A3. H7 T2 BAGGAGE PROGRAMME APPENDIX

This appendix covers the following:

- Our T2 Baggage Programme Delivery Objective.
- Our T2 Baggage Programme assumptions, risks and opportunities.
- Providing further detail of our assessments of the available options for the H7 T2 Baggage Programme.
- Further detail around the T2.2 – T2A chosen strategic option.
- Cost estimation detail of our proposed strategic option for the H7 T2 Baggage Programme.

Our proposed H7 Delivery Objective for the H7 T2 Baggage Programme

A3.1 Since RBP Update 1, and responding to CAA feedback, we have developed the following SMART Delivery Objective for the T2 Baggage Programme:

T2 Baggage Delivery Objective
Heathrow will invest £432m (2018p) in H7 and £142m (2018p) in H8 with the H7 objective of contributing to achieve the OBR baggage misconnect rate of 9/1000*, timely delivery from departures baggage system, Overall Satisfaction, Customer effort (ease), Airport that meets my needs and protecting Terminal 2's 2019 baggage peak daily throughput capability of 31,000 bags (typical peak day). This will be achieved by starting to migrate the majority of the existing baggage operation from Terminal 1 to Terminal 2A. Construction of the Terminal 2A baggage system will commence in H7 and the system will be operable in early H8. During H7, the programme will also deliver asset replacement of the Terminal 1 building and services to keep it safe and secure, protect the Terminal 1 baggage system/operation and relocate non-Terminal 1 related IT systems out of Terminal 1. *Misconnect rate is a measure of total product performance which includes system, airline and handler Key assumptions: Terminal 1 will remain until 2035 Terminal 2 will be home to airlines from 2019 and will maintain similar fly schedule and baggage peak volumes.

Our T2 Baggage Programme assumptions, risks and opportunities

A3.2 Below we set out our T2 Baggage Programme assumptions, risks and opportunities.

Assumptions:

1. Airline mix and flight schedule will align to 2019

2. Due to the low maturity of the scope and schedule, the spend for T1 building asset replacement has been profiled based on equal % year on year.

3. Recovery will not come back quicker than anticipated (RBP forecast) and apply extra pressure on the T1 system.

4. T1 is required to be safe and secure until 2035.

5. T1 baggage can be supported until 2027 with limited asset replacement, based on current spares assessment and original equipment manufacturer information.

Risks:

1. Market conditions may impact our ability to resource and mobilise the programme at the required pace.

2. T1 scopes of works require much more intrusive replacement after survey as largely conditions are unknown in great detail.

3. Extent of the presence of hazardous materials in T1 is largely unknown and could impact schedule and costs.

4. Further systems could be identified as live and support other areas of Heathrow's operation, which require replacement or relocation.

5. Technical and operational innovation not accepted leading to less baggage processing in T2A.

6. Delays in a T2A baggage system will have significant consequence to T1 Baggage asset replacement scope, a post 2027 go live will initiate significant asset replacement projects in 2024.

7. Supply chains discontinue components quicker than originally anticipated (we have seen this as a response due to Covid-19 in other projects).

8. Current baggage metrics for the quinquennium may change as part of the H7 agreement.

Opportunities:

1. T1 partial demolition over asset replacement to provide long term cost saving (masterplan alignment).

Providing further detail of our assessments of the available options for the H7 T2 Baggage Programme

A3.3 Our assessment of the T2 Baggage strategic options carried out since RBP Update 1 is set out over the following two pages.

Table 1: Assessment of T2 Baggage 'stay in T1' strategic options

Options Family	Option	Cost (H7/H8)	Capacity	Schedule	Deliverability	Masterplan alignment	Baggage performance and resilience	Impact to operation
Stay in T1	1.1- Capped (£180M) Asset Replacement (RBP Dec 2020)	Required investment £681M – £871M H7: £180M* H8: £461M* H9: £116M* Realistic delivery £350M maximum per 5 year period.	From 2026, it is highly likely that system outages will be frequent and beyond repair reducing the capacity of the system (up to 30%).	Planned completion in H9.	Unable to deliver required asset replacement in H8 without removing 50% of the operation.	Doesn't inhibit expansion of T2A to 30 MPPA. Maintains flexibility in T2 baggage solution for the future by not occupying available space in T2A.	Does not maintain 2019 service levels for H7 and H8.	Frequency of system outages is likely to increase resulting in increased missed bags and potential closure of T2. Reputational damage could also occur due to the regular occurrence of failure.
	1.2- Asset Replacement	Required investment £681M – £871M H7: £482M* H8: £176M* H9: £99M* Realistic delivery £350M maximum per 5 year period.	Maintains T2 capacity (20 MPPA) once completed. Difficult to maintain capacity during construction.	Planned completion in 2033 for baggage and 2029 for building services.	Unable to deliver required asset replacement in H7. Complex build due to interfaces with the baggage operation, poor status of the building and limited knowledge.	Doesn't inhibit expansion of T2A to 30 MPPA. Maintains flexibility in T2 baggage solution for the future by not occupying available space in T2A.	Does not maintain 2019 service levels in H7. On completion, it only maintains 2019 service levels (no improvement).	Highly intrusive construction requiring complex mitigations. Multiple areas require concurrent interventions. Unable to deliver in the required timeframes to avoid risk increase in H7.
	1.3- T1 Regeneration	Required investment £562M – £651M H7: £500M* H8: £92M* Realistic delivery £350M maximum per 5 year period.	Maintains T2 capacity (20 MPPA) once completed. 30% reduction to capacity during site works. Significant risk to constraining COVID recovery.	Planned completion in 2027 for baggage and 2028 for building services.	High risk of not being able to deliver the required quantum of works in H7 due to current business and industry circumstances. Currently governance structure does not support required pace of delivery.	Doesn't inhibit expansion of T2A to 30 MPPA. Maintains flexibility in T2 baggage solution for the future by not occupying available space in T2A.	Improved performance and resilience on completion.	Requires complex airline moves during enabling and delivery phases.

Table 2: Assessment of T2 Baggage 'exit T1' strategic options

Options Family	Option	Sub - Option	Cost (H7/H8)	Capacity	Schedule	Deliverability	Masterplan alignment	Baggage performance and resilience	Impact to operation
Exit T1	2.1- T2IB		>£1.5Bn (Not assured numbers, based on FT2 and asset replacement)	Supports increase of T2 capacity to 23 MPPA. Difficult to maintain capacity during construction.	Planned completion in 2031.	T2IB is a non intrusive construction. T1 asset replacement requirements are similar to those of option T1.2 and are therefore undeliverable.	Requires demolition to enable any T2 expansion. Inhibits T2 expansion by 10 years due to phasing and increases CAPEX by £1.6Bn +/- 30%	Improved performance and resilience on completion. Does not maintain 2019 service levels in H7.	Significant business change and transition required. T1 asset replacement impact as per option T1.2.
	2.2- T2A	2.2.A- Transfer Building	£700M – £879M H7: £366-£466M* H8: £311-£411M*	Maintains T2 capacity (20 MPPA).	Planned completion in 2028/29 for baggage and building services and mothballing.	Non intrusive construction. Speed of mobilisation and ramp up could negatively affect T1 asset replacement.	Requires demolition of the transfers building to enable any T2 expansion. Delays the T2 expansion programme by 2 years.	Improved performance and resilience on completion. Expected degraded service in early H7.	Non intrusive construction. Significant business change and transition required.
		2.2.B- WIB	£566M – £726M H7: £344-£444M* H8: £185-£285M*	Maintains T2 capacity (20 MPPA) for departures system. WIB capacity will breach at 2019 levels for transfers processing.	Planned completion in 2026/27 for baggage and 2028/29 for building services and mothballing.	Non intrusive construction. Speed of mobilisation and ramp up could negatively affect T1 asset replacement.	Fully aligned with the masterplan. Brings forward T2 Baggage System Scope (FT2)	Impact to baggage process times due to increased distance to/from WIB. Impact to missed bag rate. Expected degraded service in early H7.	CTA resilience reduced, in the event of WIB failure with T2, T3 and T5 significantly affected. Significant business change and transition required. Increased OPEX due to new overland operation.
		2.2.C- T1 Transfers	£590M – £750M H7: £360-£460M* H8: £185-£285M*	Maintains T2 capacity (20 MPPA).	Planned completion in 2026/27 for baggage and 2028/29 for building services and mothballing.	Non intrusive construction. Speed of mobilisation and ramp up could negatively affect T1 asset replacement.	Fully aligned with the masterplan. Brings forward T2 Baggage System Scope (FT2)	Improved performance and resilience on completion. Expected degraded service in early H7.	Temporary use of WIB required whilst T1 transfers replaced. Significant business change and transition required. Increased OPEX due to new overland operation.

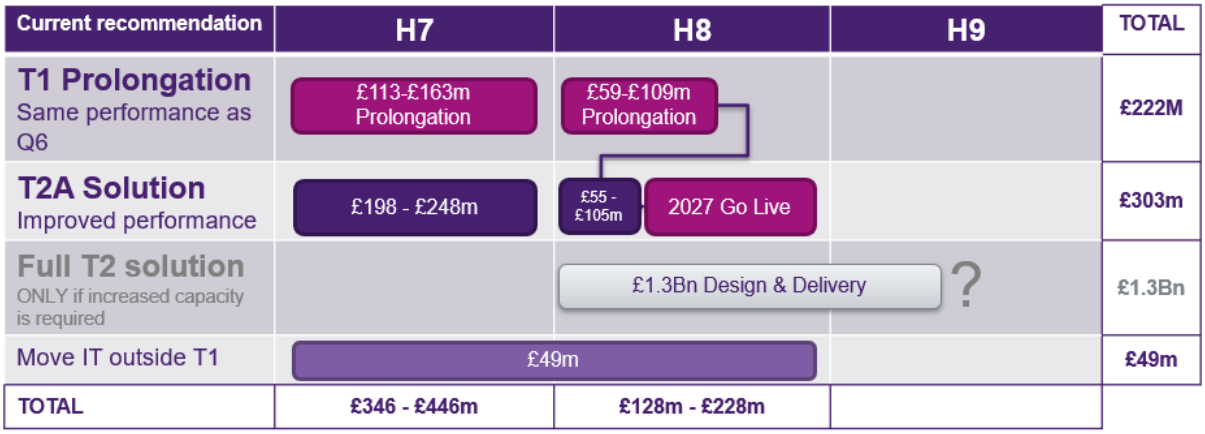
Further detail around the T2.2 – T2A chosen strategic option

A3.4 A high level output of the costing exercise for the Programme (2018p) is shown below – it is split into three categories;

- T1 Prolongation - Protecting the T1 baggage operation until a T2A system is operational, and keep the building safe and secure until 2035
- T2A Solution - Providing a new baggage solution within the T2A safeguarded space
- Asset replacement and relocation of critical IT systems within T1.

It should be noted that the full T2 solution set out in the figure below, like Future T2, is only applicable when an increase in capacity is required for the T2 airlines to grow beyond 2019 levels/ 20mppa.

Figure 1: Summary of T1 Prolongation and T2A Solution H7 - H9 – current view



Source: Heathrow – note that figures are based on the mid-point estimate and the ranges account for variation in the pace of delivery

A3.5 This above option would see the construction of a new baggage system using the baggage safeguarded space in Terminal 2A, which would include all the functions required to process departing bags (80% of the total volume of bags). This replicates the first step of the baggage system required to support an expanded Terminal 2 and is a subset of our Future T2 Programme that was halted with the pausing of the Expansion Programme in 2020.

Figure 2: The protected area in Terminal 2A today

Source: Heathrow

A3.6 In order to shape and size the correct spatial envelopes for the baggage system, we have been working with key suppliers to understand the required baggage throughputs the system must process for Terminal 2A. These throughputs have been devised using a set of historical information from 2018/2019, where bag volumes were at their highest for Terminal 2, and have been developed against operational processes that are used across campus.

A3.7 We have researched various types of technology and process innovation, which will be required to operate the baggage system from Terminal 2A. Currently, due to space limitations, the transfer sortation processes (20% of the total volume of bags) would not fit in Terminal 2A. A number of sub-options are available for us to implement in H7 to get around this.

A3.8 We have also started to assess what would be required from an enabling works perspective in order to deliver this option. Two key considerations centre on facilities currently located in Terminal 2A, which would need to be relocated to enable the works:

- The Arrivals Call Forward Area – this would have to be relocated outside of Terminal 2A. The current preferred location is to the north east of Terminal 2A.This will allow close proximity to the entrance of the building whilst unlocking key space within Terminal 2A for the new baggage system.

- The Terminal 2 and 3 Baggage Recovery Facility – this would also need to be relocated outside of Terminal 2A. This facility can store up to 5,200 bags and has screening capability. The option includes allowances to move this facility to the north east of Terminal 1.

Figure 3: Illustration of the changes to the Terminal 2 Call Forward Area and BRF locations

Source: Heathrow

A3.9 The programme still has to carry out limited asset replacement in the existing baggage system, building and supporting infrastructure in Terminal 1 to protect service levels during construction of the new system in Terminal 2A.

A3.10 We have worked with the supply chain [✂] in order to provide a realistic high level schedule and constructability advise. This has then allowed us to assign a Terminal 1 baggage system closure date and re-shape the required investment within Terminal 1 until the Terminal 2A baggage system is operational in 2027.

A3.11 If we take the baggage element of the study as an example, the programme has used our supply chain to obtain full product lifecycle details. The figure below demonstrates the life cycle of one of our types of sorters, giving a timeline and the type of interventions required to support the asset:

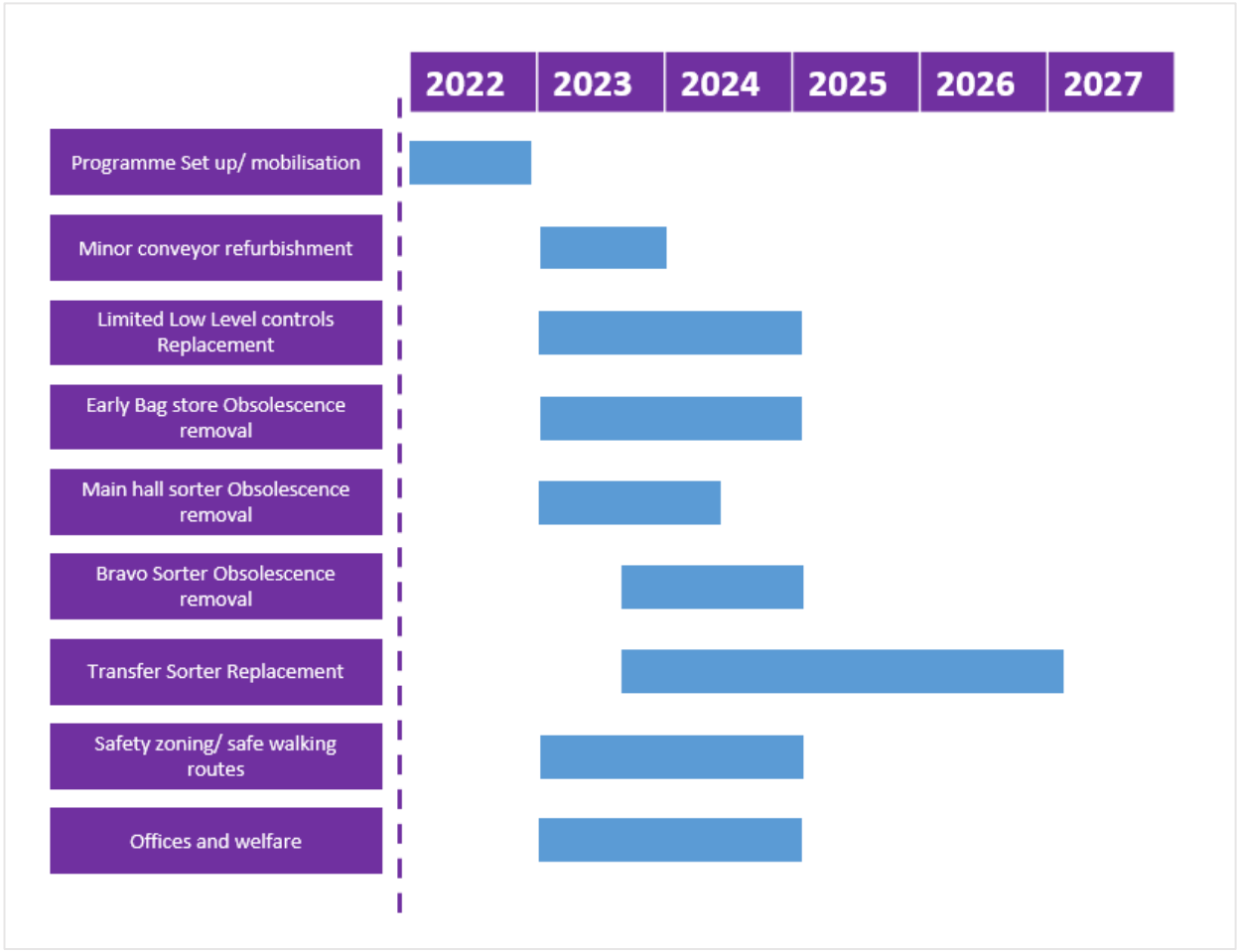
[✂]

A3.12 The Programme has also gone into the depths of product supportability and how long our spare parts holding can support the operation in order to understand the last possible moment we will need to invest in our systems. This is illustrated in the below excerpt:

[✂]

A3.13 This type of information has allowed us to look at various asset types and develop a roadmap of when assets will need to be replaced. This allows us to reduce technical risk and protect service for our operation. Below is a high level summary of the baggage asset replacement timeline:

Figure 5: High-level T1 baggage asset replacement roadmap



Source: Heathrow

A3.14 From a non-baggage perspective, information has been gathered from the engineering teams, historic studies, (such as Terminal 1 closure reports, Terminal 1 Operational Life Extension Programme) and an asset information sheet was compiled, illustrated below:

Figure 7: Non-baggage asset information sheet illustration

No.	Current Asset / Element Description	Location (Grid Ref & Name)	Reason for Replacement / Maintenance	Implications to operation/technical life if Element / Asset is not replaced / maintained over the 14 year period	Does Current Asset / Element Comply with current HAL Asset / Standards / Statutory Compliance? YES / NO (if no	Date/s required for Replacement / Maintenance	Frequency of intevention (i.e 5 years replacement)	RAG Status	Notes / Additional comments	Cost Assumptions
Scenario 1 - Current operation remains as it stands today with the live baggage operation and IT systems										
1	Roof - life expired roof systems	General	Prevention of water ingress	uncontrolled water ingress will accelerate deterioration of structural elements. In particular ceiling voids and service areas are vulnerable to sudden failure.	Yes - but deteriorated					solid average complete assume absolute plant removal, asbestos risk, and SBX roof replaced of main terminal landing
2	Suspended ceilings and services	General	gathering dust creates a fire hazard. Unchecked deterioration could lead to support failure of critical assets.		Probably not - modifications and age of areas probably don't comply.					Could consider for those areas which could be demolished, localised removal of defective parts of ceiling. Risk allowance for dust and asbestos.
4	Airside roads and Baggage area roads.	Baggage Area	deteriorating roads generate dangerous noise levels, risk to smooth transit of baggage and creates trip hazard to operatives in the area	increased risk to operatives and baggage operation. Can cause personal injury to tug drivers due to suspension on tugs	widespread deterioration below standard					Assumed they might be some upgraded needed between now and 2035
5	Structural modifications - full survey needed to ensure ongoing safety a terminal superstructure	General	uncontrolled modifications may lead to overloading of structural elements	increased risk of structural collapse.	Probably not					Capture this as a risk item. Quite low risk
6	RZ boundary - has moved within terminal. Can area remain secure. Is it vulnerable to unchecked deterioration. Also - is the area ASIAD complaint?	General	Maintain RZ boundary	Increased risk of security breach	Probably not achieving best practice.					Risk of deterioration, wooden boarding could become rotten, loss in ASIAD compliance?
7	Drainage - adjacent areas, baggage area and roof.	General	Blocked drainage will create flooding and water damage	Increased risk of deterioration	No - drains should be cleaned annually					Drainage need unblocking, Pumps and floors pressing out of gallys, drainage system has routed in many places. Inspections have been switched off.
8	MSCP1 known structural deficiencies	MSCP1	Known deterioration causing structural weakness	Prevent collapse of MSCP1	No - structural deterioration below fit-for-purpose standard					Drainage, repeal structural work, pipework. Link from 5 to 10 will need structural and
9	T1 forecourt known structural deficiencies	T1 forecourt	Substandard load bearing elements	no longer fit-for-purpose. Risk of overloading	No - structural deterioration below fit-for-purpose standard					Surfacing problems, joint problems, structure issues,
10	T1 Forecourt soffit - known failure to cladding risking safety of area below.	T1 Forecourt (arrivals level)	Safety risk	risk of falling debris on working area below	No - structural deterioration below fit-for-purpose standard					T1 soffit/façade brackets rusted and should be removed
11	Flooring deterioration leading to trip hazards	General	Mart flooring already life expired at mathball. Review and mitigate any failing flooring to remove tip hazards	Increase to slips trips and falls	No - structural deterioration below fit-for-purpose standard					Budget required to repair flooring across major reconciling routes
12	Stair Cases deteriorating leading to trip hazards and structural defects	General								Budget required to repair

Source: Heathrow

A3.15 Our chosen strategic option also presents the potential opportunity to demolish parts of Terminal 1 instead of completing asset replacement, if there are capital efficiency benefits in doing so, bringing forward future scope to an expanded Terminal 2.

A3.16 It is important to note that the option also includes, where possible, the removal of non-baggage related IT assets housed in Terminal 1 that support other areas of the campus. These would be moved into Terminal 2 or other locations to improve resilience.

A3.17 For those IT assets that must remain in Terminal 1 for longer, the option includes an allowance for the asset replacement required for these IT systems to keep the Terminal 1 operation safe and secure.

A3.18 We have worked to understand the full extent of the asset replacement requirements in order to keep the Terminal 1 building safe and secure until 2035. This also includes asset replacement to the required supporting services within the building to protect the Terminal 2 baggage operation until Terminal 2A baggage system is operational.

A3.19 Upon collating this information, a set of scope items and schedule have been developed, to provide the inputs to our costing exercise. This development was supported by our framework suppliers and internal teams to give a realistic output at concept level.

A3.20 From historical performance, notably Q6, we also understand the volume and types of works that can run in parallel without significant mitigation and disruption to the operation. This has assisted us in phasing the asset replacement and making the key allowances to protect the system capacity and performance during execution.

A3.21 Within the costing exercise where scope has aligned with types of works carried out in Q6, this information has been used to generate parts of the Terminal 2 Baggage cost plans. This is largely for the Terminal 1 building and services scope of works.

A3.22 There is also a good proportion of baggage scope for Terminal 1 that are paused projects, (for example B6313.02/.03 to replace some of the low level controls in Terminal 1 and remove obsolescence from the early bag store) within our portfolio due to the Covid-19 pandemic. These are mature to an options or scheme design level. Where this is not available, we have utilised our baggage Strategic Partner to advise the costing exercise.

Cost estimation detail of our proposed strategic option for the H7 T2 Baggage Programme

A3.23 The following pages provide more detailed initial cost breakdowns for the T2.2. – T2A strategic option.

It should be noted that:

- The forecasted investment values are inflated to the mid-point of the construction schedule;

- The level of maturity of cost estimates is pre-G0/P1.

Table 3: Cost breakdown of T2.2 – T2A strategic option (Note figures are nominal, £574m total in 2018 prices)

Tranche	Description	Benchmark	Cost (Nominal)
Programme costs	Costs to set up and run the programme as identified in the Programme Framework (P1 & P2) before a full team is mobilised	Allowance	[✂]
1- Enabling works	Relocation of T2 baggage recovery facility, arrivals call forward and clearing of basement areas of stores etc.	Q6 baggage business cases - T5 BRF	[✂]
2- T2A baggage system	A new departures baggage facility constructed in T2A	T3IB and Q6 baggage projects/ Baggage Strategic Partner Guidance	[✂]
3- T1 transfers baggage system	A transfers processing facility that will support the T2 baggage operation	Q6 benchmark / Baggage Strategic Partner Guidance	[✂]
4- Baggage system mothballing	To close and mothball the T1 baggage system (excluding transfers) once the T2A system is operational	Allowance	[✂]
5- T1 building asset replacement	To provide structural, building fabric and services asset replacement to keep Terminal 1 safe and secure until 2035	Q6 & T2A benchmarks / Estimates	[✂]
6- T1 baggage asset replacement	To replace assets within the T1 baggage system to protect the operation until the T2A baggage system is operational	Q6 benchmark / Baggage Strategic Partner Guidance	[✂]

7- IT asset replacement and relocation	To relocate IT assets that do not support T1 and asset replace those required to support the terminal building and baggage	Allowance informed by IT norms	[✂]
Prelims, overhead & profit	Contractor prelims, overhead and profit for all works	Estimate / Average Framework %	[✂]
Design & Surveys	Programme & contractor/delivery integrator design & survey fees	Allowance based on % of base costs	[✂]
Inflation	Cost plan base date to assumed mid-point of construction	BCIS TPI indices	[✂]
Risk	Risk contingency and assessment of estimate maturity applied based on the level of information known to date / Business case maturity	Applied at average of 23%	[✂]
L&L	Heathrow's leadership and logistics costs as agreed through regulatory period	Applied at 15.47% (The L&L is a 15.47% applied to the cost of the project, which represents a 13% of the total £645m with the L&L added).	[✂]
		Total	**£645m**

Source: Heathrow

A3.24 Below we provide most likely cost estimate visual breakdowns for the H7 T2 Baggage Programme, including splits for T1 Asset Replacement and T2A Baggage (please note figures are nominal pricing for full programme delivery including spend to date):

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[✂]

[✂]