

Date: 19 October 2022

Item: London Underground Train Systems Programme

This paper will be considered in public

1 Summary

£m (2022 prices)	Existing Financial Authority	Existing Programme and Project Authority	Additional Authority Requested	Total Authority	Prior Years Spend	Forecast to 2027/28
Train Systems	1207.2	1791.0	0	1791.0	665.7	1995.3

Table 1: Summary of Programme and Project Authority (see Table 7 below for further detail)

- 1.1 This paper updates the Committee on the progress of the London Underground (LU) Train Systems Programme. Table 1 above shows that no additional Programme and Project Authority is requested at this time. The Programme includes the following sub-programmes: Fleet (Fleet Renewals, Engineering Vehicles and the Fleet Heavy Overhaul programme), Signalling and Control, and Track. The Programme maintains the safety, operability, and reliability of LU assets through a prioritised programme of renewals.
- 1.2 This submission builds upon previous papers to the Committee in October 2021 for Signalling and Control, and Track, and in December 2021 for the three Fleet sub-programmes. It brings these into a single Programme and Project Authority of £1,791.0m across the years to 2027/28. The phasing of this is set out in Table 7 below.
- 1.3 The focus of this paper is to:
- present the Programme achievements since the previous submissions;
 - provide assurance to the Committee on the progress of the Programme and the future plans;
 - set out the existing Programme and Project Authority alignment to the current forecasts for 2022/23 and 2023/24; and
 - bring together the reporting of Fleet, Signals and Track under a single submission as endorsed by the Committee on 20 July 2022.

2 Recommendations

- 2.1 **The Committee is asked to note the paper and approve the consolidation of the LU Track, Signalling and Control, Fleet Heavy Overhaul, Fleet Renewals,**

and Engineering Vehicle sub-programmes into a LU Trains Systems programme with a total Programme and Project Authority of £1,791.0m.

3 Background

Strategic Context

- 3.1 The Mayor's Transport Strategy (MTS) has three key themes: Healthy Streets and healthy people; A good public transport experience; and new homes and jobs. Maintaining a State of Good Repair (SoGR) of LU assets is key to delivering all these plans. All LU Train System assets and their SoGR are directly related to a good public transport experience. Increased public transport use supports Healthy Streets and delivers growth in locations with high public transport capacity.
- 3.2 Constraints in the budget through the pandemic, coupled with pausing of project activities meant that spend was lower than planned during this period. In 2020/21, spend was £140m across Train Systems Renewals and this increased to £220m in 2021/22. In 2022/23 we have come through the period of low spend and are recovering to a run-rate which will maintain the assets in a SoGR in conjunction with increased spend in maintenance.
- 3.3 It is forecast that the spend across the Programme will be £250m this year. This increase continues into 2023/24 with the Programme building a capability going forward to deliver to a budget of £290m with a stretch delivery of up to £350m should funding allow.

Asset duties and responsibilities

- 3.4 The regulations that govern our operations with regards to assets include:
- (a) the Railways and other Guided Transport Systems (Safety) Regulations 2006, require TfL to apply to the Office of Rail and Road (ORR) for certification and authorisation to operate trains, stations, and infrastructure safely. Authority was approved by ORR in January 2022 for a further five years;
 - (b) the 2010 Rail Vehicle Accessibility (non-Interoperable rail systems) Regulations 2010 (RVAR) under the 2010 Equality Act; and
 - (c) regulations under the 1974 Health and Safety at Work Act including working at height, electricity, noise, manual handling, personal protective equipment, control of hazardous substances, and Construction Design Management.

Asset Strategy – Maintaining assets in a State of Good Repair

- 3.5 The SoGR describes the condition in which TfL seeks to maintain assets to provide a safe and reliable network that minimises whole life costs and, where appropriate, meets customer expectations. The SoGR is based on industry standard condition measures which differ by asset type, for example the standard that describes the specific condition of track is different to the condition for a signalling asset.

- 3.6 TfL records the asset condition using a combination of a five-point physical condition (Very Good, Good, Fair, Poor, Very Poor) and where the SoGR is below the preferred range it reflects the need for renewals investment to deliver a safe and reliable network and reduce the risk of injuries, restrictions, and closures arising from critical failure.
- 3.7 Data on assets is being collated to monitor both trends and forecast future performance. Asset Strategies are in place and are being enhanced to reflect ongoing developments in data maturity, asset condition and environmental targets. The high level SoGR measures for each of the areas that make up the Programme, together with details of how SoGR is measured and forecast for future years are provided in Appendix 1.

Impact on Operations

- 3.8 At present TfL is delivering a service operated percentage of 89.7 per cent across LU against a target of 90 per cent. Using a combination of increased funding in 2022/23 and further activities in maintenance, such as more frequent inspections and reactive interventions, we have limited the likelihood of assets being taken out of service, keeping current reliability constant in a constrained financial environment.
- 3.9 Due to the impact of the pandemic on TfL finances and subsequent prioritisation of works, the SoGR for all assets across TfL has deteriorated. The consequence is that there is a higher level of asset condition risk across the network. If this risk emerges, it will increase the likelihood of assets being restricted or taken out of service to maintain safety in the longer-term. This may include interim measures specific to the asset group and condition, such as reducing trains offered for service or speed restrictions being introduced along certain sections.
- 3.10 Available funding is targeted towards the most critical asset issues in the Asset Condition Report (ACR), prioritised as Code 1 (legal compliance) and Code 2 (safety related). Additionally in the Train Systems area there is a focus on longer term projects which maintain the operability of the railway, specifically related to overhauls of the major systems. These are often multi-year projects with significant design required followed by a long period of delivery, such as the Central line Improvement Programme (CLIP). This encompasses a major overhaul of the train fleet including motor renewals, the delivery of wheelchair bays, new passenger information systems and upgraded lighting to meet the requirements of accessibility legislation.
- 3.11 We will continue to use short-term mitigations to counter the service effect of asset deterioration as a result of the backlog of activities which have been replanned. In the short-term, the risk can be managed, however we need to ensure that work in the Programme continues so that the long-term impact on operations is minimised where possible.
- 3.12 In order to address the most pressing issues, the ACR is reviewed annually, and the most critical projects are moved forward to ensure that these works can be delivered and benefits realised. This is due to the lack of available funding to rectify all Code 1 and Code 2 concerns in a single year. Where projects are not progressed, risk assessment and mitigations are put in place to ensure that

safety is maintained. Typically, enhanced maintenance measures are deployed to ensure condition does not worsen over time.

- 3.13 The prioritisation process is based on a number of factors including SoGR, safety, strategic alignment with TfL priorities, commitments, value for money and priority of works. For example, the Fleet sub-programme consists of a number of overhauls and renewals projects which span multiple years. This approach ensures best value, otherwise the cost of the works and durations are likely to increase, there would be revenue loss from trains out of service and increased internal resource overheads. Through prioritisation it has been recommended that these continue in their entirety and as such Fleet will receive a larger proportion of authority across Train Systems. This will enable best value to be delivered through the use of multi-year contracts starting in 2022/23.
- 3.14 The projects within the Programme are designed to reduce and minimise these risks and are managed through a risk register across the Programme. This allows alignment of activity and/or funding to the biggest risks such that mitigations can be applied.
- 3.15 There is deterioration evident across the asset base which has an impact on operations. The average number of track defects, for example, are up from an average of five a week in 2020/21 to 10 a week in the first half of 2022/23. To mitigate this, enhanced inspections have taken place and there has been an increase in reactive re-railing projects to ensure that defects do not worsen resulting in unavailability.
- 3.16 The most significant business impacts which may build over time if renewals works do not take place are captured in Table 2 below. Actions to mitigate the risks within the programme are also shown. These are considered in terms of customer experience, costs, revenue loss arising from journey time increases, and reputational damage.

Table 2: Potential customer experience impacts

Risk	Impact	Action
Heavy overhauls not being undertaken on Victoria line, Jubilee line and S7 (District, Hammersmith and City, Circle) fleets	Removal of trains from service owing to exceeding mileage intervals – this is part of the safety system surrounding train operation. This leads to degradation of service as fewer trains are available	Maintain programme through rephasing where necessary to ensure delivery takes place to match emerging engineering issues. Increase maintenance inspections and reactive maintenance activities where required
The CLIP being unable to refurbish trains and bring them in line with RVAR leading to poor customer experience, particularly for	Removal of trains from service owing to exceeding mileage intervals – this is part of the safety system surrounding train operation.	Support the programme with more resource, allocation of higher funding level within Train Systems budget, early sight of emerging risks

Risk	Impact	Action
passengers with disabilities	<p>This leads to degradation of service as fewer trains are available</p> <p>Enforcement from ORR as trains are not refurbished to the agreed timelines as agreed through the RVAR derogation process</p>	<p>to enable timely mitigations.</p> <p>Work with engineering to extend service intervals where it is safe to do so</p>
Diminishing and unavailable spares in the market of critically obsolete components in Signalling systems lead to a reduction in functionality	Loss of functionality to operate a normal timetable, possibly leading to the unavailability of trains or areas of lines if spares are depleted before replacement can take place	<p>Continue to work with suppliers to secure 'last time buy' options and re-manufacture components where economical to do so.</p> <p>Where possible share spares across TfL, e.g. DLR and LU</p> <p>Harvest known good components from 'beyond economical repair' units to make in-house repairs where possible</p> <p>Incremental renewal projects will renew obsolete components with modern equivalents</p>
Track condition worsening	Speed restrictions put in place impacting timetable delivery, unavailability of track sections where condition falls below pre-determined thresholds	<p>Increased frequency of track inspections and resource made available to support this activity</p> <p>Increased spend in reactive re-railing</p> <p>Planning and organisational right sizing to achieve higher levels of spend from 23/24 onwards</p>
Current levels of spend leads to programme delivery risk	If critically obsolete systems are not replaced, unavailability of track areas or trains will increase. This may lead to significant customer delays or unavailability whilst solutions are found.	Early engagement with suppliers to inform their planning and resource availability to align with LU plans

Risk	Impact	Action
	Without the certainty of funding in future years the ability to offer attractive contracts to the market is restricted which may mean that projects cannot progress or costs will escalate leading to poor value for money	Planning and organisational right sizing to achieve higher levels of spend from 23/24 onwards

4 Programme Delivery in 2021/22

- 4.1 The pandemic and the resulting consequences for TfL's finances had a significant impact upon Programme delivery, particularly in 2021/22, with supply chain issues, material shortages and internal and external resource constraints all contributing to delays on several projects. Despite this, programmes continued to ramp up in the Fleet area in part due to long term programmes such as CLIP maturing. In April 2020, fleet overhauls were transferred into a capitalised sub-programme of works, previously having been undertaken as individual overhauls within maintenance. This change has enabled the overhauls to be delivered as a coordinated programme under capital project governance, enabling efficiency through economies of scale and the ability to plan and prioritise works according to resource availability. It also allows us to assess the total renewal expenditure across the fleet.
- 4.2 The total expenditure for this programme in 2021/22 was £223.2m against the revised budget (May 2021) of £269.9m. A summary by sub-programme asset group is shown in Table 3 below. There was a decline in spend during the height of the pandemic with stronger delivery performance in 2021/22. Figure 1 provides photographic examples of delivery.

Table 3: Actual spend by year (£m)

Programme £m	2017/18	2018/19	2019/20	2020/21	2021/22
Sub-programme - Asset Group					
Fleet	47.7	55.9	89.0	54.7	79.3
Signals	16.1	14.3	15.3	6.6	12.1
Track	150.6	114.3	119.6	76.0	131.8
Programme Total	214.4	184.6	223.9	137.3	223.2

- 4.3 The SoGR declined in 2021/22 due to project pauses and reductions in renewals-funding during the pandemic.
- 4.4 While some projects were paused in response to available funding, the programme had a number of notable successes including:
- completing testing of the new traction motor system as part of the CLIP;
 - completion of prototyping and installation of multi-purpose bays on the Bakerloo line (to comply with RVAR);
 - approval for use of Kirow cranes in Ruislip Depot;

- (d) completion of programmed heavy maintenance activities on 30 (of 36) Bakerloo line trains and the Central line Rail Adhesion Train;
 - (e) completion of 14 ventilation system replacements on the Victoria line;
 - (f) 9km of track renewed;
 - (g) 1.7km of track drainage renewed;
 - (h) design completed and delivery commenced on Bakerloo control system replacement;
 - (i) 26 points and crossings interventions;
 - (j) contracts awarded for Central line signalling and control system life extension; and
 - (k) competitive tendering process completed for the Remote Track Monitoring system.
- 4.5 This investment has maintained the current service levels and reliability of the assets but has not made significant improvements in the short-term. Once projects are completed, such as CLIP, benefits of reduced energy usage, improved reliability and reduced maintenance will be realised.
- 4.6 Appendix 2 contains a breakdown of this delivery by sub-programme since the last submission.

Figure 1 – Key deliverables in 2021/22

Acton

First CLIP pre-production train being shunted to Acton Works



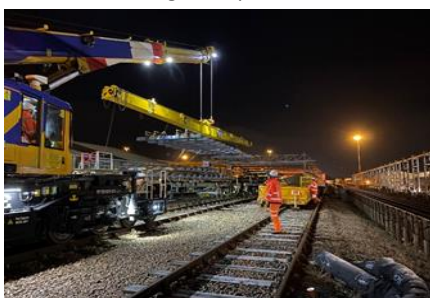
Victoria Line

Pressure Ventilation Ducting Replacement



Ruislip Depot

Kirow cranes installing track panels



Central Line

Rail Adhesion Train overhaul



- 4.7 The TfL Capital Efficiencies Plan was developed in June 2021, which has focussed on driving efficiency and delivering ‘value for money’ (VfM) across all programmes. Efficiencies are defined as delivering more for less or spending to save in future years. Examples of efficiencies delivered within this programme include saving £3m through improved stabling being delivered at Ruislip prior to the delivery of the new engineering wagons.

5 Programme delivery for 2022/23

Scope in 2022/23

- 5.1 To date in 2022/23, the Programme overall is on schedule to deliver the planned outputs. Appendix 3 summarises a full list of planned renewals in-year by sub-programme, together with costs and brief descriptions of the works.
- 5.2 There is a good level of confidence that the 2022/23 Programme of planned work will be delivered. Close management of resources, existing contracts and programme risks will be required and, should further funding become available, a workbank of further opportunities for acceleration of priority schemes is in place.
- 5.3 Highlights up to P6 of 2022/23 are:
- (a) the Piccadilly line programme lift has successfully delivered double the forecast number of units with 16 against a forecast of eight by December 2022. CLIP has completed all testing and working on four of the five planned trains;

- (b) the Kirow cranes are approved for use in sub-surface network open sections;
 - (c) in the Signalling areas, the communications installation works have completed all site works;
 - (d) a contract has been awarded for replacement of central computers which control the signalling on the Jubilee and Northern lines; and
 - (e) Bakerloo line incremental signalling upgrade enabling works have commenced.
- 5.4 At the end of 2021/22 due the funding uncertainties a number of schemes had to be deprioritised which increased the risk of asset degradation. Since the August 2022 funding agreement, we are now working to phase these schemes back into the plan in this and future years. As noted above, this will be supplemented by maintenance activities in the short term.
- 5.5 Many activities will continue beyond 2022/23 as they have project lifecycles beyond one year, with ongoing contractual commitments. The scope of work in 2023/24 will include schemes continuing from 2022/23 (shown in Appendix 3) and newly initiated projects that will be presented in the next annual submission.

Option assessment

- 5.6 Several strategic options were considered at the TfL level and are as follows:
- (a) **Financially Constrained (this is the planned level of investment)** In this scenario, the short-term constrained capital investment will have a higher reliance on maintenance activity. It will not deliver the best whole life cost for the assets. The risk of SoGR deterioration remains and will require further unplanned and reactive interventions which could result in short term unavailability. Future renewals schemes are likely to need more extensive, and therefore costly interventions which would not be the case if further funding was available. The approach to efficiently manage the programme is outlined below in paragraphs 5.7 and 5.8 below;
 - (b) **Do Minimum:** Maintains a basic level of service at minimum cost to maintain safety and operability. This option represents an absolute lower bound level of investment to hold level of SoGR without excess maintenance and reactive interventions. This would renew assets at their latest possible time and may not provide the smoothest investment profile;
 - (c) **Moderate:** Aligns with the 2020 TfL Business Plan with amendments to account for pandemic impacts on delivery in 2020/21. This can support the key themes of the MTS, however, at a slower rate and to a lower level of customer experience than the 'High Ambition' option; and
 - (d) **High Ambition:** This scenario aims to deliver the ambitions of the MTS. It prioritises walking, cycling and public transport. Areas of focus include supporting Vision Zero, and carbon reduction.

- 5.7 TfL has implemented a prioritisation process consistent across portfolios to deliver the best possible outcomes from limited funding. This will be refined through business planning, taking into account the extra funding made available through the funding settlement for 2022/23 and 2023/24. Projects have been categorised based on the criticality of the asset and impact of failure.
- 5.8 Periodic reviews will be used to assess the level of delivery achieved, risks, and whether additional commitments can be made through change control should additional funding become available or if there is slippage in a particular area of the Programme. This approach gives maximum flexibility to target funds to deliverable priorities.

Table 4: Forecast spend (£m) by sub-programme

Programme £m (values rounded)	2022/2023	2023/2024
Sub-programme & Asset Groups		
Fleet (including Fleet Heavy Overhaul and Engineering Vehicles)	130.0	159.3
Signals	33.7	36.5
Track	87.0	95.0
Total Programme Forecast	250.7	290.8

- 5.9 Combining the sub-programmes into a single authority gives greater flexibility to manage the Programme and if necessary, respond to any changing priorities within year. There remain robust controls in place to ensure visibility and accountability in decision making. These include assurance reviews and change control with decisions taken in line with delegated authorities. Contractual controls will be used to delay projects if required to remain within budget. No additional Programme and Project Authority in 2022/23 and 2023/24 is requested to that previously approved.
- 5.10 The Programme delivers a blend of repeatable work and overhaul projects. The forecast in Table 7 below, section 8.1, shows financial years to 2027/28 inclusive. This recognises that an increased spend is required to improve SoGR across the Programme.
- 5.11 As explained in section 3 above, both the Fleet Heavy Overhaul and Fleet Renewals require a different approach with a greater uplift in funding required in order to place long-term contracts as a result, this means there will be less available funding for other areas of the Programme, such as Track, which will continue to impact SoGR in some asset groups.
- 5.12 Refinement of the forecast for the coming financial years will take place through the business planning process and be presented in future annual submissions to the Committee. This will be prioritised in accordance with our Asset Strategies. A proportion of future year's spend is already contractually committed. There are

also longer-term contractual commitments that will need to be made in 2024/25 in order to deliver the Asset Strategy. e.g. the Central line Incremental Signalling Upgrade, which will continue to be refined through business planning.

Benefits and value

- 5.13 Asset modelling and historic performance trends have been used to assess the SoGR achieved by the planned investment. Appendix 1 shows a worked example (from a different renewals programme) for Lifts and Escalators as a target for data maturity. This is a priority for the Programme with work continuing to increase data maturity across all asset areas.
- 5.14 Our Financially Constrained scenario will result in deteriorating asset condition and is expected to increase the backlog of renewals that mitigate risk and allow us to maintain the level of service availability. This means whole life costs and best value are unlikely to be achieved as investment will not be at the optimum.

6 Programme risks and milestones

- 6.1 Table 5 below shows top risks associated with delivery of the Programme to address asset resilience and a decline in the SoGR.

Table 5: Top risks for LU Train Systems Programme

Risk No	Risk Description	Mitigation Actions
1	Constrained funding and increasing materials and labour costs impact delivery against objectives. Declining SoGR increases risk of asset failure. Increased risk of asset failures resulting in the programme needing to be re-prioritised in-year	Prioritise projects on whole life cost and risk to ensure best value. Strengthen regular reviews. Develop greater asset health awareness through data collection to prioritise critical assets in line with our Asset Strategies and life extend where possible. Ensure that maintenance and operations are able to react to asset condition changes
2	Lack of attractiveness to supply chain due to smaller contracts let on a case-by-case basis	Review commercial strategy within the duration of available funding
3	Resource levels in planning, delivery, and supporting teams and long lead times impacts delivery	Larger combinations to consolidate work may reduce supply chain uncertainty and make more efficient use of commercial resource. Regular deliverability reviews
4	Access to the network for delivery of works	Early engagement and co-ordination. Aggregate work in delivery to reduce overall disruption and cost
5	Maturity of Asset Strategies is variable. Data may be unreliable or incomplete.	Ongoing development of our Asset Strategies to identify data gaps and address these. Use tacit knowledge whilst Asset data matures

- 6.2 Risk allowances are applied at the project level. The Programme does not include a programme wide risk allowance so increases in costs above known and planned project risk need to be balanced by reductions or deferrals into future

years. This reflects the fact the programme is comprised of hundreds of schemes that, experience has shown, enable risk to be effectively managed across the programme using the workbank approach.

6.3 The strategic milestones for this Programme are shown in Table 6 below.

Table 6: Strategic Milestones Programme Milestones 2022/23

Project	Milestone Description	Date	Status
Track	Install 9km of new Class 2 track by end of Q4	30/04/22	Achieved
Fleet	10 th Metropolitan line train overhauled	16/06/22	Achieved
Fleet	Remote Track Monitoring – Contract award for design and delivery of two new Track Recording Vehicles	24/06/22	Achieved
Fleet	Bakerloo line RVAR – 10 out of 36 trains fitted with LED lighting to comply	30/09/22	30 days later than baseline
Fleet	Central line Improvement Programme – First train into service	26/02/23	On target
Fleet	Central Line Improvement Programme - All design signed off enabling start of full production phase.	29/11/22	Ahead of target
Fleet	Central line Improvement Programme – First train ready for service introduction	31/03/23	On target

7 Commercial Strategy

7.1 The Programme is predominantly delivered by our internal Direct Labour Organisation and by contractors using existing frameworks for rolling renewal interventions.

8 Financial Implications

8.1 The 2021 TfL Budget provides the Financial Authority needed to deliver the scope of the works set out in this request. The Programme's Financial Authority and the Programme and Project Authority is shown in Table 7 below.

Table 7: Summary of the costs and funding

LU Infrastructure Renewals		Actuals	Budget		Forecast				Total
Rounded to £m		Prior Years	22/23	23/24	24/25	25/26	26/27	27/28	
Financial Authority									
Budget		665.7	250.7	290.8	-	-	-	-	1207.2
Programme Forecast									
Forecast		665.7	250.7	290.8	312.5	362.4	372.1	406.8	2661.0
Authority request									
Prog. & Project Authority	Existing Authority	665.7	250.7	290.8	312.5	239.4	28.7	3.2	1791.0
	This request	0	0	0	0	0	0	0	0
	Future requests	0	0	0	0	123.0	343.4	403.6	870.0

Note – All future costs exclude inflation

8.2 A funding agreement is now in place with Government which allows for investment in the Programme to continue at the estimated level for the remainder of this year and 2023/24. It is not expected that additional commitments beyond 2023/24 will be made in this financial year. Any Authority granted which relates to both the current funding period and commitments that extend beyond the period of the Business Plan and Budget may need to be revised as part of future budgets to be considered by the Board.

8.3 Beyond the current agreed budget (to 2023/24), business planning will inform the allocation of funding to ensure that the forecast spend can be achieved. This will be based on the prioritisation of assets and their need in the coming years.

9 Equality and inclusion

9.1 TfL has an obligation under the Equality Act 2010 to:

- (a) eliminate discrimination, harassment, victimisation, and any other conduct that is prohibited by or under the Equality Act 2010;
- (b) advance equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it; and,
- (c) foster good relations between persons who share a relevant protected characteristic and persons who do not share it.

9.2 Most of the Programme is like-for-like renewals maintaining existing provision. However, with customer facing projects, such as those in fleet, we are taking the opportunity to improve accessibility for customers where possible. There are temporary impacts for customers during the delivery of works which may include a reduction in service provision. Equality Impact Assessments will be completed

on projects as required. A deteriorating SoGR, particularly in fleet, has a higher adverse impact on customers with accessibility needs.

10 Assurance

- 10.1 TfL Project Assurance conducted an Integrated Assurance Review (IAR) on the Programme in September 2022. This was targeted at the Fleet and Track areas and at Train Systems level going forward. Overall there were 12 recommendations by Project Assurance and five by IIPAG. There were two Critical issues raised which are related to the wider asset condition and maintenance plans. These have both been accepted and an action plan put in place to address the issues. These observations and recommendations are all in line with the TfL view of the programme and we are grateful for the support from the additional assurance. Details of these recommendations and our Management Response have been shared with the Committee.
- 10.2 An agreed Integrated Assurance Plan (IAP) for the Programme, covering the next 12 months, has been produced that sets out those projects that are expected to be reviewed. The IAP will be reviewed and updated quarterly.

List of appendices to this paper:

Appendix 1: State of Good Repair

Appendix 2: October 2020/21 – 2022/23 H1 actuals / year end forecast

Appendix 3: 2022/23 budget allocations and outputs

List of Background papers:

TfL Project Assurance Reports

Management response to TfL Project Assurance Reports

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Appendix 1: State of Good Repair

A1.1 SoGR, where possible, is based on industry standard condition measures. SoGR helps inform prioritisation of interventions, although not in isolation (other factors, such as asset criticality, risk, safety, and service are considered alongside SoGR). TfL has mapped these industry measures to a consistent five category scale of asset condition – the condition categories are Very Good, Good, Fair, Poor and Very Poor. The percentage of assets in these categories is used to calculate SoGR, namely:

- SoGR – the sum of the percentages in the Very Good, Good and Fair categories. These assets, in general, do not require planned asset renewal in the next one to three years, although in some instances it does reduce whole life costs to intervene when an asset is in the Fair category.
- Not in a SoGR – the sum of the percentages in the Poor and Very Poor categories. Typically, these assets have a higher probability of failure and should be considered for a renewal within the next one-to-three-year period (subject to assessment through prioritisation processes).

A1.2 The current scorecard target for LU assets differs by asset type.

A1.3 Table 1 below provides examples based on currently measured LU assets

Table 1: State of Good Repair – scorecard targets 2021/22 (*asset included in this Programme)

Asset	SoGR Performance 2021/22	SoGR Target 2021/22/23
Signals*	91%	91%
Escalators	82%	82%
Track*	48%	76%
Lifts	71%	71%
Fleet*	68%	68%

A1.4 Current scorecard targets are set based on an assumption that SoGR should be maintained based on current available investment. All assets are safety managed; where the SoGR is below the preferred range it reflects the need for renewals investment to deliver a reliable network and reduce the risk of restrictions and closures. Safety is maintained through appropriate inspections, minor repairs, and restrictions.

A1.5 SoGR in LU is calculated using a range of methodologies, primarily using data from Asset Condition Reporting. There are however some gaps across LU's asset base limiting our ability to calculate a total SoGR for LU. In these cases, other condition and asset health metrics are used to support prioritisation. Currently SoGR covers the following asset groups in LU; Track, Fleet, Signals, Escalators & Lifts and Buildings (approximately 75 per cent of the LU renewals investment programme). This makes comparison of condition using SoGR alone a challenge. A maturity plan has been developed with the aim of developing the

data to inform a consistent approach to SoGR analysis across all asset areas that make up LU's asset base. Work is ongoing to set targets in the maturity plan for 2022/23.

A1.6 Table 2 below and paragraph A1.7 below shows data currently measured or forecast via modelling for the Lifts and Escalator asset types indicating trends referred to in paragraph 4.2. This gives a mature example of how SOGR is calculated which is the aim for all asset areas across LU as data improves.

Table 2: Current and Predicted State of Good Repair (per cent) – Lifts and Escalators

Asset	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Lifts – SoGR existing asset base	74	73.5	70.7	69.4	68.1	66.9	65.6
Lifts – SOGR revised asset base	-	-	-	71.0	71.4	71.7	72.1
Lift Assets (no)	226	248	259	311	312	313	319
Escalators – SoGR existing asset base	85.6	83.6	82.1	78.8	75.8	72.8	69.8
Escalators – SOGR revised asset base	-	-	-	79.7	77.6	75.5	73.4
Escalator Assets (no)	458	458	463	524	526	526	529

A1.7 The modelling results for Lifts and Escalators reflects investment of £28m in 2022/23 and increased by 15 per cent for following years. For Escalators a declining overall trend is predicated both with and without additional assets to be installed. The position for lifts does show the overall SoGR is influenced by additional assets introduced (e.g. as part of Northern Line extension) in addition to levels of investment. For the existing asset base for Lifts the SoGR is predicted to decline even with the future investment assumed, but the overall SoGR is improved when the new assets are considered. These forecasts will help inform prioritisation of investment decisions for renewals and allow benefits to be monitored against forecasts supported by performance data.

Appendix 2: Delivery since last Committee submission and plan to next submission

Note: Whilst allocations and outputs for the year were part of the submission for the year 2021/22, they were reset by the TfL/DfT funding agreement as outlined in the letter from the DfT on 1 June 2021.

Fleet Heavy Overhaul Programme:

Project and Key Delivery from December 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
<p>Jubilee line fleet:</p> <ul style="list-style-type: none"> Commence pull forward activities and Programme Lift (scheduled heavy maintenance) 	<ul style="list-style-type: none"> Pull forward activities 70% complete. Phase 1 of Programme Lift commenced 	<ul style="list-style-type: none"> Complete Pull forward activities. Complete Phase 1 Programme lift on 26 trains. Commence phases 2 (HVAC [heating and cooling]), 3a (couplers) and 3b (Uncoupler Switches)
<p>District, Circle and Hammersmith & City line fleets:</p> <ul style="list-style-type: none"> Place contracts for programme lift Complete programme lift optimisation review from Metropolitan line programme lift experience. 	<ul style="list-style-type: none"> Procurement activities in progress. 	<ul style="list-style-type: none"> Complete Programme Lift optimisation periodicity extension. Place main contracts for Programme Lift
<p>Victoria line:</p> <ul style="list-style-type: none"> Complete programme lift catch back activities. Complete door overhaul of 22 trains. Complete coupler overhaul of 47 trains. Complete Pressure Ventilation system replacement on 32 trains 	<ul style="list-style-type: none"> Programme Lift catch back activities completed. Forecast to complete phase 1 door overhaul of 20 trains by December 2022 Forecast to complete coupler overhaul of 38 trains by December 2022. On track to complete pressure ventilation system install on 32 trains by December 2022. 	<ul style="list-style-type: none"> Complete phase 1 of door overhaul on all 47 trains and phase 2 overhaul on 10 trains. Complete coupler overhaul on all 47 trains. Complete pressure ventilation system install on all 47 trains. Complete wheelset overhaul on 30 trains.

Project and Key Delivery from December 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
<p>Bakerloo line:</p> <ul style="list-style-type: none"> • Complete new Programme Lift cycle of 24 trains, • Complete new Heavy Overhaul cycle of 9 trains • Complete Door Overhaul of 5 trains. 	<ul style="list-style-type: none"> • Completed 13 units of Programme Lift. • Completed 4 units of heavy overhaul. • Door overhaul delayed (to take advantage of a new improvement opportunity). 	<ul style="list-style-type: none"> • Complete Programme Lift of 24 units. • Complete heavy overhaul of 8 units. • Place all orders for door overhaul.
<p>Metropolitan line fleet:</p> <ul style="list-style-type: none"> • Complete overhaul of all 47 trains 	<ul style="list-style-type: none"> • Completed Programme Lift on 20 trains. 	<ul style="list-style-type: none"> • Complete Programme Lift on 45 trains • Agree scope and place orders for Gangways & Couplers Overhaul. • Place orders for Door Overhaul
<p>Piccadilly line:</p> <ul style="list-style-type: none"> • Complete 8 units of Programme lift • Complete remaining 5 units of seating overhaul • Complete remaining 12 units of Door scope 1 • Commence Door scope 2 works • Remobilise Pneumatic Control Module (PCM) works 	<ul style="list-style-type: none"> • Completed 16 units of Programme Lift. • All seating completed. • Door scope 1 completed. • Packages 7 & 8 of Door scope 2 commenced. • PCM works remobilised (but delivery strategy under review). 	<ul style="list-style-type: none"> • Complete Programme Lift. • Complete flooring overhaul. • Commence new delivery strategy for PCM works. • Commence all packages of Door scope 2. • Commencement of Pressure Switch replacement.
<p>Rail Adhesion Trains (RATs):</p> <ul style="list-style-type: none"> • Complete catch back activities on the two Central line RATs. • Develop overhaul scope for Metropolitan line RAT. 	<ul style="list-style-type: none"> • Catch back activities 30% complete. • Scope and Bill Of Materials drafted. 	<ul style="list-style-type: none"> • Complete catch back activities on Central line RATs • Place all orders for Metropolitan line RAT. • Initiate new project for next cycle of Central line RAT overhaul.

Fleet Programme:

Project and Key Delivery from December 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
<p>CLIP, Programme Lift and New Workshop:</p> <ul style="list-style-type: none"> • AC Traction Infrastructural testing in spring 2022 • Design Sign-off by spring 2022 • First train back to fleet in spring 2022 • Withdrawal of five trains from service from summer 2022 • Seats Repairs 	<ul style="list-style-type: none"> •Static & dynamic testing completed •Withdrawn four trains for CLIP 	<ul style="list-style-type: none"> •First train back into service •Start Programme lift on 1st train •Withdraw five trains for production •AC02 Temporary store for CLIP ramp up •TMU Hand back •Commence Seats Invitation to Tender (ITT)
<p>Bakerloo line RVAR</p> <ul style="list-style-type: none"> • First train installation of LED lighting, Passenger Information System (PIS), wheelchair bays and grab poles • Deliver above and below waist rail components • Commence works on 2nd train by spring 2022 	<ul style="list-style-type: none"> •Returned 1st train into service with all (except PIS) •Commence works on 2nd train and moved workshops into Stonebridge Park •Installed LEDs on 10 out of 36 trains 	<ul style="list-style-type: none"> •Designs sign off •Introduce the first PIS system and return 1st RVAR compliant train into service •Continue to install LEDs on 17 more trains
<p>Train Cab J-Door Security Improvement:</p> <ul style="list-style-type: none"> • Complete Detailed Design on all passenger fleets. • Commence installation on 92TS (Central), 72TS (Bakerloo) & 09TS (Victoria) fleets. 	<ul style="list-style-type: none"> •Works continued on Waterloo & City line fleet •Capital re-prioritisation to defer works on rest of LU fleet 	<ul style="list-style-type: none"> •Complete works on Waterloo & City line fleet
<p>Victoria line passenger fleet:</p> <ul style="list-style-type: none"> • Continue to deliver ventilation and fan cleaning • Complete floor repairs where required 	<p>On track</p>	<p>On track</p>

Project and Key Delivery from December 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
JVUM: <ul style="list-style-type: none"> • Commence procurement for design and manufacture • Develop technical specifications 	<ul style="list-style-type: none"> • Technical specification completed • Signed Procurement Strategy with all ITT documentation completed 	<ul style="list-style-type: none"> • Contract award to develop the design and deliver the solution
Victoria and Jubilee line Obsolescence Management (CCTV, PIS, Train Management System (TMS), and life extension)	<ul style="list-style-type: none"> • Initiated new projects for Victoria and Jubilee lines obsolescence management 	<ul style="list-style-type: none"> • Conduct feasibilities for these new projects
Jubilee line passenger fleet mid-life refurbishment	Closed	Closed
Bakerloo line Life Extension	Closed	Closed
Metropolitan line Rail Adhesion Train	Closed	Closed

Engineering Vehicles (EV) Programme:

Project and Key Delivery from December 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
<p>Locomotive Capability:</p> <ul style="list-style-type: none"> • Develop technical requirement specifications for the new fleet • Start procurement activities 	<ul style="list-style-type: none"> •Project re-characterised as a major and transferred to Major Programme Directorate (Chief Capital Office) 	<p>No further action</p>
<p>EV Overhauls Life extension:</p> <ul style="list-style-type: none"> • Overhaul of 6 locomotives, 24 wagons, deep tube cranes, and tamping machines 	<ul style="list-style-type: none"> •Procured drawgears and cab refurbishment designs for locomotive overhauls; develop bogie repair specs •Returned 2 overhauled wagons and 1 deep tube crane into service •Specifications for tamper overhauls on track 	<ul style="list-style-type: none"> •Overhaul 3 locomotives •Commence works on one Matisa and one Plasser unit
<p>Remote Track Monitoring (RTM/TRV):</p> <ul style="list-style-type: none"> • Contract award for the track geometry equipment and progress concept design • Close out of TRV SSL (Sub surface lines) project 	<ul style="list-style-type: none"> •Awarded contract for the RTM solution •Close out of TRV SSL delayed as the vehicle needed Programme Lift 	<ul style="list-style-type: none"> •Sign off concept designs for the TRV replacement •Commission TRV SSL project and extend concession to operate on other suitable lines
<p>Mechanised Renewals Vehicle (MRV)</p> <ul style="list-style-type: none"> • Initiate MRV enhanced phase 2 to add functionality and reduce manual handling on site and in the depot 	<ul style="list-style-type: none"> •Certified MRV modifications for use by Track Delivery Unit (TDU) •Completion of Phase 1 delayed due to non-availability of suitable on-site trials 	<ul style="list-style-type: none"> •Close out MRV Phase 1 and draft technical requirements for Phase 2
<p>Engineers Vehicle Depot Enabling – Ruislip:</p> <ul style="list-style-type: none"> • Complete feasibility study for a parallel stabling track for the new wagons • Conduct familiarisation for Modular Points and Crossings equipment (Mod P&C) and supply welfare facilities for Operations and Maintenance (O&M) 	<ul style="list-style-type: none"> •Delivered required stabling track for the new wagons •Procurement for new Mod P&C welfare facilities for O&M in progress •Commissioned civil works to replace the storage space for rail materials 	<ul style="list-style-type: none"> •Install lighting for the new tracks •Complete familiarisation for Mod P&C

Project and Key Delivery from December 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
Mod P&C: <ul style="list-style-type: none"> Obtain certification to work on LU Sub-surface network (open section) and Ruislip depot for track renewals. 	<ul style="list-style-type: none"> Achieved certification to operate in Ruislip Depot and open sections on the Sub-surface railway 	<ul style="list-style-type: none"> Roll out on-site trials for track renewals Confirm assurance requirements for tunnel sections on the SSL
New Wagons: <ul style="list-style-type: none"> Commence mass production of remaining wagons 	<ul style="list-style-type: none"> Received the fifth rectified wagon Completed bogie structure static testing 	<ul style="list-style-type: none"> Re-planning of dynamic testing on the Network Rail (NR) and LU network Commence mass production of wagon bogies only
Ward Coupler Modifications: <ul style="list-style-type: none"> Start concept design phase 	Re-start a round of commercial exercise to procure a design and manufacture of coupling solution	Complete concept and detailed designs for the ward coupler modifications

Signalling and Control (S&C):

Project and Key Delivery from October 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
Central line S&C life extension. Detailed Design Early deliverables CONNECT telecommunication works	<ul style="list-style-type: none"> Detailed designs commenced for work packages 1-5 and 9 CONNECT works finished on site 	<ul style="list-style-type: none"> Detailed design commencement for packages 7 and 8 Commencement of site installation works
Northumberland Park depot S&C upgrades. Completion of point detection equipment replacement Detailed design commencement	<ul style="list-style-type: none"> The project has re-entered concept design following a change of direction Two point detection replacements to complete (require closure) 	<ul style="list-style-type: none"> Concept design completed Tendering in progress for control system and new Train Movements Complex All point detection replacement completed
Northern and Jubilee lines S&C obsolescence management	<ul style="list-style-type: none"> Detailed design complete 	<ul style="list-style-type: none"> Delivery of system Project close

Project and Key Delivery from October 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
Large Data Transfer system upgrade		
<p>Piccadilly line signalling life extension / Asset Condition Works</p> <p>Contract award replacement capacitors</p>	<ul style="list-style-type: none"> •Contract awarded, production has commenced however delays have occurred due to materials shortages 	<ul style="list-style-type: none"> •All capacitors suspected of containing hazardous chemicals replaced • Four Lines Modernisation (4LM) residual capacitors replaced (if required)
<p>Bakerloo incremental upgrade</p> <p>Start of concept design works on Bakerloo</p>	<ul style="list-style-type: none"> •The concept design for all sites have been completed •Detailed design completed for site works at six sites •Site enabling works have been completed at five sites 	<ul style="list-style-type: none"> •All site enabling works completed •Detailed design for control centre completed •Detailed design for back up control completed
<p>Central incremental upgrade</p> <p>Early market engagement for market interest option selection</p>	<ul style="list-style-type: none"> •High level options development report completed •High level scope documents produced for the procurement strategy. •Technical engagement commenced for Wayside East. 	<ul style="list-style-type: none"> •Enabling works information and main works information completed in advance of tendering.
<p>Northern and Jubilee incremental upgrade</p> <p>Completion of option selection Engineering Vehicle (EV) Train Operator Display (TOD) optioneering completed Contract award for replacement of Vehicle Control Centres [central computers]) VCCs on Northern line and TODs replacement on Jubilee & Northern lines</p>	<ul style="list-style-type: none"> •Option selection completed •Contract awarded to VCC works. 	<ul style="list-style-type: none"> •Detailed design complete for TODs

Project and Key Delivery from October 2021 to December 2022	Status at October 22	Planned Oct 22 – Oct 23
<p>New projects arising from the Asset Condition Register</p> <p>Platform Edge Door (PED) overhaul District line PCBs removal Piccadilly line wire degradation Bakerloo line track circuit obsolescence</p>	<ul style="list-style-type: none"> •Projects initiated 	<ul style="list-style-type: none"> •Acton Town wire degradation works completed •PED overhaul commenced design

Track:

Intervention		2022/23 Forecast at last submission	2022/23 Forecast at October 2022	2023/24 Forecast as of October 2022
Plain-line (metres)	Deep Tube Renewals (DTR)	4,754	1760	1760
	Ballasted Track Renewals (BTR)	4,522	148	1500
	Flat Bottomed rail Conversion	10,000	6300	6600
P&C (units)	P&C full renewal + heavy maintenance activity	12	5	7
Other	Track Drainage (m)	3,000	655	1000
	Long Timber Bridges (units)	2	2	0

Appendix 3: 2022/23 planned scope

Notes

- 1) This provides an overview of the Train Systems renewals portfolio for 2022/23
- 2) This list will be subject to change as deliverability and priorities continue to be assessed
- 3) Includes additional scope to progressed if funding becomes available.

Sub-Programme	Programme/Project	2022/23 Cost (£m)	Description
Signals	Central Line signalling and control life extension	22.3	Replacement of obsolete components within the signalling and control systems
Signals	Signals essential projects	3.0	High priority safety projects to be addressed including legislative removal of components containing hazardous chemicals
Signals	Incremental Upgrade Programme	11.4	Incremental system upgrades in tranches to remove obsolescence and improve reliability for four lines (Bakerloo, Central, Jubilee and Northern)
Signals	Northumberland Park Depot control system renewal	0.6	Replacement of the 1960s control system which allows movement of train around the depot
Fleet	Heavy overhaul	81.0	Heavy overhaul of fleets as required. This is applicable to all fleets at specified points during their life according to distance moved.
Fleet Renewals	Central Line Improvement Programme,	22.4	Replacement of seats, introduction of measures to meet accessibility regulations including the introduction of LED lighting and the overhaul of the trains
Fleet Renewals	Jubilee Line Fractures (JVUM)	1.0	Weld repair of known train defects
Fleet Renewals	Bakerloo Line RVAR	4.4	Introduction of measures to meet accessibility regulations, including the introduction of LED lighting

Fleet Renewals	Victoria Line 09TS Vent & Ducting	0.4	Re-design of ventilation system to improve passenger conditions
Fleet Renewals	Initiating New Fleet Renewals Projects	0.3	Scoping of new projects
Fleet Renewals	J-Doors security improvements	0.4	Locking systems to be fitted to all driver's cabs - prototyping
Track	Integrated Track Team (ITT)	31.3	Ballasted track and points & crossing renewals
Track	Track Delivery Unit (TDU)	39.8	Deep tube renewals and flat bottom conversions
Track	Life Extension Projects	16.3	Projects that extend the asset life but aren't full renewals
Track	Other	1.1	Misc. costs
EV	EV renewal programme	15.0	Overhaul of tamping machines, track renewal vehicles, wagons and supporting works