Development of Airport Capacity in the Thames Estuary

December 2003

Halcrow Group Ltd

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Contents

1 Introduction

This report summarises the principal issues in the development of airport capacity in the Thames Estuary raised during the course of the consultation on SERAS.

Prior to the commencement of SERAS, the Department commissioned a Site Search Study. The main objectives of the study were to identify options for siting new airport capacity to serve London, the South East and Eastern regions, to highlight the most suitable areas for sustaining major development and to recommend a short list of potential sites.

The study evaluated the full range of potential sites, including greenfield, brownfield and offshore possibilities, both new and a number that have been examined in previous studies. In addition, over 400 existing operational and inactive sites, including civil, private and military airfields, were reviewed.

The study was carried out in five stages with the number of potential sites being reduced at each stage. Cliffe, The Cant (an island site in the Thames Estuary) and Sheppey were all considered in the fifth and final stage of the Site Search Study. While the others were dropped at a preliminary stage of SERAS, the Cliffe option was studied in detail.

This report draws on an initial review of the Marinair proposal, undertaken for DfT in January 2003, which also made reference to possible airport development on The Cant in the Thames Estuary. The Cant had emerged from the Site Search study undertaken for the DfT as the most promising offshore or estuarine site for a new airport. This report also draws on the appraisal of options at Cliffe undertaken in SERAS and on reviews of other estuarine proposals, onshore and offshore, brought forward by the private sector during the consultation on airport proposals. These were:

- Goodwin Sands – a new island airport east of Deal in Kent comprising two sites, each with two runways, with a total capacity of 120 mppa.
- Marinair – a new four-runway island airport in the Thames Estuary north east of the Isle of Sheppey,
- Sheppey – a new two-runway airport on the Isle of Sheppey in Kent with a capacity of 75 mppa and the potential to grow to four runways beyond 2030, and
- Thames Reach – a new four-runway airport on the Hoo Peninsula in Kent, close to theCliffe option, with a potential capacity of 120 mppa.

The purpose of the report is not to summarise the appraisal of the different proposals put forward during the consultation, but to give an overview and draw general conclusions on the concept of estuarine airport development.

The report is structured as follows.

- Section 2 deals with airport locations, layouts and capacities, and some of the impacts of airport construction

- Section 3 deals with surface access connections,
- Section 4 deals with the costs and timescales of airport development,
- Section 5 deals with passenger forecasts and the economic appraisal of estuarine airport options, and
- Section 6 deals with the environmental impacts of airport operation.
- Section 7 is a summary of the main conclusions.

Different topics are dealt with in different levels of detail. Most of the promoters of estuarine airports identified locations and made some assessment of airport layouts and capacities, even if it was not always clear where all airport facilities would be located. Surface access connections tended to be more conceptual. Some of the difficulties and costs of providing the required surface access connections have been, in our view, under-estimated. Passenger forecasts used in proposals are generally those produced from the Department's SPASM model. Environmental impacts have been identified in most cases but not in great detail.

2 Airport Locations, Layouts and Capacities

2.1 Locations

The airport locations to which some consideration has been given are shown on the attached figure. The airport proposals are as follows.

Cliffe. An onshore site on the Hoo Peninsula in North Kent, included by DfT in the consultation on airport development in the South East. The proposal was for up to four runways arranged in two east-west close parallel pairs, with a possible fifth runway on a different alignment, which might be used only at night and in particular weather conditions. The main benefits of Cliffe were identified as:

- sufficient land available for a major new airport,
- potentially good surface transport links with London, other parts of the South East and the UK,
- relatively few people would be displaced by the airport's construction for the amount of new capacity provided,
- relatively low numbers of people would be affected by aircraft noise,
- a potential for 24-hour operation to meet the needs of air freight, and
- development of an airport in this location would support regeneration policies in the Thames Gateway.

Marinair. An offshore site on an artificial island within the estuarine waters of the River Thames, north east of the Isle of Sheppey. The site is within an area of shallow water and well away from the primary tidal and shipping channels. No design details were presented to establish the capacity of or the demand for the proposed airport facilities or for its surface access links, though, as with all proposals, promoters were given opportunities to submit further relevant details.

It was assumed that two pairs of close parallel runways would be provided. A dedicated four-track high-speed railway in tunnels was proposed, to provide a direct connection between central London and the airport island, and use of CTRL and some surface rail was mentioned. The airport would be served (through dedicated tunnels where necessary) by: road links to the M25; a high speed rail link to join CTRL near Ashford; a road link to the M2; a road link from the A13 to an interchange with the high speed rail link to central London, proposed as a means of access for airport workers; and a possible road link under the shipping lanes (which run close to the north shore) to link the island with the Essex coast.

The Cant. This site, like Marinair, is an offshore site on an artificial island in the Thames Estuary, some 10 km to the west and 2 km to the south of the Marinair site. The concept also offers four runways in an east-west, twin close-parallel layout. The construction advantages of The Cant were seen to arise from shallower water and the scope for a better solution in terms of river hydrology. Surface access advantages stemmed from its closer proximity to London and therefore lower infrastructure cost and faster journey times.

Thames Reach. The location is similar to that of the Cliffe scheme, but the site area is located further west and north, on Halstow Marshes and partially onto the tidal mud flats. The site straddles what is termed a Lower Thames Tunnel, crossing from Canvey Island on the north bank, due south under the airport and emerging near High Halstow. The tunnel would carry both road and rail routes. Rail connections are provided, by various means, to Fenchurch Street, Liverpool Street and Southend on the north side, and CTRL and local lines on the south side. Road connections are given a lower priority, to encourage rail usage, but connect the site by various local links into both Kent and Essex. The airport could grow to a four-runway layout, with the runways arranged in two close parallel pairs.

Sheppey. A proposal for an onshore airport on the Isle of Sheppey in North Kent, though different from the Sheppey option addressed in the Site Search Study. Up to four runways were proposed on a low platform over an area generally of farmland. The proposed layout at Sheppey was fashioned after Singapore Changi Airport. The runways are oriented east-west in two close parallel pairs, with the 3rd and 4th runways being built only after 2030. The site is formed essentially on existing ground levels, at around 7 metres above mean sea level. No major earthworks are envisaged until the 3rd and 4th runways are needed, when some higher ground would need to be levelled.

The proposal was predicated on large scale use of rail to access the airport, with expectations of CTRL and St Pancras station having the capacity to handle up to 67% of airport passengers accessing the airport by rail, journey times of between 28 and 32 minutes between St Pancras and Sheppey and 10 minutes longer to Waterloo, provision for Park & Ride at remote airport 'terminals' above stations on the CTRL at Ebbsfleet, Ashford and Farningham (where the M25 crosses CTRL) and at St Pancras, Stratford and Waterloo.

Goodwin Sands. This proposal differs from the others in being outside the estuarine waters of the Thames. The airport is conceived as a 24-hour passenger and freight hub, located 7.5km due east of Deal on sandbanks at the southern end of the Goodwins. Two phases of development are envisaged; the first being a two-runway island site with a capacity of 60mppa. The second phase is an entirely separate island, identical in layout but located some 7km north of the first site. The total of four runways would take capacity up to 120mppa.

The surface access provisions would be similarly phased. Access to the first island would be via road and rail links from a terminal site east of Dover, linked to the A20(M20) and the CTRL. The second island would have road and rail links to Deal, but not to the first island. The second

island would need a rail connection to CTRL, either via the first island or an extended, on-shore link.

Maplin. No potential airport promoter has seriously revived the Maplin proposals during the consultation period. The plan produced in the early 1970s, following a Note of Dissent to the Report of the Roskill Commission, was for an airport and seaport, the airport in its first stage having two parallel runways with an estimated capacity of 60 mppa.

2.2 Airport Layouts and Capacities

In most cases the proposed airports were expected to be able to develop into four-runway airports, with the runways arranged in two close-parallel pairs. Such airports could provide most, and possibly all, of the capacity needed up to 2030 and beyond. To give a better prospect of their financial viability, such airports tend to be seen as the sole locations of additional runways in the South East, rather than as parts of a package with an additional runway or runways also being provided at existing airports.

The expected timing of their ultimate development varied from airport to airport. For passenger modelling purposes it was generally assumed that such airports would have runway capacities of around 780,000 ATMs, as at Cliffe, and passenger capacities by 2030 of around 113 mppa.

For some potential sites, particularly the offshore sites, the argument has been made that it would be possible to ensure that no residential properties fell within 57dB LAeq daytime noise contours, which in turn would allow 24-hour operation at the airport, thereby increasing the capacity for air freight and for night-time passenger services.

For some potential offshore sites there was an inclination to site some facilities, particularly passenger processing facilities (terminals) and car parking, onshore, with remote check-in at stations or even on trains. It was not always clear where onshore facilities might be located. Some of the issues raised by locating passenger terminal facilities and car parking at stations are covered in Section 3, which deals with surface access issues.

Airspace

In the assessment of airspace capacity issues carried out as part of SERAS, the basic structure of airspace is assumed to remain in place and aircraft have to be routed to and from the current major waypoints used to channel traffic in and out of the region.

Airspace restrictions are in force in the Thames Estuary. The main restricted area is the Shoeburyness firing ranges to the north (CAA area designation EG D136 and D138, D138A and D138BA). This occupies the whole of the Shoeburyness and Foulness coastlines and extends some 7 km out to sea over the Maplin Sands. It is assumed that the range will remain in use and all aircraft must be routed clear of it. A second restriction (CAA area EG D146, Yantlet) is located in a small area on the north tip of the Isle of Grain. We believe this is used intermittently

for ordnance disposal by detonation. While this appears unlikely to present a significant risk, it is sensible to assume it would be closed in the event of airport development.

For all options, CAA/NATS have concluded that major airspace restructuring would be required to accommodate significant new airport development. With reference back to the CAA/NATS simulation studies on Cliffe, a more easterly location of any new airport would make it easier to devise a structure to minimise conflict between this, Heathrow and other traffic, but interaction with Dutch airspace might increase.

Obstacles

The coastal or offshore locations mean there would be no close-in obstacles to aircraft navigation. Shipping would have to be kept away from the immediate runway areas to minimise obstacle risks and any potential interference with navaids.

SS Montgomery

The only other significant risk identified is that presented by the wreck of the SS Richard Montgomery, a World War II munitions carrier. This wreck (located at approximate Latitude 51^0 28', Longitude 00^0 47') is variously estimated to contain between 1,000 and 3,000 tonnes of high explosive ordnance. Its site would be beneath or close to the easterly extended centrelines of runways on the Cliffe or Thames Reach sites. The wreck lies in shallow water about 3 Km of the town of Sheerness, being visible from there at low tide.

Informed opinion appears to assess the risk of a major explosion of the Montgomery as remote if it is not disturbed, but shipping, fishery and pleasure craft are required to avoid the area. Options for removal of the hazard have, to date, apparently been considered too hazardous to attempt.

2.3 Construction Impacts

The principal impacts of airport construction – as opposed to airport operation – at onshore sites have been recorded as:

- Land and property take – residential properties, commercial/industrial properties, public buildings, recreational land, agricultural land, designated land – eg Green Belt,
- Potential contamination impacts,

- Impact on ecological sites,
- Impact on heritage sites,
- Landscape and visual impacts,
- Community impacts – on community infrastructure, community structure/distinctiveness, and employment, and
- Impacts on surface water, groundwater and flooding.

Construction of airports at offshore sites would have a range of other impacts:

- Impacts on tidal flows and on river channels,
- Compensation dredging would be required to create a new flow area equivalent to the area of the blockage that would be caused by an airport island,
- Local compensation dredging might have to be supplemented by imported material,
- Any scheme for an island of the size required would have to be the subject of detailed hydraulic modelling to assess its impacts, reduce them as far as possible and support design of the compensation dredging areas,
- In its areas of jurisdiction, under present legislation, the Port of London Authority would have to be consulted and involved in the planning of dredging and reclamation,
- Impacts on fishing and spawning grounds,
- An airport island would have to be protected by a soil bund faced with rock or concrete armour. A wave deflection wall would also be required on exposed faces. Suitable rock would probably have to be imported but the amount required would depend on the quality of the dredged material found. Availability of gravel in volume would reduce the amount of rock protection needed,
- The impact of tidal surges which could be, say, 1m above Mean High Water Spring tide level (MHWS), and the net rise in sea level (made up of the 0.1m subsidence of the Thames basin and the rise in mean sea level for the High Emissions Scenario of 0.18m, giving a total net rise of, say, 0.3m) would need to be allowed for in island design,
- Local settlement of the soils underlying the island, both short and long term, would need to be allowed for, and
- Drainage strategy for the island would require a comprehensive study. The surface of the island would have to drain into the estuary. With a gravity system,

additional fill volume would be needed to create drainage falls. A pumped or partially pumped system would balance the costs of additional filling against the costs of pumping equipment and its operating costs.

3 Surface Access Connections

3.1 Surface Access Requirements

Surface access infrastructure and services would be required to accommodate passenger and employee movement to and from the airport, air freight access and the traffic associated with other airport servicing activity.

Airports are major employers. The SERAS on-site employment forecasts for Cliffe are summarised in Table 1 below. Even when allowance has been made for lower employment levels at a new airport and continuing labour productivity improvement at a rate of 1.5% per year, Cliffe was forecast to require 35,000 employees on site in 2015 and over 52,000 in 2030. It may be possible to locate some of these jobs off-site but this would raise other planning issues. A large on-site labour force would be required and would have to draw on the labour market on both sides of the estuary.

Table 1: SERAS Employment Forecasts for Cliffe

Indicator	Two runways, 2015	Four runways, 2030
Passengers, mppa	58	110
Direct on-site employment	35,000	52,300
Direct on-site employees/mppa	603	475

Some of the airport proposals generated during consultation appeared over-optimistic in their expectations of public transport access to their airports, in terms of the services that might be achieved and the numbers of passengers and employees that those services would attract.

There were suggestions that public transport might serve up to 90% or more of passenger and employee access trips, leaving minimal levels of access by road. The current best performance by South East airports is around 37% of passengers at Stansted and 23% of employees at Heathrow accessing the airport by public transport. Government policy is to increase the use of public transport by both passengers and employees and, in SERAS, enhanced rail infrastructure and services were assumed and modelled in order to achieve that aim. Other measures such as road tolls and airport access charges might be used to increase the use of public transport.

Nevertheless, the requirements for road access capacity to an estuary site would be substantial. At a minimum they would include:

- New high capacity (dual carriageway) road connections in two directions for operational reasons,
- Road connections to both Kent and Essex to access the labour catchments on both sides of the estuary,

- A high capacity road access link towards London to serve passenger, employee and other airport traffic in the airport's main market, and

- Enhancements to parts of the existing strategic road network to accommodate the additional airport traffic.

On the rail network, the minimum requirements are likely to be:

- High speed rail services of at least 4 trains per hour between the airport and London and ideally 8 trains per hour with a larger airport. Journey time is clearly critical to airport choice,

- Other fast rail services between the airport and London to supplement the capacity of the high-speed services and to spread the load between different rail routes and London termini, and

- Connections for other, local rail services to and from the airport, primarily to accommodate employee rather than passenger trips.

3.2 Costs of New Transport Links

All new airport proposals suggested they would be served by new dedicated high speed rail lines to London. The construction of the current CTRL, a 2-track high speed rail line with few stations, will cost £5.2 billion: £1.9 billion for the 74 km (£26 million per km) of the mainly at-grade Section 1 from the Channel Tunnel to Fawkham Junction and £3.3 billion for the 39 km (£85 million per km) of the mainly tunnelled Section 2 between Fawkham Junction and St Pancras. More tracks or more stations would increase these unit costs.

Any new high speed link between an estuarine airport and London would require an equivalent of Section 2 of CTRL, a mainly tunnelled section into London, at a cost of £3.3 billion. The length and cost of the equivalent of Section 1 of CTRL would depend on the airport location. A new high speed rail link would also have to find a suitable terminal location in Central London, ideally well served by the underground network for the onward distribution of trips. CTRL will make use of spare capacity at St Pancras, but there is no other similar spare capacity obviously available.

SERAS estimated the cost of dual carriageway road links at £40 million to £62.5 million per km in tunnel or on viaduct and £2.2 million per km at grade. New junctions woild be required where new road links join existing networks.

3.3 Using CTRL

An alternative to building a new high speed line might be to make use of the line already being built – CTRL – if the proposed airport is suitably located. This was included in the SERAS proposal for Cliffe.

The available trainpaths on CTRL are currently allocated to Eurostar and domestic CTRL services. SERAS assumed that up to 4 trainpaths per direction per hour might be available for airport services if not all Eurostar or domestic trainpaths were taken up, or if domestic high speed services to London were reduced, given the presence of a large number of jobs at a new large airport in North Kent close to the line.

Capacity on CTRL is limited but would be further reduced if proposals were made for new stations on the line, for example at Ebbsfleet or where it crosses the M25, to serve airport passengers. The capacity of the line will be optimised if all services achieve the same speeds and stop in the same places. Adding airport services with additional stops would reduce capacity. Building any new stations would also be expensive and disruptive to the working of the existing services.

At best, CTRL is likely to be able to accommodate 4 airport trains per hour, which would need to be supplemented by other high quality rail services between London and a new airport. Trainpaths for 4 airport trains per hour on CTRL would be more readily achieved for airports nearer to London since the distance on CTRL over which airport services and Eurostar services were operating at different speeds would thereby be reduced.

There would be additional costs in providing the station and track infrastructure for other services, as well as providing for local services to be mainly used by employees rather than passengers.

3.4 Distances and Journey Times

Our estimated straight line distances between Central London and various existing and proposed airport locations are set out in Table 2. The closest of the proposed estuarine sites – Cliffe and Thames Reach – are two onshore airports. These are at similar distances from Central London as Luton and Stansted, at 40 – 50km. The closest offshore airports are more distant, at 66 – 77km. The furthest afield is over 100km from Central London.

Table 2 also indicates our estimated fastest rail journey times between Central London and proposed estuarine sites assuming new high speed rail lines or use of CTRL and rolling stock capable of 200km/h operation.

Cliffe and Thames Reach may have fastest rail times to London of around 30 minutes, Maplin, The Cant and Marinair may have fastest times of under 40 minutes, Sheppey under 50 minutes but Goodwin Sands approaching 80 minutes.

Table 2: Straight Line Distances to Central London

Existing Airports	km	Proposed Airports	km	Fastest rail time to London, min
Heathrow	24	Thames Reach	44	28
Gatwick	40	Cliffe	49	26
Luton	46	Maplin	66	32
Stansted	48	Sheppey	69	47 – 48
		The Cant	72	32 – 37
		Marinair	77	35 – 40
		Goodwin Sands	112	78 – 80

4 Costs and Timescales of Airport Development

4.1 Construction Costs

The costs of building a four-runway airport at Cliffe were estimated in SERAS at £11.5 billion excluding the costs of surface access schemes. Earthworks accounted for around £3 billion of this total.

SERAS estimated the cost of the largest option consulted on at Stansted – three new runways – at £6.0 billion. The combined cost of an additional runway at each of Heathrow, Gatwick (wide spaced) and Stansted was estimated at £9.8 billion, again excluding the costs of surface access schemes.

The costs estimated by scheme promoters for building other estuarine airports have ranged between £6.1 billion and £6.5 billion for two-runway airports and £8.3 billion for a four-runway airport. Greater uncertainty attaches to cost estimates for partly or wholly offshore sites than to conventional onshore development. That uncertainty relates to three main elements of offshore schemes; platform construction, additional costs associated with offshore working, and the cost of surface access infrastructure.

Most of these additional costs would have to be be borne up-front, during the initial airport construction stage. There is some scope for phasing reclamation and facility construction costs but access infrastructure has to be inplace at first opening. The need to invest ahead of demand is a feature of any airport. Development of an offshore site will, however, require investment in substantially larger increments than at a conventional site, where expansion can be more closely matched to demand.

Platform Construction

For the Marinair and The Cant proposals, SERAS estimated the costs of forming an estuarine island on which to locate an airport (but excluding airport construction costs) at £1.2 billion or £1.9 billion, depending on the site chosen and hence the water depth and the costs of the revetment, dredging and reclamation.

Reclamation by dredging and deposition in open water is a relatively slow process, as large amounts of material are lost, particularly from the deposit areas due to tidal action. Temporary as well as permanent bunds have to be formed to minimise such losses, which increases cost and time. Allowing for all of these measures, it is estimated that forming an airport island could require a timescale of 5 years, but it may be possible to phase the reclamation to achieve opening of the airport for operations in advance of the completion of the full island site. Disadvantages of the concept include:

- The long lead time before aiport operations could start
- An island would have a significant impact on the hydraulics of the whole estuary, which compensation dredging would not be able to fully mitigate
- Potential effects on the marine ecology would generate significant opposition from environmentalists and the fishing industry
- Full details of the soils in the area of dredging would need to be known before design, and therefore costs, could be confirmed. If they proved to contain significant quantities of silts and soft clays, that could require significant additional costs and time.

Settlement

Given the extent and height of fill required to form a large island, long-term settlement must be expected to occur to significant depths within the underlying strata. While it is difficult to estimate with any degree of precision, it would be prudent to allow for around 0.5m of settlement when estimating quantities of fill material required.

The risk of differential, rather than uniform, settlement increases the uncertainty of cost estimates. The relatively deep-seated nature of the long-term settlement of the underlying strata would be expected to result in relatively uniform settlement. Variations in the nature of the underlying soils or in the material deposited in reclamation could, however, lead to differential movement beneath airfield pavements or buildings. This issue can be addressed in two ways. Thorough investigation of the underlying site before construction reduces uncertainty about conditions, and careful selection of materials and design of the reclamation will minimise future movement. Secondly, pavements and structures on the island can, to varying degrees, be designed to accommodate differential movement if it occurs. Both approaches will, however, tend to increase costs.

Offshore Construction

The additional costs of building airport facilities offshore have been estimated at up to 40% above those of building on land, depending on the nature of the island site and the nature and phasing of access routes to the site. Additional costs would be generated by: on-site accommodation of labour and/or increased travel to work time, transport distances for materials and equipment, multiple handling from one mode to another, weather effects and insurance costs.

Surface Access

All potential estuarine airports examined would need new surface access infrastructure, but the scale and cost of such infrastructure is in many cases far from clear. A key issue is the provision of a high-speed rail capability between the airport and London.

For Cliffe, which is almost as close to the main London market as any proposed estuarine site and close to CTRL, surface access infrastructure costs of £1.8 billion were allowed for. These covered a connection to CTRL in the vicinity of the airport and a second connection at Wennington, a road tunnel across the Thames to Benfleet, largely to access the south east Essex labour market, and other road and rail connections. A Lower Thames Crossing (for road and rail) was also assumed to be necessary, but was deemed to be provided for Thames Gateway regeneration purposes and so not costed to the airport. These would appear to be minimum surface access requirements and costs.

One estuarine proposal suggested a new four-track high-speed rail line in dedicated tunnels between the airport and London would be built (note that CTRL is only a two-track high-speed line). Finding a suitable alignment through a congested East London corridor and terminal facilities in Central London would not be easy. Such a scheme could cost of the order of £9 billion. Long sub-sea road tunnels, at the upper limit of current design experience, were also proposed. The cost of such tunnels would be high, due to their complex ventilation and safety requirements. With the costs of other proposed road and rail links taken into account, the overall cost of access infrastructure in this case was estimated at £15 billion.

4.2 Construction Timescales

Construction of an offshore site on which to build an airport could take up to 5 years. Even if it were possible to phase construction activity so that airport construction could commence before the whole island site were completed, it would be prudent to allow, say, 3 more years for construction offshore rather than onshore.

4.3 Summary

The typically estimated costs of around £8 – 10 billion for constructing a large four-runway airport could be expected to be further increased in the offshore case by:

- Site formation costs of £1 – 2 billion
- The additional costs of offshore construction of up to £3 – 4 billion, and
- Surface access infrastructure costs of at least £2 billion and possibly as much as £15 billion.

An offshore site could cost up to £6 billion and more in excess of the cost of an onshore site.

A high proportion of these additional costs would be incurred in the construction phase of an offshore airport, before revenues are generated.

The construction phase of an offshore airport would generally be longer than that of an onshore airport, with a period of 3 – 5 years possibly needed for formation of an airport island.

It appears that the uncertainties attaching to offshore development and the scale of the investment involved have been key reasons why Dutch proposals for an offshore airport appear to have been put on hold, with approval being given for additional runway capacity to be provided at Schipol. They rendered the offshore option unfavourable in the short to medium term. It is understood, however, that offshore construction is still regarded as an option in the long term.

5 Passenger Forecasts and Economic Appraisal

5.1 Passenger Forecasts

The principal factors determining the allocation of passengers to particular airports in the forecasting process are:

- the air services available from the airport, and
- surface access times and costs between the airport and sources of demand

For new airports appraised in SERAS a consistent set of 'seeding' assumptions on the services available from new airports has been made. This means that surface access times/costs, particularly between the airport and London, the major market, are the principal differentiators in the forecasts for the various proposed airport locations. 2030 passenger forecasts at the different airports are summarised in Table 3, together with estimates of fastest rail journey times to London. In some cases we believe that proposals tended to be over-optimistic in the journey times that might be achieved between their airports and London.

Table 3: 2030 Passenger Forecasts at Estuarine Airports

Airport	Fastest rail time to London, min	2030 Pasengers, mppaa	Other
Cliffe	26	110	
Thames Reach	28	104	
Sheppey	47 – 48	59	Additional capacity at Stansted used by 27 mppa more than in Max Use case
Goodwin Sands	78 - 80	53	
Marinair	35 - 40	No forecast made	
The Cant	32 - 37	No forecast made	

The effects of distance and access times from the main market on passenger willingness to use an airport can clearly be seen. The available passenger capacity at Cliffe and Thames Reach is almost fully utilised by 2030. At more distant airports the passenger forecasts are lower. For the Sheppey forecasts, an additional runway at Stansted was forecast to attract an additional 27 mppa in 2030. The Goodwin Sands 2030 forecast is around half of the Cliffe forecast, with the difference reflecting the poorer accessibility of Goodwin Sands.

The willingness of airlines to use a new airport at all has been questioned and their willingness to use a new airport can be expected to reduce with distance from the main market. The forecasts summarised above are 'seeded': they assume that airlines are persuaded to transfer large parts of South East air services (40% of Heathrow's scheduled services, 23% of Gatwick's

charter services and 11% of Stansted's no-frills services) to the new airport. The aviation industry has suggested that airlines would be unwilling to vacate slots at existing, preferred airports, so giving their competitors who remain at these airports a possible commercial advantage. Populating a new airport with a viable range of services is likely to require Government intervention which may or may not be forthcoming.

Without such seeding, passenger forecasts are reduced. The 110 mppa forecast at Cliffe in 2030 with seeding reduces to 72 mppa without seeding. At Sheppey, the 59 mppa 2030 forecast with seeding reduces to 17 mppa without seeding, but still with an additional runway at Stansted.

5.2 Summary of Forecasts

New airports, whether in the Thames Estuary or elsewhere, require airlines and passengers to use them and there is a risk that this might not happen unless there is Government intervention which encourages or coerces them to a new site.

If airlines can be persuaded to relocate large parts of their South East air services to a new airport, the capacity of a new four-runway airport relatively close to London could be almost fully used by 2030.

For airports further out in the estuary or off the Kent/Essex coasts, considerably lower passenger volumes, of around half those for the airports closest to London, are forecast.

If Government does not or cannot persuade large parts of South East air services to relocate to a new airport, the forecast numbers of passengers will be substantially lower.

5.3 Economic Appraisal

The results of the economic appraisal of estuarine airports and other South East airport development proposals are summarised in Table 4. In each case, costs and benefits are estimated against a base case of maximum use of existing runways and incorporate new Green Book assumptions: discount rate of 3.5%, 44% cost increase and a three year delay in project completion and realisation of benefits.

Table 4: Summary of Economic Appraisal Results

Option	Costs £bn	Benefits £bn	Net Benefits £bn	Benefit:Cost Ratio
Estuarine airports				
Thames Reach	7.6	25.0	17.4	3.3:1
Sheppey	9.1	19.5	10.4	2.1:1
Goodwin Sands	9.7	11.6	1.9	1.2:1
Cliffe	13.9	24.5	10.6	1.8:1
Other airport options				
Heathrow +1, Stansted +1	7.5	24.6	17.1	3.3:1
Heathrow +1, Gatwick +1, Stansted +1	9.0	32.8	23.8	3.7:1
London Oxford	11.3	28.1	16.8	2.5:1
Redhill	2.5	5.6	3.1	2.3:1

For the estuarine airports, the promoters' cost estimates have generally been used. There are reasons to believe costs have been under-estimated in some cases, notably in site enabling works, the costs of airport pavements, terminal costs and the costs of required surface access schemes.

The present values of costs for new four-runway airports range from £7.6 billion at Thames Reach to £9.1 billion at Sheppey, £11.3 billion at London Oxford and £13.9 billion estimated by SERAS at Cliffe. Cliffe had particularly high enabling works costs which account for most of the difference in costs between Cliffe and London Oxford. There are no obvious reasons why the Sheppey costs should be 20% lower than those of London Oxford or the Thames Reach costs 33% lower. Any increases in Sheppey or Thames Reach costs would, of course, reduce their net benefits and benefit:cost ratios.

The benefits quoted are those estimated using standard SERAS procedures, consistent with the Government's published Appraisal Framework for South East Airports. No allowance has been made for other wider benefits claimed by airport promoters.

6 Environmental Impacts of Airport Operation

6.1 Reduced Environmental Impacts

An offshore or estuarine airport can be expected to minimise many of the adverse impacts of airport development at existing sites.

Noise: It may be possible to ensure that the size of the population living within the 57 dB noise contour is either zero or very small, whereas a third runway at Heathrow is forecast to add another 107,000 in 2015 to the 226,000 who would otherwise fall within the 57 dB contour at the airport. At Stansted, an additional runway is forecast to bring another 3,000 within the 57 dB contour relative to maximum use of the existing runway in 2015 and, at Gatwick, a further 9,000 would be so affected by the wide-spaced runway. Runway orientations and approach tracks at some proposed estuarine airports have been purposely designed to reduce noise impacts. A minimal level of noise impact would facilitate 24-hour airport operation.

Local Air Quality: It can be expected that no-one would be subject to concentrations of pollutants in excess of EU levels in the vicinity of estuarine airports, given the relatively low population densities in the vicinity of the proposed airports and the tendency for concentration of pollutants to the north east of an airport due to prevailing winds.

Land Take: If no existing land were taken for airport construction, impacts including the loss of Green Belt and other designated land, open land and recreational sites, ecological and heritage sites as well as residential property and other commercial property, would be avoided. Land take impacts would be created, however, to the extent that an airport was constructed partially onshore, and by the onshore sections of new road and rail links.

6.2 Environmental Impacts Unaffected

Some impacts would be similar for estuarine and offshore airports to those of onshore proposals.

Climate Change: The climate change impacts of a given amount of aviation activity should be very similar at onshore and offshore airports. Perhaps the most significant difference would be attributable to differences in surface access trips – trip lengths and the use of cars or public transport.

Urbanisation: Offshore airports would generate urbanisation impacts in the same way as onshore airports. Pre-judging the scale of urbanisation is difficult, since it is likely to be related in a complex way to a number of factors including: the availability of a suitably large and appropriately skilled labour force, which is likely to be lower at sites more distant from London; the number and nature of non-airport jobs which might be competing for the available labour; and the commercial and social facilities available to support an airport and its labour force.

6.3 New or Increased Environmental Impacts

An estuarine or offshore airport would generate some environmental impacts different from or greater than an onshore airport.

Ecological Impacts: An offshore airport site and the dredging to support it would have an effect on tidal flows and river channels which could have an adverse impact on marine ecology generally and particularly on the designated sites – Special Protection Areas – which line much of the Thames, Meday and Swale Estuaries and the Essex Coast

Safety Risk: The DfT's report, *"A Study on the Potential Safety Risks from Birds at and around a New Airport at Cliffe Marshes and Measures for Mitigating those Risks"* identified that the risk of an aircraft hull loss would be greater for the Cliffe site (between 1 in 102 and 1 in 297 years) than for any other UK airport examined (ranging from 1 in 304 to 1 in 1210 years). In general, the risks posed by bird strike would be expected to be greater at estuarine sites (particularly those just on or close to the shoreline) than at conventional inland sites

Flooding: Compensation dredging would be required to create a new flow area equivalent to the area of the blockage caused by an airport island, but there would remain the possibility of increased flood risk along the shores of the Thames estuary and its tributaries.

7 Summary of Main Conclusions

A number of estuarine airport sites have been considered, in addition to Cliffe, which were identified in the consultation process, both coastal (Thames Reach, Sheppey) and entirely offshore (Marinair, The Cant, Goodwin Sands).

In most cases these sites offer the potential for development to four runways and the capacity to accommodate growth in South East air travel demand to 2030. One proposal offered a two-runway airport to 2030 (with more runways to follow), complemented by an additional runway at Stansted, largely for no-frills traffic.

The principal uncertainties in airport layouts and operations related to how road and rail infrastructure would be configured and how and where passengers would be processed – at the airport, at onshore facilities, on trains or at stations.

Proposers took a generally over-optimistic view of the rail service speeds attainable and the numbers of passengers and employees likely to access an airport by rail. Much reliance was placed on limiting road access provisions in order to promote rail use. There were proposals to operate additional airport high-speed rail services on CTRL with additional stops at intermediate stations, which would compromise the frequencies and speeds of other CTRL services.

The closest, coastal airport sites are at similar distances from London as Luton and Stansted. The closest offshore site is at least 20km further away.

The typically estimated costs of around £8 – 10 billion for constructing a large 4 runway airport on land could be expected to increase in the case of an offshore airport by:

- Site formation costs of £1 – 2 billion
- Additional costs of offshore construction of up to £3 – 4 billion, and
- Surface access infrastructure costs of at least £2 billion and possibly as much as £15 billion.

Thus, the excess of cost for an offshore airport over an onshore site could be at least £6 billion and possibly much more.

These additional costs would be incurred largely in the early phases of an offshore development, before any revenues are generated.

The construction phase of an offshore airport would generally be longer than that of an onshore airport, with a period of 3 – 5 years possibly needed for formation of an airport island.

Offshore airports have been constructed at Kansai, Hong Kong and Seoul, and actively considered elsewhere, including near Schipol and Sydney. The SERAS work demonstrates that

the cost and attractiveness of such schemes depends heavily on the nature of the site, its distance from centres of demand and the airport capacity available elsewhere in the system. All these factors vary widely between the offshore airports so far built or considered around the world.

None of them constitutes a part of a multi-airport system, as would a new South East England site. All are intended as replacements for existing airports, rather than adjuncts to them: the South East equivalent would be to build a new estuarine airport and close Heathrow. All are relatively close to the existing airports and/or to their main demand generators.

The Dutch proposal appears to have been put on hold, with additional runway capacity now to be provided at Schipol, because the uncertainty and cost involved were considered too great for it to be regarded as other than a potential alternative long-term plan.

The viability of a new airport, whether in the Thames Estuary or elsewhere, is at risk from the reluctance of airlines and passengers to use it, unless Government intervention encourages or coerces them to the new site.

If airlines could be persuaded to relocate large parts of South East air services to a new airport, the capacity of a new four-runway airport relatively close to London could be almost fully used by 2030.

For airports further out in the estuary or off the Kent or Essex coasts, considerably lower passenger volumes would be expected, they could be as little as half those for the airports closest to London.

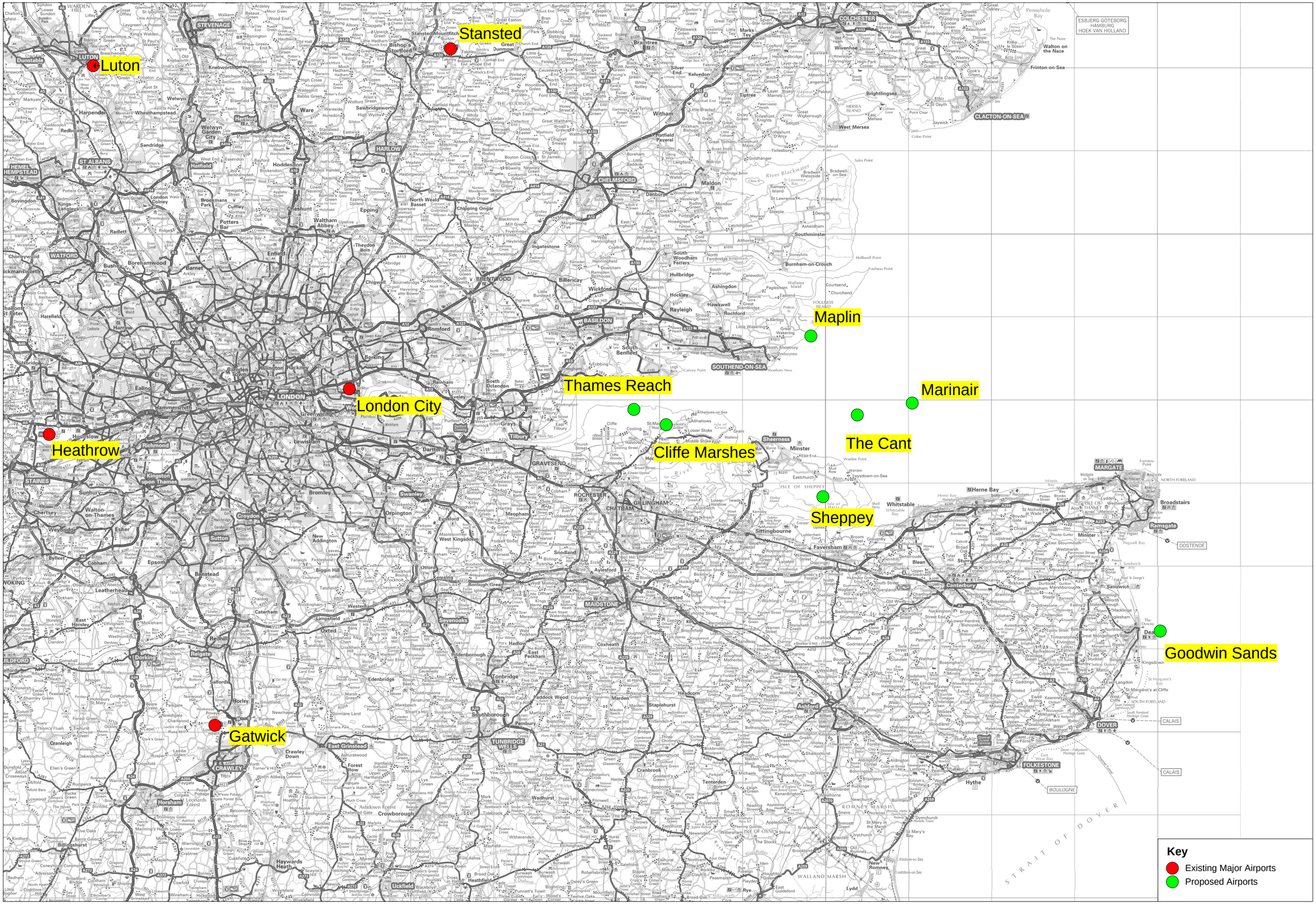
If Government could not persuade large parts of South East air services to relocate to a new airport, the anticipated numbers of passengers would be substantially lower.

Coastal or entirely offshore airports can be expected to avoid the worst impacts of onshore airports such as; residential property take and the disruption of lives and communities; taking scarce open land and designated Green Belt in an overcrowded South East; noise; local air quality impacts; heritage impacts; impacts on terrestrial ecology. They would have impacts on marine ecology and on the landscape, and could present increased flood risks along the shores of the Thames estuary and its tributaries.

Coastal or offshore airports can be expected to present higher risks to aircraft from bird strike.

The development of a major airport offshore is entirely feasible and offers advantages of high capacity and much-reduced overall environmental impact. The risks of birdstrike could be significant at a coastal site, although likely to be reduced for a fully offshore location. Cost per unit of capacity added would be high, mainly due to the additional cost of platform construction and the length and cost of road and rail connections. Costs for such a development cannot be predicted with the same level of certainty as those for an onshore airport.

Acceptable journey times depend on the use of high-capacity, high-speed rail connections, not all of which can rely on the use of spare CTRL capacity. The financial viability of an estuarine airport would depend on government intervention to ensure the early uptake of new capacity by airlines and passengers.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