THAMES REACH AIRPORT **JULY 2013**

THE INTEGRATION OF METROTIDAL TUNNEL AND THAMES ESTUARY AIRPORT

CONTENTS

See separate submission to the DfT Lower Thames Crossing consultations

1 INTRODUCTION AND EXECUTIVE SUMMARY

Metrotidal Tunnel and Thames Reach Airport are independent private sector initiatives, the first a solution to providing a new Lower Thames Tunnel, the second a new hub airport in the Thames Estuary. While the initiatives are independent they can be fully co-ordinated, with the tunnel providing surface access for a hub airport developed in phases.

Metrotidal Tunnel integrates a multi-modal Lower Thames Tunnel with new flood defences for London, tidal power and data storage. The integrated tunnel infrastructure provides economic growth without an associated increase in carbon audit. This green-growth is achieved through improved transport connectivity, with emphasis on rail, integrated with a flood defence system and tidal power plant that generates and stores renewable energy for supply on demand. The tidal plant includes energy-efficient data storage and distribution. These green-growth agglomeration benefits extend beyond the Thames Estuary region across London and the Greater Southeast.

Thames Reach Airport is the phased construction of a new, 24-hour, hub airport beside the Isle of Grain purpose-designed to be time and energy efficient, providing the shortest times for transfer and transit and the lowest carbon audit per passenger; air-side, land-side and for the surface access. This enables the new airport to command the greatest passenger catchment and offer the widest range of destinations of any hub in Europe.

The separate tunnel and airport agendas enable policy makers, planners, promoters, investors, stakeholders and regulators to distinguish their separate benefits, impacts and costs. Metrotidal Tunnel provides substantial green-growth agglomeration benefits for the Thames Estuary Region and is viable without an airport while also providing sufficient capacity for the airport surface access. Thames Reach Airport makes use of Metrotidal Tunnel, thereby significantly reducing the start-up costs for the new hub and associated facilities. The low start-up costs and environmental impacts of the separate tunnel and airport developments enable them to be funded by the private sector.

The Thames, the tunnel and the airport create a caduceus of connections between the East and West, heralding a new wave of trade, inward investment and green-growth for Britain in the 21st century.

2 THE TUNNEL AGENDA

See separate submission to the DfT Lower Thames Crossing Consultations

3 THE AIRPORT AGENDA

3.1 Hub Airports, Sustainable Aviation and Catchments

London can lead European aviation by developing a new hub with the most efficient travel-times, energy consumption and carbon audit air-side, land-side and for the surface access, in order to command the largest passenger catchment with the highest propensity to fly.

Heathrow as Europe's pre-eminent hub is yesterday's game. This English-speaking stop in the Greenwich Mean Time zone on the great-circle route between Europe and the US evolved through the post-war years of reconstruction when London to New York was at the limit of the long-haul range. With these advantages Heathrow drew in short-haul flights from Europe to feed long-haul transatlantic routes thereby increasing load factors and frequency, which in turn enabled new routes to open that drew in more short-haul flights and so hub operations evolved. Now there are competing European hubs. Some already have greater capacity with more runways than Heathrow. Most provide shorter connection times. All can reach the US non-stop. Heathrow's pre-eminence has passed.

However London still has natural advantages, being located in the GMT zone and commanding a large island catchment on the world's busiest route between North America and Europe, a route that now extends west to Mexico City and east to the Gulf. This established North America/Europe/Middle East great circle is being joined by an emerging China/Europe/South America great circle that promises to be just as powerful. London, Paris, Frankfurt and Amsterdam are fortunate in having large catchments that are close to the intersection of these established and emerging continental axes, where journeys between North America and the Middle East or China and South America can be usefully staged with a stop in Europe. In this broader perspective while Madrid may become the European hub for South America, London, Paris, Frankfurt and Amsterdam have the catchments and locations to remain the principal European stops on the established and emerging continental axes.

London and the Southeast is one of the largest catchments in Europe, where regional and high-speed rail can unite existing passenger demand, bringing together most of England, Wales and parts of northern Europe. All that is needed is a new hub that provides the most efficient travel-times, energy consumption and carbon audit air-side, land-side and for the surface access. A sustainable aviation market will then encourage the growth of this efficient new capacity and the phasing out of time-wasting gas-guzzlers. The best existing infrastructure is not wasted but put to good use while the new, efficient infrastructure evolves in a competitive and open green-growth market.

So key questions for the aviation debate are:-

1. How to create a competitive and open green-growth aviation market
2. Where and how to sustain existing capacity while the new hub is being developed
3. Where and how to build a new hub with the most efficient travel-times, energy consumption and carbon-audit, air-side, land-side and for the surface access, in a form that will evolve to replace the least efficient capacity and become a leading European hub serving the largest catchment with the highest propensity to fly.

3.2 Comparative Proximities

The SERAS Study of 2003 challenged the projected capacity of Thames Reach Airport (as proposed at that time) on the basis of its distance from Central London and the ability of the surface access to cope with demand. The DfT was using a hybrid transport model, (NAAM, SPASM and SCAB) to estimate the relative accessibility, resultant demand and net economic benefits for the various airport proposals submitted to the SERAS Study. Though the transport and passenger matrix covered the whole of England in practice a key indicator was the time and equivalent cost of travelling between Central London and the various airport options, as Central London was the proxy for a significant proportion of overall demand. The greater the surface access time the greater the cost of the journey and the more passengers would be dissuaded from using a particular airport option. On this basis Heathrow, being closest to Central London with relatively short and quick surface access, kept on emerging as the clear winner. However this defied passenger travel experience. Journeys to and from Heathrow were relatively quick but the time spent passing through the inefficient arrangement within the airport perimeter had not been allowed for by the model. Passengers perceived Heathrow to be relatively accessible, while overlooking the time spent within the airport perimeter, from the distant car parks and train platforms, labyrinthine terminals, long walks to and from the gates, and the long airside delays with aircraft taxiing and queuing on the ground for take-off and stacking to land. A new airport is purpose-designed to minimise passenger travel-time through all stages air-side and land-side. The saving of travel-times is significant, with a new purpose-designed airport saving between 30 minutes to an hour per passenger compared with Heathrow. The SERAS 2003 hybrid model was not recognising this benefit of a new-build solution.

The problem could be solved by adding the estimated surface access times for the various airport locations to the average travel-times passing through the airports, the latter being highest for Heathrow, similar for Gatwick, lower at Stansted and lowest for a new purpose-designed airport. As a result the “**comparative proximity**” of a new-build airport is significantly improved and the surface access catchment area and net economic benefits correspondingly increased. Thames Reach Airport, the closest new-build proposal to Central London, emerged with a much better comparative proximity, catchment area and net economic output than Heathrow.

A new airport is also purpose-designed to minimise passenger transit times within the airport perimeter and provide minimum connection times (MCT), with a corresponding “**comparative proximity**” benefit for transit passengers. For hubs that offer a similar frequency of flights, an hour saved on passenger transit time within an airport increases the short-haul passenger catchment radius by up to 600 miles. Munich Terminal 2 currently offers an MCT of 30 minutes. For Heathrow the MCT’s range from 45 to 90 minutes, with most being more than an hour. A purpose-designed system should aim for 20 minutes, enabling the short-haul catchment radius to be some 400 mile larger than that of Heathrow.

This c**omparative proximity** benefit also applies to air-rail substitution and the transfer times between a flight and high-speed train. These can be notoriously slow with over an hour spent transferring between the two. For a purpose-designed system where the high-speed rail station is immediately beside the CTA a saving of half an hour from the transfer time equates to increasing the high-speed rail catchment radius by 100 miles.

3.3 Offshore vs Onshore in the Thames Estuary

A fully offshore, outer-estuary airport option is a best-case solution in terms of flight noise, risk contours, emissions and environmental impacts as these are mitigated by falling entirely over the sea. However let us consider the comparative proximity, impacts and costs of the various competing Thames Estuary Airport locations by reeling a fully-offshore, outer estuary solution into Central London on its surface access umbilical. For each kilometre the umbilical is reeled-in the airport platform is on average another kilometre closer to its passenger market and workforce and significant savings are made in the construction costs of the shorter umbilical. There are also reductions in the running and maintenance costs of the surface access, reductions in the carbon audit and reductions in the travel times for both passengers and employees. Eventually the airport platform starts to come ashore with an impact on intertidal mudflats, salt-marshes and meadows. For Thames Reach Airport with two long runways located in Sea Reach most of the flight noise, risk contours, emissions and environmental impacts still fall over the sea. The residual impact on intertidal areas, salt-marsh and meadow is reduced by the airport platform being built within the two pools of the Metrotidal system. A further reduction of the environmental impacts is achieved by dividing the airport construction into two similar phases each with its own runway, terminal and associated satellites.

Now look again at the fully offshore, outer estuary solution. Even the first runway and first satellite need a long new road and rail umbilical stretching across the estuary. So the start-up costs are very much higher, along with the higher surface access travel times, energy consumption and carbon audit per passenger and employee, while the demand forecasts for the more distant offshore location are diminished by the longer travel times. The economic assessment of these factors results in the offshore solution costing billions of pounds more than the equivalent onshore solution. Even if half this sum were set aside there would still be very substantial funds available to mitigate the phased environmental impacts of Thames Reach Airport in Sea Reach.

Finally consider the independent agglomeration benefits of the fully offshore airport solution. A simple test is to ignore the airport and ask whether the surface access connections would be useful and viable on their own. If not the airport location is not the right solution. For a fully offshore location the long umbilical across the estuary provides access to and from an airport but not an efficient route between Essex and Kent. It would not provide the required agglomeration benefits. The existing Dartford Crossing would still be the main connection across the estuary, resulting in congestion and much lower agglomeration benefits. Only an inshore location within the estuary has surface access that provides the new connectivity and capacity for both the agglomeration and aviation benefits.

3.4 Air-Rail Substitution and the new Passenger Catchment Areas

Air-Rail Substitution is a useful way in which to increase hub capacity and extend the surface access catchment area while reducing the energy consumption and carbon audit. Good regional rail connectivity contributes by encouraging a mode shift from road to rail for both passengers and employees. Together these factors generate the new passenger catchment areas, with lower energy consumption and carbon-audit, needed to support a leading European Hub.

Thames Reach Airport in Sea Reach, directly above Metrotidal Tunnel with a link to the East Coast Main Line and a branch from HS1, has direct rail services to the Midlands and the North, Central London, Brussels and Paris. In terms of “comparative proximity” the new hub located to the east of London with a direct high-speed rail service for Europe and minimum passenger transfer times will compete effectively through air-rail substitution with other European hubs over a wide area of the continent from Paris to Brussels and Amsterdam. As noted above the saving of up to half an hour of transfer time between flight and train equates to an extension of the air-rail surface access catchment radius by 100 miles. Heathrow, located to the west of London and with much longer transfer times through the airport, cannot compete in this market even if directly connected to HS1 and HS2. The Metrotidal Tunnel HS1/East Coast Main Line link via Essex Cross Country provides direct services between Europe, the Midlands and the North via Thames Reach Airport. These services though using conventional track north of the Thames avoid the congestion of Central London and provide more direct routes to and from the airport. Similarly a link from HS1 to the West Coast Main Line is provided, without HS2, for connections to Birmingham and Manchester. With some WCML traffic diverted to the new ECML/HS1 link for both passengers and freight there is again spare capacity on the WCML to provide the new through services for the Midlands and West Coast. The improved connectivity encourages a mode shift from road to rail that extends the surface access catchment area and reduces the carbon audit.

There has for some time been discussion of linking the existing London Airports by new high-speed rail lines to create a virtual-hub, linked in turn by HS1 to the UK and Europe. For example one proposal to unite airports is “Heathwick”, the uniting of Heathrow and Gatwick by high-speed rail to provide a hub for the Southeast. While “Heathwick” cannot provide a satisfactory minimum connection time between existing airports and is consequently not the solution for a new hub there is nevertheless a role for regional “Thamested” and “Thameswick” rail services in the wider passenger catchment of Thames Reach Airport, improving access for employees and spreading the inward investment. Thamested, the linking of Thames Reach and Stansted Airports by a new Essex Cross-Country Line and Thameswick, the linking of Thames Reach and Gatwick Airports by an extended Medway Valley Line are not high-speed and do not provide a virtual hub but they do provide frequent and high-capacity surface access for passengers and employees to and from all three airports. These links have the following advantages over Heathwick:-

- the much lower transfer and transit times of Thames Reach Airport compared with Heathrow
- the direct connections from Thames Reach Airport to HS1 for air-rail substitution to and from Europe
- a direct connections from Gatwick Airport to HS1 for air-rail substitution to and from Europe
- the extended catchment areas and agglomeration benefits of the northeast and southeast quadrants of London
- the low carbon audit provided by the Metrotidal wind and tidal pumped-storage system

The passenger demand around Heathrow was pre-eminent in the post-war period up to the 1980’s, helped by the language and cultural connections of the US, bringing inward investment to a pattern of development extending from the SW postcode districts of Central London to Guildford, Reading and beyond along the M3/M4/Great Western Main Line corridor. Now London’s language and cultural connections are more widely spread bringing a higher proportion of inward investment from other parts of the globe, notably Europe, the Middle East, India and Russia. This inward investment is spread more uniformly over London, with an increasing proportion to the East, from the City to Clerkenwell, Shoreditch, Aldgate and Southwark, across Docklands and out into Essex and Kent across the Thames Estuary region. This concentration of wealth does not match that on the west side of London but it is growing and has greater potential to grow. Heathwick would unite wealthy but relatively static demand around inefficient aviation capacity with long transfer and transit times, thereby reducing the surface access catchment area in the long term. Thamested and Thameswick unite under-developed but relatively dynamic areas of demand around efficient, purpose-designed aviation capacity with low transfer and transit times, low energy consumption and low carbon audit enabling the passenger catchment area to grow while holding down the carbon audit generated by employees commuting to and from the airports. With this scale and efficiency, encouraged in due course by the EU ETS, the Thamested and Thameswick services contribute to enlarging the passenger catchment, enabling Thames Reach Airport to be a leading player among emerging European Hubs.

3.5 The European ETS and Carbon Audits

The potential role of the EU Emissions Trading System (ETS) to encourage a new, holistic aviation market will depend on the scope and detail of its application and operation. There are exceptional opportunities for Thames Reach Airport to achieve very efficient surface access and very low average passenger transfer times and transit times resulting in very low energy consumption and carbon audit per passenger with correspondingly low taxation under the ETS. The efficient surface access with low carbon audit also benefits the employees commuting to and from the airport, by holding down and stabilising their travel costs. Even the construction of Thames Reach Airport offers exceptional opportunities for achieving a low carbon audit. Subject to the scope of application, the ETS benefits of Thames Reach Airport could be offset against the fuel consumption of the flights. The age and technology of airline fleets using the various European Hubs including Thames Reach Airport are likely to be similar and their fuel consumption per mile of route served will also be similar. Consequently the ETS applied solely to aircraft fuel consumption will tend to evolve hubs and flight routes that match the shortest point-to-point route solutions. A broader application of the ETS to airport operations and surface access will benefit the hubs with the most efficient airport operations and the most efficient surface access, allowing them to attract transfer and transit passengers further afield from the shortest point-to-point route.

Set out below are some factors that will enable Thames Reach Airport to achieve exceptionally low transfer and transit times, energy consumption and carbon audit per passenger, enabling it to draw in passengers from a larger catchment area:-

Construction:-

- low carbon audit for construction
- solar, tidal and wind power for the airport mechanical and electrical systems
- a heat sink provided by the sea for smoothing winter and summer HVAC demands

Land-side:-

- sustainable surface access led by rail
- direct access to HS1
- direct access to the East Coast Main Line
- minimum passenger transfer and transit cost and time within the airport system
- low energy consumption of surface access, offset by wind and tidal power
- low energy consumption of airport transfer and transit, offset by wind and tidal power
- a tidal pumped-storage system serving peak and prevailing demands

Air-side:-

- minimum aircraft taxiing distances to save fuel and time
- offset runways to save fuel and time
- no queuing for take-off
- no stacking to land
- relatively flexible Noise Preferential Routes (NPRs) for departures

Heathrow or Heathwick cannot achieve these benefits. Thames Reach Airport with HS1 and the Thamested and Thameswick regional services would embrace them all. For those who would prefer the European ETS not to apply to these aspects, or not to apply at all, it is worth noting that the ETS just adds a carbon audit cost to energy prices that are rising with or without taxation. The new aviation market that will emerge in Europe is one that will respond to rising energy prices with or without the ETS.

To forecast the demand and quantify the net economic benefits of an existing or new European Hub a transport model of the new system will be required. The Government will set out energy and carbon audit policy including the scope and detail of ETS application and operation. The aviation market then determines the scale and location of new capacity with airport operators and airline alliances adapting and developing their own models to determine how the market will work for them. The new models will include assessments of travel-time energy consumption, carbon audit and ETS taxation for all stages of the journey airside, landside and for the surface access. The 2003 DfT NAAM/SPASM/SCAB matrix model provides a starting point, updated with UK models such as NAOMI and SETLUM along with other LUTI models and spatial planning to assess agglomeration, green-growth and net economic benefits. Existing model inputs such as journey lengths and duration can be compounded to assess aggregate fuel costs, carbon audit and taxation for a given hub and its catchment area. The new models will output travel-times, energy cost, carbon audit and ETS tax liability to compare net revenues from point-to-point routes with the higher frequency and load factor but longer hub-and-spoke routes. The new models will also examine "propensity to fly" to provide a better understanding of the changing demographic and geographic distribution of demand within a catchment area. The new hub catchment will address agglomeration and growth not historic patterns of demand. So for example the sixties Jet Set followed by well-heeled businessmen in the seventies generated much of the demand centred on Heathrow but today air travel is not the preserve of the wealthy. On the contrary there is a tendency for first and second generation migrants to travel far more frequently than would be implied by income, and their journeys blur the traditional distinctions between business, family and holiday flights. The realm of the new transport models will embrace London and the Southeast, England and Wales and the parts of Europe brought within the surface access catchment of Thames Reach Airport. A broader European model would take account of the surface access transfer and transit times, energy consumption and carbon audits for competing European Hubs over a region embracing say London, Paris-Charles De Gaulle and Schiphol. The broadest model would include existing and emerging long-haul and short-haul networks across Europe.

In summary the holistic application of the EU ETS to flights, airport operations and surface access for passengers and employees has the potential to encourage a new aviation market for the 21st century. This new market will evolve from rising energy and carbon costs and will benefit the hubs with the most efficient surface access and airport operations, enabling them to attract transfer and transit passengers further afield from the shortest point-to-point route. Airport operators and airline alliances will develop their own models for how this market will work to their advantage. Thames Reach Airport will achieve exceptionally low energy consumption, transfer and transit times, and carbon audits per passenger enabling it to command a very broad catchment area to become a leading European hub.

3.6 Airspace design, management and operation

For Thames Reach Airport to open while operations continue at Heathrow a review of air traffic management (ATM) is required to identify constraints that would apply to their joint operation and the scale of conflict between the airspace of Thames Reach Airport and other airports. The opening of Thames Reach Airport would result in the adjustment of operations at the City, Southend and Rochester airports. These adjustments may be minimised by using new airspace controls and new techniques such as steeper approach and departure angles. The programme for opening the first phase of Thames Reach Airport allows time to plan these adjustments. Southend Airport is as far north of Thames Reach Airport as Northolt is from Heathrow and although there is greater conflict in the orientation of the runways significant traffic can be maintained at Southend just as significant traffic has been proposed at Northolt as a means of prolonging the hub operations of Heathrow. Ultimately the transport connections of neighbouring airports would allow mixed-use redevelopment of their airfields in due course, thereby recouping the investments should these airports eventually close.

For the review of air traffic management fortunately a systematic recasting of UK and European airspace is already underway that will encourage and require substantial ATM redesign to provide the following improvements:-

- Greener airports
- Globally interoperable systems and data
- Optimum capacity and flexible flights within globally collaborative ATM
- Efficient flight paths and trajectory based operations

These are targets under the International Civil Aviation Organisation (ICAO) “One Sky” initiative that envisages movement away from traditional fixed routes to free flight. Control switches from ground based systems to global positioning satellites with a view to increasing capacity, reducing delays, improving safety and reducing the environmental impacts and cost of flights. Similarly the Single European Sky (SES) and CAA Future Airways Strategy (FAS) will reduce fuel consumption, emissions and help resolve the best Noise Preferential Routes (NPRs) for departures. Accordingly as European and UK airspace is redesigned for the new ATM system there is an opportunity for this redesign to take account of and optimise the airspace design and co-operation between Thames Reach Airport, City, Southend, Rochester, Heathrow, Gatwick, Stansted and Schiphol.

3.7 24-hour Operation

24-hour operation is emerging around the world to make best use of existing and new capacity, sustain a wide range of routes and provide flight times that are convenient for distant rather than just domestic time zones. At Heathrow night flights between 23.00 and 7.00 are permitted but severely restricted so in practice the runway capacity is generally available for only 16 hours a day. Similar restrictions apply to the other London runways, limiting their potential capacity. A new 24-hour runway accordingly has a cost-benefit advantage over building a new restricted runway at one of the existing airports.

Runways require regular inspection and maintenance. At Heathrow this is undertaken during the night closure. If we assume the runway inspection and maintenance time for a 24-hour airport is equivalent to one runway night closure of 6 hours per day we have the following comparative operational runway hours per day resulting from additional runways at Heathrow and the new-build 24-hour Thames Reach Airport:-

Airport	No. of Runways	Operational runway hours per day
Heathrow	2	36
	3	54
	4	72
	5	90
Thames Reach	2	42
	3	66
	4	90

Thames Reach Airport with just 2 runways easily outstrips Heathrow, pulls well ahead with three, and is a whole runway ahead with four. This enables Thames Reach Airport to accommodate Heathrow's hub capacity and allow for 16% growth with just two runways while four estuary runways are equivalent to five at Heathrow.

In the past the hub advantages of Heathrow enabled it to operate at times suited to the domestic time zone. This aspect of Heathrow's past pre-eminence cannot be sustained in a world of competitive hubs. New capacity needs to operate around the clock to serve international long-haul demand with arrival and departures not always convenient in the domestic time zone. The surface access during night hours for Thames Reach Airport would be led by express rail services on HS1 to and from Central London and some air-rail substitution on HS1 with improved noise protection for households affected along the line. Night-buses, taxicabs and private transport would provide a higher proportion of the direct surface access to and from the airport through the night hours when the roads are not congested. Similarly night-buses, taxicabs and private cars will conclude night-time journeys to and from the Central London termini. In this way Thames Reach Airport can provide a 24-hour service with the market free to decide how to make use of the additional runway capacity.

3.8 Split-Hub Operations

The perception of split-hub operations is that there are no successful precedents, on the contrary for the frequency and load factor benefits it makes sense to unite all the demand from a region into a single hub. This perception comes in part from the experience of building new hubs to replace old and overcrowded airports at various major conurbations around the world. These precedents typically involve a monopoly operator and predominant carrier where there were no advantages from, or specific reasons for, operating a split-hub. Furthermore the old airports were often so disadvantaged that there was little option but to close them down and switch operations to the new airport where they were so much better the airlines had little hesitation in making the move. Closer to home the perception comes from the failed attempt to run a split-hub between Gatwick and Heathrow, but here again both airport operator and predominant international carrier were already firmly established at Heathrow and there was no commercial case for a split hub, especially while the debate continued on whether to expand capacity at Heathrow and while capacity at Heathrow did in fact continue to expand. The same situation has blighted Stansted, which has spare capacity but while in the same ownership as Heathrow had no incentive for the operator or the airlines to move from their secure base at Heathrow. Another precedent is provided by Newark, JFK and LaGuardia operated by the Port Authority of New York. These airports sustain separate operations even though they would benefit from being united into a single new hub. There is also the exceptional size of the domestic O&D market for London and the Southeast with only some 15% of transit traffic overall.

Accordingly a temporary split-hub operation may be managed for London and the Southeast for the following reasons:-

- the scale of capacity that would need to be moved in London (70-80mppa) and the related economic disruption to close Heathrow over a short period is greater than that attempted elsewhere
- there is new infrastructure at Heathrow that is fit for purpose for many years to come
- the economic, social and environmental impacts from accelerating construction of the new hub and moving Heathrow’s capacity in a short timescale is greater than from phasing the move of hub operations over a longer period
- the chronic lack of runway capacity makes London and the Southeast a special case in which it is more feasible for the market to sustain split-hub operations while capacity first develops at a new site then transfers from the old sites to the new, so long as there is a policy commitment to the new hub location
- it would be less disruptive to operate Heathrow as a constrained hub alongside an emerging new hub over an agreed transition period

- the retention of capacity at existing airports rather than its closure and transfer to the new hub increases the overall aviation capacity available for O&D traffic
- a split-hub also offers a degree of security and resilience if one of the airports, existing or new, were to be out of operation for a while, either through accident, terrorism or simply the weather
- until recently the monopoly of BAA and the absence of Fifth Freedoms or regional open-access bilateral agreements has prevented the development of competitive hubs within the UK
- there is scope for competition in the London system between existing operators and a new hub, especially one with excellent air-rail substitution. Heathrow and the other existing airports cannot offer efficient or widespread air-rail substitution. Thames Reach Airport with a direct connections to HS1 and the ECML can in due course integrate long-haul flights with high-speed rail journey times of 100 minutes to central Brussels or Paris, and similar travel times to the Midlands and the North enabling it to become the leading long-haul, air-rail substitution hub for the UK with a catchment extending to Paris, Brussels and Amsterdam.

While it makes sense in terms of flight frequency and load-factor to unite all the demand into a single hub it is possible and beneficial for a large catchment area like London and the Southeast to sustain split-hub operations over a transition period to minimise disruption and make best use of existing infrastructure while efficient new capacity is being developed. The economic loss from split-hub operations over a transition period is mitigated by the benefits of competition, between both airline alliances and airport operators, and by the other benefits including security and resilience.

With Heathrow, Gatwick and Stansted now becoming independent operations following the break-up of BAA it is necessary to consider how domestic competition policy between these existing and emerging operators can be reconciled with the wish to have a single new-build 24-hour hub that is competitive in the international market. One solution is to set caps on capacity at Heathrow, Gatwick and Stansted that allow for some growth above existing levels while the new hub is being developed. The permitted growth would be sufficient to support existing airport operations but not allow substantial new infrastructure investment that would postpone or undermine the case for the new hub. There could then be a tender for the new hub in which the existing operators may purchase preference shares in proportion to their capped capacities and new operators may bid for the remaining shares, within a mechanism that levels the playing field between capped existing operations and sharing the benefits of the new hub, with the aviation market and competition commissioners working out a suitable offer. There is also the inertia of the airlines resulting from the high value of the slots they hold at Heathrow. However with suitable policies in place, once a firm decision on the location for the new hub has been made, along with capping of capacity at existing airports, the airlines would start planning to jump. They may then be encouraged by setting slot prices at the new hub to be cheaper the earlier they jump, or some similar incentive regime. Like the off-plan wholesale price of housing developments they would not have to be much cheaper for very long once the programme for the hub development was confirmed in some detail. An airline alliance would sooner rather than later break rank to open operations with minimum connection times and excellent air-rail substitution from a system that will have the capacity and catchment to become a leading hub in Europe. Wholesale slot prices and/or more shares in the hub the earlier the move would provide an incentive to start moving. A cap on capacity at existing airports would ensure the principal hub transfers in due course and helps prevent the sudden loss of existing slot values. A combination of these or similar policies will be resolved by the forthcoming aviation debate.

In summary with the appropriate Government policies in place, supported by the EU emissions trading system and a national policy framework that identifies Thames Reach Airport as the location for an efficient new hub the aviation market will determine the programme for development and the length of a split-hub operations period. In the meantime good use is made of the investment and infrastructure at Heathrow, Gatwick and Stansted with their existing facilities and employment continuing to serve UK demand. Airport operators can share the benefits while continuing to compete and airline alliances do not need to be pushed but can decide for themselves when it would be appropriate for them to open new capacity at the emerging hub.

3.9 Airport Design, Construction and Operation

A purpose-designed, new-build hub solution provides an opportunity to review the evolving relationship of aircraft design, alliance fleets and airport facilities around the world in order to build the most efficient system for passenger and employee travel-times, MCTs, energy consumption and carbon audit. For Thames Reach Airport a range of airport configurations and facilities has been examined based on the offset-runway, gill arrangement developed at Munich. On this model a Central Terminal Area (CTA) serves a number of infield satellite gills set orthogonally to the runways their length and spacing determined by the range of aircraft and load factors projected for the airport. There are a number of these systems around the world of bespoke and ad hoc design but none has yet attempted to optimise all aspects of the offset runway, gill system. So at Munich for example the runway and taxiway separations are excessive requiring aircraft to taxi greater distances to pass through the system. At Incheon the runways are not offset and the gill separation is too large requiring aircraft to taxi greater distances on the airfield. Existing infrastructure and local site constraints have prevented any airport to date from realising the full potential time savings, lower fuel consumption and lower carbon audit from the offset runway, gill system. For a purpose-designed, new-build hub airport the following aspects among others are optimised to provide the most efficient travel-times and MCTs within the airport perimeter:-

- number of runways
- runway length
- runway separation
- runway offset
- fast-exit taxiway separation
- infield width within taxiways
- satellite length
- satellite separation
- travel distance from airport station to CTA
- minimum length of passenger transit systems from CTA to satellites
- single, modular baggage and freight handling systems for all satellites

An existing constrained airport can only tackle a few of these points and at much greater expense with prolonged disruption to services. Thames Reach Airport can optimise them all and will operate a hub management system to provide minimum taxing times from landing-to-gate and gate-to-takeoff and minimum connection times between gates for flight-to-flight transit. The system will take account of high-speed and express rail arrivals and departures at the airport station so minimum transfer times train-to-gate and gate-to-train are also achieved.

For Thames Reach Airport a range of two, three, four and five widely-spaced, offset-runway configurations can be accommodated on the Isle of Grain while taking account of the local site constraints and CAP 168 Aerodrome Licensing standards. Three offset widely-spaced runways with two infields provide a higher capacity than a conventional 4 close-parallel arrangement so this has been the benchmark for testing a range of configurations on the Isle of Grain since 2009. Of the options considered two widely-spaced (1,525m) in-line, landing and take-off runways (2 x 9,250m equivalent to four conventional runways) provide a compact and efficient system with high capacity. Since this arrangement can be built in Sea Reach requiring the minimum land-take and resulting in the minimum impact on the Hoo Peninsula it is the one considered here in more detail.

The airport is constructed within the Metrotidal pools making use of the pool impoundments. The platform is raised to 8m datum with most of the material dredged from within the pools and excavated from the adjoining hillside, the impoundment helping to control sediment plumes during the platform construction. The dredging and excavation is arranged to move the minimum volume of material the shortest distance to build up the airport platform. The tidal power from the pools is used for the dredging, excavating and conveying of material to the platform site so that with locally sourced materials and tidal power the embodied energy and carbon audit of the platform construction is exceptionally low. Aggregates for construction where not available locally are dredged from the outer estuary and shipped to the site.

The platform for the first phase of the airport accommodates the first long landing and take-off long runway beside the pool impoundment and a Central Terminal Area with gates (CTA) beside an airport station formed around the Metrotidal Tunnel multimodal corridor. An airport transit system for passengers and employees runs on the axis of the airfield from the station and CTA to the infield satellites. A freight and baggage handling transit loop connects the ends of the satellites with a cargo and maintenance area to the west and a freight depot beneath the CTA with freight sidings beneath the airport station.

The platform and facilities for the second phase are the same as that for the first only rotated through 180 degrees and built beside the first phase airport platform. The materials for the second phase platform are again dredged from the pools and excavated from the adjoining hillside this time conveyed a shorter distance resulting in a broad deep channel between the airport and the Hoo Peninsula with the high and low tidal pumped-storage pools separated by Weir 3. The complete platform has an area of some 15.9sq.km. The second phase axial transit system and freight handling systems are them simply linked through to the first phase components resulting in a system with minimum travel distances for all parts of the airport.

The phased construction of the integrated Metrotidal system is justified and viable without an airport. However if built together there are benefits from co-ordinating the first phase of the airport within the first phase of the Metrotidal system as the dredging of the pools and excavation of the hillside then balance the volume of the pools lost through construction of the airport platform leaving the flood storage capacity and tidal power output of the Metrotidal system largely unchanged. For the second phase the volume of the pools lost through forming the platform is similarly recovered through the dredging and excavations so the flood storage capacity and tidal power output is again largely unchanged and the dredging can be used to adjust and balance the outputs from the high and low pools of the pumped-storage system.

With the Metrotidal Tunnel integration justified, viable and funded independently without an airport the start-up costs for the first phase of the new hub funded by the aviation market are significantly reduced and result in a purpose-designed system that has over 16% more runway capacity with lower travel-times, MCTs, energy consumption and carbon audit than Heathrow. The second phase at similar cost to the aviation market creates a system with 250% the capacity of Heathrow.

An optional third phase of the airport opens a twin-bored rail tunnel between Prittlewell near Southend and the immersed tube rail tunnel under the Thames shipping channel (6km) completing an outer Crossrail Plus orbital via the Southend conurbation with a new station below Southend Central Station that provides interchange between the Southend Victoria and C2C Lines. This route opens a frequent service between the stations of Thames

Reach and Southend Airports, a distance of 11km, thereby offering a flight-to-flight transit time of less than an hour. This allows lighter aircraft and some business flights to be redirected to Southend Airport, which continues to operate in effect as a fifth short run (equivalent to a sixth short runway for Heathrow) with services hubbing through Thames Reach Airport.

We can now turn to the environmental impact of the construction and operation of the Metrotidal system and Thames Reach Airport. Though the Metrotidal pools enclose a large intertidal area there's a strong case that on balance the environmental effects are beneficial, before taking account of the tidal power generated and the improved flood defences for London:-

- the pools reduce tidal squeeze upstream
- the TE2100 managed retreat from St. Mary's Marshes is implemented
- the pumped-storage operation exposes new intertidal area within the low pool
- a very large area of freshwater habitat at risk from storms surges is protected
- a permanent barrier across the tideway is postponed

Accordingly the environmental impacts are less than suggested by the area of the pools and the intertidal remediation is less than the existing intertidal area within the impoundments. An advantage of integrating the airport within the Metrotidal pools is that the airport environmental impacts are also largely contained by the impoundments and the integration results in only a modest increase in the loss of intertidal area. Beyond the impoundments the configuration of meadow, salt-marsh and intertidal habit in the Thames Estuary today is the result of environmental management and flood defence work related to the Thames Barrier, which opened in 1984. A benefit of allowing the market to determine the phased development of new aviation capacity within the Metrotidal system is that the environmental impacts are also phased, which helps to mitigate and minimise them through appropriate management and remediation. Nevertheless as most of the estuary is already a protected habitat it is necessary to compensate for the calculated residual loss of intertidal area, after taking account of the Metrotidal benefits listed above, by implementing managed retreat from existing unprotected agricultural land around the outer estuary where the land values do not justify upgrading the existing sea defences. There are areas from Margate to Lowestoft where this managed retreat can be implemented to provide the required intertidal compensation.

An airport protection zone is required around an airport within which the risk of bird strike is reduced to safe levels. The risk is reduced by the suppression of habitats within the protection zone. A key advantage of integrating the airport within the pools is that they already provide the necessary protection for the inbound and outbound flight paths. For the two long runway configuration an area some 3.5km wide and 15km long, extending one kilometre north and south of the outer runways and three kilometres east and west beyond the ends of the runways can define the airport protection zone. Almost all of this area falls over the pools and Thames Estuary with the area covered by water throughout the tides except for a narrow strip of the Hoo Peninsula along the south embankment of the pools and some intertidal area within the low-pool during low tides, which is located away from the runways. As a result the Metrotidal pools provide the necessary airport protection zone without requiring additional habitat suppression across the Hoo Peninsula.

Around Thames Reach Airport there are existing ancillary development zones of some 30.8sq.km. This area is sufficient to accommodate the ancillary services and maintenance for the airport. The Metrotidal system provides direct rail and road access to these existing commercial and industrial development areas close to the airport on the Hoo Peninsula, beside Hoo Junction and Kingsnorth Power Station, on Sheppey at Sheerness, Queenborough and Sittingbourne, and north of the Thames at London Gateway, Coryton and SW Canvey. The location of ancillary development in these areas enables strict development controls to be applied immediately outside the airport perimeter to prevent encroachment on the historic landscape and nature reserves of the Hoo Peninsula.

For the wider impacts on the Hoo Peninsula the location of the airport within the Metrotidal pools means that none of the existing infrastructure on the Isle of Grain is disturbed, except for some upgrading of utility connections under the estuary via the tunnel. The airport surface access provided by the Metrotidal system follows existing transport routes and ancillary developments are configured to minimise impacts on the existing habitation and heritage assets of the Hoo Peninsula. This in turns allows for full compensation, remediation and investigation where property and heritage assets need to be disturbed or taken. The most significant impact is at Allhallows-on-Sea where the holiday camp is first adopted to accommodate the workforce during the first phase of construction and then removed. The remaining habitation of Allhallows-on-Sea along with Slough Fort are taken by the second phase of construction, this allowing time for detailed investigations and full compensation. Where archaeological heritage assets would be disturbed, lost or covered a detailed investigation would determine the extent to which they were recorded and removed or left to be preserved beneath the airport platform and pools.

In summary the environmental impacts of the two long runway configuration for Thames Reach Airport fall almost entirely on the estuary and are not unlike those of an outer estuary solution. Apart from Allhallows-on-Sea the habitation and heritage impacts are minimal and the Hoo Peninsula landscape and historic character will be unchanged. The established settlements and historic assets of Allhallows, Grain Village, Lower Stoke, Middle Stoke and Upper Stoke remain unchanged. The existing infrastructure on the isle of Grain is unharmed.

3.10 Surface Access

The proposed surface access for the airport is arranged to create the largest and most efficient passenger catchment while providing access for the airport employees and maintaining the agglomeration benefits of the Metrotidal Tunnel system. Accordingly the following principles have been used as a guide for forming the new rail and road surface access networks:-

Metrotidal Tunnel principles:-

- the transport links that result in minimum travel time and cost, minimum carbon audit and highest net economic benefit
- the scope for integrating the tunnel with food defence, tidal power and data storage
- the transport links that result in the largest agglomeration benefits
- the locations where rail and road connections can be united within a single immersed-tube concrete section
- the shortest connections to existing arteries for creating new rail and road networks
- the ability to serve passenger and freight demands
- the site, gradient and curvature constraints of the tunnel approaches

Additional Thames Reach Airport surface access principles:-

- the new surface access networks should:-
    - have the capacity to serve both the agglomeration and aviation agendas
    - provide access for airport passengers and employees
    - provide rail-led surface access of between 60 – 80% of total demand
    - make best use of existing rail and road networks
    - make use of existing counter-cyclical commuting capacity
- the length of any dedicated airport surface access should be kept to a minimum

The integration of the Tunnel and Airport agendas minimises the length of a dedicated airport surface access spur and for the two long runway airport option directly over Metrotidal Tunnel none is required. The following dedicated new rail links are provided for the airport in addition to the new track already provided by Metrotidal Tunnel:-

- twin tracks west from Hoo Junction via Thong and Claylane Wood to HS1
- connection of these new tracks to the former Waterloo International CTRL line
- twin track tunnel link between the Great Eastern Mainline and HS1 west of Stratford
- twin track link between the C2C Line and HS1 at Dagenham
- twin track from Queenborough to Kemsley using the existing bridge over the Swale

The following airport services are then provided:-

High-Speed Services:
St. Pancras via Ebbsfleet, Thong and Hoo Junction
North Europe (Paris and Brussels) via Knights Place and Hoo Junction

Intercity services:
ECML via Ely, Cambridge and the Essex Cross Country Line
WCML via HS1 link at St. Pancras

Regional services and Outer London rail orbital:
Thamested (Thames Reach – Stansted) via Essex Cross Country with connections to ECML via Cambridge, TfL Central Line, Great Eastern Main Line, C2C Line
Thameswick (Thames Reach Gatwick) via Medway Valley Line

Metropolitan Passenger and Commuter Services:
Crossrail Plus Orbital via Benfleet and Gravesend

Local Rail Services
New stations at Grain, Kingsnorth and Cliffe on the Hoo Peninsula
New station at Benfleet, with optional new station at Hadleigh-on-Sea
Crossrail Plus Orbital, with outer route option via Southend Central
Essex Cross Country Line between Stansted and Ebbsfleet via Thames Reach Airport
Medway Valley Line between Gatwick and Thames Reach Airport
Sheppey Line between Sittingbourne and Thames Reach Airport

Central London Rail Services
The estimated travel times for express services between the airport and London Termini:-

Terminus	Distance (km)	Direct Service (minutes)
St Pancras International via HS1 Ebbsfleet/Thong	67	25
Liverpool Street via HS1 Ebbsfleet/Thong	64	32
Fenchurch Street via HS1 Ebbsfleet/Thong	64	32
Liverpool Street via Benfleet	58	41
Fenchurch Street via Benfleet	58	41
London Victoria via South Bromley/Thong	70	45
London Waterloo via South Bromley/Thong	72	45
London Bridge via Dartford	62	50

The high-speed rail services provide connections with Paris and Brussels the travel time to both dropping to 100 minutes once the LGV Picardie Line to Paris opens. Hybrid through-train services between HS1 and the East Coast Main Line can be provided on the new link of the Essex Cross Country Line. Though not a high-speed line north of the Thames the route avoids the stop and the line congestion in Central London thereby providing an efficient long-distance air-rail substitution service at modest cost between the Midlands and Northern Europe via Thames Reach Airport. Other direct rail services may develop in due course for improving the Thames Reach Airport catchment, for example to and from Norwich, via Chelmsford, Colchester and Ipswich.

Freight Services:

Europe via HS1
ECML via Essex Cross Country Line
WCML via HS1 link at St. Pancras
Classic Route via Hither Green
Dover via Sittingbourne
Portcentric services for Tilbury, London Gateway, Haven Ports, Thamesport, Sheerness

The new hub airport will be a major logistics and manufacturing centre. The direct connection from HS1 to the Isle of Grain Line brings European GC-gauge north of the Thames for connections to the London Gateway Port, the Haven Ports and the Midlands. The HS1-ECML link provides convenient freight access between the UK and Northern Europe via Thames Reach Airport that avoids the congestion of Central London. Classic freight routes are provided via Hither Green and Sittingbourne to prevent congestion on HS1.

Local Commuter Services

The employment and services for a new hub airport in the Thames Estuary requires the support of a conurbation the size of Manchester. The Thames and Sheppey immersed-tube tunnels of the Metrotidal system result in the agglomeration of the South Essex conurbation with North Kent, the Medway Towns and Swale, where the combined population within 20km of the airport is just over 1m. This is sufficient to serve the new hub with growth beyond the scale of current operations at Heathrow. The Crossrail-Plus orbital extends the commuter catchment into the metropolitan boroughs of Central London so that no new urban development or substantial migration is required to support the high-capacity phase of Thames Reach Airport. The new Essex Cross Country and Medway Valley Lines further extend the commuter catchment around the northeast and southeast quadrants of London enabling the percentage of employees travelling by rail to reach the higher levels within the 60-80% range.

3.11 Agglomeration and Integration Benefits

Thames Reach Airport located within the Metrotidal pools compounds a new hub airport with the agglomeration and integration benefits of the Metrotidal system. The Tunnel and Airport agendas remain separate and independent with the funding of the Tunnel justified and viable without an airport. This reduces the cost of the Airport Agenda, which can then be fully funded by the aviation market and private sector without Government subsidy. However the full costs and benefits of each airport option need to be included for the final comparison of the submissions to the Airports Commission. So for example if air-rail substitution at Heathrow requires HS2 an appropriate proportion of the HS2 costs and benefits need to be included in the overall cost-benefit analysis of the Heathrow option.

The following criteria are recommended for comparing and selecting the various airport options submitted to the Commission:-

1. extent of the surface access catchment area including air-rail substitution
2. population within the catchment and propensity to fly
3. the travel times for surface access including air-rail substitution
4. transfer, transit and MCT's within the airport perimeter
5. the cost of the surface access infrastructure outside the airport perimeter
6. the cost of the new infrastructure within the airport perimeter
7. the cost of the environmental remediation
8. the energy consumption and associated carbon audit of the airport operations
9. the energy consumption and associated carbon audit of the surface access
10. calculation of the net present value of each airport option over an agreed period allowing for estimated EU ETS carbon taxation.
11. addition of the specific agglomeration and integration benefits of each airport option,
12. the overall benefit to cost ratio

The analysis should be an improvement on the NAAM, SPASM and SCAB hybrid model used in 2003, to take greater account of hub operations including the movement of employees and place greater emphasis on the climate change and sustainability agenda, along with a better understanding and valuation of the wider agglomeration and integration benefits. The relative agglomeration benefits to the east of London will be greater than those to the west for a similar quantum of investment as the east has experienced relative decline for over a century and there are latent benefits from weaving the economies of Essex and Kent together while to the west the transport networks are already very congested and agglomeration benefits are harder to achieve.

Modest investment to the east of London provides the following agglomeration and integration benefits in addition to a new hub airport the value of which need to be assessed:-

- higher agglomeration benefits east of London
- wider rail benefits
- Stansted and Gatwick regional rail benefits
- relief of congestion on the Dartford Crossing
- the next generation of flood defences for London
- the pumped-storage tidal power output of the two pools
- new utilities and data storage
- dry dock and ancillary development
- new GC gauge European rail access for the East Coast ports

3.12 Programme and Costs

A programme and costs table to 2030 is provided. The programme for Metrotidal Tunnel starts two years ahead of the programme for the airport. Subject to the planning stages the procurement on site can result in the first phase of Metrotidal Tunnel opening with Crossrail Plus in 2020 and the first phase of Thames Reach Airport opening by 2024 with a capacity of 90mppa, including air-rail substitution. The phases of the Tunnel and Airport can be complete by 2030 for a cost of £28bn, less the sum of the agglomeration and integration benefits listed above, resulting in the net economic cost for comparison with the estimated net economic benefits of the new hub airport. This is likely to be the shortest programme leaving the aviation market free to decide how soon after the first phase the second phase of the airport is undertaken.

M.Willingale July 2013

on behalf of Thames Reach Airport Ltd.

