[REDACTED]  
[REDACTED]  
[REDACTED], and:

- [REDACTED]  
[REDACTED]  
[REDACTED];

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

**Bond Street Station**

[Redacted]

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

**Tottenham Court Road Station**

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

**Farringdon Station**

- [Redacted]
- [Redacted]
- [Redacted]

[Redacted]

**Liverpool Street Station**

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

- [Redacted]

[Redacted]

**Whitechapel Station**

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]
- [Redacted]

[Redacted]

**Woolwich Station**

[Redacted]

[Redacted]

- [Redacted]
- [Redacted]
- [Redacted]

[Redacted]





[REDACTED]

[REDACTED]

### 3.5 Completion and Handover of Integrated Systems

The success of MOHS 2018 is highly reliant upon the performance of the [REDACTED] main works contractor ATC as the principal enabler for completion of the Central Section. CRL has worked closely with [REDACTED] in the period, seeking to develop a delivery schedule which is aligned with the MOHS<sup>6</sup>; the [REDACTED]. The [REDACTED] schedule is based upon “blockade working”, a change in strategic delivery approach designed to meet the MOHS dates. This approach addresses the problem that Systemwide delivery and dynamic testing have effectively “saturated” the tunnel environment, with little scope for gaining performance improvement in one workstream without having significant impact upon the other; it also overcomes the fundamental inefficiencies of the current philosophy of alternating between dynamic testing and construction (on days and nights, respectively).

With only approximately 15 weeks until the start of Trial Running on 5 August 2018, this is probably the last opportunity for a significant change to be implemented and for sustained performance improvements to be realised. CRL has analysed time at the workface under the current day/night access cycle, allowing the routine delay impacts associated with works trains movements and tunnel logistics to be better understood<sup>7</sup>. [REDACTED]

[REDACTED]

[REDACTED] The objective is to complete Central Section Railway Systems installation before the start of Trial Running, although this will not be possible for some workstreams, as we explain below. The split between construction and dynamic testing in a given two week period is 11 days and 3 days respectively. This provides an insight both into how much construction remains, and also into the true current readiness for sustained dynamic testing.

Notwithstanding the installation recovery potential that blockade working offers, a huge backlog of associated Systemwide IRNs and other assurance documentation remains. Completion of documentation is critical to progression to dynamic testing and handover, and a significant increase in performance is necessary now to avoid downstream delay.

[REDACTED]

[REDACTED] Workplace safety benefits will arise from the certainty of [REDACTED]

<sup>6</sup> CRL MOHS Period 13 Review held on 13 April 2018.

<sup>7</sup> Results presented at the CRL [REDACTED] Period 13 PDB held on 10 April 2018.

working in longer-established work sites, and also from the reduction in the risk of human error associated with significantly fewer site handovers between construction and testing.

Blockade working is due to be implemented for the first time on 26 April 2018, extending to the start of Trial Running on 5 August 2018. CRL and its contractors are able to agree adjustments to the balance between construction and dynamic testing within the 14 day cycle, according to progress on site, and this plan offers perhaps the most robust structure for final delivery. We will report on progress next period.

Key dates in the dynamic testing phase through to Trial Operations are shown in Figure 3 - 3. Significant movements in milestone forecast dates<sup>8</sup> are described below.

Key Dates	MOHS 2018	P12 Actual / Forecast	P13 Actual / Forecast
Traction Power Energisation	01-Feb-18	01-Feb-18	01-Feb-18
Commence DT in Z1&2	25-Feb-18	25-Feb-18	25-Feb-18
ONW KD33 Power from KG	28-Feb-18	28-Feb-18	21-May-18
4 Trains ready for DT Z3&4	23-Mar-18	09-May-18	15-May-18
Fibre Backbone complete	07-May-18	27-Mar-18	07-May-18
ATS at WBP energised	07-Apr-18	07-Apr-18	27-Apr-18
Traction Power on Z3&4	10-May-18	10-May-18	21-May-18
Linewise SCADA available	30-May-18	30-May-18	30-May-18
Commence DT in Z3&4	11-Jun-18	10-Jun-18	11-Jun-18
HV Non Traction Power on	01-Jul-18	01-Jul-18	29-Jul-18
Commence DT All Zones	02-Jul-18	02-Jul-18	02-Jul-18
Commence Trial Running	05-Aug-18	05-Aug-18	05-Aug-18
Commence Trial Operations	09-Sep-18	09-Sep-18	09-Sep-18
Completed on time			
Forecast later than MOHS			
A557 - MOHS baseline date changed from 27/3/18 to 7/5/18 under change control 103			

Figure 3 - 3 ~ Key Dates to Trial Operations

To date, the high productivity rates upon which MOHS 2018 is founded continue to prove difficult to achieve in practice, as illustrated in the Systemwide progress charts in Appendix B.

[REDACTED]. This was the first of a pre-determined “daisy-chain” of HV sub-station energisations (i.e. both 11kV and 22kV) on 12 consecutive weekends, in a sequence designed primarily to support the completion of the permanent Tunnel Ventilation System. Energisation of 11kV circuits at Limmo finally took place on 1 April 2018, with the 22kV circuits following on 15 April 2018. Despite detailed review it has not proved possible for [REDACTED] to offer any significant delay recovery within the sequence, but changes in [REDACTED] management<sup>9</sup> are providing some confidence that current forecasts are sustainable. [REDACTED]. However, the propagation of the 4 weeks delay through the HV Power schedule to the final location at [REDACTED] Station on 29 July 2018, is a significant factor in the delayed completion of the permanent ventilation works until after the start of Trial Running.

<sup>8</sup> CRL MOHS Period 13 Review held on 13 April 2018.  
<sup>9</sup> Discussed at the Period 13 CRL [REDACTED] PDB held on 10 April 2018.

Permanent power delivery allows the various Stations and Rail Systems deliverables to be brought together as an integrated power distribution system, and success relies upon close co-ordination and readiness of Stations installations. Stations Shafts and Portals Systems Phase 3 integration testing requires the support of [REDACTED]

[REDACTED]

However, Phase 3 testing at some locations will still extend beyond the current start of Trial Running because of localised delays.

Other period movements are associated with [REDACTED]. These effectively provide traction power electrical separation in the OLE between Crossrail and NR, necessary to allow independent energisation, testing and commissioning of the Central Section on 21 May 2018. One PES was completed on 15 April 2018, with the remaining two currently scheduled for 19 and 20 May 2018. [REDACTED]

[REDACTED]

Platform Screen Door installation in Zone 1 has been delayed because of the prioritisation of other works which support the early stages of dynamic testing. While completion is currently scheduled just ahead of the PSD requirement to support the relevant stage of dynamic testing (due to start on 10 May 2018), further delays could impact overall dynamic testing progress. It should be noted that a supplementary submission to RAB(C) is necessary to secure the approval to proceed to this next stage of dynamic testing. See Section 3.7.3.

Having been recognised several periods ago as a risk, the delivery of GSM-R has emerged as a [REDACTED] critical issue with the potential for delay to the start of Trial Running. This has its origins with tunnel radio cable installation not being sufficiently prioritised by [REDACTED] possibly because GSM-R is not considered to be critical to dynamic testing (for which communication functionality is provided by the [REDACTED] Construction Radio). As a result, while Base Station installation at Stations Shafts and Portals has progressed well, sections of the radiating cable network at [REDACTED] and [REDACTED] in Zone 1 are not yet installed, and there has been negligible progress in Zones 3 & 4. Incomplete installation is driving a fragmented approach to system testing, for which it is difficult to secure the necessary NR support. (The Crossrail GSM-R system is effectively an extension of the NR GSM-R national network, in which NR will provide an agreed level of voice and data management service in order to support Crossrail railway operations). CRL is engaged in discussion with NR on how this workstream can be supported, given the compressed schedule and late installation.

Notwithstanding the implementation of blockade working, the [REDACTED] schedule still contains a number of workstreams which are unable to be accelerated sufficiently. These will therefore extend beyond the current start date for Trial Running and if delays are not sufficiently mitigated, into Trial Operations. Examples include:

- [REDACTED] non-dynamic testing critical works (e.g. walkways, lighting, LV cabling);
- [REDACTED] removal of temporary works (e.g. lighting, fire main, radio);
- [REDACTED] permanent ventilation system completion and testing;
- [REDACTED] completion of testing;
- [REDACTED] completion of integration testing with Rail Systems;
- [REDACTED] completion of integration testing with Stations.

Working arrangements continue to be developed between CRL and RfL that will allow the completion of these known late activities, from the time of Handover and into the Trial Running and Trial Operations periods. CRL must look to engage closely with RfL as the outputs from blockade working become evident, because these will provide an early indication of the extent to which the Trial Running and Trial Operations start dates might be threatened. RfL will influence fundamentally the broad timing of the handover process, and CRL's commitments and decision-making associated with it. We repeat our advice from last period that it is crucial that open engagement is maintained, to allow all opportunities and options for the opening of Stage 3 to be jointly explored.

## 3.6 Dynamic Testing

### 3.6.1 Dynamic Testing Management

The introduction of blockade working from 26 April 2018, described in Section 3.5 above, concentrates dynamic testing into discrete 3 day periods up to the start of Trial Running. We do not yet know the detailed planning of the test runs, but intuitively blockade working offers a much more efficient use of time and resources. While the current rates for completing test cases in Zones 1 & 2 are low, it is reasonable to assume that performance will improve significantly towards the end of dynamic testing; see also Section 3.6.2. Thus the relatively long intervals (i.e. 11 days) between each dynamic testing period is appropriate for now, but we can foresee schedule adjustments to allow longer periods of dynamic testing in June and July 2018, assuming good general progress with signalling testing. CRL has indicated that there is flexibility to do this.

Testing in the Central Section is being complemented by off-site testing at BT's facilities at Derby, and at Melton Test Track. Satisfactory initial integration testing at Derby allows software to be released to Melton. Integration testing of TCMS v.7.1.3 is currently in progress at Melton, with v.7.2 expected to follow on 4 May 2018.

The current dynamic testing sequence has been reduced to two principal elements:

- Zones 1 & 2 (EDT)
- All Zones (i.e. Zones 1 - 4)

Dynamic testing started on 25 February 2018 and will continue until Trial Running, currently scheduled to start on 5 August 2018. Testing, originally planned to be carried out over a period of 35 weeks in MOHS 2017, was compressed into 23 weeks in the original MOHS 2018; the same site testing scope is now to be carried out in 21 days of what can be summarised as 3 day periods of "highly intensive dynamic testing". Although details have not yet been confirmed, this is likely to involve testing in at least 2 shifts per testing day, with a significant step-up in supporting resources. [REDACTED]

[REDACTED] We will report further on this next period.

### 3.6.2 Zones 1 & 2 Dynamic Testing

Dynamic testing in Zones 1 & 2 continues, with steady rather than spectacular progress being made. The tests for stray electrical currents and touch potentials which were outstanding last period have been completed, allowing restrictions on testing imposed by neighbouring railways to be removed. As a result CRL moved dynamic testing to day shifts, with construction taking place at night. However, as described in Section 3.5 above, experience has shown that sharing of tunnel access between construction and dynamic testing in this way has proved inefficient and impractical, resulting in the implementation of blockade working from 26 April 2018.

██████████ has recently summarised progress to date<sup>10</sup>. Testing activities have been limited by the available functionality of the █████ software with not all signalling features proven or demonstrated beforehand at Melton. As of 12 April 2018, only 6 out of a minimum of 145 test cases planned to be undertaken in Zones 1 & 2 have been successfully completed; and even these will need to be re-tested with final versions of software and data.

A number of unexpected issues have been revealed, the most serious of which has been an incompatibility between signalling and OLE designs, which result, under certain conditions, in a train pantograph moving into an isolated electrical section at Abbey Wood. CRL has concluded that the best solution is to move the train stopping position towards London. This requires a relatively minor C620 Signalling design change, which is able to be implemented without overall schedule delay.

The recent just-in-time approval by RAB(C) of the Safety Case for Dynamic Testing with Signalling Protection allows dynamic testing with a single train only. Extension of the scope to multiple trains can only proceed under the cover of further approved safety submissions, and the availability of time and resources to develop these, along with related submissions for energisation of Zones 3 & 4, is a concern. See Section 3.7.3.

Replacement of broken rail baseplates discovered in Connaught Tunnel was completed in the period and associated temporary speed restrictions have been lifted, allowing train speed increase test to start on schedule in Zones 1 & 2.

### 3.6.3 All Zones Dynamic Testing

Under the new blockade working approach, Dynamic testing in Zones 1 – 4 will start during the blockade scheduled for 21 to 26 June 2018. Dynamic testing will be carried out over three blockade weekends in order to demonstrate end-to-end integrated signalling functionality.

Signalling transition testing at each of the NR GE and GWML interfaces is scheduled independently of the blockades, and is due to take place between mid-June and the end of July 2018 as below:

- GE - 16/17 June and 7/8 July 2018;
- GW - 14/15 July and 28/29 July 2018 (yet to be agreed with NR).

The geographic extension of energisation and dynamic testing to Zones 3 & 4 will require the development by CRL and acceptance by RAB(C) of new safety cases. We provide further details in Section 3.7.3.

## 3.7 Approvals, Assurance and Agreements

### 3.7.1 Final Design Overview (FDO) Performance

Progress on the closure of FDO “Red” issues associated with the stations and shafts has already been noted in the Section 3.4.

The close-out of FDO “Red” issues continues to frustrate CRL and the forecast dates for FDO certification continue to slip. An FDO certificate is a prerequisite for Interim Acceptance and Handover of the new assets to the IMs. At the current rate of closure, the Red FDO issues will not be closed until late May 2018, at the earliest:

<sup>10</sup> ██████████ presentation at the CRL Period 13 MOHS Review held on 13 April 2018.

- 45 “Red” issues have now been closed or downgraded to “Amber” (83 in Period 12);
- 72 “Ambers” were closed in Period 13 (18 in Period 12);
- This leaves a total of 127(172 in Period 12) “Red” issues open; comprising 78 (108 in Period 12) Stations, Shafts and Portals issues and 49 (64 in Period 12) Systemwide issues;
- IMs are raising concerns over not receiving associated assurance deliverables, as defined by the FDO Evidence list;
- At the period close, there were 52 “Red” issues (89 in Period 12) that have been proposed closed to RfL.

### 3.7.2 Interoperability

Ricardo Rail (RR), acting as CRL’s NoBo, reports that design assurance is progressing. However:

- The ongoing absence of a baseline programme from CRL, for the management and monitoring of the assurance process, is still a concern. However, joint RR/CRL programme workshops are being arranged to address this issue.
- With the high volume of evidence documentation still to be issued and current documentation under review, there is a real concern that the preparation of the Technical File and SAR within the remaining time scale may be difficult. RR has been further advised that some information may only become available after 17 September 2018. CRL has yet to advise RR what specific information will be delayed.
- The remaining NoBo Interim Safety Verification’s (ISV) have been issued with Design Status at close to 100% completion. There is, however, still no indication when Test and Commissioning evidence will start to be provided by CRL.
- CRL has yet to confirm when the evidence for Construction and T&C will be provided to the NoBo for inclusion in the Technical File, or when site inspections by the NoBo will take place. CRL has notified the NoBo that the Technical File will now be required in September 2018 (not June 2018).

The NoBo still awaits CRL’s decisions and instructions regarding the following issues:

- The NoBo has been assessing against the draft Gauging standard, while waiting for CRL to formally issue the Gauging standard.
- NR still needs to supply evidence in respect of open Persons of Reduced Mobility TSI requirements for Abbey Wood station. The associated Interim Safety Verification cannot be concluded until NR supply the remaining evidence.

RR, acting as CRL’s AsBo, continues to report major concerns relating to the finalisation of the Safety Assessment Report (SAR) in 4 months. These concerns are summarised as follows:

- The System Definition and System Safety Plan have yet to be finalised;
- There is still no clear and agreed submission schedule for the formal supply of all remaining evidence to enable the AsBo to develop a viable programme that will ensure timely delivery of the SAR;
- There is no programme for the essential CRL/contractor and AsBo interactions, necessary to achieve a supportive condition;
- The AsBo still awaits detail concerning the CRL processes for confirmation of compliance for the safety requirements;
- The preparation of the AsBo’s SAR is on hold awaiting CRL’s instruction to recommence the preparation of this document.

The AsBo’s Period 13 report summary concludes, in respect of progress to a supportive SAR, that:

- The SAR is now at significant risk that it will not be supportive. CRL has postponed the SAR and the AsBo awaits redefinition of a programme that de-risks the final SAR submission;
- There is an increasing risk that the Final SAR will also be unable to support APIS.

The AsBo continues to urge CRL to commit to the required actions identified for each of the concerns summarised above. The time to address these issues is running out.

The AsBo still awaits detail concerning the CRL processes for confirmation of compliance with safety requirements. The AsBo expected this detail to be in CRL’s ESM System Safety Plan. The AsBo has produced its Assessment Plan based on largely generic content. This plan has been issued to CRL. CRL has now agreed to develop the detail in workshops with the AsBo; but it is very late in the programme to be resolving this detail.

System Definition, System Safety Plan and contractor plans have yet to be finalised. The AsBo has actively supported CRL in its finalisation of the System Definition and update of its System Safety Plan. The AsBo has, however, been advised that the majority of the main contractor’s plans detailing the build, to validate and integrate stages of their contractual commitments, will now be updated. This is surprising considering how little time remains to complete the remaining activities that will be detailed in the Plans.

### 3.7.3 RAB(C)

RAB(C) has continued to prioritise CRL submissions which support dynamic testing progression ahead of others. The most recent achievement was the Safety Case for Dynamic Testing with Signalling Protection which was finally accepted by RAB(C) on 12 April 2018, albeit with its application to testing with a single train only. The restriction reflects Panel concerns with the way the safety argument has been expressed, and its reliance upon evidence spread across a number of documents, each with separate authors.

There is no indication that the Panel is being influenced externally. However, schedule pressure has been building gradually in the background, initially evident through missed submission dates, but now, more tangibly, through slippage in site delivery. While RAB(C) has been extremely flexible in the way it has accommodated late and “imperfect” documents, the discomfort evident in accepting this latest important submission has caused RAB(C) to re-state its minimum requirements for future approvals. While there is time available ahead of multiple-train dynamic testing for CRL to make improvements, no spare resources are available, placing further pressure upon existing teams. [REDACTED]

[REDACTED]

[REDACTED]; this is illustrated by RAB(C)’s reaction. The need to develop new safety arguments for energisation and dynamic testing in Zones 3 & 4 at the same time, compounds an already difficult challenge for CRL. The schedule for RAB(C) submissions production has very little float and is only just managing to support CRL’s energisation and dynamic testing aspirations on site. CRL must act quickly in order to address RAB(C)’s response.

In the meantime, the workload of late and deferred submissions remains, and there have been no significant improvements in the production by the Contractors of the documents that underpin the various Safety Cases. We understand that contractor resources necessary to develop assurance documentation are planned to be de-mobilised before work has been completed, and CRL must carefully factor this into the overall document production workload.

The key Engineering Safety Management submissions for the Stage 3 Safety Case are shown in Figure 3 - 4. These documents are critical to the achievement of Stage 3 Opening.

No	Key Dates	MOHS 2018	Period 13 actual / forecast
1	Contractors submit draft ESJs to CRL	31-Mar-18	31-Mar-18
2	Safety Assessment Report (SAR) substantially complete (for AsBo)	31-Mar-18	31-Mar-18
3	Draft COS Safety Case with results from Z1&2 DT	30-Apr-18	30-Apr-18
4	Contractors submit final ESJs to CRL	30-May-18	30-May-18
5	CRL submit Safety Justifications to RAB-C	07-Jun-18	07-Jun-18
6	COS Safety Case submitted to RAB-C (to facilitate Handover)	30-Jun-18	30-Jun-18
7	Final COS Safety Case updated and submitted to RAB-C	31-Aug-18	31-Aug-18
8	Submit Technical File to ORR	17-Sep-18	17-Sep-18

**Figure 3 - 4 ~ Engineering Safety Management Submissions for Stage 3 Safety Case**

The MOHS milestone for all contractor ESJs has been missed, although around 35% of submissions have been received; CRL has considered the downstream schedule impacts and has been able to agreed a range of revised dates with contractors, extending to the end of May 2018. A draft Safety Assessment Report has been received by CRL, and comments returned.

### 3.7.4 Regulatory Approvals

We described in our previous report that CRL was tracking eight approvals. There is now one additional item ‘BT re-issue updated technical file for Stage 3’. This is because all train approvals would have originally been obtained at Stage 2 Opening. The delay of Stage 2 beyond Stage 3 means that some Regulatory Approvals must be obtained for Stage 3.

CRL has adjudged the overall rating of Stage 3 as ‘amber’. We recognise that many of the approvals are in that category, but the continued slow rate of submissions to RAB-C will disrupt the AsBo and safety sign-offs of the IMs. [REDACTED]

[REDACTED] This is scheduled for 22 June 2018<sup>11</sup>. We feel that ‘amber’ does not reflect the task required to complete CRL’s safety deliverables, and that ‘red’ would be more appropriate.

### 3.7.5 Agreements

There are five agreements that are adjudged to be amber:

- Telephony Communication Agreements;
- First Crossrail Track Access Agreement between NR and MTR-C;
- Network Interface and Services Agreement;
- Infrastructure Interface Agreement for Portals and South East Spur;
- Umbrella Property Agreement.

Our key concern is the slow progress of the Umbrella Property Agreement between TfL and NR. This is required to enable TfL to permit the grant to facility operators of essential licences to occupy railway premises. The physical locations are South East Spur, Paddington Station and the Portals. Without these RfL cannot become the IM for the Central Section. The CRL Managing Director is meeting with NR in April 2018 in order to expedite the issue.

The slippage of the re-baselined<sup>12</sup> critical Agreements programme has continued into Period 13. See charts in Appendix D.1.

<sup>11</sup> P80 schedule.

<sup>12</sup> Re-baselined in Period 10 2017/18.



### 3.8 Rolling Stock

There has been a significant development since our last report, with the uploading of TCMS v7.1 onto the train. This enables it to carry out single train tests in Automatic Mode (without auto-reverse). Despite the slippage of circa 5-6 weeks, BT is holding to its programme of receiving authorisation to operate for Trial Running by 26 June 2018. This date is 6 weeks from the start of Trial Running.

We continue to have concerns whether there will be sufficient Rolling Stock to fully operate the tests required in the Trial Running Period. The total number of trains required for Trial Running is not scheduled to be reached until 17 August 2018, two weeks after the start of Trial Running on 5 August 2018. There is also the possibility that the trains could be unreliable, based upon performance on the east. This would hamper Trial Running exercises.

### 3.9 Handover

We reiterate our comments from our previous reports, that all four components of Handover continue to be critical, with the rate of improvement below what it needs to be to enable IM readiness for Trial Running.

#### Training

The training programme continues to be hampered by poor delivery of courses, whether from poor quality of training materials and training modules or cancellations. CRL's MOHS schedule for the completion of delivering training to RfL Operations and Maintenance was 3 July 2018. It is now forecasting 3 August for maintenance, and 27 August for operations. These [REDACTED] dates are likely to affect RfL's preparations for Trial Operations, with a significant risk that further delays are possible.

We expect the implications of the delay to be considered in the preparations for Trial Running.

#### O&M Manuals

There has not been sufficient progress in this period to make significant inroads into the back log of O&M manuals. O&M manuals are critical for IMs to demonstrate their ability to operate the railway. The CRL executive team is aware of the issue, and is trying to exert pressure upon the contractors. We hope this action will produce some benefit in the near future, but we do not foresee an increase in the required rate of performance.

#### Spares

There has been some progress between the IMs and CRL concerning Spares, with CRL providing further information where it can. The issue remains open.

#### Asset Information

The MOHS schedule date for IMs to receive their first of two tranches of information<sup>13</sup> was 1 March 2018. It has now been re-forecast from 30 March 2018 in Period 12 to be delivered in stages, beginning on 15 May and ending 13 July. The Asset data is important, as it allows the IMs to demonstrate they are capable of fulfilling their maintenance obligations.

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<sup>13</sup> The first tranche to RfL essentially explains how many assets there are, where they are and what they are. The second tranche explains the attributes of the equipment.

In summary, the criticality of the issues described above have increased during Period 13, and are likely to impact upon how IMs prepare for Trial Running. This situation has been critical since we first raised it in our Period 1 report<sup>14</sup>.

### 3.10 Trial Running and Trial Operations

We have explained throughout Section 3 the pressures that are likely to impact upon these phases of the project.

In our last report we asked the question as to how will the quality of Trial Operations be affected. The period is likely to be under pressure to be further reduced, and CRL works that extend into this period could further impact RfL-I preparations by restricting access, or delaying its exercises, if assets are not present.

### 3.11 Plumstead Depot

Delays to Central Section delivery has required ██████ to retain the Plumstead Railhead to support construction later than originally planned. This has caused delay to the staged handover of land to ██████ necessary to facilitate construction of the Plumstead Maintenance Facility, and introduced the risk that the Facility will be prevented from completing on time. The MOHS 2018 date for handover of the Maintenance Sidings is 21 November 2018.

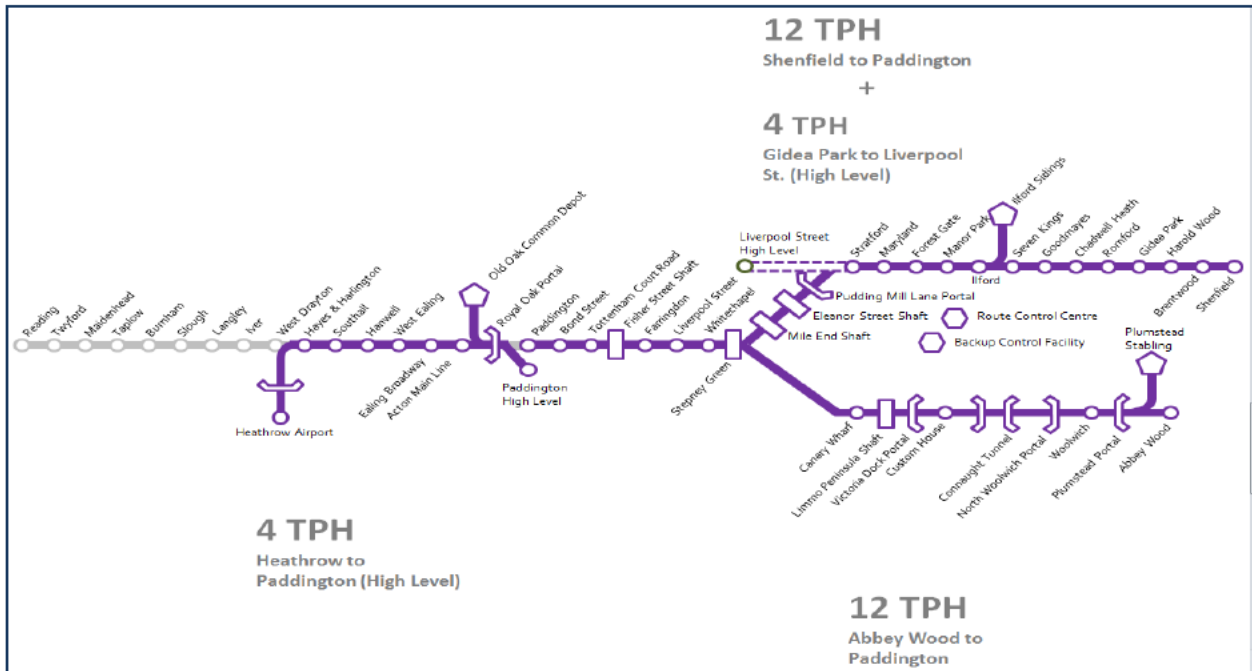
In response, CRL has investigated alternative sites upon which construction logistics support facilities can be established. This is to allow the Plumstead Railhead to be de-mobilised as soon as possible. Alternatives considered have included Hoo Junction Sidings and Plumstead Old Coal Yard, and arrangements are now in place for modifications at the latter.

The FDO for Plumstead Maintenance Facility and Stabling Sidings took place on 29 March 2018. No significant issues were revealed and the 9 Red issues are planned to be closed-out by the end of April 2018.

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<sup>14</sup> PSR 98 Period 1, 2017/18. 25 May 2017.

**4 Stage 4: Paddington to Abbey Wood & Shenfield; 19 May 2019.**



**4.1 Summary**

There are a number of risks relating to Stage 4, but they are all being mitigated by CRL and NR.

**4.2 Operational Readiness Assessment**

There are four Readiness Tasks that have been given a “Red” status by the ORSG<sup>15</sup>, a reduction of one from our last report.

	Readiness Task	Issue
	Wire height alignment corrected to standard in Ilford Depot	NR has started investigations, and is consulting with stakeholders with regard to scope. We would like to see the rate of progress increase.
	KD22 power upgrade Works – Distribution PML to Goodmayes, Gidea Park Shenfield ATS sites	NR has confirmed that the programme is forecast to complete on 29 March 2019, but there have been delays to interim activities since Period 12. CRL and RfL should plan for a scenario where there is insufficient power to operate the planned timetable.
	PML Eastbound Neutral Section Transition (incl Packet 44 data)	A plan to carry out the necessary software upgrade has been received from BT that forecasts completion by end 2018.  [REDACTED]

<sup>15</sup> 11 April 2018.

	Readiness Task	Issue
	Ilford Station Redevelopment	NR is forecasting Ilford Station to be open by December 2019. [Redacted] [Redacted] See Section 4.4.
	DOO CCTV installed and operational Stratford and Shenfield stations	[Redacted] [Redacted] [Redacted]

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 4 - 1 ~ Readiness Tasks with "Red" Status

### 4.3 Ilford Depot Line Speed Enhancement and Wire Heights

The London end exit speeds issue has been resolved and a final draft agreement is with AGA and DfT. The scope of work for Ilford wire heights is reducing, although arrangements need to be agreed with AGA.

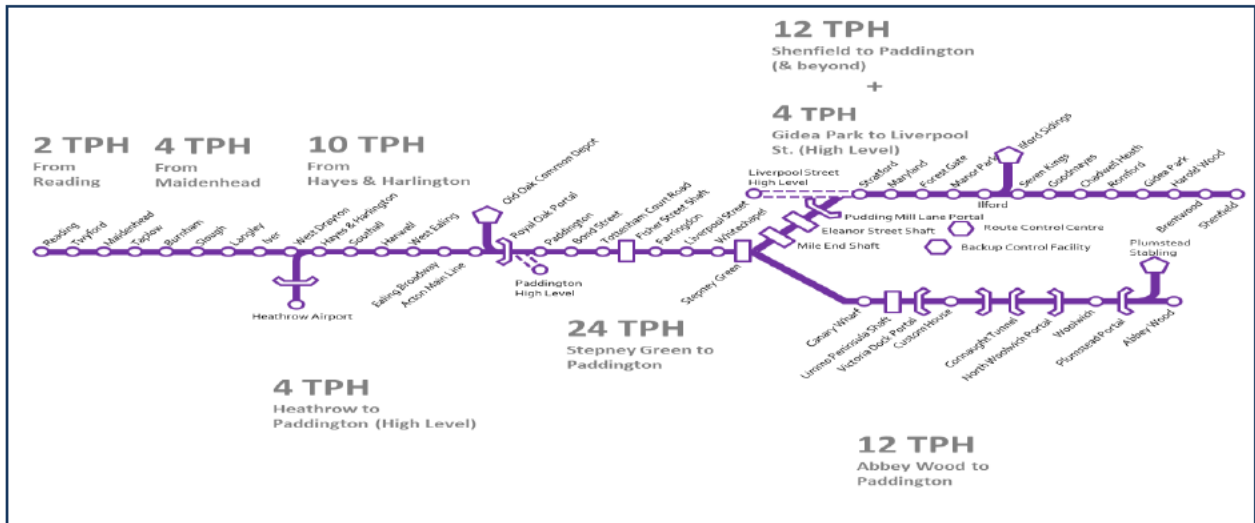
### 4.4 Ilford Station

NR has reported that the GRIP 5 Design paper for Crossrail East Enhanced Stations (Ilford & Romford) has been approved by Network Rail's Regional Change Panel. Consequently, the GRIP5 Design has been awarded on schedule to Atkins with detail design due for completion forecast for August 2018. NR reported that Volkers will be instructed under an ECI arrangement in early May 2018, with a competitively bid GRIP 6 construction contract to follow in October 2018. NR has stated that it remains committed to station opening for December 2019 and will mitigate previously reported delays.

### 4.5 Plumstead Stabling Sidings

The Supplemental Agreement for delivery of the Stabling Sidings (under C696) is currently with ATC (C610) for sign-off, but parties are effectively performing as if formal arrangements are in place.

**5 Stage 5: Reading & Heathrow to Abbey Wood; 8 December 2019.**



**5.1 Summary**

Although there are a number of concerns, these are being mitigated. The principal issue remains the possibility of delay to NR’s ETCS installation programme, and what that might entail if the existing derogation is not extended.

**5.2 Operational Readiness Assessment**

There are four Stage 5 Readiness Tasks that have been reported as a “Red” status to the PDB on 11 April 2018.

Readiness Task	Issue
ETCS available and tested Airport Jn to Paddington	If ETCS is not available then there is a technical solution that will enable CBTC to TPWS transition, but this will require ORR to extend the existing derogation. See Section 5.3.2.
ONFR Western station upgrades complete	Six stations (Hayes, Southall, W Drayton, Acton, W Ealing and Ealing Broadway) are scheduled to be completed by December 2019, with little float available. See Section 5.3.1.
Maidenhead Sidings complete for C345 FLU stabling inc staff accommodation	The issue concerns staff accommodation. Currently there is no programme or delivery vehicle. We would like to see more progress to ensure an important facility is available on time.
ORR issue APIS for ETCS (Stage B & C)	Linked to ‘ETCS available and tested airport Jn’ task.

Note: Definition of Red – no information / no owner / no schedule visibility or confidence / fundamental issues exist

Figure 5 - 1 ~ Readiness Tasks with "Red" Status

## 5.3 Network Rail Works

### 5.3.1 Platforms and Stations

NR reports that the Maidenhead Station GRIP 4 design is expected by the end of April 2018. Following the discussions between CRL and NR in respect of the implementation strategy, the delivery of staff accommodation for Maidenhead, Shenfield and Gidea Park will be de-scoped from the NR ONW works and carried out by CRL. Final arrangements to be clarified by CRL.

NR has reported that Tenders have been received for the West Enhanced Stations Main Works Package 3 (Southall, Hayes and Harlington, and West Drayton). NR is presently assessing the Tender submissions and undertaking its procurement normalising process. NR continue to report that Contract award is scheduled for 20 June 2018.

NR also confirms that Tenders for West Enhanced Stations Main Works Package 2 (Acton Mainline, Ealing Broadway, and West Ealing) were received on 16 April 2018 which will follow identical assessment processes with Contract award on schedule for 11 July 2018.

NR has confirmed that the detailed design for Hayes & Harlington, Southall, West Drayton, Acton and West Ealing is expected to achieve Approved for Construction status (AFC) for the end of April 2018.

NR continues to report to be on schedule for all stations to be open by December 2019.

### 5.3.2 ETCS Delivery on the GWML

#### **Stage A (Heathrow):**

The NR draft Safety Justification Report was presented to the Safety Review Panel on 13 April 2018. NR is responding to the Safety Assessment Report from the AsBo and reports that the Technical File submission to ORR is scheduled for 30 April 2018. NR remains on course to achieve Authorisation to Place into Service (APIS) from ORR for 15 May 2018.

#### **Stages B & C (Stockley-Acton & Acton-Paddington):**

NR reports that the Stage C asset data surveys are in progress and that 30% of infrastructure surveys have been completed. NR has confirmed that its Run 1 data is ready for testing at the Charleroi laboratory but the delay to HIA5 (integrated laboratory testing) at Charleroi, as a consequence of supporting CRL Stage A testing, is having an impact on the Stage B/C programme, delaying the start of Stage B laboratory works from 19 March 2018 to 23 April 2018. NR has identified the appropriate risk ownership with CRL.

NR reports that work will commence later in the year (2018) to consider and plan in the eventuality of an extension or fresh submission being required of the expiry of the ORR ETCS Exemption.

## 6 Health & Safety

### 6.1 Health & Safety Performance COS (CRL)

Health and Safety key performance indicators are shown below in Figure 6 - 1. The HSPI increased slightly during Period 13 but still remains well above target, with all 11 Principal Contractors (PC's) scoring over 2.20. The RIDDOR and the lost time case (LTC) AFR increased slightly but both measures remain well within target.

H&S KPI	Target	Period 12	Period 13
HSPI	2.20	2.57	2.59
PCs scoring over 2.20	11	11	11
RIDDOR AFR	0.15	0.08	0.09
LTC AFR	0.23	0.16	0.17

*Figure 6 - 1 ~ Health and Safety Performance COS*

During Period 13, there were 5 significant incidents including 1 RIDDOR, 3 LTC's and 1 High Potential Near Miss.

The Construction Phase H&S Plan for Canary Wharf Station works has finally been updated by C239 and C610, and signed-off by all relevant parties.

CRL is currently agreeing the formulation of the HSPI with its PCs for the 2018/19 year. This should be complete soon after the CRL Board meeting. CRL is also updating the PCs knowledge of the RfLI safety management arrangements following its application to ORR, and the impact of working under RfL and LUL rules following Handover. RfL has also commenced its verification of the various documents relating to the CDM Regulations.

CRL has commenced its annual 'Stepping-Up' campaign, which features a range of events across the various sites until 28 April 2018.

### 6.2 Health & Safety Performance ONW (NR)

During Period 13, NR's rolling 13 period Lost Time Incident Frequency Rate (LTIFR) has increased slightly to 0.1869. This is due to recording a RIDDOR reportable injury event at Pudding Mill Lane. The Programme's overall All Injury Rate has decreased again, and is currently 0.80 injuries per 100,000 hours worked.

At Pudding Mill Lane, an operative suffered a punctured lung and fractured ribs when two colleagues dropped an auto transformer cable that all three had been lifting. This resulted in the operative falling under the weight of the cable and on to an empty pallet. No first aid was provided at site, as the operative believed they were only winded. The operative was subsequently admitted to hospital for surgery. NR recorded three minor injuries in Period 13. Six other safety incidents and significant close calls were reported in Period 13, including three instances of trespass, vandalism and theft.

## 7 Cost

### 7.1 Summary

The Intervention Points have not changed, but the AFCDC has increased by £256m during Period 13 following the refreshed QCRA. IP2 will be formally breached by £211m at SACR19.

*IP0, IP1 and IP2 have not changed in Period 13.*

*The AFCDC at P50 has increased by £256m to £12,723m.*

*The AFCDC at P50 exceeds IP2 by £211m.*

*The P80 AFCDC is £12,790m which exceeds IP2 by £278m.*

*The P95 AFCDC is £12,855m which exceeds IP2 by £343m.*

*The QCRA increased to £475m.*

*£340m of the P50 risk exposure is URTs.*

*The AFCDC at P50 exceeds the reported financial budget by £216m.*

*Although the Target and Defined Cost gaps are showing signs of closing, the convergence is slow and the value for both still shows an increasingly upward trend.*

*The CRL ONW AFC, including VNs, remains at £2,530m.*

*The ONW FFOC reduced by £20m in Period 13 to £2,376m.*

### 7.2 AFCDC and Intervention Points

IP0, IP1 and IP2 have not changed in Period 13. CRL has reported a significant increase of £255.6m to the Period 13 AFCDC. CRL has carried out its Period 13 Q4 QCRA, which has resulted in a net increase to the Programme risk provision of £243m. Further cost increases and delays at [REDACTED] (£11.2m) and other net increases (£1.4m). At Period 13, CRL is reporting the P50 AFCDC as £12,723m, the P80 AFCDC at £12,790m and the P95 AFCDC at £12,855m.<sup>16</sup>

The CRL Period 13 AFCDC (P50) exceeds IP2 by £211m. The AFCDC (P80) is £278m above IP2 and the AFCDC (P95) exceeds IP2 by £343m. We expect CRL to formally confirm the breach of IP2 in its SACR19 report. Consequently, the Secretary of State may be required under the Crossrail Project Development Agreement (PDA) to provide additional funding.

<sup>16</sup> P80 and P95 AFCDC revised by CRL 25 April 2018.



(£ millions)	Period 12	Period 13	Delta	Movement
<b>Forecast</b>	<b>12,223</b>	<b>12,247</b>	<b>24</b>	up
Delivery Risk	5	0	<b>-5</b>	down
Programme Risk	235	472	<b>237</b>	up
Board Risk	4	4	<b>0</b>	same
<b>AFCDC total</b>	<b>12,467</b>	<b>12,723</b>	<b>256</b>	up
IP0	11,672	11,672	<b>0</b>	same
<b>IP0 Headroom</b>	<b>-795</b>	<b>-1,051</b>	<b>-256</b>	down
IP1	11,912	11,912	<b>0</b>	same
<b>IP1 Headroom</b>	<b>-555</b>	<b>-811</b>	<b>-256</b>	down
IP2	12,512	12,512	<b>0</b>	same
<b>IP2 Headroom</b>	<b>45</b>	<b>-211</b>	<b>-256</b>	down

Figure 7 - 1 ~ AFCDC (P50) Headroom to Intervention Points

During Period 13, the QCRA has increased to £475m. The Period 13 QCRA includes a provision of £25m for Programme Non-delivery Risk, which leaves £450m to fund URTs. CRL is reporting URT's at £340m for Period 13 (an increase of £49m on Period 12), leaving a QRA residual pure risk allowance of £135m. The percentage of pure risk as a proportion of cost to go (including URTs) for Period 13 has returned to Period 11 levels, rising by 26% to 20%. The level of pure risk, in terms of value, was similar from Period 11. Consequently, the order of magnitude of risk change as a consequence of the QCRA appears to be light on face value, with pure risk value echoing Period 11 and just £49m increase on URTs from Period 12. We have recently received a copy of the QCRA model and will carry out our review and report in due course.

CRL continues to seek cost efficiencies and to challenge contractors costs in its attempt to remain within funding, but we continue to note the following:

- The AFCDC (P50) continues to rise and further increases are likely. The analysis of defined cost continues to show a greater rate of increase in CRL assessments of defined costs still rising towards the contractors estimates. See Section 7.3;
- CRL is reporting that the programme is over 92% complete and engaging in the safety critical stages of testing and commissioning. Therefore, realistic prospects for major cost savings by reviewing the remaining scope at such a late stage, without compromising the necessary safety and procedural requirements of many complex interactive interfaces, remains highly improbable;
- We regard the preparation by CRL of the SACR19 Report and 2017/2018 Financial Statements for audit may not bring any benefit to funding management.

Figure 7 - 2 indicates the cumulative delivery overspend at each period.

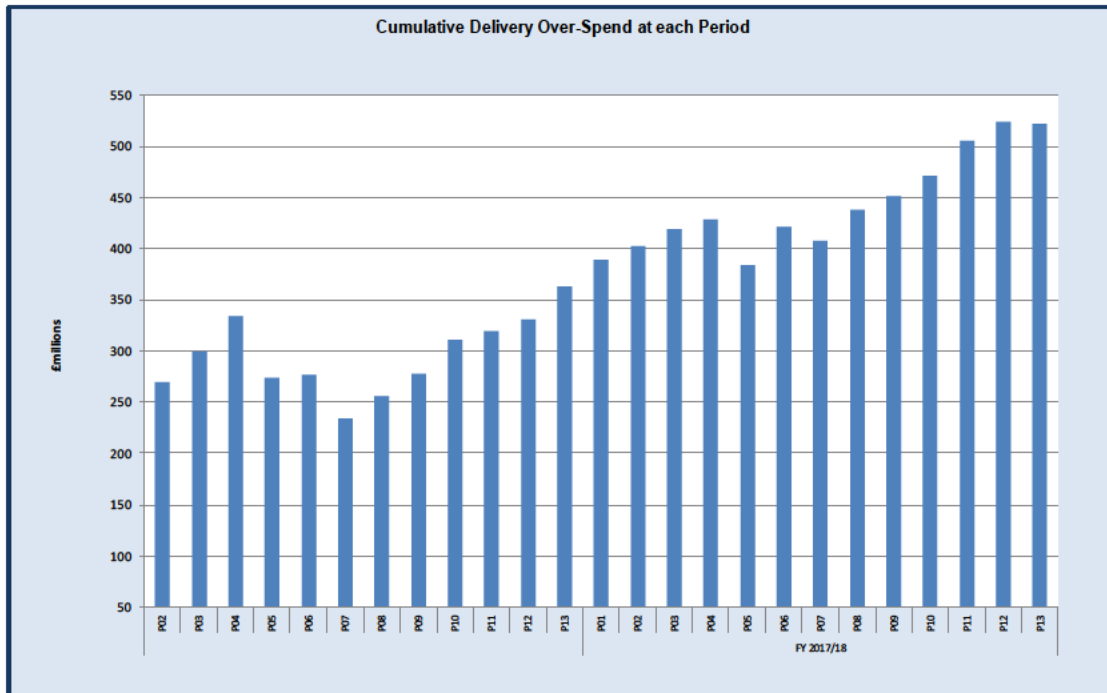


Figure 7 - 2 ~ Cumulative Delivery Overspend at each Period

The cumulative delivery overspend has reduced in Period 13 by £2m to £522m (Period 12, £524m). CRL reports that spend and performance in Period 13 continues to be dominated by Stations and Systemwide Sectors, which together accounted for 82% of Delivery’s Cost of Work Done in Period 13.

CRL reports that, in Period 13, it spent £107.5m above the 2017/18 Business Plan. This is mainly due to:

- Poor productivity, construction and logistics cost increases, access delays, changes in scope and resource mitigation resulting in prolongation at [REDACTED] (£19.3m);
- Ongoing prolongation and delays at [REDACTED] (£8.5m);
- Delays at [REDACTED] (£4.6m)
- Changes to the Masterplan Shaft sequence and prolongation at [REDACTED] (£7.8m);
- Prolongation and scope changes at [REDACTED] (£10m);
- [REDACTED]
- [REDACTED]
- Prolongation, scope changes and delays associated with [REDACTED]e interfaces at Portals and Shafts (£5.3m).

This expenditure was offset by £10.8m of apparent unspent Programme risk due to cost being reported in the Sectors.

### 7.3 Cost: Central Operating Section (COS)

During Period 13, Sponsors received a presentation from the independent review of the process and scope of the CRL cost and risk assessment. Consequently, this review has been extended to interrogate key construction contracts to verify CRL cost and delivery scenarios.

Period 13 has again seen cost increases to both CRL assessments and Contractors' estimates for Target Costs and Defined Costs. [REDACTED]

[REDACTED] due to the trend of CRL's assessments of Defined Costs rising at a greater rate than the Contractor estimates. However, our assessment forecast suggests that both Target and Defined cost gaps are converging, such that:

- CRL assessment of Defined Costs continues to rise at a greater rate towards increasing Contractors Defined Cost estimates;
- CRL Target Cost assessments continue to rise towards slightly falling Contractors Target Cost estimates.

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

- [REDACTED]
- [REDACTED]
- [REDACTED]

## 7.4 Cost: On Network Works (ONW)

The ONW FFOC reduced by £20m in Period 13 to £2,376m. This is due to confirmation of NR’s £20m cash funded contribution. The CRL ONW AFC, excluding VNs, remains at £2,376m in Period 13. The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,325.6m, which exceeds the DfT Invention Price of £2.3bn by £25.6m.

The FFOC is subject to an estimated pain share adjustment of £70.4m, which results in a Forecast to the RAB of £2,305.6m, which exceeds the DfT Invention Price of £2.3bn by £5.6m.

Figure 7 - 4 indicates the relevant breakdown.

Description	Period 12 £m	Period 13 £m
CRL AFC Excluding VNs	2,376	2,376
VN Funding	154	154
<b>CRL AFC Including VN's</b>	<b>2,530</b>	<b>2,530</b>
Cash Funding:		
CRL Funding Agreement between CRL and NR	22	22
DfT 1st tranche cash funding NR secured via the DfT Grant Funded Agreement	28	28
DfT 2nd tranche cash funding NR secured via the DfT Grant Funded Agreement	84	84
NR Funding Contribution	-	20
Total Cash Funding	134	154
<b>FFOC</b>	<b>2,396</b>	<b>2,376</b>
Pain/gain share	-70	-70
<b>Forecast to RAB</b>	<b>2,326</b>	<b>2,306</b>

Figure 7 - 4 ~ Breakdown and Formulation of the NR ONW FFOC and RAB

### 7.4.1 ONW Funding

CRL has reported that the total AFC and Variations funding for NR ONW is unchanged and remains at £2,530m for Period 13. This is in line with confirmed funding arrangements with Sponsors. NR is also reporting Total Secured Funding for NR ONW has increased by £17.3m in Period 13 to £2,835.4m, as a consequence of NR securing £17.3m WOE (OLE renewal) recovery in the period, as shown in Figure 7 - 5. [REDACTED]

[REDACTED]. NR has received approval in principle post Period 13<sup>17</sup> from the NR Portfolio Board (CP5 contingency) for additional funding (£54m) to address previously identified risks associated with Contractor cost pressures. This is due to be formally considered on 26 April 2018.

<sup>17</sup> Confirmed on the NR/DfT Conference Call 17 April 2018.

Description	P13 Source of Funding				P12
	DfT £m	CRL £m	NR £m	Total £m	Total £m
KD1A - OTP	2,049.0	-	-	2,049.0	2,049.0
CRL Managed Risk	110.0	-	-	110.0	110.0
Portfolio Board Funding	217.0	-	-	217.0	217.0
Approved £154m VNs	112.0	22.0	20.0	154.0	154.0
<b>NR Current Funding</b>	<b>2,488.0</b>	<b>22.0</b>	<b>20.0</b>	<b>2,530.0</b>	<b>2,530.0</b>
<b>Sub Total</b>	<b>-</b>	<b>118.9</b>	<b>186.5</b>	<b>305.4</b>	<b>288.1</b>
<b>TOTAL SECURED FUNDING</b>	<b>2,488.0</b>	<b>140.9</b>	<b>206.5</b>	<b>2,835.4</b>	<b>2,818.1</b>

Figure 7 - 5 ~ NR ONW Secured Funding

During Period 13, NR has confirmed its £20m funding contribution. [REDACTED]

### 7.4.2 ONW Cost

CRL reports that the Grand Total Cost has increased in Period 13 by £17.3m to £2,835.4m, with a mid-point sensitivity of plus £66.5m, as shown in Figure 7 - 6.

Description	Period 12 £m	Period 13 £m	Delta £m	Cost Sensitivity		
				Low £m	Mid £m	High £m
SPOT AFC - Gross excluding Risk	2,894.9	2,901.6	6.7	2,886.5	2,932.9	3,015.5
Risk	0.0	0.0	0.0	0.0	0.0	0.0
Efficiencies	-24.3	-24.3	0.0	-21.9	-9.7	0.0
Recoveries (Residual)	-37.2	-18.1	19.1	-13.1	-11.8	-9.1
Targeted Savings	-15.3	-23.8	-8.5	-21.5	-9.5	0.0
<b>Cost Grand Total</b>	<b>2,818.1</b>	<b>2,835.4</b>	<b>17.3</b>	<b>2,830.0</b>	<b>2,901.9</b>	<b>3,006.4</b>
Total Secured Funding	2,835.4	2,835.4	0.0	2,835.4	2,835.4	2,835.4
Funding Gap	-17.3	0.0	17.3	-5.4	66.5	171.0

Figure 7 - 6 ~ NR ONW Cost Summary

NR continues to focus on cost control; however, in CRL's view, the most significant cost risks to the ONW are in respect of unresolved commercial positions for:

- Anglia [REDACTED]
- OOCPA ([REDACTED]);
- Kent ([REDACTED]);
- Signalling ([REDACTED]);
- Stations KO4 Phase 1 Package 1 ([REDACTED]).

NR has received Tenders for West Outer enhanced stations package 3 and is currently progressing with tender reviews.

### 7.5 Contingency

The Finance Current Control Budget remains at £12,507m for Period 13. The £12,723m AFCDC (P50) consequently exceeds the reported financial budget by £216m, and exceeds the RP4.2 Baseline funding of £12,136m by £587m. The Period 13 P80 AFCDC of £12,790m exceeds the FCCB by £283m. CRL intends to increase its FCCB to a value above IP2.

CRL is reporting that the overall Period 13 contingency budget of £220m is insufficient to cover the P50 risk exposure of £475m by £256m (a £283m deterioration from Period 12). The centrally controlled Delivery contingency at Period 13 has reduced by £5m to £42m.

Figure 7 - 7 shows the trend of the decrease in the Board and Programme Contingency and compares the significantly increased Risk Exposure at P50 and P95 with the remaining contingency.

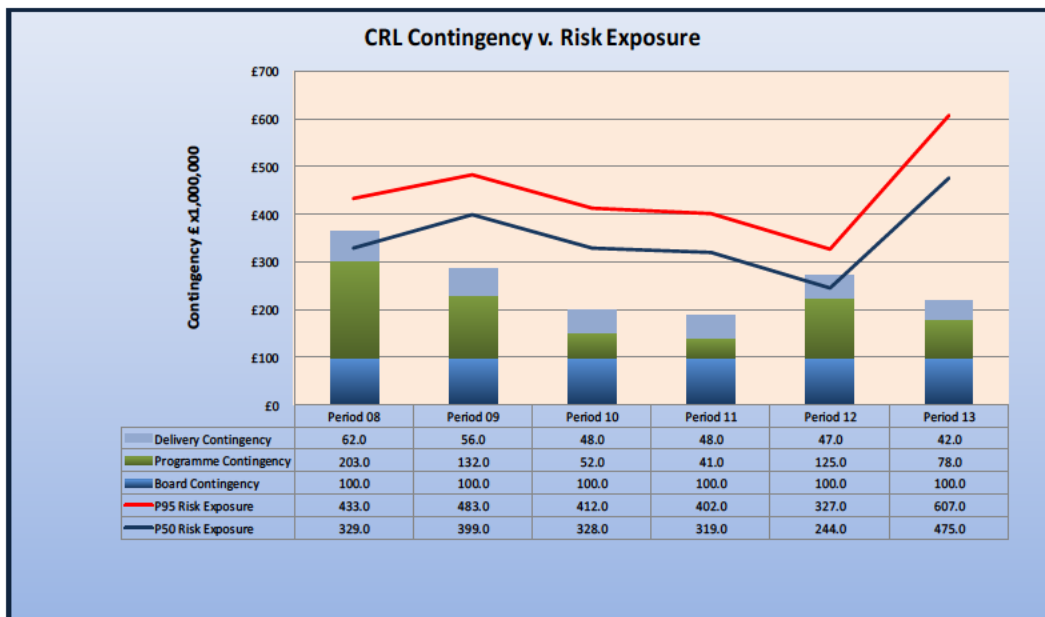
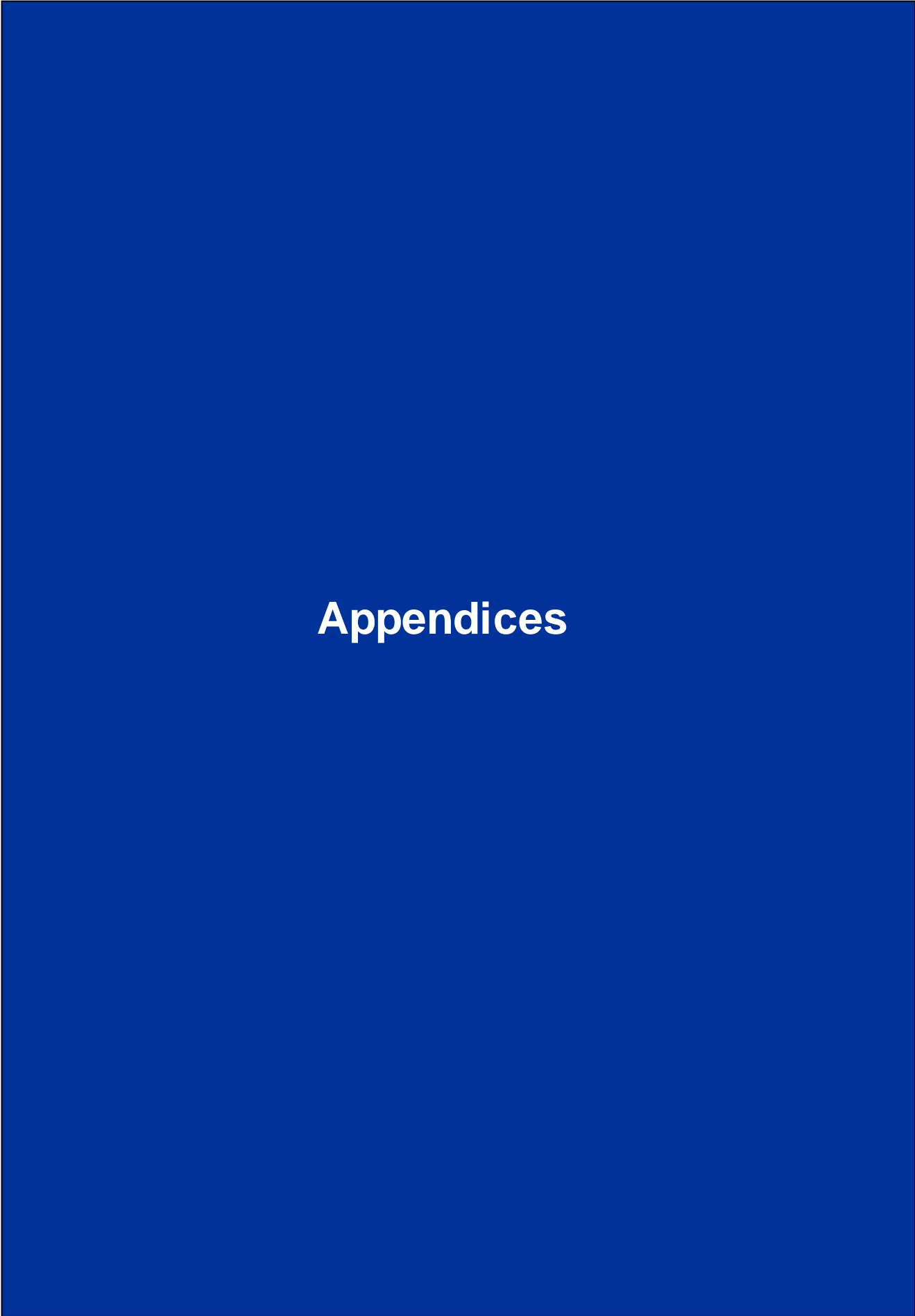


Figure 7 - 7 ~ Risk Exposure versus Contingency



**Appendices**

Appendix A Contract Administration

A.1 General

Figure A - 1, Figure A - 2 and Figure A - 3 illustrate the status of Notified Compensation Events (NCEs).

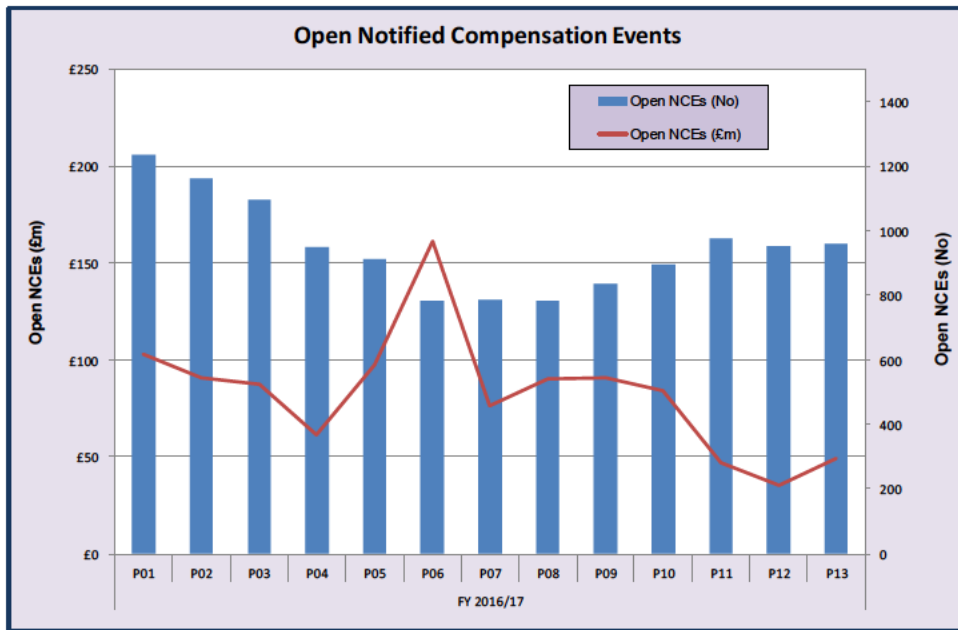


Figure A - 1 ~ Open Notified Compensation Events

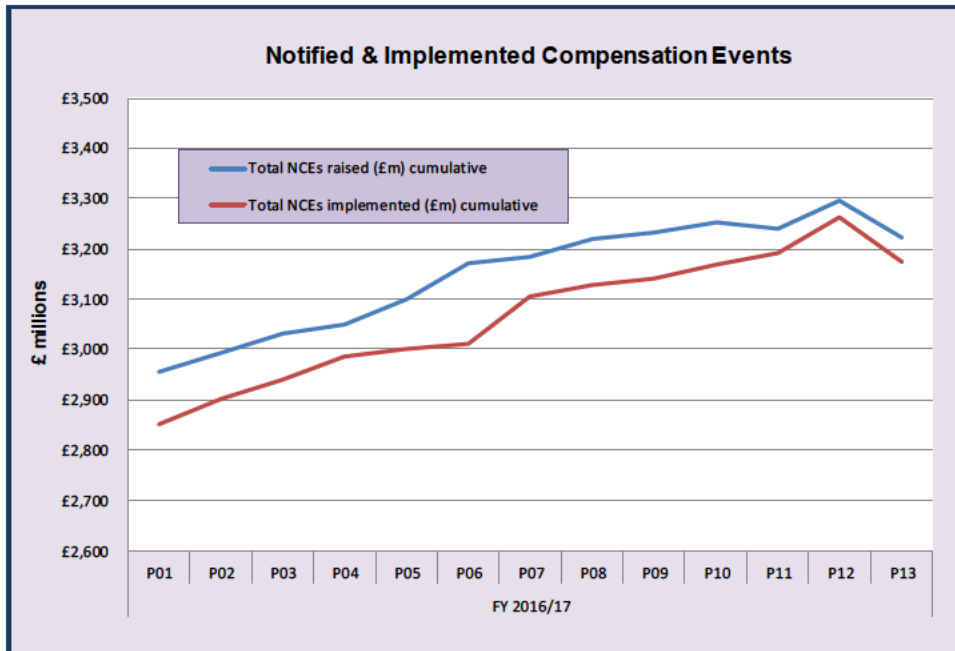


Figure A - 2 ~ Notified Compensation Events



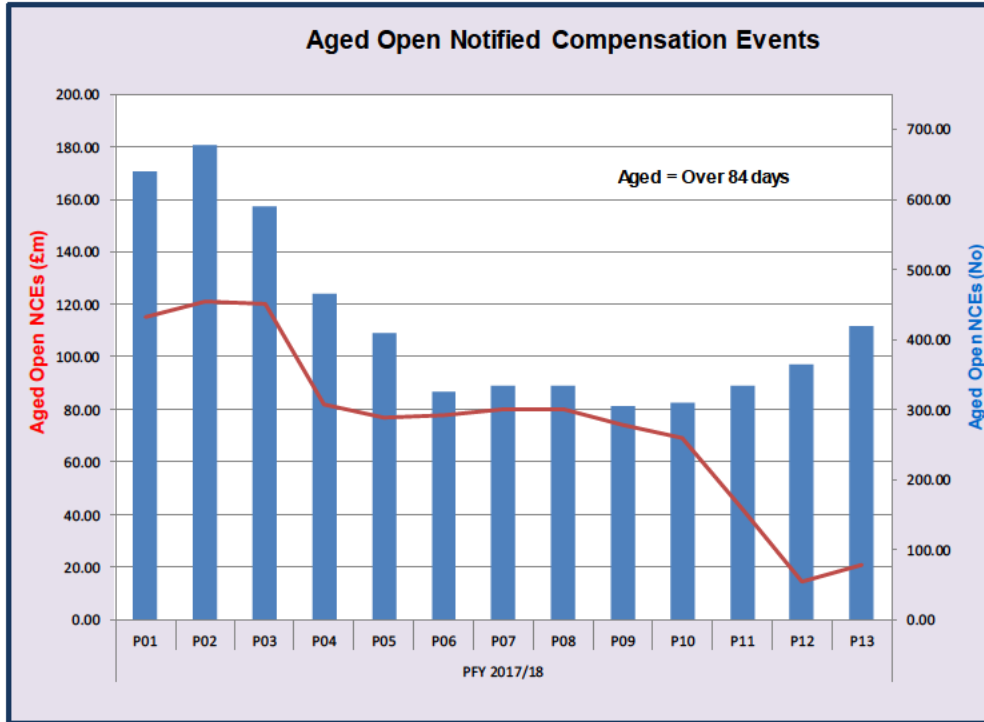


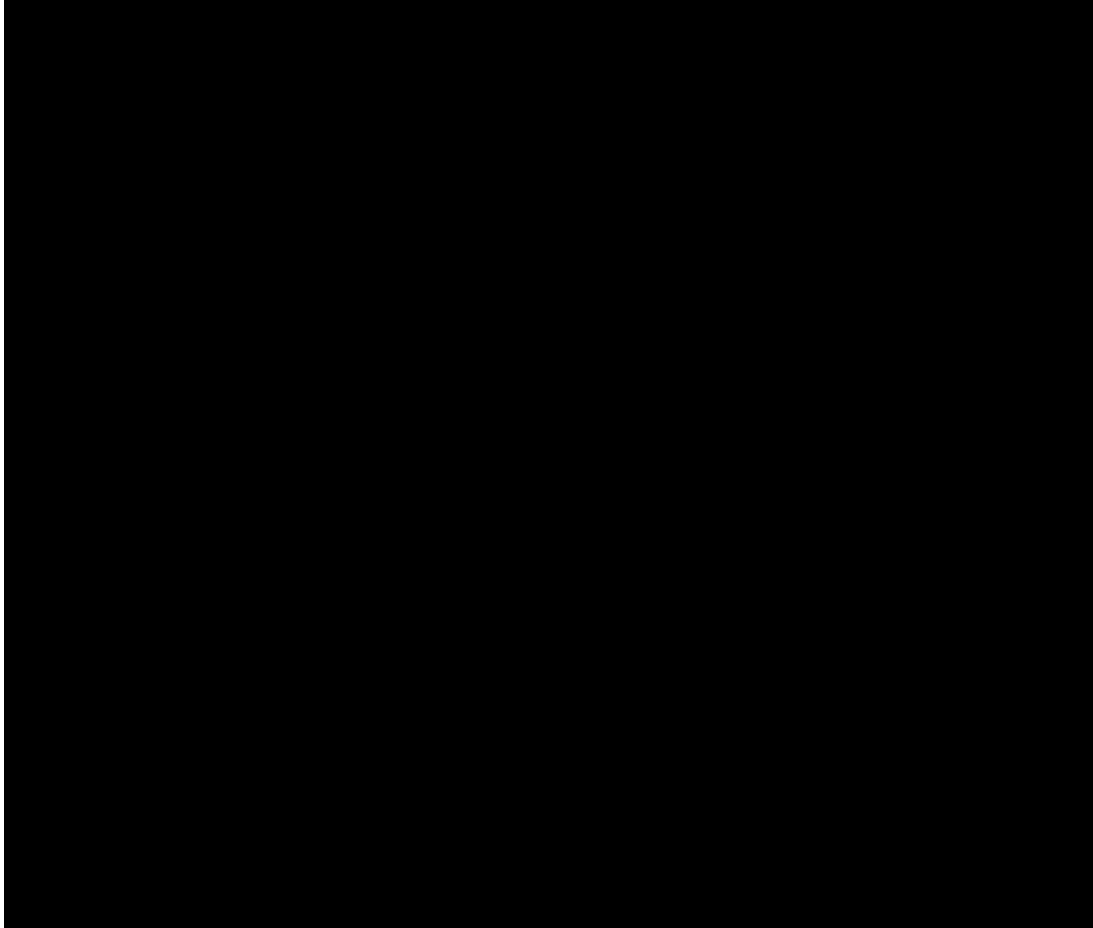
Figure A - 3 ~ Aged Open Notified Compensation Events

In Period 13, the total number of open NCEs increased by 8 to 961 and the value of open NCEs also increased by £14m to £49m.

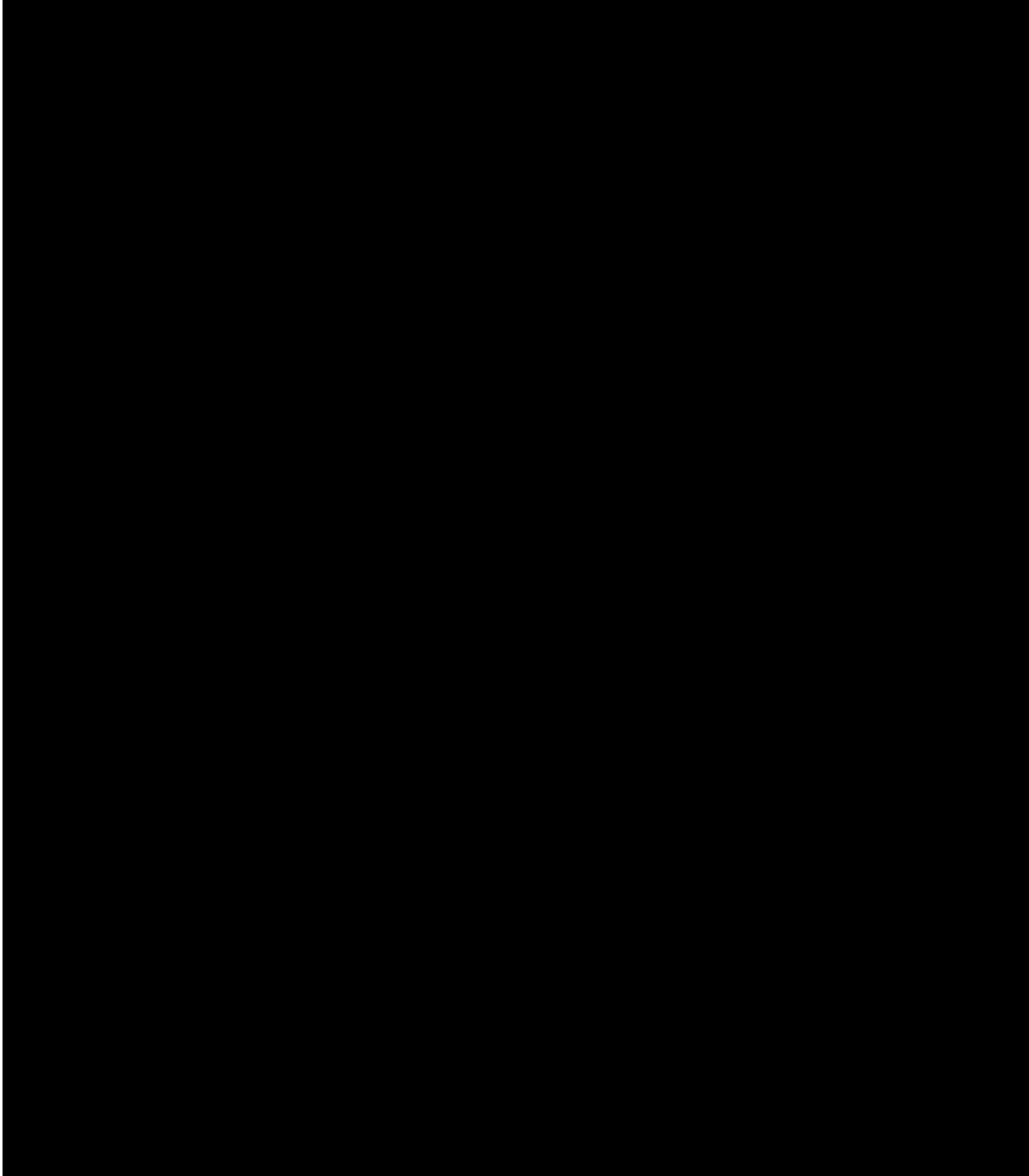
Contractors notified a further 313 Compensation Events in Period 13; 305 were processed in Period 13, with 221 implemented and 84 either rejected or withdrawn. Aged open NCEs increased in Period 13 by 55 to 419, the percentage of aged open NCEs rising from 38% to 44%.

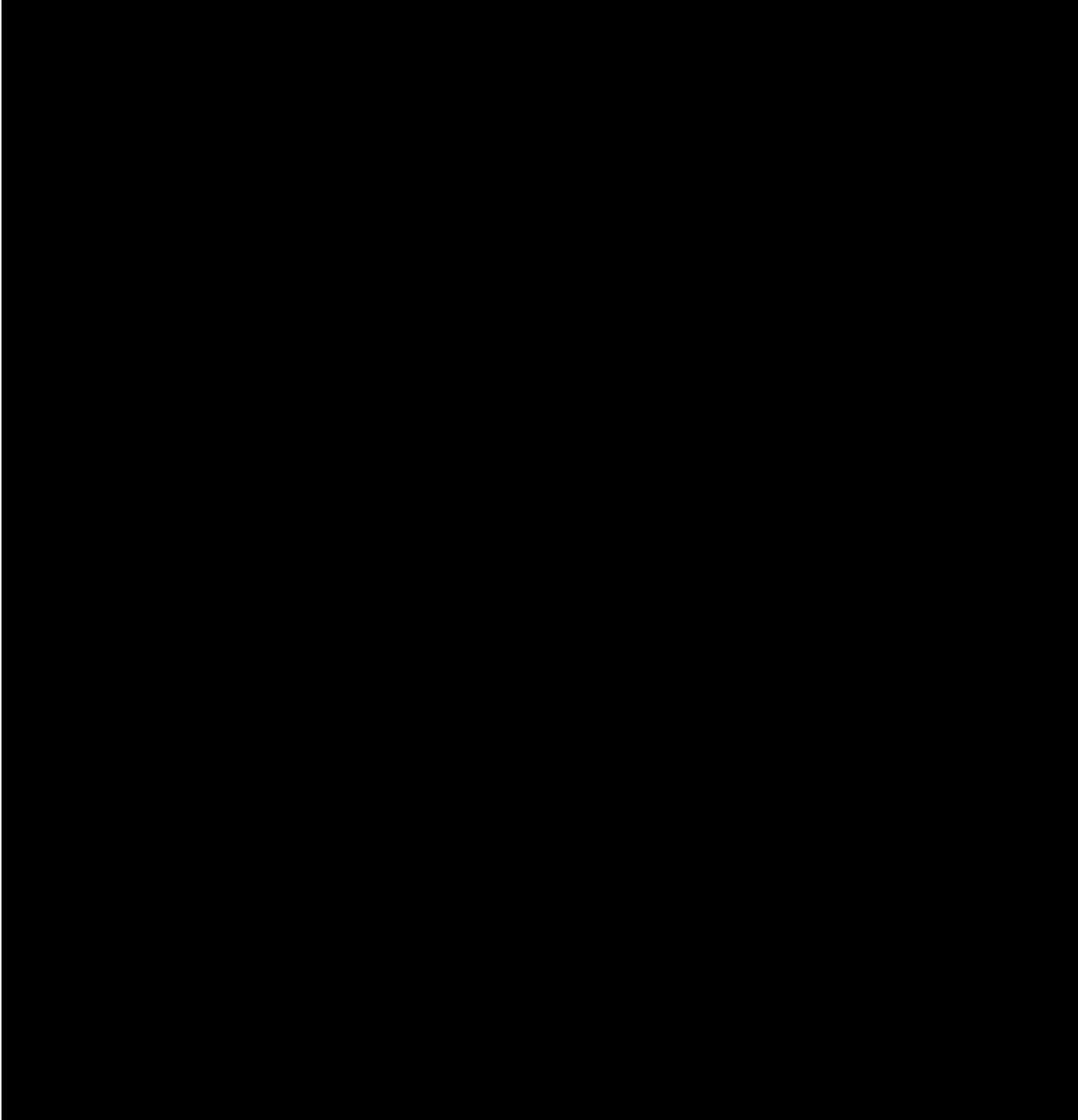
**Appendix B Schedule & Performance**

Figure B - 1 indicates the status of Anchor Milestones cumulative progress at Period 13.



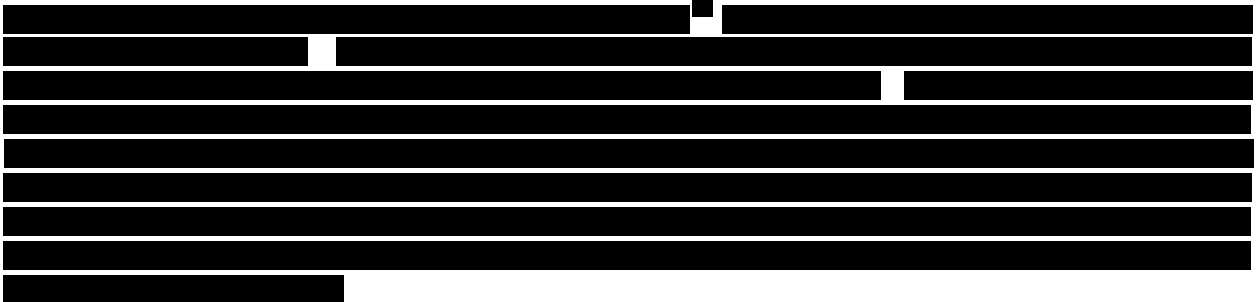
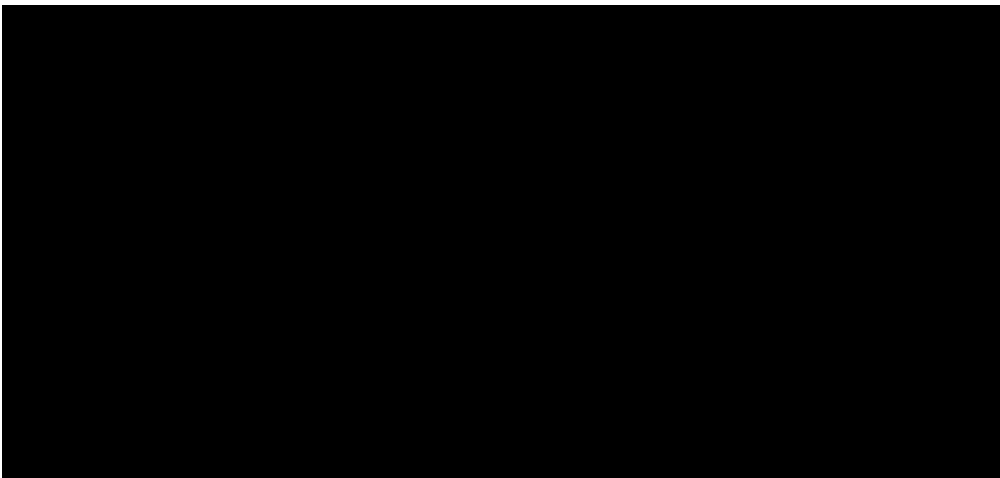
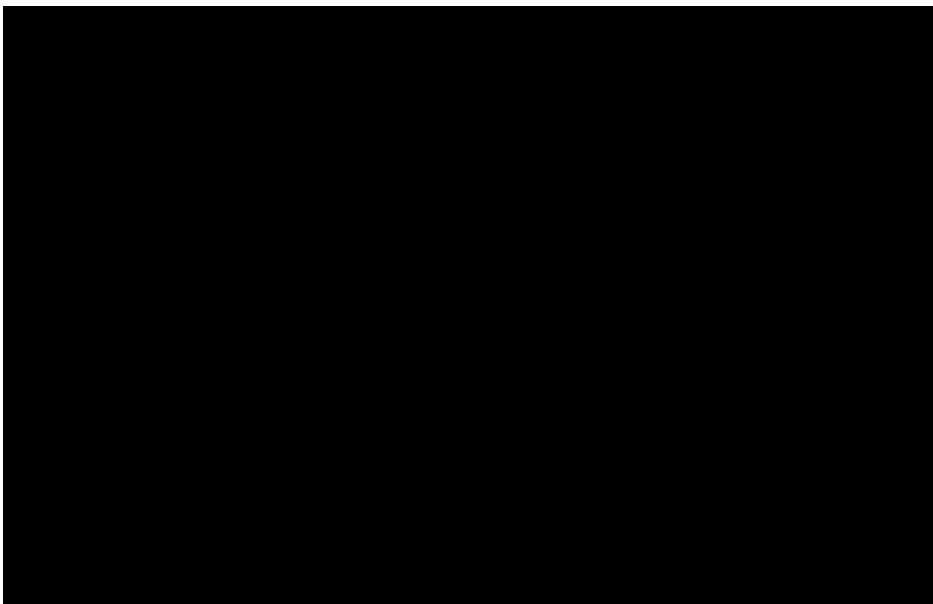
The charts at Figure B - 2 indicate cumulative progress of each Systemwide contract based on data received from CRL.



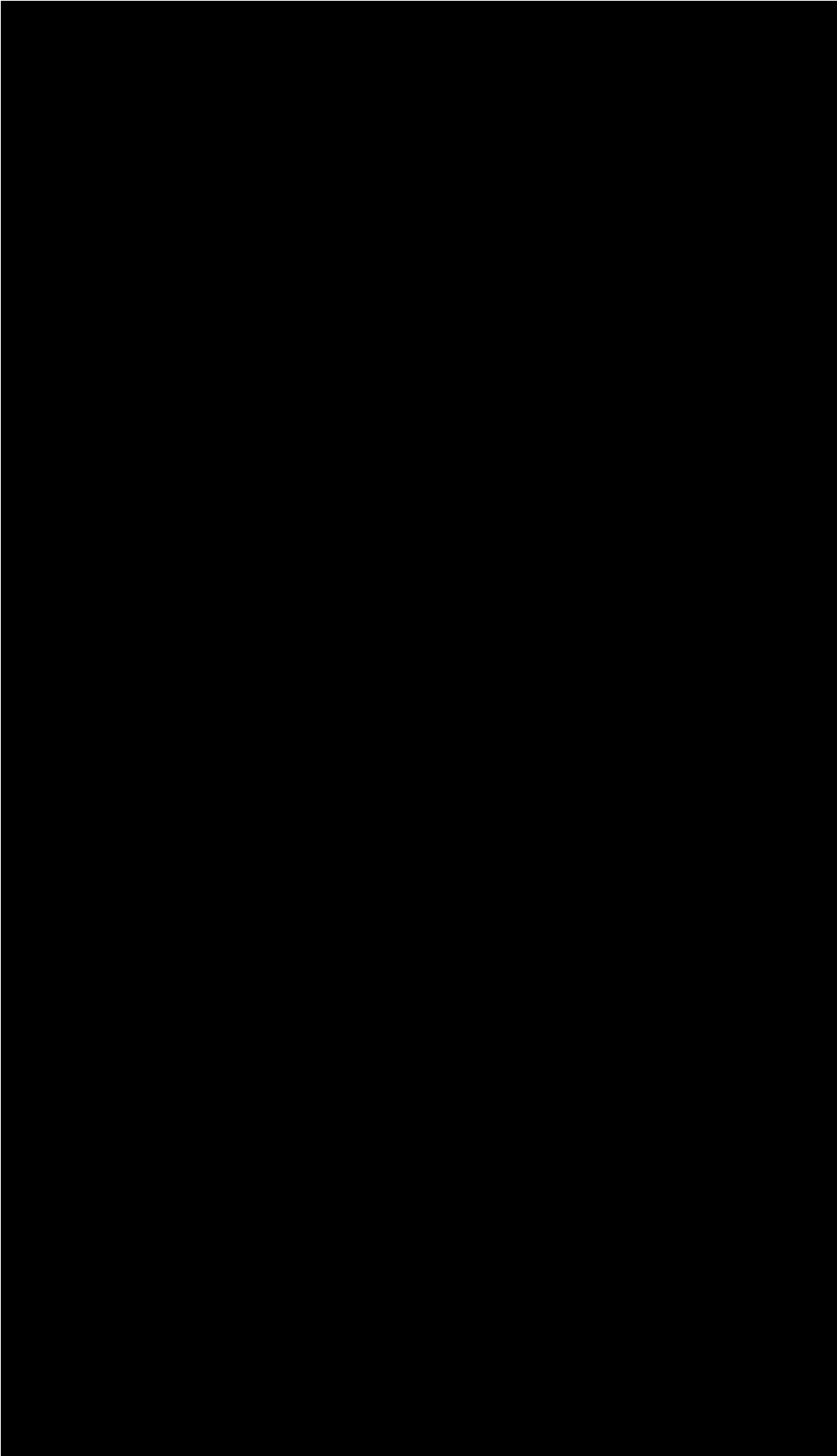


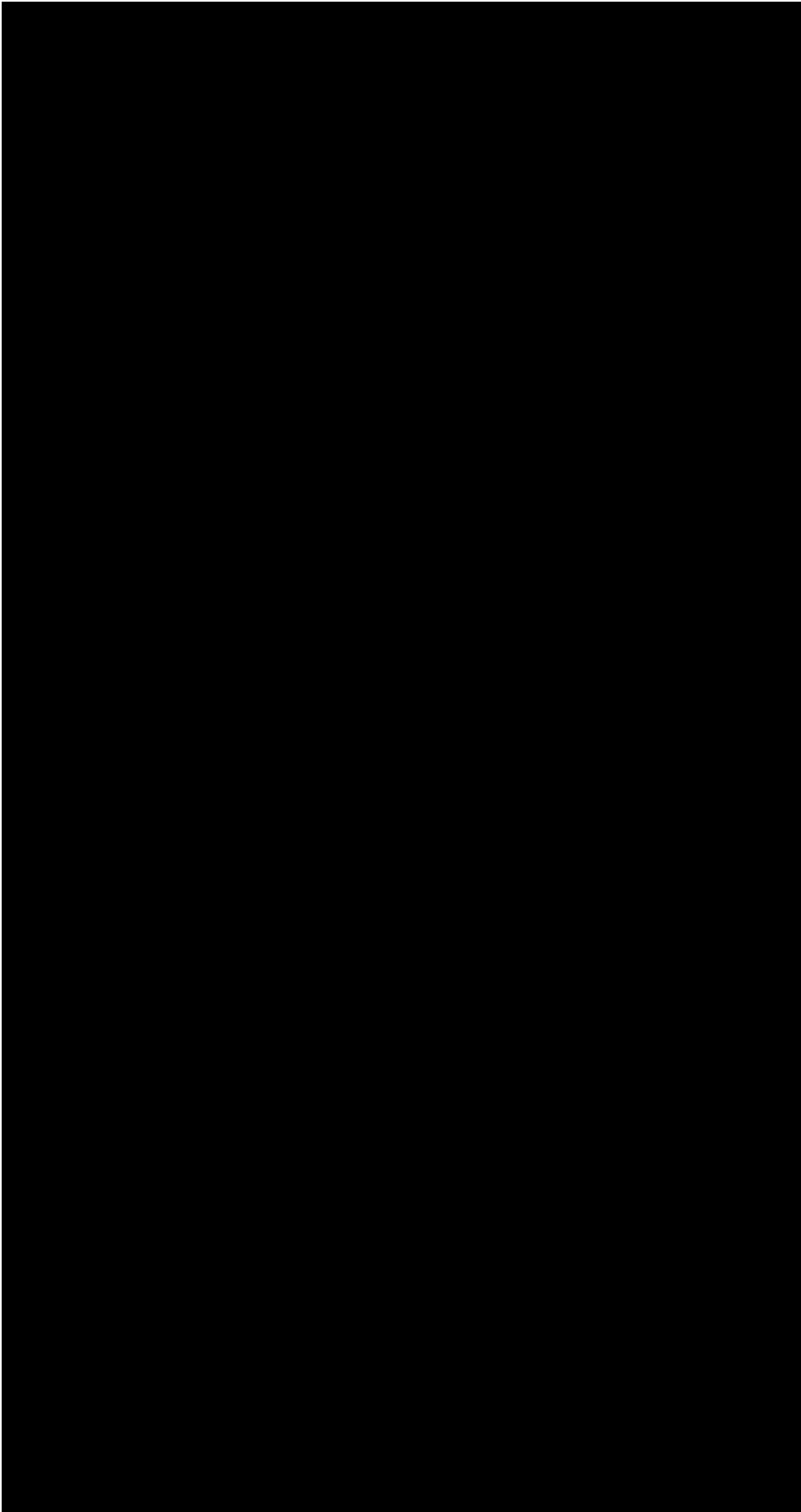
## Appendix C Stations

### C.1 Stations in the Central Section

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<sup>18</sup> Data has been abstracted from the CRL Period 13 (2017/18) station dashboards.





## C.2 Interface Works and Handovers

The “SLDs to go” report, with the planned and actual progress of accepted room and route handovers in Period 13, is summarised in Figure C - 9 below<sup>19</sup>.

Contract	Location	Rooms & Routes Accepted					
		Total per Site	Accepted (No.)		Cum Handovers		Variance (%)
			Actual	Plan	Actual	Plan	
C405	Paddington	79	65	73	82%	92%	-10%
C412	Bond Street	68	51	54	75%	79%	-4%
C422	Tottenham Court Road	125	121	125	97%	100%	-3%
C435	Farringdon	96	96	96	100%	100%	0%
C502	Liverpool Street	122	116	121	95%	99%	-4%
C512	Whitechapel	98	94	98	96%	100%	-4%
C530	Woolwich (CON, NWP, PLU)	110	110	110	100%	100%	0%
C350	Pudding Mill Lane	60	60	60	100%	100%	0%
CWS	Canary Wharf	30	30	28	100%	93%	0%
C360	Shafts	176	163	165	93%	94%	-1%
Totals		964	906	930	94.0%		

Figure C - 9 ~ Summary of re-baselined Systemwide accepted rooms/routes by location

Farringdon and Woolwich stations and Pudding Mill Lane portal have completed all SLD handovers. The re-baselining of the remaining planned SLDs has brought all of the remaining SLDs in line with plan. CRL has achieved 906 handovers against a planned 930 in the period, representing 94% of the total required.

The remaining room/routes “To Go”, by location, are summarised in Figure C - 10 below.

Contract	Location	Rooms & Routes "To Go"	
		Accepted (No.)	Cum Plan
		Cum Actual	
C405	Paddington	14	14
C412	Bond Street	17	17
C422	Tottenham Court Road	4	8
C435	Farringdon	0	0
C502	Liverpool Street	6	7
C512	Whitechapel	4	4
C530	Woolwich (CON, NWP, PLU)	0	0
C350	Pudding Mill Lane	0	0
CWS	Canary Wharf	0	2
C360	Shafts	13	15
Totals		58	67

Figure C - 10 ~ Summary of cumulative actual and planned station room/route handovers “To Go”

<sup>19</sup> The 67 remaining SLD handovers exclude the last of the C660 rooms/routes. These are now monitored separately under CRL’s C660 IRN tracker. The intermediate shafts (C360) SLDs have been added into the “SLD to go” reporting. The resultant total number of SLD handovers, to be achieved, has been reduced from 1035, as previously reported, down to 964 room/routes.



Appendix D Compliance and Assurance

D.1 Agreements

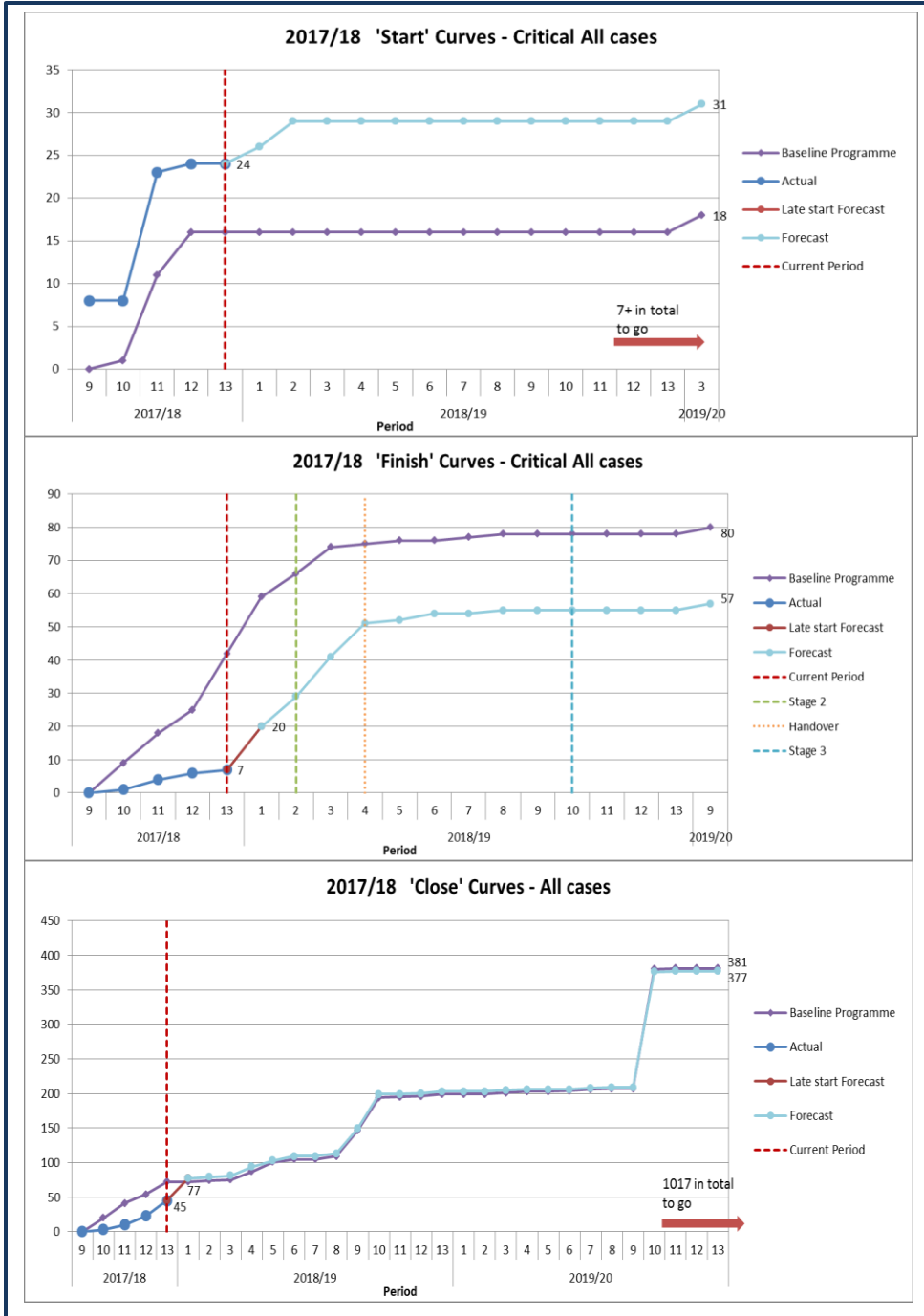


Figure D - 1 ~ 2017/18 Start, Finish & Close Curves

**D.2 Quality**

**D.2.1 Right First Time (RFT) and World Class (WC) Metrics**

The results for the quality metrics, shown below in Figure D - 2 show a gradual decline over the course of the year (with the exception of RFT 1), but remain within acceptable levels. RFT 3 has again registered 77%, the same figure as last period. We are investigating the causes behind this figure.

The planned number of packages was behind schedule for the period, a consistent theme of the year. The Acceptance graph, in Figure D - 3 shows 162 were accepted. The total planned in P12 for P13 was 339. This activity appears to lack adequate resources.

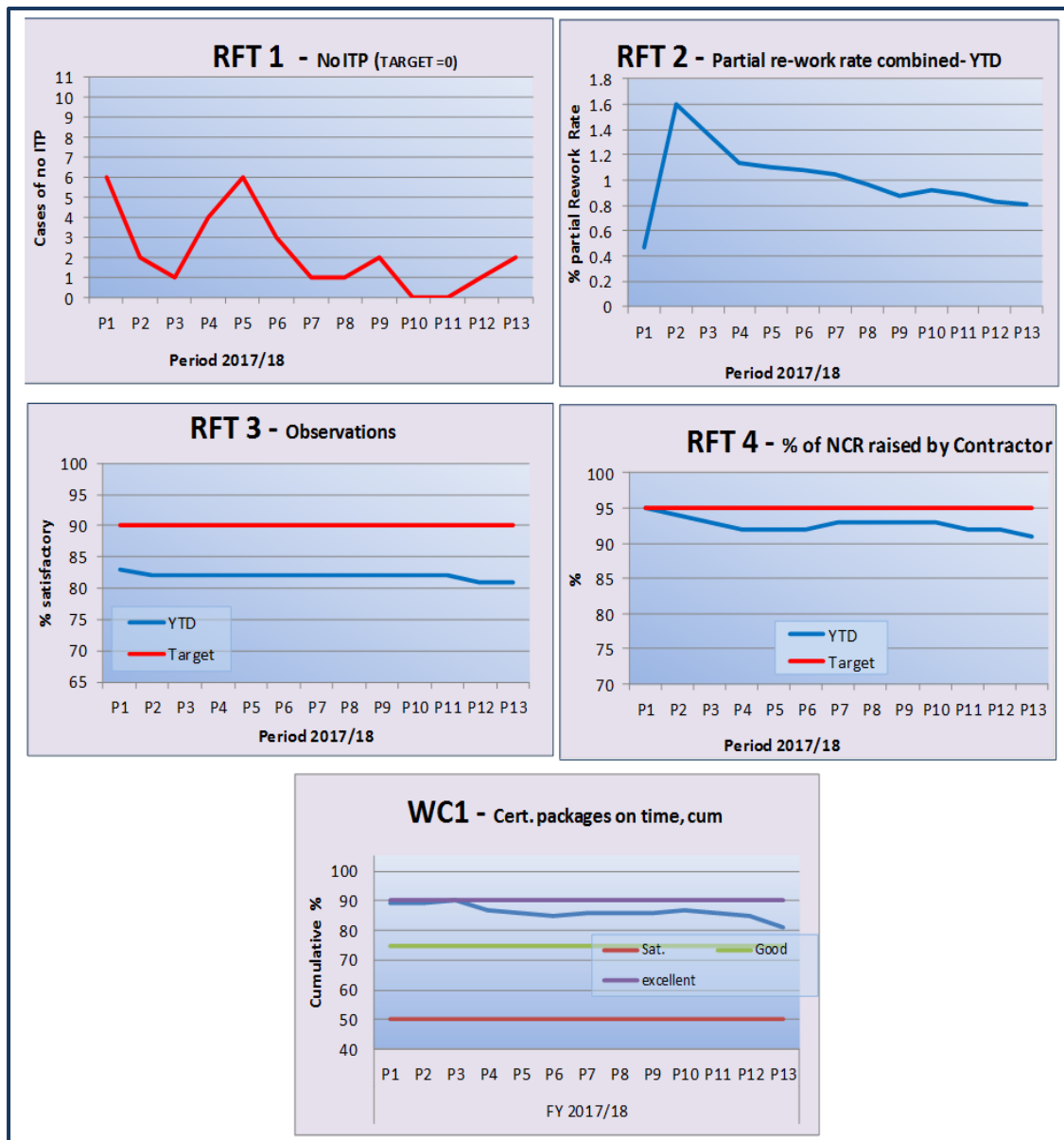


Figure D - 2 ~ Quality KPIs



Figure D - 3 ~ P13 Acceptance Graph

**D.2.2 Quality Performance Index**

No contractors received a “Red” status for their quality performance in Period 13. The overall index for the period was 1.96. CRL’s target is to be above 2.00, and it finished P13 with Year-to-date index of 2.10.

**D.2.3 Quality Issues**

There were two Category 1 NCR reported in this period;

- [Redacted]
- [Redacted]

**D.2.4 Audit Monitoring**

No audits were adjudged to be ‘poorly controlled’ in this period.

**D.3 Affirmations**

There has been no change from our comments of last period. These are:

- Affirmation 026 Supporting Communication or Utility Distribution – we are pressing for CRL’s Chief of Staff to provide the evidence that Affirmation 026 has been concluded;
- A report by RfL that addresses an outstanding action from Affirmation 005a ‘Recommendations for a Crossrail Performance and Management Regime’ has been provided to JST for information. It describes how the Sponsors Requirements for PPM to be in excess of 95% has been met, but that the cancellation and mileage rates of 1% or less have not.

#### D.4 Land & Property (L&P)

CRL's Land & Property functions have now transitioned into TfL.

#### D.5 Over Site Development (OSD) and Urban Realm (UR)

Accountability for all Over Site Developments has transferred from CRL's Land & Property team to TfL's Commercial Development team. TfL will report income receipts, from OSDs, periodically to CRL.

There have been some minor changes to CRL's forecast MOHS OSD handover dates for Fisher Street and Limmo shafts, and Woolwich station, during Period 13. A number of OSD developer start dates (shown bold text in Figure D - 4) have also been updated, together with some of estimated OSD completion of construction (Shell & Core) works dates.

Figure D - 4 provides a summary<sup>20</sup> of the current forecast Key Dates for Completion and handover<sup>21</sup> of the CRL deck slabs at each station to the OSD contractors<sup>22</sup>, as well as the OSD forecast start, duration and completion dates<sup>23</sup>. Completed handovers are shown against a green shaded background.

CRL still has one further OSD planning application to make at Liverpool Street East. Legal Agreements with Development Partners are being finalised, pending TfL approval.

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<sup>20</sup> Summary of OSD dates has been abstracted from the CRL Board Report, the MOHS and Key Dates progress summary.

<sup>21</sup> The current forecast dates for sectional completion at the CRL stations are driven by the Level +1 deck slabs at each Ticket Hall.

<sup>22</sup> The developers' start dates, durations and forecast completion dates have been abstracted from the OSD Progress Section of the CRL Board Report and CRL's Anchor Milestone summary.

<sup>23</sup> The estimated shell & core completion dates will be validated when the OSD contractors' schedules become available.



Station	Location	CRL Anchor Milestone	PDA Milestone	CRL's Forecast (MOHS) Handover Date to Station OSD Developer	Forecast Developer Start Date on Site**	Estimated Construction Duration (m)	Est. Shell & Core Completion
Bond Street	West - Davies Street	A275	10	31-Oct-18	Feb-19	20	Oct-20
	East - Hanover	A276	11	11-Jun-18	Jun-18	15	Sep-19
Tottenham Court Road	West - Dean Street	A279	15	30-Nov-18	Dec-18	22	Oct-20
	East - Astoria	A277	12	06-Sep-17	Jan-18	36	Jan-21
	East - Goslett Yard	N/A	N/A	06-Sep-17	May-19	14	Jul-20
Farringdon	West - Cardinal House	A278	13	30-Jun-18	Jan-19	18	Jun-20
	East - Lindsey Street	A280	16	29-Mar-18	Jul-18	21	Mar-20
Liverpool Street	West - 101 Moorgate	A288	19	22-Feb-18	Apr-19	21	Jan-21
	East - Blomfield Street	A284	18	28-Feb-18	Aug-19	21	May-21
<b>OSD Sites <u>NOT</u> linked to CRL Stations - Key Dates</b>							
Station / Site	Location	CRL Anchor Milestone	PDA Milestone	CRL Forecast Sectional Completion Date	Forecast Developer Start Date on Site	Construction Duration (m)	Shell & Core Completion
Paddington	PIP Triangle	N/A	N/A	Available	Aug-19	17	Jan-22
	Fisher Street	N/A	N/A	Jul-18	Jul-18	16	Nov-19
	Limmo Peninsula	N/A	N/A	Jul-19	Jul-19	24	Jul-21
	Woolwich	N/A	N/A	Jun-19	Jun-19	52	Oct-24
<p><b>Notes</b></p> <ol style="list-style-type: none"> <li>** Proposed OSD start dates will be confirmed as the Developers programme evolves</li> <li>CRL Forecast Sectional Completion Dates are abstracted from The CRL MOHS Baseline Early schedule</li> <li>TBC = To be confirmed</li> <li>Dates abstracted from L&amp;P OSD Project Dashboard and Anchor Milestones are shaded thus: </li> <li>Forecast dates that have now been achieved (with actual dates shown) are shaded thus: </li> <li>Developer start dates at Bond Street precede station forecast handover dates, due to earlier phased handovers.</li> </ol>							

Figure D - 4 ~ Summary of OSD forecast Key Dates

**Paddington (PIP Triangle)** Negotiations have commenced with British Land, who have confirmed their interest in acquiring the site. Decision expected at the end of April 2018 as to whether to proceed with British Land or market the opportunity.

Variation of the existing OSD agreement for Great Portland Estates (GPE) **Bond Street (East)** Hanover Square Office consent was approved by TfL and phased handover of the site has been instructed by CRL. The main handover of the ETH +1 roof slab, reception & basement, is forecast for 12 June 2018. This will trigger the lease and capital receipt. This will require:

- Completion of the necessary civils works;
- Handover of documentation;
- Land Valuation to be agreed, with a credible solution to the vent fan noise and vibration issues;
- Leases to be agreed;
- LONO to be in place for OSD works above CRL & operational station (logistics, fire, lifting, monitoring etc.).

Work to resolve the noise and vibration concerns continues, with further information provided to GPE for review. The handover date for the vent shaft remains a risk and is being monitored closely by both teams. Consultant teams still negotiating purchase price. Savills are being appointed as Independent Valuer as a back-up valuation mechanism. Site handover for completion of slab (triggering payment) likely to be delayed until August 2018.

The legal agreement for the Urban Realm (UR) works is with Westminster City Council (WCC) for signing. UR works sequencing and detailed arrangements for site handover are to be agreed with OSD and WCC.

The Development Agreement (DA) for the OSD for **Bond Street (West)**, between Grosvenor and TfL, was signed and exchanged on 23 February 2018. Agreement of the target handover date for the OSD has proved difficult, as a result of continued station schedule delays. CRL's current target handover date to the OSD developer is now 31 October 2018. The target handover date of the site to the OSD developer has proved difficult. It has now been set as no earlier than 28 November 2018.

WCC's comments and a revised bollard line are being implemented on the Urban Realm works for the West Ticket Hall.

The DA for the OSD at **Tottenham Court Road (East)** is complete, enabling handover and the development to commence. The Deed of Variation has been agreed and CRL handed over the Tottenham Court Road (East) OSD site at Goslett Yard to the OSD Developer (Derwent). The erection of permanent OSD hoardings have commenced.

The OSD for residential development at **Tottenham Court Road (West)** will be offered to the open market in early 2018. Retail areas will be retained for in-house (TfL) management. The site is being used for site office accommodation by CRL's delivery team until November 2018. The OSD development will not, therefore, be able to start until 2019.

The DA for the **Fisher Street** OSD has been signed with extensions to June 2018. The Developer has submitted additional information, supporting project viability, to Camden. The Planning Committee decision date has, however, still not been set. Terms agreed for a deed of variation to the DA to extend the longstop date to June 2018 at TfL's absolute discretion.

Three OSD PDA Milestones have been achieved at Liverpool Street (PDAs 14, 18 & 19). The negotiation of the DA for the **Farringdon West** office consent has concluded and the DA signed. There are, however, still a number of points awaiting resolution, namely: London Borough of Islington's approval of a render finish and the proposed cycle super highway.

The DA for Lindsey Street **Farringdon (East)** has been exchanged and the site handover has now occurred (29 March 2018), delivering receipts of £15.6m this period. The next key milestone is 31 August 2018, where CRL works need to be completed in order to maintain the future deferred payment dates.

Agreement has been reached with CoL regarding the Urban Realm for the Eastern Ticket Hall.

The DA for **Liverpool Street (West)** office consent has been approved by TfL and Commissioner. Development Agreements being finalised on Cardinal House (FAR-W) to enable exchange in April/May 2018. Handover of the Moorgate Shaft site to the developer has been re-scheduled for the end of May 2018, as the DA has not been completed.

The DA and Lease for the **Liverpool Street (East)** Office and Retail OSD in Blomfield Street has been agreed and exchange is anticipated in April/May 2018.

The **Limmo** masterplan has yet to be agreed with London Borough of Newham. Approval has been obtained to market the site through the TfL Property Partnership Framework (PPF). A JV partner selection process will be launched via the PPF in Q1 2018.

TfL wish to delay marketing of the **Woolwich** residential site, in order to review the potential for an alternative private rented sector disposal structure, to increase long term income. CRL awaits a legal decision, following a judicial review hearing, that was scheduled for the end of March 2018.

Joint work with Westminster, the City, LB Islington and Tower Hamlets continues towards a conclusion of the Urban Realm delivery agreements. The UR function within CRL now sits with each of the site delivery teams.

## **D.6 Undertakings & Assurances and Commitments - Central Section**

Six of the live contracts for the Central Section planned to upload compliance evidence into Commitments Delivery Tracker (CDT) in Period 12, in accordance with their Commitments Compliance Plans (CCP). Contracts [REDACTED] have now caught up on pending evidence reported in Periods 11 and 12. [REDACTED] ( [REDACTED] Station Main Works Platform Tunnels, Fit out) has an outstanding piece of evidence to upload in CDT in Period 1.

One PIR has been raised since the close of Period 13, relating to Farringdon Station (East Ticket Hall) D25 Assurances. Details of the PIR are summarised in Appendix D.6.1 below.

### **D.6.1 Farringdon Station (East Ticket Hall) D25 Assurances**

RfL agreed to the reduced operation of the ventilation fans at a key hour of the morning when background noise levels are low. Under this control scenario the modelling predicts that -4dB will be achieved for the ETH and that this would represent the exercise of reasonable endeavours and a report setting out that case is to be submitted to the local authority (City of London).

However, in the event that noise levels associated with tunnel ventilation, draught relief and operation of plant and equipment at a particular location are expected to be above the -5 dB level, IP D25 requires that CRL will, prior to commencement of procurement of equipment, provide the local planning authority with the following information:

- Calculated rating levels at the most sensitive receivers under the range of operational modes anticipated, including noise from the mechanical fan operation and draught relief;
- For tunnel ventilation, the frequency and duration of use of the fans expected as a result of possible congestion and train headway simulations;
- Details of the performance of noise mitigation incorporated into the deep level station, ventilation shaft and head house structures; and
- A description of the limitations to any or further mitigation being practicable.

There is no further definition around the timing of when this information is to be provided; but logically the reference to “procurement of equipment” is intended to refer to any equipment which contributes to, or potentially mitigates, the overall noise level, such that the local authority has a chance to comment on the proposed equipment prior to the commitment to purchase being made by CRL.

RfL accepted the operational constraint toward the end of October 2017. The fans responsible for the -4dB rating prediction were procured two years ago and were due to be installed in February this year. The requisite report has not been issued to the City. A level 1 PIR was raised accordingly.

Refer to our previous reports for further updates and detail in respect of the Potential Incident Reports (PIRs) noted below.

### **D.6.2 C660/C520 Custom House PAVA (D25) Assurance 465**

Assurance 465 is drawn from Information Paper D25 and requires CRL to agree criteria for the performance of the public address (PA) system with a local authority prior to specifying and

carrying out the detailed design of that system. The C660 PA design at Custom House station is essentially complete (Custom House station FDO was held in May 2017) but subsequently, following an email communication from the local authority, the London Borough of Newham, on 21 June 2016, agreement on appropriate criteria has not been reached.

The report of the noise survey carried out in December 2017 was issued to CRL on 30 January 2018 for review. Comments have been returned and a final revised report was received in February 2018. The meeting with LB Newham took place on 20 February, where the findings of the noise survey were presented and criteria discussed. The draft criteria, which were sent by CRL to LB Newham, were agreed on 8 March 2018. The process for closing this PIR can now begin.

**D.7 Undertakings & Assurances and Commitments - Surface Section**

The Commitments Delivery Tracker (CDT) is used to generate reports each period setting out the actual upload of compliance evidence against what was planned and the information is presented in the Technical Director’s Report (TDR). The matching of actual evidence against what was planned is used as a lead indicator for the risk of potential non-compliance.

[REDACTED]

Three of the live Surface Section contracts, planned to upload compliance evidence into the Commitments Delivery Tracker (CDT) in Period 12, in accordance with their Compliance Matrices.

Two contracts, [REDACTED] and [REDACTED] have not met their targets. The reason given by [REDACTED]

A meeting with NR was held on 11 April 2018 to go through this issue and seek assurances that the outstanding information will be provided, that there have been no non-compliances with commitments in the meantime and that performance will improve from hereon.

There has been no other change, with regard to what was previously reported in Period 12. This means that:

- [REDACTED] has not uploaded any evidence into CDT since Period 8;
- The D25 report that [REDACTED] was due to upload in Period 6 remains outstanding. Also, the planned upload of evidence of consultation with Thames Water remains outstanding since Period 10;
- [REDACTED] has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4;
- [REDACTED] has still not completed the D25 and D26 tasks that were due to be uploaded in Period 4.

No Surface Section PIRs were raised in Period 13.



## Project Representative Team

### D.8 Project Team

██████████:	Project Representative, Safety, Progress, Risk, Governance;
██████████:	Signalling, Railway Systems, Integration, T&C;
██████████:	Engineering, Stations, OSD, U&As, Assurance;
██████████:	Compliance & Change, Operations, RSD;
██████████:	Commercial, Cost Control, Financial, ONW;
██████████:	Administration Manager.

## Glossary of Terms & Contracts

Abbr.	Description	Abbr.	Description
A&M	Access & Maintenance	LoNo	Letter of No Objection
ABB	ASEA Brown Boverly	LoR	Line of Route
ACJV	Alstom Costain Joint Venture	LTC	Lost Time Case
ACWP	Actual Cost of Work Performed	LTIFR	Lost Time Incident Frequency Rate
AEA	Abellio East Anglia	LU	London Underground
AFC	Anticipated Final Cost	LUL	London Underground Limited
AFC	Approved for Construction status	LV	Low Voltage
AFDCD	Anticipated Final Crossrail Direct Cost	M&E	Mechanical & Electrical
AFR	Accident Frequency Rate	MAID	Mandatory Asset Information Deliverables
AGA	Abellio Greater Anglia (now known as 'GA')	MCR	Material Control Requirement
AHU	Air Handling Units	MCS	Master Control Schedule
AIP	Approved in Principle	MENTOR	Mobile Electrical Network Testing, Observation and Recording
AIP	Approval in Principal	MEP	Mechanical Electrical & Public Health
AMS	Agreements Management System	MEPA	Mechanical, Electrical, Public Health, Architecture
APS	Authorisation to Place into Service	MES	Mile End Shaft
ARS	Automatic Route Setting	MIRP	Maintenance Integration Review Panel
AsBo	Assurance Body - Ricardo Rail	MML	Mott MacDonald Ltd
ASLEF	Associated Society of Locomotive Engineers and Firemen	MOHS	Master Operational Handover Schedule
ATC	Automatic Train Control	MOS	Member of Staff
ATFS	Autotransformer Feeder System	MPS	Master Plan Shaft
ATO	Automatic Train Operation	MTIN	Miles Per Technical Incident Number
ATP	Automatic Train Protection	MTIN	Miles Technical Incident Number
ATS	Automatic Train Supervision	MTR SMS	MTR Safety Management System
ATS	Auto Transformer Station	MTR-C	Mass Transit Railway - Crossrail
AWS	Automatic Warning System	MV	Medium Voltage
B&PC	Board & Programme Contingency	NCE	Notified Compensation Event
BBM	Balfour Beatty Morgan Vinci	NCR	Non Conformance Report
BCA	Bilateral Connection Agreement	NG	National Grid
BCWP	Budgeted Cost of Work Performed (Earned Value)	NGET	National Grid Electricity Transmission
BCWS	Budgeted Cost of Work Scheduled (Planned Value)	NKL	North Kent Line
BFK	Bam Ferrovial Kier	NoBo	Notified Body
BH	Berkeley Homes	NOW	North Woolwich
BIU	Bringing Into Use	NR	Network Rail
BLL	Bakerloo Line Link	NSACS	New Sector Area Cost Summary
BOS	Bond Street Station	O&M	Operations and Maintenance
BP	Business Plan	OCS	Overhead Catenary Systems
BREEAM	Building Research Establishment Environmental Assessment Methodology	OLE	Overhead Line Equipment
BSP	Bulk Power Supply Point	OMC Building	Operations Maintenance Centre
BT	Bombardier Transportation	OME	Order of Magnitude Estimate
BT / PC	Bombardier Transportation / Prime Contractor	ONFR	On Network Functional Requirements
BTH	Blonfield Ticket Hall	ONSIP	On Network Station Improvements Programme
BUF	Bottom Up Forecast	ONW	On Network Works
C&CSC	Commercial and Change Sub-committee	OOC	Old Oak Common
CAR	Corrective Action Report	OCCPA	Old Oak Common Paddington Approaches
CARE	Crossrail Assurance Reporting Environment	OPEX	Operational Expenditure
CBTC	Communications Based Train Control	Ops	Operations

CCB	Current Control Budget	ORAT	Operational Readiness & Transfer Group
CCP	Commitments Compliance Plans	ORR	Office of Rail & Road
CCRB	Construction and Commissioning Rulebook	ORSG	Operational Readiness Steering Group
CCRRB	Crossrail Construction Railway Rule Book	OSD	Over Site Development
CCSA	Contract Commercial Status Analysis	OSP	Operations Safety Procedures
CCSC	Commercial & Change Sub-Committee	OTIS	OTIS escalators (company)
CCTV	Closed Circuit Television	OTP	Overall Target Price
CD/RA	Closed Door / Right Away	PAD	Paddington station
CDG	Competence Design Group	PCs	Principal Contractors
CDL	Central Door Locking	PDA	Project Development Agreement
CDM	Construction Design & Management Regulations	PDB	Network Rail Programme Delivery Board
CDN	Crossrail Data Network	PES	Platform Edge Screen
CDT	Commitments Delivery Tracker	PES	Permanent Earthed Sections
CE	Compensation Events	PIP	Paddington Integration Project
CEC	Chief Engineer's Communications	PIR	Potential Incident Report
CEEQUAL	Civil Engineering Environmental Quality Assessment Scheme	PLU	Plumstead
CEG	Central Engineering Group	PM	Project Manager
CEO	Chief Executive Officer	PMI	Project Manager Instruction
CFCCB	Contingency Finance Current Control Budget	PML	Pudding Mill Lane
CFO	Chief Financial Officer	PMO	Project Management Office NR
CIF	Crossrail Integration Facility	PNY	Paddington New Yard
CIS	Customer Information System	PPE	Personal Protective Equipment
CMR	Crossrail Managed Risk	PPF	Property Partnership Framework
CMS	Crossrail Management System	PPM	Passenger Performance Measurement
CoL	City of London	Prep	Project Representative
COS	Central Operating Section	PRISM	Cost Management Software
CPFR	Crossrail Programme Functional Requirements	PRM	Persons of Reduced Mobility
CPI	Cost Performance Index	PSD	Platform Screen Door
CPO	Compulsory Purchase Order	PSG	Performance Steering Group
CRL	Crossrail Limited	PSR	Project Status Report
CRV	Crossrail Requirements Variation	PTYSC	Property Sub-Committee
CSCS	Construction Skills Certification Scheme	PWay	Permanent Way
CSJV	Costain Skanska Joint Venture	QBR	Quarterly Baseline Review
CSM	Construction Safety Management	QCRA	Quantified Cost Risk Assessment
CSM-RA	Common Safety Method – Risk Assessment	QRA	Quantified Risk Assessment
CT	Computerized Tomography	QSRA	Quantified Schedule Risk Assessment
CTOC	Crossrail Train Operating Concession	RAB	Regulatory Asset Base
CUH / CHS	Custom House Station	RAB (C)	RfL Assurance Board for Crossrail
CW	Canary Wharf	RAG	Red, Amber, Green Matrix
CWG	Canary Wharf Group	RAM	Route Asset Manage.
CWS	Canary Wharf Station	RBC	Remote Block Computer
D&A	Drugs and Alcohol	RCA	Risk Control Actions
DA	Development Agreement	RCC	Route Control Centre
DeBo	Designated body	RfL	Rail for London
DfT	Department for Transport	RfL-I	Rail for London - Infrastructure
DLO	Direct Labour Organisation	RFT	Right First Time
DLR	Docklands Light Railway	RIA	Railway Integration Authority
DOO	Driver Only Operation	RIBA	Royal Institute of British Architects (Structure of Construction Stages)
DPS	Depot Protection System	RIDDOR	Reporting of Injuries Diseases & Dangerous Occurrences Regulations 1995
DT	Dynamic Testing	RIRP	Railway Integration Review Point
Dwall	Diaphragm wall	RLU	Restricted Length Unit
DWWP	Delivery of Works Within Possession	ROC	Rigid Overhead Conductor
E&B	Earthing & Bonding	ROC	Regional Operational Centre

EA	Environment Agency	ROP	Royal Oak Portal
EAC	Estimate at Completion	RP4.2	Review Point 4.2
EB	Eastbound	RR	Ricardo Rail
ECP	Employers Completion Process	RRV	Road / Rail Vehicles
ECS	Empty Coach Stock	RS	Rolling Stock
		RSD	Rolling Stock & Depot
EDT	Early Dynamic Testing	RSSB	Rail Safety & Standards Board
EED	Emergency Exit Door	RTU	Remote Telemetry Unit
EFC	Estimated Final Cost	S&C	Sw itches & Crossings
ES	Entry into Service	SA	Supplementary Agreement
ELRSG	Elizabeth Line Readiness Steering Group	SACR	Semi Annual Construction Report
EMC	Electromagnetic Compat bility	SAP	System Applications Products
EMU	Electrical Multiple Unit	SAR	Safety Assessment Report
ERTMS	European Rail Traffic Management Systems	SAT	Site Acceptance Test
ESJ	Engineering Safety Justification	SCADA	Supervisory Control and Data Acquisition
ESM	Engineering Safety Management	SCL	Sprayed Concrete Lining
ETCS	European Train Control System	SCN	Sponsor Change Notice
ETH	Eastern Ticket Hall	SDG	Signalling Design Group
EVM	Earned Value Management	SDO	Selective Door Operation
FAR	Farringdon	SDS	Scheme Design Specification
FCCB	Finance Current Control Budget	SER	Signalling Equipment Room
FDC	Framework Design Consultant	SES	South East Service
FDO	Final Design Overview	SESR	South East Signalling Room
FDS	Final Design Statements	SFA	Sponsor Funding Account
FFOC	Final Forecast Outturn Cost	SHELT	Safety and Health Leadership Team
FGW	First Great Western	SIRP	Systems Integration Review Panel
FIS	Fisher Street Shaft	SISS	Station Information and Security System
FLU	Full Length Unit	SJR	Safety Justification Report
FoI	Freedom of Information	SLD	Single Line Diagrams
FRAG	Fraud Risk Assurance Group	SMS	Safety Management System
FTS	Floating Track Slab	SMTA	Smithfield Market Traders Association
GAF	Greater Anglia Franchisee	SOC	Statement of Compat bility
GE	Great Eastern	SONIA	Sterling Overnight Index Average
GEFF	Great Eastern Furrer & Frey	SOR	Systems Operation Room
GEML	Great Eastern Main Line	SORBA	Shaping Architecture Company (sub cladding contractor)
GFRC	Glassfibre Reinforced Concrete	SPI	Schedule Performance Index
GLA	Greater London Authority	SPS	Secondary Part Steel
GPE	Great Portland Estates	SR	Sponsors Requirement
GPE	Great Portland Estates	SRP	Safety Review Panel
GRC	Glass Reinforced Concrete	SSE	Scottish & Southern Electricity
GRIP	Governance for Railw ay Investment Projects	SSP	Stations, Shafts, Portals
GSM-R	Global System for Mobile Communication - Railw ay	STG	Stepney Green
GW	Great Western	STS	Standard Track Slab
GWML	Great Western Main Line	SVP	Safety Verification Panel
GWR	Great Western Railw ay	T&C	Testing & Commissioning
H&S	Health & Safety	TAP	Technical Assurance Plan
HAL	Heathrow Airport Limited	TBM	Tunnel Boring Machine
HALARP	Heathrow Airport Limited Assurance Review Panel	TC&HSG	Testing, Commissioning and Handover Steering Group
HAS	High Attenuation Sleeper	TCMS	Train Control Management System
HAVS	Hand Arm V bration Syndrome	TCR	Tottenham Court Road
HEP	Handover Execution Plans	TCRW	Tottenham Court Road West
HIA	Heathrow Implementation Agreement	TDY	Tunnel Drive Y
HM	Her Majesty	TfL	Transport for London
HMDL	Handover Master Deliverable List	TOC	Train Operating Company
HRW	Heathrow Airport	TPA	Tunnel Planning Authority

HSPI	Health & Safety Performance Indicator	TPH	Trains Per Hour
HV	High Voltage	TPS	Train Protection System
HVAC	Heating Ventilation & Air Conditioning	TPWS	Train Protection & Warning System
IA	Interim Acceptance	TRAIL	Transport Reliability Availability Integrated Logistics
ICD	Interface Control Document	TRH	Temporary Rehousing
IECC	Integrated Electronic Control Centre	TSI	Technical Standard for Interoperability
IEP	Intercity Express Programme	TTVS	Temporary Tunnel Ventilation System
IFC	Issued For Construction	TUCA	Tunnelling & Underground Construction Academy
IFD	Ilford Yard	TWAO	Transport & Works Act Order
IM	Infrastructure Manager	TXM	TXM Plant
IOSH	Institution of Occupational Safety and Health	U&A	Undertakings & Assurances
IP	Intervention Point (0, 1, & 2)	UKPN	UK Power Networks
IR35	Inland Revenue Taxation Regulation 35	UR	Urban Realm
IRN	Installation Release Note	URT	Unresolved Trends
IRSG	International Regulatory Strategy Group	UTX	Under Track Crossings
ISJ	Interim Safety Justification	VDP	Victoria Dock Portal
ISV	Intermediate Statements of Verification	VERP	Value Engineering Review Panel
ITP	Inspection & Test Plan	VFL	Volker Fitz Patrick
ITT	Invitation to Tender	VN	Variation Notice
JST	Joint Sponsor Team	VT	Voltage Transformer
KBR	Knorr-Bremse Rail	WAD	Works Authorisation Document
KD	Key Deliverable	WBP	Westbourne Park
KE	Kinematic Envelope	WBS	Work Breakdown Structure
KG	Kensal Green	WC	World Class
KO	Key Output	WCC	Westminster City Council
KPI	Key Performance Indicator	WCCC	Whole Contract Construction Certificate
L&P	Land and Property	WHI	Whitechapel
LB	London Borough	WITI	Western Inner Track Infrastructure
LBTH	London Borough of Tower Hamlets	WOE	Western Outer Electrification
		WOO	Woolwich Station
LFB	London Fire Brigade	WOTI	Western Outer Track Infrastructure
LIV	Liverpool Street	WTH	Western Ticket Hall
LMU	London Metropolitan University	YC	Yard Control
LO	London Overground		

Contract No.	Contract Name	Contract No.	Contract Name
A013	Paddington Station Urban Realm	C501	Liverpool Street Station (Piling & Dwall)
A014	Bond Street Urban Realm	C502	Liverpool Street Station (Main Station Works)
A015	TCR Urban Realm	C503	Liverpool Street Station (Civil Advance Works)
A016	FAR Urban Realm	C510	Station Tunnels East - Early access Shafts and SCL Works
A036	TCR Undertaking Consultants - rdy	C511	Whitechapel Station (Piling & Dwall)
Ax12	TCR OSD revisions to Goslett Yard	C512	Whitechapel Station (Main Station Works)
C100	Architectural components	C520	Custom House (Main Station Works)
C102	Material and Workmanship Specifications	C530	Woolwich station
C121	Sprayed Concrete Linings (SCL)	C610	Systemwide Main Works
C122	Bored Tunnels	C620	Signalling Systems
C123	Intermediate Shafts	C631	Platform Screen Doors
C124	Aero-dynamics and ventilation, M&E, rail systems	C641	Kensal Green Bulk Supply Point
C130	Paddington Station	C643	Pudding Mill Lane Bulk Supply Point
C131	Paddington Integrated Project	C644	Central Section Track power infrastructure
C132	Bond Street Station	C650	Non Traction High Voltage Power
C134	Tottenham Court Road Station	C651	Limmo Bulk Supply Point
C136	Farringdon Station	C660	Communications and Control Systems
C138	Liverpool Street Station	C695	Plumstead Maintenance Facility
C140	Whitechapel Station	C701	Instrumentation & monitoring
C146	Custom House Station	C730	Lifts
C150	Royal Oak Portal	C740	Escalators
C152	Pudding Mill Lane Portal	C750	Schedule of Defects Surveys
C154	Victoria Dock Portal	C751	Schedule of Defects Surveys
C156	North Woolwich and Plumstead Portal	C752	Schedule of Defects Surveys
C158	Woolwich	C801	Operation and Logistics Centre
C164	Bulk Power Supply	C802	Transportation Control
C166	Route Control Centre	C803	Traffic Signage
C170	Communications and Control Systems	C806	Wallasea Temporary Jetty
C175	Crossrail Tunnelling Academy Design	C807	Marine Transportation
C176	Wallasea Island	C808	Removal of Wallasea Temporary Jetty
C178	Westbourne Park elevated bus deck	C809	Noise insulation
C181	Scott Wilson - Continuity	C810	Noise insulation
C182	Atkins - Continuity	C815	Tunnelling Academy
C183	Mott Macdonald - Continuity	C828	Ilford Yard Stabling sidings
C184	Instone Wharf Surveys	CXX5	Management of First Buses at WBP
C185	(OCN1169) EWMA	LU01	LU Works -Westbourne Park, incl WS
C300	Tunnel Drive X - Royal Oak to Farringdon	LU02	Farringdon Barbican IMR Relocation
C305	Tunnel Drive Y - Limmo to FAR & Drive Z , SGJ to FML & Drive G, Limmo to Victoria Dock Portal	LU03	Bond Street
		LU04	TCR Goslett Yard Main Works
C310	Tunnel Drive H - Thames Tunnel	LU06	LU - Liverpool Street Station Works
C315	Connaught Tunnel refurbishment	LU07	LU - WHI Plain Lining and West Ham Turn-back
C330	Royal Oak Portal (Civil Works)	LU10	Griffiths House Bulk Supply Point
C335	Shaft and Portal Finishing Works	LU11	Station Operations Rooms (SOR)
C336	Paddington New Yard	MD04	General Paddington
C340	Victoria Dock Portal Civil Works	MD05	Bond St Highway Alterations
C350	Pudding Mill Lane Portal Civil Works	MD11	Bond St Third Party Costs
C360	Eleanor Street & Mile end Shafts Civil Works	MD19	Bakerloo Link & Increase PAD Passage
C400	PAD - Box Works/Piling & DWall	MD20	TCR Office Accommodations
C405	Paddington Station (Main station works, Fit out)	MD22	Bond Street Site Accommodation
C410	Station Tunnels West - Early access Shafts and SCL Works	NR	Network Rail Invest Authority and APA FML
C411	Bond Street Station (Piling & Dwall)	NR01	Network Rail Interface Works

C412	Bond Street Station (Main works, Fit out)	NR04	Network Rail Interface Works
C420	TCR Access Shafts & SLC Works	NR07	Surface Works - Design
C421	Tottenham Court Road (Piling and Dwall)	NR08	IA & APA Works
C422	Tottenham Court Road (Main Station Works)	R131	PIP - C131 Recharge to LU
C430	Farringdon Station (Shaft Piling & Dwall)	R132	Bond St Recharge
C435	Farringdon Station (Main Station Works)	R271	PIP - C271 Recharge to LU
		R272	PIP - C272 Recharge to LU