FOISA exempt
☐ **Yes**
☐ **No**

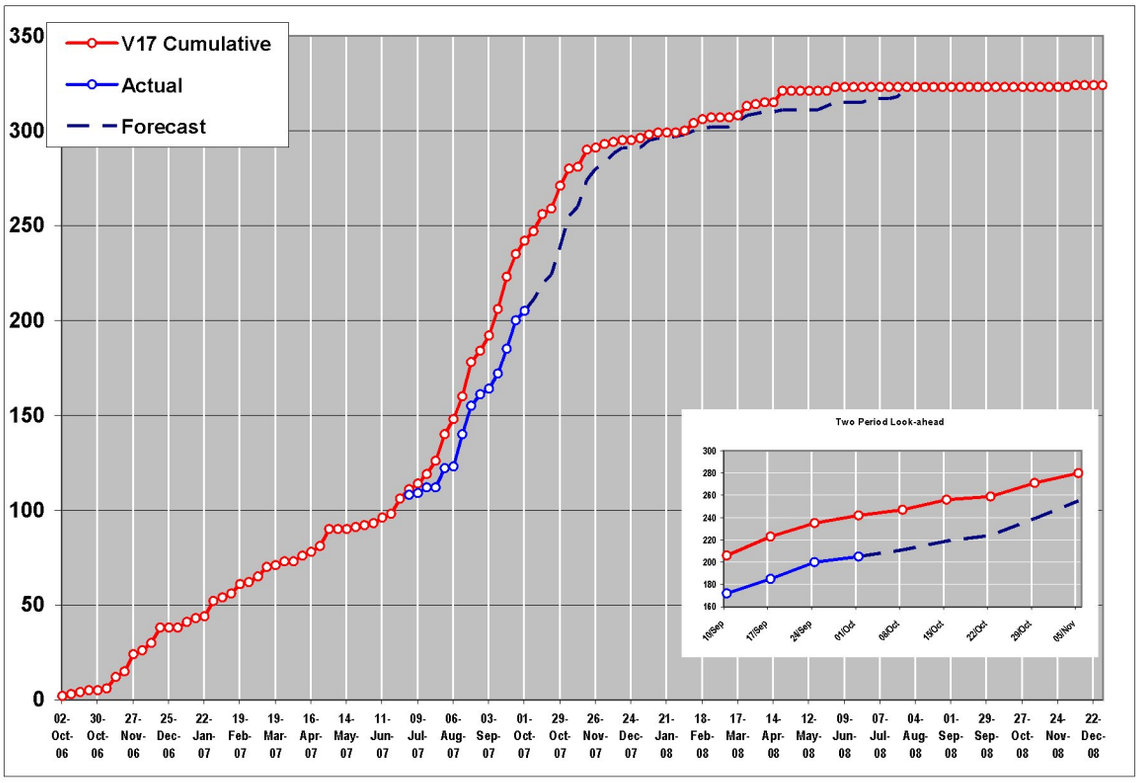
Paper to:	**DPD**	**Meeting Date:**	25 Oct 2007
Subject:	**SDS Update – P7**		
Agenda Item:			
Preparer:	D Crawley / T Glazebrook		

FOR INFORMATION ONLY

1.0 Summary

The design deliverables summary is shown below. As for last period, this is still referred to V17 as this was the first period after removal of all critical issues. The solid blue line is the record of delivery after this point and the dotted line is the V20 forecast.

This is shown below at V20 (actual and forecast)



Slippage of actuals at V20 with respect to forecast at V19 is minimal.

2.0 Issues

These issues below are receiving constant attention, in terms of design, planning, traffic modelling or stakeholder or neighbour agreements. Each has the potential to become a critical issue impeding progress, and all are being managed effectively through a weekly review to ensure that progress is maintained. The ownership of these items is with SDS to deliver the relevant designs but **tie** and

CEC input is necessary to remove blockages, particularly in respect of negotiation with Forth Ports and SRU.

Section 1a
Lindsay Road – Ensuring that there is a new design which can effect connection of the junction following redesign caused by the need to accommodate ADM Milling near Ocean Terminal. Heads of terms are required to be finalised between **tie** and Forth Ports

Ocean Terminal – Close out of the final details of the redesign caused by Forth Port's request for a change in the tram alignment. Heads of terms are required to be finalised between **tie** and Forth Ports

Section 1a bridges – Accommodation of footway provision to ensure that the structures are adoptable by CEC following transfer from Forth Ports.

Section 1b
Leith Walk footway reinstatement specifications – definition of scope of re-instatement required.

Section 1c
Picardy Place – Remodelling to accommodate development. A 'T' junction design has been identified by CEC as preferred over the extant design. SDS are to define what the programme impacts will be before a decision is taken.

St Andrew's Square – MUDFA delay with a new programme being devised.

Casino Square – An agreement between **tie** and the casino is required and SDS drawings are required to support this.

Section 5a
SRU – Agreement to allow training pitch movements has been gained informally with formal agreement understood to be close. However, the SRU have advised that, notwithstanding this, they need to begin consultation with their tenant (Wanderers) at some time in the future. With the design as currently packaged **tie** Prior Approval will not be possible despite SRU agreeing to the public consultation process beginning. As a result, the Prior Approvals process will be split to isolate that part associated with the SRU tenant accommodation and progress made on the major portion. This still requires SRU agreement to the split.

Section 6
Depot – Design of the water main depends upon receipt of survey information by SSD from MUDFA.

System Wide
Drainage – Acquisition of survey data from MUDFA / AMIS remains a risk.

Issues will be escalated from time to time as required in order to maintain progress.

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Proposed	Name David Crawley Title Director, Engineering Approvals & Assurance	Date: 09-10-2007
Recommended	Name Matthew Crosse Title Project Director	Date: 09-10-2007
Approved	…… …… David Mackay on behalf of the Tram Project Board	Date: ……

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☐ **Yes**
☐ **No**

Paper to: **TPB** **Meeting Date:**

Subject: **System Performance**

Agenda Item:

Preparer: **Alastair Richards**

1.0 Introduction and key issues

1.1 The key operational parameters defining the system performance of the Edinburgh Tram Network are system availability, operational runtime and service frequency. This paper sets out the high level plan for establishing and developing the targets and explains how the associated allocation of risks, incentives and penalties for their delivery have been incorporated into the framework of contracts.

1.2 The elements that give rise to System performance are developed through the key stages of the project lifecycle, design, construction, validation through system acceptance testing, the initial period of reliability growth post-opening and then the ongoing process of performance monitoring and improvement.

1.3 SDS have been contracted to produce a reliable and robust design that achieves a target runtime, which formed the basis of the procurement of supply and commissioning of the infrastructure and trams. The Infraco and Tramco contract delivers against this design and will be validated by a series of acceptance tests; including factory acceptance tests, site acceptance tests, integration tests and system performance tests. These are followed, post opening to the public, by a reliability demonstration period. The contracts with the Operator, the Infraco and Tramco are fixed price with a performance improvement related component based on achievement of key reliability, availability and quality performance indicators.

1.4 With such a large proportion of the Edinburgh Tram route running on street through the heart of Edinburgh, the tram service reliability performance will, to a large extent, be dependent on the level of priority that can be provided through critical city centre junctions. A delicate traffic balance must be achieved with the priorities at these key junctions however, in order to allow buses on the non-tram corridors to also flow. Optimised junctions solely for tram could compromise the effectiveness and economic success of the public transport network overall. Although traffic modelling is being used to optimise the junction design and signal phasing, it will only be with the benefit of actual experience that they can be fixed with a degree of certainty. The decision criteria will be to provide tram and bus runtimes which will be able to achieve the best balance for public transport delivery as a whole. As a consequence the responsibility for achieving tram runtime must inevitably be shared between the contractors, TEL and CEC in order to achieve a successful outcome.

1.5 The purpose of this report is to make the DPD and the Board aware of the approach and allocation of responsibility for system availability, operational runtime and the primary processes to develop these before commencement of passenger services and thereafter.

2.0 System performance

2.1 To achieve the key project objectives of modal shift from private car and enhancement of the current public transport system, the ETN must perform reliably and consistently. This requires that reliability, availability and maintainability analysis underpins each stage of the project lifecycle.

Design & construction requirements

2.2 SDS have been designing to a series of top down availability targets which they derived from operational data from existing UK tram networks. A version of these availability targets have been used in the Tramco and Infraco procurements to date, and form an important part of the design requirements which must be verified at each stage of manufacture, installation and commissioning. Validation will be achieved by the specified system acceptance tests contained in the employers requirements.

2.3 The sequence to be followed is shown in figure 1. Following depot commissioning and energisation of power, testing will then be undertaken on the line between the depot and the airport, to provide a test track for acceptance testing of each tram. This will also allow the start of driver training. Following this the remainder of the line will be commissioned and tested, allowing the on-street driver training and route familiarisation to commence.

Edinburgh Tram – Extract from System Life Cycle Model			
Stage	**Flow Chart**	**Tests**	**Description**
8	 **Service Commencement date**	**Network Performance and Reliability Test (T4)**	The date upon which the Edinburgh tram Network will open to public service
7	 **Shadow Running**	**Pre-operations test (T3)**	The period of tram operations that simulates full public service operation including running to published timetable and calling / dwelling at Tramstops before the ETN enters public service
6	 **Test running and driver familiarisation**	**Performance Test 1 (T2)** **Post-commissioning Test (T1)**	The period post System commissioning used to complete driver and control room staff training and gain confidence to enter Shadow Running Phase
5	 **Commissioning**		All sub-systems, including the tram are integrated to form the Total system and are tested to demonstrate that they work together successfully and meet the overall system requirements
4	 **Set to work tests**		The point at which systems have been installed and then tested to prove they meet their requirements
3	 **Installation / Construction**		Once the System has passed Factory Acceptance Tests installation / construction at site will take place
2	 **Factory Acceptance tests**		Through demonstrable testing of the total System at Infraco's premises
1	 **Build/Manufacture**		Manufacture and assembly of the System by Infraco
DD	 **Detailed Design**		The scope of works contained with the SDS Contract through to production of Pre-Approval for Construction documentation and thence taken forward by Infraco to Actual Approved for Construction Drawings

2.4 The system performance tests confirm that it is possible to achieve consistent performance for passengers, measured in the same manner as passengers perceive system performance, using the average maximum waiting time for the

next tram (headway) and the end to end runtime. Targets for punctuality, availability and runtime form the success criteria which must be met in the pre-operations system acceptance test, as a conditional step prior to which revenue service may not commence. Failure to achieve a successful test on-time by the contractors will result in liquidated damages to off-set the costs of late opening for the client and milestone payment schedule will also exert cash flow pressure for the contractor.

Test	Test Name	Test Description	Programme
T1	Post Commissioning Test	The test shall demonstrate and prove that the ETN is able to perform in an acceptably safe manner and deliver the required run times. This is the gateway test to driver training.	Post Commissioning Test will immediately follow the successful commissioning of the nominated section and is a requirement for progressing into the Driver Training.
T2	Performance Test 1	The test shall demonstrate and prove that the ETN is able to perform satisfactorily to move into the three-month Shadow Running period. This is the gateway test to shadow running.	Performance Test 1 will immediately precede the Shadow Running period and is a requirement for progressing to this phase of the programme.
T3	Pre-operations Test	The test shall cover a seven day period during the latter part of the Shadow Running phase of the programme. The test is the operation of the initial entry into service timetable and includes infrastructure, trams, and operations systems	Pre-operations Test shall immediately precede the Service Commencement Date.
T4	Network Performance Test	The Test shall be carried out over a 28 day period in Passenger Service to establish that the ETN can reliably operate the Operational Timetable	To be completed within twelve months of the Service Commencement Date.
T5	Network Reliability Test	Reliability Testing of sub-systems in passenger service	To be completed within twelve months of the Service Commencement Date.

2.5 Achievement of the system acceptance tests and safety approval during the shadow running period are the precursor to passenger service commencement. Tram service frequency will commence at a reduced level for the first 12 months in order to lower the risk associated with service startup, familiarisation of staff, passengers, other road users and for the system to bed down. Appendix 2 contains a description of the planned sequence of timetables to be operated.

Reliability growth in passenger service

2.6 Successful achievement of the reliability test can only be demonstrated when sufficient major fault free tram mileage and system availability has been achieved in public service. This is expected to be achieved between 9 and 12 months after commencement of service. At this same time the increased peak service frequencies will be introduced as required. Upon successful achievement, a combination of retention bonds and retention payments shall be released to the contractors.

2.7 To avoid paying excessive risk premiums during the initial reliability growth period and to incentivise all three contractors to collaborate effectively to achieve a successful tram system, a pre-set deduction from each contractor's fee will be made until 12 months or achievement of the reliability certificate. This period of operational experience shall be used to calibrate the performance payment regime thresholds and targets.

2.8 If the reliability certificate is achieved inside of 9 months from service commencement, then all the contractors shall each be entitled to payment of the deductions in fee made up to that point. However, if the reliability certificate takes between 9 and 12 months then the rebate paid to all the contractors shall taper down to zero. If it is achieved beyond 12 months, then all the contractors forfeit any right to receive payment back, they also then become subject to the ongoing level of deductions according to the contractual performance regime, and the possible escalation of sanctions leading up to potential termination and calling of the retention bond in the extreme.

2.9 The measures and targets of the reliability test are deliberately based on the specific performance of individual systems supplied and operational elements which are directly within the contractors control.

Ongoing Performance Regime

2.10 Once reliable passenger service and availability of the system has been demonstrated, the operator, tram and infrastructure maintenance contractors become subject to a performance payment regime as follows:

KPI	Tramco	Operator	Infraco	Target level
Punctuality	Late Trams (adherence to scheduled headway) monitored at specific points along the route.			98%
Availability	Trams offered for service		Infrastructure offered for service	99%
Quality (Edqual)		Inspections of qualitative service delivery (eg cleaning, information provision, system appearance).		Various levels
Fault Correction		Self-reporting by contractors of response/repair times performance		Various levels
Revenue Collection		Ratio of tickets checked to passengers travelling		To be established annually by joint revenue committee
% of fee at risk	15%	10.5%	40%*	

* Subject to final negotiation.

2.11 The operator regime places 10.5% of the fee at risk, weighted 70% Punctuality, 15% Revenue Collection, 12.5% Edqual and 2.5% Fault Correction / Information Provision. It proposes a single measure for the Punctuality element, incorporating both the number of trams run and their punctuality, with punctuality determined using a headway approach. It proposes a qualitative regime to be known as Edqual with a low performance level, zero points level and maximum points level for each measure in line with the existing qualitative regime for Manchester Metrolink trams.

2.12 The Infraco regime places 40% of the fee at risk, weighted 30% Punctuality, 7.5% Edqual and 2.5% Fault Correction / Information Provision. The same measurement of punctuality as for the Operator regime is proposed. The same Edqual qualitative regime as for the Operator regime is proposed.

2.13 The Tramco regime places 15% of the fee at risk. Punctuality is the same measurement used for the Operator and Infraco regimes. A further refinement is added, in that the number of defective trams and the availability of hot spares are included in the measure.

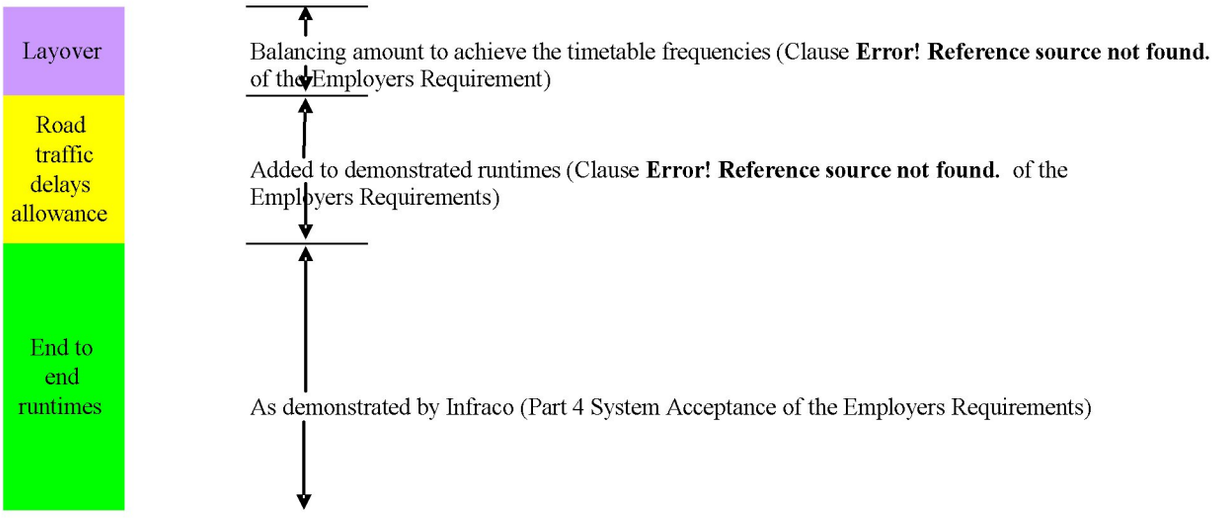
2.14 A number of external influences and variable factors must also be taken into account when providing a good service to passengers. These include passenger boarding times due to crowds at different stops at different times of the day, as well as junction, traffic management and pedestrian interaction on the on-street section of the tramway. These strongly influence the operational runtime which can reliably be achieved on the system.

3.0 Operational runtime

3.1 To construct a reliable operational timetable, it is necessary to establish the statistical distribution of operational runtimes by time of day and by day of the week. Actual values will start to emerge during the test running in 2010.

3.2 A laws of physics model has been produced for the CAF tram, based on the vertical and horizontal track alignment designed by SDS and practical speed limits applied in accordance to adjacent road traffic, expected sightlines and civil limits.

3.3 In order to calculate the operational runtime, assumptions have had to be made for the variable additional delays incurred. These have particularly been on the on-road section of the line for road junctions, road traffic congestion levels and passenger loading and unloading times in each direction and by time of day. Realtime GPS based data has been collected from existing experience with the buses on these sections of road in Edinburgh. Using this data, predicted variability of operational runtimes have been extrapolated and the required number of trams, electricity consumption and required number of operational staff have been calculated for each of the planned service frequencies.



Management of the development of operational runtime

3.4 Projects in the past which have followed the design, build, operate and maintain approach have contractually placed the risk that the operational runtime is longer than planned fully on the private sector. Although the projects which have had difficulties in achieving the planned runtimes, a fair proportion of all schemes, it has been difficult to determine how much is as a result of external events as opposed to those events within the contractors control. Despite the contract, contractors have not been obliged to provide additional trams, and instead the operational timetable has been adjusted to suit.

3.5 With the contractual arrangement in place in Edinburgh, where **tie** have a separate contract with the operator to that with the design, build and maintain contractor, the situation is further complicated. In addition to this, junction priority and the degree to which segregation of tram and bus from each other and other road users can be achieved given the available road space lie with CEC, as the roads authority, and TEL, whose overall business requires that both tram and bus are successful in combination and not in isolation.

3.6 For Edinburgh Tram Network the practical operational runtime risk is shared between CEC, TEL, the Operator and Infraco, allocated as follows:

	Responsibility
Scheduled crew relief and recovery time	Operator and TEL
Variable dwells for passenger loads	Operator and TEL
Junction and traffic management variability	CEC and TEL (supported by the operator)
Laws of physics runtime[1]	Infraco (supported by SDS and Tramco)

3.7 A process will be followed to manage the runtime emerging through the testing and the implications that changes have and how these will be mitigated. Appendix 1 shows a flow chart showing the key stages to be followed. This utilises the experience from the modelling, supplemented by the practical experience of the impact on traffic movement gained during the MUDFA and Infraco road works and finally using the tram testing and initial period of operation to optimise and fine tune the achievable operational runtime.

4.0 Recommendations

4.1 The Board are requested to note the position and proposed actions and allocation of risk share.

Proposed: Alastair Richards — Date: 29 June 2007
Operations and Maintenance Director

Recommended: Matthew Crosse — Date: 29 June 2007
Project Director

Approved: …… — Date: ……
David Mackay on behalf of the Tram Project Board

[1] (Including 25s tramstop dwell at each platform, junction design, sightlines and speed limits.)

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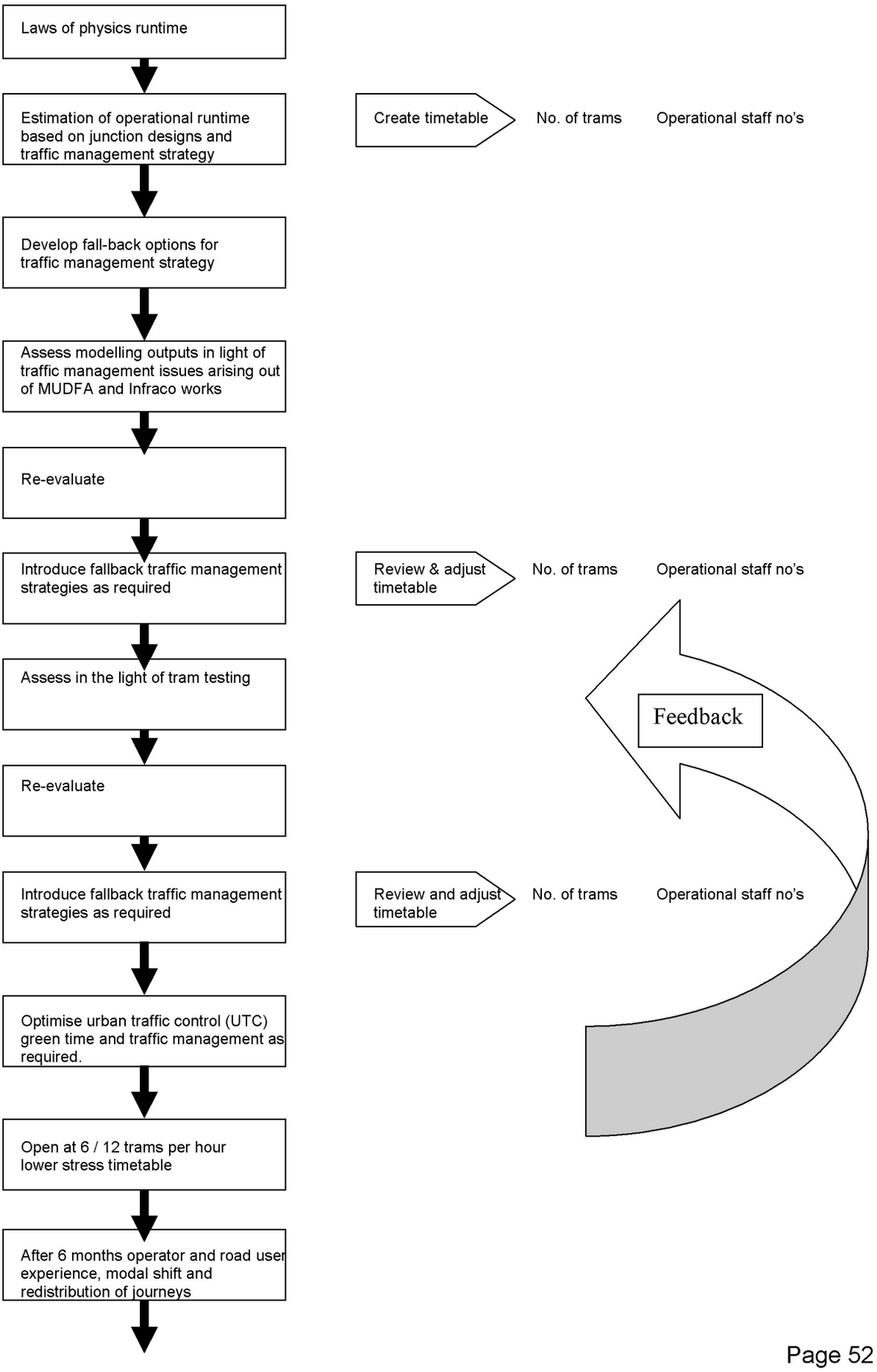
☐ No

Appendix 1



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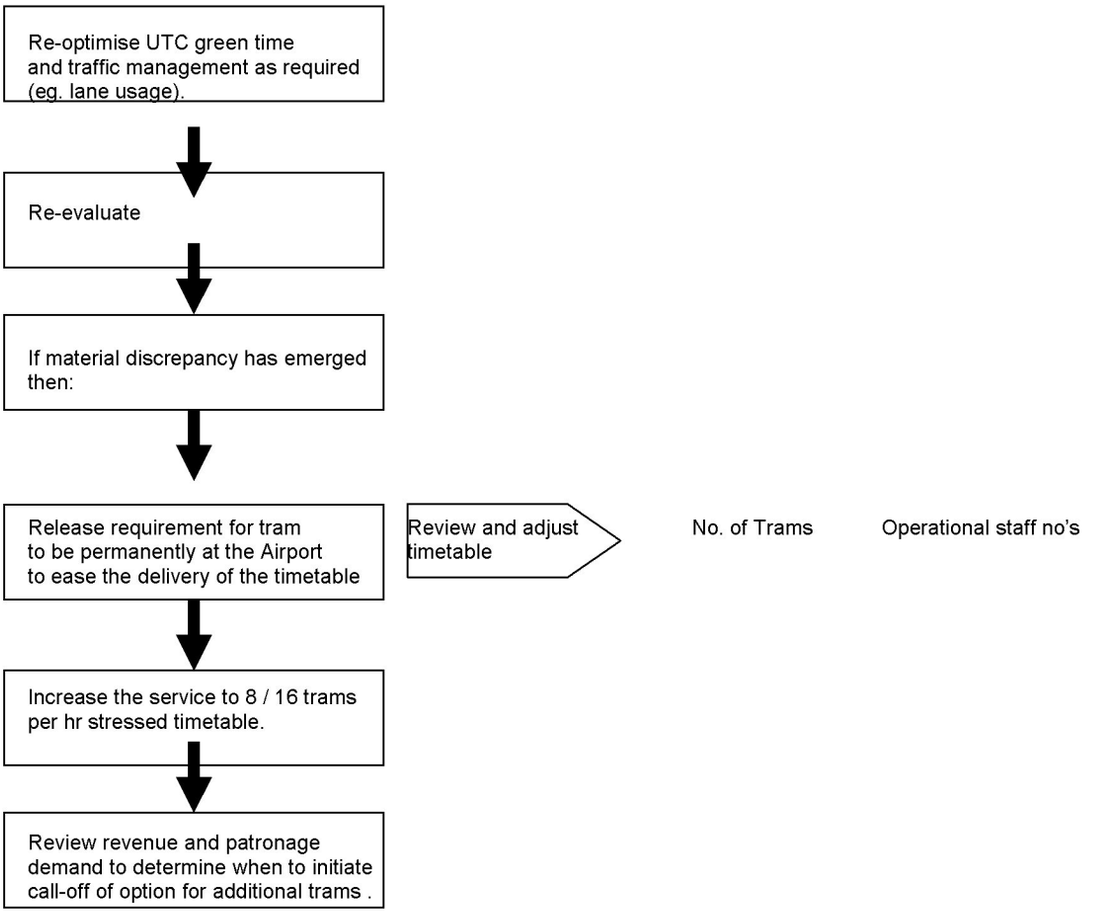

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Appendix 2

Three timetables are planned to be progressively introduced in response to patronage demand growth. These are intended to allow for reliability growth and operator familiarisation with the Edinburgh Tram Network.

Operational Timetable: A timetable providing trams at a frequency of twelve trams per hour in each direction on the common section between Haymarket and Ocean Terminal. Six trams per hour in each direction are operated on the sections between Haymarket and the Airport and between Ocean Terminal and Newhaven. For Phase 1b, trams at a frequency of six trams per hour in each direction on the section between Haymarket and Granton square shall be operated. The Operational Timetable shall be in effect from Commencement of Service for a minimum of one year.

AM and PM Peak Enhanced Timetable: A timetable providing trams during the AM and PM peaks at a frequency of sixteen trams per hour in each direction on the common section between Haymarket and Ocean Terminal. For Phase 1b providing trams at a frequency of eight trams per hour in each direction on the section between Haymarket and Granton square for the AM and PM peak times only, reverting to the Operational Timetable during the inter peak period. The AM and PM Peak Enhanced Timetable shall be introduced no earlier than one year after the Commencement of Service and shall be operated for a minimum of six months.

Enhanced Timetable: A timetable providing trams at a frequency of sixteen trams per hour in each direction on the common section between Haymarket and Ocean Terminal. For Phase 1b providing trams at a frequency of eight trams per hour in each direction on the section between Haymarket and Granton square. The Enhanced Timetable shall be introduced no earlier than two years after the Commencement of Service.