MAYOR OF LONDON

Transport for London

Inner Thames Estuary Feasibility Study

Response to Airports Commission Call for Evidence

The Mayor of London's Submission:

Supporting technical documents

23 May 2014

Title: **Hub Airport Capacity**

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Purpose of paper: **To suggest additional objective criteria and detail needed to adequately assess airport capacity, beyond runway capacity on its own.**

Key messages:

- There are significant gaps in the evidence presented so far about the shortlisted schemes, including the airport capacity considerations of airspace design, runways, taxiways, stands, terminals and surface access.
- A new hub airport in the Inner Thames Estuary offers the scale of new capacity necessary for London and which is much greater than that on offer from the shortlisted schemes.

Mayor's Aviation Works Programme - New Hub Airport

Technical Note – Hub Airport Capacity

Transport for London

May 2014

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Summary

A new hub airport in the Inner Thames Estuary offers the scale of new capacity necessary for London and which is much greater than that on offer from the shortlisted schemes. The Commission does not currently recognise this. The potential capacity increase that each scheme purportedly offers must be better understood. We would like to draw the Commission's attention to the following issues;

- The factors governing airport capacity have not been fully considered to date, and some have not been considered in enough detail to make conclusive judgements between different schemes.
- There are significant gaps in the evidence presented so far about the shortlisted schemes, including the airport capacity considerations of airspace design, runways, taxiways, stands, terminals, and surface access.
    - Airspace capacity – the Commission needs to conduct further work here. Please see the separate Atkins technical note, "Potential airspace impacts of a new hub airport" commenting on the airspace issues that the Commission should revisit and look at in more detail.
    - Runway capacity - different modes of operation provide different opportunities. The capacity each offers varies, and because different modes have different impacts, their acceptability at different locations will vary too.
    - Taxiway capacity – all schemes must demonstrate that there are no unacceptable delays inherent in the geometry of individual proposals. This should be supported by fast time airfield simulation.
    - Stand capacity – our analysis shows that both Heathrow Airport Ltd and Heathrow Hub schemes make insufficient provision in their current plans. Their sites will have to be enlarged to handle the proposed traffic.
    - Terminal capacity – our analysis shows that the identified footprints are theoretically large enough subject to the number of levels provided.
    - Surface access capacity – the Commission needs to conduct further work here. Please see the separate Atkins technical note, "Surface access demands and impacts".

1. Introduction

1.1. Background

The Airport Commission has assessed the potential capacity/operational viability of the shortlisted options in their sift documents using the following headings;

- Runways (net increase)
- Passengers (net mppa)
- ATMs (net)
- London Airports' operations (arrows indicating capacity change)

It could be argued that the capacity assessment as published is over selective in the choice of criteria and insufficiently comprehensive or developed to use as a tool for evaluating the shortlisted airports on a capacity basis, because other criteria can also have a major impact on capacity.

1.2. Purpose of technical note

The purpose of this document is to suggest additional objective criteria that should be used to assess the capacity of an airport. The definition of an airport's physical infrastructure capacity requires consideration of a combination of measures that interact together. In this context it should be noted that for a number of years the capacity constraints that are used to govern airline scheduling at Heathrow have included not just runway capacity but also stand availability and terminal capacity, both of which have a major impact on the overall size and cost of an airport development. In addition it can be argued that the current assessment of runway capacity is oversimplified and therefore understates effect of variations in the operating regime within individual proposals.

An airport's capacity is only as great as its weakest link, so to assess the potential capacity of an airport proposal it is necessary to consider a number of potential capacity constraints. Typically these constraints are recognised within the industry as;

1. Airspace limitations
2. Runway capability
3. Taxiway configuration
4. Stand provision
5. Terminal capacity
6. Surface access infrastructure

The Airports Commission has not published any assessment of some of the above criteria – taxiway configuration, stand provision, terminal capacity. It can also be argued that the surface access evaluation has not been carried out on an equivalent basis for all the sites, but this is the subject of a separate technical note.

The following sections consider each of the headings individually and suggest areas where further work is needed.

2. Capacity assessment

2.1. Airspace limitations

The following issues should be considered in further detail;

- Airspace planning of the SE of England for all sites
- The interaction of Northolt and Farnborough with Heathrow
- The interaction of London City and Southend with the Isle of Grain
- The interaction of an enlarged Gatwick with other airports

More detailed consideration of airspace issues is the subject of a separate paper.

It is recommended that airspace design for the South East of England for the various options is developed further and detailed analysis is conducted using modelling tools such as Fast Time Simulation. For the various options this will clarify their predicted/expected traffic interactions, relative capacity and environmental impacts, and overall network resilience.

2.2. Runway capacity

The NATS benchmarks for runway capability are presented at a very simple level. As presented they do not differentiate the relative impact of:

a. Traffic mix and in particular the differences in capability that can be attributed to the percentage of 'heavy' aircraft (40% Heathrow & 10% Gatwick)
b. Mode of Operation as the result of runway geometry or operating restrictions. There are multiple operational options for parallel runways, with varying capacity limitations. Different sites and different runway spacing lead to different capacities. A single standardized approach appears to have been adopted by NATS in undertaking capacity assessment. ICAO provides guidance for pairs of parallel runways in the SOIR manual (doc 8643), which covers;

1. Mode 1 – independent parallel approaches
2. Mode 2 – dependent parallel approaches
3. Mode 3 – independent parallel departures
4. Mode 4 – segregated parallel operations

The above can also be modified by mixed, or semi-mixed mode parallel operations where individual runways are used for both take offs and landings increasing overall capacity. In the example of a pair of runways, Modes 1 and 3 offer the greatest capacity to service arrival or departures peaks, and can be further increased by mixed mode operations on each runway. Mode 2 reduces arrivals capacity, while Mode 4 reduces both arrivals and departures throughput and therefore has the lowest capacity, although is the least complex in operational terms;

- Heathrow operates for most of the day in Mode 4, with tactical use of Mode 2 in the early morning known as TEAM.
- In future Heathrow Airport 's NW runway proposals are anticipated to operate with 2 runways in Mode 4, while a third (either the most northerly or southerly but not the central runaway should be able to operate as mixed mode.
- The Heathrow Hub proposal will need to operate in a combination of modes, the Northern 2 runways will have to operate in a manner similar to Mode 4 while the Southern runway will have to operate in Mode 1 with mixed mode operations. This is anticipated to preclude the use of alternation to reduce noise exposure.
- Gatwick will be able to operate in Mode 1 and 3 with mixed mode on each runway.
- The Airport Commission's proposals for the IoG can operate in Modes 2 and 3 with the currently illustrated runway separations.
- The Foster Thames Hub can operate only in Mode 4.
- The TfL proposals for the IoG can operate in Modes 1 and 3 with mixed mode on each of the 4 runways.

It can be argued that requirements to achieve consistent levels of resilience or limit average delays can be facilitated by Mixed Mode operations.

A study by SH&E – UK CAA Runway Resilience Study – Final Report December 2008 para 1.42 suggested that being able to operate in mixed mode contributed to 'natural robustness .... against wind and low visibility conditions primarily because of the reduced pressure and increased flexibility to sequence arriving and departing aircraft compared to heavily utilised segregated mode runways'.

NATS recognise that operating strategies for various options on the Isle of Grain could vary significantly in part dependent on the runway spacing and the sophistication of radar-based monitoring aids. It is recommended that more detailed analysis of runway capability is undertaken on all sites.

2.3. Taxiway configuration

No consideration appears to have been given to the capacity limitations of the proposed taxiway systems. Specific consideration should be given to the relative impact on capacity and safety of the following design approaches;

- The contribution from end around taxiways in avoiding runway crossings and incursions.
- The differing requirements for ground movement of aircraft, departures re-sequencing, contra-flows from rapid exit taxiways (RETs) and rapid access taxiways (RATs), allowance of simultaneous push back and access to stands, towing to remote stands or maintenance bases and the implications for resilience and delays.
- The potential for movement conflicts and therefore delays on single rather than dual taxiways between satellites.

It is recommended that ground movement simulation is undertaken on all options to demonstrate that there is not a capacity constraint in the taxiway system.

2.4. Stand demand

Arguably lack of stands, and airbridge served stands in particular, at Heathrow is an even more severe constraint on overall capacity than runway capability. Benchmarking of the 5 major European Hubs suggests that approximately 3 stands are needed for each million annual passengers travelling, recognising that there are significant variations dependant on length of haul and size of aircraft, and requirements for airbridge service. A trend towards larger aircraft flying longer sectors and any airline requirement for stand stability will inherently increase stand demand.

These benchmarks generate demand for stand frontage some 25% greater than Heathrow assume. If this approach were adopted it would remove some of the scheduling constraints from the airlines, reduce towing, improve punctuality and stand stability and be in line with other European airports.

Using the above benchmark and assuming a representative mix of stand sizes, similar to Heathrow today, of 25% Code F, 50% Code E and 25% Code C the following frontages excluding equipment areas and roads are generated as shown in Table 2-1.

mppa	25% Code F (frontage* of 90 m/stand)	Code E (frontage* of 75 m/stand)	Code C (frontage* of 45 m/stand)	Total Frontage*
90				19,238m
100	6,750 m	11,250m	3,375m	21,375m
110				23,513m
120				25,650m
130				27,788m
140				29,925m
150				32,063m
160				34,200m
170				36,338m
180				38,475m

*Includes interstand clearway

Table 2-1 Stand frontages using existing Heathrow criteria

Notwithstanding the above, the stand frontages provided in the various options have been measured and a comparative assessment of their varying capacities and is set down in Annex 1, assuming that the proposed number of stands at Heathrow prior to a third runway can cope with the projected 80 - 90 mppa.

On the latter basis, stand analysis suggests that the stands proposed for the Gatwick (on the basis of a capacity of 84mppa used by the Airports commission), Heathrow Hub and the Commission's IoG option are generally consistent with the claimed overall capacity of the airport. However it is considered that the numbers of new stands required at Heathrow NW have been underprovided. Should Gatwick reach 95mppa it now aspires to it too will require more and larger stands.

Heathrow airport on page 9 of their Technical Submission Volume 3 state that the stand frontage for the T6 apron is measured as 5220 metres but only approximately 4100 metres is illustrated in their submission. The Heathrow Hub option developed since the sift analysis shows more stands for a lower claimed capacity and would require a lesser increase in site area to support the claimed traffic levels.

The existing stand frontages are assessed by Heathrow Airport Ltd as 15, 400 metres while measurement suggests a slightly lower figure of 14,740. This can be explained by the stand frontages being measured net having removed roads and tunnel entrances etc. If the stands excluding T6 apron can handle 80 - 90mppa on a frontage of 15,400 metres the 5220 metres increase put forward by Heathrow would give a total of 20,654 metres and should proportionately be capable of handling an additional 27 - 34mppa. However measurement indicates that only some 4,100 metres net additional frontage is provided limiting the capacity increase to some 22 – 25 mppa and not the 40 mppa increase declared. To provide the required capacity the land take would need to be greater and the airport boundary enlarged.

2.5. Terminal sizing

No specific layouts have been issued for any of the options, but the footprint area in each option (excepting Fosters on the IoG) could be consistent with the declared capacity on each site, subject to the number of levels proposed.

2.6. Surface access

Assessments of traffic volumes identifying peak passenger movements by time of day have been derived for each of the options. They are used as an input to surface access studies undertaken to identify the landside infrastructure improvements that are needed at each of the sites to handle the predicted volumes of traffic. This is the subject of a separate study.

3. Overall airport capacity

Table 3-1 illustrates the relative capacity of runway (ATMs) and airport mppa, as assessed by the Commission, together with the NATS assessment of airspace (ATMs), and an Atkins assessment of stand capacity (metres frontage and mppa), of each of the options below. Appendix A provides the supporting calculations for the stands assessment.

Sponsor	Runway – AC assessment	NATS Assessment	Stands – Atkins assessment
Heathrow Airport Ltd - Existing Max Capacity	480,000 ATMs 90 mppa	500,000 ATMs	14,740 metres 80 – 90 mppa
Heathrow Airport Ltd – Revised 3R – 13/05/14	740,000 ATMs 130 mppa	700,000 ATMs	20,740 metres 104 -117 mppa
Heathrow Hub Revised – 13/05/14	670,000 ATMs 120 mppa	Not assessed	20,940 metres 106 – 117 mppa
IoG - Airports Commission	830,000 ATMs 150 mppa	800,000 ATMs(1)	28,200 metres 153 – 172 mppa
Gatwick Existing Max Capacity	280,000 ATMs 45 mppa	250,000 ATMS	8,000 metres 40 – 45 mppa
Gatwick 2R	502,500 ATMs 84 mppa	500,000 ATMs	12,800 metres 72 – 81 mppa
IoG – Foster (phase 1)	600,000 ATMS(2) 110 mppa(2)	Not assessed	23,800 metres 130 – 146 mppa
IoG – Foster (phase 2)	830,000 ATMS(2) 150 mppa	Not Assessed	23,800 metres 130-146 mppa
IoG – TfL	1,000,000 ATMs(2) 180 mppa(2)	Not assessed	32,400 metres 175 – 198 mppa

Table 3-1: Comparative assessment of hub airport capacity

(1) NATS assumes that an airport with four parallel runways (as specific by SOIR – Simultaneous Operations on Parallel or Near Parallel Instrument Runways, ICAO document 9643) would be capable of supporting 800,000 ATMs per annum.
(2) Sponsor assessment

4. Conclusion

There appears to be an imbalance between the capacity of various components of many of the options which requires further analysis and design development to resolve. A number of the short listed proposals do not appear to be capable of handing the anticipated volumes of traffic in all parts of the airport system.

Appendix A. Stand assessment

4.2. Assessment of Heathrow 3R NW master plans – Stand provision

Drawing included as part of May 14th submission

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T5A	500+260+170	930		No Domestic stands
T5B	620+660	1280		
T5C	660+680	1340		
T5D	590+550+40	1180		
T5 overall			**4730**	28-33 mppa
T3A	550+310+150	1010		T3 stands served by T1
T3B	680+670	1350		
T3C	660+240+330	1230		
T3 overall			**3590**	
T2A	700+270+190	1160		
T2B	660+660	1320		
T2C	550+550	1100		
Maintenance	330+330+130+330	1120		
T2 overall			**4700**	40-45 mppa (T2+T3)
T4	750+200+270	1220		
T4 Victor+remote	280+220	500		
T4 overall			**1720**	10 mppa
Cargo stands	NA		**0**	Not counted
Heathrow Overall			**14,740**	**80 - 90 mppa**

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T6A (Core)	500	500		
T6B(Satellite)	1260+1290	2450		
T6D(remote)	620	620		
T6E(remote)	520	530		
T6 F (remote)	250	250		
T6 Overall			**4350**	**24 – 27 mppa**

Heathrow total stand frontage 14,740 + 4300 = 19,840 metres

Capacity offered by T6 stands = 4350/14,740 x 80 - 90mppa = **24 - 27 mppa**

LHR overall stand capacity = **104 - 117 mppa**

4.3. Assessment of Heathrow Hub master plans – Stand provision

Drawing included as part of May 14th submission

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T5A	500+260+170	930		No Domestic stands
T5B	620+660	1280		
T5C	660+680	1340		
T5D	590+550+40	1180		
T5 overall			**4730**	28-33 mppa
T3A	550+310+150	1010		T3 stands served by T1
T3B	680+670	1350		
T3C	660+240+330	1230		
T3 overall			**3590**	
T2A	700+270+190	1160		
T2B	660+660	1320		
T2C	550+550	1100		
Maintenance	330+330+130+330	1120		
T2 overall			**4700**	40-45 mppa (T2+T3)
T4	750+200+270	1220		
T4 Victor+remote	280+220	500		
T4 overall			**1720**	10 mppa
Cargo stands	NA		**0**	Not counted
Heathrow Overall			**14,740**	**80 - 90 mppa**

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T6A(terminal)	500+260+170	930		
T6B(satellite)	650+650+50	1400		
T6C(satellite)	650+650+50	1400		
T6D(remote)	650	650		
T6 Overall			**4380**	**24 – 27 mppa**

Heathrow total stand frontage 15,740 + 4380 = 20,120 metres

Capacity offered by T6 stands = 4380/14740 x 80 - 90mppa = **24 - 27 mppa**

LHR overall stand capacity = **104 - 117 mppa**

Note there are other issues limiting capacity as drawn, or requiring the airport boundary to be enlarged, including lack of cargo, ancilliary, commercial, flood protection balancing ponds and car parking which will increase land take.

4.4. Assessment of Airport Commission IoG master plan – Stand provision

Drawing included within Sift 3 Reference No 67

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T1A	1200 +450+450	2100		
T1B	1200+1200	2400		
T1C	1200+1200	2400		
T1D	1200+1200	2400		
T1E	1200+1200	2400		
T1F	1200+1200	2400		
T1 overall			**14,100**	71-80 mppa
T2A	1200+450+450	2100		
T2B	1200+1200	2400		
T2C	1200+1200	2400		
T2D	1200+1200	2400		
T2E	1200+1200	2400		
T2F	1200+1200	2400		
T3 overall			**14,100**	71-80 mppa
Cargo stands	NA		**0**	Not counted
IoG Overall			**28,200**	**153 - 172 mppa**

IoG total stand frontage 14,100 + 14,100 = 28,200 metres

Capacity offered by IoG stands = 28,200/14740 x 80 – 90mppa = **153 - 172 mppa**

Note there are however other issues limiting airport capacity as drawn

- Runways stated to be operating in segregated mode
- Runway crossings reducing availability of slots
- Single lane taxiways between satellites restricting ground movement of aircraft

4.5. Assessment of Foster IoG master plan – Stand provision

Aerial perspective of 22/05/2014

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T1A	650 + 650	1300		
T1B	1500+1500	3000		
T1C	1500+1500	3000		
T1D	1500+1500	3000		
T1E	1500+1500	3000		
T1F	1500+1500	3000		
T1G	1500+1500	3000		
T1H(remote)	1500+1500	3000		
T1J(remote)	750+750	1500		
Terminal overall			**23,800**	**120 - 135 mppa**
Cargo stands	NA		**0**	Not counted
IoG Overall			**23,800**	**130 - 146 mppa**

IoG total stand frontage 23,800 metres

Capacity offered by IoG stands = 23,800/14740 x 80 - 90mppa = **130 - 146 mppa**

Note there are however other issues limiting capacity as drawn

- Runways stated to be operating in segregated mode
- Runway crossings reducing availability of slots
- Single lane taxiways between satellites restricting ground movement of aircraft
- Single terminal operation

4.6. Assessment of TfL Hub Airport IoG master plan – Stand provision

Drawing included within Sift 2 Reference No 51

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
T1A jetty	1220+1250+1250	3700		
T1B jetty	1250+1250+1250+1250	5000		
T1C jetty	1250+1250+1250+1250	5000		
T1D jetty	1250+1250	2500		(excl post 2050)
T1 overall			**16,200**	80 – 90 mppa
				excludes remotes
T2A jetty	1220+1250+1250	3700		
T2B jetty	1250+1250+1250+1250	5000		
T2C jetty	1250+1250+1250+1250	5000		
T2D jetty	1250+1250	2500		(excl post 2050)
T2 overall			**16,200**	80 - 90 mppa
				excludes remotes
Cargo stands	NA		**0**	Not counted
IoG Overall			**32,400**	**175 - 198 mppa**

IoG total stand frontage 16,200 + 16,200 = 32,400 metres

Capacity offered by IoG stands = 32,400/14,740x 80 - 90mppa = **175 - 198 mppa**

Safeguarded expansion post 2050 = 5000 metres = **25 – 28 mppa**

4.7. Assessment of Gatwick 2R master plan – Stand provision

Aerial perspective from May 14th submission

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
South Terminal				
Pier 1	270	270		(after baggage project)
Pier 2	600 + 600 +50	1250		
Pier 3	630	630	**2150**	
ST Total				
North Terminal				
Pier 4	900	900		
Pier 5	700	700		
Pier 6	330 + 90+ 330	750	**2350**	
Remotes				
41-43	220	220		
130s & 140s	420 + 460	880		
Tower	340 + 240 +120	700		
Cargo	450	450		
Sierra West	460	460		
NW zone	570	570		
Fuel Farm	220	270	**3500**	
Gatwick Overall			**8000**	**40 - 45 mppa**

Terminal/Satellite	Stand Frontage metres	Sub Total metres	Overall Total metres	Comment
New Terminal				Assessed from aerial perspective image
Short Haul Pier	600 + 600	1200		
Satellite 1	1000 + 1000	2000		
Satellite 2	1000 + 1000	2000		
Remotes	600 + 600	1200	**6400**	
New Overall				**32 – 36 mppa**

Gatwick total stand frontage 8000 + 4800 = 12800 metres

Capacity offered by T6 stands = 6400/8000 x 40 – 45mppa = **32 – 36 mppa**

LGW overall stand capacity = **72 – 81 mppa**

Note: This assessment assumes the runways are placed approximately 1100 metres apart i.e. significantly greater than 1035 metres

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