PROPOSAL TITLE:	Isle of Grain	Group:	Inner Thames Estuary
SUBMITTED BY:	Foster + Partners, Mayor of London, Metrotidal Tunnel & Thames Reach Airport	Reference No.:	67 Updated

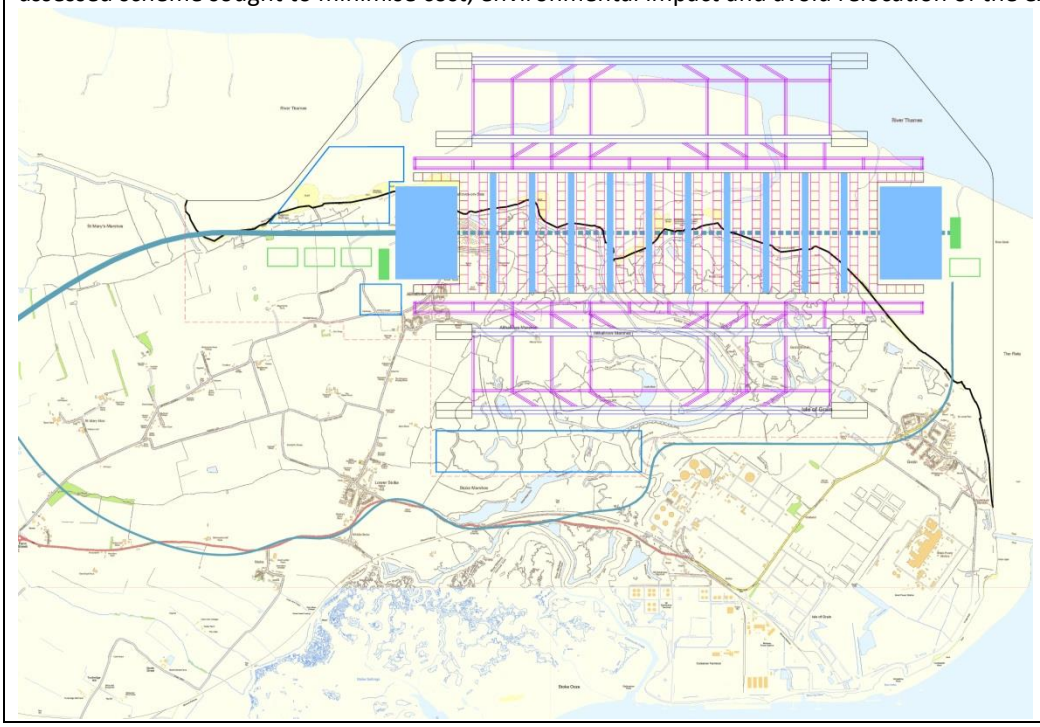
PROPOSAL

New four runway airport on the Isle of Grain at the eastern end of the Hoo Peninsula on the north Kent coast. On opening of the new airport Heathrow would be closed and its site redeveloped.

Four runway airport constructed on a reclaimed land platform partially extending into the Thames Estuary. The airport comprises two pairs of closely-spaced parallel runways in an East/West orientation, each 4,000m long. The airport is proposed to operate in a segregated mode.

Requires all supporting infrastructure (road and rail links, utilities, etc.), plus settlements (with their supporting infrastructure) to accommodate direct and indirect employees to be constructed.

The assessed option is based upon a combination of a number of submissions for suggestions on the Hoo Peninsula. The assessed scheme sought to minimise cost, environmental impact and avoid relocation of the existing LNG facility.



ASSESSMENT SUMMARY

STRATEGIC FIT / ECONOMY / OPERATIONS

Runways (net increase)	Passengers (net mppa)	ATMs (net)	London Airports Impact
	62	370,000	LHR ✖
	60	317,000	
2	▶ 53 ◀	268,000	LGW
	46	260,000	STN
▶ 1 ◀	40	▶ 250,000 ◀	
	34	222,500	LTN
	30	190,000	LCY ✖

ENVIRONMENT

57 dBA Leq 2030 pop'n with scheme	Listed Bldgs Grades I&II*, SM, CA, RP&G	Heritage & Designations Affected
▶ 1,400 ◀	0	SPA
2,500	3	Ramsar
6,300	4	SSSI
13,500	5	Grade I
142,600	▶ 8 ◀	Grade II*
144,000		
144,600		Sched. Mon.
180,900	14	

SURFACE ACCESS

45 min Population (millions)	1hr Population (millions)	2hr Population (millions)
17	18	38
14	16	36
10	14	27
▶ 9 ◀	▶ 13 ◀	▶ 25 ◀
6	12	20

COST / DELIVERY

2030 Risk-Adjusted Total (£bn)	Aero Yield (relative to LHR Q6)
9-13	1.3x
10-13	1.5x
13-18	1.6x
16-22	2.4x
50-67	
▶ 54-67 ◀	▶ 3.4x ◀

PEOPLE

Houses Demolished	IMD (Average within5km
200	▶ 26 ◀
260	21
720	20
800	19
1,300	14
1,500	8
▶ 1,600 ◀	7

Leigh Fisher JACOBS Bickerdike Allen Partners Architecture Acoustics Technology

Airports Commission

PROPOSAL TITLE:	Isle of Grain	Group:	Inner Thames Estuary
SUBMITTED BY:	Foster + Partners, Mayor of London, Metrotidal Tunnel & Thames Reach Airport	Reference No.:	67 Updated

OVERVIEW

Approach

Enabling legislation to be provided 2015-2020 with construction commencing in 2022; new airport opened and Heathrow closed by 2029.

Opening Year: 2029

Operational Viability

Although the new airport would probably require the closure of Heathrow and London City and, the greater capacity of the new runways provides a significant passenger capacity increase. At Sift 3 stage, the potential impact on Southend was not assessed. However, subsequent analysis conducted as part of the inner Thames Estuary feasibility studies indicates that its capacity may be reduced.

Capacity	Airport	Net	Forecast Use of Maximum Capacity	
			2030	2050
Runways	4	1		
ATM	830,000	250,000	75%	100%
pax	150	53	70%	95%

Cost

Foster + Partners estimates stated. Excludes cost of Heathrow purchase.

£b	Airport	Access	Other	Total	Risk	OB	Risk Adjusted Total	Promoter Estimate
2030	15 - 20	9.5	~1-2.4	25.5 -31.9	10.2 - 12.8	17.9 - 22.3	53.6 - 67.0	£24bn
2050	18 - 25	21.0	~1-2.4	40.0 - 48.4	16.0 - 19.4	28.0 - 33.9	84.0 - 101.6	

Surface Access

New high speed rail line to central London with one service using the HS1 lines to St Pancras and the other service using new tunnels from London Riverside to Waterloo. An eastwards extension to Crossrail 1 from Abbey Wood is also proposed. Additional road connections include a new D3 access link from the A2, an additional lane on the Lower Thames Crossing (Option C rather than Option A is preferred) and 1 lane widening of the A2 between the M25-M2, the M25 J27-31 and the M25 J1A-7.

Isochrone	Pop^{n} (million)
45 min	9
1 hr	13
2 hr	25
London centre	33 miles

Economic

Borough	Dartford	Gravesham	Medway UA	Maidstone	Swale	Havering	Thurrock UA	Basildon
Unempnt (%)	7.0	9.1	9.5	6.7	7.5	9.6	7.7%	8.1%
Ave. Salary (£/yr)	29,510	28,106	27,378	28,236	28,085	30,378	28,033	28,553

County	Medway UA	Kent exc UAs	Thurrock UA	Essex exc UAs	Outer London E&NE
GVA (£/cap)	13,631	15,883	14,956	16,707	13,428

Environment

- Significantly lower population affected by noise than for any other option. Although currently unaffected by noise, the nature of the location means that even with significant growth there is a minimal local noise impact.
- Large scale direct loss of SPA/Ramsar sites (1,610 ha) and possible additional impacts on protected Estuary sites within 5km. This would require establishing no alternative and overriding public interest along with compensatory habitat to maintain integrity of the Natura 2000 network.
- Cultural heritage impacts include 7 listed buildings within the airport footprint (2 Grade I and 1 Grade II* listed buildings) and 2 Scheduled Monuments.
- Villages of Isle of Grain, Allhallows and Allhallows-on-Sea would be demolished.
- Much of the area is at risk from coastal flooding.
- 171 ha of good quality grade 1 agricultural land lost.

57 dBA L_{eq}		
2012 local		0
2030 local - with scheme		1,400
2030 Net Local Impact		1,400
2030 system - with scheme		16,600
2030 Net System Impact		(229,100)
55 L_{DEN}	2030	5,600
50 L_{night}	2030	1,700
N70	2030	900

SAC[1]	SPA[1]	Ramsar	CA[1]	AONB[1]	SSSI[1]	Listed Buildings	SM[1]
-	1	2	-	-	2	7 (8)	2 (5)

[1] SAC: Special Areas of Conservation; SPA: Special Protection Areas; CA: Conservation Area; AONB: Area of Outstanding Natural Beauty; SSSI: Site of Special Scientific Interest; SM: Scheduled Monument. Note: figures relate to the numbers of separate designations but in some cases these are split across a number of separate site locations (in brackets).

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People	Highest IMD score of all options indicating a population characterised by a higher level of deprivation than other schemes.		IMD	Houses Lost
			26	1,592
Delivery		Aero Yield	Airport Only	Including Access
		Increase Indexation	~5%	~105%
		No indexation	~75%	~235%

ECONOMY

Borough	Dartford	Gravesham	Medway UA	Maidstone	Swale
Unemployment (%)	7.0%	9.1%	9.5%	6.7%	7.5%
Ave. Salary (£/yr)	29,510	28,106	27,378	28,236	28,085
Borough	**Havering**	**Thurrock UA**	**Basildon**		
Unemployment (%)	9.6%	7.7%	8.1%		
Ave. Salary (£/yr)	30,378	28,033	28,553		
County	**Medway UA**	**Kent exc UAs**	**Thurrock UA**	**Essex exc UAs**	**Outer London E&NE**
GVA (£/capita)	13,631	15,883	14,956	16,707	13,428

Impact on Industry

Although a new airport at the east end of the Hoo peninsular with four independent runways would provide a net one runway increase assuming Heathrow and London City are required to close, passenger capacity would increase. This creates benefits by allowing new services and reducing operational costs by operation of a more efficient airport and allowing significant improvements in connectivity over time. This would support growth of aviation, tourism, logistics and related support businesses. It would allow significant expansion of airlines based in London (assuming most moved existing operations from Heathrow), and a significant improvement in connectivity to a wide range of long haul destinations, Europe and in connecting other parts of the UK to long haul destinations. It is likely to help increase the share of airline traffic carried by UK based network carriers. This may be offset in part by increased landing charges to recover costs of construction, and being less well located for the airline's prime passenger market than Heathrow. It would free up land at Heathrow which would allow development of the site for housing.

Airports	A four-runway hub airport would provide sufficient capacity to meet anticipated hub airport demand and would likely attract some network traffic away from Gatwick. It closes Heathrow and London City airports, but otherwise there is relatively little impact on other remaining airports. Although relatively small, capacity at Southend would also be lost. By enhancing connectivity with the regions, it may see an increase in services to airports in the north of England, Scotland and Northern Ireland.
Airlines	Airlines currently using Heathrow and others seeking to use the new airport would benefit from the increase in capacity allowing new direct routes, higher frequencies and reduced delays, because of sufficient capacity for resilience. Greater competition and significantly reduced airline 'slot' values would have a countervailing effect on some airlines. Interline traffic would have more potential to increase, through increased network size and better connection timings, enhancing the viability of more direct routes, particularly by airlines based at the new hub. Some network traffic may transfer from Gatwick because of the greater interlining opportunities, freeing capacity at Gatwick potentially increasing airport choice for LCCs and charter airlines.
Passengers	Passengers would potentially benefit from increased capacity at the new site via delay reductions, a greater choice of destinations/enhanced frequencies, more competition (reducing fares) and faster terminal throughput times. Travel times and costs would increase on average for typical customers, though assuming a new lower Thames crossing and thus local connections by road and rail on both sides of the Estuary, many airline customers in Kent, Essex and east London would experience reduced travel times to a major airport. The closure of Heathrow and London City would be detrimental to passengers local to those airports.

Local & Regional Economic Impacts

The airport is located in Medway district, and close to Gravesham, an area of relatively high unemployment and low economic productivity for the southeast. It is also close to Thurrock, the cross river connection, and not far from Havering, the latter being an area of high unemployment and low economic productivity. The new site providing an expanded airport with sufficient capacity to meet expected short to medium term demand would facilitate growth of new and existing industries in aviation, airport and aviation support services and travel, tourism, logistics and other related sectors, to service the growth in passenger and freight demand met by the new airport. Most of these businesses would likely have relocated from the vicinity of Heathrow. The immediate effect would be to increase commercial property development in the vicinity of the new site (and conversely reduce demand for such property near Heathrow), but there would also be significant potential to redevelop the Heathrow site primarily for residential development. The agglomeration effects of the existing Heathrow/Thames Valley/M4 corridor would be diluted, as such businesses may prefer to locate closer to the new airport on either side of the Thames Estuary. Reduced noise impacts are likely to increase residential land prices to the east of the Heathrow site, but also areas with easy access to the new airport (which are not exposed to high noise levels). There would be dislocation of employment, with many employees needing to relocate, which would require extensive housing development in nearby towns to make such relocation affordable. Existing commuters in the Thames Estuary may experience increased congestion and travel costs, despite the improved transport connections, due to higher demand on existing transport networks. The scale of direct and indirect employment would be in proportion to the numbers of additional passengers.

National Economic Impacts

The main impacts come from the provision of new capacity, enabling more flights and connectivity, and the increase in business and leisure trips, and trade in goods and services (and the indirect effects on inward investment). Increased choices of flights and airlines, reducing travel time and possibly fares should generate significant consumer/welfare benefits. The benefits would be offset by higher average access time and costs from London (although lower costs for Kent, Essex and east London), and the net costs of closing Heathrow.

SURFACE ACCESS

Time/Distance to Central London	Isochrone	Pop^{n} (million)	Key required upgrade schemes
28 minutes (by rail) 33 miles	45 min	9	▪ Express service to Central London (Central London) via extension to HS1 ▪ Southern extension to Crossrail 1 from Abbey Wood.
Journey times to other population centre	60 min	13	▪ Extended local rail lines to Kent and Essex. ▪ Optional Northern Crossrail Extension from Shenfield via Billericay
Birmingham 1hr 12 mins Manchester 1hr 32 mins	120 min	25	▪ Optional semi-fast service to Waterloo ▪ Optional Airport Express service to Waterloo (new underground route and stations). ▪ New D3 airport access road and g/s junction to A2. ▪ Assumes Lower Thames Crossing Option C is constructed with 1 additional lane in each direction. ▪ 1 lane widening of A228/A289 in each direction. ▪ 88km widening of the M25 (73km single lane widening and 15 km double lane widening). ▪ 17km single lane widening of the M2. ▪ 17km widening of the A2 (2km single lane widening and 15km double lane widening). ▪ Around 30km single lane widening of the A12/A127/A13/A3 roads on their approach to the M25 from outside London.

Mode Split Assumptions

Public transport mode split assumptions proposed by Mayor and Foster are 65% and 60% respectively for passengers and 75% and 60% respectively for employees. We consider a public transport mode split of 60% (50% rail and 10% bus/coach) for passengers and 35% for employees (25% rail and 10% bus/coach) as reasonable, albeit optimistic. Below the Mayor's assumptions for passengers and substantially below for employees, as we felt the latter very optimistic since they far exceed the levels at any UK airport (Heathrow ~30%, Stansted 24% and Gatwick 29%).

Rail Infrastructure Capacity Analysis

Several options presented to meet 2030 demand: 1) Do minimum; 2) Waterloo Stopper; 3) Crossrail Northern Extension but no Airport Express; and 4) Airport Express but no Crossrail Northern Extension. Option 4 is required to meet 2050 demand.

Option 1) includes local rail lines, southern Crossrail extension, HS1 extension and additional HS1 platform at St Pancras; 2) adds a semi-fast service to Waterloo; 3) adds Crossrail Northern Extension; 4) substitutes Airport Express for Crossrail Northern Extension.

Airport Express strategy based on a new high speed service from the airport to London Riverside, where it would bifurcate, with one line using spare paths on the HS1 line to terminate at St Pancras, and the other line going in a new tunnel under Central London to Canary Wharf, London Bridge and Waterloo. Journey times to St Pancras and Waterloo would be just under 30 minutes. Crossrail 1 would be extended eastwards from Abbey Wood, providing a local access route for passengers and employees. Local rail connections would also be provided to Kent and Essex.

The proposals are similar to those proposed by the Mayor, but without the use of the HS1-HS2 link line, which has been dropped by the Government as a core component of HS2, and including the Crossrail Northern Extension as proposed by Foster + Partners and Metrotidal Tunnel and Thames Reach Airport.

Under Option 4, estimated passengers per hour in the peak direction in 2030 are HS1 (841); AEX (947); Crossrail South Canary Wharf to Airport (1,240); North Kent Line (449); South Essex Line (445); and Waterloo stopper (460).

Estimated volume/capacity (v/c) ratios for airport + background related demand: HS1 (0.30); AEX (0.34); Crossrail South Paddington-Liverpool Street (0.91); North Kent Line, Swanley-Strood (1.08); South Essex Line (0.54); Waterloo stopper, Waterloo-Bromley South (1.36).

As the High speed airport express would solely be used by airport-related traffic there is sufficient capacity to cater for the airport-related demand, assuming currently planned HS1 additional routes are not taken up, and subject to currently unavailable platform capacity at St Pancras and Waterloo. Furthermore, there is enough capacity on the Crossrail 1, and the local rail services to cater for other commuter and leisure trips.

Highways Capacity Analysis

Based on our estimates for the geographic distribution of airport-related car trips, ~4,700 cars per hour in the peak direction (phpd) estimated arriving at the airport in 2031. This would require a new D3 airport link from a grade-separated junction on the A2 to the airport and 1 lane widening of the current A282/A289 road in the Hoo peninsular. Additional airport related demand of between 2,600-2,800 cars phpd on the A2 between the M25 and the M2, necessitating 1 lane widening of this section. Airport related demand of around 1,300 cars phpd on the Lower Thames Crossing, between 1,000-1,200 cars phpd on the M25 J1A-J7 and between 700-900 cars phpd on the M25 J27-31, necessitating 1 lane widening of all these sections of road. Furthermore, our analysis predicts additional airport related demand of between 500-600 cars phpd on the M25 J7-12 and around 400 cars on the M25 J21A-27, but it is uncertain whether this airport-related demand on these sections on its own requires further road widening. Over a wider area, airport-related traffic dissipates quickly to <200 cars phpd and no further road widening required, although some of those corridors experience congestion at peak times today.

The core baseline plan for 2030 indicates that the following road links would need capacity enhancements as a result of airport-related traffic:

- The A2 between the M25 and its junction with the M2 (junction 1);
- The M25 between junctions 3 and 4, 6 and 7, 8 and 10, 23 and 25, and 29 and 30;
- The A282 south of the Dartford Crossing (M25 between junctions 1A and 1B).

In addition, works may be required in 2030 on the following links as airport traffic increases the VCR above 85%:

- The M25 between junctions 2 and 3, 4 and 5, 16 and 17, 21A and 22, 25 and 26, and 27 and 29;
- The A12 on its approach to the M25 from the east;
- The A127 on its approach to the M25 from the east;
- Small sections of the A2 to the west of the M25;
- Small sections of the A13 south-west of Basildon.

Accessibility to Population & Business centres

A high speed service to St Pancras (taking 29 minutes) and Waterloo (taking 28 minutes) would provide connectivity to two key destinations within Central London, with limited stops at key intermediate stations. An extension to Crossrail 1 from Abbey Wood and improved local links to Kent and Essex would help serve local populations and employees.

Accessibility to Transport Interchanges

Key interchanges directly served by the proposed rail services include Canary Wharf; London Bridge, Waterloo, Stratford, Paddington and St Pancras. Local rail services would serve Dartford, Erith, Abbey Wood, Grays and the Medway towns.

Accessibility to Workforce

The airport would have strong public transport and highway links to local towns in the North Kent and Medway area, to South Essex via the proposed Lower Thames Crossing and to East London. Thus the workforce is expected to be drawn mainly from these areas from towns such as: Gillingham/Chatham/Rochester, Maidstone, Gravesend, Dartford, Grays, Bexley/Bexleyheath and Outer South-East London and Romford and Outer East London.

Demand Management

Measures to achieve the mode split targets include incentivising high car occupancy for air passengers and employees, restrictions on staff car and freight movements during peak hours, airport parking changes and tolls, providing proportionately less on-airport car parking than at most other major airports and developing a proactive parking management strategy to encourage high levels of public transport usage.

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ENVIRONMENT

Overall noise impact	Currently unaffected by aircraft noise so the net local effect with scheme sees new, but small, population affected. All 1,400 people within the 57 L_{eq} contour would be newly affected by aircraft noise (in 2030), but still significantly lower than new people affected for all other options. Heathrow's closure is a major system noise benefit from 2012 (although the population affected at Heathrow is reduced over time due to technology improvements resulting in quieter aircraft).	57 dBA L_{eq}	2012 local	0
			2030 local - without scheme	0
			2030 local - with scheme	1,400
			2012-2030 Local Impact with scheme	1,400
			2030 Net Local Impact	**1,400**
			2012 system	269,250
			2030 system - without scheme	245,700
			2030 system - with scheme	16,600
			2012-2030 system impact with scheme	(252,650)
			2030 Net System Impact	**(229,100)**
		2030 population within 2012 and 2030 57dB contour		0
		2030 additional population within 2030 57dB contour		1,400
		55 L_{DEN}	2030	5,600
		50 L_{night}	2030	1,700
		N70	2030	900

SAC	SPA	Ramsar	AONB	SSSI	CA	Listed Buildings	SM
-	1	2	-	2		7 (8)	2 (5)

Air Quality

Isle of Grain location has advantages in that the Hoo Peninsula is sparsely populated and significant pollutant dispersion would occur over North Sea. The prevailing winds are from the south-west carrying Heathrow pollution over London. Promoters of Thames Estuary schemes claim that health impacts could be reduced by 60-70% compared to expansion at Heathrow. A 2012 MIT study estimated that an Estuary based airport could reduce premature deaths caused by airport emissions by 100 per year compared to Heathrow. Based on the 2003 study for Cliffe airport, no people would be exposed to NO_2 above daily or annual mean objectives. Compared to an estimate of 5-35,000 people (depending on mitigation) exposed to non-compliant levels of NO_2 with a Heathrow third runway. However extensive surface access improvements required for this option would affect existing AQMAs and populations, particularly in the urban conurbation of Rochester/ Chatham/Gillingham, along the A2, and beyond.

Noise

2030 Forecast:

The Mayor of London estimates that 8,200 people would be living within the 57 dBA Leq contour and proposes to manage new development to minimise incoming population affected, reduce passenger vehicle movements and offer mitigation for new / existing rail and road access. Independent noise modelling provided the following results based on a 2030 forecast population distribution and forecast aircraft mix appropriate for the aircraft movement and passenger load and taking account of housing demolished:

- 57 dBA L_{eq}: 1,400 people affected all of which would be newly affected population not currently affected by aircraft noise.
- 55 L_{DEN}: 5,600 people affected.
- 50 L_{night}: 1,700 people affected.
- N70: 900 people affected at the 50 event contour, which is significantly lower than all other hub and additional runway options.

The option affects a smaller population across all the noise contour measurements compared to all the other options.

2050 Forecast: From 2030 to 2050 ATMs are expected to increase by around 32% potentially leading to an increase of about 1.4 dB in overall noise levels, which would affect all contours equally. However, assuming no further change to the aircraft mix, it is considered likely that improvements in aircraft technology would result in quieter aircraft which would off-set this increase. Even without a change to measured noise levels however there is potential for increased nuisance to residents from the greater numbers of flights passing overhead.

Net Noise: Locally the population affected in 2030 are all newly affected (1,400). In terms of the overall system, closure of Heathrow results in a major system noise benefit with 229,100 fewer people within the 57 L_{eq} (although the population affected at Heathrow is reduced over time due to technology improvements resulting in quieter aircraft).

Designations

Internationally important nature conservation sites (SACs, SPAs and Ramsar) and nationally important sites (SSSIs) are located within the zone of influence. The majority of the airport footprint lies within the Thames Estuary and Marshes SPA and Ramsar, while the airport footprint also encroaches on the Medway Estuary & Marshes Ramsar close to the southern boundary. These sites are primarily noted for their important populations of over-wintering birds. Three further SPAs (Medway Estuary & Marshes, Foulness (Mid-Essex Coast Phase 5) SPA, Benfleet and Southend Marshes SPA) and Essex Estuaries SAC are located within 5km of the site. The Medway Estuary and Marshes and South Thames Estuary and Marshes

are also nationally designated as SSSI (overlapping with the international designations) and would be within the footprint of the scheme.

Around 1,600ha of intertidal mudflat, saltmarsh and grazing marsh would be lost. The habitats are already at risk from habitat loss arising from coastal squeeze / sea level rise, storm surges and coastal erosion. Bird strike risk reduction measures may further affect the conservation objectives of the remaining SPA designations. Compensatory habitat would need to be sought in the Thames Estuary or nearby in areas that would be of value to the populations of overwintering, breeding and feeding/passage birds that would be displaced by this scheme. Expectation is for compensatory habitat to be provided in excess of 1:1 of the area or bird numbers lost, to reduce the risk of net loss. However, it is unlikely that the quantity of suitable sites for compensatory habitat within or near the Thames Estuary would be sufficient to make a significant contribution to even 1:1 compensation requirements.

Provisions of Habitat Directive Article 6(4) would be required and the proposal would need to demonstrate that there are no alternatives, before pursuing imperative reasons of overriding public interest and providing compensatory measures. This could be an issue going forward with regards the Secretary of State's refusal of Southampton Dibden Bay Container Terminal on grounds that there were alternative sites elsewhere in the UK that could provide port infrastructure which would not be as damaging to European sites.

Significant impacts would be associated with changes in hydrodynamic patterns arising from the airport footprint and foundations. Subsequent changes to coastal geomorphology through erosion and deposition in different places which would likely lead to the loss of further designated habitat from the north and south shores of the Thames Estuary.

Management Plans for the area (including TE2100) are focussed on delivering increased flood storage capacity combined with habitat improvements, even within the areas already designated as SPAs and SACs. Submitter's proposals suggest that funding could be provided through TE2100 to assist their planned completion of four managed realignments and other habitat improvement projects in the Thames Estuary by 2050. However, these plans are already in place and would not therefore be suitable to provide additional compensatory habitat for the airport development. In any case the schemes are too small to provide the required area of habitat.

A suggested target compensatory habitat would be between a 2:1 and 3:1 ratio. However the actual test is that the compensatory habitat is functionally equivalent and maintains the Natura 2000 site integrity.

Surface access including rail and road links could lead to additional impacts on designated sites and in-combination effects with those sites affected by the footprint of the scheme.

Cultural Heritage:
Two Scheduled Monuments, including the Isle of Grain Coastal Artillery Defences (which covers several locations, three of which would be affected) and Slough Fort, would be lost.
7 listed buildings lie within the airport footprint. These include two Grade I listed churches (Church of St James and Church of All Saints), Grade II* listed Slough Fort , two listed public houses, listed WWII shoreline defences, and scheduled Coastal Artillery defences. Surface access connections would lead to additional cultural heritage impacts.
Landscape and Townscape: No national landscape designations affected. Surface access connections could lead to impacts on landscape designations further away from the airport location.

Climate Change
Operational: Increased efficiency of aircraft movements (in air, on ground) would improve carbon efficiency per ATM / PAX compared to current operations at congested airports. Proposer's suggested potential use of renewable energy sources e.g. construction of 1,000 tidal energy turbines in the Thames Estuary. However the feasibility and potential significant impacts of this were not addressed.
Construction: The large quantities of material to be sourced from dredging to create the platform for the airport would be a source of significant embodied carbon emissions. Construction related carbon emissions are indicated as 2.45Mt in a central estimate based on runway, taxiway and terminal build, and significant surface transport improvements. However, it is likely that the nature of this build means that construction emissions are underestimated. The footprint is broadly comparable to a Stansted hub, but higher than 4 runway Heathrow option (due to extant infrastructure at Heathrow, although more demolition is involved).

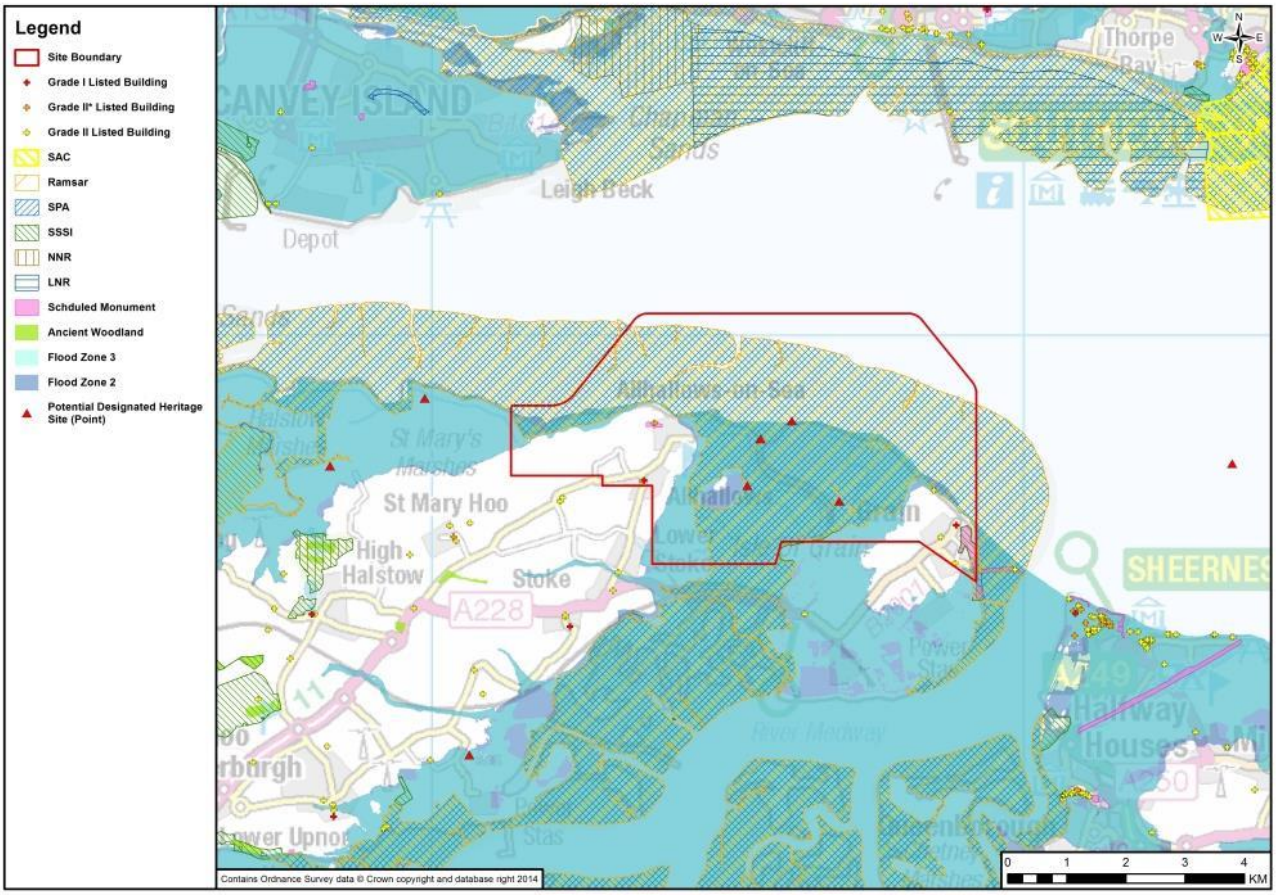
Other Issues
Water Resources and Flood Risk:
- Significant flood risk (~70% of footprint in Flood Zones 2&3), primarily from coastal flooding.
- Airport construction into the Thames Estuary is likely to result in changes to pattern of erosion and sedimentation in the Estuary and lead to additional impacts on fisheries and flood defences. Current significant flood and coastal erosion risk from tidal Thames likely to increase due to sea level rise and would need to be addressed in airport design.

Land Use and Development:
- No loss of Greenbelt.
- Loss of over 300 ha of Grade 1 and 2 (best and most versatile) agricultural land.

- Approximately 2,600 ha of greenfield land would be lost. This is likely to include loss of local landscape and cultural heritage features, significant length of hedgerows, field boundaries and ditches (possibly with historic landscape value), protected species habitat, footpaths and archaeological interest.
- No significant contaminated land issues.
- A licence would be required under the Marine and Coastal Access Act 2009 for aggregate dredging from the Marine Management Organisation. A licence is also required for depositing substances within the UK marine licensing area.
- Large scale change to open marsh landscape character with loss of cultural heritage associated with what the proposer describes as characteristic historic ditches, grassland, military and industrial installations and ancient trackways.

Surface Access Improvements:

Potentially significant impacts related to all access improvements including over 250km of road widening and over 100km of new rail links.



Housing

Demolished
1,592

- The Isle of Grain and wider Hoo peninsula are sparsely populated. However a number of communities lie within the airport footprint and a total of around 3,000 people would need to be relocated and the approximately 1,600 houses demolished. The villages of Isle of Grain, Allhallows and Allhallows-on-Sea would be lost. Potential significant new housing provision would be needed to accommodate employees of the airport and supporting industries relocating to the area.
- The number of properties to be demolished and population affected is slightly greater than for the north-west Heathrow (1,500) and south-west (1,300) options and significantly greater than the Heathrow Hub (720) and 5 runway Stansted (800) options.

Vulnerable Groups

- Overall Index of Multiple Deprivation (IMD) averaged over 5km area around the site is 26.1, compared to the less deprivation affected populations around Heathrow (IMD ranges from 18.7 to 20.8). The areas around Stansted (IMD 7.5) and Gatwick (14.4) have a much lower proportion of the population affected by deprivation.
- North Kent area is identified as currently suffering lack of employment and poor transport which affects vulnerable groups. Mitigation measures for vulnerable groups would be required in terms of additional assistance and inclusion of considerations in design.
- Potential for significant health related benefits related to reduced noise and improved air quality for some vulnerable groups from the closure of Heathrow. However, these groups may also be most adversely affected by the loss of a source of local employment and possible reduction in services in the Heathrow area.

Quality of Life and Health

- Approximately 5,250 and 58,780 people located within 2km and 5km respectively of the airport.
- Foster and Partner's proposal notes 2013 study conclusions that air pollution from Heathrow could be responsible for 100 premature deaths each year, and many more suffer sleep deprivation and difficulty learning due to aircraft noise. By contrast, the Isle of Grain is one of the most sparsely populated areas of the South East and the majority of flights would approach over water. A large number of residents around Heathrow would experience health benefits due to reduction in noise nuisance and improvement in air quality compared to a small number of existing residents around the proposed Isle of Grain Hub.
- Significant benefit to population affected by aircraft noise around Heathrow: around 150,000 people who would otherwise be subject to aircraft noise in 2030 within 57 L_{eq} contour would no longer be affected.

Wider Social Impacts

Promoters reference the potential for wider economic benefits and associated social opportunities for social mobility, regeneration and increased aspiration in the Thames Gateway region.

Significant impact of loss of Heathrow airport on the surrounding economy, and on access and services with their associated employment and social effects.

Two primary schools (St James, Isle of Grain, and Allhallows) and Isle of Grain Fire Station will be lost.

COST

Capital Cost

2030 cost estimate based upon a 3 runway layout and basic road and rail package. 2050 cost includes construction of 4th runway and supporting infrastructure, and enhanced road and rail package. Costs associated with the closure of Heathrow are excluded but could be in the order of £13.5-21.5bn.

Cost estimate for 2030 includes purchase of all land and reclamation works for a 4 runway layout. The layout assumes that the LNG facility is retained as currently to the south of the proposed layout and no cost allocated for reconfiguration or displacement.

Foster and Partners estimates £24bn for the first phase only, no cost provided for later phases. Thames Reach Airport estimates airport work only at £23bn, excluding the Metrotidal Tunnel works. Mayor of London estimates £68.3bn, although the location and size of the proposed airport are different from the scheme independently assessed.

£ bn	2030	2050
Airport	15 – 20	18 – 25
Access	9.5	21.0
Other	~1 – 2.4	~1 – 2.4
Total	25.5 – 31.9	40.0 – 48.4
Risk	10.2 – 12.8	16.0 – 19.4
Optimism Bias	17.9 – 22.3	28.0 – 33.9
Risk Adjusted Total	53.6 – 67.0	84.0 – 101.6

Key Risks

- Nature of reclaimed land platform poses increased risk of differential settlement.
- Possible requirement for relocation of LNG facility.
- Surface Access Links including M25 widening and high speed rail connections.
- Marine habitat compensation and coastal flood/erosion protection measures.
- Sea Bed Licences.
- Creation of compensatory bird habitat.
- Compensatory habitat costs of £149m to £2.04bn depending on ratio required and land cost per ha.

Risk and Contingency Allowances

40% contingency adopted for all costs. 50% optimism bias applied.

Surface Access Costs

Range of rail costs from Option 1 (do minimum; £4.675bn) to Option 4 (Airport Express but no Crossrail Northern Extension; £12.845bn) for 2030. Option 4 is required to meet 2050 demand.

Road costs include a lower estimate of £4.8bn for: 88km widening of the M25 (73km single lane widening and 15 km double lane widening); 17km single lane widening of the M2; 17km widening of the A2 (2km single lane widening and 15km double lane widening); and around 30km single lane widening of the A12/A127/A13/A3 roads on their approach to the M25 from outside London.
The upper road cost estimate is £8.2bn and includes schemes for which the scheme would bring volume/capacity ratios above 85% threshold: 20km single lane widening of the M25; 3km single lane widening of the M2; and around 55km single lane widening of the A12/A127/A13/A3 roads.

The lower range of total road and rail costs could be £9.5bn, while a package comprising Option 1 rail and upper range road schemes could cost £12.88bn.

Other Off-Airport Costs

An allowance of £0.4bn has been included within the independent cost analysis for Marine habitat compensation and coastal flood/erosion protection measures. A further allowance has been included to cover other typical Environmental mitigation measures.
The upper range includes an allowance of up to £2.0bn for habitat compensation, assuming a 3:1 ratio and a higher cost per hectare.

PROPOSAL TITLE:	Isle of Grain	Group:	Inner Thames Estuary
SUBMITTED BY:	Foster + Partners, Mayor of London, Metrotidal Tunnel & Thames Reach Airport	Reference No.:	67 Updated

OPERATIONAL VIABILITY

Capacity

The new airport would probably require the closure of London City in addition to Heathrow. However, the one net additional runway provides a significant passenger capacity increase across the system.

At Sift 3 stage, the potential impact on Southend was not assessed and is not reflected in this document. However, subsequent analysis conducted as part of the inner Thames Estuary feasibility studies indicates that its capacity may be reduced.

The considered four runways may avoid the need to relocate the LNG facility and limit off-shore construction, but constrain capacity below four fully independent runways.

	Net	Airport	Net	Forecast Usage of Maximum Capacity	
				2030	2050
Runways	4		1		
ATM	830,000		250,000	75%	100%
pax	150		53	70%	95%

Resilience, Reliability and Efficiency

The proposal supports independent parallel approaches, but dependent within runway pairs. The proposal could be defined to meet resilience targets.

Safety

The runway configuration requires runway crossings to access the outer runways.

There does not appear to be any need to overfly significant population centres on final approach or immediately after departure. The removal of approaches to Heathrow over central London would increase system safety.

The LNG facility to the south infringes obstacle limitation surfaces and would negatively impact operations, particularly during periods of low visibility. Such infringements however are not uncommon. Nonetheless, the close proximity of an LNG facility may heighten perception of risk.

The Kentish Flats windfarm may conflict with radar and may require relocation or other mitigation.

Bird strike would represent an unusually high threat compared to inland airport locations. Fog may also present a significant hazard, although its greatest negative impact may be on capacity.

Scalability

Although the proposal is defined within an identified boundary, it appears that additional capacity could be developed if required, although this would be either further into the Estuary, or certainly require the removal of the LNG facility.

Airspace

The proposal would require significant considerable airspace design in terms of relocating the boundaries of the London terminal manoeuvring area (LTMA), SIDs, STARS and interfaces with en route airspace. The LTMA would extend from the new airport in the east to Gatwick in the South, Luton and Stansted in the north. This would be a major reconfiguration and would also require international consultation and agreement. Given the long-term nature of the option and the likely airspace and air traffic management developments under SESAR, restructuring may be achieved as part of the on-going development process, however this is not certain. International boundaries may require amendment.

DELIVERY

Timescale

Proposer's timescale suggests: Aviation policy statement 2017; DCO 2018; start construction 2022; Phase 1 open 2029; 2032 redevelopment of Heathrow site complete. Redevelopment of Heathrow appears optimistic, but timescale for new airport may be achievable.

Commercial Deliverability

Independent high level assessment suggests that, to meet the full debt requirement, aero yield may have to be increased by between ~5% and 105% above an assumed competitive market place charging structure and indexed at 2.5% per annum thereafter, depending upon the level of contribution to surface access costs. Alternatively, without indexation, an increase of between ~75% and 235% may be required.

Aeronautical yield index relative to Heathrow Q6 to breakeven: 3.4

Peak borrowing is likely to be considerably in excess of market capacity for any form of private capital market or bank finance solution and therefore would fall wholly or almost entirely on Government. Furthermore, the scale of capital investment for this option, coupled with the absence of an existing RAB, means that some form of significant government subsidy is likely to be required even once the airport is established and operating. This may not be consistent with a RAB based model.

There is no modern day precedent for undertaking a project of this scale and cost in the UK.