TR020002 – SMAa representation to the Secretary of State for Transport

Response to report by Arup (Part 1)

Re-determination of the Application by RiverOak Strategic Partners Limited ("the Applicant") for an Order granting Development Consent for the reopening and development of Manston Airport in Kent.

Save Manston Airport association (SMAa) has over 3,700 members who are in full support of the Development Consent Order to reopen Manston Airport, many wanting jobs for themselves, their family or other Kentish people. Thus, we wish to make further representations to assist in the re-determination of the DCO.

1.0 Introduction

Unfortunately, the terms of reference were not disclosed but we feel it very surprising that the Arup report only addresses the first two "Matters" as outlined by the Secretary of State. Clearly Arup intended to cover Matter 3 regarding the Sixth Carbon Budget because in the published first draft version it showed at 1.3 "*Section 6 - considers the extent to which the sixth Carbon Budget affects the need case for the Proposed Development."* At first, we believed that it had been missed out in error, but the second draft iteration published instead of including the missing section removed all reference to it completely.

This omission seems unbelievable considering that, at the time of writing, there is COP 26 dominating the news. It also seems wrong that Arup have barely considered representations sent by interested parties concerning Matter 4 (any other matters arising since 9 July 2019 which Interested Parties consider are material for the Secretary of State to take into account in his re-determination of the application).

Although the Arup report does draw on published evidence giving the appropriate references there is a substantial reliance on secondary sources, that is: evidence presented by various interest groups. As such, these sources ought to be subjected to rigorous critical examination to determine the reliability of the evidence and arguments they offer.

One source in particular is heavily utilised as a source of evidence/information to support the internal argument of the ARUP Report. The source in question is the York Aviation Report prepared for Jennifer Dawes by Louise Congdon (LC). In several places the ARUP Report appears to rely on the York Aviation Report (LC) as if it were a source of objective information, but this is not the case. LC was commissioned by opponents of the proposed development including the previous owners of Manston Airport, and should be subject to critical scrutiny by the writers of the ARUP Report in the same way that other evidence sources have been scrutinised e.g. the Nethercourt Group and KNMA submissions.

2.0 Doubt over the validity of evidence produced by LC

In our response to the representation by Jenny Dawes Annex 1, Report by Louise Congdon of York Aviation (LC), we went into great detail about the errors and/or serious omissions within the report. In summary:

- LC has failed to acknowledge the positive implications for the development of the long delay in the Heathrow expansion.

- LC has underplayed the significance of the Making Best Use (MBU) for the development.
- LC misunderstood or misrepresented the situation in section 3.14.
- The points raised by LC in section 3.14 of her report were irrelevant to the granting of the DCO for Manston. [1]
- The point raised by LC in section 3.15 about reviewing the Policy is pointless. The airport is safeguarded for airport related uses and the applicant owns the airport land.
- The statement by LC "*To the extent that there is ongoing unemployment in Kent, the Airport would, at best, make only a small contribution to overcoming the issue*" is blatantly untrue. [2]
- The statement by LC that the "*Thames Freeport will be of no benefit to Manston Airport"* is not true.
- The comments by LC about The London Resort and Ebbsfleet City are pointless.
- LC refers to the Lower Thames Crossing, but it is hard to see that the opening of the Lower Thames Crossing will make anything but a positive difference to the decision of granting the DCO.
- LC used incorrect data in representing the freight situation in May 2021[3].
- LC tried to imply that predictions for future freighter numbers have remained static whereas they equate to a 60% growth[4].
- It seems astonishing that LC decided not to include the effect the pandemic has had on e-commerce and internet sales because of the implications it has for air cargo and dedicated freighter use.
- LC's statement that "*Prima facie, there is no change in the need for additional airport capacity going forward for dedicated freighter operations as a consequence of the Covid-19 pandemic"* is not correct.
- New trade deals will increase the need for both bellyhold and dedicated freighters and the latter will increase the quantitative need for Manston. For LC to suggest otherwise goes against all the evidence**.**
- Contrary to what LC stated, evidence shows 51% of new freighters will be for growth and not replacements[5].
- LC has failed to mention a recent trend away from wide-body aircraft towards narrow-body planes which, if it continues, strengthens the quantitative need for the development.
- LC has failed to make the case that other airports in the Southeast will have sufficient Cargo ATMs to meet the cargo needs.
- LC has failed to grasp that dedicated freighter aircraft will make up at least 50% of global air cargo traffic[6].
- LC has failed to grasp that carrying freight as bellyhold has limitations.
- LC continues to make aviation forecasts when it has been established at the Stansted Airport Appeal that, although she is qualified to be an expert in socio-economic factors, she is not qualified as an expert witness for aviation forecasts so such forecasts should be afforded little weight by the SoS.

[1] CORSIA – FAQs – page 20 section 2.14
[2] District Unemployment Level Kent 2021
[3] CAA airport data May 2021
[4] Boeing WACF – page 10
[5] Boeing WACF – page 90
[6] Boeing WACF – page 89

2.1 Lack of Accuracy

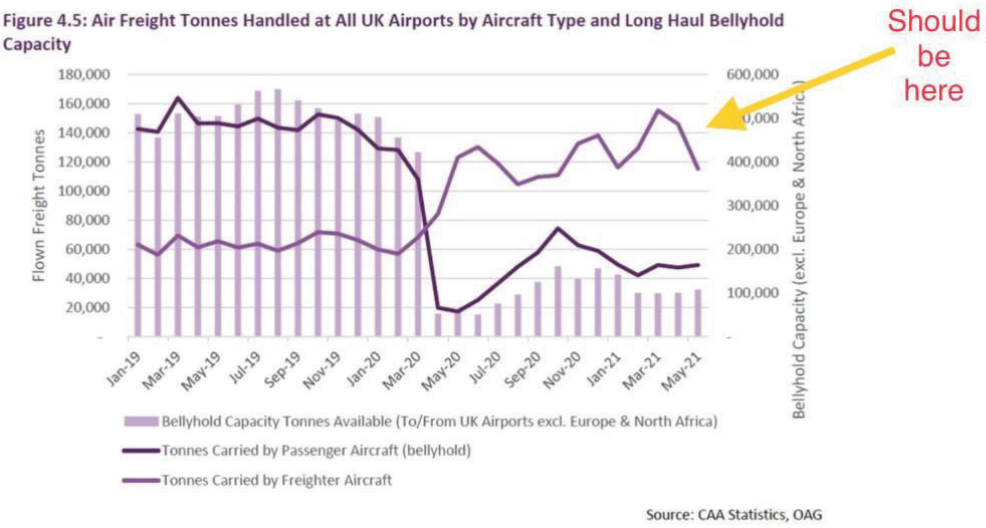
Although all of the above cast serious doubt on the decision by Arup to accept on trust the points made by LC, we wish to highlight a couple of areas where errors by LC have not been picked up by Arup and have been used as "evidence" to draw conclusions.

In her submission (Annex to representation by Jenny Dawes) section 4.2 LC states *"Figure 4.2 presents the overall freight tonnage flown to or from UK airports on a monthly basis from January 2019 through to May 2021"*[7].

Unfortunately, LC seems to have used the wrong data for May 2021. The cumulative total should be 192,369 (bellyhold 40,394 + freighter 142,975)[8] and not the approximately 160,000 shown by LC. **This lack of accuracy is very worrying and does call into question her attention to detail.**

This figure is referred to by Arup on page 23 and this same error is reproduced in Figure 4.5 that was included in the Arup report on page 28 with nobody from Arup noticing the mistake.

2.2 Smoke and mirrors?



[7] [LC] - page 20
[8] CAA airport data May 2021

In her report LC states, "***Figure 4.5*** *shows the volume of freight handled by passenger and freighter movements across all UK airports between January 2019 and May 2021 (left axis), and the volume of bellyhold capacity available between the UK and long-haul markets*."

Firstly, tonne is a measurement of mass not volume. This is relevant because when looking at available capacity, the density of the cargo (mass/volume) is crucial. If the cargo is of low density, then it will occupy a far bigger volume for its mass. This would mean that although there was available tonnage capacity there was not the volume to accommodate additional cargo.

In addition, the shape of the cargo and the shape of the cargo container will play a part. It will often be the case that there is theoretical available capacity but in reality, no additional cargo could fit in the spaces left.

It should be noted the IATA, who represent 290 airlines (83% of total air traffic) do not use the method adopted by LC. They use the % change in Available Cargo Tonne Kilometres (ACTK) to indicate capacity. A positive % change indicates an increase in capacity and vice versa.

Returning to the report by LC on which Arup have based their assumption about available capacity, in section 4.21 LC makes the statement that "It is evident that freighter activity increased in direct response to the fall in bellyhold capacity …. "

But then goes on to make a statement for which there is no evidence "*but that, when bellyhold capacity increased during the autumn of 2020, the tonnage carried on freighter aircraft fell back again."*

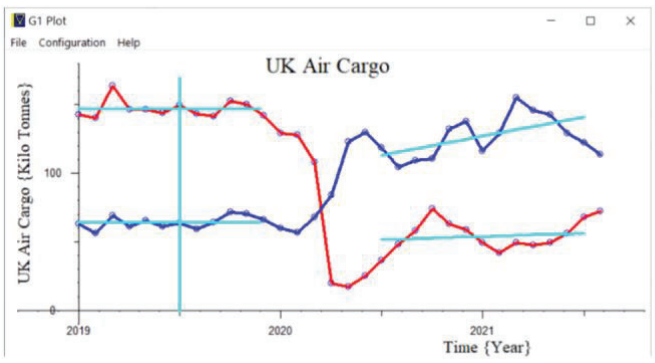
LC then bases the following statement on this incorrect statement (without any further evidence): Section 4.22 "*This would suggest strongly that, over the longer term, as passenger services are reinstated and bellyhold capacity becomes available again, the reliance on dedicates freighter operations would reduce again pro-rata*."

However, there is no discussion of the representation based on similar CAA data, and graph, from SMAa Chairman and Director of local scientific SME business Lab-Tools Ltd. (nano-science), Dr. Beau Webber: Do we have a new air cargo regime, post Covid, that Manston Airport could help facilitate? This correctly identifies, rather than there being a "fall back" in freighter tonnage, that after the jump in freighter tonnage, due to the drop in bellyhold tonnage, there is then a continual on average linear increase in freighter tonnage.

We have now further CAA monthly data; here is an updated graph, Graph 1:

Red : Bellycargo monthly tonnage.

Blue : Freighter monthly tonnage



We are, as per the SoS' guidelines, looking for changes in Bellyhold cargo and Freighter air freight tonnages, since the key date specified, 9 July 2019.

At that time, both Bellyhold and Freighter tonnages were fairly steady:

Bellyhold average: 147 kTons per month

Freighter average: 64 kTons per month

A ratio Bellyhold / Freighter of about 2.3 in favour of Bellyhold.

Currently, we see that this ratio has reversed:

Bellyhold average: 54 kTons per month

Freighter average: 127 kTons per month

A ratio Freighter/Bellyhold of about 2.4 in favour of Freighter.

The combined net change of the Freighter/Bellyhold of a factor of about 5.4 in favour of Freighter.

Freighter tonnage has doubled.

We also see that Freighter tonnage over the last year is further going up at an average rate of nearly 28 kTons per year, consistent with many industry reports.

Whereas the average tonnage rate for Bellyhold over the year is nearly static.

This evidence, from the data rather than based on opinion, completely disproves the above statements by LC which were used as the basis of the conclusions reached by Arup.

It is our belief that Figure 4.5 does not provide proof that there is sufficient "slack" in the system to accommodate the levels of freight envisaged at Manston. It must also be stated that there are specific roles for bellyhold freight and specific roles for dedicated freighters. Even if there was some bellyhold capacity that is not necessarily a substitute for freighter capacity.

3.0 The key role of dedicated freighters

This is explained by Boeing[9]:

"Freighters comprise less than 8% of the total commercial jet fleet, yet they carry more than 50% of all air cargo traffic. Their essential role in the global supply chain is underpinned by a number of factors.

- *Of the 26,000 jet transports in service at year-end 2019, over 19,000 were single-aisle and/or regional jet airplanes that do not have lower holds to accommodate freight pallets or containers. Freight forwarders prefer palletized capacity, which is only available on widebody passenger or freighter airplanes.*

[9] Boeing WACF – page 89

- *Most passenger airplanes with lower-hold capacity do not serve key trade routes, and for such routings, freighters are the most efficient form of cargo transport.*
- *Dedicated freighter services offer control over timing and routing that is unmatched by lower-hold capacity. As air cargo is an industrial tool, demand for cargo capacity surges on weekends as shippers try to use idle time between different factories as the "warehouse in transit." Consequently, twin-aisle passenger airline schedules often do not meet shipper timing needs for industrial demand.*
- *Freighters offer speed to market for high-value, time-sensitive products such as capital equipment, electronics, pharmaceuticals, fashion goods and perishable commodities.*
- *Passenger airplane lower holds are severely limited for transporting hazardous materials and project cargo, meaning a group of shipments moving as one aggregated consignment. The grounding of much of the world's passenger airplane fleet because of the COVID-19 pandemic during 2020 has only served to underscore the importance of freighters. With the removal of significant twin-aisle passenger airplane lower-hold capacity, freighter utilization rates from March through September 2020 surged up to 20% over 2019 levels to partially compensate for this missing capacity.*
- *Nearly 90% of all air cargo revenue is generated by airlines that operate freighters. Freighters augment an airline's cargo operations, helping the airline compete more effectively."*

In 5.2.4 Post-Brexit trade, the report concludes that "*There is some available capacity for long-haul bellyhold freight, which is expected to increase as passenger demand recovers*."

This seems to suggest that Arup think bellyhold capacity is the solution but, for the reasons outlined above, available bellyhold capacity alone will not be able to meet the increased need for airfreight. According to Boeing:

"*The combination of 4.0% annual average RTK growth, in addition to the proven need for dedicated freighter capacity to support our global transportation system, results in the need for a 60% larger fleet during the next two decades"*[10].

Clearly Boeing is predicting a continued growth in the need for dedicated freighters to deliver goods globally and it is inconceivable that the UK will not make the necessary trade deals within the next ten to twenty years to benefit from this trade.

According to CEBR, who were involved in producing the Arup report:

"*New research has highlighted how the UK could undergo an economic pivot post-Brexit, with non-European Union (EU) trade potentially increasing by 20 per cent over the next five years, from nearly £473 billion in 2019 to £570 billion in 2025.*

According to the Centre for Economics and Business Research, aviation will need to be at the heart of this pivot."[11]

Manston will be able to play a very significant part in this growth for UK PLC by providing a state of the art, carbon neutral freight hub in the southeast.

[10] Boeing WACF – page 10
[11] CEBR – International Airport Review

Arup conclude "*overall, the Independent Assessor has not seen any evidence – one way or the other – on how changed trading arrangements post- Brexit will affect long distance trade or air freight demand.*"

However, the evidence above, particularly the quote from CEBR, show that Arup's statement is very hard to justify. Indeed, we feel the SoS should afford it little or no weight.

Manston, in tandem with East Midlands airport, will provide the necessary resilience to the system and the development at Manston "*would support the government's policy objective to make the UK one of the best-connected countries in the world and for the aviation sector to make a significant contribution to economic growth of the UK.*"[12]

4.0 The impact of e-commerce on demand for air freight

The Arup report refers to a statement by the Applicant:

"The UK is one of the top three online shopping nations. E-commerce retail sales here reached almost a third of all retail in May 2020, a dramatic increase as shown in Figure 5. Since online shopping has become a daily norm for millions of UK consumers, it is likely that levels will remain high, far exceeding pre- pandemic estimates" (paragraph 12).

"*The Applicant proposes that by using air freight, e-commerce retailers are now able to move smaller but more frequent shipments from factories to fulfilment centres, providing quicker responses to consumer preferences and fluctuating demand*." [13]

The Arup report quotes from Logistics UK in reference to the increase in online shopping:

"*To support this demand, express freight airlines operate a significant number of services. (...) Logistics UK is calling on government to facilitate the movement of airfreight throughout the day and, where possible, at night to keep goods moving and reaching their end customers in good time."*

For some reason Arup highlight the "*where possible at night*" (8 hours) but ignores the 16 hours that Manston would be available to meet the increased need. Manston with up to 19 European Aviation Safety Agency compliant Code E stands for air freight aircraft with markings capable of handling Code D and F aircraft in different configurations, 6,500m2 of cargo facilities plus landing and take-off slots being readily available would "*facilitate the movement of airfreight throughout the day*".

It should be noted that the future of night flying in the UK is uncertain with many calls for it to be curtailed or stopped.

In December 2020 the government undertook a consultation on night flights at Heathrow, Gatwick and Stansted and although they decided to extend the present regime until 2023, they are going to ban QC 4 aircraft from flying during the night quota period and that, following consultation in 2023, a new regime will commence in 2025.

[12] Secretary of State Decision Letter – section 21
[13] Arup report – page 17

"This will enable decisions to be taken against a background of a wider evidence base, including on the negative impacts on sleep and health, against which the economic benefits of night flights have to be balanced."[14]

Although this particular study did not apply to all airports in the UK it is clear that the whole issue is being looked into by the government.

The Arup report comments that "*no forecasts of future e-commerce volume or market share have been put forward through the SoM consultation*" but then do not appear to have produced any of their own to help them draw suitable conclusions.

CBRE have indicated that "*due to COVID-19, internet sales in most markets rapidly increased in 2020 with a lasting effect"* and go on to predict that "*over the next five years globally, 138 million sq. m. of additional e- commerce-dedicated logistics space will be required to support the growth of internet sales worldwide."*[15]

We believe that it is astonishing that Arup did not think it necessary or useful to have researched whether forecasts on the future growth of e-commerce would support the case for the development at Manston or not. Without sight of the Government's brief for the Arup report, it is impossible to understand why this approach was taken.

It is our firm belief based on the evidence that the increase in e-commerce is going to continue and that *"since online shopping has become a daily norm for millions of UK consumers, it is likely that levels will remain high, far exceeding pre- pandemic estimates."* [16]

We believe this strengthens the case for the Manston Development.

4.1 Past, present and future trends

LC argues, albeit unconvincingly, that:

"*Increases in e-commerce activity, however, do not necessarily lead to an increase in the volumes of air freight carried to or from UK airports."*[17]

She goes on to argue that, although e-commerce goods travel from China by air and other (unspecified) surface modes, they go to a retailers' distribution centre and are stored for some (unspecified) time before being dispatched directly to the consumer. LC then concludes that:

"Whilst increased e-commerce activity has resulted in an increase in demand for last-mile logistics between distribution centres and consumers, there has so far been a neglible (sic) net impact in the volumes of air freight carried to and from UK airports."[18]

Arup then attempt to prove whether this statement is true but uses historical data (most data before Brexit and Covid) to reach their conclusion. Although recent historical data can be useful to predict future trends, we would argue that this is not relevant when the UK has been affected by

[14] Dft Night Flight Restrictions – Decision Document
[15] CBRE – Global e-commerce outlook
[16] Arup report – page 16
[17] Arup report – page 18
[18] Arup report – page 18

two such dramatic events; Brexit and Covid. In any event, looking backwards is unlikely to be a good predictor of the future, particularly where new technology and social trends are concerned.

Arup produced Figure 1 which they argued showed no correlation between % change in internet retail sales and % change air freight volumes (sic).

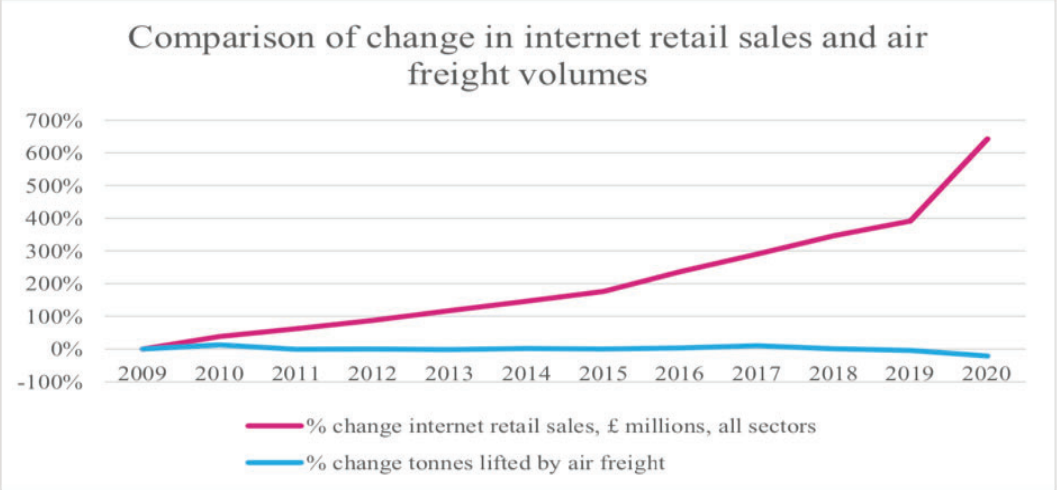
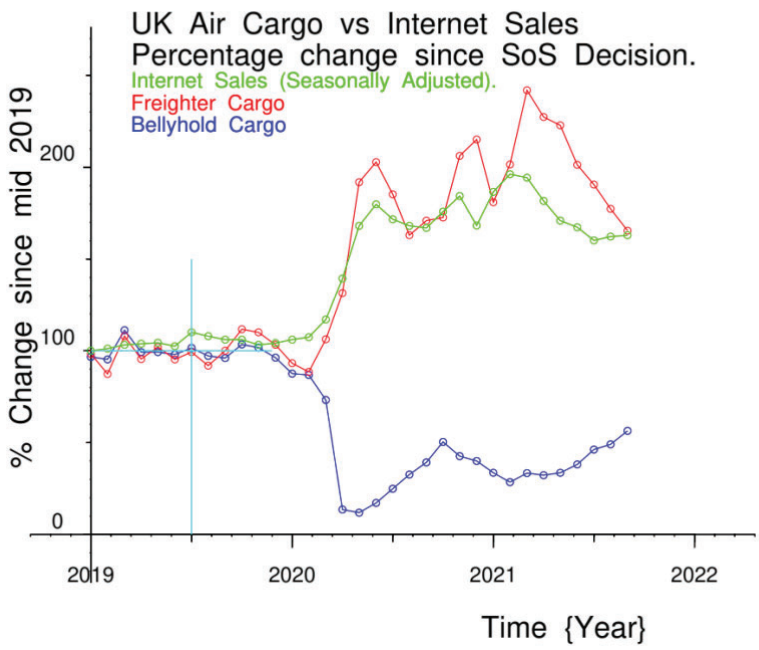


Figure 1: Change in internet retail sales and air freight volumes indexed from 2009[19] [20]

Notwithstanding that Arup are not comparing like with like (£millions v tonnes), we have produced what we believe is a more relevant graph as it shows data from 2019 onwards[19], Graph 2:

Percentage change UK Air Cargo {Tonnage} and Internet Sales {GBP}



The data seems to contradict the conclusion reached by LC and Arup. There appears to be a clear correlation between % change in internet retail sales and % change in freighter cargo. This supports the assertion by the applicant that:

[19] https://www.ons.gov.uk/businessindustryandtrade/retailindustry/datasets/retailsalesindexinternetsales

"*The Applicant proposes that by using air freight, e-commerce retailers are now able to move smaller but more frequent shipments from factories to fulfilment centres, providing quicker responses to consumer preferences and fluctuating demand*." [20]

Obviously, there will still be a major role for transporting goods by sea freight with these goods stored in Distribution Centres for eventual onward distribution to the customer. However, the evidence, including the data above, suggests that Covid has fundamentally changed consumer expectations and that there is an increasing role for air freight to deliver urgent goods to consumers and businesses.

5.0 Shift to narrow bodied aircraft

As indicated earlier there is a clear role for both dedicated freighters and bellyhold freight but there seems to a false assumption that bellyhold cargo is the answer to any capacity problems.

The Arup report accepts that "*for environmental and cost reasons, many airlines have been slowly retiring older B747s and other four-engined aircraft (with large bellyholds), replacing them with twin-engined planes with a narrower (sleeker) body design*".[21]

However, they conclude that "*overall, while there is a reduction in bellyhold capacity, the Independent Assessor does not consider it to be that significant*."

To justify this, they claim that the B747s will be replaced by the A350-9 and / or the B787 Dreamliner which only have "*two fewer LD3*".

Assuming they are correct it is still staggering that Arup consider the reduction of two LD3s on every plane replaced for each and every journey it takes will not bring about a significant reduction in bellyhold cargo capacity.

Although some LD3s can carry as much as 2.3 tons the average LD3 carries a maximum of 1.5 tons[22] so each B747 replaced has its capacity reduced by 3 tons for each journey. Typically, a long-haul plane will do two journeys a day meaning each plane will be capable of carrying 6 tons less each day which is more than 2,000 tons a year.

According to Cirium Core Fleet data[23] there were 157 passenger B747s in 2020. If each of those were replaced, as Arup suggest, by A350-9 or B787 Dreamliners then that would bring about a reduction in bellyhold capacity of over 300,000 tons a year. As outlined earlier, due to density and shape issues, containers rarely if ever reach maximum capacity but even if they were only half capacity, 150 thousand tons a year is a significant figure. To put these figures in perspective, according to CAA figures,[24] in the UK there is on average 650 thousand tons of bellyhold freight carried per year so the loses in capacity are equivalent to between 23% and 45% of the UK totals.

The reality is the losses are likely to be higher because the evidence shows that airlines are already opting to use A321 aircraft for long haul flights. Although the numbers are relatively low at the

[20] Arup report – page 17
[21] Arup report – page 25
[22] Annex 3: Applicant submission – page 8
[23] Cirium Core Fleet data 2020
[24] CAA flight data

moment[25] (7 airlines covering 27 routes), and they are predominately using the A321LR, orders for the new Airbus A321XLR are strong with 20 companies and 450 ordered so far[26].

"*The A321XLR is a single-aisle, narrow-body aircraft with a typical two-class capacity of 180-200. But it pushes the range to the highest of any narrowbody – up of 8,700 kilometers (4,700 NM)*"and "*should enter service in 2023*"[27].

It seems inconceivable that airlines would purchase these planes, that are capable of such a long range, and not use them for long-haul flights. According to the applicant the A321XLR will only be able to accommodate a maximum of 3 tons[28] which is significantly lower than the A350-9 and the B787 Dreamliner. Using the data from the applicant and the data from Arup each journey by a A321XLR on long haul will reduce the bellyhold capacity by 7 tons each way (compared with the A350-9 and B787 Dreamliner) which is 14 tons per aircraft per day or over 5000 tons reduced capacity per aircraft per year. Remember, there are 450 of these planes on order!

"A trend among airlines of phasing out four-engine widebody aircraft in favour of smaller, more fuel-efficient two-engine aircraft, including even narrow bodies, has accelerated"[29].

This trend is explained because *"a narrow-body airplane can make money in good times and lose money in bad times, but the swing in either direction is not so great. A wide-body can make more money in good times, of course because they can carry more people. But they also can lose a lot more in weaker times, because of their high monthly ownership costs, fuel, and labour requirements"[30]*.

According to Airbus figures, the A321XLR will have "*20% lower fuel burn per seat, 5,000 tonnes less CO2 per year, and a noise footprint that is 50% lower for passengers and airports*"[31].

For aeroplane operators, the increased range, increased fuel economy and a smaller Carbon footprint will make such planes an attractive proposition.

All the evidence suggests that the conclusion by Arup that the reduction in bellyhold capacity is not significant is clearly untrue and should be disregarded by the SoS.

6.0 Changes in Capacity at Other Airports

There has been much debate about whether existing airports have sufficient capacity to meet the future increases in air cargo demand in the southeast. The two alternatives are the proposed 3rd runway at Heathrow and Stansted Airport.

6.1 Heathrow expansion

What is not in doubt is that there will be delay in the expansion of Heathrow (the Ex. A believed that it would be completed by 2026). However, what is in uncertain is how long that delay will be with some questioning whether it will happen at all.[32] One possible reason given in the report for

[25] Simple Flying – A321neo routes
[26] Travel Daily – switch to narrow bodied
[27] Simple Flying - A321XLR
[28] Annex 3: Applicant submission – page 8
[29] Forbes – fewer wide-body aircraft
[30] Forbes – fewer wide-body aircraft
[31] Simple Flying - A321XLR
[32] Arup report – page 34

Heathrow expansion not going ahead would be "*as a result of lower growth in UK air passenger and cargo traffic than originally forecasted.*" At their recent Annual General meeting, when discussing their Net Zero plans, IATA still anticipate passenger numbers to double to 10 billion by 2050[33]. This is supported by Airbus who predicted a 64% growth[34] in their fleet by 2038 and Boeing predicting a 60% growth in their freighter fleet by 2039.[35]

The reasons for a lengthy delay were outlined in detail in SMAa [Matter 2] section 1.2 but bear repetition here because Arup seem to underestimate the potential problems. They conclude that a lengthy delay or the development being stopped altogether by non-demand factors is unlikely.

Arcadis produced a report for the CAA in relation to the expansion at Heathrow and it highlighted a number of factors that could delay the opening date for the third runway.

"Much of this work is outside of the airport's existing boundary and will be reliant on gaining the appropriate consents, acquiring land and working with other agencies or organisations. This could create a level of risk to the programme that HAL may not be able to mitigate".[36] P3

- The possibility that the submission is disputed during the pre-examination and examination process. P34
- Delays caused by disputes over land acquisition through Compulsory Purchase Orders, [Compulsory Acquisition within the DCO?] and the need for Vacant possession. P35.
- Problems if utility companies responsible for assets do not agree to the necessary works under local Town and Country Planning Acts (TCPA). P36
- Problems could arise from the resighting of the Energy from Waste Facility requiring a local TCPA. P32
- Problems could arise from the resighting of a Primary School requiring a local TCPA. P37
- Problems could arise from the resighting of the Colnbrook Immigration Facility requiring a local TCPA. P37
- The project requires river diversions and the consent granting bodies associated with these water courses has significant interest and powers over the scheme, which could lead to tensions in the approval process. P38
- The project involves considerable earthworks which are dependent on Vacant possession and the clearing of existing assets referred to above. P35
- Works on the M25 near to the A4 are dependent on the demolition of a bridge which cannot be done until the alternative A4 is completed. P39
- Arcadis considers the time allowance between DCO approval and start of works (date redacted) is ambitious with little or no contingency. It will rely on a period of effective and swift discharging of the planning conditions imposed on HAL after the DCO date. P48
- The Heathrow scheme has attracted a lot of public scrutiny over the years and there would be no reason to suggest that it will not be subject to intense scrutiny during the Development Consent Order process. P36
- Any delays will have a negative impact on the costs estimates of the project. P5

That final point has been brought into sharp focus by recent events. It has been reported that "*Heathrow Airport's top shareholder <u>Ferrovial</u> has signalled it will cut off new investment in the*

[33] IATA Annual General meeting – Net Zero
[34] Airbus 2019 forecast – page 13
[35] Boeing WACF – page 90
[36] Heathrow CAA review of plans (relevant page numbers indicated in text)

airport, dealing a "killer blow" to plans for a third runway, according to a report in the Sunday Telegraph."[37]

Although the final costs for R3 are unknown, any delays in the implementation are bound to push the figure way above the initial figure of £14 billion and it is by no means certain that there will be the appetite for such an investment when other cheaper, more environmentally friendly options are available such as a combination of expansion at Gatwick for passengers and the development at Manston for dedicated freighters and some passenger flights.

Another key area identified is the assumption by Heathrow Airport Limited (HAL) that the DCO process will be completed in 17 months. The report casts doubt on this timescale on page 34 (P34) and this is also borne out by the Manston DCO, which has taken far longer than that timescale while being a far simpler project. It was accepted for examination on 14th August 2018 and is still ongoing over 3 years later with no end in sight.

This is particularly relevant because a) it is an airport DCO b) the Manston DCO is far less complex in comparison to Heathrow and c) HAL need to Compulsorily Acquire large tracts of land unlike the Applicant.

One legal challenge, following the granting of the Manston DCO, will have taken the 17-month time scale anticipated by HAL to resolve. It is inconceivable that there will not be multiple legal challenges to the Heathrow plans.

The Arup report states that:

"*If, however, Heathrow expansion were to be prevented or substantially delayed by non-demand factors – such as successful further legal challenges on environmental or planning grounds – despite a clear need case being demonstrated in future,* ***this would support the need case for the Proposed Development at Manston, as capacity at other airports may not be sufficient to meet the shortfall in air freight capacity this would create***."(Our emphasis)

The expansion of Heathrow has already been substantially delayed from its anticipated opening of 2026 and for all the reasons outlined above this delay can only get much longer. For that reason, we completely agree with the statement above that such delays "***support the need case for the Proposed Development at Manston.****"* (Our emphasis).

6.2 Stansted expansion

The Arup report states that "*Expansion of passenger operations at Stansted will also create additional bellyhold capacity*."

It should be noted that Stansted passenger operations have predominately featured low-cost airlines and these do not tend to carry bellyhold freight. It has attracted some long-haul operations, but these are limited and according to CAA data[38] Stansted has only carried 10,500 tons of bellyhold freight since January 2019. To put that in perspective, Gatwick would expect to handle nearly 9,000 tons of bellyhold freight a month.

[37] Bloomberg – Ferrovial threaten removal of funding
[38] CAA airport data

We would like to reiterate, bellyhold is not a replacement for freighters. They perform different distinct roles within the aviation sector.

Arup then go on to consider the argument we put forward in our submission that if Stansted reaches or nearly its 43mppa limit then that would seriously reduce the number of slots available for freighters.

Arup appear to agree and state that "*this reinforces the view that if Stansted meets or comes to close to meeting its cap on passengers per annum, it will be highly unlikely to also provide increased freight capacity in the long term*."

They then appear to backtrack and refer to the drop in passenger numbers because of Covid and speculate that the cap of 43mppa "*may well not be met, given the challenges facing passenger aviation post-Covid.*" This is at odds with all the experts with passenger numbers expected to return to pre-covid levels within just a few years and IATA predicting passenger numbers to have doubled to 10 billion by 2050[39].

The conclusion by Arup that "*Events since July 2019, as outlined above, therefore now appear to confirm the ExA's position – there remains significant capacity for dedicated freight movements at Stansted, and an increase in passenger flights will provide further bellyhold capacity*" is not supported by all the evidence and should be disregarded by the SoS.

6.3 East Midlands

We do not believe this should be seen as an either East Midlands or Manston Airport situation. Instead, it should be seen as a vital opportunity to build significant resilience to the air freight market by having both airports available for dedicated freighters, one serving the Midlands / North and the other the South of England. Surely it is healthy for there to be competition between airports for trade? After all, this was the point of privatisation and the 1986 Airport Act.

7.0 Conclusions

- The Arup report only addresses two of the four matters raised by the SoS.
- The Arup report relies heavily on the report by LC without proper scrutiny of it.
- The LC report contains many errors and omissions which cast doubt on the validity of the "evidence" produced.
- The Arup report reaches conclusions based on data containing errors.
- The Arup report reaches conclusions based on the wrong metrics.
- The Arup report appears to have ignored previous submissions that have highlighted these errors.
- The Arup report does not appear to understand the distinct roles that bellyhold and freighters play in the air cargo market.
- The Arup report seems to suggest that bellyhold capacity alone is the answer.
- The Arup report appears to ignore the evidence that freighter numbers are predicted to increase considerably in the next twenty years (by 60%) to meet increased demand.
- The Arup report appears to have ignored evidence from one of its partners (CEBR) that post-brexit trade with non-European countries could increase by 20% over the next five years.

[39] IATA Annual General meeting – Net Zero

- The Arup report appears to have ignored what effect this increase in trade will have on the need for increased air cargo including dedicated freighters.
- The Arup report ignored evidence that clearly shows the rapid growth in e-commerce as a result of COVID-19 is a "*lasting effect*".
- The Arup report uses historical data rather than data from 2019 onwards resulting in them drawing the wrong conclusions.
- The Arup report has failed to understand the significance in the shift to narrow bodied planes for long-haul flights and the implications this has for overall bellyhold capacity.
- The Arup report has ignored the evidence that the expansion at Heathrow is going to be seriously delayed and may not even happen at all.
- The Arup report has failed to accept that lengthy delays in the delivery of R3 strengthen the case for the Manston development.
- The Arup report underplays the need for building resilience into the supply chain that would be achieved by the Manston Development.
- The Arup report seems to suggest that competition for trade between airports is not a good thing. Surely that was one of the main drivers in privatising the airline industry?
- The Arup report fails to acknowledge that RSP and their investors clearly believe there is not only the demand for the Manston Development but also that it will bring a return on their £500 million investment.
- The Arup report has failed to consider the SoS statement that the "*Development would support the government's policy objective to make the UK one of the best-connected countries in the world and for the aviation sector to make a significant contribution to economic growth of the UK."*
- The Arup report has failed to consider the SoS statement that "*it is the Government's aviation policy that airports should make the best use of their existing capacity and runways, subject to environmental issues being addressed."*
- The Arup report has failed to consider the SoS statement that "*Substantial weight is given by the Secretary of State to the conclusion that the Development would be in accordance with such policies and that granting development consent for the Development would serve to implement such policy."*

For all the reasons outlined in this submission, we urge the Secretary of State to form his own opinions based on reliable data and, by giving comprehensive well-argued reasons, grant the DCO for the Manston Development.

From the SMAa Committee on behalf of the 3,700 members

Dr Beau Webber (Chairman)

[redacted]

References for SMAa representation to the Secretary of State for Transport
Response to Arup Report – Part 1

		Pages
1.	CORSIA FAQs	17
2.	District unemployment level Kent 2021	18-23
3.	CAA airport data May 2021	24-25
4.	Boeing WACF	26-29
5.	CEBR – International Airport Review	30-32
6.	Dft Night Flight Restrictions – Decision Document	33-36
7.	CBRE – Global e-commerce outlook	37-40
8.	Cirium Core Fleet data	41
9.	Simple Flying – A321neo routes	42-44
10.	Travel Daily – switch to narrow bodied	45-46
11.	Simple Flying – A321XLR	46-48
12.	Forbes - Fewer Wide Body Aircraft	49
13.	IATA Annual General meeting – Net Zero	50
14.	Airbus 2019 Forecast	51
15.	Heathrow CAA review of plans	52-135
16.	Bloomberg – Ferrovial threaten removal of funding	136

	offsetting, are exempted from the offsetting requirements of the CORSIA, while retaining simplified reporting requirements. The requirement to monitor, report and verify CO_2 emissions from international aviation is thus independent from the offsetting requirement. The data reported by States will be used for the calculation of the CORSIA baseline (see question 2.17 for more details on CORSIA's baseline) as well as for the calculation of the aeroplane operators' offsetting requirements, where applicable.
2.11	Can an aeroplane operator have offsetting requirements, even if its State of registration does not participate in CORSIA offsetting?
	Yes. Because of the CORSIA's route-based approach, an operator operating on routes between participating States would be subject to the offsetting requirements under the CORSIA, no matter whether its State of registration participates in CORSIA offsetting or not.
2.12	What would happen to the CORSIA emissions coverage if an operator of a non-participating State flies on the routes between participating States (e.g. fifth-freedom traffic right)?
	Because of the CORSIA's route-based approach, these routes between participating States would be subject to the coverage of emissions offsetting requirements under the CORSIA. Thus, an operator of a non-participating State would be subject to offsetting requirements if it had a flight between two participating States, and emissions from such flights would be added to the coverage of CORSIA's offsetting requirements.
2.13	What would happen to the CORSIA emissions coverage if a State without an operator undertaking international flights decides to participate in the CORSIA offsetting?
	States without an operator flying international flights are encouraged to participate in all phases of the CORSIA. If such a State decides to participate, international flights to and from that State to other participating States are additionally included for the CORSIA's offsetting requirements, due to the route-based approach. The total international emissions covered by CORSIA offsetting would ultimately increase.
	Key design element 3: CORSIA offsetting requirements and eligible emissions units
2.14	What is offsetting and how does it work, in general?
	In general, offsetting is done through the purchase and cancellation of emissions units (see question 4.20), arising from different sources of emissions reductions achieved through mechanisms, programmes or projects. The buying and selling of eligible emissions units happens through the carbon market. The price of the emissions units in the carbon market is influenced by the law of supply (availability of emissions units) and demand (level of offsetting requirements). "Cancelling" means the permanent removal and single use of an emissions unit so that the same emissions unit cannot be used more than once. This is done after an aeroplane operator has purchased emissions units from the carbon market. For CORSIA, an aeroplane operator is required to meet its offsetting requirements by cancelling CORSIA Eligible Emissions Units in a quantity equal to its total final offsetting requirements for a given compliance period. CORSIA Eligible Emissions Units are to be determined by the ICAO Council, and up-to-date information on eligible units is made available on the ICAO CORSIA website (see question 4.21).
2.15	How are an aeroplane operator's offsetting requirements calculated?
	Paragraph 11 of the Assembly Resolution A40-19 addresses the distribution of the total amount of CO_2 emissions to be offset in a given year among individual aeroplane operators. This is accomplished by introducing a dynamic approach for the distribution

Unemployment in Kent

Last updated: 15 June 2021

Related Documents

Welfare Reform Report

Ward unemployment interactive model

Unemployment Measures Bulletin

Universal Credit Claimants

COVID-19 continues to have a significant impact on the number of claimants of unemployment benefits.

The claimant rate in Kent is currently 5.6%, below the national average rate of 6.0%. Unemployment in Kent fell by 5.1% over the previous month, whereas nationally it increased by 3%.

Youth unemployment (18-24) in Kent is slightly higher than the national average: 8.7% in Kent, 8.2% UK, however Kent saw a reduction (-5.8%) while nationally youth unemployment increased (+1.5%).

Unemployment has fallen for both males and females over last month: -4.9% for males in Kent compared to -5.4% for females.

The latest data for May 2021 was released on the 15th June 2021 and is presented below.

Further Information

This workbook looks at the number of people claiming either Jobseekers Allowance or Universal Credit principally for the reason of being unemployed. It also looks at the age and sex of claimants, in particular at youth unemployment which is defined as those aged 18 to 24.

This workbook uses information from a dataset called The Claimant Count by Sex and Age. This experimental series counts the number of people claiming Jobseeker's Allowance plus those who claim Universal Credit who are out of work.

Under Universal Credit a broader span of claimants are required to look for work than under Jobseeker's Allowance. As Universal Credit Full Service is rolled out in particular areas, the number of people recorded as being on the Claimant Count is therefore likely to rise.

Unemployment rates are calculated using the Office for National Statistics Mid-year Population Estimates 2001-2019. The resident working age population is defined as all males and females aged 16-64. These denominators will be updated annually with the ONS mid-year population estimates.

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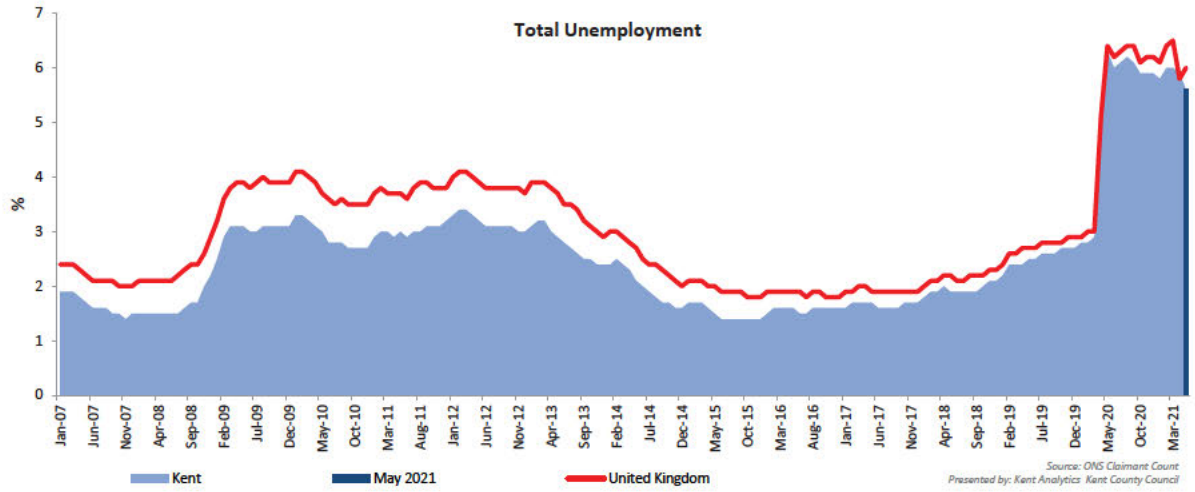


May 2021	Number	% rate	Number change since April 2021	% change since April 2021	Number change since May 2020	% change since May 2020
Kent	52,985	5.6%	-2,860	-5.1%	-7,060	-11.8%
United Kingdom	2,503,160	6.0%	+73,635	+3.0%	-158,180	-5.9%

District unemployment

May 2021	Number	% rate	Number change since April 2021	% change since April 2021	Number change since May 2020	% change since May 2020
Ashford	4,250	5.5%	-200	-4.5%	-695	-14.1%
Canterbury	4,815	4.6%	-220	-4.4%	-660	-12.1%
Dartford	3,725	5.2%	-265	-6.6%	-445	-10.7%
Dover	4,150	6.0%	-250	-5.7%	-695	-14.3%
Folkestone & Hythe	4,440	6.7%	-220	-4.7%	-455	-9.3%
Gravesham	4,635	7.1%	-260	-5.3%	-280	-5.7%
Maidstone	5,100	4.9%	-290	-5.4%	-645	-11.2%
Sevenoaks	2,655	3.8%	-250	-8.6%	-370	-12.2%
Swale	5,625	6.2%	-240	-4.1%	-745	-11.7%
Thanet	7,615	9.4%	-220	-2.8%	-1,180	-13.4%
Tonbridge and Malling	3,090	3.9%	-195	-5.9%	-470	-13.2%
Tunbridge Wells	2,875	4.0%	-250	-8.0%	-440	-13.3%
Kent	52,985	5.6%	-2,860	-5.1%	-7,060	-11.8%
Medway	11,590	6.6%	-440	-3.7%	-735	-6.0%

Kent unemployment headlines May 2021

The unemployment rate in Kent is 5.6%. This is below the rate for United Kingdom (6%).

52,985 people were claiming unemployment benefits in Kent.This has fallen since last month

Thanet has the highest unemployment rate at 9.4%. Sevenoaks has the lowest unemployment rate at 3.8%.

The 18-24 year old unemployment rate in Kent is 8.7%. They account for 19.9% of all unemployed people in the area

Thanet has the highest 18-24 year old unemployment rate in the South East at 14.9%.

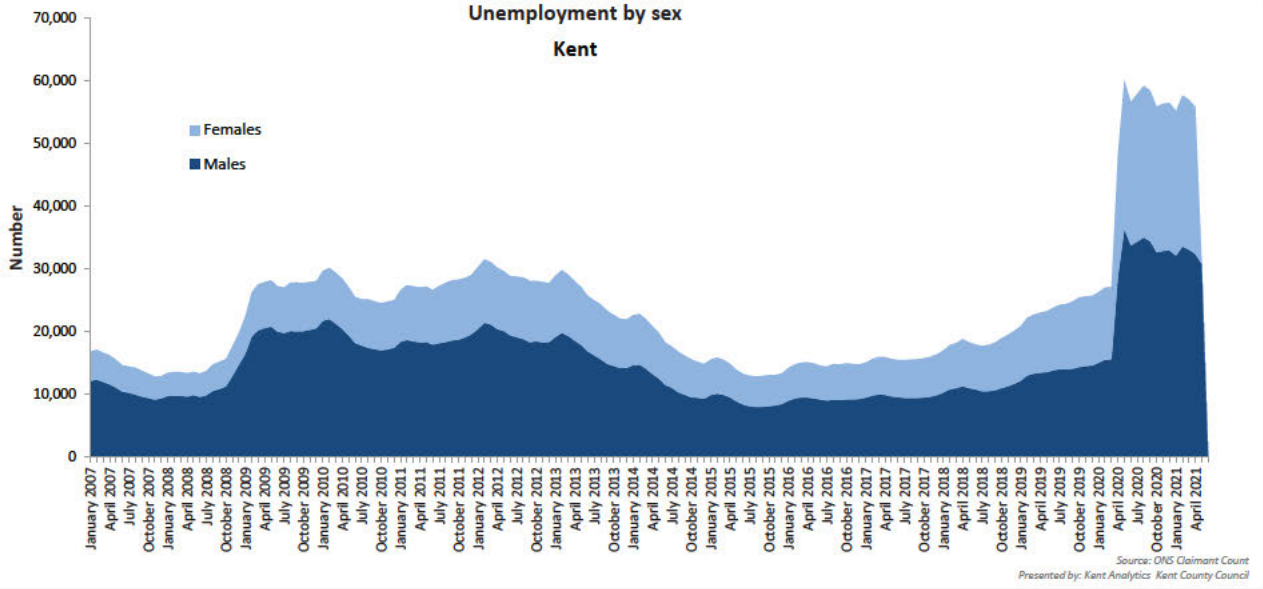
Unemployment by sex

Kent

May 2021	Number	% rate	Number change since April 2021	% change since April 2021	Number change since May 2020	% change since May 2020
Males	30,765	6.5%	-1,585	-4.9%	-5,600	-15.4%
Females	22,220	4.6%	-1,275	-5.4%	-1,460	-6.2%
Total	52,985	5.6%	-2,860	-5.1%	-7,060	-11.8%

District unemployment by sex

May 2021	Male claimants	Males claimant rate	Female claimants	Female claimant rate
Ashford	2,415	6.4%	1,835	4.6%
Canterbury	2,865	5.4%	1,950	3.7%
Dartford	2,065	5.8%	1,665	4.6%
Dover	2,425	7.0%	1,725	4.9%
Folkestone & Hythe	2,680	8.1%	1,760	5.4%
Gravesham	2,640	8.1%	1,995	6.1%
Maidstone	2,930	5.6%	2,170	4.1%
Sevenoaks	1,485	4.3%	1,170	3.3%
Swale	3,260	7.2%	2,365	5.2%
Thanet	4,605	11.6%	3,010	7.2%
Tonbridge & Malling	1,740	4.4%	1,345	3.3%
Tunbridge Wells	1,655	4.6%	1,220	3.4%
Kent	30,765	6.5%	22,220	4.6%
Medway	6,775	7.7%	4,815	5.5%

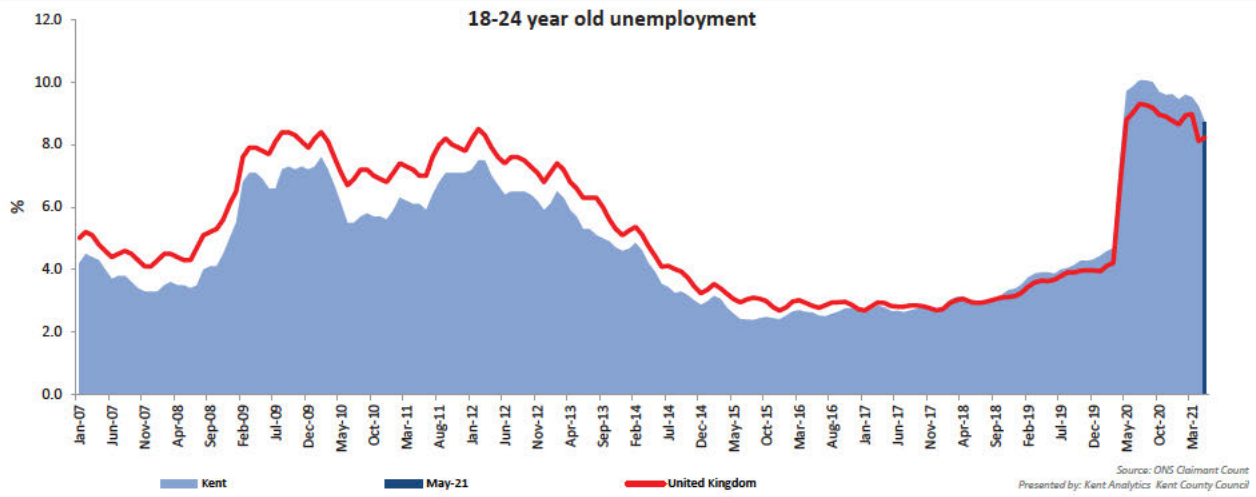


Unemployment by age group in Kent

May 2021	Number	% rate	Number change since April 2021	% change since April 2021	Number change since May 2020	% change since May 2020
18-24	10,560	8.7%	-645	-5.8%	-1,220	-10.4%
25-49	29,260	6.0%	-1,485	-4.8%	-4,310	-12.8%
50-64	13,080	4.2%	-720	-5.2%	-1,460	-10.0%

District unemployment by age group

May 2021	18-24 claimants	25-49 claimants	50-64 claimants	18-24 claimant rate	25-49 claimant rate	50-64 claimant rate
Ashford	890	2,290	1,065	10.1%	5.7%	4.1%
Canterbury	1,055	2,605	1,150	4.1%	5.6%	4.0%
Dartford	660	2,280	775	8.7%	5.5%	3.9%
Dover	830	2,215	1,095	10.3%	6.6%	4.2%
Folkestone & Hythe	835	2,340	1,260	11.4%	7.3%	5.2%
Gravesham	945	2,595	1,090	12.4%	7.4%	5.3%
Maidstone	950	2,970	1,175	8.1%	5.4%	3.5%
Sevenoaks	510	1,450	690	7.1%	4.1%	2.8%
Swale	1,250	2,985	1,375	11.0%	6.5%	4.6%
Thanet	1,485	4,215	1,905	14.9%	10.6%	6.7%
Tonbridge and Malling	635	1,680	770	7.1%	4.1%	2.9%
Tunbridge Wells	510	1,630	730	7.2%	4.3%	3.0%
Kent	10,560	29,260	13,080	8.7%	6.0%	4.2%
Medway	2,480	6,595	2,505	11.0%	7.0%	4.8%

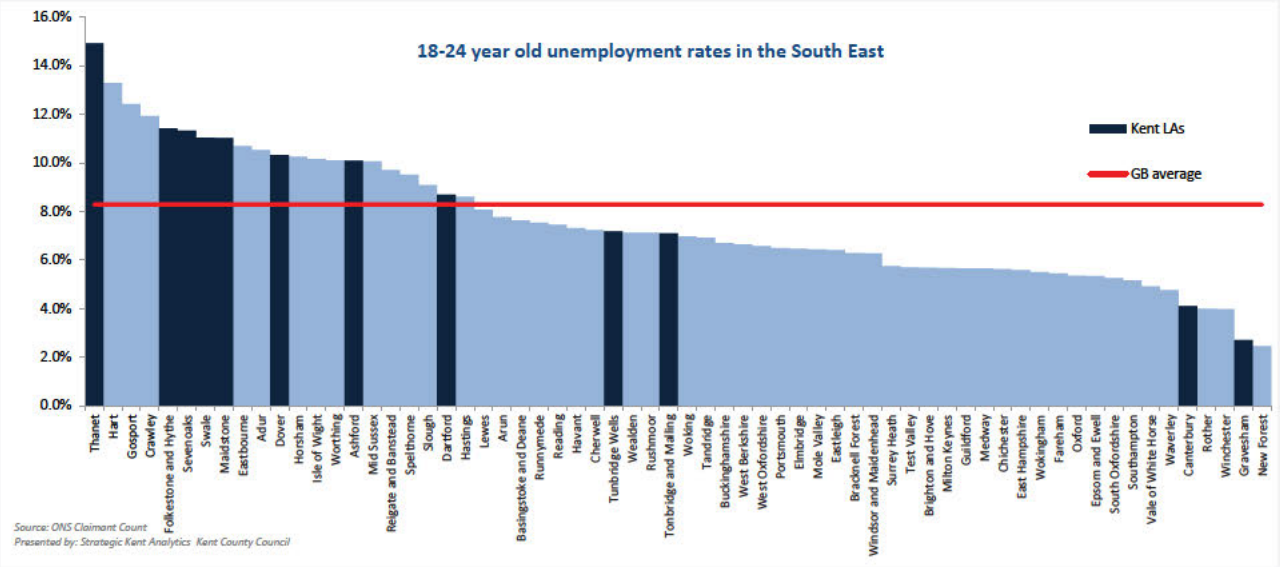


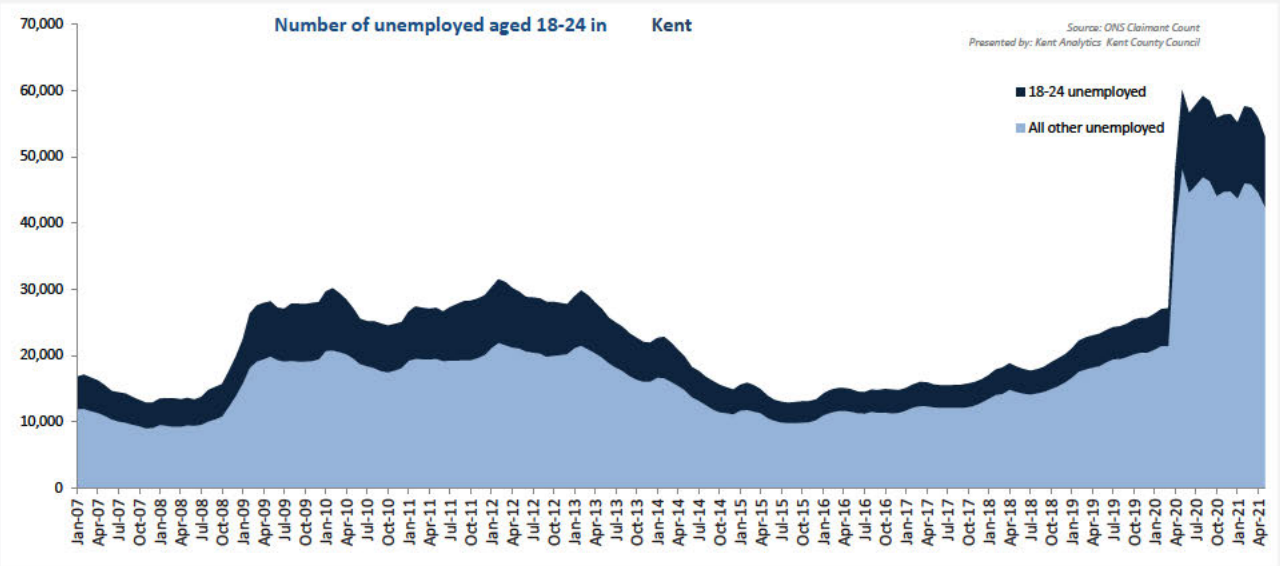
18-24 Unemployment

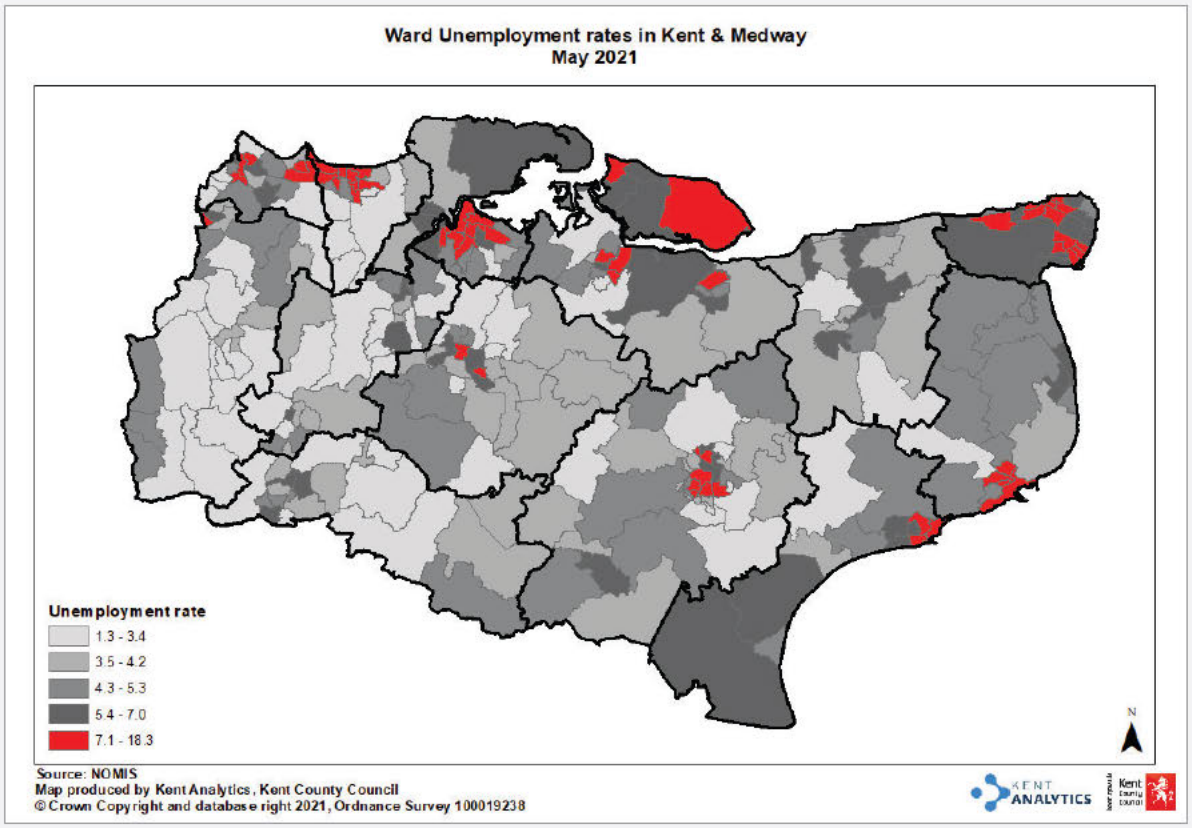
May 2021	Number	% rate	Number change since April 2021	% change since April 2021	Number change since May 2020	% change since May 2020
Kent	10,560	8.7%	-645	-5.8%	-1,220	-10.4%
United Kingdom	465,245	8.2%	+6,660	+1.5%	-30,930	-6.2%

Unemployment by age group - % of all unemployed

May 2021	Number of claimants in Kent	% of all unemployed in Kent	Number of claimants in United Kingdom	% of all unemployed in United Kingdom
18-24	10,560	19.9%	465,245	18.6%
25-49	29,260	55.2%	1,434,100	57.3%
50-64	13,080	24.7%	598,035	23.9%







This workbook looks at the total number of people claiming either Jobseekers Allowance or Universal Credit principally for the reason of being unemployed. It also looks at the age profile of claimants, in particular at youth unemployment which is defined as those aged 18 to 24.

This workbook uses information from a dataset called The Claimant Count by Sex and Age. This experimental series counts the number of people claiming Jobseeker's Allowance plus those who claim Universal Credit who are out of work. The dataset currently includes some out of work claimants of Universal Credit who are not required to look for work; for example, due to illness or disability. Therefore this dataset is considered experimental and the results should be interpreted with caution.

Unemployment rates are calculated using the Office for National Statistics Mid-year Population Estimates 2001-2018. The resident working age population is defined as all males and females aged 16-64. These denominators will be updated annually with the ONS mid-year population estimates.

Introduction of Universal Credit
Since 2013 the roll out of Universal Credit has progressed across the UK. Universal Credit will replace a number of means-tested benefits including the means-tested element of Jobseeker's Allowance (JSA).

The Universal Credit Live Service roll out in Kent & Medway began in April 2015. This was replaced in 2016 with the Universal Credit Full Service using the DWP bespoke digital system. The full service rollout in Kent was completed in autumn 2018. The table below shows how Universal Credit rolled out within Kent districts.

While initially Universal Credit was only available to single claimants without a partner and without child dependents, the roll out of the full service made Universal Credit available to all new claimant types and to those reporting changes to their personal circumstances.

From July 2019 the government intends to begin a pilot scheme transferring claimants of existing benefits (those that Universal Credit was designed to replace) onto Universal Credit. This managed migration will start initially with 10,000 existing claimants. They won't start moving people over to Universal Credit in great numbers until the pilot scheme has been completed and assessed, however they plan to have completed the full migration process by the end of 2023.

For more information on Universal Credit: https://www.gov.uk/universal-credit

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Freight by Aircraft Configuration May 2021 (a)
Comparison with Previous Year
Tonnes

Table 15

	<---------- Passenger Aircraft ---------->			<---------- Cargo Aircraft ---------->			<---------- Total ---------->		
	2021	2020	Percentage Change	2021	2020	Percentage Change	2021	2020	Percentage Change
London Area Airports									
GATWICK	390	3	12900	509	-		899	3	29867
HEATHROW	47 189	16 345	189	70 311	63 751	10	117 500	80 095	47
LUTON	-	-		1 736	2 464	-30	1 736	2 464	-30
STANSTED	16	12	33	22 037	19 829	11	22 053	19 840	11
Total London Area Airports	47 595	16 360	191	94 593	86 043	10	142 188	102 403	39
Other UK Airports									
ABERDEEN	113	121	-7	347	280	24	460	401	15
BARRA	1	-		-	-		1	-	
BELFAST CITY (GEORGE BEST)	3	-		-	-		3	-	
BELFAST INTERNATIONAL	-	-		2 253	1 838	23	2 253	1 838	23
BENBECULA	2	2		-	-		2	2	
BIRMINGHAM	29	15	93	1 200	474	153	1 229	489	151
BOURNEMOUTH	-	-		2 090	-		2 090	-	
CARDIFF WALES	-	-		-	72		-	72	
DONCASTER SHEFFIELD	-	-		1 766	3 069	-42	1 766	3 069	-42
EAST MIDLANDS INTERNATIONAL	-	-		35 214	28 404	24	35 214	28 404	24
EDINBURGH	170	1	16900	1 383	1 202	15	1 553	1 203	29
GLASGOW	8	12	-33	183	54	239	191	66	189
HUMBERSIDE	5	3	67	1	1		6	3	100
ISLAY	7	1	600	-	-		7	1	600
ISLES OF SCILLY (ST.MARYS)	4	1	300	6	4	50	9	5	80
KIRKWALL	2	1	100	-	-		2	1	100
LANDS END (ST JUST)	3	1	200	5	4	25	9	5	80
LIVERPOOL (JOHN LENNON)	1	10	-90	-	-		1	10	-90
MANCHESTER	1 414	749	89	2 557	576	344	3 971	1 325	200
NEWCASTLE	-	-		61	-		61	-	

Freight by Aircraft Configuration May 2021 (a)
Comparison with Previous Year
Tonnes

Table 15

	<---------- Passenger Aircraft ---------->			<---------- Cargo Aircraft ---------->			<---------- Total ---------->		
	2021	2020	Percentage Change	2021	2020	Percentage Change	2021	2020	Percentage Change
NORWICH	8	22	-64	-	-		8	22	-64
PRESTWICK	-	-		1 314	1 069	23	1 314	1 069	23
SCATSTA	-	11		-	-		-	11	
SOUTHAMPTON	2	2		-	-		2	2	
STORNOWAY	12	8	50	-	-		12	9	33
SUMBURGH	14	3	367	-	-		14	3	367
TIREE	1	-		-	-		1	-	
Total Other UK Airports	1 798	963	87	48 382	37 047	31	50 181	38 009	32
Total All Reporting UK Airports	49 394	17 322	185	142 975	123 090	16	192 369	140 412	37
Non UK Reporting Airports									
ALDERNEY	4	4		-	1		4	4	
GUERNSEY	5	3	67	59	40	48	63	44	43
ISLE OF MAN	1	10	-90	-	4		1	14	-93
JERSEY	2	2		82	26	215	85	28	204
Total Non UK Reporting Airports	12	19	-39	141	71	99	153	90	70

(a) Domestic traffic is counted both at the airport of arrival and the airport of departure.
The total domestic plus international traffic is, therefore, only a measure of airport activity.

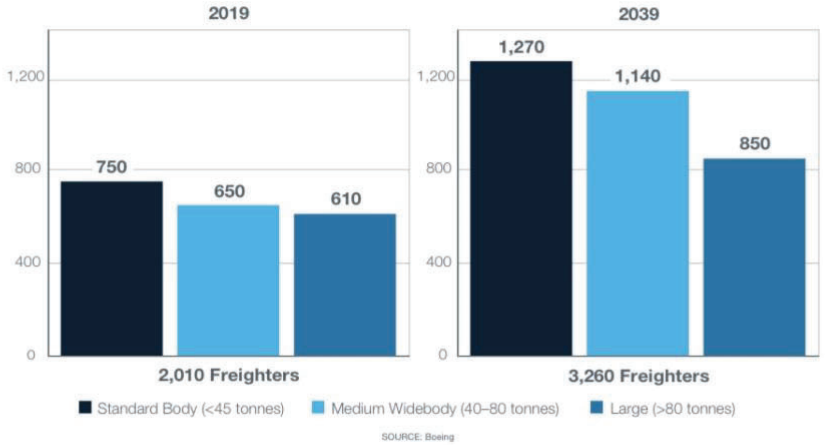

BOEING
WORLD AIR CARGO
FORECAST 2020–2039

Freighter fleet forecast

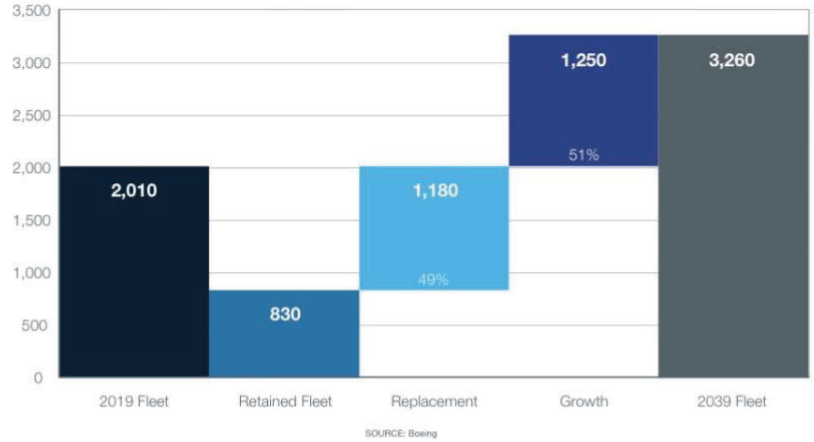
The combination of 4.0% annual average RTK growth, in addition to the proven need for dedicated freighter capacity to support our global transportation system, results in the need for a 60% larger fleet during the next two decades.

Over the next 20 years, the freighter fleet will grow more than 60% from 2,010 to 3,260 units. There are 2,430 freighters forecast to be delivered, with approximately half replacing retiring airplanes and the remainder expanding the fleet to meet projected traffic growth. More than 60% of deliveries will be freighter conversions, 72% of which will be standard-body passenger airplanes. Of the projected 930 new production freighters, just over 50% will be in the medium widebody freighter category.

Freighter Fleet Will Grow More Than 60%



2,430 Freighters Required for Growth and Replacement



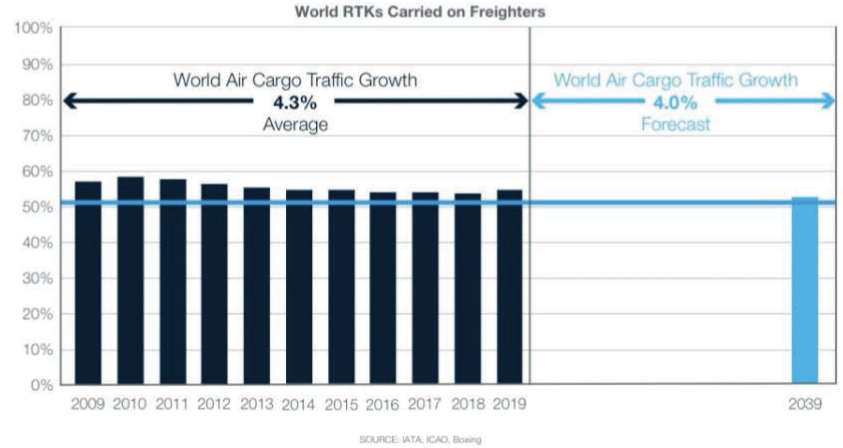
The Role of Freighters in Air Cargo

Freighters comprise less than 8% of the total commercial jet fleet, yet they carry more than 50% of all air cargo traffic. Their essential role in the global supply chain is underpinned by a number of factors.

- Of the 26,000 jet transports in service at year-end 2019, over 19,000 were single-aisle and/or regional jet airplanes that do not have lower holds to accommodate freight pallets or containers. Freight forwarders prefer palletized capacity, which is only available on widebody passenger or freighter airplanes.
- Most passenger airplanes with lower-hold capacity do not serve key trade routes, and for such routings, freighters are the most efficient form of cargo transport.
- Dedicated freighter services offer control over timing and routing that is unmatched by lower-hold capacity. As air cargo is an industrial tool, demand for cargo capacity surges on weekends as shippers try to use idle time between different factories as the "warehouse in transit." Consequently, twin-aisle passenger airline schedules often do not meet shipper timing needs for industrial demand.
- Freighters offer speed to market for high-value, time-sensitive products such as capital equipment, electronics, pharmaceuticals, fashion goods and perishable commodities.
- Passenger airplane lower holds are severely limited for transporting hazardous materials and project cargo, meaning a group of shipments moving as one aggregated consignment. The grounding of much of the world's passenger airplane fleet because of the COVID-19 pandemic during 2020 has only served to underscore the importance of freighters. With the removal of significant twin-aisle passenger airplane lower-hold capacity, freighter utilization rates from March through September 2020 surged up to 20% over 2019 levels to partially compensate for this missing capacity.

Nearly 90% of all air cargo revenue is generated by airlines that operate freighters. Freighters augment an airline's cargo operations, helping the airline compete more effectively.

Freighters Will Continue to Carry Over 50% of World Air Cargo Traffic



SOURCE: IATA, ICAO, Boeing

Types of freighters

The freighter fleet forecast categorizes airplanes by capacity, measured in tonnes.

Standard-body freighters are those with less than 45 tonnes of carrying capacity. Fuselage cross-sections are those of single-aisle airplanes. Standard-body freighters are supplied to the industry almost exclusively through the conversion channel. The uptake of factory-built small freighters has been modest and is not expected to increase.

Medium widebody freighters have capacities of 40 to 80 tonnes. In cross-section, these are twin-aisle airplanes. They are supplied through both conversion and production, with the product mix influenced by operator requirements as well as feedstock availability.

Large freighters are those with more than 80 tonnes of capacity. Although large freighters were historically sourced from both the conversion and factory-production channels, we believe that, in the future, demand in this segment will favor factory production.

Freighters for replacement and growth

The freighter fleet forecast calls for 3,260 airplanes in service by 2039, an increase of over 60% against the in-service 2019 fleet of 2,010.

During the forecast period, we expect 1,180 retirements of older and less-efficient types, which will create demand for replacement by new conversion and production airplanes.

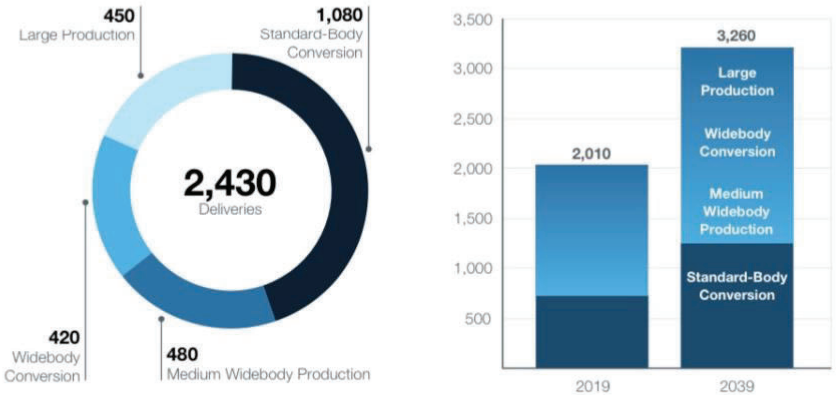
In addition, we forecast that 1,250 airplanes will be required for growth. In the immediate aftermath of the COVID-19 pandemic, a reduction of widebody passenger flights diverted time-sensitive cargo toward dedicated freighter services, resulting in increased activity and strong yields. Longer term, we expect the increase in e-commerce and the global spread of express services to support further growth. Passenger lower-hold capacity is an imperfect substitute for the critical advantages of freighter services, and the need for dedicated freighters will continue.

Freighter Fleets Are Categorized by Capacity

Standard Body <45 tonnes	Medium Widebody 40–80 tonnes	Large >80 tonnes
Boeing 727	Boeing 767	Boeing 747
Boeing 737	Boeing DC-10	Boeing 777
Boeing 757	Airbus A300/A310	Boeing MD-11
Boeing MD-80	Airbus A330	Antonov An-124
Boeing DC-9	Ilyushin Il-76TD	Ilyushin Il-96T
Airbus A320 Series		

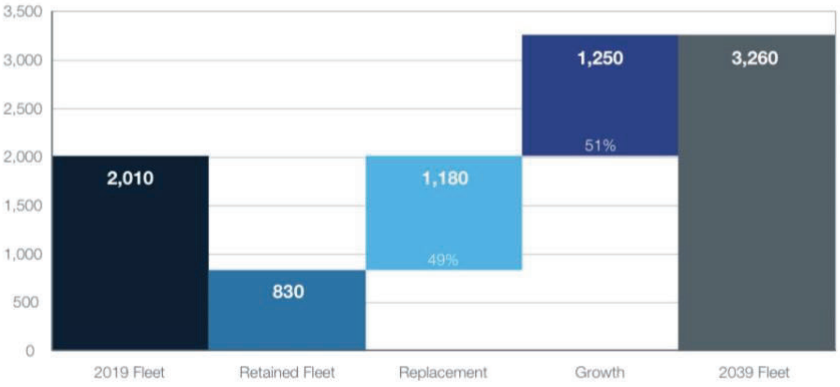
NOTE: Production and conversion models assumed for each type unless otherwise specified.

Freighter Fleet Will Grow Over 60% by 2039



SOURCE: Boeing

2,430 Freighters Required for Growth and Replacement



SOURCE: Boeing

July 14, 2021

International Airport Review – Heathrow and UK aviation industry to support economic pivot post-Brexit

New research has highlighted how the UK could undergo an economic pivot post-Brexit, with non-European Union (EU) trade potentially increasing by 20 per cent over the next five years, from nearly £473 billion in 2019 to £570 billion in 2025.

According to the Centre for Economics and Business Research, aviation will need to be at the heart of this pivot. The findings suggest that the value of trade through London Heathrow Airport (LHR) to non-EU countries could increase by 11 per cent by 2025, while trade with EU countries decreases by seven per cent over the same period. Regions across the UK would benefit from these new trading links, with Heathrow playing a key role in opening up valuable new markets, from Asia Pacific and Australia to the U.S.

Aviation is critical to the UK government's plans for a Global Britain post-Brexit. Heathrow alone has the potential to facilitate a £204 billion trade bonanza, benefitting British businesses in every corner of the country, creating opportunities for the entire aviation sector and strengthening the UK's trade network.

However, this trade boost won't be realised unless the UK's aviation industry is supported by government policies and is allowed to resume. Industry figures for May 2021 show that some of the European competitors that benefitted from sector-specific support during the pandemic, such as the Netherlands and Germany, are seeing the fastest growth. Cargo tonnage at the UK's hub airport is still down by 19 per cent on 2019 levels, compared to both Amsterdam Airport Schiphol (AMS) and Frankfurt Airport (FRA), which have surpassed their 2019 levels, growing by 14 per cent and nine per cent respectively over the same time period.

This research comes as Heathrow works with British Airways (BA) and Virgin Atlantic to launch trials that aim to help government and industry understand how to practically ease restrictions for fully vaccinated passengers, a move which is key for restarting travel and trade. By capitalising on the country's vaccine dividend, ministers can help to deliver this economic stimulus for exporters across Britain, ensuring that the UK retains its competitive edge as the country comes out of lockdown.

The Global Britain report reveals that:

- By 2025, the value of trade through Heathrow could grow to over £204 billion (up from £188 billion in 2019), representing 21.2 per cent of the UK's total trade in goods and 14.6 per cent of its trade in goods and services
- The growth in trade could boost every part of the UK: regions with high manufacturing propensities – including the Midlands and the North East – are likely to benefit most from future trade agreements with fast growing economies around the world. Scotland and Wales could also benefit from increased trade in agriculture, forestry and fishing
- Heathrow could help to drive future Free Trade Agreements – with 46 per cent of trade by value with CPTPP countries facilitated through the airport – while the airport is ideally placed to play a major role in deals with the U.S. and Australia
- Heathrow is a major facilitator of UK trade, accounting for two thirds of all trade transported by air in the UK (by value), with this figure rising to over 75 per cent for non-EU trade
- While 90 per cent of the UK's trade by volume is transported by sea, high value goods are transported by air. Heathrow is the UK's largest port by value, accounting for 21.2 per cent of UK trade in goods by value in 2019.

The new research reaffirms the importance of the global hub airport model to the UK post-Brexit and to Britain's ambitious exporters, which rely on aviation trade routes. The hub model helps to drive trade growth, by pooling demand for global connections and providing more choice of destinations for passengers, businesses, entrepreneurs, exporters and importers.

Heathrow's CEO, John Holland-Kaye, said: "Heathrow is well placed to supercharge the government's Global Britain ambitions and deliver a post-lockdown, post-Brexit economic stimulus worth billions of pounds. As the UK's only hub airport and largest port by value, we are ready to play a central role in creating economic opportunities for businesses across the country, facilitating new free trade agreements and serving as a vital link to our key trading partners. Ministers must seize the opportunity to secure this crucial economic boost by backing British aviation and its own vaccination programme by safely easing travel restrictions for fully vaccinated passengers from 19 July 2021."

The UK's Minister for Exports, Graham Stuart MP, commented: "As we continue to strike free trade agreements with countries across the world, our airports will play an important role in the UK's global ambitions – from our accession to CPTPP to the recently-signed UK-Australia trade deal. Our trade policy agenda will help to level up all parts of the UK, reduce tariffs and cut red tape for businesses. Support from the aviation sector will help to facilitate this, ensuring the even smoother journey of UK exports to key markets such as New Zealand, the Middle East and India."

To showcase the work of British businesses up and down the country that export their goods and services via Heathrow, the airport will also be launching a Global Britain Business Champions campaign. These businesses have kept the country trading over the course of 2020 and 2021 amidst the pandemic, and are set to play a central role in driving a global Britain in the years ahead.

Department for Transport

Night Flight Restrictions at Heathrow, Gatwick and Stansted

Decision Document

July 2021

Executive summary

This government response follows the consultation launched on 2 December 2020 which sought views on the night flights regime at the designated airports (Heathrow, Gatwick and Stansted) beyond 2022, and night flights in the national context. This government response is in relation to Part One of that consultation, which closed on 3 March 2021. Respondents were able to reply via online SmartSurvey, e-mail and by post.

Part One of our consultation featured two main proposals. Firstly, the proposed rolling over of existing night flight restrictions for the designated airports from 2022 to 2024. This would mean that the current limits in place at Heathrow, Gatwick and Stansted airports would remain unchanged (aside from the proposal to ban QC4 rated aircraft movements during the night quota period as discussed below) between October 2022 and October 2024. We considered that maintaining the existing restrictions would mean minimal change for communities that are overflown compared to the period of the current regime (2017-2022) and would be the fairest approach given the uncertainty around post-COVID-19 consumer behavioural changes and the recovery of the aviation sector. We also noted that there is an argument for not changing limits at this stage, in so far as we do not have sufficient evidence to support a substantial change in policy.

The second main proposal within Part One of the consultation was to place an operational ban on QC4 rated aircraft movements at the designated airports during the night quota period (23:30 – 06:00). We proposed to take advantage of the withdrawal of QC4 rated aircraft (e.g. a Boeing 747-400 on departure) from most scheduled services due to the COVID-19 pandemic, by banning movements of such aircraft during the night quota period. We presented our view that this will have minimal negative impacts for industry but would benefit communities by removing the noisiest aircraft from operating during the night quota period.

Following this consultation and taking into account responses from industry, community groups and individuals, the following decisions have been reached. Firstly, the night noise objective and existing restrictions will be rolled over for a period of three years rather than two as originally proposed in our consultation. A two-year rollover, which would have necessitated consultation on new proposals in 2022, would no longer provide enough time for the government to have conducted

thorough research to properly inform and develop a new evidence-based night noise regime. This is because of a change in the government's view on the pace and trajectory of the aviation sector's recovery. By rolling over for three years, the extra year will allow the government to develop a more meaningful evaluation of the costs and benefits of night flights (as called for in a number of consultation responses from community groups), taking into account the effects of the pandemic and the extent and speed with which aviation demand returns. This will enable decisions to be taken against a background of a wider evidence base, including on the negative impacts on sleep and health, against which the economic benefits of night flights have to be balanced.

Some recovery is necessary to allow for research which is representative of pre-pandemic times, and which can therefore accurately examine the benefits of night flights, alongside how night flights at, or closer to, their normal level would impact on local communities. Although many individuals urged the government to implement change now as skies are quieter, basing policies on a time when the UK was in full or partial lockdown and most international travel had been halted, would not be representative of future demand for aviation services and would be likely to have negative longer-term economic effects. In reaching this decision we took into account the views of community groups and considered that it was likely that a longer extension would increase the strength of feeling expressed by consultees opposed to any extension. Nonetheless, even considering this our decision is that time must be allowed for the sector to recover to enable an accurate analysis of the benefits of night flights and associated negative impacts for communities. The restrictions will be reassessed in time for a new regime to commence in October 2025, by which time we would have a better understanding of how COVID-19 has impacted the aviation sector.

Secondly, the government will proceed with the implementation of a ban on QC4 rated aircraft movements, at the designated airports, during the night quota period. Despite receiving some opposition to the proposal from industry, the government has not received robust evidence that this would have more than a minimal impact on industry, while benefitting communities by taking the noisiest aircraft out of operation during the night quota period.

The rules for the next regime are summarised in the table below:

Table 1 – Structure of the night flights regime, October 2022-2025

		Movement Limit	Noise Quota Limit
Heathrow	Winter	2,550	2,415
	Summer	3,250	2,735
Gatwick	Winter	3,250	1,785
	Summer	11,200	5,150
Stansted	Winter	5,600	3,310
	Summer	8,100	4,650

Part Two of the consultation, which sought early views and evidence on policy options for the government's future night flight policy at the designated airports beyond 2024, and nationally, remains open until 3 September 2021. Work is now underway to analyse the responses to this part of the consultation, which will be used to shape long-term policy proposals for the period beyond 2025.

Consultation responses received on revisions to our night flight dispensation guidance will be used to revise the guidance for airport operators with a view to providing better clarity. We will publish this updated guidance before the new night flight regime takes effect in October 2022.

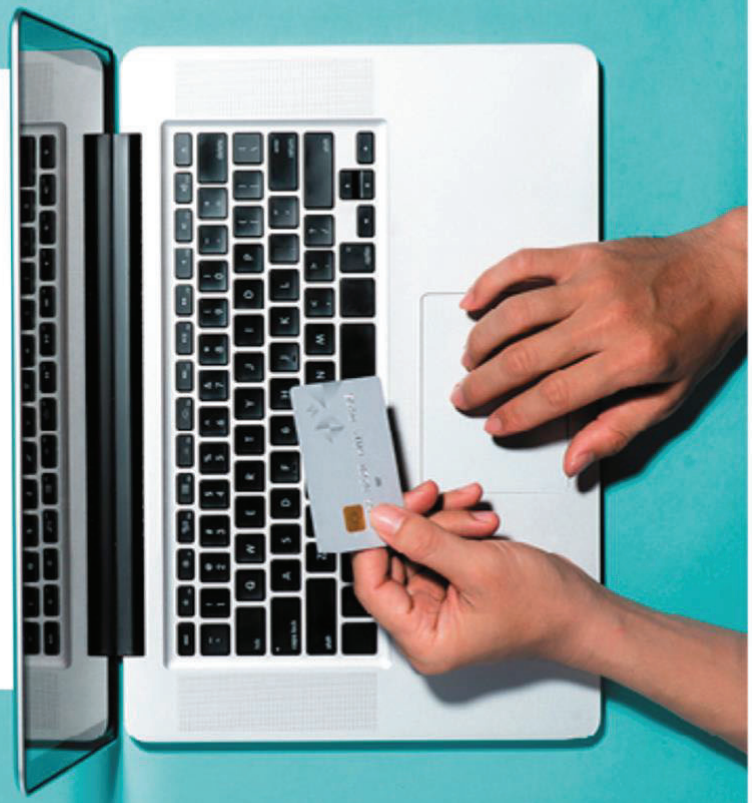
We now aim to publish a further night flight restrictions consultation during 2023, and it is at this stage that we will set out firm proposals for longer-term policy reform.

JUNE 2021

GLOBAL E-COMMERCE OUTLOOK

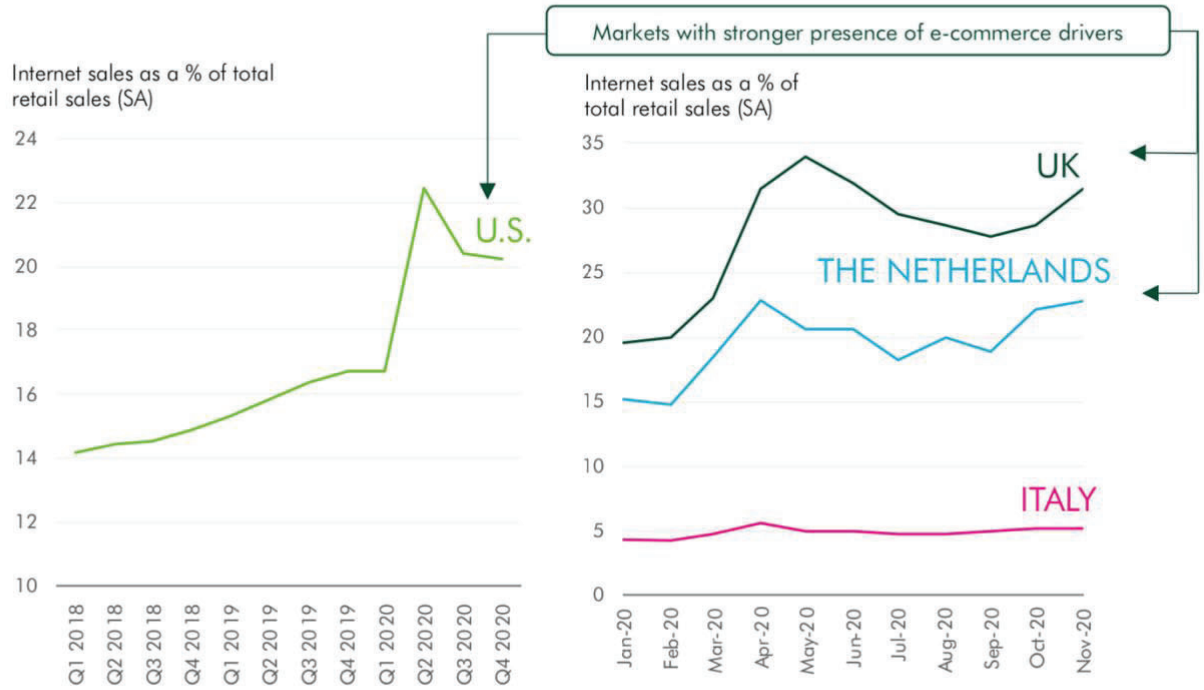
What is Driving E-commerce Growth in Different Markets?

CBRE

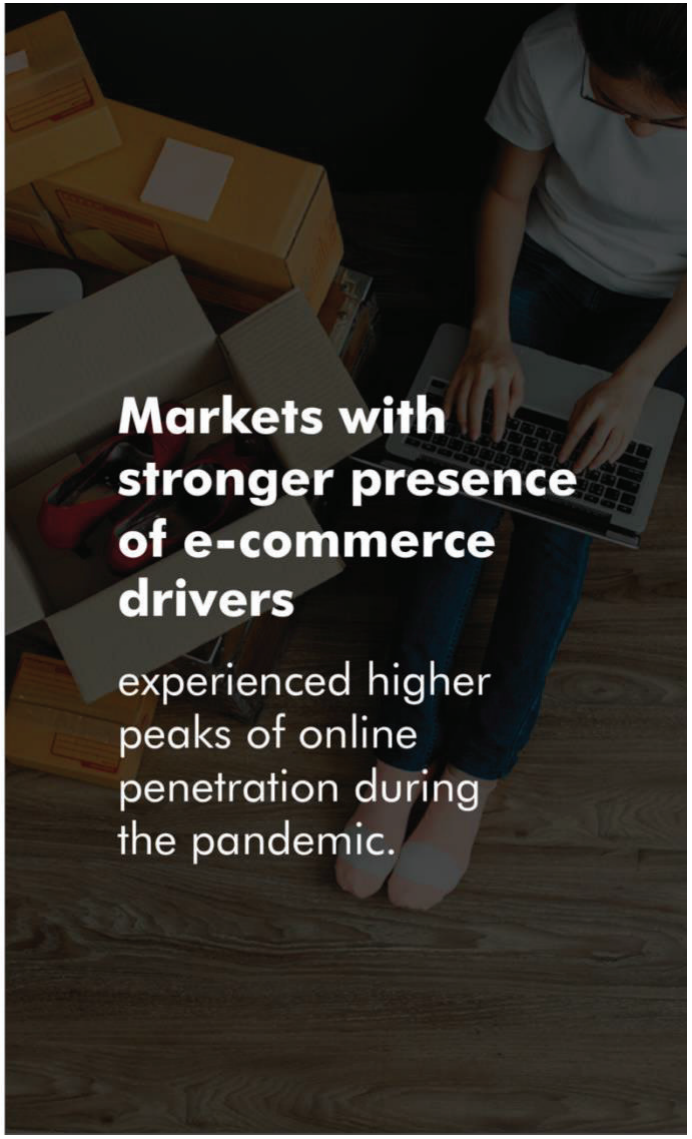


INTERNET SALES HAVE INCREASED RAPIDLY DURING THE PANDEMIC WITH A LASTING EFFECT

EXAMPLES FROM THE U.S. AND EUROPE



Source: Macrobond, Eurostat, US Census, CBRE Research.



LOGISTICS SPACE REQUIREMENTS GLOBAL FORECAST

ESTIMATED 5 YEAR SPACE REQUIREMENTS DUE TO THE GROWTH OF E-COMMERCE

GLOBAL

2020-25
Change

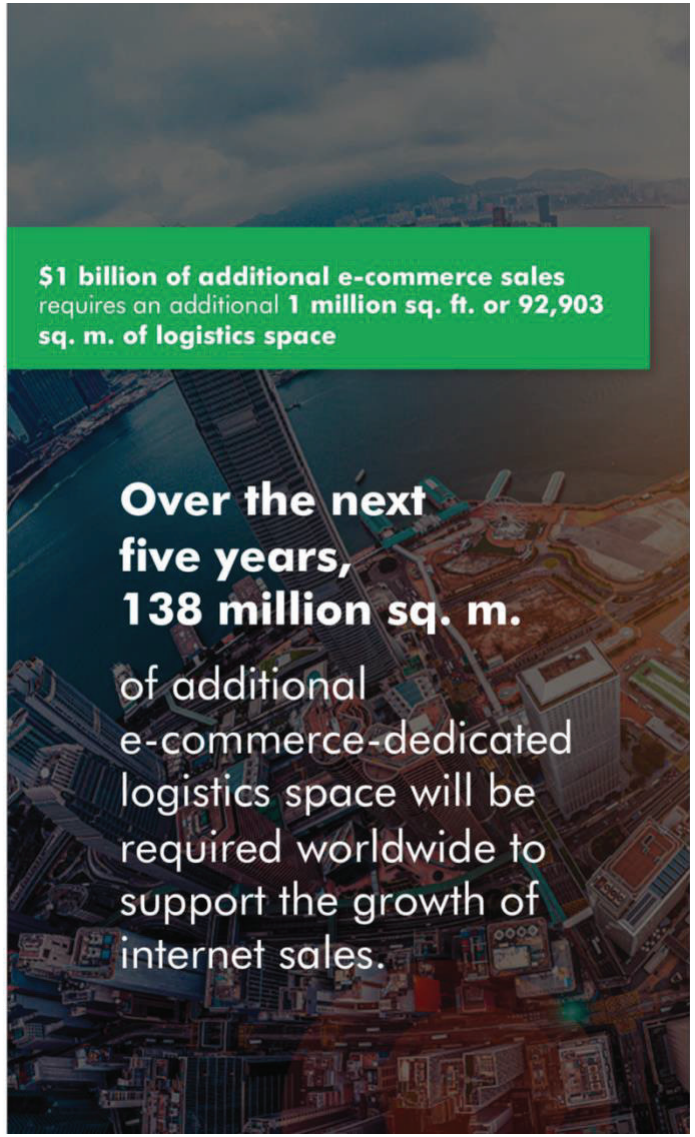
E-COMMERCE SALES

+$ 1.5 Trillion
- $3.9 Trillion in 2025
- $2.4 Trillion in 2020

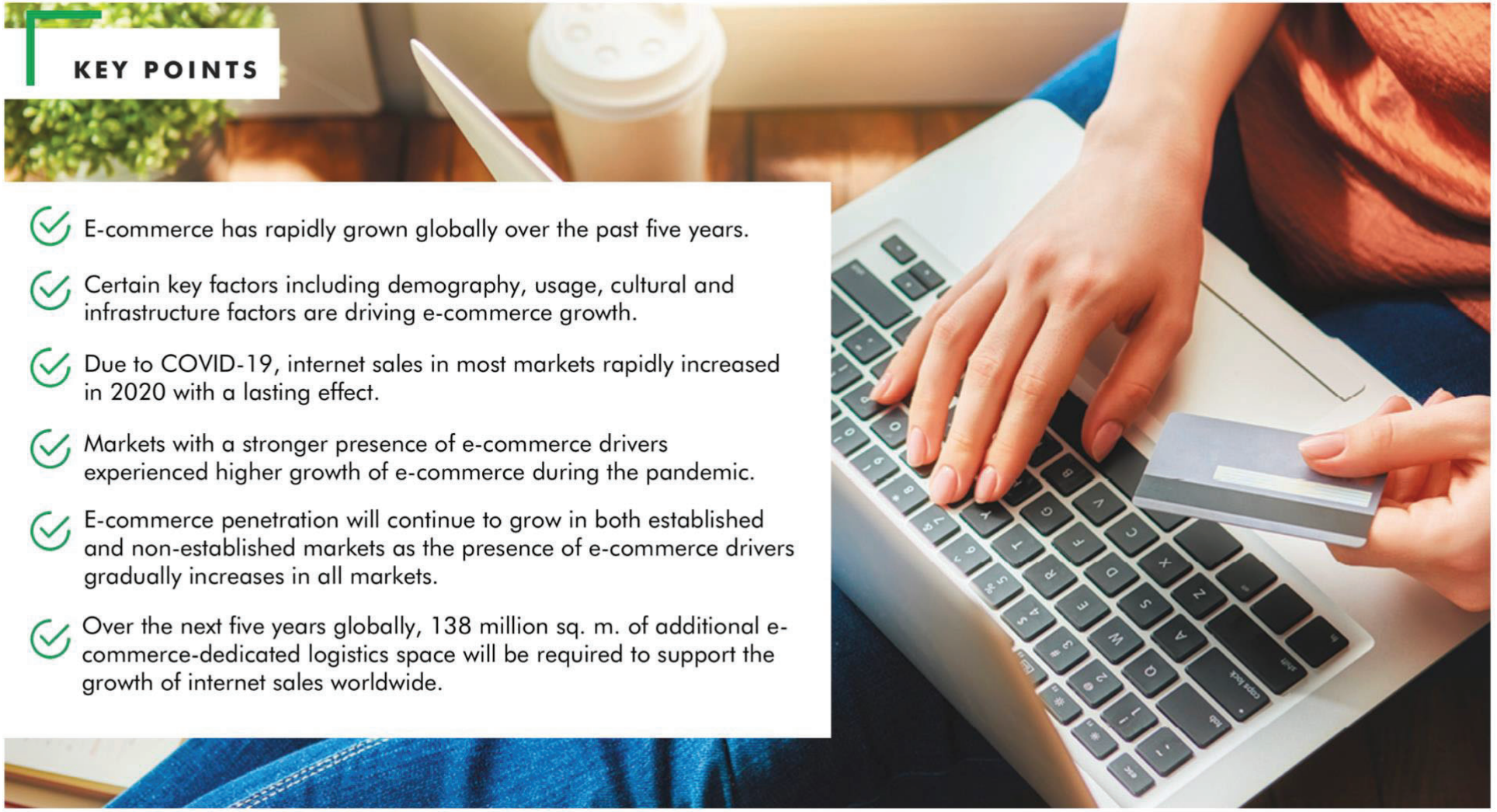
LOGISTICS SPACE

Additional
138 million sq. m.
to support
e-commerce growth
over five years

Source: Euromonitor, CBRE Research. Aggregated estimates of the 43 markets included in the analysis. List of all markets included in the Appendix.
E-commerce sales forecast is based on our forecast of e-commerce penetration rate per different market, using 2020 data from Euromonitor as the base year.
Our calculation assumes an estimate of $1 billion of additional e-commerce sales requiring an additional 1million sq. ft. or 92,903 sq. m. of logistics space.



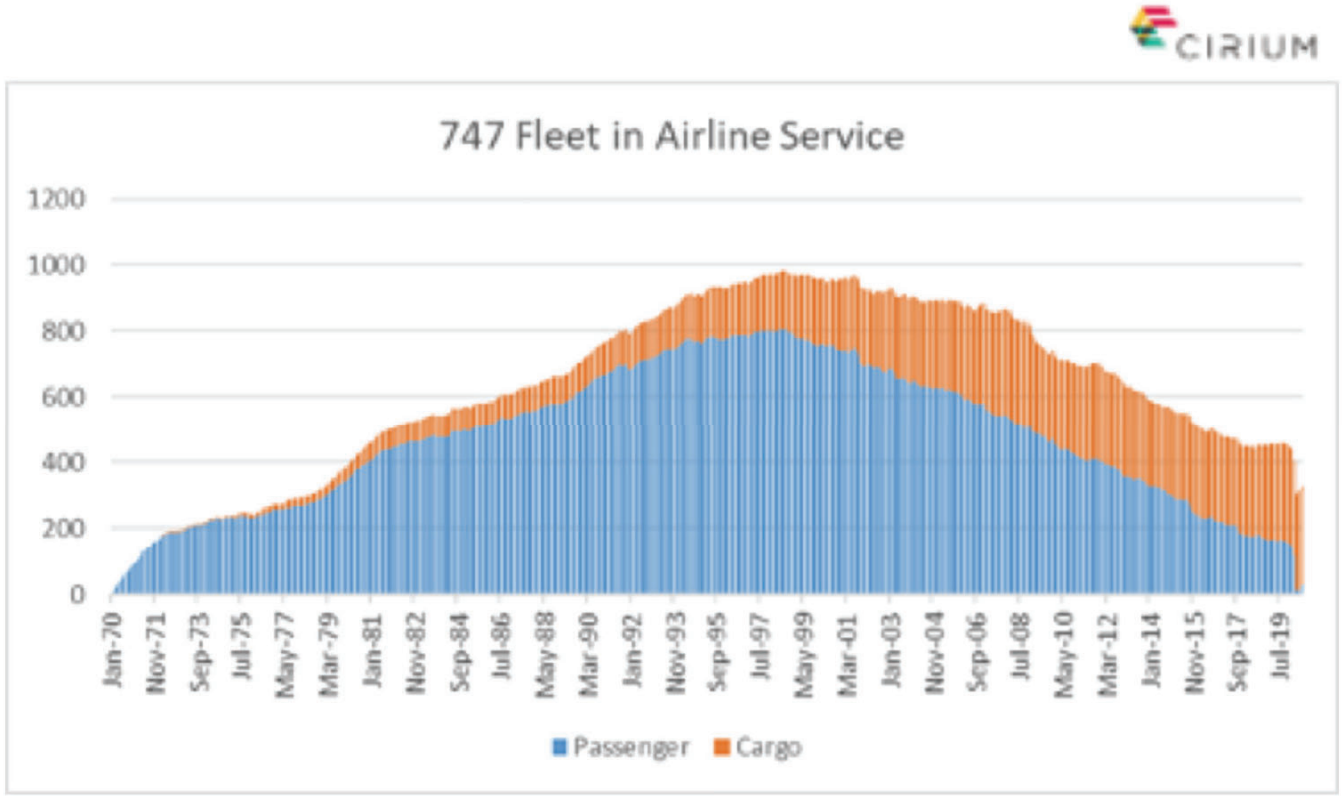
KEY POINTS



- E-commerce has rapidly grown globally over the past five years.
- Certain key factors including demography, usage, cultural and infrastructure factors are driving e-commerce growth.
- Due to COVID-19, internet sales in most markets rapidly increased in 2020 with a lasting effect.
- Markets with a stronger presence of e-commerce drivers experienced higher growth of e-commerce during the pandemic.
- E-commerce penetration will continue to grow in both established and non-established markets as the presence of e-commerce drivers gradually increases in all markets.
- Over the next five years globally, 138 million sq. m. of additional e-commerce-dedicated logistics space will be required to support the growth of internet sales worldwide.

Stay informed: Sign up for our daily aviation news digest.

According to Cirium's analysis, there are 492 Boeing 747s in service, stored, or on order with airlines worldwide. 157 of these are passenger aircraft. 35 are in use, while 122 are in storage. Of these 35, 21 are passenger versions of the Boeing 747-400. Lufthansa is one of the only airlines operating a significant number of 747 aircraft for passenger flights.



The number of passenger 747s active has plummeted. Graph: Cirium

The proportions are almost reversed when it comes to cargo 747s. 335 of these aircraft are active, in storage, or on order. Staggeringly, only 23 are in storage, while 14 are undelivered. That leaves 298 that are in service. There is a massive demand for these large freighters, given the lack of capacity generated by the grounding of many cargo aircraft.

Airline	From	To	Distance (miles)
TAP	Belém	Lisbon	3,726
Air Transat	Faro	Toronto	3,693
SAS	Boston	Copenhagen	3,671
TAP	Lisbon	Recife	3,628
TAP	Lisbon	Washington Dulles	3,592
Air Transat and TAP	Lisbon	Toronto	3,576
Air Transat	London Gatwick	Toronto	3,576
Air Transat	Malaga	Montreal	3,554
Air Transat	Porto	Toronto	3,515
TAP	Lisbon	Natal	3,496
TAP	Fortaleza	Lisbon	3,478
JetBlue	London Gatwick	New York JFK	3,470
JetBlue	London Heathrow	New York JFK	3,451
Air Transat	Montreal	Paris CDG	3,442
Air Transat	Manchester	Toronto	3,434
Aer Lingus	Dublin	Washington Dulles	3,404

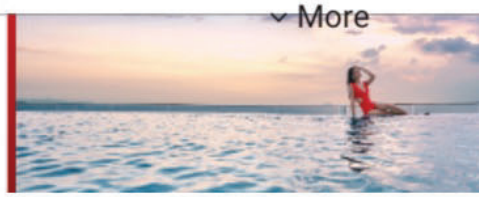
TAP	Lisbon	Newark	3,384
TAP	Lisbon	New York JFK	3,366
Aer Lingus	Manchester	New York JFK	3,341
Air Transat	Glasgow	Toronto	3,293
Aer Lingus	Dublin	Toronto	3,278
Aeroflot	Moscow Sheremetyevo	Tenerife South	3,262
Air Transat and TAP	Lisbon	Montreal	3,261
Aer Lingus	Dublin	Newark	3,193
TAP	Boston	Lisbon	3,192
Aer Lingus	Dublin	New York JFK	3,179
American Airlines	Anchorage	Dallas Fort Worth	3,043

Manchester to the US coming with Aer Lingus

Aer Lingus is one of seven airlines to operate long-haul A321neo routes this winter. It has five routes, with all but one from its Dublin hub. The sole exception is Manchester to New York JFK, due to launch on December 1st by Aer Lingus UK. This new carrier will also operate from Manchester to Orlando and Barbados, using the A330-300.

Aer Lingus' longest narrowbody route will be Dublin to Washington. Photo: Anna Zvereva via Flickr.

Manchester to New York



AIR FEATURES GLOBAL

Airlines will be forced to aim at long and thin routes

By **Joe Cusmano** — On **Jun 7, 2021**
Guest Writer

A trend among airlines of phasing out four-engine widebody aircraft in favour of smaller, more fuel-efficient two-engine aircraft, including even narrow bodies, has accelerated.

With business travel and long-haul international flying expected to be the slowest to recover from the pandemic, airlines are looking to utilise lower-capacity aircraft to operate long-haul routes, and many are permanently parking

With business travel and long-haul international flying expected to be the slowest to recover from the pandemic, airlines are looking to utilise lower-capacity aircraft to operate long-haul routes, and many are permanently parking their Airbus A380s and Boeing 747s. The new star among next-generation "long-haul" aircraft is the Airbus A321XLR, which will offer a range of 4,700 nm, the longest range ever for a single-aisle aircraft.

Assembly of the first flight-test A321XLR has just started, with the aim of deliveries commencing in the second half of 2023. The order book for the A321XLR is robust, with more than 20 customers—ranging from lessors to mainline airlines to LCCs—ordering 450 of the type in total. The aircraft is expected to open new route possibilities for airlines in much the same way the Boeing 787 widebody made new city pairs possible when it was launched.

Airbus is not stretching its A321LR or modifying the aircraft's Pratt & Whitney GTF engines—it is adding range but keeping the same ceiling on passenger load (around 220). The XLR's added 700 nautical miles in range over the LR (Long Range) is made possible by an extra fuel tank in the rear centre of the aircraft. It is a telling sign of where the marketplace stands that airline are enamoured with an aircraft that allows for carrying more fuel, but not more passengers.

Airbus has said that airlines operating the A321XLR will be able to fly "long, thin routes" such as India to Europe or China to Australia, or transatlantic routes beyond the traditional hub-to-hub flights. Among the US-based routes, Airbus envisions the A321XLR on routes such as New York JFK-Hamburg, Washington Dulles-Lima, Orlando-Santiago de Chile, Chicago O'Hare-Milan, Houston Intercontinental-Reykjavik, Boston-Casablanca, JFK-Rome, and Miami-London.

New York-based JetBlue Airways, which has just taken delivery of its first A321LR to be used on New York JFK-London flights, has said it will use the XLR to fly nonstop from New York to continental European destinations such as Madrid.

The pandemic has driven both Airbus and Boeing to slash production on their popular twin-engine widebodies. Airlines are still ordering them but in smaller numbers.

Lufthansa, for example, in early May placed an order for five A350-900s and five 787-9s. As a result, Airbus has cut monthly production for the A350 from 10 to under five aircraft per month, while Boeing has lowered 787 productions from 14 aircraft per month to just five per month.

The Airbus A321XLR: 10 Things You Must Know

by **Justin Hayward** · May 21, 2021 · 17 shares · 8 minute read

The upcoming A321XLR is a real gamechanger. It will expand the possibilities of the narrowbody with a range significantly ahead of its rivals and bring in a new era for passengers. There are many exciting things worth knowing about this new aircraft – here are 10 to get you started.

The Airbus A321XLR has over 450 orders so far. Photo: Airbus

1. It is a narrowbody with an incredible range

The A321XLR is a single-aisle, narrowbody aircraft with a typical two-class capacity of 180-200. But it pushes the range to the highest of any narrowbody – up of 8,700 kilometers (4,700 NM).

To put this into context, the standard A321neo has a range of just under 6,000 kilometers. And the 737 MAX 8 reaches 6,570 kilometers. It is still a long way behind much larger widebodies. The A350-900 offers a range of up to 15,000 kilometers. But it is enough to make a big difference to narrowbody options.

2. It should enter service in 2023

There have been delays in aircraft production and deliveries during 2020 and 2021. The A321XLR so far seems to be getting through with minimal damage, though. It remains on course for first delivery in 2023.

In February 2021, Airbus confirmed it was preparing to start the main assembly of the first test aircraft. This is taking place in Hamburg, with a pilot production line in the area that previously handled assembly of front and rear fuselage sections of the A380.

Full-scale mockups of some parts of assembly were in place by April 2021. Component assembly will take place at various Airbus facilities across the UK, Germany, and France.

3. Opens up longer routes to lower capacity aircraft

This is why there has been so much excitement over the A321XLR. It offers new possibilities for efficient, narrowbody flying.

With several large orders from US carriers, there are many options from routes there, both transatlantic and within the Americas. JetBlue will use it for New York to London flights, but other European cities could also be used. Transcontinental, Hawaii, and Alaska services are also possible, as are routes to much of South America, including Santiago or Buenos Aires from the Southern US.

European operators can reach the Middle East and Indian destinations. And from the Middle East, much of Europe, Asia, and Africa are possible. Air Arabia has an order for 20 aircraft, and Wizz Air plans to deploy its A321XLR's in Abu Dhabi.

And in Asia, transpacific routes are possible too. From Tokyo, it could reach Vancouver, Seattle, or San Francisco. But internal Pacific routes are more likely – from Tokyo, it could reach India, Indonesia, and Australia, as well as all of China, of course.

This infographic from Airbus shows just some of the range options for the A321XLR. Photo: Airbus

Airlines Will Need Fewer Wide-Body Aircraft Post-Pandemic

When people think of airplanes and airl nes the mage that typically comes to mind s a large wide-body aircraft traveling long d stances around the globe. The original Boeing 747 transformed the way the world was able to connect followed by safe and stable two-eng ne wide-bodies. Today the Boe ng 777 and Airbus A330 are common worldwick.

Yet despite their outsized image wide-body aircraft are a cha lenge for airlines because of their size and costs to acquire and operate. Few markets provide year-round demand that can fill their large cabins requiring that connect ng hubs br ng in more traffic from beyond dest nations. In his new demand environment due to the pandemic these aircraft are uniquely cha lenged and likely will become a smaller proportion of a l aircraft lown over the next 10 years.

Very Difficult For Smaller Airlines

Smaller airlines that have tried to use w de-body a rcraft have generally been unsuccessful. Years ago airlines like Amer ca West and People Express started their downfa ls when they brought in a wide body to extend their route networks. More recently WOW A rlines has shuttered largely because of the pressures brought on from the A330 and Norwegian A rlines has finally abandoned their long-haul strategy after rarely breaking even before the pandemic.

Things that xtra le ar nes often greatly under-estimate are the disruption costs caused by th s kind of airplane the over-pr oritization of resources and attention to it and the massive losses possible during weaker travel t mes. They become enamored with the network growth and perceived status th s kind of plane brings and rationalize all kinds of things to keep it flying.

Wide Body Relative Risk

The reason wide body aircra t are so d fficult for small airlines and still challenging for large airlines is their relative risk. A narrow-body airplane can make money in good times and lose money in bad t mes but the swing in e ther direction is not so great. A wide-body can make more money in good times of course because they can carry more people. But they also can lose a lot more in weaker t mes because of their h gh monthly ownersh p costs fuel and labor requirements. This relat ve profitability is outlined in th s graphic

The U S Air Force Just Admitted The F-35 Stealth Fighter Has Failed

United Airlines Won't Negotiate Over Catering Workers' Future, Union Charges

The F-111 Was The "F-35 Of Its Day," But Its Failure Was A Boon To U S Air Power

ravel Seasonality

Even without the pandem c the biggest volumes of a r travel are highly seasonal. Airlines often have to adjust capacity by season in order to address this and there are t mes of year in most geograph es where supply far outstrips demand. With a narrow-body aircraft there are often alternative opportunities to move the aircraft during low-season travel times. These may not be as profitable as the high-season opportunities but could cover the a rcraft s lease rent and the fl ght variable costs. Scheduled this way a narrow-body aircraft can be prof table in most months of the year. By comparison a w de-body because of its s ze has more problems in low-season per ods because there are fewer opportunities to redeploy. This combines with h gher f xed costs of ownership to create a financial mismatch. Consider this a new Airbus A321 or Boeing 737 might be leased for $300 000 per month rent. An Airbus A330 or Boeing 777 would have monthly rent two to four times this amount. Thus when the plane can t be filled the airline almost always loses money.

he Need For Hubs

Connecting hubs work by effectively growing a local market by br nging in people from other locations. Delta can launch a long-haul fl ght from Atlanta and fi l the plane not only with people from Atlanta but also with people from dozens of other cities that arrive n time to meet the plane in Atlanta. Without those connect ons the local demand may not be big enough to f ll the large plane n most weeks of the year. This gets even less risky with connections at both ends which is why all arcos have been good for larger airlines. Delta can br ng in dozens of cit es to meet te Atlanta flight and when the plane lands n Amsterdam customers have easy connection options to more cities on KLM.

There are two financial challenges with this hub structure though. First the flights that bring customers to he hub must be profitable on the r own. W thout this the long-haul fl ght may be profitable because it is full but the losses incurred to f ll it would be prohibitive. This is often why long-haul fl ghts from smaller or secondary hubs have not generally been successful. Second the nature of the hub requires a big build up of people and a lot of facilit es to accomodate a lot of planes n one place for a short per od of time. These "banks" of fl ights are rela vely act vity but when all the planes leave there s not much to do until the next bank. This makes for higher costs because of the lower util zation of people and fac lities.

Fewer Wide Body Aircraft Are Needed

Smaller narrow-body aircraft with longer range like the Airbus A321LR (Long Range) have made it possible for some longer fl ights with fewer connections at either end or even flying point-to-point with no connections. Delta has used older Boeing 757s in this way as well. The efficiency of these a rcraft reduce the need for as many wide-body aircraft.

Addit onally any reasonable scenar o of air demand recovery recognizes that long-haul travel is the least certain to return quickly or completely. This means that most true point-to-point flights wi l not return and a rlines like IAG s Level will likely not succeed. With fl ights only operating to and from larger connect ng hubs there are fewer needs for wide-body aircraft.

The net result s that narrow-body aircraft which have always far outsold wide-body a rcraft in numbers w ll become even more dominant. Manufacturers suppliers MROs and everyone in the industry should be plann ng for a world with fewer wide-body aircraft.

Follow me on LinkedIn. Check out my website.

Press Release No: 66

Date: 4 October 2021

Net-Zero Carbon Emissions by 2050

Translations:

Élimination des émissions nettes de carbone d'ici 2050 (pdf)
Zero emissão líquida de carbono até 2050 (pdf)
Cero emisiones netas de CO2 en 2050 (pdf)
国际航协：2050年实现净零碳排放 (pdf)

Boston - The International Air Transport Association (IATA) 77th Annual General Meeting approved a resolution for the global air transport industry to achieve net-zero carbon emissions by 2050. This commitment will align with the Paris Agreement goal for global warming not to exceed 1.5°C.

"The world's airlines have taken a momentous decision to ensure that flying is sustainable. The post-COVID-19 re-connect will be on a clear path towards net zero. That will ensure the freedom of future generations to sustainably explore, learn, trade, build markets, appreciate cultures and connect with people the world over. With the collective efforts of the entire value chain and supportive government policies, aviation will achieve net zero emissions by 2050," said Willie Walsh, IATA's Director General.

Achieving net zero emissions will be a huge challenge. The aviation industry must progressively reduce its emissions while accommodating the growing demand of a world that is eager to fly. To be able to serve the needs of the ten billion people expected to fly in 2050, at least 1.8 gigatons of carbon must be abated in that year. Moreover, the net zero commitment implies that a cumulative total of 21.2 gigatons of carbon will be abated between now and 2050.

A key immediate enabler is the International Civil Aviation Organization's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). This will stabilize international emissions at 2019 levels in the short-to-medium term. Support for this was reaffirmed in today's resolution.

Industry-wide Collective Efforts:

The path from stabilizing emissions to emissions reductions will require a collective effort. All industry stakeholders, including governments must each individually take responsibility to address the environmental impact of their policies, products, and activities. And they must work together to deliver sustainable connectivity and ultimately break aviation's dependance on fossil fuels.

"Achieving sustainable global connectivity cannot be accomplished on the backs of airlines alone. All parts of the aviation industry must work together within a supportive government policy framework to deliver the massive changes that are needed, including an energy transition. That is no different than what we are seeing in other industries. Road transport sustainability efforts, for example, are not being advanced by drivers building electric vehicles. Governments are providing policies and financial incentives for infrastructure providers, manufacturers and car owners to be able to collectively make the changes needed for a sustainable future. The same should apply to aviation," said Walsh.

The Plan

The strategy is to abate as much CO2 as possible from in-sector solutions such as sustainable aviation fuels, new aircraft technology, more efficient operations and infrastructure, and the development of new zero-emissions energy sources such as electric and hydrogen power. Any emissions that cannot be eliminated at source will be eliminated through out-of-sector options such as carbon capture and storage and credible offsetting schemes.
"We have a plan. The scale of the industry in 2050 will require the mitigation of 1.8 gigatons of carbon. A potential scenario is that 65% of this will be abated through sustainable aviation fuels. We would expect new propulsion technology, such as hydrogen, to take care of another 13%. And efficiency improvements will account for a further 3%. The remainder could be dealt with through carbon capture and storage (11%) and offsets (8%). The actual split, and the trajectory to get there, will depend on what solutions are the most cost-effective at any particular time. Whatever the ultimate path to net zero will be, it is absolutely true that the only way to get there will be with the value chain and governments playing their role," said Walsh.

The resolution demands that all industry stakeholders commit to addressing the environmental impact of their policies, products, and activities with concrete actions and clear timelines, including:

- Fuel-producing companies bringing large scale, cost-competitive sustainable aviation fuels (SAF) to the market.
- Governments and air navigation service providers (ANSPs) eliminating inefficiencies in air traffic management and airspace infrastructure.
- Aircraft and engine manufacturers producing radically more efficient airframe and propulsion technologies; and
- Airport operators providing the needed infrastructure to supply SAF, at cost, and in a cost-effective manner.

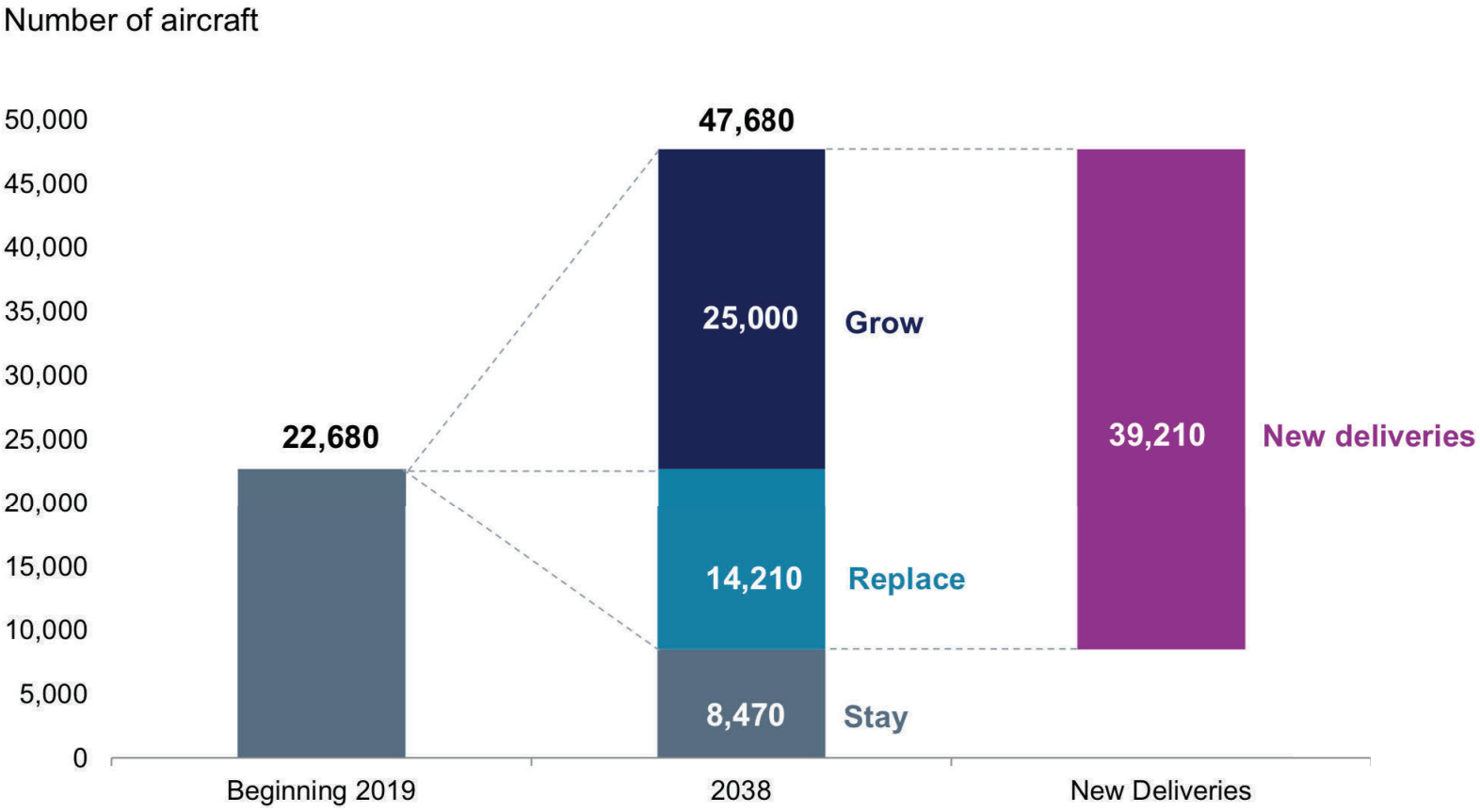
The Role of Governments

The energy transition needed to achieve net zero must be supported by a holistic government policy framework focused on realizing cost-effective solutions. This is particularly true in the area of SAF. Technology exists, but production incentives are needed to increase supply and lower costs.

The resolution calls on governments through ICAO to agree a long-term goal equivalent to the industry's net zero by 2050 commitment. In line with the longstanding approach to managing aviation's climate change impact, the resolution also called for governments to support CORSIA, coordinate policy measures and avoid a patchwork of regional, national, or local measures.

"Governments must be active partners in achieving net zero by 2050. As with all other successful energy transitions, government policies have set the course and blazed a trail towards success. The costs and investment risks are too high otherwise. The focus must be on reducing carbon. Limiting flying with retrograde and punitive taxes would stifle investment and could limit flying to the wealthy. And we have never seen an environment tax actually fund carbon-reducing activities. Incentives are the proven way forward. They solve the problem, create jobs and grow prosperity," said Walsh.

36% of new deliveries for replacement, 64% for growth



Notes: Passenger aircraft (≥100seats), Freighters (>10t) | Rounded figures to nearest 10
Source: Airbus GMF 2019

AIRBUS

ARCADIS Design & Consultancy for natural and built assets

ARCADIS GUIDANCE TO THE CIVIL AVIATION AUTHORITY ON HEATHROW EXPANSION PROGRAMME

HEATHROW AIRPORT LIMITED MASTERPLAN REVIEW

STEP 0 REPORT - FINAL

OCTOBER 2019

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STEP 0 REPORT

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GLOSSARY

Abbreviation	Description
ADRM	Airport Development Reference Manual
ANPR	Automatic Number Plate Recognition
ANPS	Airports National Policy Statement
ATET	Around the End Taxiways
ATMs	Air Transport Movements
ASD	Airport Supporting Development (essential for safe and efficient operation of the airport)
ATP	Automated Ticket Presentation
BA	British Airways
BAA	British Airports Authority
CAA	Civil Aviation Authority
CAPEX	Capital Expenditure
CBS	Cost Breakdown Structure
CRA	Cost Risk Analysis
CDG	Paris Charles de Gaulle Airport
DCO	Development Consent Order
DDS	Design Day Schedules
DfT	Department for Transport (UK)
EASA	European Aviation Safety Agency
EEA	European Economic Area
EfW	Energy from Waste
GSE	Ground Service Equipment
HAL	Heathrow Airport Limited
HEP	Heathrow Expansion Programme
HSPG	Heathrow Strategic Planning Group
IATA ADRM 10	IATA Airport Development Reference Manual 10th Edition
ICAO	International Civil Aviation Organization
IDT	Integrated Design Team

Abbreviation	Description
IFS	Independent Fund Surveyor
JFK	John F. Kennedy International Airport
LoS	Level of Service
mppa	million passengers per annum
NA	Not Available
NATS	National Air Traffic Service
NWR	North West Runway (The 3rd runway as part of the Preferred Masterplan option)
OLS	Obstacle Limitation Surfaces
Oneworld	Refer Appendix B
OPEX	Operating Expenditure
PHP	Peak Hour Passengers
pph	Passengers per hour per lane
PT	Public Transport
RAG	Red; Amber; Green
RICS	Royal Institution of Chartered Surveyors
RWY	Runway
SkyTeam Alliance	Refer Appendix B
Star Alliance	Refer Appendix B
TAAM	Total Airspace and Airport Modeler
TfL	Transport for London
TN	Technical Note
Totex	Total Expenditure
Tph	Trains Per Hour
TWY	Taxiway
T5N	Terminal 5 North
UK	United Kingdom

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EXECUTIVE SUMMARY

Arcadis has undertaken a review to assess whether Heathrow Airport Limited (HAL) has put forward a Preferred Masterplan that is operable, deliverable, timely, reasonable and reliably costed and in the interest of consumers.

Our review has concluded that the Preferred Masterplan has been well developed and is technically compliant in meeting the requirements of the ANPS to deliver additional runway capacity at Heathrow by 2030.

At this moment in time, some detailed elements of the plan will not be fully developed but this is not unexpected for a scheme of this size or complexity. It is noted that HAL's approach has been diligent and they have engaged with stakeholders and consumers throughout the development process.

Arcadis' Key Findings

Operable:

- HAL has undertaken the appropriate level of detail to assure the proposed infrastructure will meet the operational demands placed on it at **Step 0**;
- The integration of the new infrastructure with the existing airport operation is feasible and is unlikely to conflict with current operations;
- HAL has demonstrated the increase in runway capacity will provide more operational flexibility and resilience; and
- HAL is yet to develop detailed Operational Readiness and Trials workstreams which will be key to ensuring a smooth transition without causing any operational issues.

Deliverable:

- HAL's delivery of the elements of the scheme are presented in a logical sequence;
- HAL has sought to deliver the most efficient sequencing with the aim of delivering the new runway by 2026 however this has created a programme that has little margin to allow for delays or risk;
- HAL's programme is not unfeasible however this is reliant on the programme timings set out in the plan to be delivered; and
- HAL will be reliant on other organisations to deliver some of the elements of the scheme which they do not control or can mitigate against. Delays could pose a risk to HAL's own delivery programme.

Timely:

- HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable;
- The current programme includes risk allowances for each component of the masterplan assessed on the basis of industry norms. There is no apparent programme-wide allowance for schedule risk; and
- With such a complex programme involving a significant range of interdependencies, many of which are out of the control of HAL, the objective to deliver an operational runway by 2026 carries a high level of risk.

Cost:

- HAL's Cost Estimate for **Step 0** is reasonably and reliably costed;
- HAL has developed a holistic baseline cost estimate and the approach to the structure and methodology of compiling the Cost Estimate reflects industry best practice; and
- The level of quantification and benchmarking has increased leading to an increased level of cost certainty.

Interest of Consumers:

- HAL continues to engage with consumers to capture insights as part of the masterplanning process to ensure that the interests of consumers are reflected in the Preferred Masterplan.

Arcadis has been appointed as a technical advisor to the Civil Aviation Authority (CAA) to undertake a review of Heathrow's Preferred Masterplan.

Arcadis has been asked to assess the Preferred Masterplan across different timeframes based upon the "Step" process utilised by Heathrow Airport Limited (HAL) throughout the masterplan development process.

These 'Steps' are in alignment to the "Phases" included in the single Preferred Masterplan released as part of the Airport Expansion Consultation on 18th June 2019.

***Step 0** is aligned to **Phase 1** that represents infrastructure required on the runway opening day, anticipated to be in 2026.*

*Arcadis has not been asked to undertake an assessment that is aligned to **Phase 2** for 2030 that is a specified year in the Aviation National Policy Statement (ANPS) for public transport mode share.*

***Step 3** is aligned to **Phase 2a** that represents the infrastructure requirement to meet 700,000 ATMs and 122.5mppa by the year 2033.*

***Step 8** is aligned to **Phase 4** where by 2050, the capacity at Heathrow is expected to be 142mppa.*

This **Step 0** report has assessed whether HAL's Preferred Masterplan and associated infrastructure required for the runway opening day in 2026 can deliver expansion in a manner that is operable, deliverable, timely, reasonably and reliably costed and is in the interest of consumers.

Two further reports will consider the delivery of expansion at **Step 3** and **Step 8** against the same objectives of this review.

Our assessment has been based on workshop and presentation sessions held between the CAA and HAL teams, and the review material provided by HAL. As part of the assessment process, Arcadis has raised queries with HAL based on these workshops, presentations and material. In addition, Arcadis has undertaken independent benchmarking assessments

It is worth noting that the meetings to date with HAL have been of a productive nature and the exchange of information and response to queries has in general been direct and forthcoming. Arcadis appreciates that some information that HAL has used to develop their Preferred Masterplan is commercially sensitive and access to this has been limited.

Report Themes

This report considers whether HAL's Preferred Masterplan proposal is:

- Operable;
- Deliverable;
- Timely;
- Reasonably and Reliably Costed; and
- In the Interest of Consumers.

All of the above themes are assessed in detail in separate chapters. The theme relating to 'In the Interest of Consumers' is assessed in all of the other themes and is concluded substantively in the last chapter of this report.

Operability

Heathrow is a live operational environment and the existing airport has to be able to function unhindered during the construction phases. To achieve this, airport operations must be maintained during the development of the proposed infrastructure and facilities. The development phases must also integrate into existing airport infrastructure.

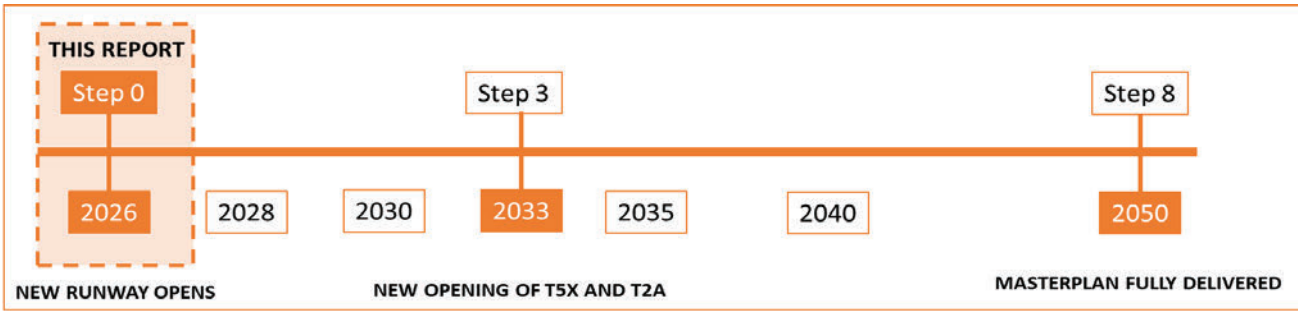
Arcadis has assessed both the design and the programme of the Preferred Masterplan to assess the operability of the airport from the existing situation to **Step 0** that takes the expansion up to the opening of the new 3rd runway.

Summary

Arcadis has undertaken its assessment using the information provided by HAL either directly or out in the public domain that takes the scheme to **Step 0**. The Preferred Masterplan sets out the infrastructure requirements up to **Step 0** using clearly developed capacity assessments of the airside, terminal and landside facilities.

Arcadis has analysed these assessments and is satisfied that HAL has undertaken the appropriate level of detail to assure the proposed infrastructure will meet the operational demands placed on it at this step of the development.

Arcadis has considered the level of flexibility and resilience that will be in place at **Step 0**. On the basis that the information provided by HAL has demonstrated the airport can adequately provide for the growth in passenger numbers and the increase



in runway capacity will provide more operational flexibility and resilience.

Arcadis acknowledges that HAL has used the masterplanning process to also look at today's operation and to take the opportunity to remove existing Airfield Hotspots. In addition, HAL is seeking to introduce taxiways around the end of runways (Around the End Taxiways (ATETs)) that will increase the flexibility of runway operations and be the first purpose built for this purpose incorporating international standards in a UK context.

Arcadis has identified potential challenges that may arise at **Step 0** in Landside areas if passenger mode choice is unchanged through some of the Surface Access Strategy work proposed by HAL.

If HAL cannot deliver the shift in mode share to public transport, there may be a greater demand on parking and forecourts than anticipated which could cause delays and congestion at the airport. However, at this stage in the masterplan process the level of detail required to assure the plan is not yet fully developed.

Arcadis is satisfied that the assimilation of the new infrastructure with the existing airport operation is feasible and is unlikely to conflict with current operations. HAL is yet to develop detailed Operational Readiness and Trials workstreams which will be key to ensuring a smooth transition without causing any operational issues.

Notwithstanding Arcadis' opinion that the Preferred Masterplan at **Step 0** will be operable, the challenges of deliverability, timeliness and cost still present the scheme with some challenges to open the new runway by 2026.

Delivery

The delivery of such a large and complex infrastructure project requires HAL to develop a delivery plan that is phased in a logical, feasible manner and has a robust programme for delivery taking into account the risks associated with it.

Arcadis has reviewed the Preferred Masterplan material to assess whether **Step 0** is deliverable and how new and impacted facilities will link with existing infrastructure and how HAL will maintain key assets during construction phases of delivery.

Summary

Arcadis has assessed the key elements required for the delivery of the new runway from the existing airport operation to 2026, **Step 0**.

It is clear from the significant amount of work that HAL has undertaken that the sequencing and multiple elements of the scheme are presented in a logical and well thought out sequence.

Arcadis has seen evidence that HAL has sought to deliver the most efficient sequencing to aim to deliver the new runway by 2026. This efficiency has however created a programme that has elements that HAL does not have direct control over that could create little margin for delays or risk.

HAL has undertaken a Quantitative Schedule Risk Analysis (QSRA) assessment of the proposed schedule, with respect to schedule integrity. This assessment resulted in a P value of [redacted], indicating a [redacted] likelihood of achieving the schedule. Arcadis recognises that this reflects a schedule that has been designed to deliver the new 3rd runway at the earliest possible opportunity. Arcadis has not reviewed the likelihood of any alternative runway opening dates as part of this review.

Although it is not unfeasible that this programme and sequencing for the delivery of the required infrastructure is achievable, this is reliant on the programme timings set out in the plan to be delivered on time.

Arcadis has identified a number of deliverability challenges that, although achievable to meet the ANPS target of 2030, could only be deliverable by 2026 if no significant delays take place in the programme.

The challenge presented by the development of a Preferred Masterplan is about creating the space and then using that space to deliver a new runway and the associated infrastructure. This involves a significant amount of clearance of existing assets as well as undertaking a very significant number of earthworks to enable construction to proceed.

Much of this work is outside of the airport's existing boundary and will be reliant on gaining the appropriate consents, acquiring land and working with other agencies or organisations. This could create a level of risk to the programme that HAL may not be able to mitigate.

It is clear from the evidence that HAL has undertaken a significant amount of planning in connection with logistics and the use of off-site hubs that are a mitigation to some of the delivery risks identified.

As well as off-site hubs, HAL has sought to develop its procurement strategy to ensure it has mitigated the supply chain risks associated with delivering such a complex programme.

Timing

The success of delivering expansion at Heathrow is predicated on the fact that the planned deliverables for each step can be provided in accordance with the specified duration in the programme and the dates and deadlines detailed.

Arcadis has assessed whether the Preferred Masterplan can be delivered in a timely manner. In doing so, consideration has been given to the risks to delivery and what the potential impact of failing to provide for the relevant deliverables does to the programme.

The review has considered the strategies HAL has developed to mitigate risks and any subsequent

impacts from failure to deliver in a timely manner, with consideration for interdependencies

Summary

Arcadis considers that the overall Preferred Masterplan programme schedule is at the level of detail required for a programme of this scale at this stage of the development process.

HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable.

The assessment by Arcadis highlights that whilst the activities controlled by HAL can probably be delivered within the timescales indicated in the masterplan programme, the overall sequence necessary to deliver an operational runway by 2026 are dependent on the timely completion of activities that are outside of the control of HAL. For example, the masterplan assumes that the DCO will be resolved within statutory timescales.

Furthermore, whilst individual elements of the masterplan include risk allowances based on benchmarks, there is little programme-wide contingency. With such a complex programme involving many critical interdependencies, the objective to deliver an operational runway by 2026 is associated with a high level of risk.

Arcadis can see from the evidence that HAL has undertaken the appropriate level of work in developing its plans and is confident that the approach used would allow HAL to achieve the ANPS target for increased runway capacity by 2030.

Although HAL has indicated that they could mitigate some of the potential delays through re-phasing and moving around work elements within the programme, the key consequence of delays to the delivery of the runway or re-scheduling of works is likely to be an increase in costs and a risk of not achieving the 2026 date.

In the report we highlight four areas where we believe that HAL is particularly reliant on positive programme outcomes to deliver the 2026 operational date:

- Dependency on the timing of the DCO;
- Delivery of enabling infrastructure (e.g. A4 relocation);
- Earthworks schedule; and
- Operational readiness.

Cost Estimate

A high-level summary of the Cost Estimate is detailed in the Table 1. A breakdown of the Task Orders contained in the **Step 0** report are detailed in Section 5. All costs within HAL's Cost Estimates are based on Q3 2014 prices.

The Risk Reserve detailed in Table 1 is HAL's assessment of programme level risk. Risk allocation related to the Task Orders is contained as contingency and is included in the Direct and Indirect Costs in Table 1.

[redacted]

Arcadis has assessed whether the capital expenditure of the Preferred Masterplan phase for **Step 0** has been reasonably and reliably costed in relation to its design and programme.

Arcadis has reviewed HAL's approach to the Cost Estimate and process for development and has assessed the certainty and reliability of the Cost Estimate, including quantification, pricing and confidence in costs, the application of on-costs and HAL's approach to risk.

The review has observed that the level of maturity within the Cost Estimate, including the robustness of the evidence provided by HAL, in relation to its Preferred Masterplan and associated cost is appropriate for the current stage of the programme.

Arcadis has not reviewed property valuations as part of this review, and due to the confidential nature of the property cost estimate a breakdown of these costs is not available as part of this report.

Summary

It is Arcadis' opinion that on balance, HAL's Cost Estimate for **Step 0** is reasonably and reliably costed.

HAL has taken on board Arcadis's comments from previous reports regarding the structure of the Cost Estimate and produced a comprehensive document capturing all the relevant Cost Estimate data in one singular, well integrated, document.

The structure of the Cost Estimate reflects industry best practice standards and forms a good baseline on which to move forward. This can now form the basis on which to monitor and implement a change control process.

The structure of the Cost Estimates for each Task Order (TO) provides a standard platform for approaching the estimate and reflects best practice with how HAL has approached the quantification and pricing of direct and indirect costs

The level of quantification within the detailed estimates reflects the level of detail provided by HAL. The extent of quantification has increased since the Purple Book and the reliance on

allowances reduced which leads to an increased level of certainty.

Whilst HAL has reflected schedule risks in their risk models Arcadis is of the opinion that due to the ambitious and optimistic programme, as discussed in Sections 3 and 4 of this report, there remains further risk on the programme which could have an inherent risk on the Cost Estimate and the associated risks realised. The Cost Estimate is currently based on a risk percentage, the level of which has been reviewed against the Quantitative Cost Analysis.

Interest of Consumers

For the purpose of this report 'consumers' are defined as both passengers and users of the cargo users at the airport.

To review HAL's Preferred Masterplan with regards to the interest of consumers Arcadis has considered how HAL has acquired consumer insight and how well HAL has incorporated consumer insight into their masterplan development process.

This review will be building upon a previous Arcadis report submitted in December 2018, '*An initial review of consumer interests in the development of the HAL Masterplan*'.

Summary

Although not explicitly considered as part of this report, Arcadis has continued to see examples where the interests of consumers are being tested through the development of the Preferred Masterplan.

In considering elements that are valued by consumers, the development of the infrastructure seeks to ensure that the existing airport operation can function whilst this phase of construction is taking place.

In addition, some of the work seen by Arcadis is seeking to increase the flexibility of the airport and ensure there is sufficient resilience available to cope with operational challenges.

HAL is seeking to minimise disruption for both consumers and the local community. HAL has spent a significant amount of effort to develop its delivery programme in a logical sequence to reduce the impact the works will have on both these groups.

In **Step 0**, there are no direct infrastructure improvements being proposed to support cargo users. However, there is evidence that HAL is actively engaging with the cargo community to develop improvements that will be delivered in future steps of the masterplan.

The majority of infrastructure improvements will benefit the consumers at Heathrow. The increase in runway capacity and on-going capacity improvements should contribute to delivering a scheme that is in the interest of consumers.

1 INTRODUCTION

Arcadis has undertaken a review of the Heathrow Airport Expansion Programme (HEP). This section sets out the objectives and approach to the key areas of focus Arcadis has adopted in compiling the report.

The steps taken by Arcadis to gather the relevant supporting information from HAL and other stakeholders have been identified and outlined in this section.

1.1 Background

Arcadis has been appointed by the Civil Aviation Authority (CAA) to provide technical advice in support of their work on capacity expansion at Heathrow Airport.

As part of this process Arcadis is undertaking a review of the Heathrow Airport expansion plans as detailed in their Preferred Masterplan published in June 2019. The Preferred Masterplan will act as part of Heathrow Airport Limited's (HAL) application for a Development Consent Order (DCO). HAL's application for a DCO is anticipated to be submitted in 2020. The DCO, if granted, will contain the relevant permissions for building and operating an expanded Heathrow.

The Preferred Masterplan comprises of four phases. Each phase indicates the predicted annual passenger throughput, air traffic movements (ATMs) and the infrastructure enhancements required to accommodate this growth.

The phases represented in HAL's Preferred Masterplan are split into sub-phases. Previously the phases and sub-phases were identified as 'Steps'.

Preferred Masterplan Phases					
Phase	**Step**	**Year**	**Passengers (mppa)**	**ATMs (000s)**	**Infrastructure**
1	**0**	**2026**	[redacted]	[redacted]	[redacted]
1a	1	2028	[redacted]	[redacted]	[redacted]
2	2	2030	[redacted]	[redacted]	[redacted]
2a	**3**	**2033**	[redacted]	[redacted]	
3	4	2035	[redacted]	[redacted]	[redacted]
3a	5	2040	[redacted]	[redacted]	[redacted]
3b	6	2040+	[redacted]	[redacted]	-
3c	7	2040+	[redacted]	[redacted]	-
4	**8**	**2050**	[redacted]	[redacted]	[redacted]

Table 2 Preferred Masterplan Phases
Source: (01 Masterplan Briefing - HAL May 2019), (04 Forecasting and Capacity - HAL 2019)

Arcadis has been tasked with reviewing three key steps throughout the entire process: **Step 0, Step 3** and **Step 8**.

Arcadis' review of HAL's Preferred Masterplan will take the form of three reports. This approach has been approved by the CAA.

Step 0 Report (this report): Reviews the Preferred Masterplan with a focus on the requirements to open the 3rd runway in 2026 providing a capacity of 95mppa.

Step 3 Report: Reviews the requirements to achieve a capacity expansion of 122mppa using 2033 as the indicative point that this number of passengers will be processed.

Step 8 Report: Reviews the requirements up to the planned completion of the expansion programme with a date point of 2050, achieving a capacity of 142mppa.

1.2 Objectives

Our review of HAL's Preferred Masterplan considers whether the proposal is:

- Operable;
- Deliverable;
- Timely;
- Reasonably and Reliably Costed; and
- In the Interest of Consumers.

All of these themes are assessed in detail through the reports in separate chapters. The theme relating to 'In the Interest of Consumers' is featured in all of the chapters and is concluded substantively in the last chapter of the **Step 0** report.

This report focuses on analysing the themes as part of the **Step 0** proposals linked to the opening of the 3rd Runway. Steps 3 and Step 8 will be addressed in future reports.

When conducting our review, we have focussed on the following key technical areas, including elements of capex:

- Airfield;
- Terminals and Satellites;
- Landside;
- Surface Access; and
- Other key components including enabling works.

All the above key technical areas have been reviewed from the perspective of the themes identified. The scope of our review with regards to each theme is described in the following sections.

1.2.1 Operability

The airport will remain open during the construction phases. To achieve this, airport operations must be maintained during the development of the proposed infrastructure and facilities. The development phases must also integrate into existing airport infrastructure.

Arcadis has assessed both the design and the programme of the Preferred Masterplan to assess the operability of the airport from the existing situation to **Step 0** that takes the expansion up to the opening of the 3rd runway.

Arcadis's assessment includes analysis on the following:

- The impact the Preferred Masterplan has on existing and future airport operations, including: Airfield, Terminals, Landside & Surface Access;
- Analysis of the operability of the plan with regards to complex issues including configuration, flexibility and resilience;
- Testing the reliability of forecasts and evaluating assumptions made by HAL;
- Reviewing the detail and calculations behind capacity assessments produced by HAL;
- The anticipated impact on existing consumers and operating airlines; and
- Observed level of maturity with regards to airport operations in the future.

1.2.2 Delivery

Arcadis has reviewed the Preferred Masterplan material to assess whether **Step 0** is deliverable. Our review has considered the following:

- The scope, design and programme;
- Feasibility of construction and ongoing airport operation during construction;
- Scope gap in deliverables, including the robustness of the programme for delivery and any risks associated with it;
- How new and impacted facilities will link with existing infrastructure and how HAL will maintain key assets during construction phases of delivery;
- The appropriateness of the detail provided in Project Management Plans and Programmes;
- The observed level of maturity with regards to deliverability; and
- Evidence that the single Preferred Masterplan and future development of the masterplan to DCO submission are adequately considered and appropriate for DCO award.

Some of these issues will be discussed in more detail in further reports as their impact on the deliverability of the scheme in **Step 0** is minimal.

1.2.3 Timing

This report assesses whether the single Preferred Masterplan at **Step 0** can be delivered to the anticipated timelines. Our analysis considers the following:

- Evidence that the single Preferred Masterplan and planned deliverables for each step can be provided in accordance with the specified duration in the programme and the dates and deadlines detailed;
- The risks to providing the relevant deliverables in accordance with the current specified duration in the programme and/or on the dates and deadlines detailed;
- The potential effect on overall programme durations of requirements that are not directly controlled by HAL, including the DCO and consent for the Energy from Waste (EfW) Plant.
- The impact of failing to provide for the relevant deliverables in accordance with the current specified duration in the programme;
- What strategies have been developed to mitigate risks and any subsequent impacts from failure to delivery in a timely manner, with consideration for interdependencies; and
- Evidence that the single Preferred Masterplan and future development of the masterplan to DCO submission are adequately considered and appropriate for DCO award.

1.2.4 Cost Estimate

Arcadis has assessed whether the capital expenditure of the Preferred Masterplan phase for **Step 0** has been reasonably and reliably costed in relation to the design and programme provided in the single Preferred Masterplan.

Arcadis' study has reviewed HAL's approach to create and develop the Cost Estimate of their masterplan, including:

- Review of approach to Cost Estimate and process for development and future development, amendments to Cost Estimate based on progress, assessment of progress and amendments to date;
- Scope gap review;
- Accounting for inflation; and
- Any corresponding impact with Opex and/or Totex.

Arcadis has assessed the certainty and reliability of the Cost Estimate, including:

- Quantification of costs (assessing the amount measured, the basis of the measurements and the extent of the work where quantification has not yet been undertaken);
- Pricing and confidence in costs (total, measured, assessed, benchmarks);
- Application of on-costs; and
- Approach to risk.

In addition, Arcadis has observed the level of maturity within the Cost Estimate. This includes:

- The robustness of evidence provided by HAL in relation to its single Preferred Masterplan and associated cost; and
- The integration of Cost Estimate with other elements of the single Preferred Masterplan such as; design, procurement, programme, logistics, external and mitigating factors, project specifics.

1.2.5 Interest of Consumers

For the purpose of this report 'consumers' are defined as both passengers and cargo operators of the airport.

To review HAL's Masterplan with regards to the interest of consumers Arcadis has considered the following:

- HAL's process for acquiring consumer insight
- The relevance of the information and the utilisation of customer insight;
- How well HAL has incorporated consumer insight into their masterplan development process;
- How well HAL's Masterplan reflects the stated and expected interests of existing and future consumers; and
- How well the future development of the masterplan reflects the interests of consumers.

This review will be building upon a previous Arcadis report submitted in December 2018, '*An initial review of consumer interests in the development of the HAL Masterplan*'.

1.3 Review Approach and Key Steps

Arcadis has proposed an approach to this masterplan review to meet the objectives identified above. The approach is aligned with CAA's expectations as agreed in a memo titled *HAL Masterplan Review* submitted by Arcadis to the CAA in July 2019.

The approach, and key steps taken are set out below:

- Arcadis has collected data and assessed all the information provided to it by HAL and has also used its own information and data for benchmarking and industry standards;
- Data and information have been analysed to understand the basis or source of the data. In addition, an assessment of the assumptions and parameters have been checked to ensure any proposed outcomes are aligned with these;
- The proposed technical solutions in the Preferred Masterplan have been reviewed and validated to ensure they meet the required criteria and objectives set;

- The impact of the proposed masterplan on various stakeholders has been considered;
- The delivery sequence and timing of the proposed masterplan has been reviewed;
- A study of the existing infrastructure has been undertaken to understand its link to the proposed facilities;
- The future demand and capacity needs of the expanded airport have been analysed and validated;
- An identification of any gaps in the robustness of the proposed masterplan, and an assessment of confidence in its delivery, have been undertaken;
- An interrogation of capacity assessments/ calculations has been made and these have been validated to ensure their alignment to expectations; and
- A review of the direct costs, indirect costs and programme specific costs in the Cost Estimate has been made to determine the appropriateness of quantities, rates, percentage additions and allowances.

In the Interest of Consumers

Although this theme does not have a dedicated chapter as part of this **Step 0** report, Arcadis has considered the consequential impact that the themes will have on consumers and has made the relevant commentary within the theme chapters.

Arcadis has considered:

- To what extent HAL has gathered and utilised consumer insights to develop the masterplan;
- How well HAL has incorporated the interests of consumers into its masterplan development process; and
- Whether the masterplan reasonably reflects the stated and expected interests of existing and future consumers.

This element primarily builds upon the recent Arcadis Report '*An initial review of consumer interests in the development of the HAL Masterplan*' (dated December 2018).

2 OPERABILITY

Arcadis has assessed the **Step 0** proposals from an operational perspective. The impact on airport operations, configuration, flexibility and resilience has been assessed. This includes analysis of airside, terminal and landside infrastructure.

Arcadis has considered the simulation studies, assessed the reliability of forecasts and evaluated assumptions used in determining HAL's models. **Step 0** has also been assessed against industry planning and compliance standards.

Arcadis's key findings are:

- HAL has undertaken the appropriate level of detail to assure the proposed infrastructure will meet the operational demands placed on it at **Step 0**;
- HAL has demonstrated the increase in runway capacity will provide more operational flexibility and resilience;
- The integration of the new infrastructure with the existing airport operation is feasible and is unlikely to conflict with current operations; and
- HAL is yet to develop detailed Operational Readiness and Trials workstreams which will be key to ensuring a smooth transition without causing any operational issues.

2.1 Definition of Theme

This section of the report reviews the operability of **Step 0** and included an overview of the existing airport infrastructure and an analysis of the future infrastructure required to achieve the objectives of the HAL's Preferred Masterplan.

Step 0 corresponds to Phase 1 of the Preferred Masterplan. This step/phase is when the new third runway becomes operational. This is currently anticipated to be 2026. This phase also includes some enhancements to existing facilities to meet the terminal and apron capacity demand.

This section of the report also assessed the assumptions contained within the Preferred Masterplan, considered the compatibility of the proposals with the existing layout of Heathrow Airport and reviewed the adherence to statutory requirements and known constraints.

In this high-level assessment of operability, we have considered the following elements of the Preferred Masterplan:

- Airfield, including the 3rd Runway;
- Terminals;
- Landside; and
- Wider surface access considerations.

As part of the masterplan HAL has completed forecasting and demand analysis. The Arcadis analysis has considered the appropriate metrics, including passenger numbers and aircraft movements, in the review.

2.2 Assessment

2.2.1 Methodology

Our review consists of a high-level assessment of publicly available information and documentation provided to us by HAL at the time of writing this report. This documentation (listed in Table 3) includes a number of reports, presentations as well as a number of reference drawings.

Report Title	Report Source
Heathrow Strategic Brief	HAL – Public Documents
Preferred-Masterplan - June 2019	HAL – Public Documents
Updated-Scheme-Development-Report-Document-1-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-2-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-3-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-4-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-5-of-5	HAL – Public Documents
[redacted]	HAL – Airline Sharepoint
	HAL - Presentations
	HAL - Presentations
	HAL - Presentations
	HAL - Presentations
	HAL
	HAL
	HAL
	HAL – Airline Sharepoint
	HAL – Airline Sharepoint
Cargo Transformation Board pack	CAA

Table 3 Operability Documents Reviewed
Source: (CAA 2019), (HAL 2019)

2.2.2 Overview of Existing Infrastructure

The airport currently operates with a two-runway configuration. The runways are parallel and spaced far enough apart to enable independent parallel approaches. The dimensions of the runways are as follows:

- Northern Runway (09L/27R) – 3,902m x 50m; and
- Southern Runway (09R/27L) – 3,660m x 50m.

The declared capacity of the existing airfield is 88 movements per hour. The airport is currently limited to a total of 480,000 ATMs per year due to a planning condition associated with the construction of Terminal 5.

In the period 1st April 2018 to 31st March 2019, the airport handled 467,000 ATMs which is 98% of the capacity limit and equates to approximately 650 arrivals and 650 departures per day.

The terminal infrastructure at Heathrow consists of four terminals. Terminals 2, 3 and 5 are situated between the runways and Terminal 4 is located to the South of the Southern Runway.

In 2018 the airport handled approximately 80 million passengers per annum (mppa). The following data has been provided by HAL for each Terminal:

- Terminal 2 – [redacted] mppa;
- Terminal 3 – [redacted] mppa;
- Terminal 4 – [redacted] mppa; and
- Terminal 5 – [redacted] mppa.

The terminal facilities have surface access links for both private vehicles and public transport. The surface access infrastructure consists of adjacent vehicle forecourts, short stay car parks, road links to the motorway network and public transport interchanges for coaches, local buses, London Underground, and taxis.

2.2.3 Background of Current Operations

2.2.3.1 Airfield

Runways

The existing two runways at Heathrow are 3,902m x 50m and 3,660m x 50m. The runways are separated by 1,425m between centrelines. This allows for independent parallel approach. The runways are designed to operate the largest commercial aircraft, categorised as Code F by European Aviation Safety Agency (EASA) standards, which have a wingspan of up to 80m wide.

The runways are generally operated in segregated mode – landing aircraft are allocated to one runway and departing aircraft to the other. At specific times of the day when there is a build-up of airborne holding for arriving aircraft, tactical measures such as using both runways for landings can be applied to minimise delays.

Despite the fact the minimum runways separation requirements as per EASA CS-ADR-DSN issue 4 and ICAO Aerodrome Design Manual (Doc 9157) Part 1 Runways are met, there is still a dependency between where air traffic control can position the arrival of an aircraft approaching one runway and an arrival on the other runway. The reasons behind this constraint are related to thresholds, approach categories, approach slopes, CTR Obstacles and abatement procedures. Separation between aircraft needs to be increased which reduces the landing rate on the runways and therefore the overall capacity. Solving the capacity constraint in this respect may impose the upgrade of the approach instruments / equipment and procedures and more advanced radar monitoring techniques.

Heathrow currently utilises its runways in an alternating operation, where they are switched for departing and arriving aircraft. This is done primarily to offer respite to local communities living under the flight paths from noise and overflying of aircraft. During westerly operations, the runways are alternated at 3pm each day. During easterly operations, the legacy of the now rescinded Cranford Agreement which prevented departures over Cranford from the northern runway, prevents runway alternation.

2.2.3.2 Terminals and Satellites

Heathrow has four operational terminals – T2, T3, T4 and T5. Terminal 1 is closed but houses the baggage handling system for T2. Terminal 1 is scheduled for demolition to enable future expansion of T2.

Terminal 2

- T2 opened in 2014;
- The main T2 terminal building is supported by a satellite – T2B;
- T2 is used by Star Alliance members and also by other non-affiliated airlines e.g. Aer Lingus;
- Handled [redacted] million passengers in 2018; and
- Current T2 area – 297,900m^2.

Terminal 3

- T3 is the oldest operational terminal at Heathrow today and opened in 1961;
- T3 is used by Oneworld members, Virgin Delta and SkyTeam;
- Handled [redacted] million passengers in 2018; and
- Current T3 area – 225,780m^2.

Terminal 4

- T4 is the only terminal located outside of the central core of the airport, being situated to the south of the southern runway;
- T4 opened in 1986;

- T4 is used by SkyTeam Alliance members and other non-aligned airlines;
- T4 handled [redacted] million passengers in 2018; and
- Current T4 area – 132,400m^2.

Terminal 5

- T5 opened in 2008;
- T5 is used exclusively by British Airways and Iberia;
- T5 handled [redacted] million passengers in 2018; and
- Current T5 area – 526,000m^2.

2.2.3.3 Landside

Car Parking

HAL has stated that the current car parking facilities for both airport workers and passengers total 67,050 spaces around the airport. This is made up of:

- 42,000, HAL controlled spaces;
- 9,500 off-site (Purple Parking in Southall, Bath Road and other)*;
- 9,300 onsite tenanted spaces;
- 3,100 off-site tenanted spaces;
- 2,700 car hire; and
- 450 taxi feeder park.

The airport has an existing cap of 42,000 spaces as part of the planning consent obtained for Terminal 5.

Of the total 67,050 car park spaces available the following spaces reserved for passengers and staff are:

- 33,000 passenger spaces across short stay, multi-storey and surface car parks including offsite locations;
- 24,800 staff spaces; and
- The remaining spaces are onsite tenanted spaces.

*It should be noted that the 9,500 off-site spaces declared by HAL has significantly decreased since the site being used by Purple Parking has now been redeveloped for housing.

2.2.2.4 Surface Access

Heathrow's baseline 2017 Public Transport mode share is circa. 40%. The mix of Public Transport services at the airport consist of:

- Heathrow Express – 4 trains per hour (tph);
- Piccadilly line – 12tph;
- TfL Rail Service – 2tph; and
- Various bus and coach services from CTA, T5 and T4.

This Public Transport infrastructure is currently not operating at full capacity which gives the airport scope to increase the use of public transport with this existing infrastructure as well as introducing new services such as the recently launched *Guildford Railair* coach as indicated in its plans.

2.2.4 Review of Preferred Masterplan

2.2.4.1 General Overview

The previous sections provided an overview of the infrastructure and operations of the current airport. This provides context for the review of the Preferred Masterplan proposals.

This section follows the overview by providing analysis on the operability of the masterplan proposals. It follows a logical sequence starting with the work HAL has undertaken on traffic forecasting and the design day schedule. This forms the basis of the capacity and design of the masterplan proposals.

The review then focuses on the individual aspects of the **Step 0** proposals, namely airfield, terminal and landside developments.

2.2.4.2 Traffic Forecasting

A fundamental aspect of airport masterplanning is the development of traffic forecasts. This provides the basic assumptions required to plan for the future growth of the airport.

HAL has developed Design Day Schedules (DDS) as part of this process. The DDS is typically used as the basis of designing the future size and capacity of an airport.

From our engagement with HAL, Arcadis has seen examples of the DDS and summaries of the methodology process behind their development. We note references to the [redacted] and [redacted] that documents the schedule generation methodology. Arcadis has not been provided with this documentation.

The DDS examples and extracts that were presented to Arcadis, included the following information:

- Flight and passenger information;
- Load factors;
- Annual passengers;
- Transfer rates; and
- Allocated stands.

The DDS has been used to derive passenger flows, transfer volumes and number of aircraft on the ground. The DDS information has been used for a range of workstreams in the masterplan process. The DDS has been used to inform the following sections of the masterplan:

- Masterplan design;

- Airfield;
- Terminal, satellites, aprons;
- Connectivity (bags and passengers);
- Surface Access;
- Environmental; and
- Utilities.

For example, the data from the DDS has been used in conjunction with the input assumptions for terminal and airside capacity modelling. The DDS suite serves as a single source so that all HAL workstreams use the same data for consistency.

Arcadis has seen evidence that a comprehensive suite of DDS has been developed by HAL. These were initially formulated back in 2015 and have been updated over subsequent years as the masterplan process has progressed.

The initial DDS were developed to match the Airports Commission and were provided for key years (2030 and 2040) with different scenarios, including carbon capped, carbon traded and baseline. These have been updated to account for future traffic, new layouts and phasing years. As a result, the DDS suite has expanded to encompass schedules for additional phasing years and different traffic scenarios such as high and base case.

Table 4 shows that HAL has developed DDS for a number of scenarios including a base and high case up to the opening of the new runway, and a base case and three variations of a high case in the year the third runway becomes operational. It should be noted that HAL has also developed DDS for two runway operations with increased traffic scenarios in the years prior to the opening of the third runway.

Year	Runways	Annual Movements			
		Scenario 1	Scenario 2	Scenario 3	Scenario 4
2018	2	[redacted]			
2022	2				
2023	2				
2024	2				
2025	2				
2026	2				
2027	3				
2030	3				
2035	3				
2040	3				
2045	3				
2050	3				

Table 4 Suite of DDS Currently Available for Use
Source: [redacted])

Based on this information, Arcadis is satisfied that the DDS suite appears comprehensive, providing parameters and assumptions that should aid various disciplines under the masterplan process, such as the terminal and airfield capacity studies.

The provision of schedules for a range of years in the masterplan period, as well as different traffic levels (high and base) indicates that HAL are testing different operating and growth scenarios for the development of the airfield.

The DDS for a two-runway scenario between 2018 to 2026 demonstrates that HAL has considered the operation of the airfield during the development works prior to the opening of the third runway (**Step 0**).

The DDS work appears to be detailed and is an ongoing process as per the Preferred Masterplan and phasing, as well as any layout changes. Arcadis notes that the DDS suite encompasses important years in the masterplan period and a variety of air traffic growth scenarios. To ensure confidence in the validity of the DDS data as an input to the different masterplan interfaces, we recommend that ongoing monitoring of the process is maintained by HAL in order to mitigate any potential risk.

2.2.4.3 Airside

3rd Runway Location

The requirement of the Airports National Policy Statement (ANPS) is that the runway must be at least 3,500m in length and enable an additional 260,000 ATMs per year. The position of the new runway must enable independent runway operations.

The position of the new runway has been through an extensive evaluation process and has been sited in accordance with the ANPS. This review does not revisit the previous study, but HAL has detailed the process in *Document 2* of their *Updated Scheme Development Report*.

The new runway will be separated by 1,035m from the existing Northern Runway, from centreline to centreline. This will enable independent runway operations. HAL has previously stated that further benefits would be realised by separating the runways further apart than 1,035m. However, they have decided against this as greater separation would require further loss of property in Harmondsworth and 1,035m runway separation would be more efficient for ground operations. As a comparison, the centreline separation between the existing Northern and Southern Runways is 1,425m.

Arcadis agree with HAL's assessment with regards to the separation of the new 3rd runway from the existing Northern Runway and believe that a separation of 1,035m (as per the ICAO & EASA requirements) creates the conditions for operations density increase by introducing the independent parallel approaches and departures strategy, leading therefore toward absolute higher probabilities to meet the objectives in the ANSP. However, the delivery of the extra 260,000 ATMs is still subject to modelling which is currently an ongoing process.

3rd Runway Length

Analysis into the appropriate length of the runway was completed during the Airports Commission process. HAL provide a summary of the approach taken to the determine the length of the runway in *Document 2* of their *Updated Scheme Development Report*.

The length of the proposed runway is 3,500m. It will be 60m in width, comprising 45m of runway and 7.5m wide shoulders on either side. This enables Code F operations.

The design of the runway also includes provision of displaced thresholds at both ends. These would be 550m (subject to final NATS/HAL safety case) at each runway end and this is designed to reduce noise impacts from aircraft on surrounding communities.

Runway Infrastructure and System

With the provision of the 3rd Runway, adjustments have been proposed for the two existing runways that will enable independent alternation of flightpaths across the three runways. These adjustments are designed to reduce the impact of aircraft noise on the surrounding community, enable efficient use of taxiways around the end of runways (Around the End Taxiways (ATETs)) and increase the flexibility of runway operations.

ATETs are a type of taxiway with the same characteristics as existing taxiways across the airfield. The only difference is that they are positioned at the end of runways to enable aircraft to taxi from one side of a runway to the other without having to cross an active runway. They are designed to be operated independently of runways and the ATET and the runway can be used simultaneously. Arcadis believes that this will contribute to the more effective operation of the airport and is configured for minimum land take.

On the existing southern runway, a 550m displaced threshold will be introduced. The centre runway (existing northern runway) will have 1,101m displaced thresholds introduced at both ends. Aircraft on approach will be at a higher altitude as they overfly local communities with the aim of reducing noise impact. At the east end of the centre runway, a new 211m starter extension strip will be provided to maintain a 3,500m take off run available as a result of the ATETs located at the western end.

The introduction of the 3rd runway requires changes to the modes of operation. One runway will be dedicated to landing aircraft, one to departures and the other used for landing and departing aircraft in a mixed mode operation. The different modes of operation will be circulated around the three runways to provide periods of respite from aircraft noise for local communities.

Airfield Modelling

Airfield modelling and simulation work has been undertaken for the future runway operations by HAL. This has been undertaken in conjunction with NATS. The modelling software used by HAL is Total Airspace and Airport Modeler (TAAM). TAAM is an industry recognised tool for airfield modelling and it is understood that this has been used for a number of years by HAL. Arcadis is satisfied that this is an appropriate tool to conduct airfield modelling.

HAL has confirmed that the modelling process has included engagement with airlines on a bi-lateral and multi-lateral basis. It is understood that these discussions are confidential but Arcadis is satisfied that the airlines have been involved to provide a further level of verification, debate and analysis to the modelling process.

We have seen evidence that the simulation work has taken into account the daytime mode changes – alternating each runway between landing, departure and mixed mode. Furthermore, simulation has been undertaken for both easterly and westerly runway operations.

From our review of supporting documentation relating to the airfield design provided by HAL, a comprehensive list of modelling assumptions demonstrates that development work and analysis has been undertaken behind the future runway operations and airfield assessments for the masterplan development. The list of modelling assumptions encompasses both airspace and airfield characteristics which relate to aircraft separation, arrival and departure routings, taxiway flows, stand plans, ground movement speeds and the planned runway threshold displacements.

From these modelling assumptions, Arcadis believes that HAL has conducted airfield modelling that accurately replicates the future layout and assumed operation that this might entail. Arcadis has seen select outputs of the airfield modelling work that has been undertaken by HAL which were presented in workshop sessions. The outputs that have been made available indicate airborne delay, arrival taxi time and departure taxi time for different configurations of the runway operating modes.

HAL has not completed modelling for low visibility procedures at this stage but has started initial consideration for understanding the impact on the most complicated areas of the airfield. Arcadis is satisfied that the modelling is sufficiently advanced at this stage and would not expect this level of detail for a masterplan.

Overall, Arcadis is satisfied that HAL has conducted modelling that accurately tests their assumptions and proposed airfield infrastructure. It has been indicated by HAL that airfield modelling is ongoing to further develop the airfield design and test the proposed infrastructure against other scenarios such as low visibility operations and runway outages.

Taxiway System

The taxiway system is thoroughly described in the *Updated Scheme Development Report* produced by HAL in *Chapter 2*, *Document 2*.

The general layout of the current taxiway system consists of dual parallel taxiways assigned to each runway in part connected with nine cross-field taxiways linking north and south areas. Located to the south side of the Southern Runway (09R/27L) are Terminal 4 and the cargo area which are also linked with the whole airport taxiway system.

The new runway will require a taxiway system that connects with the new aprons and terminal as well as with the existing taxiway system. The taxiway system will have to comply with many requirements

to avoid any single points of failure, predictable and reliable respite from noise and compliance to EASA requirements for airfield geometry. In order to meet the above criteria, HAL decided to adopt a detailed scheme development process of optimisation regarding options development and selection.

The current layout of the airfield does not include any taxiways that go around the ends of the runways. All aircraft currently accessing T4 and the cargo area must cross the Southern Runway. The new sections of the airfield are designed to eliminate similar scenarios. Aircraft using the new 3rd Runway will not be required to cross the central runway to reach the rest of the airfield. It is preferable that, following the requirements for taxi time reduction, aircraft using T4 and the cargo area to be assigned the use of the future Centre and South Runways. Longer term, aircraft using T5N will use the new 3rd Runway and the existing Northern Runway.

The Total Airspace and Airport Modeller (TAAM) and Air Traffic Control (ATC) simulator modelling employed by HAL indicates that if aircraft were required to cross the central runway then it would not be possible to deliver the additional 260,000 ATMs as detailed in the NSP.

HAL propose dual Around the End Taxiways (ATETs) on the central runway to prevent aircraft having to cross active runways. These will be located at the west side of the airfield where the majority of the apron capacity is located. Situating the ATETs on this side reduces the overall land take required. This will also provide environmental and operational benefits as it minimises taxi times for aircraft accessing the new runway.

The ATETs will be Code F compliant and therefore compatible with all aircraft sizes using the airport. This provides maximum operational benefits and, as they are dual taxiways, will enable one taxiway to be used for departures and the other for arrivals.

On a localised section of the ATETs, the vertical stabiliser of Code F and some larger Code E (Boeing 7474-8i) aircraft will infringe the take-off climb surface of the obstacle limitation surfaces (OLS) associated with the central runway, as indicated in Figure 1. This will have an impact upon airfield operations whilst Code F aircraft are taxiing in this area. The impact of this could be either airfield operations related restrictions or amendments to aircraft performance (through updates to Type A charts) depending on detailed solutions to be agreed upon with the airlines at the detailed design stage.

However, considering the small proportion of Code F aircraft movements Arcadis does not believe this should have a detrimental impact on safety or capacity. Movement of Code F aircraft in this area will be managed operationally by ATC to comply with airfield operations requirements and maintain the safe movement of aircraft, expected by routeing Code F aircraft on the outer of the two taxiways.

The alternative would be to redesign the airfield with wider spacing between the runway and taxiways. Arcadis believes that this would be excessive and is satisfied that the design proposed is sufficient with regards to safety and operational risks and that HAL has provided a pragmatic solution.

[redacted]

Overall, Arcadis agrees with the location and the design of the ATETs from an operational and airfield safety perspective.

Aprons and Stands

During **Step 0** there is no significant terminal expansion proposed with additional capacity being accommodated within the existing infrastructure. As a result, the apron infrastructure will remain similar to the existing layout. However, additional aircraft stands will be provided on existing airside areas.

Currently, Taxiway Kilo is under construction. The taxiway is located between the now closed Terminal 1 and Terminal 2B, as can be seen from Figure 2. Its completion will provide a new link between the two existing runways. The completion of the taxiway will also allow for additional aircraft parking space (Kilo box stands) either side of the taxiway. Some of these are already operational whilst others are under construction.

Figure 2 Taxiway Kilo and Asocciated Stands
Source: (NATS - AIS 2019)

As part of the 'T5 Plus' scheme, five non-contact stands located at the northern and southern ends of the T5B and T5C satellites will be converted to contact stands. It is expected that the required conversion works would render these stands temporarily unavailable and that during this period, alternative stands should be provided to accommodate any associated shortfall in capacity that may arise on the T5 apron. If the stands are currently used for towing, when aircraft are on the ground for prolonged periods between flights, then we believe that this would not be an issue as these can be accommodated elsewhere, for example in the Eastern Maintenance Base or on the 580s/590 stands.

It is proposed in HAL's *Stand Throughput* report that some or all of stand numbers 580s and 590s, currently located in the middle of the airfield between Terminal 5C and Terminal 3, could be reallocated from T3 to T5.

Arcadis are satisfied that these additions can be provided in an operable manner. The new stands will be accommodated within the existing airside infrastructure.

The *Stand Throughput* document outlines the mppa/stand ratio for the actual and declared capacity in 2018, on a per terminal and total stand basis. For both actual and declared capacity, the mppa/stand ratio is just below 0.5mppa.

At **Step 0**, the proposed additions and re-allocation of stand infrastructure, along with the envisioned capacity, the mppa/stand ratio for the overall airfield is 0.51 mppa. We have undertaken a high-level benchmark of airports which are either operating with three runways or have proposed development of a third runway with passenger throughput similar to the rate that is expected in **Step 0** (see Table 5 below).

For clarity, HAL provide two scenarios (A & B) in the *Stand Throughput* document. The difference between the two scenarios is the allocation of remote stands between terminals and consequently how this corresponds to the mppa/stand figures. However, in each scenario the total number of stands, the overall airport capacity and the overall mppa/stand throughput is constant. Therefore, the analysis in Table 5 accounts for both scenarios.

Our high-level benchmark analysis indicates that the annual passenger to stand ratio in **Step 0** is aligned with similar sized airports operating with or proposing a third parallel runway. It is Arcadis' opinion that the annual passenger to stand ratio is in the upper range. However, based on comparison with similar sized airports, Arcadis is comfortable with the stand throughput proposed by HAL.

Airfield Hotspots

The existing layout has four airfield hotspots as indicated below:

- **HS1 (Links 23, 22 and 21)** – Pilots must maintain a good lookout and are responsible for wing tip clearance;
- **HS2 (SATUN)** – Pilots must maintain a good lookout and are responsible for wing tip clearance;
- **HS3 (Link 28)** – Code F movements must take care. Link 28 East of Taxiway Alpha is not Code F compliant; and
- **HS4 (TWY Y)** – Pilots are to ensure they have clearance to enter the runway before crossing the holding point.

The masterplan process is removing these hotspots by design over a period of time. Arcadis believes using the masterplan process to eliminate the hotspots is a sensible approach to enhancing the safety of the airfield. Arcadis' analysis of the airfield layout does not indicate that any new hotspots will be created.

Cargo Facilities

In 2018, approximately 1/3 of the UK's long-haul export goods moved through Heathrow airport and the airport is the UK's biggest port by value. The main cargo facilities are located to the south of the airport. This infrastructure handles a significant amount of cargo which equates to c. 1.7 million tonnes per annum. This is supported by the large amount of freight and logistics businesses located

Airport	Total No. of Terminals	Annual Pax - based on 3 parallel runways (MPPA)	Total No. of Stands	Annual Pax per Stand (MPPA)	Comments
Heathrow*	4	95.0	186	0.51	
Hong Kong*	3	97.0	160	0.61	Based on three runway system with 3rd runway passenger building (Masterplan 2030)
Singapore Changi*	4	82.0	159	0.52	
Kuala Lumpur	2	70.0	162	0.43	
Munich*	2	61.0	156	0.39	Third runway plans submitted but not pursued during the current Bavaria Coalition Government legislative period (2018 – 2023).
Beijing Capital	3	95.5	171	0.56	

*Third runway proposed or in development

Table 5 Comparison of Heathrow Step 0 Scenario mppa per Stand Ratio
Source: (Arcadis Internal Library 2019)

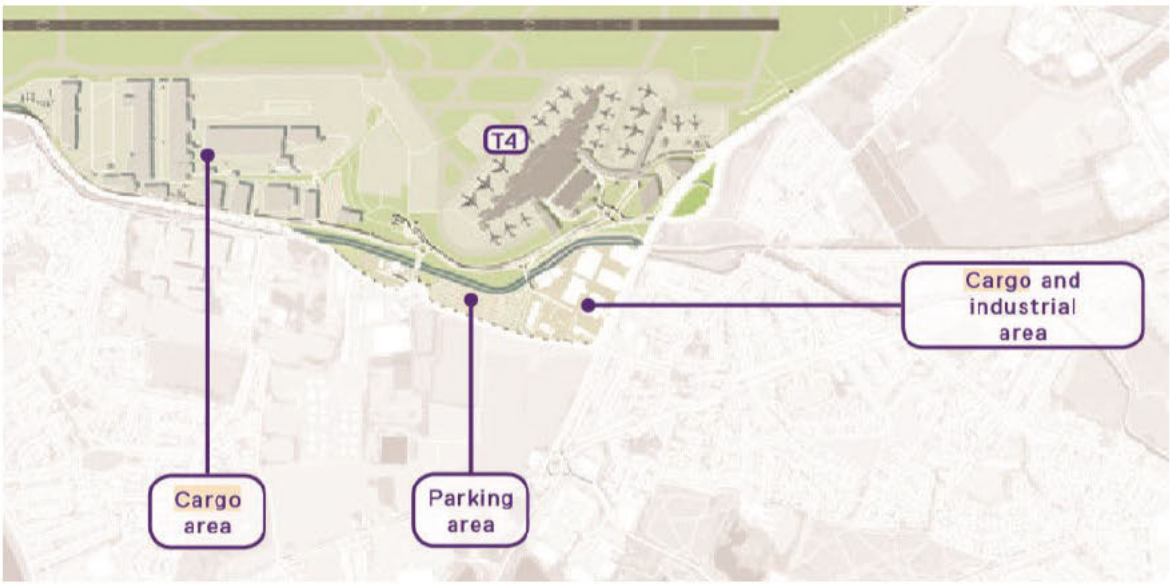


Figure 3 Location of Cargo Terminal and Cargo Related Businesses in the Surrounding Area
Source: (Preferred Masterplan - HAL 2019)

in the surrounding areas of this airport (refer to Figure 3 above).

Arcadis understands that new third runway would permit the growth of cargo volumes to the forecasted demand which is anticipated to reach 3 million tonnes per annum by the year 2040.

The Preferred Masterplan proposes up to 206,000m^2 of additional cargo facilities to support the forecasted demand. The development strategy followed to meet the projected demand comprises of four key criteria:

- Increasing capacity to facilitate the throughput of 3M tonnes per annum;
- Improving performance and efficiency;
- Reducing freight vehicle traffic; and
- Minimising risk of delivery vehicles.

HAL has proposed improvement measures support each of the development strategies. The improvement measures are explained concisely in Table 6.

These infrastructure developments are not proposed to be delivered before 2026 so are not covered in the **Step 0** report. Arcadis aims to undertake a full analysis of the proposed cargo infrastructure in the Step 3 and Step 8 reports.

Air Traffic Control Tower

A second ATC tower is proposed in the masterplan (refer Figure 4). This is positioned adjacent to the hard stands array facing T5XN in the west side.

HAL anticipates that technology may negate the need for a second tower. Therefore, the position of the tower is for safeguarding purposes only should it be required in future.

Arcadis has no information about the height, line of sight or any other parameter in relation to its construction.

From aeronautical point of view the location of the tower must be checked against the height limitations imposed by the Obstacle Limitation

Development Strategy	Improvement Measures
Increasing Capacity To facilitate cargo throughput of 3M Tonnes P.A	• Facilitating growth and intensification of land use on site • Provision of additional capacity thorough development of new cargo terminals / transhipment facilities
Improve performance and efficiency	• Minimising Minimum Connection Times (MCTs) for transiting freight through • Addressing traffic issues at Control Posts • Addressing access issues with Dnata City • Reducing number of touch-points
Reducing Freight Vehicle Traffic	• Consolidation of freight forwarder facilities • Providing excellent airside road links from new apron areas to the cargo areas • Provision of cargo staging areas close to aprons • Provision of transhipment areas
Minimising risk of delivery vehicles using residential roads by	• Developing a truck park with appropriate call forward facilities • Investigate the possibility of an Intermodal / Rail hub for cargo

Table 6 HAL Development Strategy for Cargo
Source: (Cargo Transformation Board pack 2019)

Surfaces provisions – *EASA CS ADR DSN – Chapter H*.

Rescue and Fire Fighting Services

ICAO Document 9137 – Airport Services Manual Part 1 details the regulations and requirements for the fire protection level based upon the air traffic movements at airports. Heathrow Airport is able to provide Rescue and Fire-Fighting Services category A 10 level.

Within the Preferred Masterplan document HAL is declaring a Satellite Fire Station in relation to the 3rd Runway operation positioned in proximity of new THR 27R, east of TXN satellite. The requirement is that the fire service must be able to response to emergencies and reach the runway thresholds within three minutes of a call.

It is noted that the position of the facility may require 90 degree turns when accessing taxiways. ICAO recommends that 90-degree turns should be avoided. However, Arcadis accepts that the level of detail in the masterplan may not show all of the airside roads. We would expect that the design will allow provision for local airside roads to prevent this scenario.

A more centrally located position to the runway would provide a faster response time to the west side of the new 3rd Runway, however, with the competing demands of other airfield infrastructure Arcadis believes the proposed location can provide a compliant solution.

Therefore, Arcadis is satisfied that the location of the fire station can be made compliant regarding emergency response times.

As the masterplan develops the final design of the facility will be determined. This will include items such as the vehicle fleet allocation and the extinguishing agents. Following this, the Emergency Plan will detail the response plan for emergencies and the specific detail regarding equipment and personnel.

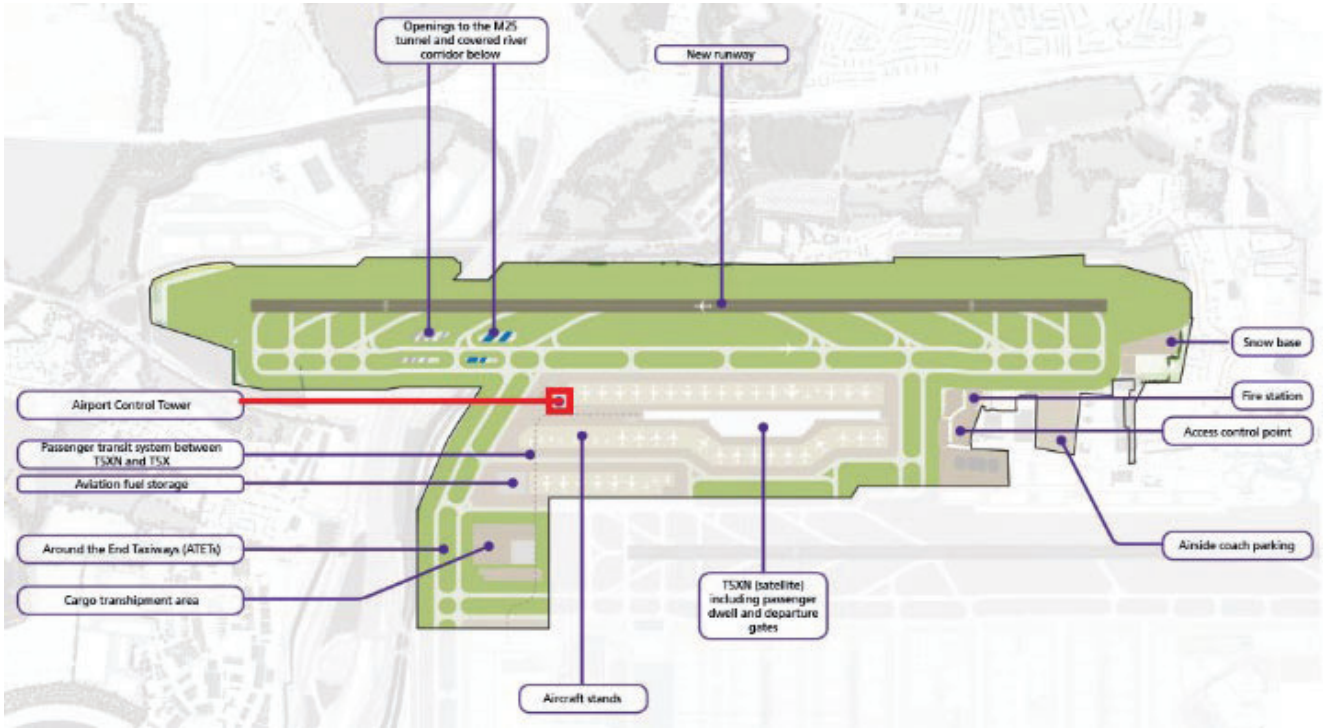


Figure 4 ATC Second Tower Location – 3rd Runway
Source: (Preferred Masterplan - HAL 2019)

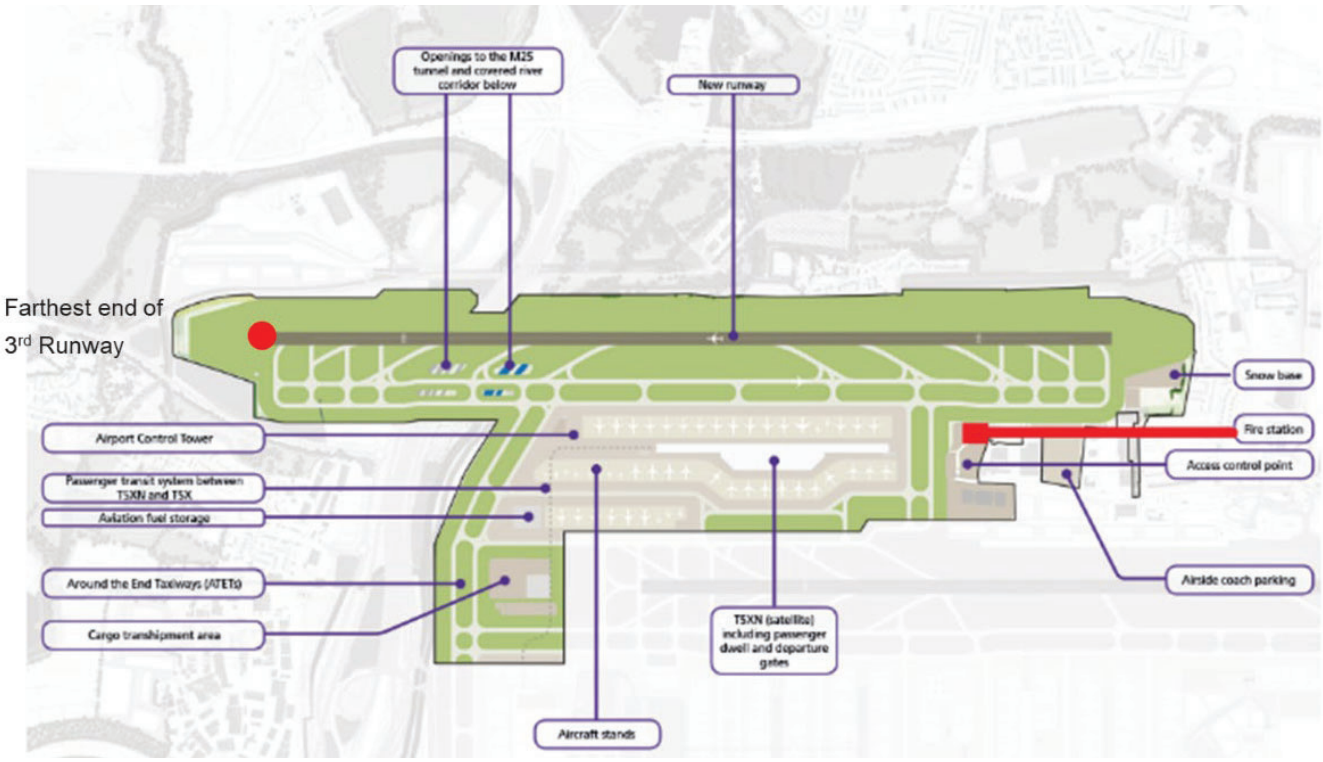


Figure 5 Satellite Fire Station Location
Source: (Preferred Masterplan - HAL 2019)

Fuel Farm

The aviation fuel demand at Heathrow today is [redacted] million litres per day. This is delivered primarily through an extensive pipeline system including the use of rail transport.

Before being pumped through the hydrant systems, the aviation fuel needs a buffer (ground level tanks) in order to ensure a settling period for quality aircraft delivery purposes and in a certain adequate volume aiming to continue to feed the airport in case of supply disruption.

There are two fuel farms at Heathrow today:

- Northern (Perry Oaks) Fuel Farm; and
- Southern (Cargo Zone) Fuel Farm.

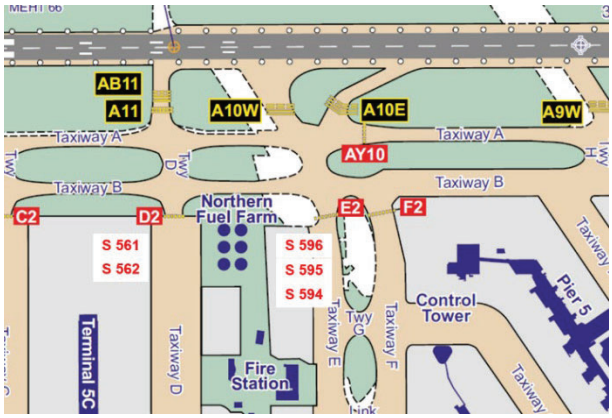


Figure 6 Existing Fuel Farm – Perry Oaks Depot
Source: (NATS - AIS 2019)

The Northern Fuel Farm is located west of Pier 5 Terminal 3, South form TWY B, neighbouring Stands 596, 595,594. (Figure 6).

The Cargo Zone Fuel Farm is located South from TWY S, across Cargo Apron Z (Figure 7).

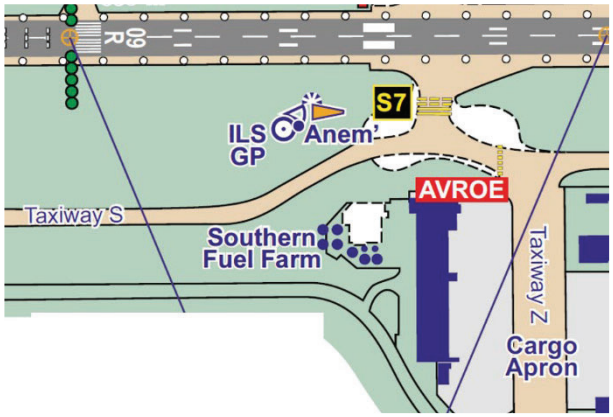


Figure 7 Cargo Apron Fuel Farm
Source: (NATS - AIS 2019)

HAL has evaluated several options for fuel storage facilities development in order to cope with the forecasted 740k ATMs average peak demand schedule and [redacted] million litres per day required by the expanded airport. Some supply disruptions were considered - ranging from 2 to 14 days with severity of fuel loss of supply from 25% to 40%.

The most fuel resilient option identified as optimum was the construction of four supplementary tanks next to Perry Oaks Depot, on parking stand 596 and six more tanks on the Southern Apron. Thus, this option would be able to withstand a prolonged 35% supply disruption and up to five days at 40%.

Together with the above planned extension there are also reconfiguration of the supply network as pipelines and Railhead.

The development of the fuel farms and space reconfiguration must also take into account the safe distances in relation to the existing structures and operating aircrafts. Information received from HAL indicates that the safety clearances for the fuel tanks are compliant with the Control of Major Accidents Hazards (COMAH) regulations.

Arcadis believes that HAL has undertaken a comprehensive analysis of the fuel demand. The proposed expansion of the existing facilities planned to meet this demand, whilst providing the necessary capacity for disruption.

Ground Support Equipment (GSE)

HAL has presented a high-level view within the Preferred Masterplan document setting out the positioning of the Maintenance Base for Ground Support Equipment (GSE) repairment and parking within Area A, 3rd Runway related.

While the location of the GSE Maintenance (and other similar facilities) is dictated by the aerodrome performance and standard operating practices, the GSE inventory and capability is important for the entire airport operations.

This defines the services assumed by HAL and technical capabilities of other airport users such as Handling Companies.

Currently, Arcadis has not analysed any GSE fleet inventory, capacity estimation or planning in relation to the new 3rd Runway operations. There is a risk that GSE may need to take up stand space that could cause operational inefficiencies.

Snow Base

The Preferred Masterplan has the location of the Snow Base at the east end of new runway 09L/27R in the proximity of the GSE Repairment facility.

The location of the Snow Base as indicated in Figure 8 below is dictated by the local standard operating procedures of the aerodrome.

Arcadis believes that the snow base is located in a suitable position on the airfield to respond to operational needs in periods of adverse weather.

2.2.4.4 Terminal and Satellites

As **Step 0** does not include expansion to existing terminals or the construction of new terminals, Arcadis has focused on the external airport infrastructure and the construction of the runway. However, as part of the existing 'On-Airport' portfolio of capital projects, HAL currently has plans to increase the capacity of T5 and potentially T3 in advance of the new terminal facilities being developed and to maximise the opportunity of a potential uplift in ATMs following the DCO approval. These projects are referred to as the 'Plus' projects.

Additional demand in this period is anticipated by HAL to be absorbed by the existing terminal facilities. There will be additional capacity measures implemented but these will be through alterations to the existing infrastructure and measures including technological enhancements to processing facilities.

Arcadis is satisfied with the approach taken by HAL. Namely, that **Step 0** concentrates on external infrastructure and airfield infrastructure. Arcadis after a high-level assessment based on the thumb

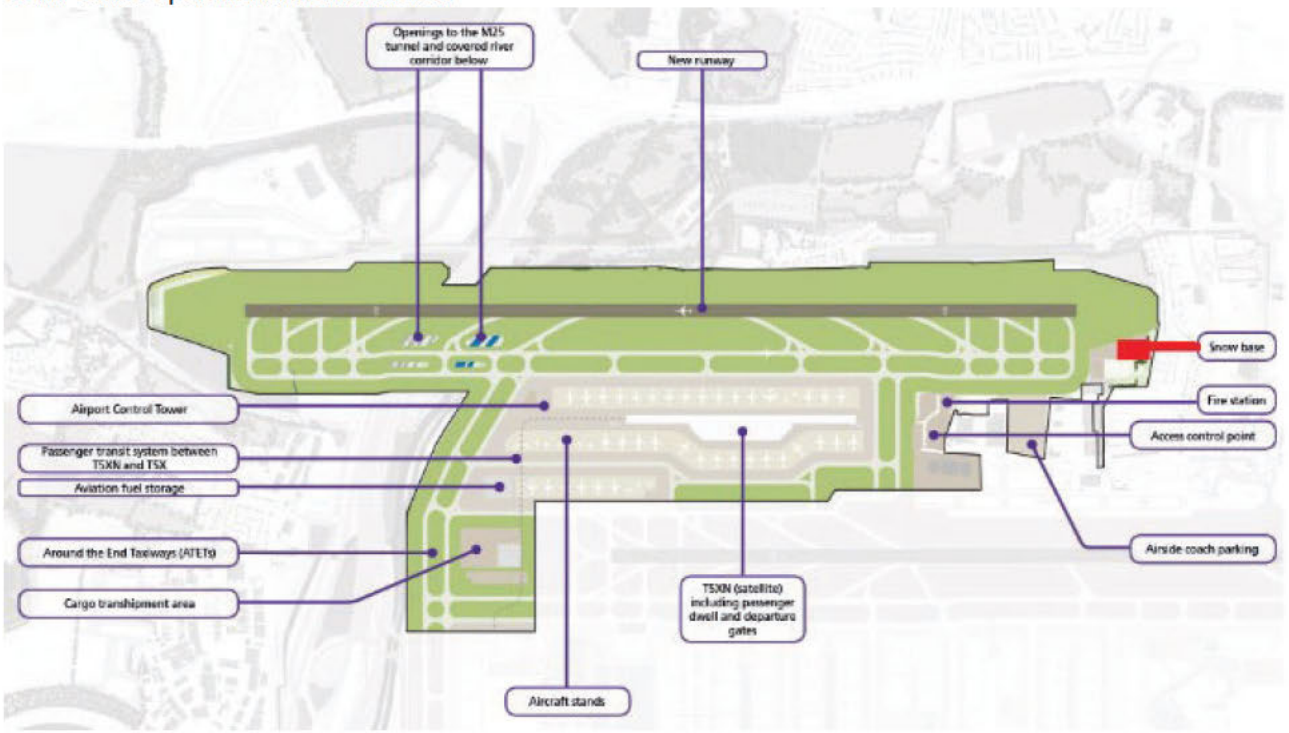


Figure 8 Snow Base Location Zone A
Source: (Preferred Masterplan - HAL 2019)

rules and benchmarks due to limited access to information is satisfied that the terminal facilities can cater for the passenger demand in the Step 0 phase.

2.2.4.5 Landside

Forecourts

HAL is proposing to provide 'Kiss and Fly' facilities within the new parkways. Arcadis has measured the total airport wide kerbside that amounts to circa 32m per mppa. Arcadis has not been provided with any figures for the equivalent Kerb length HAL's new scheme will provide. It is not possible to make any meaningful analysis on whether this will be operable to a reasonable level of service. Arcadis considers that if HAL significantly reduces capacity from today's available kerb capacity, the drop off services may become have operational challenges

Taxi and Private Hire Vehicles

Arcadis has considered the effect that the proposed Heathrow Access Charge may have on Black Taxi and Private Hire Vehicle (PHV) fares and availability. The Heathrow Access Charge is a strategy to be implemented, originally as a pollution charge and then moving on to an access charge in 2026, this fare will be enforced for both private vehicles and taxis, with staff, freight and busses/coaches being exempt. If the access charge is applied upon every entry rather than on a daily basis, passengers will have to pay more to use these services.

Some passengers are unable to use public transport due to their location (when the public transport network is not operational -such as very early mornings) or due to a physical disability (that reduces access to public transport). Those passengers are likely to be adversely impacted financially by HAL's access scheme

In addition, this may lead to a reduction in the number of taxis and PHVs available at the airport, which would create longer queues at the Taxi ranks and for passengers seeking to use PHVs.

Bus and Coach

HAL has stated that they will expand the Central Bus Station and landside terminal zones to account for their improved bus and coach network. Arcadis has not been provided information by HAL of any plans to expand the bus and coach facilities at T4 and T5, with the proposed increased bus and coach services.

Arcadis considers that there is a risk that without an increase in available facilities, the airport will be unable to manage this increase in demand which will cause operability problems and cause delays to both passengers and staff using these services.

Car Parking

The current number of passenger parking spaces both short and long stay is 33,000, this includes both HAL controlled spaces and offsite Purple Parking. This sets a ratio of 435 parking spaces per mppa.

Whilst HAL do not have a target for **Step 0**, the current proposals for the number of HAL controlled parking spaces for passengers is 38,600 for 2030 with this number increasing in line with expansion through to **Step 8** (2050). This level of parking sets a ratio of between 330 and 335 parking spaces per mppa.

Arcadis notes that HAL has included 9,500 off-site parking spaces currently outside of their control in their baseline numbers. This has created a surplus of parking in their current levels compared to the proposed expansion plans as the latter only includes HAL controlled spaces.

As HAL is unable to rely on the additional provision of external parking for passengers, Arcadis have analysed the HAL provided numbers in terms of operability despite this discrepancy in methodology.

This reduction is reliant upon a significant level of change in how passengers choose to travel to and from the airport over the next ten years where the airport has little control. HAL has set out its Surface Access Strategy which includes high level information on incentives that aim to offer a Public Transport alternative for passengers travelling to and from the airport.

However, aside from the introduction of the Heathrow Access Charge, it is not apparent within the documentation how HAL will achieve this reduction in demand if passengers choose to continue to access the airport by private car and wish to park.

The risk associated with the reduction in parking space ratios is that HAL will have to manage the demand.

Staff Travel

The baseline of staff parking numbers for 2013 originally recorded has been flagged as anomalous by HAL, and as such are mediating between the significantly higher 2009 and 2017 values for their baseline. This does not affect their ability to operate the airport post 2026 but will significantly affect their ability to meet the 2030 and 2040 ANPS targets.

A modal shift to public transport will reduce car parking spaces for staff allowing spaces to be used for passengers. Car parks are to be consolidated into fewer sites that are clustered together into groups with good access to road networks. HAL has anticipated an increase of 2,150 car parking space provision in 2026.

The allocation of staff car parking is within HAL's control and the opportunity to achieve their proposed reduction is possible. This is however dependant on alternative options being available for staff to be able to get to and from work. Arcadis notes that without other options being available, there is a risk that the ability of the airport to bring in this change is limited and their ability to deliver the parking capacity for use by passengers at **Step 0** is reduced. This again may create the knock-on operability issues highlighted above in both the car parks and forecourts.

Freight

The opening of the 3rd Runway will see an increase in ATMs and will result in an increase in the availability of air freight capacity at the airport. This will mainly be in the availability of more 'belly hold' capacity rather than through a significant growth in dedicated air cargo flights.

Although HAL has set out a plan to increase the use of virtual consolidation of freight, the evidence or impact of this is yet to be demonstrated. Arcadis believes that the increase in air freight capacity at Heathrow is likely to lead to a greater volume of road-based freight traffic accessing the airport campus to feed this demand.

This increase in air freight activity will impact on the operability of the airport as the resulting increase in road-based freight is likely to increase queuing at control posts and delays on the airport and wider road networks.

HAL has not set out detailed information on the level of freight activity linked to the opening of the 3rd Runway in 2026. Arcadis is therefore unable to fully review the operability implication the growth of air freight will have in Step 0 at this stage.

2.2.4.6 Surface Access Strategy

The ANPS detailed a number of requirements for surface access as follows:

- Increase the proportion of passengers accessing the airport by public transport, cycling and walking to at least 50% by 2030 and at least 55% by 2040;
- Reduce staff car journeys by 25% by 2030 and by 50% by 2040 from a 2013 baseline level;
- Strive to meet the HAL public pledge to keep landside related traffic no greater than 2019 levels;
- Set out the mitigation measures that it considers are required to minimise and mitigate the effect of expansion on existing surface access arrangements; and
- Keep CO^2 emissions within UK climate change targets.

This section analyses the assessment for Step 0 up until the anticipated runway opening in 2026. It should be noted that there are no specific ANPS targets set for this period. However, the existing Surface Access Strategy mode share targets seek to maintain a public transport mode share above 40% with a goal of 45% by 2024.

Most of the targets set out as part of the ANPS for an expanded airport are measures that are required beyond the Step 0 date. Arcadis recommends that the work to achieve these targets should begin in the early phases. The masterplan does not include the anticipated metrics for achieving these targets by 2026. However, it does include the progress expected to be made by HAL by 2027.

HAL has stated that 'good progress' is expected to be made on the mode share and staff travel targets. HAL also state that compliance with UK Air Quality limits is expected to be achieved by 2027. HAL is confident that the pledge to keep landside traffic levels no greater than 2019 levels is expected to be achieved.

HAL's pledge of generating no more airport related traffic greater than 2019 levels is in the process of being monitored by HAL for the purpose of setting a baseline. HAL are utilising an Automatic Number Plate Recognition (ANPR) systems in a tight corridor around the airport. To date, HAL has not provided information on how their consolidation areas for retail and construction traffic will be taken into account for this purpose.

As the current proposed monitoring cordon does not include airport specific facilities such as the proposed Consolidation Centre the quantity of traffic not using 'airport roads' but still Heathrow related traffic will not be captured as part of this calculation.

In order to achieve this a range of infrastructure measures have been proposed for the period up to 2027. The relevant tangible measures proposed to achieve these targets include:

- Expanded coach facilities at Central Bus Station and Landside Terminal Zones;
- Cycle lanes and bus priority on A3044;
- Cycle lanes and bus priority on A4;
- Piccadilly Line enhancements (by TfL);
- New Multi-storey long stay car park at T4 (on site of existing surface level parking); and
- Staff parking reduced from approximately 25,000 spaces to approximately 19,000.

The following operational improvements are proposed:

- New taxi backfilling model;
- Vehicle access charge;
- Elizabeth Line operational;
- New Heathrow Travel Account for staff; and
- New coach services.

The above measures will contribute to the achievement of increasing the use of Public Transport and sustainable modes of travel and that these infrastructure and operational models will help meet the surface access targets. However, the targets for **Step 0** are not clearly defined and these are only specified for later phases.

The provision of this information for **Step 0** would assist Arcadis in determining the potential impact that these could have on the operability of the Landside areas of the airport in 2026.

2.2.5 Review of ANPS and Regulatory Compliance

This section of the report reviews **Step 0** against the main principles of the ANPS. The main points for **Step 0** relate to the airport design specifications and the surface access considerations.

2.2.5.1 Airport Design

The Preferred Masterplan has adopted the airport planning principles including those provided by:

- International Civil Aviation Organization (ICAO);
- European Aviation Safety Agency (EASA) Certification Specifications and Guidance Material for Aerodromes Design (CS-ADR-DSN);
- UK Department for Transport (DfT); and
- Civil Aviation Authority (CAA).

Arcadis agrees that the Preferred Masterplan provides the minimum required runway length and meets the requirements set out in ANPS regarding the 3rd Runway.

The working assumption is that the new 3rd Runway will be operational by 2026. In order to achieve this a significant amount of non-airport infrastructure works will be required to accommodate the new runway including river diversions, moving the M25 motorway, building other local roads etc. This is in addition to the works necessary to integrate the new runway and associated infrastructure including taxiways, service roads and utilities.

Analysis of how this will be achieved is detailed in the Delivery section of this report however from an operational perspective there are a range of issues to consider. The analysis in this section focuses on the on airport operational aspects once the infrastructure has been completed.

Step 0 assumes that when the runway opens the maximum capacity of the airport will be 95mppa (Updated Scheme Development Report 2 of 5) split between terminals as per the *Masterplan Proposal Study* and [redacted]

[redacted]

However, **Step 0** does not propose any significant changes to the existing terminal facilities. Additional demand is anticipated to be catered for by enhancing existing facilities which are part of the existing 'On-Airport' portfolio of capital projects and are referred to as the *Plus* projects. This includes increasing T5 capacity to 40mppa through the T5 plus programme comprising of works including the extension of T5B and C by converting remote stands to contact stands.

A layout of the airport at **Step 0** is located in Appendix A. This image is sourced from *HAL's Preferred Masterplan* dated June 2019.

2.3 Capacity Review

2.3.1 Airside

Arcadis is aware that prior to **Step 0** HAL is seeking to raise the capacity through the removal of the ATM cap through the DCO process. The removal of the cap will enable an additional 25,000 ATMs per annum on the two existing runways.

HAL states that this growth can be achieved mainly with airspace and operational changes along with minor infrastructure changes. For this reason, this has not been considered as a separate phase of the masterplan.

HAL states that the capacity of the three-runway system will achieve a minimum rate of 129 movements per hour. This is broken down per runway as follows:

- 48 movement per hour on the mixed mode runway (arrivals and departures);
- 39 arrivals per hour on the arrivals runway; and
- 42 departures per hour on the departures runway.

This capacity that this achieves will enable HAL to deliver its stated aim of achieving 756,000 ATMs, supporting 142mppa including an 8% resilience allowance.

Arcadis is satisfied with the fact that HAL has considered consumer interest as a key consideration in the evaluation of masterplan assembly options and also during the development of the Preferred Masterplan. However, we still foresee possibility of passenger dissatisfaction due to increased taxi time from the new 3rd Runway.

The forecasted proportion of narrow-body aircraft to the total traffic at Heathrow is more than 62% while for wide-body aircrafts is around 38% in the year 2022 and 2023. Arcadis foresees a scope for up gauging the fleet mix. This might result in substantial reductions in infrastructure requirements. Due to insufficient data, we are unable to analyse the rationale used behind keeping the percentage of NB aircrafts as high as 62%. However, to support our observation we have prepared a benchmark study in comparison with the Paris Charles de Gaulle Airport which is Europe's second-busiest airport after London Heathrow airport. This analysis can be found in Table 7.

Airport	LHR		CDG
Year	2022	2023	2018*
Annual ATM's (000s)	[redacted]		481
Annual Pax (MPPA)			72.22
% of NB Daily Pax ATM's			48%
% of WB Daily Pax ATM's			52%
Total	100%	100%	100%

**2018 data is used for comparison due to unavailability of future fleet mix*

Table 7 Comparison of Aircraft Fleet Mix with Arcadis Benchmarked Data
Source: (Arcadis Internal Library 2019)

Arcadis believes that there will be potential to increase the proportion of wide-bodied aircraft once the NWR is operational. Prior to this, Arcadis believes that the proportion of narrow-body to wide-body aircraft is unlikely to change due to the existing capacity constraints and business models.

However, after assessing all the available documents and information provided by HAL, Arcadis is satisfied that HAL has undertaken the necessary detailed work in the development of **Step 0** proposal.

Apron Facility Review

This section reviews the proposals for the planning and design of the apron and stand facilities. It also reviews the methods used for stand planning.

The [redacted] document details the current assumptions being used by HAL to generate apron frontage and stand planning. HAL has used the ICAO wingspan standards for Code C, E and F aircraft.

The proposed clearances being used by HAL are a 7m inter-stand clearway plus 1m clearance either side. The ICAO publication, *Document 9157 Aerodrome Design Manual,* states a minimum of 7.5m clearance for Code E and F aircraft and 4.5m for Code C.

HAL is using an approximate stand depth of 92m. The justification for this depth is that there is sufficient space for an 82m length aircraft with clearance all around. HAL has indicated that Heathrow is not considered by the airlines as being a critical airport for fuselage length. These are also dimensions that HAL has previously used for apron and stand facilities.

HAL is also applying a [redacted] buffer to the calculated stand frontage to provide resilience for events such as:

- Arrivals / departures off slot;
- Stand outages;
- Clearing time between aircraft departing or arriving; and
- Layout inefficiencies.

This [redacted] buffer is based on historic planning figures validated by HAL data from 2009 and 2016. Although Arcadis does not see this approach as being unreasonable, no rationale has been provided as to why the resilience buffer is a percentage of stand frontage and if alternatives have been considered. For example, additional stands for resilience are based on a percentage of provided stands rather than frontage.

However, Arcadis is satisfied that the HAL parameters comply to relevant industry standards and in some cases exceed the standards for apron and stand design.

With regards to stand planning, HAL has used stand planning models to determine how effectively flights can be allocated to the defined stand layouts within the masterplan. This includes validating the stand frontage. The relevant stand planning assumptions include:

- Linking flights i.e. the turnarounds based on the design day schedules;
- Time between flights on stands (buffer) to build in resilience – [redacted] minutes;
- Towing of aircraft that are on the ground for a prolonged period of time between flights – HAL has used a time of more than [redacted] hours and a minimum of [redacted] minutes on stand for arrivals and departures if an aircraft is towed as per the HAL operational stand planning;
- No allocation preferences other than the over-arching terminal occupancy – airlines are assigned any stand within the allocated terminal / apron;
- Resilience of one remote Code E contingency stand on each apron which aligns with HAL operational stand planning; and
- Target pier service level of 95% as per the current regulated service level.

This is a typical approach used in airport planning and Arcadis agrees with the principles being used to develop the input assumptions used for stand planning. The majority of the assumptions are aligned with HAL's operational stand planning practices and reflects the current operation and is assumed by HAL as being low risk.

It should be noted that although the stand planning model has been developed on the assumption that airlines can be assigned to any stand within their allocated terminal or apron, airlines currently have preferences for stands. HAL supports the principle that airlines can be assigned to any stand, as detailed in [redacted]

Arcadis notes that HAL's plans appear to be working on the assumption that this current airline behaviour will need to change. There is no supporting evidence that the airlines are willing to adopt to this new way of working.

Arcadis notes that there may be a risk that if the airlines do not change their current behaviours, the consequences may lead to the introduction of stand

inefficiencies and may therefore impact on the operation.

Notwithstanding this, Arcadis is satisfied that the approach being used by HAL for stand planning is appropriate and provides enough flexibility for operational purposes.

2.3.2 Terminals and Satellites

Arcadis has reviewed a document produced by HAL titled [redacted] in order to assess the requirements for terminal and apron facilities.

This document sets out the parameters and assumptions used by HAL in determining the initial view of terminal and apron facility requirements for each of the masterplans used for the M3 Gateway evaluation.

M3 is a milestone used to confirm the shortlisted masterplan options to be taken forward in the detailed masterplan evaluation.

The assumptions are based on information that is related to industry recommendations, operational assumptions and standards previously used by HAL:

- Assumptions that other airports / airlines have already achieved;
- IATA ADRM;
- Previous HAL standards;
- HAL standards relating to operations and passenger service levels;
- Service offering that is currently being worked towards at Heathrow; and
- Observations of passenger processor / transaction times and data.

[redacted] includes recommendations for sensitivity testing focussing in particular on assumptions that affect space take. The [redacted] document categorises the tabled parameters and assumptions under the following themes:

- Stand planning;
- Passenger waiting times;
- Passenger processing;
- Baggage Reclaim; and
- Transfers.

The parameters and assumptions are used within HAL's models to derive the facility requirements in each masterplan for:

- Stands;
- Check-in processing facilities;
- Ticket presentation ATP / desks;
- Security lanes;
- Lounge population;
- Immigration processing facilities;
- Baggage reclaim belts;
- Queue lengths to inform queueing space; and
- Transfers.

The *IATA Airport Development Reference Manual (ADRM)* – 9th and 10th editions – has also been considered by HAL. Arcadis is aware that the 11th edition of ADRM has been published and is the latest version.

Arcadis acknowledges that much of the masterplanning work undertaken by HAL was developed prior to the March 2019 publication of the 11th edition of the ADRM. HAL is aware of the latest edition of ADRM and will be undertaking a comparison with earlier editions to ensure that the input assumptions are aligned with the latest industry recommendations.

Terminal Assumptions

This section reviews the proposals for the planning and design of the terminal facilities.

A comparison of some of the relevant parameters relating to passenger processor waiting times in [redacted] with ADRM 10 are presented in Table 8. Arcadis is satisfied that the passenger processor waiting time assumptions in [redacted] appear to be within the range of IATA ADRM LoS C / Optimum.

Arcadis notes that for some processors, HAL has utilised a mid-range value such as for standard bag drop. However, for other processors, such as standard check-in or security lanes, a lower or upper range value has been applied.

Arcadis has observed that for some processors, [redacted] refers to a transaction. An example of this is for self-service kiosks and premium (business and first class) check-in counters. The transaction is a metric that accounts for varying processing times aligning with IATA ADRM. Arcadis assumes that these transaction times relate to the processor transaction assumptions stated in [redacted] Clarification has been sought from HAL on this point.

Our analysis has identified that the immigration waiting time assumptions in [redacted] are noticeably different from the IATA ADRM recommendations (see Table 8).

Passenger Waiting Times (minutes)			
Processor	**Passenger Type**	**IATA ADRM LoS**	**ADRM LoS Assumption**
Kiosks	All Passengers		1 - 2
Bag Drop	Standard		1 - 5
	Premium		1 - 3
Check-In Full Service	Standard		10-20
	Business		3-5
	First		3-5
Ticket Presentation	All Passengers		ADRM 10 does not consider automated ticket inspection gates
Security	Standard	**LoS C / Optimum**	5-10
	Premium		1 - 3
	Transfer		5-10
Immigration*	Non-EEA		5 - 10
	EEA		
	eGates		ADRM 10 does not consider eGate processors
	Premium		1 - 5
	Transfer		5
Baggage Reclaim	All terminals except northern apron		ADRM considers waiting times based on narrowbody / widebody aircraft
	Northern apron		

Table 8 Comparison between ADRM LoS and [redacted] Passenger Processor Waiting Time Assumptions
Source: [redacted] Modelling Assumptions 2018) & (IATA ADRM Edition 10 2014)

Although IATA ADRM does not distinguish the different types of immigration lanes (in the case of Heathrow, EEA and non-EEA immigration facilities), the parameters used by HAL does account for these different immigration lanes as well as standards that reflect the airport's operation i.e. previous BAA (HAL) standards. Arcadis believes that this is a sensible approach to immigration facilities reflecting the actual operations of the airport.

HAL has set out a comprehensive list of parameters and assumptions that relate to processor transaction times and modal splits for different check-in types (desks, kiosks, bag drop) or immigration routes (EEA/non-EEA or eGate).

Arcadis has reviewed these assumptions and compared with its own benchmarked data for New York – JFK and Paris – CDG airports. We consider that JFK and CDG are reasonable comparisons for terminal parameters and assumptions due to the mixture of traffic and the passenger profile. The figures in Table 9 provide a comparison of processing times.

The figures provided by HAL for [redacted] indicate that check-in processing times are broadly in line with JFK and CDG. The exception is with bag-drop where JFK and CDG are achieving lower processing times. However, Arcadis is comfortable that [redacted] per transaction represents a reasonable assumption as HAL is in the process of testing the impacts of shorter and longer transaction times.

HAL currently process [redacted] passengers per hour in security, which is lower than both JFK and CDG. The proposal in [redacted] is for [redacted] passengers per hour. Arcadis is comfortable that this is a reasonable assumption, considering that HAL aims to introduce high automation in its operating system.

However, Arcadis considers that significant improvements in the system and operational processes would be required to achieve reliable throughput above [redacted] passengers per hour.

Arcadis understands that this is a sensitivity test and is attempted to make significant improvements in the process. However, Arcadis is unable to assess the impacts and benefits of such an aspirational number due to unavailability of further information as to how the expectations would be fulfilled.

	[redacted]	JFK (T5)	Paris CDG
Airport-wide Pax 2018 (MPPA)		62	72.
Processor		cessor Transaction Times (seconds)	
Self-Service Kiosk		125	90
Bag Drop		30	50
Assisted Check-In Desks		140	130
Security Lane		~180 pax per hour	~150 pax per hour
Immigration		Not useful for comparison as based on US CBP requirements.	Not available for comparison
		ovision (%)	
Departure Lounge		50%	70%

Table 9 Comparison of [redacted] Assumptions of Processor Transaction Times and Arcadis Benchmarked Data
Source: ([redacted] Modelling Assumptions 2018) & (Arcadis Internal Library 2019)

Arcadis is satisfied that HAL's capacity modelling inputs are reasonable for the studies it has undertaken as part of its masterplanning process. The parameters / assumptions for the processor transaction times, modal splits for check-in methods and immigration channels (EEA or non-EEA) and baggage reclaim operation and capacity have been developed from a range of information sources including:

- British Airways data;
- Data from current terminal operations;
- Previous BAA (HAL) planning assumptions;
- HAL surveys;
- Passenger analysis;
- T5 modelling assumptions; and
- UK Border Force – source of assumptions relating to immigration.

Although these information sources are referenced in [redacted] they have not been made available to Arcadis by HAL.

Arcadis has been able to determine from our engagement with HAL and the available information in [redacted] that the planning parameters and assumptions have been developed from and align to industry recognised standards, such as *IATA ADRM Version 10* and a broad range of data related to Heathrow's operation.

Arcadis is satisfied that these assumptions in [redacted] are reasonable inputs for the capacity analysis workstreams in the masterplan process. Arcadis has validated its assessment with analysis of industry guidelines such as IATA and our own benchmarked data.

Terminal Sizing

The terminal buildings are not being expanded during **Step 0**. HAL has studied the maximum potential capacity of the terminal facilities, particularly for T5 as provided in the presentation 04 Forecasting and Capacity. This has resulted in the assumption that the maximum capacity can be increased. For example, T5's capacity could be increased from the current [redacted] to [redacted]

According to HAL, this increased capacity could be achieved by implementing terminal operating process improvements, including stand and other facility upgrades. HAL's studies have resulted in the updated capacities for all terminals:

- [redacted]
- [redacted]
- [redacted]
- [redacted]

This generates an overall capacity of 95mppa. No specific details of the internal terminal operating process improvements have been provided by HAL. Additional stands and stand upgrades are being provided on the T2 (with 4 new Code F stands) and T5 aprons.

The lack of information for the current and proposed passenger processor facilities within the terminals means that Arcadis is unable to assess and review in detail whether the capacity increases proposed by HAL can be achieved.

However, from a high-level perspective, Arcadis has analysed the terminal capacity in terms of required area and mppa. Based on the passenger throughput in 2018 and the terminal area, the

overall m^2 per mppa ratio for all terminals is [redacted]

This is substantially above the [redacted] per mppa ratio targeted by HAL in Evaluation 2 of the masterplan process. As indicated in Table 10, all terminals are currently achieving a m^2 per mppa greater than [redacted]

Arcadis has used the [redacted] per mppa ratio and the terminal areas to estimate the maximum highest potential capacity at high level in terms of mppa, the results of which are summarised in Table 12. When compared with the proposed capacity increases by HAL, it can be seen that by using HAL's own benchmark, there is excess capacity at a declared 95mppa throughput.

These high-level outputs cannot be used to arrive at a definitive conclusion. This would need to be verified by the capacity modelling undertaken by HAL which assesses the terminal facility and passenger processor requirements. From the available information provided by HAL, Arcadis understands that the terminal design will move to a 'bottom up' analysis, based on the DDS and input assumptions as stated in technical note [redacted] HAL has stated that this will be completed at the end of August 2019.

Table 10 below presents the square metre per mppa currently achieved in all terminals. The square metre area per mppa ratio is used to validate the amount of space achieved per million passengers annually. This analysis clearly helps to establish that the area per mppa in T2, T4 and T5 is well above the targeted high-level metric of 12,500m^2/mppa which was established during Evaluation 2. Whilst, in T3 the area per mppa falls just below the targeted value.

Subsequently, in Table 11 we have derived the terminal area requirements from the php numbers based on the regulations provided in the *IATA ADRM 10*. It is noted that the areas of T2 and T5 are substantially above the mandatory IATA space definition criteria. T3 just falls above the expected range, whilst T4 is experiencing a minor shortfall to align with the expected IATA requirements. However, we are comfortable that the Terminal areas are within the acceptable range of IATA recommendations.

Terminal Current	Terminal Area (sqm)	MPPA (2018)	Achieved Space (sqm/MPPA)
	Source: HAL	*Source: www.heathrow.com*	
T2	[redacted]	18.5	[redacted]
T3		19.5	
T4		9.4	
T5		32.8	
Total		80.2	

Table 10 Existing Square Metre per mppa Achieved
Source: (Arcadis 2019)

Terminal	T2		T3		T4		T5		T5X	
[redacted]										
Area/PHP by IATA (sqm)	30	30	30	30	30	30	30	30	30	30
Required Area (sqm) per IATA	[redacted]									
Total Required Terminal Area (sqm) per IATA										
Existing Terminal Areas (sqm) from HAL									Not available	
Difference (sqm)	63,900		5,280		-2,600		205,000		-	

Table 11 Terminal Area Requirement Based on IATA ADRM 10
Source: (IATA ADRM Edition 10 2014), (HAL 2019), ([redacted] - HAL 2019), (Arcadis 2019)

Terminal Current	Terminal Area (sqm)	Space target (sqm/MPPA)	[redacted]	MPPA (2018)	Capacity Gap (MPPA)
Source	From HAL	[redacted]		www.heathrow.com	
T2	[redacted]				13
T3					4
T4					4
T5					22
Total					43

Table 12 Terminal Capacity Gap
Source: (www.heathrow.com 2018), [redacted] Modelling Assumptions 2018), (HAL 2019)

Arcadis is satisfied that HAL is undertaking the necessary detailed work in the development of planning parameters and assumptions for the purpose of determining the facility requirements for the terminals and aprons.

2.4 Summary

Arcadis has assessed all the available information and data shared during the **Step 0** to consider whether the Preferred Masterplan will be Operable.

The approach taken by Arcadis has been analyse the capacity assessments made by HAL of the airside, terminals and landside facilities and consider whether these are appropriate.

In addition, Arcadis has also assessed the simulation studies, forecasts, assumptions and parameters used in developing the HAL Preferred Masterplan to determine whether these use industry and compliant standards.

Arcadis is satisfied that HAL's capacity assessments are based on sound data and are fit for purpose. In addition, the forecasts, models and standards used to develop the Preferred Masterplan are also compliant with industry best practice and there are no departures from standards in the information used by HAL.

Arcadis observes that based on the capacity requirements set out by HAL, their Preferred Masterplan does provide a scheme that can assimilate with the existing airport operation and the current configuration in **Step 0**.

Arcadis has considered the level of flexibility and resilience that will be in place at **Step 0**. On the basis that the information provided by HAL has demonstrated the airport can adequately provide for the growth in passenger numbers and the increase in runway capacity will provide more operational flexibility and resilience.

Arcadis has identified potential challenges that may arise at **Step 0** in Landside areas if passenger mode choice is unchanged through some of the Surface Access Strategy work proposed by HAL. However, at this stage in the masterplan process the level of detail required to assure the plan is not yet fully developed.

Although there may be some challenges that may arise, at this point in the masterplan process Arcadis is satisfied that on balance the proposals are operable and can be integrated into existing airport infrastructure.

HAL is yet to develop detailed Operational Readiness and Trials (ORAT) workstreams which will be key to ensuring a smooth transition without causing any operational issues.

Notwithstanding Arcadis' opinion that the Preferred Masterplan at **Step 0** will be operable, the challenges of deliverability, timeliness and cost still present the scheme with some challenges to open the new runway by 2026.

3 DELIVERY

Arcadis has assessed whether the masterplan and plans for **Step 0** are deliverable. As part of this review, consideration has been given to the scope and design provided for and when this is scheduled to be delivered according to HAL's current programme.

The review has assessed the feasibility of constructability (including logistics) and ongoing delivery during "construction" phases of the programme from today's existing operations to **Step 0**.

Arcadis has analysed any scope gap in deliverables, the robustness of the programme for delivery, the internal and external risks to delivery, and the confidence in HAL's ability to deliver the infrastructure required for **Step 0**.

Arcadis's key findings are:

- HAL's delivery of the elements of the scheme are presented in a logical sequence;
- HAL has sought to deliver the most efficient sequencing with the aim of delivering the new runway by 2026 however this has created a programme that has little margin to allow for delays or risk;
- HAL's programme is not unfeasible for the delivery of the required infrastructure however this is reliant on the programme timings set out in the plan to be delivered; and
- HAL will be reliant on other organisations to deliver some of the elements of the scheme which they do not control or can mitigate against. Delays could pose a risk to HAL's own delivery programme.

3.1 Definition of Theme

This section of the report reviews the deliverability of **Step 0** to understand if the required changes can be achieved in practice and can integrate with the existing airport infrastructure.

Arcadis has reviewed the proposals to ensure that they follow a logical delivery sequence. The scale and complexity of the proposed expansion of Heathrow requires a significant volume of work outside of the existing airport perimeter including earthworks, roads, rail, rivers and utilities before airport related infrastructure can be built.

The critical path to constructing the runway relies on these works being completed in a logical sequence. This review analyses the logical sequence of events to ensure that overall layout at the end of **Step 0** can be achieved.

Arcadis has reviewed the Preferred Masterplan material to assess whether **Step 0** is deliverable. Our review has considered the following:

- The scope, design and programme;
- Feasibility of construction and ongoing airport operation during construction;
- Scope gap in deliverables, including the robustness of the programme for delivery and any risks associated with it;
- How new and impacted facilities will link with existing infrastructure and how HAL will maintain key assets during construction phases of delivery;
- The appropriateness of the detail provided in Project Management Plans and Programmes;
- The observed level of maturity with regards to deliverability; and
- Evidence that the single Preferred Masterplan and future development of the masterplan to DCO submission are adequately considered and appropriate for DCO award.

Some of these issues will be discussed in more detail in further reports as their impact on the deliverability of the scheme in **Step 0** is minimal.

The review includes the following stages of the scheme delivery:

- Proposed Construction Phasing;
- Procurement;
- Pre-Construction;
- Early Works;
- Creating the Space;
- Earthworks; and
- Main Works.

Arcadis has identified potential risks to delivering the infrastructure needed to achieve Step 0. These are important to identify and mitigate against due to the volume of external infrastructure works required to achieve the Step 0 airport works.

3.2 Assessment

3.2.1 Methodology

This review is based upon discussions with HAL and a review of documentation released by HAL (listed in Table 13 below). This documentation includes a number of reports, presentations as well as a number of reference drawings.

Report Title	Report Source
HEP Procurement Strategy Review	Arcadis
[redacted]	HAL
	HAL
	HAL
	HAL
	HAL
	Gardiner & Theobald LLP
	Gardiner & Theobald LLP
	Gardiner & Theobald LLP
	HAL
	HAL
	HAL
DfT Heathrow Expansion Programme Assurance Review of Heathrow Airport Limited's Delivery Schedule	Costain

Table 13 Delivery and Timing documents reviewed
Source: (CAA 2019), (HAL 2019), (Arcadis Internal Library 2019), (IFS 2019)

In addition to this documentation Arcadis has had various workshops and briefing meetings with HAL where there was the opportunity to discuss with HAL the detail behind the information presented.

It is apparent that a significant amount of work has been undertaken by HAL on the likely sequence, impacts and durations of the overall Preferred Masterplan schedule. This would be in keeping with a Nationally Significant Infrastructure Project seeking approval via the Development Consent Order (DCO) process.

The need to assess the impacts of construction on all the receptors around Heathrow required a detailed review of the methodologies and timings being proposed for the development.

The following sections review the deliverability of the proposed development at Heathrow. They will review the sequence of the works as a whole and in detail for key elements of the development.

3.2.2 Proposed Construction Phasing

Step 0 requires an expansion of the airport boundary to accommodate the new runway and airfield infrastructure. Prior to this, the main works required are outside of the existing boundary.

The challenge presented by the development of a preferred Masterplan is about creating the space and then using that space to deliver a new runway and the associated infrastructure. This involves a significant amount of clearance of existing assets as well as undertaking a very significant number of earthworks to enable construction to proceed.

HAL has created a time slice walk through (images in Appendix A) of the likely construction process that will be undertaken to allow for a runway to open in the 4th quarter of 2026, **Step 0**.

These time slices are in 6-month windows and help to explain the thinking and challenges associated with the development. It is apparent from a detailed assessment of the points in time that the challenge to the development timescale is the creation of the space, the requirement for HAL to clear the construction zone of existing occupiers and incumbents prior to undertaking the construction process.

Any relocation, from rivers and roads to people, businesses and ecology, must be considered within the timescale and context of availability and vacant possession. The proposed relocations may be a significant and very real constraint and may be perceived as potentially negative.

Arcadis understands that it is difficult to capture the real impacts of these process on people, flora, fauna, infrastructure and the environment however, it is apparent that much thought has gone into how the construction process can be incorporated into this live environment.

The development requires the removal or relocation of some key utilities to the west of the existing boundary. These are indicated as early works and will pave the way for the construction of the new M25 route. the indicated sequence of works shows these works being undertaken prior to gaining approval for the overall development via the DCO process.

HAL will also require early engagement with the utility companies and will therefore incur costs before the approval for the scheme has been achieved.

The sequencing proposed by HAL will also require front end design and procurement for key replacement facilities that are required to be vacated to deliver the proposed earthworks strategy. These include the following:

- Energy from Waste facility;
- Harmondsworth Primary School; and
- Colnbrook Immigration Centre facility.

Arcadis understands that the Energy from Waste facility move will be subject to a separate Town and Country Planning Application. Arcadis has not seen any evidence that HAL has considered the risk to the delivery programme or any mitigation if this application is refused or challenged.

The proposed construction phasing indicates when the location of these facilities will be developed, and the detailed programme gives an indication for when the replacement facility will be constructed and made operational

The outer boundary indicated on Figure 9 is the extent of the construction works for **Step 0**. This is the work envelope for all works associated with the HAL Masterplan and includes areas outside of the current and future airport boundary.

Arcadis understands that prior to DCO approval HAL has identified a number of enabling works that they could start which are restricted to utilities and linked to environmental issues. HAL has proposed the phasing for these early works begins in the first half of 2020 with the relocation of utilities in the path of the realigned M25. This is followed by ecological works in the first half of 2021.

HAL has indicated that, upon DCO approval the following works will begin in early 2022:

- Utilities diversions;
- River diversions;
- Local road diversions;
- M25 diversion;
- Earthworks; and
- Establishment of the Construction Consolidation Site.

These elements of work are critical features of **Step 0** and require to be progressed in advance of the airfield works. The schedule issued to Arcadis for review indicated timescales for these activities, some of which occur prior to DCO approval. However, the sequence and timings are built around the needs of vacant possession of key areas to facilitate construction activities associated with the new runway development.

Arcadis considers that this approach to deliverability developed by HAL is sequenced logically. The programme set out by HAL indicates that the utility works will begin shortly after DCO approval, followed thereafter by the other infrastructure listed above. This culminates in construction of the airfield infrastructure starting in mid-2023.

3.2.3 Procurement

HAL has created a delivery procurement strategy that has been reviewed by the airline community. The high-level mission statement seeks to "Create a Heathrow Expansion Procurement Strategy that motivates productivity, drives value for money to create a new UK benchmark for the way infrastructure is sustainably procured that delivers the programme."

This has then been further clarified by HAL who list 5 statements on how this will be achieved. These

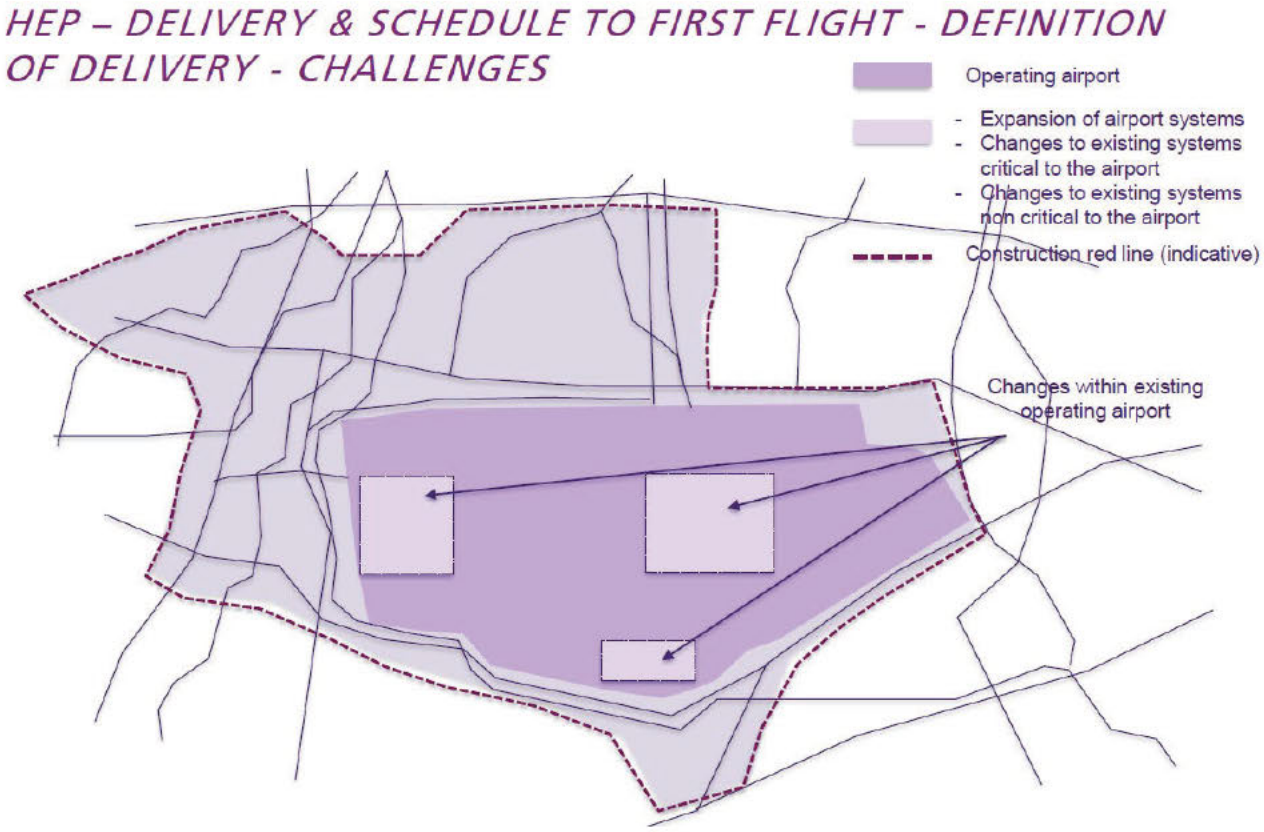


Figure 9 Extent of Expansion Works
Source: ([redacted] - HAL 2019)

are extracts form a report created by HAL and offered as part of the review process.

1. Establishing HAL as a UK Client of Choice

There is a strong pipeline of infrastructure work in the UK over the next 10+ years. Heathrow's total spend accounts for 4%, with the remainder lying largely with the government. To attract the supplier market, it is critical that HAL positions itself as a client of choice. HAL will be placed front and centre in the programme as the owner and will define long-term value.

2. Mobilising the UK supply chain for successful delivery of an expanded Heathrow

Delivering a programme that will enable an aircraft to take off from the new northern runway will be an enormous construction delivery challenge. It is vital that HAL sets the supply chain up for success and utilises different procurement engagement models to harness the value created in the supply chain by being a capable owner that will build relationships.

3. Creating the right environment that motivates the supply chain to be successful to deliver the programme

Once the supply chain is mobilised onto the programme, it is essential that commercial and contracting environment motivates productivity and value for money. Heathrow will form long-term enterprises through the creation of an inclusive ecosystem (supply chain) environment that stimulates value creation and focuses on outcomes. Additionally, HAL will need to create the environment that helps people and the supply chain fulfil their potential and work together to deliver with energy and pride.

4. Supporting the operation, the passenger and the local community

Construction will be delivered against the backdrop of a live airport environment, busy road network and bustling local communities. It is of paramount importance that any potential impacts by construction activities are managed and mitigated and communicated with the operation and airlines. Heathrow will optimise the use of off-site hubs to increase productivity and predictability, improve quality, health and safety thereby significantly reducing the number of workers on site.

5. An alert and agile Procurement Strategy that is aware of market dynamics and forces

The programme will be spanning numerous years. During this time, Britain with be exiting the European Union and numerous market movements and changes will take place. Therefore, the procurement strategy needs to be agile to manage challenges and optimise opportunities.

Arcadis understands that HAL has undertaken a deep review of the procurement process that they wish to use to engage with the required supply chain. HAL has set out to engage the whole of the UK into the development giving opportunities to other parts of the UK and not just the South East construction market.

This strategy seems to be targeted to spread the manufacturing process across a large an area as possible. The manifestation of this strategy will most likely be a benefit during the latter stages of the development when the development moves to a more terminal and passenger process facilities delivery. During the early stages the works are mainly around works in the ground and demolition and clearance of existing space.

The approach for expansion demonstrates HAL has learnt lessons from their previous experience of T5 and T2A developments. This learning has been brought into the strategy procurement plan.

In discussions with HAL during this review process the key themes that are to be targeted involve identification of the interface between work packages. Examples were discussed around how the key earthworks packages should be phased to minimise the risk of disruptions and delays across the geography of Heathrow. This proactive approach should provide dividends when applied to key packages, however there are multiple interfaces across the planned works, and this will require a significant input from HAL.

As part of the document review, it should be noted that there was no detailed procurement timeline, or a detailed design development programme available however, this would not be unusual for a development at this stage.

Success in the next stages will require careful and detailed design development and procurement to ensure works are brought at the appropriate time and with the right level of commercial tension built into the process.

Some of the key early works packages may require to be procured under the OJEU guidance process. This adds time to the overall period due to the rules governing notification and assessment of a large pool of potential contractors. HAL are seeking clarification of the need to follow OJEU processes. At the point of review this had not been clarified.

The early utilities reconfiguration (SSE power lines) require the works to be procured via the utility companies own contractual arrangement prior to the DCO approval. HAL will need to work closely with the existing supply chain to achieve the goal of clearing the existing pylons and substations by the required date to facilitate the M25 works. Also, within these early works will the need to instigate the replacement of the Lakeside Energy from Waste (EfW) facility. The procurement of this facility will be undertaken by a third party on behalf of HAL. This will add risk into the programme that HAL can only attempt to influence but not control.

HAL has also identified other key assets that will require separate procurement strategies. These include the replacement Colnbrook Immigration Centre facility and Harmondsworth Primary School. HAL identified these as likely to be design and build contracts with a modulization delivery strategy.

These projects may undergo a re-evaluation as HAL works through the detailed design development programme.

In line with statement 2 listed above, HAL is cognisant that the magnitude of HEP will require a wide range of suppliers and contractors to deliver the programme successfully. In particular, it is key that HAL engage early with the supply chain to allow potential suppliers to understand the pipeline of opportunities associated with HEP.

This will be a key factor in ensuring that the supply chain have the capacity to respond to the aggregate demand of HEP. From our interactions with HAL, it is clear that they have initiated engagement with the supply chain in specific areas, such as earthworks contractors where capacity may be a particular concern. HAL also plan to undertake market-wide supplier engagement, commencing with the "Heathrow Expansion Supplier Event" in September 2019.

The key to any procurement strategy is to choose the most appropriate to the needs of the projects, no one solution fits all situations. The strategy of supply chain engagement and a non-confrontational strategy will require detailed assessment over the next few months to establish the requirements.

3.2.4 Pre-Construction

The key to any development is to gain the required statutory approvals for the scheme. With the development at Heathrow this will primarily be gained by using the systems designed for Nationally Significant Infrastructure Projects (NSIP) also known as the Development Consent Order (DCO) process. This process was created by the Planning Act of 2008.

As part of the process defined by the Act, there are various defined processes that must be achieved within prescribed timescales. To fulfil all the requirements of the process the developer (in this case HAL) must create a design the sets out and defines the extent of the proposed development. HAL has created a series of drawings and plans the defines the 3R Masterplan which establishes the extent of the proposed works. These plans have been used as the basis of the assessments as required by the DCO process.

Whilst Arcadis has not undertaken a detailed assessment of the quality of the design outputs HAL has created, it should be assumed they will be fit for purpose. HAL has set a target to achieve the required public and specialist consultations by the end of 2019 to enable the completion of the pre-submission process in early 2020. The target submission date for the DCO documentation is [redacted] 2020.

The Planning Act of 2008 set out a prescribed process that will be followed submission. These includes set timescales for each section of the process. Therefore, the period from submission to expected delivery of the approval by the Secretary of State for transport is set at between [redacted] to [redacted] months. HAL has allowed a period of [redacted] months within their proposed programme. Which translates into an average of 520 calendar days.

The HAL programme for the development process gives a clear indication of the timelines for pre-submission and post submission as set out by HAL. It also shows some of the early works required to be processed while the DCO process is being undertaken, to maintain the programme. These activities are to be progressed at risk and are required to underwrite the 2026 runway opening date, **Step 0**.

Arcadis has compared HAL's timescales compared with other development that have used the DCO process and there are examples where the timings to achieve consent have been extended.

The HAL programme is dependent upon having an undisputed submission that will pass through the pre-examination and examination process without dispute. To underwrite this aspiration the original documentation will have to achieve total and full compliance with the DCO requirements.

Whilst there is little doubt that HAL is planning to achieve a 100% compliant submission there are always external influencers that could cause the planned timescale to be extended beyond the planned 17-month period.

Although none of these examples are a direct comparator to Heathrow Expansion, as can be seen from the graph in Figure 10 the process does not always follow the prescribed timescales. One third of all the applications that have been through this process having exceeded the number of days HAL are planning that their application will take, with two going to Judicial Review.

The impacts of any delay will have a significant influence on the overall development at Heathrow. The current plan is to follow the achievement of the DCO approval in November 2021 with the start of earthworks in the spring of 2022.

The approval will also grant approvals for various key activities such as ecology mitigation works in the winter of 2021 and spring 2022, The approval also triggers the following key activities:

- River diversions;
- Demolition of properties;
- Establishment of construction consolidation sites;
- Utility diversion; and
- Construction of the trunk roads diversions.

The period between delivery of the DCO approval and the start of the key earthworks is only four months which also includes the Christmas period. HAL has indicated that they are confident that they will be able to set up the team to deliver this.

This period would have to include for the finalisation of the contract conditions and the mobilisation of key staff and equipment for an activity that is key to the success of the opening of the new runway in 2026.

Any prolongation of the strict timescales will have a detrimental impact on the early works of the development.

HAL will also have to consider any constraints placed upon the development by the planning process. Whilst detailed consultation with the public, local authorities and the key consent granting bodies will help to clarify and draw out any imposed constraints; until the planning process has completed its full course these will not be fully known, and the impacts assessed. Which may impose restrictions on the planned early works.

A key part of the development phasing proposed by HAL will be to gain access to key areas to deliver the programme. HAL has identified key Vacant Possession (VP) dates, which have been derived from a detailed phasing strategy. To manage the impacts of and plan to minimise the influence of the key VP dates HAL has undertaken extensive negotiations with the relevant owners and interested parties.

While these are commercial agreements which have not been open to review, the principle is to negotiate key VP dates and not rely on legislation that would be granted as part of the DCO process. The normal convention would be to seek Compulsory Purchase Orders (CPO) powers over all the required land identified in the Preferred Masterplan. However, this process can take up to 9 months to deliver the required access, which would have a detrimental impact on the planned timescales.

No information was offered as to the likely success of this strategy and it remains a key constraint on the development. In discussions with HAL, the current strategy is underwritten by the main earthworks being sequenced to commence in an area not requiring VP of property and in an area already agreed with the landowners. However, some of the early works associated with ecology and river diversions require access to significant parcels of land around the western side of Heathrow.

The current plan as declared by HAL will be to obtain key VP of land as soon as the DCO has been declared. There are at least [redacted] VP's required to be obtained by mid November 2021. These relate to setting up of the construction logistics and the early earthworks. HAL assume that these will be obtained, and the work commenced as envisaged. The impact of no availability of the vacant possession dates will require assessment if the dates slip. The worst-case scenario would be to delay the development; however, it may only involve a re-sequence of the works until the possession dates are achieved.

A development of such a size as the expansion at Heathrow requires a significant amount of design input to feed into the procurement process. The schedule issued to Arcadis to review did not contain a detailed design programme.

When questioned, HAL indicated that the design programme would be developed during the next stages of the programme. This would be in keeping with a development at this stage in the process. There will therefore be a need by HAL to work up the design to a suitable stage to allow for a meaningful procurement process.

This will be a balance between the commercial decision to commit funds to designing a development that has not gained planning approval. However, the expansion at Heathrow has been

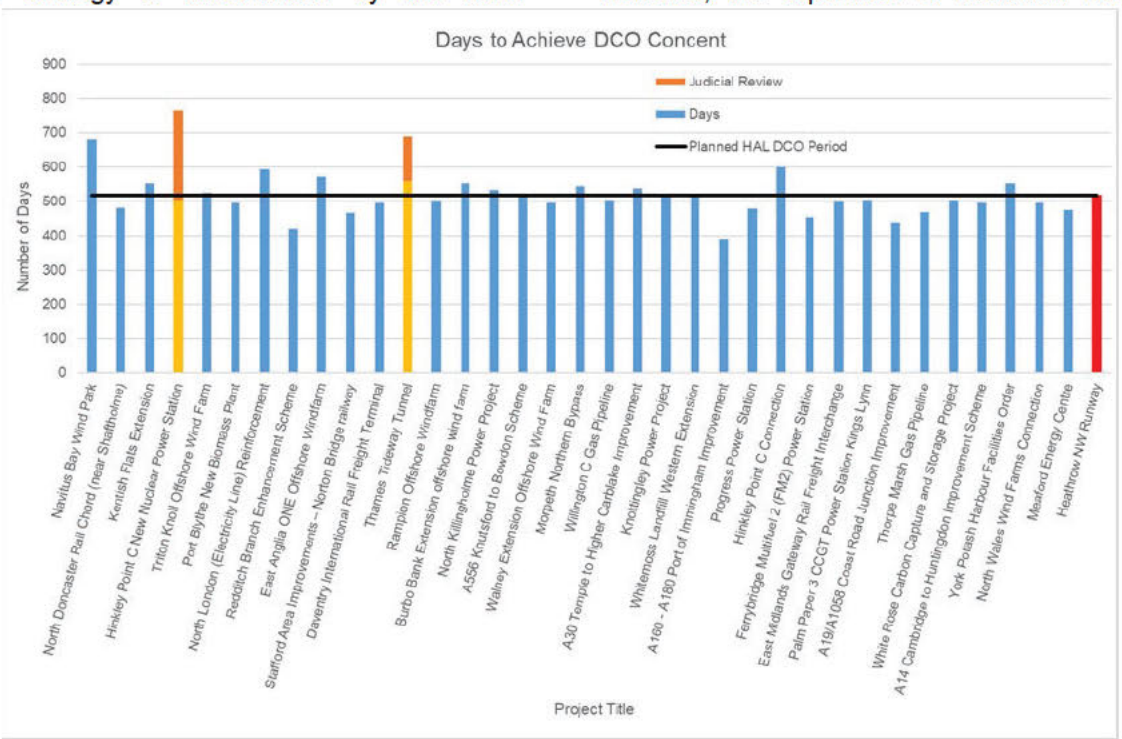


Figure 10 Graph Presenting the Days to Achieve DCO Consent
Source: (Bircham Dyson Bell-DCO Applications 2014)

sanctioned by the government and parliament so it is more a question of undertaking the design at the most appropriate stage in the development balanced against incurring costs in advance of official approval.

However the front end of this development is aggressive in its need to commence works four months after formal approval and the design will need to be progressed over the next few months to ensure the procurement process can be developed to ensure the works packages are set up to deliver the works when required.

The key to delivering **Step 0** by 2026 requires the full DCO process to have been completed by the 4th quarter 2021. Thus, allowing HAL to mobilise the required early works contractors. Whilst HAL has planned the DCO timescale around the "normal" allocation of time, it does not allow for any contingencies in the timings. The Heathrow scheme has attracted a lot of public scrutiny over the years and there would be no reason to suggest that it will not be subject to intense scrutiny during the Development Consent Order process.

The proposed development programme requires that the earthworks proceed in the spring of 2022, and therefore any delays in the approval process will have a detrimental impact on the proposed start of works.

3.2.5 Land and Property Acquisition

Prior to the DCO application, HAL will need to have identified the extent of land and building acquisitions that will be necessary for expansion. It is understood that these acquisitions will be through a combination of agreed purchases followed by compulsory purchases.

The main period for this stage will be from [redacted] 2019 to [redacted] 2022 including the periods for acquisition by mutual agreement followed by compulsorily powers coming into effect. HAL has identified the stages as follows:

Timescale	Agreement
[redacted]	Create Bond subject to board approval
	Agree relocation and options agreement
	Bonds redeemed subject to board approval
	Businesses start to relocate
	Acquire homes
	Compulsory Acquisition Powers

Table 14 Acquisition Timescales
Source: [redacted];HAL 2019)

HAL has provided the total number of bonds and agreements required for residential and commercial properties prior to the DCO submission. This is broken down into the completion requirements per month and day.

Arcadis has not seen any assessments from HAL regarding the level and complexity of these acquisitions so cannot determine whether HAL's timescales or their ability to process the volumes of transactions set out below is feasible. It is however important to note that where HAL cannot secure acquisitions through agreement, the use of compulsory purchase powers may throw up additional complications that may impact on delivery.

Acquisition	Type	Requirement
Bonds	CPZ Residential Properties	[redacted] per month
Bonds	Wider Property Offer Zone (WPOZ)	TBC
Commercial Agreement	Business relocation	[redacted] agreements per week

Table 15 Acquisition Requirements
Source: [redacted];HAL 2019)

3.2.6 Early Works

HAL has identified works that are required to commence prior to receiving full approval of the development via the DCO process. These are in addition to the main works design and procurement process that would naturally occur during the DCO timescale, in support of an earliest start on site of the main body of works.

The works revolve around the clearance of existing infrastructure that due to restrictive timescale are required to commence early to facilitate the relocation of the main M25 road re-alignment works. See the extract below from a presentation created by HAL to indicate these early works.

The image below shows the extent of these works to clear the area for the M25 reconfiguration. From the programme information and phasing slides produced by HAL it is apparent that these works are required to commence in early 2020. The assumption being that the utility company responsible for the assets will undertake these works under a local Town and Country Planning Application (TCPA). The risk to the programme would be that if this strategy is brought into question then the overall development would be significantly compromised.

As part of an overall Heathrow development HAL will be undertaking expansion works within the western campus. These works will be improvements to T5A and expansion of T5B and T5C. These works are listed as Business As Usual (BAU) investments and will contribute to the baseline growth at Heathrow. However, these will also support the additional passenger processing requirement to be in place when the new runway capacity is delivered.

The key to the expansion of Heathrow will be to remove the constraints in the way of the new airfield development. The M25 is a significant impediment to the expansion. Therefore, HAL propose to move it further west and build over the existing alignment. However, to undertake these works the proposal will require designing to the relevant standards imposed by Highways England. Currently HAL propose to

[redacted]

design and procure these works on behalf of Highways England and manage the delivery to achieve a transfer of the motorway across to the new alignment by [redacted] 2025. This will require the design to be progressed sufficiently to allow for procurement of the main packages of motorway works to commence from the [redacted] of 2022. There will be a significant amount of design, approvals and procurement required over the next 2 years to ensure this target is achieved.

The risk to the HAL development timelines will be that some of these activities within this timescale are not under the direct control of HAL and are therefore susceptible to other organisation's timescales. The procurement process associated with the M25 possibly required to follow the OJEU process which could add time and complications to the process. The HAL procurement department are actively investigating this risk. Until this has been clarified it remains a procurement timescale risk.

Other areas that are required to be replicated or replaced include the key Energy from Waste (EfW) facility as managed by Grundon. There is also a primary school to be replaced and a key immigration facility. HAL has worked hard to minimise the need to replace existing facilities, and when investigated as part of the Arcadis study, the response has been to consolidate functions within the impacted organisations existing facility or to agree a commercial agreement. This has helped to minimise the quantum of works that require re-provision and replacements. Of those identified to be replaced HAL have a clear strategy to create replacement facilities. However, these replacement projects may require separate (TCPA) applications due to the need to gain vacant possession early in the overall programme.

Existing Facility	Vacant Possession Date	Programme Indicating Replacement
SSE Power Lines Relocated	[redacted]	
Energy from Waste Facility		
Immigration Centre		
Harmondsworth Primary School		
Heathrow Primary School		
Heathrow Special Needs Farm		

Table 16 Key Facilities that Need to be Replaced
Source: [redacted])

There will be a residual risk to the development timelines if these projects cannot gain the required planning approval by the required date.

It should be noted that there does not appear to be a timeline for replacement of the Heathrow Primary school or the Heathrow Special Needs Farm.

There is a significant amount of key activities that are positioned as early works within the proposed development timelines. While this is not unsurprising within the context of the volume of works required to be completed within a tight target to achieve a new runway by 2026. Some of the identified works will require separate approval routes to the main DCO, they will also require

commitment to placement of contracts to deliver replacement assets before the main works are let.

There is also a need to review the planned dates for some of the replacement assets as the school replacement projects are not harmonised with the school academic year.

3.2.7 Creating the Space

3.2.7.1 Rivers

Water courses are a significant constraint to the development at Heathrow. Not only for flood risk mitigation but also because of their wider influence on the surrounding environment. It will be of interest to the Environmental Agency as to how HAL deals with the migration from the existing systems to the new. The following slide extracted for the HAL presentation gives an indication of the challenge.

Part of the early works will be to divert the existing rivers, creating new fluvial paths and infill existing ponds. The impact of these environmentally sensitive systems will require very careful management and will be seasonally influenced.

The proposed phasing and schedule identify the time periods for these works. There is a significant risk to the front end of the programme associated with these works, due to the potential restrictions imposed by the consent granting body.

Prior to any earthworks to the west and north of the existing campus the river diversions are key to the release of the space. Due to the nature of river flows the system of temporary or permanent diversion are subject to key invert levels. HAL has created a strategy where these factors are considered.

The phasing diagrams provide evidence that HAL is working closely with the various bodies top provide a system that will maintain the river flows necessary to support aquatic life above and below the development zone.

Further work will be required to fully understand the risks associated with the fluvial flows around Heathrow. With reference to the protection measures to be put in place to protect these vulnerable environments. This will be particularly key during the earth work seasons where the potential to cause pollution damage to watercourses is at the highest.

The agreed code of construction practice would be the document that sets the criteria for working in and around any water courses at Heathrow. Although Arcadis has not been provided with specific monitoring or enforcement criteria that would be used to ensure compliance, the high-profile nature

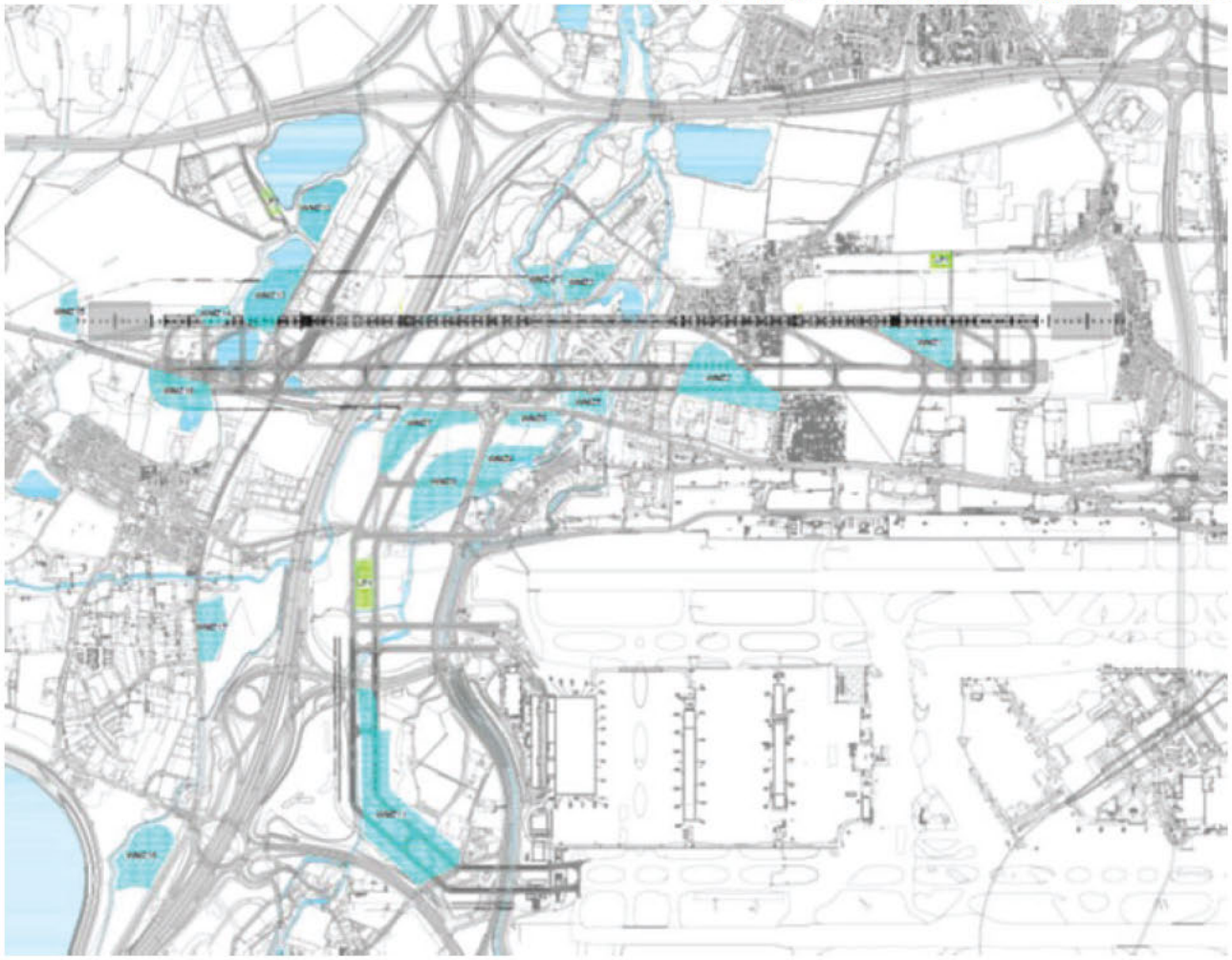


Figure 12 Waterways Impacted by Expansion Plans
Source ([redacted])

of the development should ensure the works are kept under scrutiny and any pollution or risk of pollution of water course will reflect badly on HAL and could cause a delay to the progression of the works.

The river diversions as required by the development place these environmentally sensitive areas in conflict with the timings and demands of the construction process. The consent granting body associated with these water courses has significant interest and powers over the scheme, which could lead to tensions in the approval process. Careful management of the changes to the water courses will be the route through these challenges. HAL will need to be aware of the seasonal nature of some of these works and draw up a plan accordingly. The existing rivers and water courses and the new routes play a significant role in the ecology and environment of the areas around Heathrow and are very susceptible to damage caused by the construction process.

3.2.7.2 Roads

Heathrow is surrounded by an extensive road system. Ranging from nationally significant roads system (M25) to major trunk roads and minor local roads. The planned development impacts this road system from the south of the airport around the western side and too the northern zone. Part of the early works will be to reconfigure these roads to create the space to deliver the Heathrow expansion as set out in the Preferred Masterplan.

To facilitate the expansion at Heathrow, major changes to the surrounding road network are required. This includes realignment of the M25 and A4. The schematic of the existing road network is shown in Figure 13 and the new road network is shown in Figure 14.

The A4 will be realigned and reconfigured to the north of the NWR. HAL has currently produced a number of alternative alignments due to the complexity of this work. The proposals will however enable offline construction prior to connecting to the existing road network. It is proposed that the A4 diversion works begin in [redacted] 2022 and conclude in [redacted] 2024.

HAL has built an extensive road development sequence that respects the need to maintain access for all around the airport as well as maintaining routes for staff and passengers into the airport. The road system are the main arteries for all the functions at the airport, and ensure it continues to function.

While much has been made of the relocation of the M25 to free up the runway development the re-provision of the existing A4 provides a much more challenging route and resolution and will directly influence the earthworks to the north of the existing runway.

The sequence published by HAL indicates the significant level of thinking that has gone into the works and indicates that the road design has also been adjusted to provide the maximum space for the earthworks.

The impact of the works sequence associated with the relocation of the M25 is a significant strand through the main works programme. The re-provision of the HV infrastructure is planned to commence before the DCO approval has been achieved.

Once approval is given the space can be cleared for the new M25 route. This can be constructed "off-line" to minimise disruption. Once completed, the existing M25 can be transferred to the new route. The existing M25 can then be cleared and the area prepared for the earthworks and runway infrastructure construction.

This string of activities is key to the creation of the new runway and requires the early works to commence before the main approval of the Preferred Masterplan. This indicates the significant nature the road system will play in the development of the Heathrow scheme. Arcadis notes that the delivery of the road elements is crucial to the timeline risk associated with works commencing before the DCO process has delivered the required development approval.

The current scheme indicates that the relocation of the M25 infrastructure will be constructed adjacent to the existing route. This would be the preferred solution to creating the space required to deliver the runway. It also creates the opportunity to construct most of the new motorway "off-line" with minimal disruption to the existing traffic flows.

There are significant challenges associated with the motorway junctions as these will be re-modelled to provide access to the new road layout. These will be the areas of concern during the development because of the risk that these will be the cause of major disruption and delays to the free flow of traffic into the Heathrow campus.

There will be an area of the M25 / A4 development that will require careful co-ordination. This will be the construction of the new M25 route around the existing A4 overbridge. This bridge cannot be demolished and cleared until the alternative A4 route has facilitated the closure of the existing road.

This will place areas of the A4 road development as constraints on the creation of the alternative M25 route. This will require careful management and close co-ordination between two key packages of works. The phasing plans as presented by HAL indicates that the new A4 route will be opened in early 2024. With a target to complete the M25 works 1 year later.

In addition to the M25 realignment, the existing single J14 on the M25 will be removed and replaced with two junctions. Again, Arcadis understands that this will be constructed offline and then connected once complete.

Arcadis understands that the diversion of the A3044 is included within the local roads programme however the delivery programme does not state if the realignment will be constructed offline. It is

proposed that the construction of the A3044 diversion begins in [redacted] 2022 and concludes in [redacted] 2024.

Arcadis agrees with the principle that constructing the roads offline is the right approach as it should simplify and speed up the construction process, whilst minimising impact on the existing road network or airport operation.

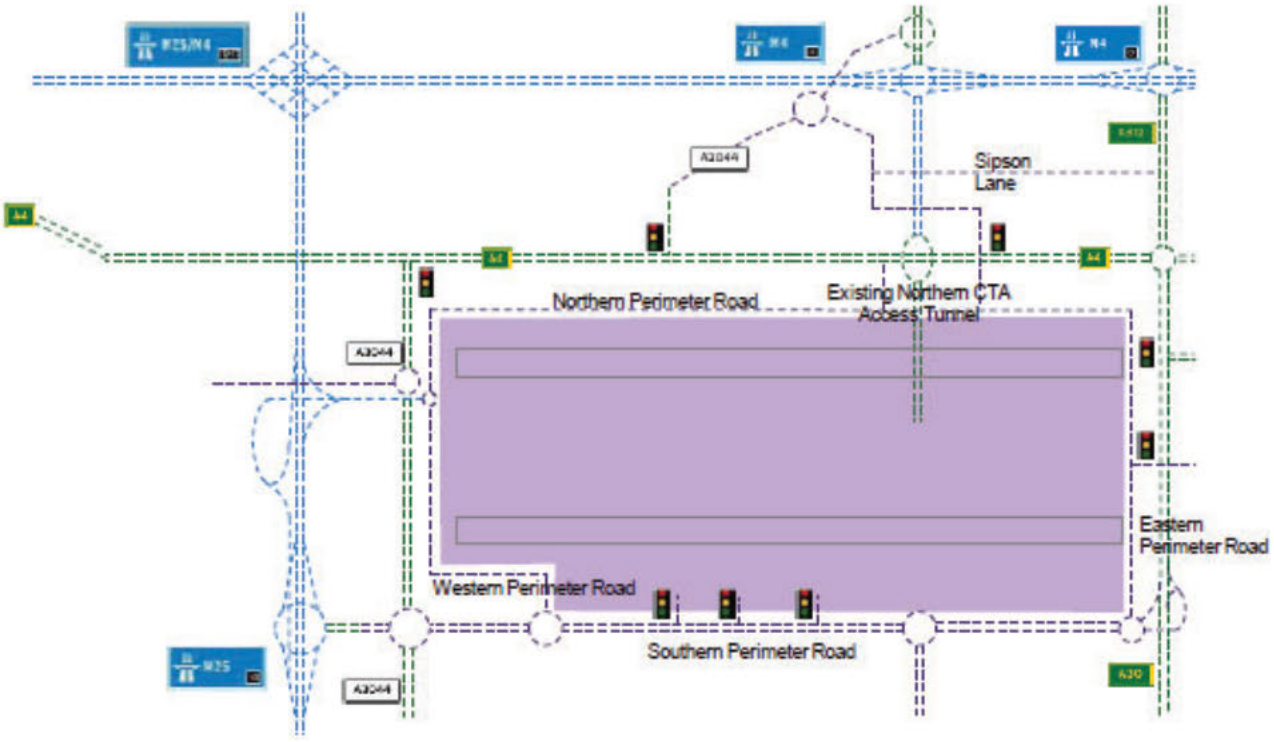


Figure 13 Existing Roads Layout
Source: ([redacted])

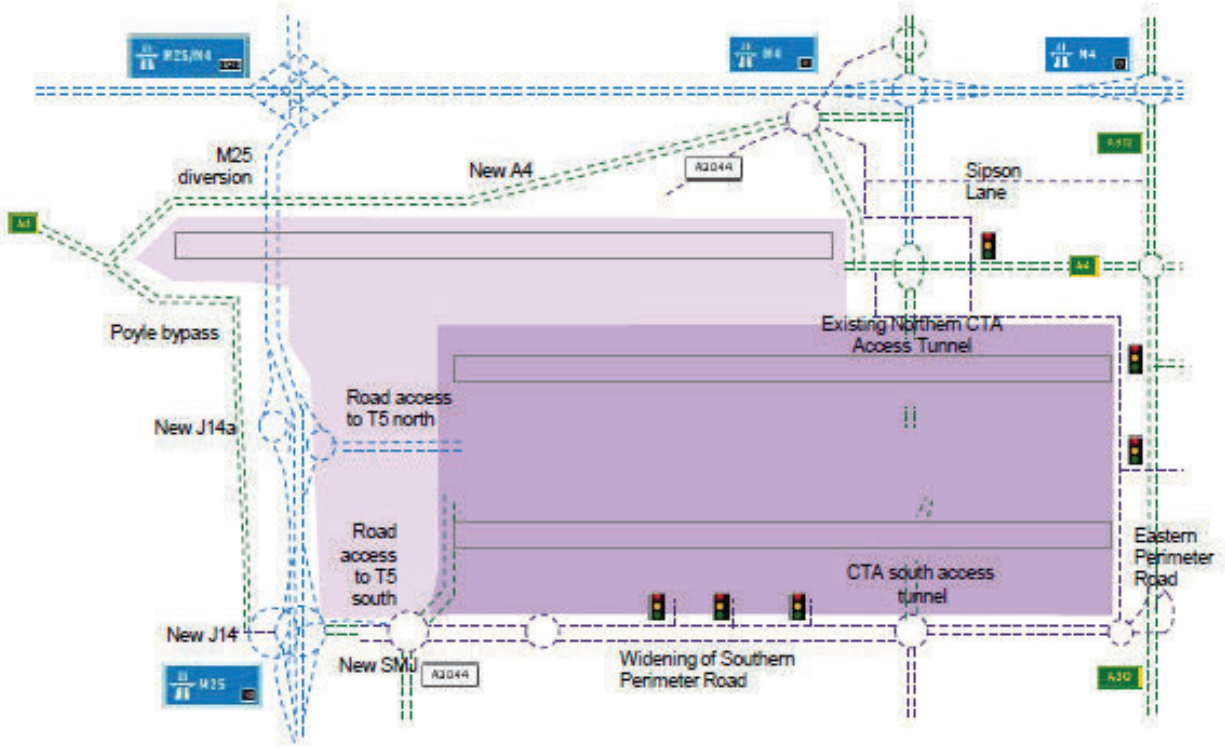


Figure 14 New Roads Layout
Source: ([redacted])

3.2.7.3 Rail for Construction

The non-passenger rail system will be enhanced with new freight, fuel and sidings facilities to the north-west of the new 3rd runway.

For operational purposes the primary use of the rail facilities is to provide and maintain the fuel supply

to the airport. However, HAL has indicated that the rail facilities are also planned to be used to transport construction materials to and from the site.

The railhead is scheduled to be completed in [redacted] 2023 – and so will not be available for the first year of construction which includes the construction of the A4, A3044 and M25, initial earthworks, river diversions, property demolition and utility diversions.

3.2.7.4 Utilities

The first major utility works is currently planned by HAL to commence prior to DCO approval. The works to the M25 are dependent on relocating the existing above ground electricity pylons. These are currently situated in the path of the realigned M25. The works to relocate these are scheduled for [redacted] 2020.

All utility works are scheduled for completion in [redacted] 2024.

3.2.7.5 Properties

HAL has indicated that demolition of properties will commence in [redacted] 2022 with the last demolition scheduled to be completed [redacted] 2024. This is consistent with the assumption that the acquisition process will have concluded by [redacted] 2022.

However, as indicated in the risk section below, there is a risk that the acquisition process takes longer than anticipated which may then impact upon the overall delivery timescales.

The acquisition of properties is controversial with any development. Arcadis has not seen any provision in the delivery timetable to take into account potential action by protestors that may slow down or hinder the delivery of this phase of the process.

3.2.8 Earthworks

HAL has placed a significant amount of work to resolve the earthworks strategy and when questioned provided a credible sequence of works.

The following extracts from a HAL presentation captures the strategic view of the early earthworks around the area of Harmondsworth, Sipson and Longford villages.

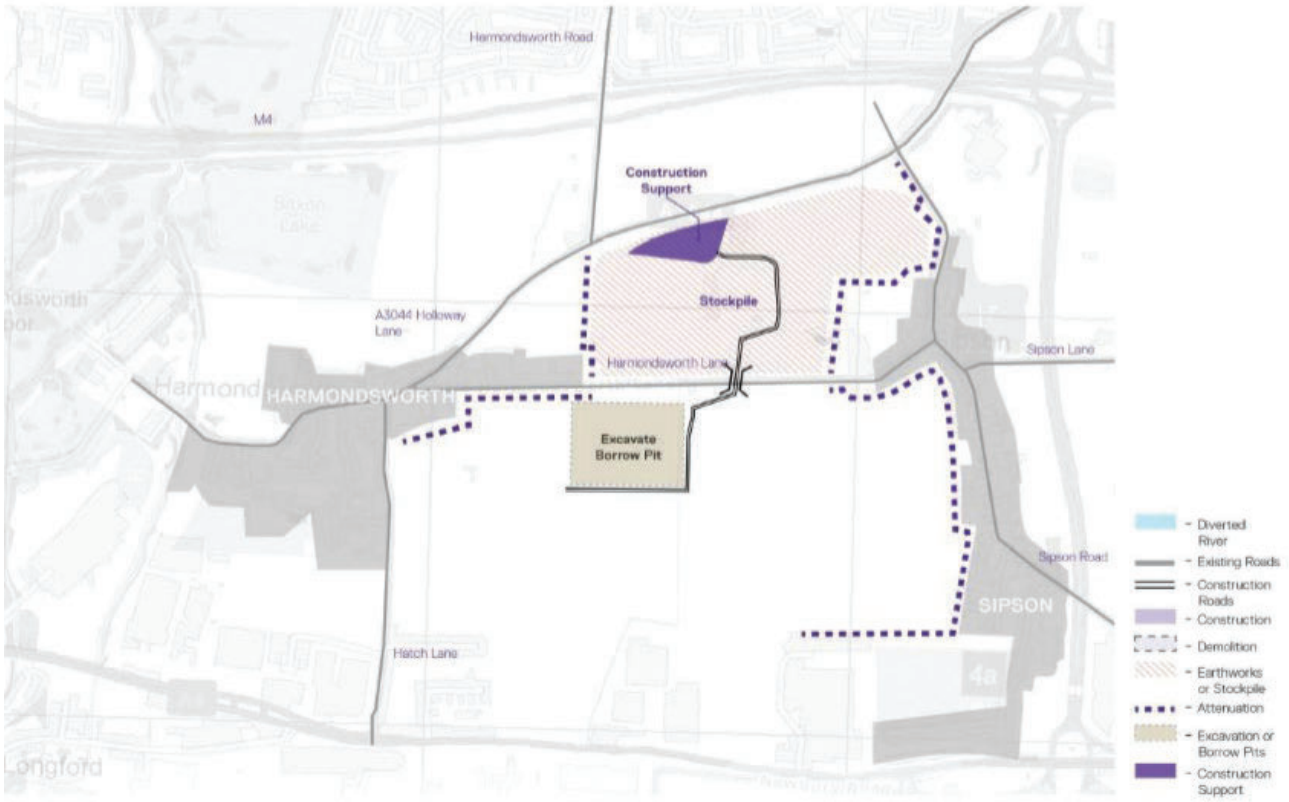


Figure 15 Earthwork Phasing – Stage 1
Source: ([redacted])

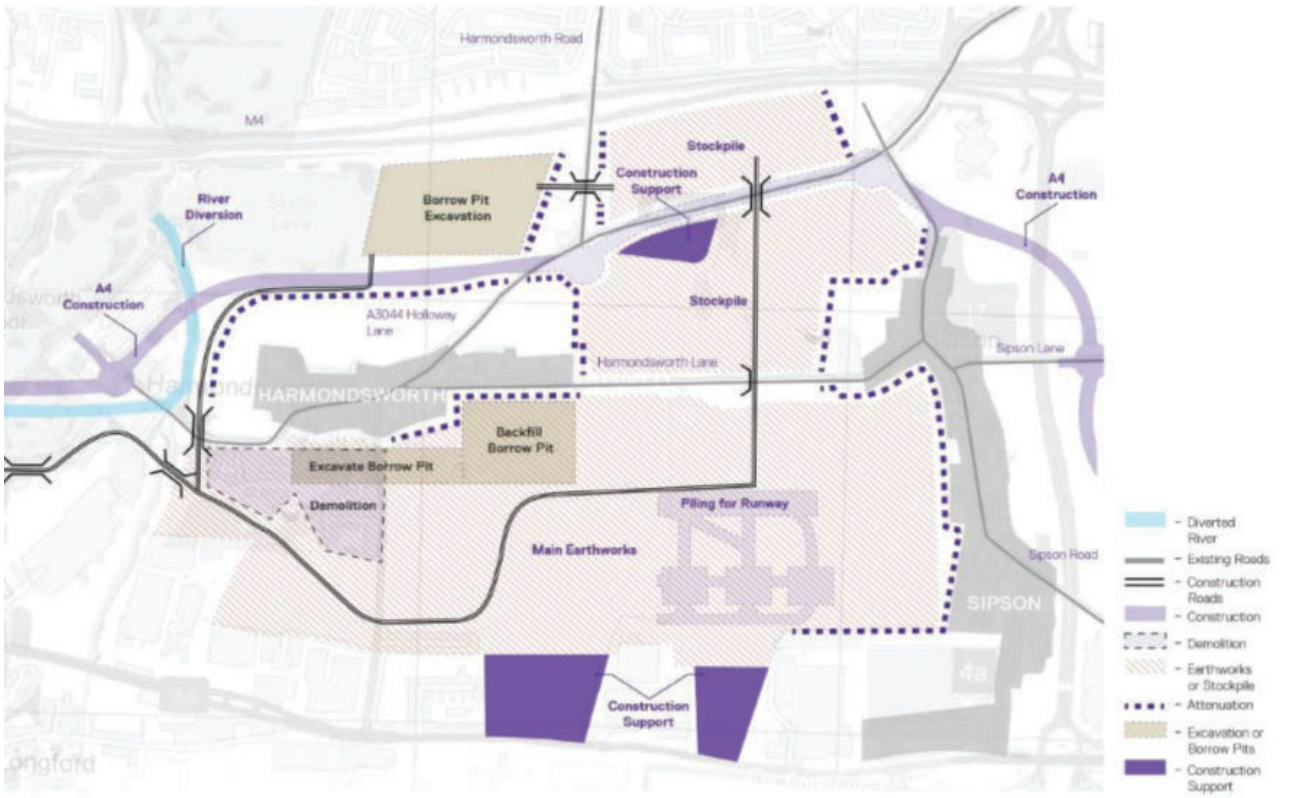


Figure 16 Earthwork Phasing – Stage 2
Source: ([redacted])

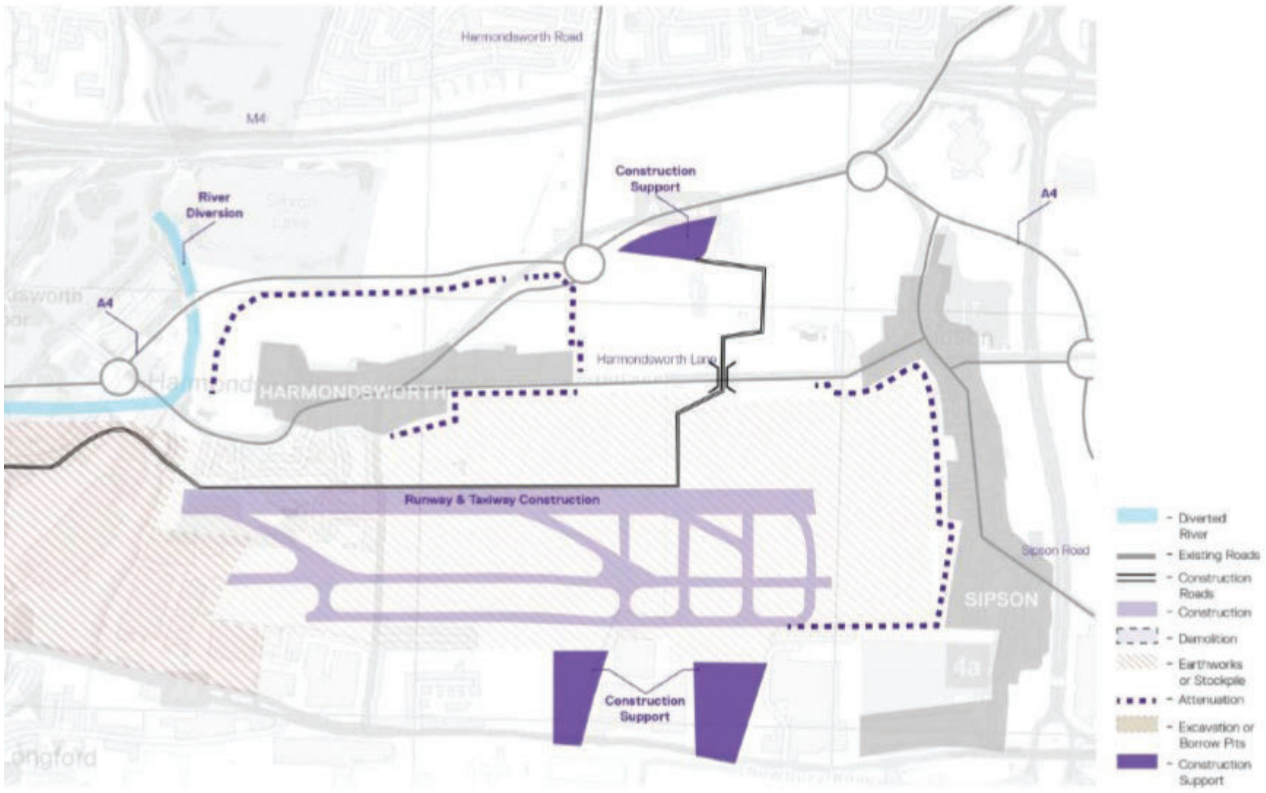


Figure 17 Earthworks Phasing – Stage 3
Source: ([redacted])

As can be seen from the high level slides the earthworks and reconfiguration of the road system are linked and create a delivery sequence.

The challenge to the earthworks will be the need to create borrow pits that provide clean fill and transfer any contaminated arisings into the borrow pits to mitigate any migration of spoil off site. This sequence is critical to the success of the earthworks strategy and relies heavily on integration between differing suppliers and the works commencing at the earliest opportunity in [redacted] 2022.

When asked for clarification HAL confirmed that they will require long working windows and multiple shifts during the first year to achieve the target of moving [redacted] material during the first year and approximately [redacted] the following year. This presents a very challenging target to be achieved by the supply chain and will require detailed engagement with existing contractors. When challenged HAL responded that they have had extensive dialogue with the supply chain and validated the targets against industry norms. However, it is a challenging target and could be easily de-railed by exceptionally inclement weather or curtailed by intervention by the local authorities if the impacts of the works become intolerable.

The success of the earthworks programme will rely heavily on a positive engagement with the specialist supply chain, as well as the contractors having access to the right equipment in enough volume to achieve the goals set. Procurement of the supply chain will have to have progressed to the point of placement of the contracts due to the limited mobilisation period after approval has been granted. There are significant risks within the earthworks works packages due to the interfaces between each area. HAL is aware of this risk and intend to engage with the supply chain on a more collective responsibility contract.

With a limited earthwork season (spring to autumn) these targets are ambitious and will require multiple shifts per day and 6 days a week working. Which may cause conflicts with the local authorities due to detrimental impacts. Arcadis understands that HAL is working through these challenges to create a stable working regime that will help to achieve these goals.

3.2.9 Main Works

Once the space has been cleared by the early works and the reconfiguration of the road systems, the remain space will be developed to create the new runway. There are multiple areas of development that will be progressed upon completion of the DCO process. The constraints at the beginning are around the environmental mitigation measures that will be required to be instigated as soon as the DCO approval has been granted. The early stages are governed by the need to set up the construction support areas and logistic strategy.

Very quickly the whole area will be impacted by the development. With the earthworks dominating the northern sector. The early years are dominated by

the need to relocate and remove the existing occupiers of the areas under development. These include commercial properties, residential properties and a few key utility relocations. This is shown as taking 2022 and 2023 in the phasing plans. While the areas are being cleared of existing functions and facilities the existing airfield will be adapted to allow for connections into the new areas.

HAL has undertaken a detailed assessment of the main body of works to understand the required sequence, constraints and influencers on the works. They have created a high-level programme with the appropriate time periods to undertake the identified scope in the required sequence. It is the appropriate level of planning with the information available at this early stage in the development. Further work will be required to determine the next level down in detail to enable a guidance programme can be created to inform the procurement process. The programme has a series of key milestones that help to identify the targets to be achieved it also identifies the multiple level of projects that are to be delivered.

The development at Heathrow is complex in that it requires a significant number of projects to clear space and then change the function of that space. Which in a normal development would provide a clear and concise path through the development to enable the easy identification of the key or critical projects. The reconfiguration of Heathrow to facilitate additional airline capacity requires the redevelopment of entire sections of the surrounding areas. The consequence will be that any of these projects and sub-projects could have a detrimental impact on the overall development. It will be up to HAL to instigate a robust management and control plan to ensure close monitoring of all projects with the portfolio of development at Heathrow.

HAL has published a works delivery sequence in the form of time slices slides (Appendix A). These provide a pictorial representation of the main works over a period of 2020 to runway opening in 2026. It is clear to see from these slides that the area around Heathrow will be significantly impacted by construction activities. There will be concerns that the extra traffic needed to feed the construction sites will cause disruption to the normal operations at Heathrow. HAL is fully aware of this risk and in discussion have referenced the work done to identify remote parking, and remote manufacturing centres to move as much of the construction process away from the Heathrow site. There is bound to be a detrimental impact of the works on the day to day operations, with particular concern around the changes to the roads systems. Further work will be required to fully understand these risks and impacts.

3.2.10 Risks

HAL has identified the top 15 Expansion Risks for the **Step 0**, as indicated in Figure 18. A number of these directly relate to Deliverability.

HAL has identified that the pre-DCO enabling works can begin prior to the main external works. The schedule indicates that this will include ecology related works beginning [redacted] in 2022. This will be ongoing whilst the DCO application is under consideration and awaiting a final decision. We do not consider this a risk to the delivery programme.

Arcadis considers the earliest risk to the delivery of **Step 0** comes from the DCO process, property acquisition and business relocation. These must be completed prior to the main **Step 0** construction programme.

The risks have been identified by HAL and mitigation measures are in place. The relevant Risk ID and Risk Titles are detailed in the HAL document, Risk Management – M4 and the summary of these risks are indicated below.

Arcadis has seen evidence that HAL has been working through the risks identified in this early phase of the process and is seeking to develop appropriate mitigation measures to minimise the impact of any risks.

HAL has undertaken a Quantitative Schedule Risk Analysis (QSRA) assessment of the proposed schedule, with respect to schedule integrity. This assessment resulted in a P value of [redacted], indicating a [redacted] likelihood of achieving the schedule. Arcadis recognises that this reflects a schedule that has been designed to deliver the new 3rd runway at the earliest possible opportunity. Arcadis has not reviewed the likelihood of any alternative runway opening dates as part of this review.

It should be acknowledged that such a major programme will have risks that HAL can mitigate as these are directly under HAL's control. However, there will be a number of risks that HAL does not have direct control over which could lead to delays in the programme that will impact on HAL's ability to deliver the timetable for **Step 0**.

3.3 Summary

Arcadis has assessed the key elements required for the delivery of the new runway from the existing airport operation to 2026, **Step 0.**

It is clear from the significant amount of work that HAL has undertaken that the sequencing and multiple elements of the scheme are presented in a logical and well thought our sequence.

Arcadis has seen evidence that HAL have sought to deliver the most efficient sequencing to aim to deliver the new runway by 2026. This efficiency has however created a programme that is both ambitious and optimistic with little margin for delays or risk.

Although it is not unfeasible that this programme and sequencing for the delivery of the required infrastructure could be achievable, this is reliant on the programme timings set out in the plan to be delivered.

Arcadis has identified a number of deliverability challenges that, although may be achievable to meet the ANPS target of 2030, could only be deliverable by 2026 if no significant delays take place in the programme.

The first challenge to delivering the new third runway by 2026 requires the full DCO process to have been completed by [redacted] 2021.

Whilst HAL has planned the DCO timescale around the “normal” allocation of time, it does not allow for any contingencies in the timings. The Heathrow scheme has attracted a lot of public scrutiny over the years and there would be no reason to suggest that it will not be subject to intense scrutiny during the DCO process.

The proposed development programme requires that the earthworks to proceed in [redacted] f 2022, and therefore any delays in the approval process will have a detrimental impact on the proposed start of works.

There is a significant amount of key activities that are positioned as early works within the proposed development timelines. While this is not unsurprising within the context of the volume of works required to be completed within a tight target to achieve a new runway by 2026, some of the identified works will require separate approval routes to the main DCO, they will also require commitment to placement of contracts to deliver replacement assets before the main works are let. There is also a need to review the planned dates for some of the replacement assets such as the school replacement projects that are not harmonised with the school academic year.

The river diversions are environmentally sensitive areas in conflict with the timings and demands of the construction process. The consent granting body associated with these water courses has significant interest and powers over the scheme, which could lead to tensions in the approval process.

Careful management of the changes to the water courses will be the route through these challenges. HAL will need to be aware of the seasonal nature of some of these works and draw up a plan accordingly.

The existing rivers and water courses and the new routes play a significant role in the ecology and environment of the areas around Heathrow and are very susceptible to damage caused by the construction process.

The road system amendments proposed by the scheme are a significant risk to the development due to the complex sequence of works required. There are many risks associated with the re-configuration of the road systems and as such the construction activities will present many challenges

The success of the earthworks programme will rely heavily on a positive engagement with the specialist supply chain, as well as the contractors having access to the right equipment in enough volume to achieve the goals set.

Procurement of the supply chain will have to have progressed to the point of placement of the contracts due to the limited mobilisation period after approval has been granted. There are significant risks within the earthworks works packages due to the interfaces between each area.

The volume of earthwork required to be achieved in the first two years is significant. A limited earthwork season (spring to autumn) means these targets are ambitious and will require multiple shifts per day and 6 days a week working. Which may cause conflicts with the local authorities due to detrimental impacts.

HAL has published a works delivery sequence covering the main works over a period of 2020 to runway opening in 2026. It is clear to see that the area around Heathrow will be significantly impacted by construction activities. There will be concerns that the extra traffic needed to feed the construction sites will cause disruption to the normal operations at Heathrow.

HAL is fully aware of this risk and in discussion have referenced the work done to identify remote parking, and remote manufacturing centres to move as much of the construction process away from the Heathrow site.

There is likely to be a detrimental impact of the works on the day to day operations, with particular concern around the changes to the roads systems. Further work will be required to fully understand these risks and impacts.

4 TIMING

Arcadis has assessed whether the masterplan and plans for the **Step 0** period is timely. The review has considered whether the Preferred Masterplan and planned deliverables for **Step 0** can be provided in accordance with the specified duration in the programme and the dates and deadlines detailed.

Arcadis has considered the risks to providing the relevant deliverables in accordance with the current specified duration in the programme and on the dates and deadlines detailed in HAL's plans.

The review has analysed the impact of failing to provide for the relevant deliverables in accordance with the current specified duration in the programme and what strategies have been developed to mitigate risks and any subsequent impacts from failure to delivery in a timely manner, with consideration for interdependencies.

Arcadis's key findings are:

- HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable;
- The current programme includes risk allowances for each component of the masterplan assessed on the basis of industry norms. There is no apparent programme-wide allowance for schedule risk; and
- With such a complex programme involving a significant range of interdependencies, many of which are out of the control of HAL, the objective to deliver an operational runway by 2026 carries a high level of risk.

4.1 Definition of Theme

This section of the report reviews whether the Preferred Masterplan can be delivered in a timely manner from the existing airport infrastructure to **Step 0.**

Arcadis has already reviewed the proposals to ensure that they follow a logical delivery sequence. This purpose of this section of the report is to assess the programme Work Breakdown Structure (WBS) and overall schedule resilience.

The WBS has been presented to Arcadis in a form of a detailed Gantt chart developed in recognised programme management software using benchmarked and as build data sources to develop the schedule. Table 17 sets out the key dates that are contained within the programme that HAL is seeking to achieve to be able to deliver the new runway by 2026, **Step 0**.

Table 17 List of Milestones
Source: (Arcadis 2019)

4.2 Assessment

In order to undertake this review Arcadis has engaged with HAL attending presentations with HAL then providing the presentation slide decks.

In addition, Arcadis has undertaken sessions with the relevant Subject Matter Experts at HAL who have developed the programme schedule and have answered detailed questions regarding the information presented to Arcadis.

Arcadis has been provided with access to a detailed assessment of the schedule structure that was undertaken by Costain on behalf of the Department for Transport in June 2019. The report investigated the Work Breakdown Structure (WBS) and overall schedule resilience

The results of those investigations is published in a report *DfT Heathrow Expansion Programme, Assurance Review of Heathrow Airport Limited Delivery Schedule* dated 14th June 2019.

Arcadis' review has fundamentally considered the same information and approach that has already been assessed by Costain but for the purpose of this report has only considered the programme up to **Step 0**.

4.2.1 Pre-Construction

Development Consent Order

The expansion at Heathrow requires the developer to seek a DCO and there are clear steps that the developer will need to follow to comply with the process.

Arcadis has examined HAL's programme and the timings are dependent upon HAL having an unopposed submission that will pass through the pre-examination and examination process without dispute. The proposed DCO timescale does not allow for any deferral of the final approval date of the submission. To underwrite this aspiration the original documentation will have to achieve total and full compliance with the DCO requirements.

HAL is fully aware that there is opposition to their scheme and there have been legal challenges and attempts to seek multiple judicial reviews over time to seek to slow down or stop expansion at Heathrow. HAL has experience of working through complex planning submissions and are aware of the level of engagement required to gain approval.

As part of the DCO process, there is a requirement to create a body of information and evidence prior to formal submission. HAL has undertaken multiple formal consultations as well as many informal consultations. This has enabled them to capture a significant amount of responses and points of issue.

These consumer insights have been fed back into the design development process. This should give HAL the opportunity to balance their emerging design and associated mitigation with the needs of the scheme objectors.

Arcadis has not undertaken a comparison between the 3,000 responses received in the spring 2018 consultations and the emerging design agreed at the M4 gateway. HAL has confirmed that it has taken into account, and sought to address, the concerns raised during the public consultations.

Having also engaged with the relevant consent granting bodies, HAL has a clear understanding of the concerns and areas of objections likely to come from these sources.

In addition, HAL has also taken extra measures to ensure that they gain acceptance from a wider audience with the introduction of an inclusive procurement strategy and a draft construction management plan. The dedicated expansion website pages have extensive information and are designed to help engagement of all relevant parties.

Whilst there is little doubt that HAL is planning to achieve a 100% compliant submission there are always external influencers that could cause the planned timescale to be extended beyond the planned [redacted] month period. As can be seen from the graph (refer to Figure 10) the process does not always follow the prescribed timescales.

The period allowed by HAL from submission to approval of approximately [redacted] days. Arcadis has compared these timescales against other submissions and although some simpler developments are shorter, 1/3 of schemes that have gone through the DCO process have taken longer.

Arcadis considers that a vigorously pursued Judicial Review could cause enough delay to the approval process to cause the planned spring earthwork window being lost, delayed or compromised.

Arcadis considers the time allowance between DCO approval and start of works in [redacted] 2022 is ambitious with little or no contingency. It will rely on a period of effective and swift discharging of the planning conditions imposed on HAL after the DCO date.

It is likely that HAL will be aware of the planning conditions at the point of the Planning Inspectors recommendation to the Secretary of State. However, there will be a risk that more will be imposed during the final stages of the process.

Consent Deliverables.

Arcadis is aware HAL understands its requirement to map the environmental impacts of the planned works in detail. HAL has indicated an understanding of the seasonal variations for each species expected to be discovered within the development zone.

As part of its assessment Arcadis discussed with HAL how they would deal with contingencies if species were discovered in key earthwork zones. One example includes Badger Setts within the area of the early earthwork areas. There are known Badger Setts on the edge of some of the early earthwork zones. These will be of interest to the Environmental Agency and the means by which HAL will protect existing species.

As part of the Preliminary Environmental Impact Report (PEIR) a full field and desktop study of all the areas impacted by the scheme will need to be undertaken by HAL. Arcadis understands the scope of this study has been agreed with the relevant authorities. This will form the basis of all studies and environmental mitigation measures undertaken between pre-submission and the completion of all works.

HAL has indicated that they have created all documentation as required by the Development Consent Order (DCO) process as well as enquires by the relevant authorities. The published schedule indicates the time allowed for these studies. HAL is aware of the need to create the full information pack in support of the DCO submission prior to the review by PINS (Planning Inspectorate) as any failure to provide the full information will risk the rejection of the submission at the first hurdle.

4.2.2 Design

The Preferred Masterplan schedule supplied by HAL has indicated a period for design development. HAL has indicated that there are several key design Consultants engaged to deliver the necessary detail, from concept guardians through to engineering specialists.

The design programme as indicated on the Preferred Masterplan schedule indicates the required time frame for the design and is at a level that would be in keeping with a pre-submission scheme. However, Arcadis considers that the complexity and potential impacts of the works would requires a clearer statement of the design development process.

Arcadis has not been able to analyse the fully detailed design programme but HAL has indicated that this has been set up to feed into the procurement timescale. Arcadis considers that with a scheme of this complexity there will be a need to progress the design on many fronts to ensure visibility of the interfaces between works packages and systems to ensure compliance. HAL is aware of this constraint and are pursuing this strategy through the procurement process.

HAL is currently working through the design development to achieve the Preferred Masterplan milestone of M5. This is intended to pull in all the comments and issues raised during the consultation process to provide an updated design that will form the basis of the DCO submission in [redacted] 2020.

This should also provide the basis upon which the early works packages will be progressed into the procurement process. There are indications of the need to progress key areas of design early to feed the requirements of the early works and procurement of the large infrastructure works.

Arcadis were unable to review in detail the plan for elements such as the SSE high voltage works, the M25 infrastructure, the replacement of the Immigration Centre and Harmondsworth School facilities. These will require detailed work over the next period to ensure full compliance prior to the works commencing on site.

Arcadis is aware that one of the key constraints to the development of the new runway construction will be the Energy from Waste facility. HAL are working with the owner of this asset to undertake a separate planning application to relocate this facility. There is a significant risk that by removing this facility from the DCO process that the Local Authority Planning Application could reject or defer this application and causing this project, and the DCO, to be delayed.

It is Arcadis' view that this could have a detrimental impact on the planned construction sequence and timings of the main runway works. Although HAL is aware of this risk, by transferring this to a separate developer they have diminished their close control of this risk and any opportunity to mitigate this.

4.2.3 Procurement

HAL has created a delivery procurement strategy that has been reviewed by the airline community. The high-level mission statement to "Create a Heathrow Expansion Procurement Strategy that motivates productivity, drives value for money to create a new UK benchmark for the way infrastructure is sustainably procured that delivers the programme."

Arcadis has not been provided a detailed procurement plan built into the information supplied by HAL. Discussions with HAL indicates that it has been undertaking a review of the works packaging strategy and procurement methodology to ensure their stated aims (as listed above) will be achieved.

The focus to date has been to create the design and delivery strategy as required to meet the requirements of the DCO process. Whilst HAL has engaged the services of a professional construction adviser who has advised them on construction methodology, sequence, and timings, there is a lack of detail to the next level on procurement.

Arcadis has raised queries in discussion with HAL on the likelihood of the need to build the OJEU process into the time allowance for works, especially those relating to works outside of the airport boundary.

HAL has not yet clearly identified which packages of works may require OJEU. This may be a function of the unknown status of the UK post 31st October 2019 however any requirement to undertake OJEU procurement could extend the programme and therefore delay the implementation of works.

4.2.4 Pre-DCO Works

Arcadis understands that, to achieve the required clearance of the development space there are certain projects that need to be undertaken prior to the full DCO approval has been achieved.

These are required to clear key areas to facilitate the works and are time critical. This is because of the long string of works that follow these key early works or the need to remove the constraint on the development early.

These projects include the relocation of a high voltage cables and associated substations, which are required to cleared out of the way to make room for the construction of the new M25 alignment. This works sequence influences the requirement to demolish the existing M25 road to allow for construction of the new runway. Whilst it is not a constraint on the commencement of the runway works it is an influence on the middle section of the runway development.

Other projects are pre DCO due to the need to re-provide the facilities to enable occupancy by the construction contractors to clear the areas and commence the earthwork as soon as possible. These projects include for the re-provision of the Harmondsworth Primary School, Immigration Centre, and Energy from Waste facility.

4.2.5 Roads

The reconfiguration of the M25 and A4 are key to the release of a significant area of the development site, to the north and west of the existing Heathrow campus.

The M25 road amendment is constrained by two primary strings. The first will be the design and procurement processes that are required to deliver a Highways England compliant scheme. the second will be the need to clear high voltage surface cables from the development zone.

This sequence is shown below.

Source [redacted]*)*

Due to the timing of the works the HV infrastructure works will occur prior to the scheme DCO approval. These works will have a significant influence on the overall development timescale and any delays in this work stream will impact in HAL's ability to deliver the runway for 2026.

The current sequence and timings assume that all the works will commence at the earliest opportunity and the design and procurement and works to the SSE HV network will commence pre DCO approval. Arcadis understands that there are few opportunities to mitigate delays in this sequence, however it will not completely stop the commencement of the runway build but significantly influence the completion of the middle section.

The other key road system will be the relocation of the A4 trunk road. This again will influence the earthworks and development to the north west of the current campus. It is vital that traffic is routed away from the main earthworks zones and an alternative route around the western perimeter is created, before the existing road system is shut down.

The significance of the A4 will also play into the relocation of the M25, as there is currently a significant bridge that takes the A4 over the M25. The impact of this can be seen by the following works sequence. Deliver the alternative A4 Route including a temporary bridge over the 'live' M25 and an enabling A4 bridge over the M25 diversion.

Source [redacted]*)*

The creation of the new A4 route will involve a significant bridge structure over the live M25 to allow traffic to pass from the west of Heathrow to the north.

These two areas will need to be worked up in detail with the supply chain to de-risk these very difficult scope of works. Whilst a period for these works has been allowed within the Preferred Masterplan programme schedule, Arcadis understands that it will be difficult for HAL to assess the certainty of the proposed timescale until further design work has been undertaken.

Although the existing construction delivery consultant will have undertaken a review of the sequence and timings to give a professional opinion on the likelihood of achieving the required dates, there is a risk that any delay to the A4 is again likely to impact on HAL being able to achieve the runway opening of 2026.

4.2.6 Earthworks

HAL has developed a strategy around the DCO consent being delivered in [redacted] 2021, and the main earthwork commencing in [redacted] 2022.

The requirement is therefore for HAL to mobilise, set up the required logistics centres, clear any DCO conditions, achieve vacant possessions, and undertake environmental mitigation measures in order to achieve a meaningful start of the earthworks in [redacted] 2022.

The stated goal of the first year of earthworks is to move approximately [redacted] of material. To achieve this goal HAL is planning to work extended days and weeks during this first season. Whilst much thought

and investigation of the possible methodologies has been undertaken, HAL cannot finalise the actual methodology until the DCO process has delivered any imposed constraints.

Due to the tight timescales allowed in the programme, between the DCO approval and the start of works, any delays in the DCO approval process will have a direct impact on the ability of HAL to achieve the planned start of the works in the [redacted] 2022. The target of the [redacted] of material to be moved would then be compromised.

The HAL strategy requires large areas of land and existing facilities to be available under Vacant Possession at the beginning of the works. To achieve this, HAL has indicated that they will be negotiating agreements with the various landowners and vested interests prior to the DCO. These agreements are planned to come into force at the point of DCO approval with dates indicated within the programme for some of the key land acquisitions to become operational [redacted] after the issue of the DCO.

Arcadis is not able to accurately forecast whether the required parcels of land will be available on the required date, with the risk that the process may take longer than planned. This will also put pressure on the earthworks sequence and methodology leading to potential delays in the release of areas to following activities.

The earthwork periods are constrained by weather impacts, with the expectation that the majority of the work will be carried out from spring to autumn in 2022 and 2023. Seasonal variance and inclement weather could have a significant impact on the ability of HAL to deliver the required production targets.

Arcadis considers that with a limited earthwork season (spring to autumn) the programme targets are challenging and will require multiple shifts per day and 6 days a week working. Arcadis understands that HAL is working through these challenges to create a stable working regime that will seek to achieve these goals.

4.2.7 Runway Opening

The runway delivery sequence as defined by HAL in the time slice presentation (images in Appendix A), seems to be in keeping with the known constraints around the campus at Heathrow.

Arcadis has seen a sequence that shows a clear strategy to deliver the works as and when required. It highlights the works necessary to be cleared in advance of the main runway delivery. It also shows the constrained method of delivery for the main runway works. The Preferred Masterplan programme schedule supplied by HAL indicates the proposed time periods for the works.

Arcadis has discussed the development of the programme with HAL. Arcadis notes that no separate allowance has been made for programme-wide schedule risk. HAL has clarified that programme allowances for individual work-packages are based on industry benchmarks for completed work and accordingly include allowances for programme delay.

However, in our experience, a prudently designed masterplan schedule will include some allowance for programme risk, dealing for example with the interdependency of work items on the schedule.

Arcadis has analysed the document "[redacted]t" that was published on [redacted] 2019. HAL's report sets out information on the benchmark data used and the source of that data. Although this helps to validate the time periods allowed within the programme, it does not eliminate any schedule risk and only clarifies the periods used.

4.2.8 Schedule Risk

Arcadis notes that, throughout the schedule and delivery sequence published, HAL has taken an optimistic approach to the interdependency of key components of the Masterplan. Whilst this outcome may indeed be delivered, it would be a prudent step by HAL to take greater account of a number of highly significant sequencing risks that we set out below:

Dependency on the Timing of the DCO.

HAL has been optimistic in achieving the key dates as set out above. HAL's Preferred Masterplan programme schedule assumes the ability to complete the DCO process within the proposed 17-month timescale.

Delivery of Enabling Infrastructure

The timescales to relocate the SSE High Voltage infrastructure, the M25 Motorway and the A4 Trunk road is again reliant on a smooth programme without delays or disruption. The A4 relocation must be completed for the site for runway construction to be made fully available.

Earthworks Schedule

Even once the site is available, the need to achieve [redacted] of earthworks in the first year, to the start of works within [redacted] of receiving the DCO is again ambitious, relying on additional consents to allow for extended working days.

Operational Readiness

HAL has not yet shared their plan for "day one operations". Arcadis has analysed the programme and has identified a period allowed for operational readiness. This period is indicated on the programme as 5 1/2 months, from [redacted] 2026 to [redacted] 2026.

Arcadis' assessment, based on other operational readiness activities that Arcadis has been involved with (including T5 and T2 at Heathrow) is that this duration is optimistic, as the new runway will require extensive integration into the existing Heathrow operations.

Arcadis understands that the new infrastructure will also require integration into a revised airspace plan.

Prior to this testing and proving period, there will be a need to update the airfield licence and operating procedures to accommodate changes to airspace.

These tasks are not highlighted on the master schedule received by Arcadis. The assumption being that these tasks will be undertaken in parallel with the construction delivery team and be ready and agreed prior to the operational testing period.

The date is driven by completion of the runway construction, which is shown as [redacted]. There is little or no contingency built into the start of this operational readiness period which we considered to be an optimistic position.

No information was provided on the detailed programme as to how the new runway capacity will be integrated into the existing Heathrow operations. Further work will be required to clarify all the conditions necessary to achieve a successful integration of the new assets.

Given the high reputational risk associated with handover and operational readiness, we expect that HAL would take a more conservative approach to their planning of handover timescales.

4.3 Summary

Arcadis considers that the overall Preferred Masterplan programme schedule is at the level of detail required for a programme of this scale at this stage of the development process.

HAL has developed a programme that has all the necessary steps needed to achieve the ANPS target for 2030 and there is no reason to suggest this date is not achievable.

HAL are aware of these risks. Figure 18 for example sets out HAL's assessment of the top 15 expansion risks, which include for example, the extension of the DCO period.

The programme has been developed from a sequence of discrete activities that each include their own allowances for schedule risk based on industry norms. There is no apparent programme-wide allowance for schedule risk and, based on our understanding of the methodology adopted by HAL, no additional risk allowance for the particular challenges associated with the delivery of the works sequence in a constrained location.

The risks and the work HAL has undertaken to consider these to the delivery and therefore the timing is set out in 3.2.10 above. Arcadis has seen evidence that HAL is continually developing and refining its risk assessment to the programme.

Arcadis has no doubt that HAL has spent a significant amount of resource developing its plans and is confident that this approach would allow HAL to achieve the ANPS target for increased runway capacity by 2030.

However, there are a number of elements within the programme that HAL will not have full control over and therefore cannot fully mitigate the risks associated with these tasks being delivered. The lack of control on specific elements such as the DCO process, SSE HV works, the Waste to Energy facility and M25 works could lead to timings and key milestones not being achieved that will have a knock-on to the rest of the programme.

Although HAL has indicated that they could mitigate some of the potential delays through re-phasing and moving around work elements within the programme, the key consequence of delays to the delivery of the runway or re-scheduling of works is likely to be an increase in costs and potential failure to achieve the 2026 date.

The ***Heathrow Expansion Programme, Assurance Review of Heathrow Airport Limited Delivery Schedule*** report prepared for the DfT by Costain has also highlighted a similar set of risks associated with meeting the 2026 timescale but again agrees with Arcadis' view that the ANPS target of 2030 can be achieved.

5 COST ESTIMATE

Arcadis has assessed whether the Preferred Masterplan Capital Expenditure (CAPEX) for the **Step 0** period is reasonably and reliably costed. The review has considered the approach HAL has taken to build, further develop and update their cost estimate in accordance with the Preferred Masterplan.

Arcadis has examined HAL's approach to developing the cost estimate any 'Scope Gap' and the certainty of the cost estimate based on the quantification of costs, pricing and confidence in costs, application of on-costs and HAL's approach to risk and maturity.

Arcadis's key findings are:

- HAL's Cost Estimate for **Step 0** is reasonably and reliably costed;
- Arcadis's comments from previous reports to the CAA have been taken on board by HAL and an all-encompassing baseline cost estimate has been produced by HAL;
- HAL's approach to the structure and methodology of compiling the Cost Estimate reflects industry best practice;
- The level of quantification and benchmarking has increased since previous iterations of the Cost Estimate with analysis of benchmarks from other sectors incorporated leading to an increased level of cost certainty; and
- [redacted]

5.1 Definition of Theme

This section of the report reviews the Cost Estimate for **Step 0.** HAL's Cost Estimate has already been reviewed and assured by the Independent Fund Surveyor (IFS). To understand the IFS's approach Arcadis met with the IFS in May 2019. Arcadis consider that the IFS has undertaken a thorough and detailed review of the Cost Estimate and have therefore looked to build on and further the work already done by the IFS rather than duplicate.

Arcadis has assessed whether the Preferred Masterplan Capital Expenditure (CAPEX) is reasonably and reliably costed. Arcadis has based their assessment on industry practice and Royal Institution of Chartered Surveyors (RICS) New Rules of Measurement (NRM).

An industry recognised approach to cost estimating is detailed below in Figure 19.

After compiling the Base Costs of the Cost Estimate Indirect costs are taken into consideration, these are detailed in Figure 20.

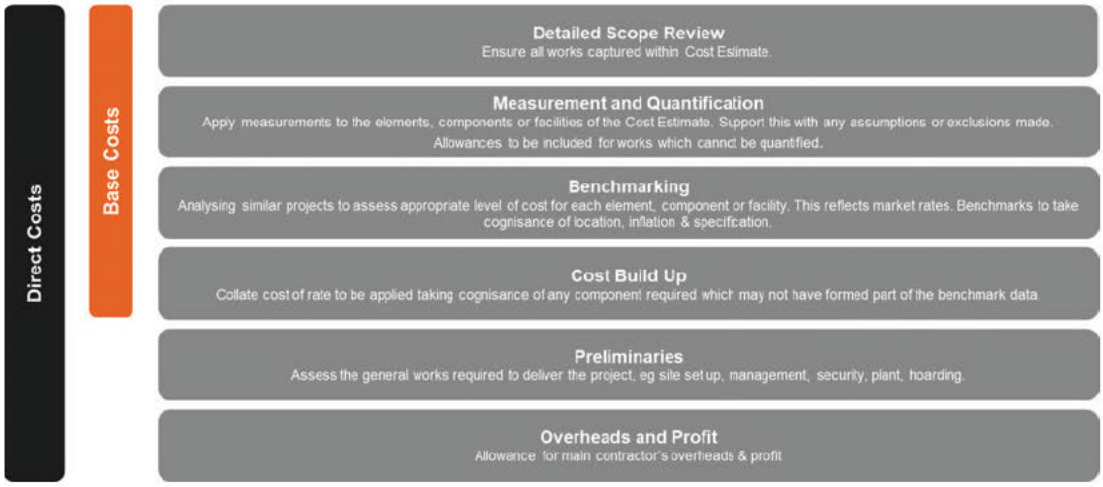


Figure 19 Approach to Cost Estimating, Direct Costs

Figure 20 Approach to Cost Estimating, Indirect Costs

Arcadis has considered the approach HAL has taken to build, further develop and update their Cost Estimate in accordance with the Preferred Masterplan. This consideration includes:

- HAL's approach to developing the Cost Estimate, process for development and future development, amendments to the Cost Estimate based on progress, assessment of progress and amendments to date; and
- Scope Gap review (Cost Estimate to design and delivery of Preferred Masterplan).

Arcadis has reviewed the certainty of the Cost Estimate that HAL has produced for the Preferred Masterplan This review includes:

- Quantification of costs: Assessing the amount measured, the basis of the measurements and the extent of work where quantification has not yet been undertaken;
- Pricing and confidence in costs (total, measured, assessed, benchmarks);
- Application of on-costs; and
- Approach to risk.

Arcadis has assessed the observed level of maturity within the Cost Estimate. This has included assessing:

- The robustness of evidence provided by HAL in relation to its Preferred Masterplan and associated cost; and
- The integration of Cost Estimate with other elements of the Preferred Masterplan such as; design, procurement, programme, logistics, external and mitigating factors, project specifics.

5.2 Assessment

5.2.1 Information Reviewed

In order to undertake this review Arcadis has engaged with HAL attending presentations with HAL for each Task Order. These Task Orders reflect the packages of work that the Cost Estimate is broken down into and is likely to be reflective of the structure of the packages to be procured. Following the presentations HAL provided the slide decks. These presentations were:

Report Title	Report Source
[redacted]	HAL
	HAL
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	HAL

Table 18 Presentations and Documentation Provided by HAL

Following these presentations, HAL provided their Cost Estimate; dated [redacted], which forms the main document for review under this section of this report. This document contains sections on scope, cost, schedule, risk & inflation. It has appendices containing:

- [redacted]

This document collates all the elements of the Cost Estimate and as such addresses one of the concerns Arcadis previously noted in earlier reports to the CAA.

Task Order	Direct (£m)	Indirect (£m)	Sub-Total (£m)
Enabling works	[redacted]	[redacted]	[redacted]
Earthworks	[redacted]	[redacted]	[redacted]
Utilities	[redacted]	[redacted]	[redacted]
Rivers	[redacted]	[redacted]	[redacted]
Roads	[redacted]	[redacted]	[redacted]
Runways & Taxiways	[redacted]	[redacted]	[redacted]
Landscape	[redacted]	[redacted]	[redacted]
Programme Specifics	[redacted]	[redacted]	[redacted]
		Total:	[redacted]

Table 19: Direct and Indirect breakdown of Cost Estimates
Source: ([redacted])

The largest section of the document is Appendix C: Cost Estimate. This contains cost reports at Task Order level, that reflect the different type of works being delivered as part of the programme.

Each Task Order outlines the scope, quantification, pricing, direct costs, indirect costs, assumptions & exclusions and benchmarking. In addition to the main document, Excel files were provided for the Cost Estimate element.

The Task Orders in the Cost Estimate cover all the works necessary for the Preferred Masterplan to be delivered. Arcadis has considered the following for review in **Step 0**:

- Earthworks;
- Utilities;
- Enabling Works;
- Rivers, Roads; and
- Runways & Taxiways and Landscaping.

In addition to the documents compiled by HAL Arcadis has also referred to the Independent Fund Surveyor's (IFS) report dated March 2019.

5.2.2 HAL Approach to Cost Estimate

HAL has set out their approach to the Cost Estimate in the following presentations and documents:

- [redacted]
- [redacted]
- [redacted]

The Cost Estimate is based on the M4 Preferred Masterplan and is further derived from the steps of the Illustrative Masterplan, the 'Kit of Parts', which was developed by the IDT and describes the key elements of scope, and other design & scoping information.

The Cost Estimate is broken down at Task Order level into direct costs and indirect costs.

HAL's structure and approach is set out as follows:

Direct Costs

- Receive design documents, drawings, scope/specifications, assumptions;
- Quantify, measure, enumerate, understand assumptions, raise queries, prepare Cost Estimate. Quantities are based on data provided or confirmed by the HAL's Integrated Design Team (IDT) which have been spot checked by HAL;
- Assumptions & exclusions made at Task Order level;
- Price using either top down benchmarks, bottom up pricing, reach back to business, speak to supply chain. Rates based on facilities benchmarked or elemental/bottom up rates; and
- Finalise Direct Costs within Cost Estimate.

Indirect Costs (added to direct costs)

- Project Specifics – assess costs specific to location/operation of construction;
- Preliminaries – Percentage added to allow for cost of site establishment, contractor management and consumables during construction;
- Overheads & Profit – Percentage added to allow for margin made by Main Contractor;
- Design – Percentage added to allow for Architectural, Structural, Civil, M&E etc. fees;
- Leadership & Logistics – Percentage added to allow for Heathrow Management, Client PM/CM, Programme Logistics;
- Risk/Contingency – Percentage added to the base costs, project specifics, preliminaries, OH&P, L&L and design of each Task Order to allow for project and programme risks, supported by a cost risk analysis with derived probability confidence level; and
- Risk Reserve – Enhanced risk percentage added at Programme level.

Following the production of the Cost Estimate, HAL has then put in place the following assurance measures:

- Level 1 Assurance is defined as carried out by peers. The assurance is specific to the Task Order but includes the activities identified in the

HAL assurance check list this includes computation checks which Arcadis, in their previous reports, stated that HAL needed to address;

- Level 2 Assurance is a review undertaken by a Senior separate individual;
- Level 3 Assurance is Cost, Time and Scope review undertaken by the Development Director, supported by the Head of PMO and Head of Estimating and presented by the Task Order PM's (with Estimator and scheduling support);
- Each estimate is signed separately against the headings of prepared by, assured by, approved by and endorsed by. These signatories are the Estimator, Lead Estimator, Head of Estimating and HAL Project Manager respectively;
- External Review is undertaken by the IFS and a report has been provided – recommendations from the report are being worked through from HAL and the IFS to inform future estimates; and
- HAL held a series of engagement sessions with the IFS presenting the schedule and Cost Estimates.

This level of assurance should eliminate arithmetical errors, this was previously addressed and recommended by Arcadis when undertaking the review of the Purple Book which was HAL's previous iteration of the Cost Estimate.

Arcadis considers the structure, approach and assurance to be reasonable for the stage of the project.

Inflation

All costs within HAL's Cost Estimates are based on Q3 2014 prices, which aligns to the reviews undertaken by the Airports Commission.

In the period between 2014 and the time of this review, there has been a net positive inflation rate for both construction and general price levels in the UK and in London. Therefore, when HAL adjust the estimate to take account of this inflation, the total of HAL's Cost Estimate will increase.

HAL's approach has been to track the costs of a number of indexes against RPI, shown in Figure 21, including:

- Indices produced by the Office for National Statistics:
  - Construction Output Price Index (COPI); and
  - Infrastructure Output Price Index (IOPI) Enabling works.
- The Building Cost Information Service's (BCIS) Tender Price Index (TPI); and
- Indices produced specifically for HAL:
  - Heathrow Price Index (HPI); and
  - Heathrow Cost Index (HCI).

Indices are produced by Professional Consultants from the construction market. Due to the diverse nature of the scope of the Heathrow Expansion Programme, HAL is currently undertaking a review of the scope to identify the most appropriate indices to apply to specific areas of scope. For example, it may be appropriate to apply Building Cost Indices to some aspects of scope and Infrastructure Indices to others.

Arcadis consider this a reasonable approach to analysing and applying inflation, however, would expect HAL to have provided their Cost Estimates in real terms at this stage, making clear their assumptions on the appropriate indices for use by scope area. Furthermore, HAL should consider the impact of inflation on prices throughout the duration of the programme.

5.2.3 Step 0 Review

The overall Cost Estimate and its component parts are approximately made up of:

- Direct costs: [redacted]
- Indirect costs: [redacted]
  - Project specifics;
  - Preliminaries;
  - Overheads & profit;
  - Design;
  - Leadership & logistics; and
  - Risk.
- Other costs: [redacted]
  - Programme specific costs; and
  - Management risk reserve.

Each of these component parts have been reviewed through this report. A detailed review of the individual Task Orders is contained within Appendix C of this report.

The direct costs and indirect costs are attributed to Task Orders in the Cost Estimate. The Task Orders are not fully contained in any of the Steps of the Preferred Masterplan.

However, for the purposes on the **Step 0** review, Arcadis has selected the Task Orders where most of the cost falls within the timescale of **Step 0**. The Programme Specific costs also mainly fall within **Step 0**, so they are also considered in this report.

HAL has reached the total of [redacted] for **Step 0** by time-slicing the costs, based on assets that are in operation to deliver an operational runway. The sum of the sections for review will not directly equal the total for **Step 0**. Arcadis has considered as part of this review whether the costs are reasonable and reliable.

Any Cost Estimate can only be based on the scope, design, programme and data that is available at the point in time that the estimate is carried out and any assumptions and exclusions that are made.

The Cost Estimate is integrated with the other elements of the masterplan.

Arcadis has assessed the approach to the Cost Estimate and the inputs and outputs used to develop the estimate and consider these to be reasonable and reliable. However, the outcome is still subject to multiple influences, some of which are highlighted in the Deliverability & Timing sections of this report.

The planned construction methodology and sequencing have been incorporated into the Cost Estimate. If the plan changes or there are any issues with activities that have interdependencies with others there will be an impact on the Cost Estimate.

The provision for risk in the estimate is designed to build in cost for uncertainties and takes a benchmarked and probabilistic modelled approach to cover risk events. It covers most likely eventualities rather than all eventualities.

5.3 Direct Costs

5.3.1 Introduction

Direct costs are the labour, material, sub-contractor, plant and equipment costs that can be directly attributed to creating an asset. They are typically activities that are quantified and priced for which allowances can be made that are directly related to the project scope.

Within HAL's Cost Estimate the direct works Task Orders considered in the **Step 0** report are:

- Earthworks;
- Utilities;
- Enabling works;
- Rivers;
- Roads;
- Runways & taxiways; and
- Landscaping.

Whilst reviewing the direct costs Arcadis has looked at each Task Order individually and address the items listed in the table below.

Area Assessed	Assessment Undertaken
Scope vs priced activities	Relative to design & Cost Estimate maturity
Key quantities analysis	IDT vs HAL quants check
Key rates analysis	View on rates; benchmarks
Key quantities sensitivity	What could change; impact
Key rates sensitivity	What could change; impact

Table 20 Arcadis' Assessments Undertaken

The review of the individual Task Orders is contained in Appendix C of this report.

5.3.2 Direct Costs Step 0 Overview

Scope vs Priced Activities

In general, Arcadis considers the priced activities are a reasonable reflection of the scope outlined.

The level of detail varies across each of the Task Orders which is reflective of the level of design development and maturity. The level of maturity for individual Task Orders is aligned with DCO and programme requirements.

Earthworks, roads and runways & taxiways have a high level of quantification and benchmarking whereas for utilities and landscaping is considerably lower.

Key Quantification Analysis

Across the Task Orders considered in this report, the overall level of quantified activities, by value of the direct costs, is [redacted]

The highest level is [redacted] for earthworks and the lowest level is [redacted] for utilities, which is reflective of the maturity of design. The levels of quantification are shown in the graph below.

The quantities used in the Task Order Cost Estimates come from several sources:

- Provided by the IDT;
- On screen quantification;
- Drawings;
- Design guidelines; and
- Google Earth.

The earthwork volumes have also been modelled by a leading earthworks contractor. This was stated by HAL at a presentation/review meeting on 6th June and adds to the level of assurance.

The level and methods of quantification are reasonable at this stage, however, could be improved significantly for utilities as the project develops. It would be better to have a higher level of quantification now, but it is not untypical for the level to be low at this stage as utilities are an 'open and see' item.

The reliability is good given that the quantities provided by the IDT have also been spot checked by HAL, Arcadis has not seen evidence of this but HAL has stated in meetings with Arcadis that spot checks have been carried out and the IFS report also states that HAL informed them the quantities have been spot checked. HAL's Level 1 Assurance requirements also includes major quantities checks for accuracy.

Pricing and Key Rates

The Cost Estimate has been priced using a combination of benchmarking, market testing, bottom up elemental estimating, calculated rates, historic rates including Purple Book 0.63, previous Heathrow projects, other UK projects, estimators experience and allowances.

In our earlier reports Arcadis commented on the source of HAL's benchmarking where HAL had only analysed previous Heathrow projects. HAL has now addressed this and incorporated benchmark data from other sources, namely:

- Environment Agency;
- Highways England;
- London Underground;
- Rail sector;
- Water sector;
- Utilities;
- International airports;
- Consultant databases; and
- Heathrow, T5 and T2A.

Arcadis considers that this approach is reflective of industry best practice.

Across the Task Orders considered the overall level of benchmarked, market tested or calculated activities by value of the direct costs is [redacted] The highest level is [redacted] for earthworks and runways & taxiways whilst the lowest level is [redacted] for enabling works.

Arcadis considers the level is too low for enabling and HAL needs to benchmark, or market test these work activities to increase cost certainty. Currently there is a risk regarding the cost assurance of this Task Order.

The levels of pricing are shown in Figure 23.

[redacted]

Arcadis considers that the extent and coverage of the pricing and benchmarking is generally reasonable at this stage, however It could be improved for enabling works, landscaping, utilities and rivers as more detail becomes available as the design develops.

Cost Significant Items

Across the Task Orders considered, 85% of the cost is in 23% of the items.

The level of quantification for Step 0 increases to 75%, compared to 72% of all the cost.

The largest contributors to the cost significant items are

- Earthworks ([redacted]
- Roads ([redacted]
- Utilities ([redacted] and
- Runways & taxiways ([redacted]

Earthworks, roads and runways & taxiways all have a high level of quantification and benchmarking so the cost significant items can be considered reasonably and reliably quantified and priced. Utilities is the least developed in both quantification and benchmarking and Arcadis considers that this would benefit the most from an increased level of detail to price against. Arcadis has not had the benefit a presentation/review meeting on Utilities so the level of information available is not fully known.

5.4 Indirect Costs

5.4.1 Project Specifics

Project Specifics are extensions of direct costs that are specific to a location or operation of construction. As a result, they are generally priced on an individual Task Order basis.

HAL set out in their Assessment of Cost Estimate Adjustments that at M4 estimate stage masterplan relevant project specifics will be individually assessed and priced and this is demonstrated in each of the Task Order Cost Estimates.

Project Specific allocations have been added as a percentage at line item level in the Cost Estimates to allow for costs that have not been included in the direct costs i.e. not covered in the benchmark cost, market cost or allowance. Where they have been added it is generally in groupings of line items within each Task Order.

The allocations may include allowances for airside working, site specific complexities, temporary works, phasing or night-time working assumptions. These are reflective of the programme and HAL's proposed methods for delivering the works.

The percentages applied appear higher than the overall percentage of direct costs for each Task Order as they are only applied to selected direct cost items.

Table 21 details the percentage for Project Specifics applied to each Task Order, column A. However, for some of the Task Orders this percentage has not been applied to all of the line items forming the base construction cost, therefore column B shows the total value of project specifics included expressed as a percentage of the total base cost.

This table highlights that the project specifics for Task Orders such as Utilities and Rivers may be low.

Task Order	Project Specifics % applied (Col A)	Project Specifics expressed as a % of base cost (Col B)	Description
Earthworks	[redacted]	[redacted]	Night-time working
Utilities	[redacted]	[redacted]	Airside working
Enabling Works	[redacted]	[redacted]	Asbestos removal
Rivers	[redacted]	[redacted]	River diversions
Roads	[redacted]	[redacted]	Complexity, interfaces, modifications, temporary works
Runways/ Taxiways	[redacted]	[redacted]	Night working, phased working, disrupted shifts
Landscaping	[redacted]	[redacted]	Interfaces

Table 21 Summary of Project Specifics included in HAL Cost Estimate
Source: ([redacted])

Task Orders

Earthworks – Project specifics have been applied to line items in the Cost Estimate where HAL's programme shows night-time working is required. These are generally cut & fill activities where it has been assumed that [redacted] of work will be done at night.

Utilities – Allowance applied to activities that are within the current airport boundary. Most of the utilities work is outside the current boundary and as such project specific items are not applicable.

Enabling – Allowance applied to items relating to building and properties demolition for asbestos removal which is the only area applicable to project specifics.

Rivers – Allowance applied to river diversions. This includes the requirement for temporary culverts under the A4, the requirement for temporary bridges at J14 & A4 and EA attendance during construction.

Roads – Multiple allowances have been applied at different locations to take account of airside working, traffic management, temporary works during construction and the complexity of works due to interfaces and modifications to existing road. The percentages that have been applied against line items in the Cost Estimate include:

- M25 alignment [redacted]
- Junction 14, [redacted]
- J14A [redacted]
- J14 Running Lanes [redacted]
- A4 Western [redacted]
- Emirates Junction [redacted]
- Western Perimeter Road [redacted]
- Northern Perimeter Road [redacted]
- Beacon Road Roundabout [redacted]
- Southern Access Tunnel [redacted] and
- Eastchurch Road & Southern Road [redacted]

Runways & Taxiways – Several separate allowances have been applied to active runway and taxiway safety zones. These include labour premiums for night working, allowances for phasing to align with runway alterations & operational restrictions and disrupted shifts. Percentages that have been applied include:

- Existing runway [redacted]
- Decommissioning [redacted]
- Taxiways 23.6% to [redacted]
- Relocation [redacted] and
- De-icing pads [redacted]

Landscaping – The airside working allowance is applied to cover possible interface of works required for the NE noise mitigation bund with other works.

5.4.2 Preliminaries

Preliminaries are added to the individual Task Order's direct costs and project specific costs to cover the cost required to deliver the works but not included in the rates, such as:

- Contractor's Project Management and Engineering team;
- Site accommodation;
- Scaffolding;
- Hoarding;
- Temporary services;
- Temporary works;
- Office equipment;
- Safety & security & environmental protection;
- Bonds, guarantees, warranties & insurances;
- Plant & equipment; and
- Maintenance of site records, completion and post-completion requirements.

Within HAL's Cost Estimate preliminaries have been applied at [redacted] for civils works and [redacted] for building works. Previously in the Purple Book HAL had applied a wider range of percentages with the majority of the works having between [redacted] applied to the equivalent **Step 0** Task Orders.

HAL's assessment of Cost Estimate adjustment states that at M4 stage there will be a review of preliminaries at an asset by asset level informed by clarity of project specifics. This is not how HAL has applied preliminaries within the Cost Estimate. Arcadis considers that this needs to be developed to assure the costs. This will be affected by the procurement strategy and how the works packages are structured. Arcadis consider that a bottom up estimate of the preliminaries needs to be undertaken for the next iteration of the Cost Estimate.

HAL has undertaken benchmark studies to review the percentages applied. They have reviewed 50 projects at Heathrow from the Q5 and Q6 programmes. The Q5 works at Heathrow were large scale projects with similar types of facilities to the Heathrow Expansion Programme. HAL has also reviewed 16 projects from rail, utilities, property sectors and other aviation projects.

The percentages applied in the M4 estimate are consistent with these benchmarks.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] preliminaries applied to all Cost Estimate line items, in line with the [redacted] provision for civils works.

Enabling Works has [redacted] preliminaries applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are

deemed to already include preliminaries, so no further provision has been added. The overall percentage for preliminaries for Enabling Works is therefore expressed as [redacted]

Roads has [redacted] preliminaries applied to all items except for the commuted sum relating to Highways England works where the preliminaries are deemed to be already included. The overall percentage for Roads is therefore expressed as [redacted]

Arcadis considers the current percentage allowances to be reasonable.

5.4.3 Overheads & Profit

Overheads & Profit are added to the direct costs, project specific costs and preliminaries. Overheads & Profit reflect the operating expenses (or head office administrative costs) of running the main contractor companies that will implement the projects and the profit margin to be made by the main contractors after accounting for all costs and expenses.

Overheads & profit have been applied [redacted] in the HAL Cost Estimate.

HAL has undertaken benchmark studies to review the percentage applied. HAL has reviewed at least 49 projects at Heathrow from Q5 and Q6. HAL has also reviewed 37 projects from other sectors. The projects from rail, commercial, infrastructure, schools, facilities management & retail sectors. Whilst Arcadis has seen the results of this review we have not interrogated these results.

The percentage applied in the Cost Estimate falls is in line with the average of all the benchmarks.

The benchmark for the Q5 works and the other sectors exceed the average. As the Q5 works is comparable with the Heathrow Expansion Programme it could be considered appropriate to apply a higher percentage for overheads & profit i.e. [redacted] However, the Q6 works are more recent and are lower than the average, which could be indicative of the Heathrow market trend.

Arcadis considers that as Overheads & Profit are at company level rather than site level it would be more pragmatic to use a blend of the Q5 and Q6 data.

Previously HAL had generally applied a percentage of [redacted] however they did apply [redacted] to demolitions and earthworks.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] overheads & profit applied to all Cost Estimate line items.

Enabling Works [redacted] overheads & profit applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include overheads & profit, so no further provision has been added. The overall percentage for overheads & profit for Enabling Works is therefore expressed as [redacted]

Roads has [redacted] overheads & profit applied to all items except for the commuted sum relating to Highways England works where the overheads & profit is deemed to be already included. The overall percentage for Roads is therefore expressed as 7.2%.

5.4.4 Leadership & Logistics

Leadership and Logistics costs cover HAL's programme/project delivery management and programme wide logistics and overhead requirements.

HAL's definition of Leadership costs include:

- Central charges for accommodation;
- Utilities;
- Control posts;
- Staff costs for development;
- IT;
- Central resource;
- Insurance charges; and
- Commercial & control consultancy – including project management, cost management, project controls & risk management; delivery integration services – integration services including early construction/build advice & scheduling; programme design integration services – coordinating integrated schedule across the programme and commercial audit – across the programme.

Logistics costs include:

- Site security;
- Site accommodation for operatives;
- Waste management;
- Car parking and bussing;
- Catering; and
- Delivery strategy & escorting and traffic management.

HAL provides these services to contractors instead of the contractors providing them, with the costs coming through the preliminaries. This gives HAL the opportunity to benefit from economies of scale as well as guaranteeing consistency and compliance with security requirements.

Leadership & Logistics costs are added to the direct costs, project specific, preliminaries and overheads & profit at [redacted] HAL has based this percentage on the Q6 model which was derived from Q5. The approximate split in the Q6 model is [redacted] leadership and [redacted] logistics.

The Assessment of Cost Estimate Adjustments states that at M4 stage there will be a review of Leadership & Logistics and improved understanding of Preliminaries to ensure no overlap in costs.

Arcadis has not seen any evidence that this has been undertaken and would expect to see this when bottom estimates for preliminaries and Leadership and Logistics are undertaken. We would expect to see this at M5.

A review of the Leaderships & Logistics costs has not been incorporated into the M4 estimate but HAL plan to carry out a review and test the model for the M5 estimate. It would be ideal for a review to be incorporated in the current Cost Estimate, but it is still a reasonable allowance and it should not adversely affect the outcome.

The IFS conducted a benchmarking study for Leadership & Logistics in Q6 and found it to be comparable with other programmes.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] leadership & logistics applied to all Cost Estimate line items.

Enabling Works has [redacted] leadership & logistics applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include leadership & logistics, so no further provision has been added. The overall percentage for leadership & logistics for Enabling Works is therefore expressed as [redacted]

5.4.5 Design

Design costs have been accounted for within the estimate and include for architectural, structural, civil engineering, mechanical & electrical design and any other specialist design and consultancy fees required to deliver the HEP programme.

Design costs have been applied [redacted] in the Cost Estimate, this percentage has been applied to the direct costs, project specific costs, preliminaries and overheads & profit. The application of this percentage is consistent with industry standard best practice as recommended in the NRM2 which sets out guidelines for production of estimates.

HAL's Assessment of Cost Estimate Adjustments states that at M4 stage the design costs will be based on benchmarked percentages in accordance with the complexity of the works for all assets.

HAL has undertaken benchmark studies to review the percentage applied. HAL has reviewed 36 projects at Heathrow from Q5 and Q6 programmes. They have also reviewed 503 projects from other sectors.

The Q5 works at Heathrow is considered comparable with the HEP as it consisted of large high value and high-profile buildings such as T2A. The Q6 works were smaller scale projects, split between new build and refurbishment works. The projects from other sectors include water, rail, middle eastern airports, laboratory building and office building. The other sectors may not be directly applicable, but they provide a useful sample for reference.

The percentage applied in the M4 estimate falls in between the Q5 benchmark and other sectors/Q6 benchmarks. This is representative of the location and type of works being carried out and takes account of all the benchmarks.

Arcadis consider that this might be slightly low as there will be other consultancy services associated with the DCO process and land acquisition which would probably not have been required in the Q5 or Q6 programmes.

Task Orders

The earthworks, utilities, rivers, runways & taxiways and landscaping Task Orders all have [redacted] design applied to all Cost Estimate line items.

Enabling Works has [redacted] design applied to all items except for ground investigations and surveys where the works are in progress, so no further provision is required. Consolidation Centre's included in the estimate are allowances that are deemed to already include design, so no further provision has been added. The overall percentage for design for Enabling Works is therefore expressed [redacted]

Roads has [redacted] design applied to all items except for the commuted sum relating to Highways England works where the design is deemed to be already included. The overall percentage for Roads is therefore expressed as [redacted] Within this Task Order these are an allowance so Arcadis are unable to verify this.

5.4.6 Risk

Risk is added to the direct costs, project specific costs, prelims, overheads & profit, design and leadership & logistics to cover the cost of unforeseen circumstances or uncertainties in the project. It covers the cost of events that might happen but are not certain to happen.

Risk contingency has been applied at [redacted] to all Cost Estimate line items which is the same as the M3c estimate. This includes [redacted] for costs, uplifted by [redacted] for scheduling/finance.

Overall the M4 Cost Estimate includes [redacted] risk, as a risk reserve has been added. Between M3c and M4 significant scope re-assessment took place reducing the programmatic flexibility in execution, so further risk contingency was required which has been defined as Risk Reserve.

Risk Reserve has been added at a programme level and is therefore not directly seen in the Task Orders within the Cost Estimate. It is calculated by replacing the [redacted] provision at line item level with [redacted] for off airport infrastructure, [redacted] for on airport infrastructure and [redacted] for property.

The IFS M3c report quotes that the risk range applicable to this stage would be [redacted]. As the risk is now [redacted] this meets the IFS recommendation and is in line with industry benchmarks.

The Assessment of Cost Estimate Adjustments states that at M4 stage there will be a programme specific Quantitative Schedule Risk Analysis (QSRA) / Quantitative Cost Risk Analysis (QCRA).

HAL undertook a Cost Risk Analysis (CRA) to provide a bottom up view of whether the applied contingencies percentages were appropriate for this stage. This did not directly inform the contingencies applied in the estimate, but it does provide a countermeasure.

CRA Basis

The risk was modelled against the 142mppa scheme to Step 8 (inclusive of Step 0 and Step 3).

The risks were evaluated collaboratively by risk managers, project managers and commercial managers.

There were [redacted] risks and opportunities considered. Of these [redacted] risks & [redacted] opportunities were modelled discretely in the cost risk model. The risks and opportunities included in the CRA were derived from the programme level risk register, red risks from the task orders and risks and opportunities identified during interviews with the task order project managers and costs estimators i.e. programme wide employer risk and categories of risk by contract/area.

Some example risk drivers, applicable to Step 0 include:

- Property market forces;
- Southern Road tunnel construction;
- Impacts on airfield operations;
- Insufficient time given for businesses to relocate could result in extinguishment;
- Acceleration of compulsory property purchases;
- Increased Wider Property Offer Zone scope;
- 3rd party service diversions for utilities works;
- Ground slab required for M25 tunnel; and
- Reuse topsoil/aggregates on site.

Uncertainty ranges were derived from benchmarks or programme experts and used on direct costs at Cost Breakdown Structure (CBS) level 2 (approximately [redacted] items) for rates, quantities and design maturity. Going forward, design maturity will not be used when scheme progresses to M5 as the scheme will be more developed.

The risk contingency and risk reserve included in the M4 estimate were replaced by quantified uncertainties, risks and opportunities and a risk analysis was carried out using Monte Carlo analysis in MS Excel using @Risk to model the risks.

The CRA shows that [redacted] level of confidence aligns with the [redacted] risk provision in the M4 estimate. This means a [redacted] probability of completing the programme within the total Cost Estimate.

Historically, typical or standard probabilities used in programmes and projects are P50 and P80. [redacted] is a reasonable mid-point of these probabilities. If a higher level of confidence is required, the risk contingency in the Cost Estimate would need to be increased.

At the M5 stage HAL is looking to increase the probability rating through improved development and knowledge of design, scope, quantities and/or rates without reducing the risk and contingency allowances.

Optimism Bias has not been included in the Cost Risk Analysis. If it had been the risk provision and overall Cost Estimate would increase, so the additional assurance it would give would come at a premium.

Stage Observations

The risk analysis was carried out for the whole programme and is not split between stages.

However, it can be derived from the M4 P50 contribution to total cost above base cost that the top 3 category contributors are Terminals, Piers & Satellites (Step 3), Property (Step 0) and Baggage (Step 8).

It is also possible to derive that just under half of the cost by category can be attributed to Step 0 and that there is a high number of low to medium cost categories in Step 0.

From the P90 percentage risk by CBS scope it can be derived that categories in Step 0 are typically lower than the overall average.

This could be in part due to the design for Step 0 categories being more developed than the later stages and more cost being in the base cost.

5.5 Programme Specific Costs

Introduction

Programme specifics capture the programme level costs that facilitate the delivery of the Heathrow Expansion Programme that can't be directly attributed to the Task Orders.

The scope for programme specifics includes property acquisition, noise insulation, development consent order (DCO) CAT B costs, T5+, T1 baggage prolongation and other operational and community spends.

HAL has engaged with specialist property consultants and HAL finance department to inform their preparation of the Cost Estimate.

Scope vs Priced Activities

The priced activities align with the scope summarised above and detailed in the Cost Estimate.

The Cost Estimate contains lump sums that are either calculated separately elsewhere or are allowances retained from Purple Book 0.63. Items calculated separately include the property cost forecasted and items within the Management Business Plan 2019.

Within the Programme Specific Costs HAL have included a section for Community mitigation scope which includes Section 106 payments and noise mitigation. Allowance for Community Infrastructure Levy (CIL) is also included. An assumption has been made that any additional community requirements will be funded from CIL and Section 106 payments. HAL have not made any specific inclusion or reference to an annual Communities Compensation Fund which was referenced as part of the National Policy Statement.

Key Quantities

There are no quantities provided in the Cost Estimate to review.

However, HAL states that there is quantification in the Management Business Plan (MBP)19 provided by HAL and the property costs provided by the specialist property consultants.

[redacted]

It should be noted that HAL has engaged specialist professional property consultants to develop this element of the cost plan. Due to the sensitivity of this data Arcadis has not had sight of the build up to this element of the cost plan and are therefore unable to comment and conclude on HAL's approach to quantification of this element. However, the fact that specialist consultants have been engaged infers that HAL's approach is reasonable as these consultants should have access to reliable sources of data.

Key Rates

There are no rates provided in the Cost Estimate to review due to the sensitivity of the data.

However, HAL states that [redacted] of the Cost Estimate has been market tested. This is mainly associated with property costs, noise insulation and DCO costs.

The remaining [redacted] of the Cost Estimate is based on allowances associated with T5+, T1 baggage prolongation and allowances retained from Purple Book 0.63.

[redacted] market testing would lead to good reliability in the Cost Estimate. Property costs are entirely dependent on the market so we can verify that the approach is reliable but can't verify the detail as we don't have the rates to review.

Indirect Costs

Indirect costs have been considered on a line by line basis and applied where applicable, which is reasonable for this level of Cost Estimate.

Project specific costs have not been applied to any of the line items.

Preliminaries, OH&P, Design have only been applied to building works.

Leadership & Logistics have been applied to buildings, resource efficiency and airfield vehicles.

Risk has been applied to all items except noise insulation, T5+ and T1 baggage prolongation.

Quantity/Rate Sensitivity

It is not possible to comment on individual quantities and rates as the detail is not included in the Cost Estimate.

The fact that cost forecasted data from specialist property consultants and HAL has been utilised by HAL increases confidence and should reduce sensitivity. Clearly any change in extent of provision or changes in market rates will impact the overall cost.

Items relating to programme specifics are included in the Cost Risk Analysis and risk allowance has been included in the indirect costs. There is not a direct correlation between the two but there is provision.

5.6 Summary

It is Arcadis' opinion that on balance, HAL's Cost Estimate for **Step 0** is reasonably and reliably costed.

HAL has taken on board Arcadis's comments, from earlier reports to the CAA reviewing the Purple Book, regarding the structure of the Cost Estimate and produced a comprehensive document capturing all the relevant Cost Estimate data in one singular document.

The above document also includes the detailed estimates for each individual Task Order. The build up to the estimate for each Task Order takes cognisance of the data provided by the IDT, HAL's programme and HAL's proposed methods of execution.

The structure of the Cost Estimate reflects industry best practice standards and forms a good baseline on which to move forward. This can now form the basis on which to monitor and implement a change control process.

The structure of the Cost Estimates for each Task Order provides a standard platform for approaching the estimate and reflects best practice with how HAL has approached the quantification and pricing of direct and indirect costs.

The level of quantification within the detailed estimates reflects the level of detail provided by the IDT. The extent of quantification has increased since the Purple Book and the reliance on

allowances reduced which leads to an increased level of certainty.

However, there are some Task Orders where the level of quantification is lower than we would expect at this stage. The most significant one being the utilities. This is partly reflective of the nature of the works and the reluctance for utility companies to engage on developments at such an early stage of the programme.

Arcadis considers that this could be progressed further and that this currently poses a risk to the Cost Estimate. There is also potential for this to impact the programme which would put further pressure on the Cost Estimate.

The level of benchmarked rates for **Step 0** accounts for an average of [redacted] which is a significant increase from Arcadis' review of the Purple Book, albeit that one would expect to see a higher level of benchmarking for **Step 0** as these works are the initial works in the programme and the design is more progressed for these Task Orders.

When analysing the Purple Book, the resultant [redacted] is the benchmarked percentage for the HEP as a whole. As previously recommended by Arcadis HAL has drawn on benchmark data from other large programmes of work in other sectors and brought this into their analysis with their own internal data.

Arcadis considers the [redacted] to be a reasonable percentage for the current stage however there are two Task Orders, in particular where we would have expected the benchmarking to be further progressed, namely utilities and for enabling works, in particular the demolitions, hence these add a level of uncertainty to the Cost Estimate. These two elements account for [redacted] of the Step 0 total.

With regards to HAL's approach to indirect costs, this appears reasonable, however we would expect to see the assessments for preliminaries and project specifics moving away from benchmarked percentages and towards bottom up estimates. HAL has started to address this within the Project Specifics by reflecting specific items identified within the delivery reports.

HAL has applied a percentage for risk at Task Order level and at management reserve level, they have also undertaken a QCRA to verify this. Whilst this a reasonable iterative approach Arcadis would expect to see risk applied at TO level based on a fully managed risk structure with a further risk reserve being held at management level reflecting the outputs of a fully managed risk approach.

Whilst HAL has reflected schedule risks in their risk models Arcadis believes that due to the level of control HAL has on some of these elements, as discussed in Sections 3 and 4 of this report, there remains further risk on programme which will have an inherent risk on the Cost Estimate.

6 INTEREST OF CONSUMERS

Although not explicitly considered as part of the Step 0 report, Arcadis has continued to see examples where the interests of consumers are being tested through the development of the Preferred Masterplan.

This view has mainly been formed through and building upon a previous Arcadis report submitted in December 2018, *'An initial review of consumer interests in the development of the HAL Masterplan'*.

Arcadis's key findings are:

- HAL is seeking to ensure that the existing airport operation can function whilst this phase of construction is taking place;
- HAL is seeking to increase the flexibility of the airport and ensure there is sufficient resilience available to cope with operational challenges;
- HAL is seeking to minimise disruption for both consumers and the local community; and
- HAL has spent a significant amount of effort to develop its delivery programme in a logical sequence to reduce the impact the works will have on both these groups.

'Consumers' are defined as both passengers and cargo operators of the airport for the purpose of this report.

To review HAL's Preferred Masterplan with regards to the interest of consumers Arcadis has considered how HAL has acquired consumer insight and how well HAL has incorporated consumer insight into their masterplan development process.

Step 0 does not necessarily deliver infrastructure that consumers will directly identify with as assets as much of the work is enabling and 'making the space' for the construction of the 3rd Runway.

In Step 0, there are no direct infrastructure improvements being proposed to support cargo operations. However, there is evidence that HAL is actively engaging with the cargo community to develop improvements that will be delivered in future steps of the masterplan.

The majority of infrastructure improvements will benefit the passenger consumers at Heathrow. The increase in runway capacity and on-going capacity improvements should contribute to delivering a scheme that is in the interest of consumers.

Our discussions with HAL have indicated that the interest of consumers is now embedded into their masterplanning thought processes and HAL can point to examples where the interests of consumers has informed the evaluation process and option appraisal choices for a number of different components of the Scheme.

APPENDIX A Layouts

The Airport layouts images below set out the main infrastructure changes that will be in place through the three Steps that Arcadis has been asked to review the Preferred Masterplan. The HEP construction phasing images set out the time slices in 6 monthly increments from DCO through to 2026.

AIRPORT LAYOUT AT STEP 0

AIRPORT LAYOUT AT STEP 3

AIRPORT LAYOUT AT STEP 8

APPENDIX B Alliances

Oneworld

Oneworld is an airline alliance. The objective of this alliance is to be the passengers first choice for the world's frequent travellers. This company is based in New York and comprises of the following member airlines:

Figure 24 Oneworld Alliance Member
Source: (Oneworld 2019)

SkyTeam Alliance

Amsterdam headquartered SkyTeam is formed of 19 member alliances. This group targets to make the global travel seamless and provides access to 1,150 destinations worldwide.

Figure 25 Airline Members of SkyTeam Alliance
Source: (SkyTeam Alliance 2019)

Star Alliance

Star Alliance currently comprises of 28 member airlines, each with a unique culture and style. The Alliance members offer smooth connections across the global air network. It is coordinated by a German based project company. All the members of this group are presented below in Figure 26.

Figure 26 Members of Star Alliance
Source: (Star Alliance 2019)

APPENDIX D Document Register

The **Step 0** review undertaken by Arcadis for all the themes is based upon discussions with HAL, publicly available documents and the documentation shared by HAL (listed in Table 32 below). This documentation includes a number of reports, presentations as well as a number of reference drawings.

Report Title	Report Source
Operability	
Heathrow Strategic Brief	HAL – Public Documents
Preferred-Masterplan - June 2019	HAL – Public Documents
Updated-Scheme-Development-Report-Document-1-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-2-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-3-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-4-of-5	HAL – Public Documents
Updated-Scheme-Development-Report-Document-5-of-5	HAL – Public Documents
[redacted]	HAL – Airline Sharepoint
	HAL - Presentations
	HAL - Presentations
	HAL - Presentations
	HAL - Presentations
	HAL
	HAL
	HAL
	HAL – Airline Sharepoint
	HAL – Airline Sharepoint
Cargo Transformation Board pack	CAA

Report Title	Report Source
Delivery and Timing	
[redacted]	

Report Title	Report Source
Interest of Consumers	
[redacted]	

*Table 32 List of Documents Referred During **Step 0** Review*
Source: (Arcadis 2019)

APPENDIX E References

Arcadis has used a number of reference source documents as part of this Step 0 review. A number of these documents have been supplied by HAL and others are benchmarking or technical documents used by Arcadis in assessing the Preferred Masterplan.

Document/ Author Name	Source/ Author/ Website	Year
[redacted]		
Arcadis	-	
Arcadis Internal Library	Arcadis	2019
Bircham Dyson Bell-DCO Applications, Overall days from application to decision	Arcadis	2019
CAA	-	2019
Capital Cost Estimate – Arcadis Review.	Arcadis	17th May 2019
Cargo Transformation Board Pack	CAA	2019
HAL	-	2019
[redacted]		
HEP Assurance Review of HAL Delivery Schedule	DfT	2019
[redacted]		
IATA ADRM 10th Edition	Arcadis Internal Library	2014
IFS	-	2019
[redacted]		
NATS – AIS	http://www.nats-uk.ead-it.com	2019
[redacted]		
Heathrow Website	http://www.heathrow.com	2018
Oneworld Alliance	https://www.oneworld.com/members	2019
SkyTeam Alliance	https://www.skyteam.com/en/about/	2019
Star Alliance	https://www.staralliance.com/en/member-airline-details	2019

Table 33 List of References
Source: (Arcadis 2019)

APPENDIX F Technical Glossary

Technical Terms	Page Number (First Use)	Description
CTR Obstacles	11	Area around the control tower with a radius of 25 miles, where the significant obstacles for the local air traffic are plotted on the charts published in AIP
Code F Aircraft	11	Code F aircraft is categorised by a wingspan of 65m but < 80m. Common example is Airbus A380 "Superjumbo"
TfL Rail Service	12	Refers to the stopping service that runs from Paddington along a similar line to the Heathrow Express. This will be replaced by the Elizabeth Line once it comes into full operation but until then the service is referred to as TfL Rail
DDS	12	For the purpose of forecasting, it is necessary to develop detailed flight schedules for a design day or busy day and are also referred as Design Day Flight Schedules (DDS)
NATS	14	It is the main air navigation service provider in the UK.
Code E Aircraft	15	Code E aircraft is categorised by a wingspan of 52m but < 65m. Common examples are B777 Series / B787 Series / A330 Family
OLS Surfaces	15	Combination of multicomplex angled surfaces around airports defining the airspace maintained free of any obstacles posing threat to air navigation and operations
NB aircraft	23	Aircraft with single-aisle arrangement
WB aircraft	23	Aircraft with twin-aisle arrangement
Code C Aircraft	24	Code C aircraft is categorised by a wingspan of 24m but < 36m. Common examples are Boeing 737/ Airbus A320 Family
LoS	25	Accounts for demand, processing rates and service quality considerations while defining the quality of service provided at an airport. it is measured by IATA on three levels such as overdesign, optimum and suboptimum

Table 34: Technical Glossary
Source: (Arcadis 2019)

ARCADIS Design & Consultancy for natural and built assets

Arcadis is the leading global Design & Consultancy firm for natural and built assets. Applying our deep market sector insights and collective design, consultancy, engineering, project and management services we work in partnership with our clients to deliver exceptional and sustainable outcomes throughout the lifecycle of their natural and built assets. We are 28,000 people active in over 70 countries that generate more than €3 billion in revenues.

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Business

Spain's Ferrovial to Halt Funding for Heathrow: Sunday Telegraph

By Bill Lehane +Get Alerts
31 October 2021, 11:08 GMT

- Key shareholder's move signals third runway may not be built
- U.K. regulator criticized for blocking higher landing charges

A passenger aircraft lands at London Heathrow Airport. *Photographer: Jason Alden/Bloomberg*

Heathrow Airport's top shareholder Ferrovial has signalled it will cut off new investment in the airport, dealing a "killer blow" to plans for a third runway, according to a report in the Sunday Telegraph.

Executives from the Spanish infrastructure company criticized the Civil Aviation Authority's decision to block plans for a 90% increase in landing charges from next year. The regulator has proposed allowing charges to rise by up to 56% instead.

Ferrovial Portfolio Management Director Ignacio Castejon told the newspaper he was skeptical about the company's appetite for future investment in Heathrow after the decision on landing charges, which he said would leave investors shouldering low returns.

The withdrawal of support by Ferrovial, which owns 25% of Heathrow, means that the third runway project is unlikely to go ahead, the report said. The expansion has also been threatened by the sharp drop in air traffic during the pandemic.