

Airports Commission **Inner Thames Estuary: Feasibility Study I** **Environmental Impacts**

The Mayor of London's response

August 2014

1. Purpose of Paper

- 1.1. In July 2014 the Airports Commission published four feasibility studies related to building a new hub airport in the Inner Thames Estuary (ITE).
- 1.2. The Airports Commission have invited responses, and they have asked that respondents focus on i) the factual accuracy of the Commission's work, and ii) whether there is any new information or evidence.
- 1.3. This paper comprises the Mayor of London's response to the Commission's Feasibility Study I, – Environmental Impacts, authored by Jacobs ('the study'). Given the time available, and the need to respond robustly on Ecology and Estuarine Processes, this paper offers no new evidence in relation to Flood Risk, Landscape or Cultural Heritage. It should also be remembered that the scope of the Commission's feasibility study does not include a number of key environment impacts such as noise and air quality.
- 1.4. In order to underpin the Mayor's response to the Commission's call for evidence in May 2014, a number of technical studies have been undertaken by TfL. Some elements of this work are referenced in our response below. These studies should form an important part of the baseline information should the Commission short-list the ITE scheme.

2. Summary of the Mayor's response

- 2.1. The Mayor of London welcomes the opportunity to respond to the report on Environmental Impacts associated with an Inner Thames Estuary airport produced by Jacobs on behalf of the Airports Commission.
- 2.2. The study does not draw any conclusions regarding the feasibility of the ITE option, and in general adopts a neutral tone. Whilst the report refers to some uncertainty associated with the ITE option, this is not regarded as being sufficient to preclude the option from being shortlisted for further consideration by the Commission. This would be consistent with the decision taken in December 2013 by the Department for Transport to subject one of the options for a Lower Thames Crossing to more detailed study despite an acknowledgement that it would affect

internationally-designated sites as it potentially had other wider benefits over a discarded option.

- 2.3. The Mayor, however, has a number of concerns regarding the report, in particular in relation to some important factual inaccuracies and misunderstandings with regard to the measure of impacts, an inadequate review of case studies, and the accuracy of the report's approach to dealing with the Habitats Regulations Assessment process. This response deals with each of the Mayor's concerns drawing on advice from consultants and legal advisors and seeks to assist the Commission in addressing these matters.
- 2.4. It would be premature for the Commission to exclude the Inner Thames Estuary Option in September, as although there would be an impact on at least one Natura 2000 site, no evidence has been placed before the Commission at this stage to demonstrate that it would be significant enough to render the scheme undeliverable. No factual evidence or legal opinion has been presented by any party to support the view that the ITE option would fail the alternatives test (though this was an unsupported assertion in two submissions), nor that the option could not demonstrate *Imperative Reasons of Overriding Public Interest* (IROPI). Indeed it is acknowledged that an ITE option would potentially demonstrate IROPI on a number of grounds including public health outcomes which are not achievable with any other option.
- 2.5. It is also noted that the Heathrow option potentially affects an SPA and therefore could also trigger HRA. Since Heathrow is on the Commission's shortlist despite the HRA issues, then it cannot be a simple binary decision at this stage to remove options which potentially affect Natura 2000 sites. We also note that in the case of the Lower Thames Crossing, alternatives are being taken forward for further consideration that would have greater impacts on Natura 2000 sites than others on the shortlist. This represents a sound approach to balanced decision-making. Without further study and fair comparison it is not possible to say whether or not one potential disbenefit of an option would be out-weighed by a number of potentially significant benefits.
- 2.6. This being the case, the ITE option should be added to the shortlist and be subject to appraisal alongside the other shortlisted options. Only then can a fair appraisal of the options be made. Whilst we acknowledge the importance of the ecological considerations associated with the ITE option, it is capable of performing very strongly indeed against the criteria of strategic fit, socio-economics, noise, air quality, and public health. For this reason, we contend that the Commission should include the ITE option on its shortlist for further consideration. Only then will it be subject to a full and fair appraisal, based on further and comparable data, and allow decision makers to take a properly balanced view on which option would best serve the nation.

3. Key observations

3.1. *The broad agreement on a number of factual matters between the Feasibility Study I report, The Mayor of London, and several other submissions, is welcomed.*

3.2. The Mayor recognises that there is broad agreement on a number of topics. Many of these points were made by a number of the May submissions to the Commission. Specifically, we welcome acknowledgement in the study that there would be no impact on priority habitats or species. It is also acknowledged that whilst there would be potentially-significant direct habitat losses to Natura 2000 site(s), and the scheme would need to pass the Alternatives and IROPI tests, and provide adequate compensation there is no reason at this stage to suggest that these tests would not be passed. The study also recognises that the creation of the required compensatory habitat is technically feasible. Finally, as for other short-listed options, it is agreed that further study would be required to fully characterise the impacts of the airport and to develop more specific compensation proposals.

3.3. *The Feasibility Study I report asserts that an ITE airport could require up to 20,400ha in habitat compensation land; our evidence suggests that this would be no more than 6,500ha.*

3.4. At p54, in Table 4.12, the study provides further detail on the indicative estimates of habitat loss, which are quoted below, with an explanation of where it is clear to us that there has been a misunderstanding and/ or miscalculation of the figures when compared to the studies carried out to underpin the Mayor's proposal. The figure for direct habitat loss from SPAs of 2360ha is based on an old submission (July 2013) and not the hybrid scheme on which the study and call for evidence in May 2014 is based. The remainder of the figures in Table 4.12 attributed to TfL have not been taken from any of the Mayor of London's submission documents and misrepresent the potential impacts of the ITE scheme.

3.5. **Direct loss – the study states 2360ha.** The study states that 2360ha is the direct loss of habitats within the SPA designated from the footprint, which is an over-estimate, which does not take into account the reduced footprint of the hybrid scheme on which the study is based. In the Mayor's May 2014 submission, we stated that the revised boundary would result in a direct loss of habitat of around 1609ha, with 2099ha reported as the total direct loss of functional habitat both in and out of the SPAs. Therefore the study of direct losses of 2360ha is an error and would represent a substantial over estimation from the Mayor's May 14 submission of 1609ha. (Section 3.1, p 1617, Technical Note C, Environmental Review (Habitats Directive – Compensation Review) [ABPmer].

- 3.6. **Additional loss of functional habitat (disturbance) – the study states 370ha.** It is recognised that any additional loss of functional habitat, as a result of the disturbance to the adjacent SPAs within 1 km of the ITE proposal, primarily the Benfleet Marshes and Medway Estuary and Marshes SPA, cannot be fully quantified at this stage. However, we are confident that by applying the 3:1 ratio in the Mayor’s submission for the area of compensation required, sufficient compensation habitat would be provided. It can therefore be concluded that the additional 370ha stated in the study is not required, as this has already been taken into account by applying the higher ratio.
- 3.7. **Additional loss (1000ft approach / departure route) – the study states 0ha.** We have no comment on this figure.
- 3.8. **Additional loss (2000ft approach / departure route) – the study states 570ha.** The study acknowledges that the additional loss of 570ha is of only ‘moderate’ certainty. Again, as above, whilst the full effect is not known in precise terms, we are confident that the use of the higher 3:1 ratio for compensation fully takes any impacts associated with additional loss into account.
- 3.9. **TE2100 Compensation site – the study states 900ha.** We note that the proposed TE2100 compensatory habitat would be displaced by the ITE airport and that the proponents of any future scheme would need to work closely with the Environment Agency to address this issue. However it is wrong to count this as an additional 900ha compensation requirement of the project. The proposed TE2100 compensation sites do not yet exist (nor are they consented) and thus should not be treated as habitat to be lost. Two of the five proposed compensation sites identified in the the TE2100 wholly overlap with the footprint of the project (768ha), and all five are located within the Zone of Influence of the project and thus are at risk of being “double-counted” either as direct or indirect impacts.
- 3.10. **Indirect loss from water level change – the study states 100ha.** Our estimate of the effects of water level change was 70ha (section 3.2, p19, Technical Note C, Environmental Review (Habitats Directive – Compensation Review) [ABPmer]), but given the outline nature of the modelling undertaken by HR Wallingford (HRW) to date, we have no issue with the estimate of 100ha as being of the correct order of magnitude.
- 3.11. **Morphological change – the study states 2500ha.** The study makes reference to a total of 2,500ha of habitat change (maximum indirect change with potential to cause loss) from morphology/hydrology changes within the estuary. This estimate of 2500ha is based on the HRW submission, to which the study assigned a “Moderate” degree of certainty. The HRW submission, however, provides insufficient detail for this level of certainty to be assigned, particularly with respect to indirect losses from morphological change. The modelling results that have been used to derive this number are described by HRW as preliminary and it is fully acknowledged that additional studies are required to better determine the level of

indirect change. The indirect morphological change, as presented within the HRW report, has been estimated from a consideration of a potential change in flow speeds alone. It does not take in to account many other factors including whether the thresholds of sediment transport are exceeded, how often over the tidal cycle the areas involved are affected and whether the changes in flow speeds are positive or negative (i.e. resulting in erosion or accretion). Furthermore no evidence of the HRW model calibration and validation is contained within the submission.

- 3.12. Our studies have shown that in the region of 100ha is likely to be a more realistic estimate of the habitat change from morphology changes within the estuary. In practice, the scale of indirect intertidal change as a result of morphological change can be expected to be of a lower order of magnitude, compared to the scale of the direct losses. This is based on a conceptual understanding of the baseline conditions within the Thames Estuary, and previous experience of large reclamation schemes within estuarine environments. We therefore consider the estimate in the study of 2500ha for morphological change (g) to be wholly unrealistic.
- 3.13. The net effect of all of the above is that the figures provided by in the study are significant over-estimates of the scale of habitat loss.
- 3.14. In the section, Compensation Areas and Ratios (Section 4.7.2, Table 4.16, p60), the following compensation requirements are quoted in the study:
- At a ratio of 1:1 between 2,130ha and 6,800ha
 - At a ratio of 2:1 between 4,260ha and 13,600ha
 - At a ratio of 3:1 between 6,390ha and 20,400ha
- 3.15. Whilst it is recognised that an ITE airport would impact upon Natura 2000 sites and that compensation in the form of estuarine habitat creation would be required, it is important not to over-estimate the scale of this operation.
- 3.16. In the Mayor's 23rd May 2014 submission, (para 3.24, p10), TfL identified a likely range of between 4000 and 6500 ha of habitat to be created. This represented replacement habitat of between approximately 2:1 and 3:1 ratio of the known habitat loss through direct and indirect means. Any, as yet unknown, indirect effects and other uncertainties were taken account of in the higher ratio. As any ITE scheme was developed, this estimate would be refined. It is likely that the predicted area of loss would increase as indirect impacts on qualifying species of birds were elucidated. However, the ratio of habitat created to that lost would decrease accordingly as the levels of uncertainty around impacts and their adequate compensation was reduced. It is relevant to note that the BTO's submission, submitted on behalf of Medway Council, refers to a 2:1 ratio of compensation habitat, and not a 3:1 ratio (p32). Natural England also refers to a likely need for compensation of at least 2000ha, which is again of a similar order of magnitude to TfL's view (thousands rather than tens of thousands of hectares). No

other submissions have suggested that the figure of 20,400ha, as proposed in the study, is a reasonable estimate.

3.17. The approach taken to calculating habitat compensation land in the study is erroneous in that it both attempts to quantify every element of direct and indirect loss and places substantial over-estimates on several of them (as described above). These inaccuracies are then further compounded when a 3:1 ratio is applied. The higher ratio of 3:1 is accepted as being applied to counteract uncertainties over impacts or the effectiveness of compensation. However generous estimates of the indirect impacts over which uncertainty exists had already been applied. The net effect of this has resulted in the study quoting a maximum figure of 20,400ha of habitat replacement being required. This represents an over-estimate of an order of magnitude of what is likely to be necessary to maintain favourable conservation status and preserve the integrity of the Natura 2000 network. In reality, a range of between 4000 and 6500ha will be sufficient to provide the compensation habitat required.

3.18. In order to further refine the proposals for an ITE airport, and provide a greater degree of certainty, it is recognised that further study would be required in three key work streams as outlined below:

a) Detailed numerical modelling:

An initial phase of numerical modelling has been undertaken to provide a high-level estimate of the likely changes in tidal propagation (water levels and flow speeds) associated with the introduction of an airport to the Inner Thames Estuary. To refine these predictions, the suite of numerical modelling tools would be further developed to refine the understanding of the direct and indirect impacts of the scheme. This would include the following key steps:

- Increased resolution of the model grid and inclusion of additional (more recent) bathymetry data within the model setup;
- Inclusion of wave modelling; and
- Sediment modelling.

3.19. These more detailed model outputs would be reviewed to enable a more complete understanding of the potential scale of environmental impacts arising from the scheme, as well as the associated compensation requirements.

b) More detailed review of compensation options:

3.20. The work completed to date has identified that there is sufficient suitable land available to meet the compensatory requirements of the scheme (see below at paragraph 3.34 et seq.), subject to further analysis. A further review of potential options would be carried out through the application of more stringent criteria. This would include for example, proximity to infrastructure, tourism and nature reserves

as well as a review of those locations already requiring enhancements to flood defences.

c) Review of bird management measures:

- 3.21. A lot of the published information with respect to bird strike is focussed on aviation safety as opposed to impacts on bird populations. Information on bird management measures that are currently employed by coastal/ estuarine airports would be reviewed alongside bird strike data to help determine whether this issue has the potential to impact at the bird population scale.

3.22. *The Feasibility Study 1 report asserts that the scale of costs of compensation could be as high as £2.04bn. This is based on erroneous calculations of habitat loss and an over estimate of costs per hectare. Our detailed review of costs indicates that the true cost would not exceed £500m.*

- 3.23. At Section 4.7.3.(iii), p65-66, the study states that “Using the potential range of area required for compensation habitat creation and the range of costs per ha, the cost of Compensatory Measures has been calculated to lie between £149million and £476million assuming 1:1 ratio with the lower cost rate per ha, and up to £2.04billion assuming a 3:1 ratio for the higher loss estimate and the higher cost rate per ha”. The authors of the study had assumed a cost of £100k/ha, whereas our May 2014 submission provided evidence of a recent study which confirmed the average cost of habitat creation associated with compensation measures as being £75k/ha (section 4.1.3, p 25, Technical Note D, Compensation and Mitigation Measures in Relation to Natura 2000 sites) [ABPmer]). Indeed, the average costs of managed realignment schemes up to and including 2011 was £34k/ha, which further demonstrates that £75k/ha is a more realistic estimate of the likely cost implications than the £100k/ha outlined in the study.
- 3.24. Based on the issues described above, there is a threefold over-estimate in the “higher loss estimate” quoted in the study, and hence a massive over-estimate of the potential costs of the compensation provision. Based on our research to date, and the evidence presented in our submission, we estimate a maximum cost of compensation of £500M.
- 3.25. A full review of the costs incurred in habitat creation projects was provided in our May 2014 submission (section 4.1.3, p25-27 Technical Note D, Compensation and Mitigation Measures in Relation to Natura 2000 sites [ABPmer]). The costs associated with habitat creation are incurred at all stages of a project including:
- Site selection and land purchase;
 - Scheme design;

- Assessment and consenting;
 - Stakeholder engagement;
 - Planning and construction; and
 - Post implementation monitoring and review.
- 3.26. The most significant 'known' costs are land purchase and construction, with the costs of providing new flood defences a substantial element of the construction costs in the majority of cases. The costs associated with existing schemes have ranged greatly due to the various site-specific considerations. The potential exists for economies of scale given the size of the compensation site proposed.
- 3.27. *The study identifies that an ITE airport would need to pass the Alternatives test in Habitats Regulations Assessment but comes to no conclusion about whether it could. But the evidence is clear that this test could be passed given the unique advantages of the ITE scheme which are not offered by other proposals.***
- 3.28. The Commission's terms of reference are clear that *"its overarching objective is to identify and recommend...options for maintaining the UK's status as an international hub for aviation... In carrying out its work, (it) should consider all factors relevant to a thorough assessment of relevant options including environmental, economic and social costs and benefits."* No other option under consideration can deliver the public health and economic benefits that derive from an ITE hub airport, which has the runway capacity to support the UK's connectivity needs while located a suitable distance from densely populated areas. This strongly suggests that no alternative could be deemed to exist. The other options before the Commission do not offer the same substantial range of benefits.
- 3.29. Any future policy based upon the Commission's work will need to take into account wider economic, social and environmental opportunities and constraints. Given that the specific benefits of the ITE option are yet to be fully tested against other options, it is not possible to state at this stage that the ITE option could not pass the Alternatives test.
- 3.30. The study does not come to a conclusion on this issue, although it refers selectively to case study examples, including the Dibden Bay case (Section 4.8(ii), p67). This case has also been mentioned in other submissions in response to the Commission's call for evidence with the suggestion that because of the existence of other shortlisted options, the ITE could not pass the Alternatives test. We do not think that the case can be relied upon in this way, nor is it relevant to the different nature and scale of a new hub airport.

- 3.31. The Dibden Bay project sought to increase the number of deep water berths at Southampton. The derogation was rejected by the Secretary of State as the assessment of alternatives had not included an assessment of alternative facilities at other ports on the south and east coasts that would have provided increased shipping capacity for southern England. It also failed on IROPI grounds. The IROPI case was simply to provide further shipping capacity for southern England and substantial benefits unique to the proposal were not put forward.
- 3.32. To assist the Commission we have included at Annex I a review of further relevant case studies that illustrate how the Alternatives test has been dealt with in a greater range of circumstances.
- 3.33. *The study is unclear as to whether Alternatives and IROPI should be considered as sequential or in-parallel tests in HRA. Legal advice supports the Mayor's view that these should be conducted in parallel to ensure that only alternatives that offer equivalent benefits are compared.***
- 3.34. The study at Section 4.2.5, p23, suggests a sequential approach to these tests, though the description of the process is not consistent.
- 3.35. For example, the report (at page 23) states “*there are clearly strong potential IROPI relating to health, public safety and socio-economic reasons which constitute the objectives or rationale for a new hub airport. However, the Competent Authority would need to be certain that the imperative nature of the reasons for authorising a new airport on the Hoo Peninsula were imperative only at that site. Otherwise, a project proposed on the Hoo Peninsula would be unlikely to pass the Alternative Solutions test (see section on assessment of Alternative Solutions.)*” This does not appear to support a sequential approach to the two tests.
- 3.36. The 2012 Defra guidance on Habitats Regulations Assessment [Habitats and Wild Birds Directives: guidance on the application of article 6(4) Alternative solutions, imperative reasons of overriding public interest (IROPI) and compensatory measures] refers to three sequential tests being met (Alternative solutions/ IROPI/ Compensation).
- 3.37. Alternative solutions and IROPI need to be considered in parallel, as, put simply, if IROPI cannot be met, then there is little value in considering alternatives. This commonly accepted view is expressed by the RSPB in their submission to the Commission at page 12. Furthermore, in the Commission v Portugal decision (the Castro Verde case), the Advocate General concludes that “the choice does not inevitably have to be determined by which alternative least adversely affects the site concerned. Instead the choice requires a balance to be struck between the adverse effect on the integrity of the SPA and the relevant reasons of overriding public interest.”

- 3.38. The study goes on to say that “public health IROPI may be stronger in an estuary option than other options” (p23) but that “It would appear, however, unlikely that an estuary option would out-perform all other options in relation to safety to the degree that it would be imperative to site any future hub airport on the Hoo peninsula”(p24).
- 3.39. We would contend that the estuary airport would have strong IROPI on the grounds of public health that could not be delivered by the Heathrow option. The IROPI and Alternatives tests can also be deemed to be satisfied, in particular, based on:
- the fact that there is no other comparable alternative in terms of providing long term airport capacity and no other proposal that can offer the same national and regional benefits;
 - the very significant public health benefits that arise from relocating Heathrow – a 95% reduction in aircraft noise over Heathrow today – a benefit not promoted by any other option;
 - the national economic benefits from the unique level of connectivity offered by an unconstrained hub, including providing peripheral regions of the UK with vital access to markets;
 - the regional development and regeneration benefits, tackling areas of deprivation in the Thames Gateway and wider need for housing capacity for London, specific to a Thames estuary location.
- 3.40. TfL note that the Commission’s consultants recognise the need for legal advice on the approach to this matter (see study, p22). To assist the Commission, Counsel’s Opinion has been sought and is appended to this submission at Annex 2.

3.41. *The study raises concerns regarding the deliverability of compensation. These concerns are over-stated and can credibly be addressed.*

- 3.42. The Commission makes it clear that the scale of compensatory habitat creation required would be very large and that such a large site has not been the subject of estuarine habitat creation in the UK. The study’s authors however go on to imply that this makes successful habitat creation more difficult or uncertain. For example, it is stated “there is potential for providing adequate compensation in that it is technically feasible”, which conclusion we support. However, it adds “but the scale required is unprecedented in the UK to date and there is a high level of uncertainty given that the full requirement is yet to be understood.” Whilst we accept that the compensatory habitat creation project would be large, it is not without precedent internationally. To assist the Commission we present information on a number of case studies, at Annex 4, illustrating how such projects

have previously been carried out. Of particular note is the San Francisco Bay case study, which is of a similar order of magnitude to that proposed here.

3.43. One element of the uncertainty expressed in the study appears to be the difficulty in finding a suitable site. TfL has conducted a preliminary review of available compensation sites which meet the following criteria:

- Size of the site in relation to the distance from the airport location;
- Elevation of land in the context of adjacent tidal levels;
- Exclusion of major infrastructure, railways and roads;
- Exclusion of internationally designated site; and
- Not within a 13km buffer of airports.

3.44. This resulted in a total of approximately 37,795ha of potentially-suitable land being identified within 200km of the ITE airport option and 73,500ha within 500km. It is acknowledged that, in practice, numerous additional site selection criteria would need to be applied to identify those sites that offer a realistic prospect of delivering effective compensatory habitat. However, this indicates that it is possible to create the scale of compensation required for the Inner Thames Estuary Option within the UK.

3.45. The study also refers to technical difficulties in creating the habitat at the required scale. A review of case studies, such as those provided on the Online Managed Realignment database (www.omreg.net) demonstrates the potential for successfully creating a number of compensation habitats at sites of a range of sizes. These case studies demonstrate the feasibility of creating a mosaic of different but complementary habitats within one site with careful planning, modelling and design. Zoning or compartmentalising of a site during design and construction appears to be an effective method of achieving this mosaic of various marine, freshwater and terrestrial habitats. Such habitats include:

- Intertidal mudflats;
- Saltmarsh;
- Saline and freshwater lagoons, ponds and ditches;
- Reedbeds;
- Wet and transitional grasslands;
- Coastal peat bogs;
- Coastal grazing marsh; and
- Roosting/nesting bird islands.

- 3.46. The ability of the compensation site to be suitable for all species or the same mosaic of habitats, is also called into question. We recognise that the proponents of any future scheme will have to take each qualifying species in turn and ensure that what is proposed will maintain each at Favourable Conservation Status. However, there is no evidence at this stage to suggest there is any species for which compensation for any impacts could not be provided.
- 3.47. Through the creation of habitat mosaics, compensation sites can accommodate a diverse range of wildlife with varying ecological requirements. Measures can also be taken to promote early use of a site by birds and other wildlife. Examples of large scale projects where this has been demonstrated include: Medmerry, West Sussex, UK (300ha); Beltringharder Koog, North Friesland, Germany (853ha); and Anklamer Stadtbruch, Oderhaff, Germany (1,750ha). A number of other large scale projects that will incorporate habitat mosaics are also currently in development including the Wallasea Island Wild Coast Project, Essex, UK (677ha) and the Steart Coastal Management Project, Severn Estuary, UK (469ha). Specific valuable habitat types, such as saline lagoons have been created in habitat compensation projects elsewhere on the River Medway.
- 3.48. Valuable lessons have been learnt with respect to all stages of compensatory habitat provision. These relate to scheme implementation costs, project management and communication, site selection, design and assessment, ecological development and monitoring, wider benefits and overall sign-off/compliance procedures. Further information is given in the case study examples provided at Annex 4.
- 3.49. *The timescales for successful habitat compensation are achievable given the potential programme of any ITE airport scheme. Appropriate monitoring against suitable performance indicators could be achieved.***
- 3.50. The study (at section 4.8 (iii) p 68) states that there would be uncertainty over the successful outcome of the compensation which would remain until displacement occurs and there had been long term monitoring. It refers to Wallasea Island where the process has taken 12 years from site selection.
- 3.51. We are not aware of any projects where long term success of the compensation habitat was required to be proven before development commenced. Indeed, this issue was raised in the Able UK Marine Energy Park case, where the Secretary of State considered the issue associated with the time lag between commencement of the development and the compensation site becoming fully functional. He stated (paragraph 39 of 18th December 2013 letter) that “*EU and Defra guidance on compensatory measures allow for a possible time lag, although obviously they will not encourage it*”.

- 3.52. It is normal practice to require that the compensation habitat is in place and usable by target species before the original habitat is lost. Monitoring would then commence and there would be a requirement for intervention if the compensation habitat was not performing as required. Given the time scales required for an infrastructure project of this scale to reach the construction stage, it is not envisaged that it would be problematic to carry out substantial advance works of this nature. The most suitable route for consenting these advance works would be reviewed. This is dealt with in the Mayor's response to Discussion Paper 7.
- 3.53. There are, furthermore, a number of instances where compensatory habitat has not been provided in advance of the losses. The compensation provided for port developments including Immingham Outer Harbour and London Gateway, for example, were not delivered in advance of the works. There was, however, a requirement for details of the compensation schemes and the associated planning permissions to be in place prior to the start of the construction works. Similarly the compensatory habitat for the Cardiff Barrage was not implemented in advance of the losses occurring. We have prepared at Annex 3 a number of case studies detailing compensation projects and demonstrating the gap between loss of a feature and the full effectiveness of the compensatory habitat provision. In many cases the losses were not compensated for in advance, and in some cases, many years passed before any compensation was in place.
- 3.54. The study states at p24 that "a Competent Authority may only authorise a project where it is *certain* that the Compensatory Measures are sufficient to maintain each designated species of affected sites in FCS". We do not believe that demonstrating this level of certainty is justified by the Directive or is suggested in Defra's 2012 guidance, which uses the language of "confidence". As explained in the Mayor's submission, there is adequate time to carry out the necessary studies to fully characterise and quantify the impacts of an ITE option, which would then be used to design appropriate compensation measures.
- 3.55. The use of a robust monitoring scheme, with further actions triggered in the event that an outcome was not as predicted, would best serve the needs of the Natura 2000 network.

4. Summary table:

Compatibility of the Study with the Mayor's view

Summary of the key observations made:

Issue	Draft Feasibility Study I	The Mayor's view	Is the study compatible with Mayor's position?
Impacts on NK2 sites	There would be no impact on priority habitats or species. There would be potentially significant direct habitat losses to the Thames Estuary and Marshes SPA and potentially the Medway Estuary and Marshes SPA	Agree that there will be potentially significant impacts on the NK2 sites as a result of the of the ITE proposal, and there would be no impacts on priority habitats or species.	Yes
Feasibility of habitat creation	Creation of the required compensatory habitat is technically feasible	The recognition that the habitat creation is technically feasible is welcomed.	Yes
IROPI case	An estuary option would have strong IROPI on the grounds of public health	The ITE option would have significant advantages in terms of public health and safety.	Yes – it is agreed that there are strong grounds to consider the ITE option as demonstrating Imperative Reasons of Over-riding Public Interest.
Area of habitat creation required	Up to 20,400ha	Up to 6,500ha	The study considerably over-estimates the area of habitat creation required.
Cost of habitat Creation	Up to £2.04bn	Up to £500M	The study considerably over-estimates the cost of habitat creation.
Could an ITE option pass the HRA “alternatives test”	Not specified	It cannot be determined at this stage that it could not and therefore cannot be discounted at this stage	This has not been specified.
Should the HRA Alternatives and IROPI tests be carried out in parallel or sequentially	The report refers to a sequential approach but says that it is not clear-cut and that legal advice is required.	Alternatives and IROPI should be considered in parallel. Legal opinion is provided within this response.	The study recognises that legal advice on this matter is required.
The levels of uncertainty regarding delivery of the required habitat compensation package	The scale of the habitat compensation requirement is unprecedented in the UK, and may present a significant risk to the option.	The scale of the habitat compensation requirement has precedent in the US. Sites are available in the south-east of England that are potentially suitable, and there are no insurmountable technical difficulties in creating estuarine habitat at this scale.	The FS I report refers to a possible risk, but a review of case studies confirm that habitat creation at this scale is technically feasible, using tried and tested methods.

Issue	Draft Feasibility Study 1	The Mayor's view	Is the study compatible with Mayor's position?
Timescales for compensation	There would be uncertainty over the successful outcome of the compensation which would remain until displacement occurs and there had been long term monitoring	We are not aware of any projects where long term success of the compensation habitat was required to be proven before development commenced. It is normal practice to require that the compensation habitat is in place and usable by target species before the original habitat is lost. Monitoring would then commence and there would be a requirement for intervention if the compensation habitat was not performing as required	It would not be problematic to undertake substantial mitigation / compensation works in advance of construction.

Annex I – Case studies of Article 6(4) decisions in relation to alternative options.

Project Name	Summary of Project	Consideration of Alternatives	Outcome	Relevance to ITE Airport
Deepening and widening of river Main at Wipfeld, Garstadt and Schweinfurt, Bavaria/ Germany (2013)	To widen the existing fairway of the river Main, and to deepen the waterway.	A number of potential alternatives were assessed, including the do nothing option. This included the option of widening both banks equally, which although would reduce the impact on the NK2 site in question, would negatively affect NK2 site. Another alternative would still impact on the NK2 site, but would not achieve the project objectives.	Each of the alternative options would have adverse impacts on the NK2 site(s). It was considered that the 'proposed solution was the best balance between ecological and river transportation objectives'. ¹	It is not necessary to choose an option that has a lesser effect on the NK2 site but a balanced approach that offered the best mixture of benefits can be acceptable. Just because there may be possible options that would avoid the impact on the affected site, it does not mean that they represent true alternatives to the benefits of the proposed scheme.
Able Marine Energy Park (2013)	Construction of a new quay, and onshore facilities for the manufacture of offshore wind turbines on the south bank of the Humber Estuary.	Several alternative options were considered: <ul style="list-style-type: none"> • Zero option • Alternative sites • Alternative scale of development • Alternative designs • Alternative operation of the facility 	<p>The Secretary of State agreed that the alternatives had been comprehensively addressed and that the do nothing option could be discounted, as it would fail to meet the objectives of the project.</p> <p>The application site is the only location on the east coast that could host such a major development and achieve the project objectives. He concluded there are no alternative solutions which would secure the aims and objectives of the project,</p>	This demonstrates that importance of identifying the project objectives, when determining whether alternatives to that proposal exist.

¹ European Commission (05/03/13) COMMISSION OPINION of 5.4.2013 delivered upon request of Germany pursuant to Art. 6(4) sub par. 2 of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive'), concerning the deepening and widening of the ship fairway of the river Main at the sections Wipfeld, Garstadt and Schweinfurt (Bavaria/Germany). <http://ec.europa.eu/environment/nature/natura2000/management/docs/Commission%20Opinion%20Main%20EN%20SEC-2013-1871.pdf>

Project Name	Summary of Project	Consideration of Alternatives	Outcome	Relevance to ITE Airport
			whilst being less damaging to the NK2 network. ²	
Immingham Outer Harbour (2013)	Port Extension to create a new roll-on roll-off ferry terminal, to allow increased traffic and a new generation of larger 'super-ferries'.	Alternative proposals considered included: <ul style="list-style-type: none"> • Better use of existing facilities at Immingham • Alternative designs at Immingham • Alternative locations (within Applicant's ownership) • Do nothing • Humber Sea Terminal (HST) - which had also submitted an application for a ro-ro facility. 	SoS determined that there was no alternative solution, to meet the project objectives. The HST would not meet the purposes of the Applicant's proposals, as 24hr access, nor sufficient capacity would be provided. ³ A need for 24hr access was identified.	The consideration of alternatives must take into account the objectives of the project; in this case it also includes 24/7 operation of the site which may be a consideration for a UK hub airport.
Green Port, Hull Development (2012)	Manufacture, assembly, testing and shipment of offshore wind turbines, helicopter landing site, reclamation of 7.5ha of Humber Estuary, infilling of 6.85ha of the Alexandra Dock, and associated works.	Alternative solutions considered included: <ul style="list-style-type: none"> • The reconfiguration of the Green Port development • Undertaking the project elsewhere within the Port of Hull • Undertaking the project in other UK ports • Other North sea ports on the European mainland 	The Secretary of State determined that none of the alternative solutions would have a lesser effect on the integrity of the NK2 site, and still meet the project objectives. ⁴	This demonstrates that importance of identifying the project objectives, when determining whether alternatives to that proposal exist. An alternative that avoids impacts on the N2K site but does not offer the same package of public interest benefits need not be preferred.

² Department for Transport (18/12/2013) letter ref TWA/8/1/4 Planning Act 2008: Applications for the proposed Able Marine Energy Park Development Consent Order and for Certificates under Section 127 <http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/TR030001/3.%20Post%20Decision%20Information/Decision/SoS%20Decision%20letter%20with%20annexes.doc.pdf>

³ Department of Transport. Associated British Ports (Immingham Outer Harbour) Harbour Revision Order. <http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/shippingports/ports/dl/associatedbritishportsimming4915?page=3>

⁴ Communities and Local Government (17/07/2012). Letter ref: NPCU/CHR/V2004/70056. Green Port, Hull Application Nos 31772, 31772B, 31772C, 31772D and 26841C Reference to the Secretary of State under Regulation 62 of the Conservation of Habitats and Species Regulations 2010 (Habitats Regulations 2010). http://infrastructure.planningportal.gov.uk/wp-content/ipc/uploads/projects/TR030001/2.%20Post-Submission/Representations/Additional%20Representations/120817_TR030001_Hull%20CC%20copied%20letter%20from%20the%20SoS%20regarding%20Green%20Port%20Hull.pdf

Project Name	Summary of Project	Consideration of Alternatives	Outcome	Relevance to ITE Airport
Deeping of the River Elbe, Germany (2011)	Deepening (dredging) and widening of the River Elbe to increase capacity at Hamburg port, and to enable entry to the port of the "benchmark container vessel", function as a major transport hub, of economic importance to the region and the country.	Six alternatives & do-nothing options were considered. <ul style="list-style-type: none"> Reduction of speed and use of sea tugs Additional dams and floodgates International convention limiting ship size Different dimensions of dredge Use of other German ports Partial unloading downstream to reduce draft of ship 	All alternatives were rejected, as they were either technically unfeasible or the objectives of the project would not have been met (ships would have been discouraged from using the port). The competent authorities considered that the proposed solution was the best balance between ecological and economic objectives. ⁵	This demonstrates the importance of finding the best balance between ecological and economic objectives.
A643 Schiersteiner Brücke, Germany (2011)	Replacement of motorway bridge, with irreparable damage needing replacement, along with extension of the motorway from 4 to 6 lanes. – required for safety aspects, and increase in traffic capacity as part of the traffic concept within the Rhine-Main area.	Two alternatives considered and do nothing: <ul style="list-style-type: none"> Restoration of the existing bridge Maintenance of the existing bridge 	All alternatives were rejected, as restoration or maintenance of the existing bridge were technically unfeasible; do nothing option would not have met the objectives of the project, as bridge would have been closed, and increased traffic on the remaining routes would cause greater harm to the NK2 sites. ⁶	This demonstrates the importance of seeking alternatives that are technically feasible and can offer the same opportunity to meet the project objectives.
Bristol Deep Sea Container Terminal (2010)	Construction of Deep Sea Container terminal, and associated dredging of the navigation access channel, to be able to accommodate Ultra Large Container Ships.	Consideration was given to alternative proposals within Bristol harbour, but none would be able to meet the project objectives.	The Secretary of State accepted that alternative options within the port and harbour of Bristol for accommodating increased demand for container handling capacity would be inadequate or less suitable and that a new riverside terminal at	This demonstrates the importance of having the objectives of the project clearly defined, when considering viable alternative options to the scheme.

⁵ European Commission (06/12/2011) COMMISSION OPINION of 6.12.2011 on request of Germany pursuant to Art. 6 (4) Sub Par. 2 of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, concerning the deepening and widening of the ship fairway Unter- and Außenelbe (river Elbe) to the port of Hamburg (Germany) [http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/1_EN_ACT_part1_v4\[1\].pdf](http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/1_EN_ACT_part1_v4[1].pdf)

⁶ European Commission (14/09/11) COMMISSION OPINION of 14.9.2011 delivered upon request of Germany pursuant to Art. 6 (4) Sub Par. 2 of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, concerning the replacement construction of the motorway bridge "Schiersteiner Brücke", the extension of the motorway A 643 from 4 lanes to 6 lanes and the enlargement of the motorway junction, Hesse (Germany) http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/schiersteiner_en.pdf

Project Name	Summary of Project	Consideration of Alternatives	Outcome	Relevance to ITE Airport
			Avonmouth would be best situated to cater for large container vessels. ⁷	
A49 motorway extension, Germany (2010)	Construction of new section of motorway (part of the trans-European road-network). The objectives included enhancing the development of the region, and a reduction in traffic density on the subordinate road network (which would reduce air quality and noise issues).	12 alternative routes were assessed.	None of the alternative solutions would adequately reach the goals of the national traffic concept plan, without affecting the NK2 site. Only one option would have less of an impact on the NK2 site, but it would not achieve all the objectives of the project. The competent authorities were satisfied there is no alternative solution that would allow reaching the objectives of the project in the light of the national traffic concept plan. ⁸	This demonstrates the importance of considering environmental criteria within the objectives (noise and air quality) when determining if suitable alternative solutions exist or not.
Lubeck-Blankensee Airport (2009)	Runway extension and development and improvement of associated infrastructure, to enable more airlines to operate in a more efficient way.	Alternatives considered: <ul style="list-style-type: none"> • Extension to Hamburg Airport • Construction of new airport in the region • Five variations to the runway extension at Lubeck • Do nothing option 	The European Commission concluded that there are no viable alternatives to the airport expansion. The chosen solution is the best alternative ensuring a sustainable air traffic growth in the region whilst minimising the environmental effects of intensified air traffic, airport management and construction works. Neither the possible extension of nearby Hamburg airport, nor the null alternative would achieve these targets to the same extent. ⁹	This demonstrates the importance of considering all of the project objectives (including sustainable transport and environmental considerations) when determining the optimal solution for the scheme.

⁷Department for Transport (25/03/2010). <http://assets.dft.gov.uk/publications/bristol-deep-sea-container-terminal-decision-letter/decisionletter.pdf>

⁸ European Commission (03/12/2010) COMMISSION OPINION of 3 December 2010 on request of Germany pursuant to Art. 6 (4) Sub Par. 2 of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, concerning the construction of the extension of the motorway A 49 by linking the end of the completed A 49 at Neuental with A 5 in Hesse (Germany) http://ec.europa.eu/environment/nature/natura2000/management/docs/hessen_en.pdf

⁹ European Commission (05/05/2009) OPINION OF THE COMMISSION delivered upon request of Germany according to Art. 6 (4) Sub Par. 2 of Council Directive 92/43/EEC of 21 May 1992 on the conservation of the natural habitats as well as the wild animals and plants, concerning the approval of the extension of the Lübeck- Blankensee

Project Name	Summary of Project	Consideration of Alternatives	Outcome	Relevance to ITE Airport
Second Maasvlakte, Netherlands (2003)	Expansion of Rotterdam Port by land reclamation – a dual objective was identified for the project: reinforcing the Rotterdam transport hub to increase capacity for growing demand and improving the living environment in the Rijnmond area.	<p>All options for port expansion in the wider Rotterdam area were examined. These included:</p> <ul style="list-style-type: none"> • Better use of the existing space in the Rotterdam Port area • Increased use of existing port sites in SW Netherlands <p>Different land reclamation designs were also considered.</p>	<p>Approval given to expand the existing Maasvlakte artificial peninsula by land reclamation.</p> <p>European Commission accepted the selection process between alternatives had been carried out in an appropriate manner. <i>'the SW Netherlands option was abandoned because of large investments in hinterland connections and lack of space for the kind of developments to be expected in Rotterdam, while the landside expansion of the existing Rotterdam port areas was not considered because of too large potential for conflict with environmental, social and safety requirements'</i>¹⁰</p>	The objectives of the project were not just related to expansion of the port, but also linked to an improved living environment. The ITE option offers significant environmental benefits.

airport http://ec.europa.eu/environment/nature/natura2000/management/docs/c_2009_3218_en.pdf

¹⁰ Commission of the European Communities (24/04/2003) OPINION OF THE COMMISSION delivered pursuant to Article 6.4 § 2 of Council Directive 92/43/EEC of 21 May 1992 on the conservation of the natural habitats and of wild fauna and flora (Habitats Directive), concerning the "Request by the Netherlands for advice and exchange of information with the European Commission within the framework of the Birds and Habitats Directives ", in relation to the "Project Mainport Rotterdam" Development Plan http://www.slu.se/Documents/externwebben/ltj-fakdok/Landskapsarkitektur,%20planering%20och%20f%C3%B6rvaltning/Personal/CV/Jesper%20Persson/Projekt/EU%20fallen%20kompensation/rotterdam_en%20Artikel%206%20Kompensation.pdf

Annex 2

OPINION

Introduction

1. We are asked to advise Transport for London ("TfL") with regard to its preparation of a response to the Airports Commission ("the Commission") which is in the process of considering the need for additional UK airport capacity with a view to recommending to the Government how this can be met in the short, medium and long term.
2. In December 2013 the Commission produced an Interim Report in which it offered a very high level assessment of the long term options for further runway capacity in the south east of England, short-listing two development options at Heathrow, one at Gatwick and identifying another option for further consideration in the Inner Thames Estuary (the "ITE"). The Mayor of London has proposed the ITE option. The Commission published a Feasibility Study on the environmental impacts of the ITE option by Jacobs consultants in July 2014 (the "Jacobs Report")¹, and is currently seeking responses to that document.
3. The Jacobs Report notes what has been acknowledged by TfL from the outset, that the ITE option would result in potentially significant adverse environmental effects, in particular to the Thames Estuary and Marshes Special Protection Area (the "SPA"), which supports populations of breeding and migratory bird species that are protected under Article 4 of consolidated Directive 2009/147/EC on the conservation of wild birds ("the Wild Birds Directive") to which the safeguards in Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive") apply. The report raises a number of practical and evidential matters in relation to this and related issues to which TfL is preparing a response.
4. The need for our Opinion arises because of the Mayor's concern to ensure that the Commission is properly advised as to the interpretation and application of the Wild Birds and Habitats Directives, in particular the requirement in Article 6(4) of the Habitats Directive to demonstrate "the absence of alternative solutions". We are asked to consider this matter and specifically whether the Habitats Directive allows the

¹ The Inner Thames Estuary Feasibility Study 1: Environmental Impacts July 2014 is one of four studies undertaken as part of the review of the feasibility of the estuary option.

competent authority to take into account the imperative reasons of overriding public interest (“IROPI”) justifying a project when determining whether or not alternatives exist. In relation to the circumstances of this case, for the reasons set out below we consider that the IROPI claimed for the ITE option are of central relevance to the question of alternatives. Accordingly, it would be wrong for the Commission to rule out the ITE proposals on the basis of an absence of alternative proposals without considering the particular IROPI associated with the ITE option.

The Habitats Directive and Regulations

5. The Habitats Directive is implemented in England and Wales by the Conservation of Habitats and Species Regulations 2010 (the “2010 Regulations”) and the Offshore Marine Conservation (Natural Habitats, &c.) Regulations 2007 (the “2007 Regulations”). There is no material difference between the requirements in these Regulations for the purposes of this Opinion. In short, unless the competent authority of a Member State, having regard to the conservation objectives for which an EU nature conservation site is designated, is able clearly to ascertain that a plan or project will not adversely affect the integrity of the site, it may not grant authorisation to it, except as provided for by the derogation within Article 6(4) of the Habitats Directive (as transposed by Regulations 62 and 26 of the 2010 and 2007 Regulations respectively).
6. The Court of Justice in Case C-258/11 *Sweetman v An Bord Pleanála* considered that in order to avoid an adverse effect on the integrity of a site, it needs to be preserved at a favourable conservation status, which entails “the lasting preservation of the constitutive characteristics of the site concerned that are connected to the presence of a natural habitat type whose preservation was the objective justifying the designation of that site ...” (paragraph 39).
7. The derogation in Article 6(4) of the Habitats Directive is as follows:

“If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected. It shall inform the Commission of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the Commission, to other imperative reasons of overriding public interest.”

8. Consideration of alternative solutions, IROPI and possible compensatory measures logically succeeds consideration of the impact upon the integrity of a site, although in Case C-182/10 *Solvay v Region Wallone*, the Court of Justice recognised a relationship between Article 6(3) and Article 6(4):

“Moreover, it [Article 6(4)] can apply only after the implications of a plan or project have been studied in accordance with art.6(3) of the Habitats Directive. Knowledge of those implications in the light of the conservation objectives relating to the site in question is a necessary prerequisite for the application of Article 6(4), since, in the absence of those elements, no condition for the application of that derogating provision can be assessed. The assessment of any imperative reasons of overriding public interest and that of the existence of less harmful alternatives require a weighing up against the damage caused to the site by the plan or project under consideration. In addition, in order to determine the nature of any compensatory measures, the damage to the site must be precisely identified.” (paragraph 74).

9. In Case C-239/04 *Commission v Portugal* [2006] ECR I-10183, a case about a road project through the Castro Verde special protection area (“the *Castro Verde* case”), the Advocate General gave guidance as to when possible compensatory measures fell to be considered:

“Within the framework of Article 6 of the Habitats Directive, the adverse effects on a site must be strictly separated from the compensatory measures. Under the regulatory system of the Habitats Directive, adverse effects are to be avoided as far as possible. That is done preferably by eliminating any risk of harm or by taking appropriate damage mitigation and prevention measures. By contrast, compensatory measures can be considered only when adverse effects have to be accepted in the absence of any alternative, for overriding reasons of public interest. The preservation of existing natural resources is preferable to compensatory measures simply because the success of such measures can rarely be predicted with certainty” (paragraph 35).

Absence of alternative solutions

10. In Article 6(4), the requirement is “the absence of alternative solutions” (similarly in Regulation 62(1) the competent authority must be satisfied of “there being no alternative solutions”).
11. There is no statutory definition of “alternative solutions”, but the expression cannot sensibly be understood in a vacuum. The justification for the plan or project is necessarily relevant. The first question that needs to be considered in approaching the issue of alternatives must be: what are the objectives of the plan or project? Then it

falls to be considered whether there are other ways of achieving *those* objectives which avoid or reduce the nature conservation impact.

12. Clearly not *all* alternatives have to be considered, it is necessary to read in a word such as “reasonable” before “alternatives”. As the European Commission’s Guidance document on Article 6(4) (2007/2012) says, “[a]ll feasible alternatives ... have to be analyzed” including “alternative locations or routes, different scales or designs of development or alternative processes” (paragraph 1.3.1); Defra’s guidance on Article 6(4) (December 2012) similarly states that a competent authority “should use its judgement to ensure that the framing of alternatives is reasonable” (paragraph 13). Again, what is a reasonable alternative will have regard to the specific nature and objective of the plan or project under consideration.

13. The only relevant EU authority to give detailed consideration to the requirement relating to alternatives solutions is the *Castro Verde* case. At paragraph 42 of her opinion Advocate General Kokott set out the purpose of the requirement:

“Article 6(4) of the Habitats Directive permits authorisation of projects only in the absence of alternatives. That prerequisite for authorising a project is intended to prevent protected sites from being adversely affected even though the aims of the project could be achieved in a manner which would affect the protected sites less adversely or not at all. The absence of alternatives corresponds to a stage in the test of proportionality, according to which, when there is a choice between several appropriate measures, recourse must be had to the least onerous”.

14. At paragraphs 44 to 45 the Advocate General said:

“...the choice does not inevitably have to be determined by which alternative least adversely affects the site concerned. Instead, the choice requires a balance to be struck between the adverse effect on the integrity of the SPA and the relevant reasons of overriding public interest.

The necessity of striking a balance results in particular from the concept of 'override', but also from the word 'imperative'. Reasons of public interest can imperatively override the protection of a site only when greater importance attaches to them. This too has its equivalent in the test of proportionality, since under that principle the disadvantages caused must not be disproportionate to the aims pursued.”

15. In this regard, the assessment of alternatives enables the decision-maker to understand the respective impacts and opportunities of any given proposal.

16. Her conclusion at paragraph 46 is in clear terms and important:

“The decisive factor is therefore whether imperative reasons of overriding public interest require the implementation of specifically that alternative or whether they can also be satisfied by another alternative with less of an adverse effect on the SPA. That comparison presupposes that the various alternatives have been examined on the basis of comparable scientific criteria, both with regard to their effects on the site concerned and with regard to the relevant reasons of public interest.”

17. On the facts of the *Castro Verde* case, Portugal had not considered any alternatives along routes to the west of the SPA (for the road project). At paragraph 52, the Advocate General suggested that it might be “demonstrated that similar routes further away from the settlements are ruled out because of higher costs or disadvantages from a traffic engineering point of view”, but Portugal had not demonstrated that. The Court of Justice agreed (see paragraph 38) and upheld the complaint.

18. Accordingly, it seems to us conceptually impossible to conclude an assessment on alternatives without, or prior to, understanding the purpose and objective of a project. While a range of alternatives should be assessed, in determining whether or not these amount to alternative solutions for the purposes of the Habitats Directive, it is necessary to have regard to the respective benefits and disbenefits of each option and to weigh those against the harm to nature conservation interests. The analysis in the *Castro Verde* case supports this logic: a road may be able to be routed to avoid passing through a special protection area, but if this would involve unacceptable harm to other acknowledged interests (not just nature conservation interests) it may not properly represent an alternative solution. Moreover, the focus on IROPI is in accord with the principle of proportionality. As noted by the Advocate General, the decisive factor is whether the IROPI specifically require the option under consideration, or whether an alternative will suffice.

19. It is acknowledged that the European Commission’s guidance, which is not binding as to the law, says generally that Article 6(4) has to be applied “in the sequential order established by the Directive” (section 1.2.1) and presents its guidance in that way. However, significantly, the Advocate General’s opinion in relation to the approach to the specific questions of alternatives and IROPI is expressly referred to (sections 1.2.1 and 1.3.1).

20. We also note that national guidance presents the issue of alternative solutions as a “separate and sequential” test to that of IROPI. Paragraph 27 of Defra’s December 2012 guidance says:

“The alternatives and IROPI tests are separate and sequential tests, and the competent authority must decide whether there is an alternative solution before (if necessary) it formally decides whether IROPI exists. However, in limited circumstances it may be helpful to consider the IROPI test alongside the assessment of feasible alternative solutions. This would only apply where it is very clear that a plan or project will not meet the IROPI test. In such cases there would be no point in spending time looking into possible alternatives.”

21. This formal separation does not seem to us to provide a sound basis for decision making if the result is that the decision-maker does not have regard to the specific objectives of the proposal under consideration in framing his consideration of and conclusions upon alternatives. Nor do we think the language of the Habitats Directive requires strict separation between these considerations in Article 6(4). Such an interpretation would make the assessment of alternatives potentially prohibitive and would run counter to the principle of proportionality which informs all EU law (see Article 5 of the Treaty on European Union). We can see nothing in our interpretation that undermines the objectives of the Habitats Directive, rather it promotes rational and consistent decision making. Whether or not a “formal” decision on IROPI is not made until after alternatives are considered, the consideration of alternative solutions requires an analysis of the underlying imperative justification for the project under consideration. In that sense, it is at least in part a combined approach.

Application in this case

22. It seems to us therefore that a necessary preliminary step to considering whether alternative solutions are available for a new hub airport on the Hoo Peninsula is the identification and articulation of the particular justification for the ITE option.
23. The specific benefits of the ITE option have already been recognised by the Commission. We understand that the proposal is of a very different nature to the shortlisted options. The Mayor’s outline proposal (July 2013) states as follows:

“The Isle of Grain has the space to accommodate a world-class, efficient hub airport, avoid the overflying of Greater London, and the potential to catalyse growth and development across the Thames Gateway – the largest regeneration area in the UK – and East London. It could take advantage of close proximity to the London Gateway port, and enable a flexible night flying regime. Excellent surface access connections, building on existing and planned infrastructure will get passengers, staff, and freight to and from the airport quickly, and in an environmentally sustainable way. Heathrow will have to take on a different role, but it can be part of the solution. It could offer London a redevelopment opportunity of unprecedented size and scale”

(The Mayor of London's submission to the Airports Commission, outline proposal, July 2013, section 1).

24. In terms of the ability to meet long-term demand, enable 24/7 operations and provide flexible hub capacity, the ITE option has a combination of advantages that are not obviously available elsewhere. In particular, it has significant public health benefits and is unique in providing an opportunity to address existing and potential environmental and public health issues at Heathrow by avoiding flight paths over properties in Greater London and the associated blight from noise and air pollution. The particular socio-economic benefits for the Thames Gateway region are also not met by any of the other options remaining before the Commission. We understand that the ITE option has been retained for further consideration by the Commission precisely because it is considered capable of meeting long-term airport capacity as well as providing very significant economic, environmental and public health benefits.
25. On the approach set out above with reference to the Advocate General's opinion in *Castro Verde*, if the Government in due course was to proceed with an Inner Thames Estuary project, the assessment of alternatives under Article 6(4) would have to take account of the particular IROPI that arise. A judgment would have to be made then as to whether or not there is an alternative solution that would meet the same substantial beneficial objectives so as to satisfy the Government that it could reject the ITE option on the basis of its adverse impacts on the SPA. Given this, to reject outright at this stage the ITE option on the basis that there are "alternative solutions" would be premature. A full assessment is required of at least all the remaining options against their respective IROPI cases before a balancing exercise can properly be undertaken.
26. Accordingly, not only does the Habitats Directive allow a competent authority to take into account any IROPI relied upon when determining whether or not feasible alternatives exist, but that is the correct approach, especially for a project such as the ITE proposal where the imperative reasons relied upon are readily discernable and relatively specific.

The Jacobs Report

27. On alternative solutions, the Jacobs Report says as follows:

"Some legal commentators have argued that, when considering Alternative Sites, it is possible to take account of Imperative Reasons of Overriding Public Importance (IROPI) ... This is an issue on which legal advice will be required" (page 22).

28. The Jacobs Report refers to the alternatives and IROPI tests as sequential, but then in considering IROPI refers back to the question of alternatives as follows:

“There are clearly strong potential IROPI relating to health, public safety and socio-economic reasons which constitute the objectives or rationale for a new hub airport. However, the Competent Authority would need to be certain that the imperative nature of the reasons for authorising a new airport on the Hoo Peninsula were imperative only at that site. Otherwise, a project proposed on the Hoo Peninsula would be unlikely to pass the Alternative Solutions test” (page 23).

29. The discussion that follows refers to the “clearly strong IROPI relating to health, public safety and socio-economic reasons which constitute the objectives or rationale for a new hub airport”, such as the ITE proposal. The report rightly notes that it would be necessary to show that the imperative objectives could only be achieved at the ITE site. It then briefly discusses the IROPI, acknowledging that overriding importance would need to be shown. The Jacobs Report does not come to a concluded view on the question at this stage, although we note it expresses some doubts in respect of public safety IROPI. On socio-economic IROPI, we note that the report states that “[a] prior opinion from the European Commission may be sought”, but the reason for this is unclear; we understand it to be common ground that the European sites affected do not host priority species. In that case there would be nothing to prevent the Commission or Government from seeking such an opinion, but it is not required by reference to Article 6(4). Notwithstanding this, the approach appears to be correct in law in so far as it combines the question of IROPI with that of alternatives.

30. As far as the legal issue identified on page 22 of the Jacobs Report is concerned, we hope that our Opinion is of some assistance to the Commission.

Conclusion

31. In our view, with due regard to the evolving nature of this area of law, there is no legal reason that could justify the Commission ruling out an ITE option at this stage, subject to it remaining credible in other respects.

32. Indeed, given that the Commission has otherwise selected the Inner Thames proposal as capable of meeting one of the longer-term strategic objectives (airport capacity) it would seem inappropriate for it to be ruled out at this stage on grounds that properly require a comparison with the shortlisted options.

33. In this regard it may be noted that it is almost inevitable at some stage that the Government will have to subject its airport expansion policy to environmental assessment under Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment (“the SEA Directive”). Article 5(1) of the SEA Directive requires assessment of “reasonable alternatives” (see also Annex I(h)). It seems to us that it could be difficult for the Commission and/or Government to justify excluding an obvious alternative on the Hoo Peninsula at that later stage. While it is

clear that not every possible alternative needs to be considered, European Commission guidance on the implementation of the SEA Directive (2003) sets out the basic scope. Paragraph 5.13 says:

“The text of the Directive does not say what is meant by a reasonable alternative to a plan or programme. The first consideration in deciding on possible reasonable alternatives should be to take into account the objectives and the geographical scope of the plan or programme. The text does not specify whether alternative plans or programmes are meant, or different alternatives within a plan or programme. In practice, different alternatives within a plan will usually be assessed (e.g. different means of waste disposal within a waste management plan, or different ways of developing an area within a land use plan). An alternative can thus be a different way of fulfilling the objectives of the plan or programme. For land use plans, or town and country planning plans, obvious alternatives are different uses of areas designated for specific activities or purposes, and alternative areas for such activities. For plans or programmes covering long time frames, especially those covering the very distant future, alternative scenario development is a way of exploring alternatives and their effects. As an example, the Regional Development Plans for the county of Stockholm have for a long time been elaborated on such a scenario model.”

34. In the domestic courts it has been held that the consideration of alternatives must be conducted at a similar level of detail to the other options (see *Save Historic Newmarket Ltd v Forest Heath DC* [2011] EWHC 606 (Admin); [2011] JPL 1233 per Collins J at paragraph 40; *Heard v Broadland DC* [2012] EWHC 344 (Admin); [2012] Env LR 23 per Ouseley J at paragraphs 67-71; see also the European Commission guidance cited above at paragraph 5.12).
35. If the Commission is fully to assess the options for airport capacity expansion and to avoid the risk of subsequent challenge, it would in our view be wise to keep the ITE project on the table as an option to be considered. Certainly, for all the reasons set out above, we can see no legal impediment to it doing so.

Craig Howell Williams QC
Ned Westaway

FTB Chambers, Temple,
London
8 August 2014

Annex 3: Summary of habitat creation: loss ratios from past case examples

Location of Compensation	Extent of Habitat Lost or Changed (ha)	Extent of Habitat Created (ha)	Approx. Gain:Loss Ratio	Background Details	Timing of delivery
Humber CHaMP - Coastal Squeeze, UK	600ha	600ha	1:1	Based on 6mm SLR and upper limit of estimate of loss associated with coastal squeeze (Black & Veatch Consulting Ltd., 2004)	To be delivered over the next 50 years, subject to ongoing monitoring.
Humber CHaMP - losses associated with reconstruction and maintenance works, UK	15ha	45ha	3:1	Losses associated with the implementation of the Humber Flood Defence Strategy (Black & Veatch Consulting Ltd., 2004)	To be delivered over the next 50 years, subject to ongoing monitoring.
Humber CHaMP - temporary losses/ disturbance, UK	27ha	27ha	1:1	Losses associated with the implementation of the Humber Flood Defence Strategy (Black & Veatch Consulting Ltd., 2004)	To be delivered over the next 50 years, subject to ongoing monitoring.
Humber CHaMP - Provision of flood storage, UK	45ha	45ha	1:1	Losses associated with the implementation of the Humber Flood Defence Strategy (Black & Veatch Consulting Ltd., 2004)	To be delivered over the next 50 years, subject to ongoing monitoring.
Paull Holme Strays, Humber, UK	Not known	80ha	Not known	Predicted losses are not comparable with the area created because it formed part of the overall flood defence strategy (Environment Agency, 2006). Implemented 2004.	Created 2003 due to predicted losses as a result of coastal squeeze.
Brandy Hole, Crouch, UK	12ha	12ha	1:1	Coastal squeeze. Implemented 2002.	Scheme implemented in response to predicted losses due to coastal squeeze.

Location of Compensation	Extent of Habitat Lost or Changed (ha)	Extent of Habitat Created (ha)	Approx. Gain:Loss Ratio	Background Details	Timing of delivery
Gwent Levels Habitat Creation, near Newport, UK	200ha (SSSI)	438ha	2:1	To offset impacts of the Cardiff Bay barrage. Habitat types lost and gained are reportedly very different (Burton, 2006).	Implemented in 2000 after completion of the barrage works. The compensation scheme took several years to fully define and agree with stakeholders.
Allfleet's Marsh (Wallasea Island North Bank), Crouch, UK	54ha	115ha	2:1	The high level objective of the managed realignment scheme was to ensure overall coherence of Natura 2000.	Habitat created many years after the losses associated with East Coast port developments (ABPmer, 2003).
Welwick, Chowder Ness and Doig's Creek; Humber, UK	31ha	59ha	2:1	Losses associated with port development on the Humber Estuary (ABPmer, 2004).	Implemented 2006, post IOH development (2005) but prior to Quay 2005 development (now known as GPH – construction predicted to start 2014).
Trimley Marsh/ Shotley Marshes enhancements; Orwell, UK	3.93ha, plus 0.2ha annually (indirect)	24ha	not strictly applicable*	Losses associated with Trinity III Felixstowe Port Development. (Royal Haskoning, 2005).	Implemented 2000, prior to Felixstowe development in 2004.
Little Oakley, Hamford Water, UK	72ha (69ha of direct loss)	105ha	1.5:1	Intertidal habitat to be created as a result of losses associated with port development.	Not yet implemented.
London Gateway, Thames, UK	14ha direct loss (not EMS) plus 60ha indirect, functional change (within EMS)	74ha	1:1	Habitat created as a result of losses associated with port development. Two sites required to deliver compensation habitat.	First site (Site A) implemented 2010 (27ha), concurrently with start of port construction. Further site (Site 'X') planned to be completed in 2015.
Hesketh Out Marsh, Ribble, UK	11ha	52ha (of a 180ha site)	4:1	Loss of sandflat under footprint of breakwater (7ha) and under mitigation area (4ha) (Young Associates, 2001) compensated for by saltmarsh realignment.	Implemented 2008 in part to compensate for previous damage to the Morecambe Bay SPA due to defence works (large multiplier due to compensation not taking place in Morecambe Bay).

Location of Compensation	Extent of Habitat Lost or Changed (ha)	Extent of Habitat Created (ha)	Approx. Gain:Loss Ratio	Background Details	Timing of delivery
Steart Habitat Creation Scheme, Bristol Channel, UK	113ha (33.5ha direct loss, not all EMS; rest functional/ indirect)	120ha (legal agreement), 132ha (planning application)	not strictly applicable**	Compensation for consented Bristol Deep Sea Container Terminal.	Not yet implemented – must be fully operational before port development
Medmerry, UK	Primarily to reduce flood risk and offset predicted coastal squeeze losses	300ha	n/a	Specific areas of compensation have not been allocated by the Environment Agency to particular schemes.	The habitat creation at Medmerry will compensate for coastal squeeze losses which will occur gradually over time across the whole of the Solent.
Cherry Cobb Sands, UK	58ha (44ha intertidal and 14ha subtidal)	100ha (including target 76ha mudflat) Plus an additional 38ha of wet grassland.	2:1	Compensation for Able Marine Energy Park.	Neither development nor compensation site yet implemented
Alkborough Flats	Primary purpose of the site was to provide flood protection	370ha	1:1 (coastal squeeze) 3:1 (compensation)	Newly created intertidal habitats will offset those lost through coastal squeeze and due to flood defence works, in addition to providing compensation for habitat loss elsewhere in the estuary.	Created 2006 as flood storage site and to offset future losses due to coastal squeeze.
Beltringharder Koog, Germany	3350ha	3350ha (although only 853ha due to RTE scheme)	1:1	Regulated tidal exchange (RTE) site that created 853ha of intertidal habitat as part of wider 3350ha compensation package.	The site provided in situ compensation for advancing the sea defences into Nordstrand Bay, works undertaken simultaneously.
Anklamer Stadtbruch, Germany	Undertaken to reduce flood protection costs	1750ha	n/a	Prior to breach the site was extensively overtopped, particularly during the 1995 storm surge.	Official breach works undertaken 2002 to 2004, after storm damage to the dike during heavy storms, in particular 1995.

Location of Compensation	Extent of Habitat Lost or Changed (ha)	Extent of Habitat Created (ha)	Approx. Gain:Loss Ratio	Background Details	Timing of delivery
Bremerhaven, Germany	105ha	348ha	3:1	Compensation for the expansion of a container terminal - provided across a five different sites	Most of the compensation tasks were accomplished by the end of the site specific development.
South Bay Salt Pond Restoration, USA	Undertaken to improve natural habitat and reduce flood risk	6,000ha	n/a	Conversion of industrial salt ponds to a rich mosaic of tidal wetlands and other habitats.	Work across the Bay started in 2008 and is still ongoing.
* Due to indirect losses being expressed in annual terms					
** Due to some losses not being within the EMS, and also due to large proportion of indirect/functional losses					

Annex 4 – Case studies of compensatory habitat creation

Case Study – Alkborough Flats

Site Name: Alkborough Flats	Location: Humber Estuary, UK
Size: 370ha	Date of Creation: 2006

Project Background and Objectives

The primary purpose of the Alkborough Flats scheme was to provide flood protection/alleviation. The size of the site provides a large capacity for water storage and is designed to reduce tidal levels in the upper Humber Estuary and Trent tributary (especially during storm surges), thus delaying the need to raise other flood defences. A further objective of the scheme was to create new intertidal habitats to offset those lost through coastal squeeze and due to flood defence works.

Tidal inundation of the site has led to the development of valuable intertidal habitat including mudflats, saltmarsh, lagoons and reedbeds which serves to provide compensation for habitat loss elsewhere in the estuary.

The project was funded by the Environment Agency and its partners.

Target Habitats and Species

The primary aim of the project was to provide flood defence/alleviation, although it also sought to create intertidal habitats to offset loss due to coastal squeeze and flood defence works. The site aimed to create new habitat at a 1:1 ratio of habitat loss to creation for coastal squeeze and a 1:3 ratio for habitat loss to creation for direct construction related losses.

Habitats Created

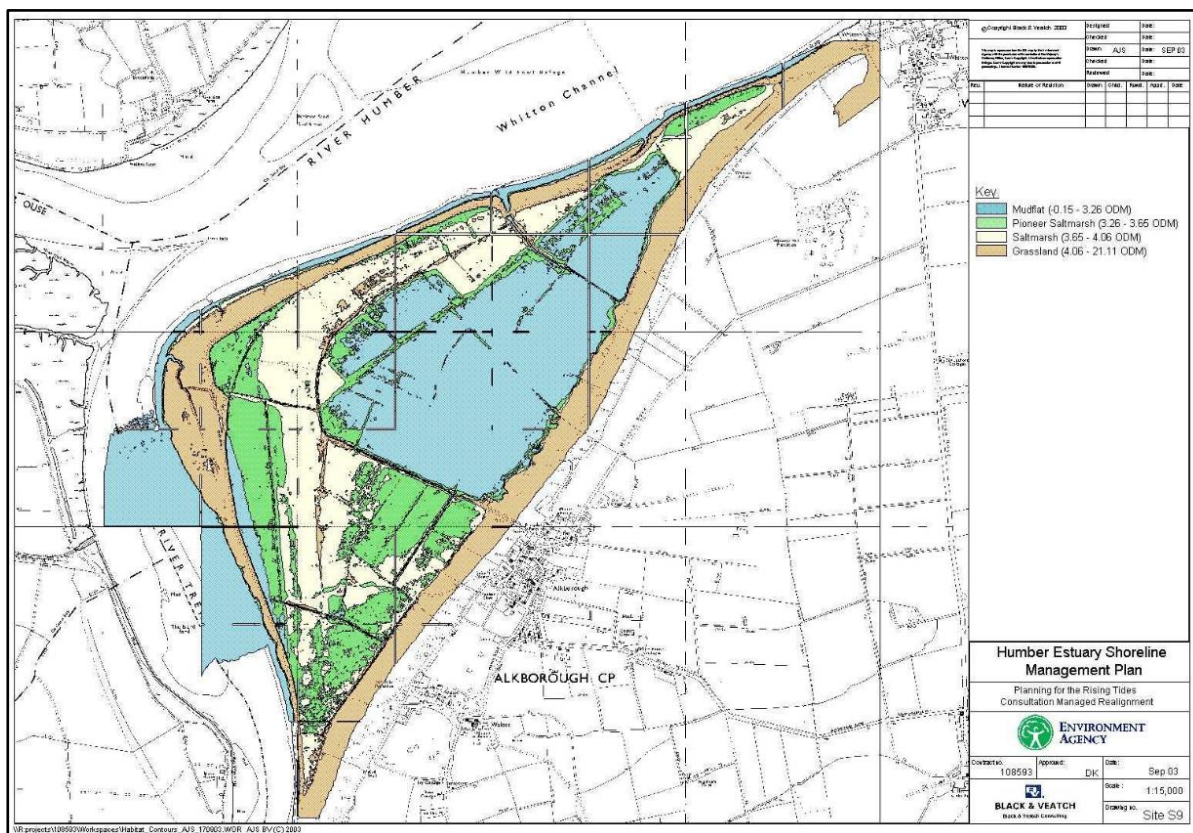
The managed realignment of the Alkborough site created a number of habitats including saltmarsh, mudflat, transitional grassland, reedbeds and lagoons. A mix of 170-180ha of lagoon was originally created that reverted over time to mudflat/saltmarsh. Broadly, the following areas of habitat had developed by 2011:

- 100ha mudflat;
- 50ha reedbed;
- 80ha saltmarsh;
- 40ha transitional grassland; and
- 100ha wet grassland.

Scheme Design

A major factor influencing the design for the project was the need to maintain navigability of the Humber Estuary. The solution was to lower the outer flood defence with the Humber. One strongly armoured breach (20m wide) through which tidal waters can flow was created, with the remaining 1,500m of the fronting flood bank lowered to act as a weir and to allow overtopping in extreme weather events. Half the flood bank was lowered to 1.5m OD and half at 5.45m OD.

Currently 170ha of the site is exposed to regular (twice-daily) tidal inundation, creating intertidal habitats. The remaining 230ha serves as storage capacity for surge events and continued grazing. The layout of the scheme is indicated in the image below.



Observations and Lessons Learnt

Implementation of the scheme was delayed by a range of factors: (1) by very complex modelling to assess the impacts outside of site; (2) by land negotiations; (3) by difficult construction conditions (access, weather), and (4) by unexploded bombs (a large number were found on site, which delayed construction). It is therefore important that such schemes are underpinned by thorough environmental assessments. It is also important to plan ahead and ensure effective communication throughout all stages of a project. Despite these difficulties the site has been successful in providing flood protection and creating various habitats.

The site appears to have served its purpose during the December 2013 tidal surge, when large volumes of water were stored on site.

A ten year monitoring plan is in place for the Alkborough site. The first 5-year phase began in 2007 and results were reviewed in 2011/2012. The first phase sought to assess the general development and function of habitats at the site. The following aspects of the site are being monitored:

- Mudflat development/accretion;
- Invertebrates;
- Saltmarsh communities;
- Aquatic plants;
- Fish and epibenthos;
- Birds; and
- Bathymetry.

By 2008/09 a total of 150 different species of bird have been recorded on the site and 30 red- and amber-listed species have bred on site including Avocet. In the winter of 2007/08, 10,000 Lapwing, 6,500 Golden Plover and 600 Shelduck were recorded feeding and roosting at the site. In addition, 14 species of mammal, 20 types of butterfly and 14 species of dragonfly and damselfly have also been observed.

Accretion has continued across the realignment site, with sediments characterised as coarse silts and fine silts. Initial accretion within the site was rapid but has stabilised. With regards to invertebrates, a total of 21 species were recorded across the site in 2009, with low infaunal diversity, typical of upper estuarine areas. Biomass was also low within the site.

Vegetation recorded at the site includes *Puccinellia maritima*, *Aster tripolium*, *Juncus inflexus*, *Carex otrubae* and *Phragmites australis*. The density of these species has increased, indicating the development of saltmarsh at the site.

Fish species within the site are indicative of the oligohaline nature of the area and are dominated by estuarine, diadromous and freshwater species. The more abundant species include 3-spined stickleback, chub, roach and bream. Perch, a predatory fish, has also been recorded which indicates the use of the site by prey species.

References

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Manson, S. and Pinnington, N. 2012. Alkborough Managed Realignment. Measure analysis 30 in the framework of the Interreg IVB project TIDE. December 2012.

<http://www.northlincs.gov.uk>

Case Study - Medmerry Managed Realignment

Site Name: Medmerry Managed Realignment	Location: Selsey Peninsula, West Sussex
Size: 450ha	Date of Creation: 2011 to 2013

Project Background and Objectives

The Medmerry site was highlighted as one of the main potential sites for intertidal habitat creation that will aid in offsetting coastal squeeze losses brought about by the implementation of Environment Agency and Local Authorities' flood and coastal erosion risk management schemes elsewhere within the area covered by the North Solent Shoreline Management Plan (SMP).

Prior to breaching the shingle foreshore required regular costly maintenance. Between 1976 and 1980 a recharge scheme was implemented, placing 230,000m³ of shingle on the Medmerry frontage. In December 1989, the shingle bank naturally breached and approximately 70% of the beach material was lost. Subsequently, regular and extensive beach management has been required to maintain the existing level of defence.

Overwashing usually occurs several times each year and the shingle bank has breached 14 times since 1994. The most serious recent event occurred on 10 March 2008 when a breach occurred during a major storm. This caused flood damage to over 500 caravans at West Sands Holiday Village and required evacuation of the site. This event resulted in serious risk to life and of injury, as well as significant damage.

Given the high risk of the shingle defence failing and the potential for flooding at Medmerry, there was a pressing need to carry out the scheme to improve flood protection as soon as possible. Construction of the Medmerry scheme therefore commenced in 2011. The site now functions as a Royal Society for the Protection of Birds (RSPB) reserve and is open to the public.

As well as the significant flood risk benefit provided by the scheme, mudflats, saltmarshes, saline lagoons and transitional habitats were also created which are under threat around the UK due to the effects of climate change and sea level rise.

Target Habitats and Species

An aim of the Medmerry managed realignment project was to create habitat for various species of waders, wild ducks and geese and other bird species that rely on coastal wetlands that are being lost in and around the Solent as a result of coastal squeeze. The scheme therefore sought to create the following habitats and target the following species:

- High saltmarsh for breeding waders and Skylark, wintering Brent Geese and Wigeon;
- Tidal lagoons for Avocet;
- Intertidal mudflats for various foraging waders;
- Raised areas to remain exposed at high water for nesting and roosting waders;

- Freshwater reed beds and ponds for species such as Cetti's Warbler, Reed Warbler, Water Rail and Reed Bunting;
- Transitional habitats; and
- Gravel archipelago behind the main embankment for nesting Ringed Plover, Sandwich, Common and Little Tern, Mediterranean Gull.

Habitats Created

The site successfully created a range of habitats over an area of 450ha and now consists of a range of intertidal, wetland and terrestrial habitats. The main habitats successfully created at the site include:

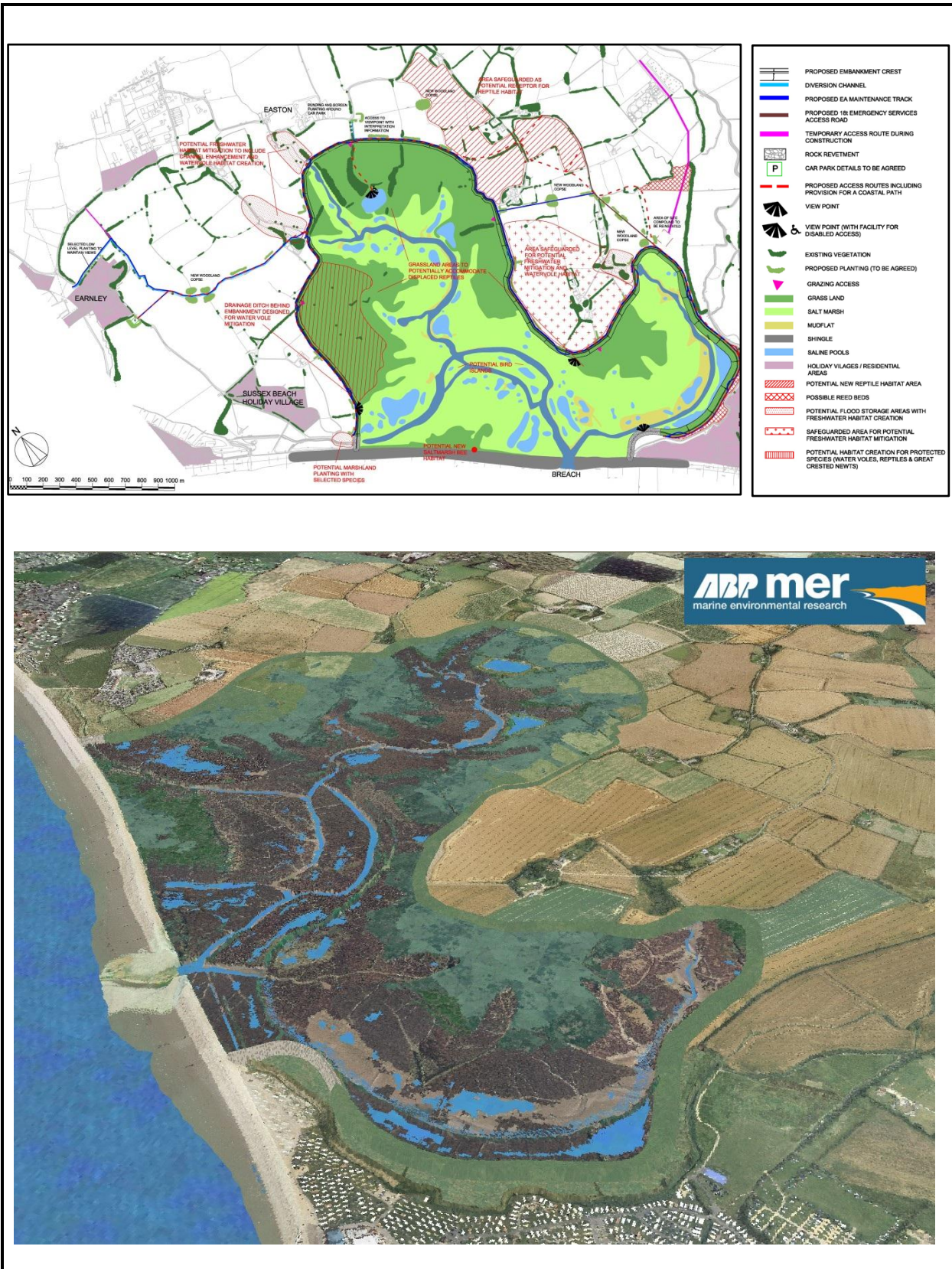
- Mudflats;
- Tidal lagoons;
- Saltmarsh;
- Terrestrial grassland; and
- Transitional grassland.

Of the 450ha of habitat created, 300ha was seaward of the new sea wall. This comprised 183ha are intertidal habitat and 120ha of surrounding grassland, including 41ha of transitional grassland. The site is mainly saltmarsh (130ha), mudflat (45ha), lagoon (8ha) and reedbeds (3ha). A total of 100-150ha of hinterland borrow dyke and mitigation habitat has also been created to the landward side of the embankment.

Scheme Design

The main embankment encloses the site and provides an improved standard of protection against flooding from the current protection. The embankment was constructed using material excavated from within the scheme boundaries, and where possible the locations for the sources were chosen such that they further enhanced the environment (e.g. creating intertidal creeks, ponds or scrapes). Material sourced during construction that was unsuitable for engineering purposes (i.e. embankment construction) was used for general landscaping within the site. Some drainage channels were specially dug to aid tidal flows across the large site while others were left to erode naturally. Construction occurred over a two year period.

A number of design scenarios were considered that provided varying opportunities for habitat creation while using the existing topography of the site. The chosen realignment scheme provides the optimum combination of habitat gain to offset losses within the region and flood risk management. Multiple habitat enhancements were built in to maximise biodiversity. The main features of the site are indicated in the images below.



Observations and Lessons Learnt

Early stakeholder engagement incorporating liaison groups, public exhibitions and individual meetings with interested parties was highly beneficial to achieving consent at this site.

During construction, the archaeology found at the site was extensive and important, and resulted in the one of the largest most challenging investigations in south east England. This resulted in considerable costs and programme delays; however, the resultant scheme design avoided deliberate impacts to archaeological deposits.

One innovative solution to breeding bird issues involved use of a 'push-pull' land management approach during construction. Guided by RSPB land use was managed to discourage birds away from phased areas of construction while encouraging them to other low/no activity areas.

Water vole and great crested newt mitigation work was undertaken (habitat creation and translocation) drawing on lessons from other realignments (e.g. Wallasea) and its effectiveness is being monitored.

The Environment Agency's Environmental Action Plan (EAP) provides requirements for post monitoring to assess the success of the habitat creation and ecological mitigation aspects of the scheme. Features of the site that will continue to be monitored include:

- Breach morphology;
- Creek morphology;
- Bird populations;
- Coastal Processes;
- Fish usage;
- Amphibians/Reptiles;
- Vegetation;
- Terrestrial/Freshwater species; and
- Sediment/soil quality.

The EA are working with Brighton University to monitor protected species while the RSPB are monitoring habitats, bird use and reptiles. ABPmer and the EA have modelled and are monitoring the evolution of the lagoons and channels at the east of the site.

There will be valuable lessons from this project about the nature and rate of natural morphological evolution after breaching and about the most effective methods for protected species mitigation. The site responded very well to the severe 2013/14 winter storms that followed its breaching.

The habitats created are already being used by increasing numbers of birds, including flocks of several hundred Teal and Wigeon and large flocks of Lawping. In summer 2014 Black-winged Stilt chicks successfully fledged at the site, the first to do so in the UK since 1987. Other wildlife is also present at the site, and post project monitoring will give a better understanding of the longer term success of the project in successful habitat creation, although early results suggest the scheme is suitable for both overwintering and breeding birds.

References

ABPmer Online Marine Registry (2014) Database of international shoreline adaptation and habitat creation projects (latest update 23 July 2014) [Online] Available from www.omreg.net [Accessed 30 July 2014]

Environment Agency, 2010. Medmerry Managed Realignment Environmental Statement.

Case Study – Wallasea Island Allfleet's Marsh

Site Name: Wallasea Island Allfleet's Marsh	Location: Crouch Estuary, Essex
Size: 133ha	Date of Creation: 2006

Project Background and Objectives

The Allfleet's Marsh site is located on the north coast of Wallasea Island in Essex, in the estuary of the River Crouch. The site was previously agricultural land.

The project was undertaken by the Department for Environment and Rural Affairs (Defra) as compensation for habitat losses incurred due to developments at Lappel Bank (in the Medway Estuary, Kent) and Fagbury Flats (in the Orwell Estuary, Suffolk) during the late 1980s and early 1990s. In 1993 the Medway Estuary was classified as a Special Protection Area (SPA) under the European Commission Birds Directive by the UK Government. The Government excluded 22ha of mudflat at Lappel Bank on the grounds that its reclamation was deemed to be essential for the continued viability of the port of Sheerness. This exclusion was challenged by the Royal Society for the Protection of Birds (RSPB) on the grounds that the ability to exclude habitat from an SPA on economic grounds was unlawful. In 1997, the House of Lords, after referring the matter to the European Court of Justice, ruled against the Government. As a result the UK Government was committed to providing compensation measures to offset the environmental impacts from the exclusion of Lappel Bank from the SPA and at Fagbury Flats, where a similar situation occurred. These developments resulted in the cumulative loss of 54ha of intertidal habitat including 22ha of mudflat at Lappel Bank and 32ha of both mudflat and saltmarsh at Fagbury Flats.

The Allfleet's Marsh project therefore aimed to create new compensatory mudflat and saltmarsh habitat to ensure overall coherence of the Natura 2000 network. In addition to the habitat gains the scheme was also designed to improve the levels of coastal protection afforded to Wallasea Island.

The approximate cost of the scheme was £9.3 million; that is £7.5 million for the project itself plus a further £1.8million that has been spent by the landowner on one of the sea walls prior to the project beginning. That represents around £80,000 per hectare with a lot of the cost coming from the need to recharge the back of the site to raise the landform for the purposes of saltmarsh creation.

Target Habitats and Species

The Allfleet's Marsh site was primarily created as compensation for habitat lost due to the developments described above. The scheme was designed to comprise 115ha of intertidal habitat, of which 92ha was designed to be mudflat and 23ha to be saltmarsh to provide feeding and roosting habitat for waterbirds.

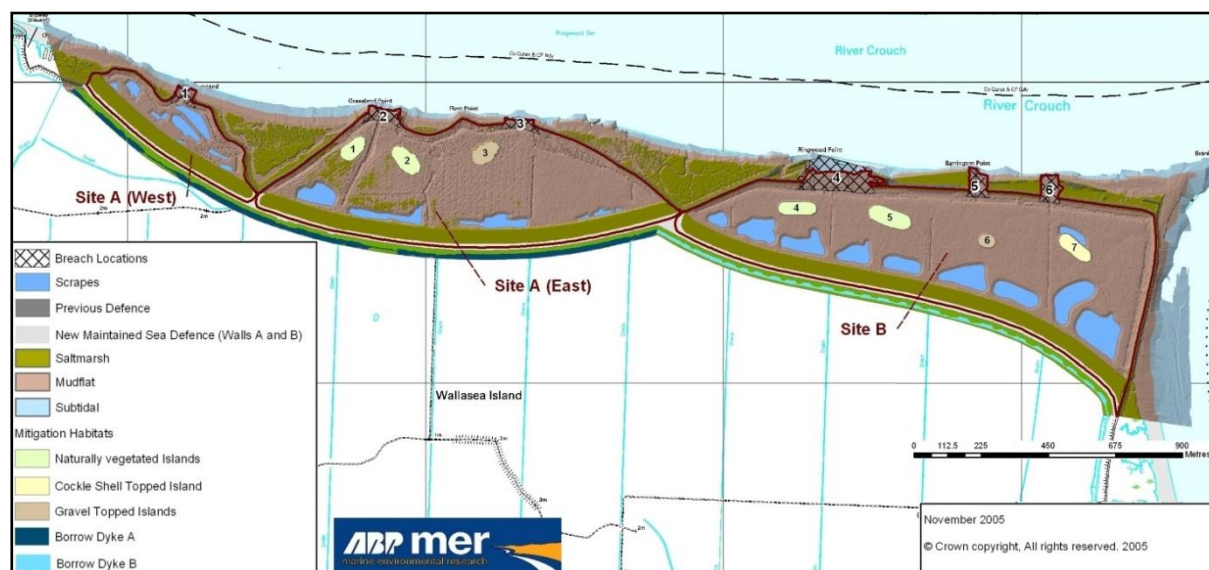
Habitats Created

The site was breached in early summer 2006. The majority of the habitat created by the scheme was intertidal, with 33ha of saltmarsh and 85ha of mudflat created by the end of 2010. A further 5ha of saline lagoon and 10ha of terrestrial grassland has been created to the landward side of the seawall.

The ratio of habitat replacement to loss was therefore approximately 2:1 within the Greater Thames Natural Area. This compensation habitat was created many years after the losses associated with East Coast port developments.

Scheme Design

The scheme involved breaching of the sea wall and the raising of the land to the rear of the site. Six breaches between 60 and 210m wide (total 590m) were created that were wide and deep enough to ensure stability. Particular attention was paid to creating a 'regime' shape to the breaches which was in keeping with their hypsometry (i.e. the tidal flow character through them as dictated by the hinterland shape of the site). A large-scale sediment recharge was undertaken (550,000m³) at the back of the site to raise the landform and create saltmarsh. Existing field drains and borrow dykes were left in place and the project made beneficial use of dredged material to create a diversity of features such as islands. The scheme layout is indicated in the image below.



Observations and Lessons Learnt

This project has benefited from detailed investigative work and consultations that were undertaken as part of the site selection, scheme design and impact assessment work as well as for the preparation of the monitoring programmes. The landowners also recognised the need for the project and the limitations associated with continuing farming and therefore were supportive of the realignment.

There was a full time project manager with supporting teams which has enabled problems to be foreseen and rapidly addressed. The team approach has also allowed innovative new design elements to be identified which should provide high value at low cost (e.g. the island features in the site and a new 'heterogenic' borrow-dyke design).

An initial five-year monitoring programme was undertaken to describe ecological development of site and determine whether it meets its compensation targets. This 'site success' monitoring included

monitoring of the following:

- Accretion/erosion patterns on and off site;
- Estuary subtidal bathymetry;
- Estuary and breach flow speeds;
- Marine and freshwater invertebrates;
- Saltmarsh vegetation growth; and
- Overwintering and breeding bird surveys.

Monitoring work was overseen by a Project Management Group including Defra, Natural England, RSPB and the Environment Agency. A project steering group made up of a technical advisory panel meet and review the monitoring data to facilitate adaptive management.

Results of the bird monitoring show that over the course of the monitoring programme the site has supported very good numbers of waterbirds. During the first winter survey (2006/07) the site supported around 7,000 waterbirds and included good numbers (i.e. relatively high in a national or international context) of many key species such as Shelduck, Dunlin, Black-tailed Godwit, Ringed Plover and Golden Plover. In the following two winters the value of the site continued to improve as the abundance of waterbirds increased to around 10,000 and then 12,000.

The numbers of birds using the site as a roost reduced in 2009/10 while the number of birds feeding increased.

Saltmarsh coverage of elevated areas of the sites has occurred relatively rapidly, with saltmarsh plant coverage increasing year on year to 100% coverage of the areas at higher elevations.

References

ABPmer Online Marine Registry (2014) Database of international shoreline adaptation and habitat creation projects (latest update 23 July 2014) [Online] Available from www.omreg.net [Accessed 30 July 2014]

Case Study – Wallasea Island Wild Coast Project

Site Name: Wallasea Island Wild Coast Project	Location: Crouch and Roach Estuaries, Essex
Size: 677ha (under construction)	Date of Creation: Under development

Project Background and Objectives

The Royal Society for the Protection of Birds (RSPB) is undertaking a national 'flagship' coastal habitat creation project on Wallasea Island which lies at the junction of the Crouch and Roach Estuaries (Essex). It is envisaged that the the Wallasea Island Wild Coast project will return the bulk of the Island to a diverse range of dynamic, nationally threatened, intertidal habitats that will be rich in birds, fish and invertebrates. The creation of new intertidal mudflat, saltmarsh and transitional habitats is designed to contribute towards UK Biodiversity Action Plan targets and also help mitigate for the losses of these habitats elsewhere in Essex where they are under increasing threat due to the effects of climate change and sea level rise. Planning permission was granted for the project in July 2009 and delivery of inert materials for landscaping of the site began in 2012.

Target Habitats and Species

The project aims to create habitat for a range of bird species under the requirements of the EC Birds Directive by creating sufficient diversity and area of habitats for wild birds. Such species will include waders, waterfowl and terrestrial and coastal species and it is anticipated that a number of species of bird will be attracted to the site that require a variety of habitat types. The project aims to create the following habitat types:

- Mudflat;
- Pioneer to Upper Saltmarsh;
- Transitional Saltmarsh;
- Habitat Adaptation Zone;
- High Level Lagoons;
- Regulated Tidal Exchange (RTE) Lagoon;
- Lagoon Islands;
- Coastal Grazing Marsh;
- Brackish Marsh; and
- Saline Marsh/Lagoon.

Habitats Created

The habitats listed above will be created on the Wild Coast project site. As yet, no sections of the site are fully complete. When complete, it is anticipated that some 133ha of mudflat, 276ha of saltmarsh, 53ha of saline lagoon, 11ha of brackish marsh, 160ha of grassland and 15ha of rotational arable fields as 'wild bird cover' will be created.

Scheme Design

To achieve the coastal habitat creation the site will be divided into five different cells through the use of internal bunds. To allow for the development of a mosaic of saline and brackish habitats, three cells will be subjected to full realignment and one cell will be a RTE area. The fifth cell will mainly contain mitigation habitat to offset impacts to existing protected species and habitats on Wallasea Island.

The project will involve the importation of inert fill materials, notably the beneficial use of recovered material from the London Crossrail project. A total of 7.5Mm³ of material is expected to be required. Shallow sloping profiles will be created in Cells 1, 2 and 4; there will be a gradual transition from the channels which will guide the water into the Cells, to the internal bunds and seawalls. Internal bunds will be constructed mainly with material sourced from the re-profiling of the site, as well as channel and lagoon excavation works. Six 100m wide breaches will be excavated through the existing seawall, and channels dug to their landward and seaward sides to facilitate water exchange. On site, a network of sinuous creeks will be cut into saltmarsh areas, and selected creeks will conduct water into 'high level' lagoons excavated from elevations associated with upper/transitional saltmarsh. Cell 3, the RTE cell, will not receive recovered material, but will be subject to reprofiling to excavate a large shallow lagoon, and create slopes up to the internal bunds.



Observations and Lessons Learnt

As the project is currently under development no habitats have as yet been created. A range of monitoring of the site is proposed including impact verification, sediment settling, ecological functioning and habitat success monitoring. This monitoring will be used to understand the functioning of the site, the success of habitat creation and the changes that occur within the Crouch and Roach as a result. Monitoring of bird populations will indicate the success of the site in creating functional bird habitats.

The results of the monitoring outlined above will provide final lessons and an understanding of the success of the Wallasea Island Wild Coast Project in creating a diverse mosaic of habitats to promote biodiversity within the site upon completion of the project and the monitoring period.

References

ABPmer, 2008. Wallasea Island Wild Project – creating a new coastal nature reserve Environmental Statement. R.1474. November 2008.

Case Study – Steart Coastal Management Project

Site Name: Steart Coastal Management Project	Location: Steart Peninsula, Severn and Parrett Estuaries.
Size: 469ha (under construction)	Date of Creation: Under development

Project Background and Objectives

The Steart Coastal Management Project is being undertaken the Environment Agency to create new intertidal habitat on the Steart Peninsula (in the Parrett Estuary, Somerset). The Environment Agency has obligations to create new intertidal habitat to compensate for losses that are expected on the Severn Estuary due to coastal squeeze. Over the next century it is estimated that between 1500 to 3500ha of intertidal habitat will be lost. Much of this intertidal habitat is internationally designated for its importance as wildlife habitat.

For the Environment Agency this provides compensatory habitat for their new coastal defence schemes and allows them to maintain 208km of existing defence that protects 116,500 residential and commercial properties.

Target Habitats and Species

It is anticipated that the project will create a range of wetland habitat types. It is expected that the following habitat types will be created:

- 183ha saltmarsh;
- 40ha intertidal mudflat;
- 69ha transitional marsh;
- 93ha coastal grazing marsh;
- 26ha freshwater lagoon;
- 19ha saline lagoon;
- 13ha brackish lagoon;
- 20 freshwater ponds;
- 3.3km freshwater ditches;
- 1.9km saline ditches; and
- 4.4km brackish ditches.

The project will therefore create a mosaic of different but complementary habitats that will maximise the biodiversity of the site. It is expected that the creation of new habitat will benefit wildlife including plant diversity, breeding and wintering wading birds, wintering wildfowl, amphibians and fish. Notable Ecosystem Services provided by the site include new intertidal feeding habitat for fish at high tide, and carbon storage with new vegetation communities.

Habitats Created

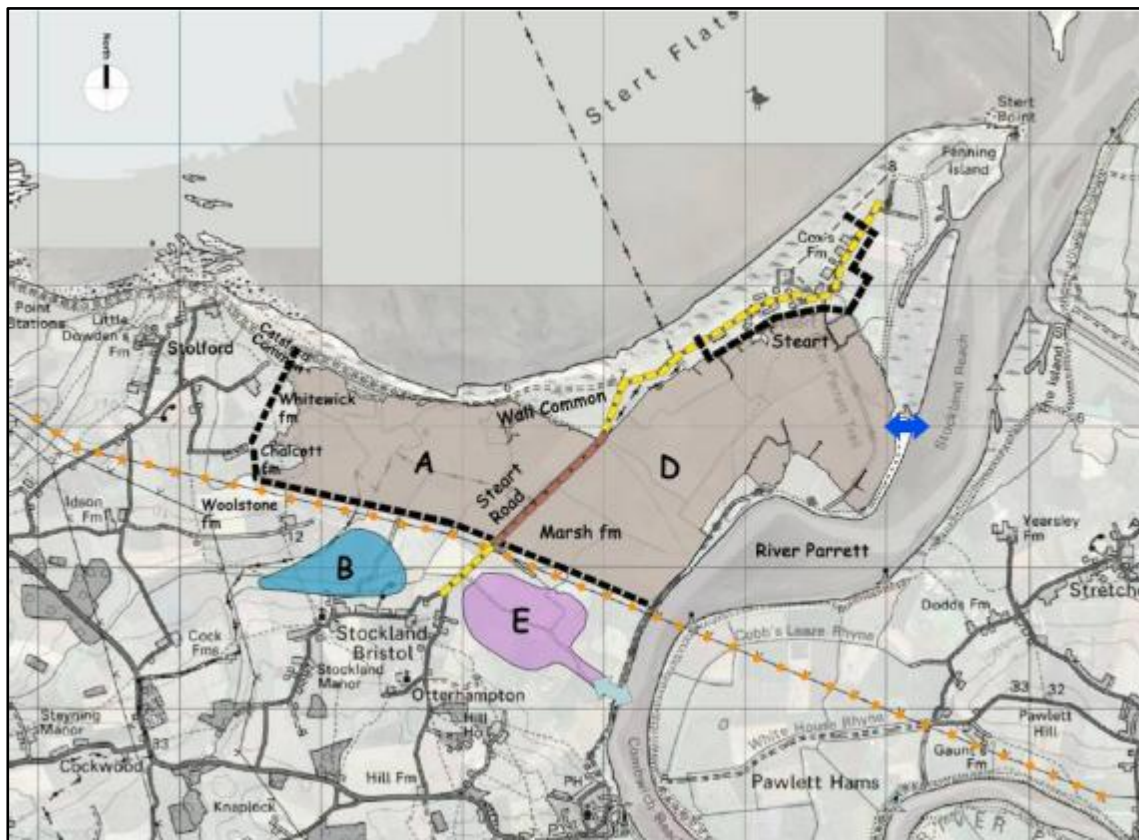
Construction works are currently ongoing and the main part of the site will be breached in September 2014.

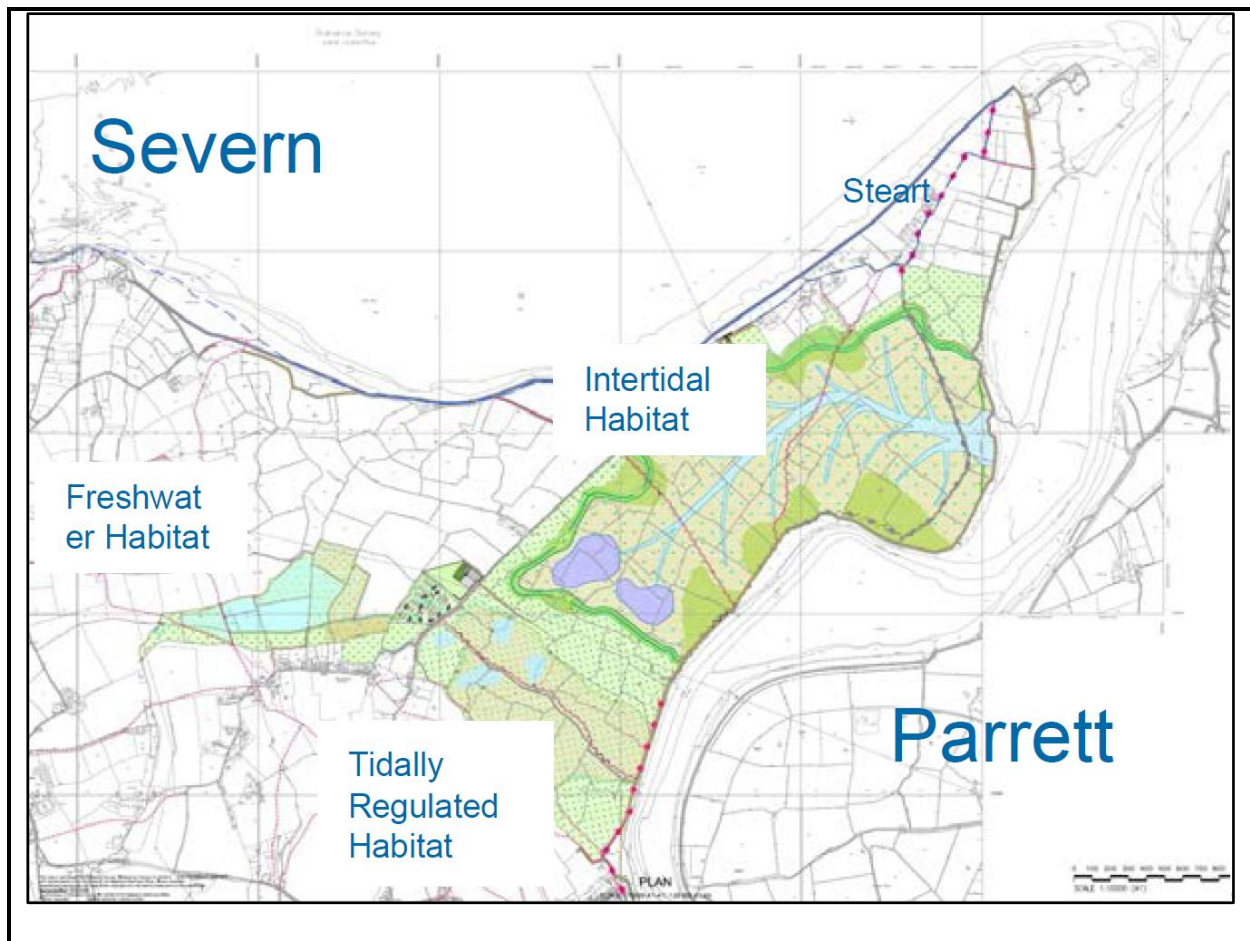
Scheme Design

The scheme design uses a zoned approach, with the site divided into three compartments B, D and E (compartment A is a separate/ future realignment project proposed as compensation for habitat lost as part of The Port of Bristol Deep Sea Container Terminal; compartment C is separated from the other areas by an area of raised land and there are no immediate proposals for this area). The works will aim to create different habitat in each of the four compartments as follows:

- Compartment B: Freshwater habitat by impounding stream flows including freshwater, reedbed, marsh/wet grassland, scrub/hedgerow, ponds and ditches
- Compartment D: Intertidal habitat by managed realignment with the Parrett, with set-back banks constructed from excavated material from the creek network, grazing areas, borrow pits and lagoons for wading birds
- Compartment E: Transitional brackish habitat by tidal exchange with the Parrett and impounding stream flows, including grazing marsh, saline and freshwater lagoons and ditches.

The locations of the compartments and the layout of the site are indicated in the images below.





Observations and Lessons Learnt

The Environmental Statement for the Steart Coastal Management Project identified a need for medium to long term environmental monitoring of the site in order to demonstrate the effectiveness of the habitat creation scheme. Specifically, monitoring recommendations have been outlined with regards to the topography of the site, hydrology and water quality, people, archaeology and flora and fauna.

Monitoring proposals of flora include percentage species cover, species composition and NVC types within Compartments B, D and E. With regards to fauna, rare and protected species, particularly translocated species will be monitored to assess their distribution at receptor sites. Annual monitoring of benthic invertebrates will be undertaken along with monitoring of breeding and overwintering birds using WeBS methodologies. Fish using Compartments D and E will also be monitored.

References

Environment Agency, 2011. Steart Coastal Management Project Environmental Statement.

Case Study – Anklamer Stadtbruch Managed Realignment

Site Name: Anklamer Stadtbruch Managed Realignment	Location: Oderhaff/Szczecin Lagoon, Germany
Size: 1750ha	Date of Creation: 2004

Project Background and Objectives

The Anklamer Stadtbruch managed realignment project was carried out to reduce flood protection costs in the coastal areas of the Szczecin Lagoon on the Oder Estuary. This followed extensive overtopping of the site, notably after a severe storm in 1995. The project also aimed to create new coastal flooding marsh habitat.

Target Habitats and Species

The creation of habitat for bird species was not the primary aim of the Anklamer Stadtbruch project, rather the project aimed to reduce the cost of flood protection by creating areas of managed coastal flooding.

Habitats Created

The site largely consists of areas of lagoon habitat and transitional grassland that have been created as a result of the breach and that existed at the site prior to the breach. Habitat across the site is dominated by 1000ha of large, low salinity (< 10%) lagoon and 750ha of other habitats including swamp forest and coastal and transitional grasslands. A number of coastal, wetland and terrestrial bird species are present in the Szczecin Lagoon and also now use the managed realignment site.

Scheme Design

Natural overtopping and wearing away of the existing dyke, which was only 40cm high in places, aided the development of the site. In order to aid drainage after the 1995 storm surge a sluice gate was opened permanently in the main drainage creek. Due to objections, this was later closed again, however it essentially remained open, as it malfunctioned. In 2004, after planning approval, the remaining dike was breached to 50m wide in one location, permanently flooding the site. The layout of the scheme is indicated in the image below.



Observations and Lessons Learnt

No formal monitoring of the site has been undertaken since the breach in 2004 due to a lack of funding, although it is subject to occasional student projects.

With no formal monitoring and no specific requirements for habitat creation other than coastal flooding habitat, the success of the project cannot easily be judged. However, a member of the Peene Valley Countryside Conservation Project (pers. comm. 2005) rated the project as a success as large areas of coastal flooding had been created and the site has managed the flood risk for the area.

References

ABPmer Online Marine Registry (2014) Database of international shoreline adaptation and habitat creation projects (latest update 23 July 2014) [Online] Available from www.omreg.net [Accessed 30 July 2014]

Case Study – Beltringharder Koog Regulated Tidal Exchange

Site Name: Beltringharder Koog	Location: North Friesland, Germany
Size: 853ha	Date of Creation: 1988

Project Background and Objectives

The Beltringharder-Koog site is a regulated tidal exchange (RTE) that was created in 1988 as in situ compensation for advancing the Nordstrand Bay sea defences into the Wadden Sea tidal flats in 1987. This advancement was carried out in order to shorten the overall length of the defence line along Germany's North Sea coast.

The advancement of the sea defences reclaimed an area of 3,350ha of mudflats, saltmarsh and sandflats which required compensation. The 853ha RTE scheme forms part of the compensation package for the loss of these habitats, undertaken in the newly reclaimed area.

The scheme was financed by the federal state of Schleswig-Holstein and the German federal government, although the proportions and exact costs are unknown.

Target Habitats and Species

The 853ha scheme forms part of the compensation for the losses of the habitats listed above. No specific bird species were targeted by the scheme, although the project aimed to create new intertidal feeding habitat for wader and waterfowl species in general.

Habitats Created

A number of habitats were created in the area of reclaimed land that was created by the advancement of the sea defences. Of the 853ha of RTE, the main habitat created is saline lagoon, which comprises 378ha of the site. Approximately 380ha of intertidal habitat was also created, including 166ha of intertidal mudflats and 214ha of saltmarsh. Around 95ha of transitional habitat also exists to the rear of the site. The remainder of the 3,350ha that was reclaimed was converted to a number of freshwater and terrestrial habitats for nature conservation purposes. These include reedbeds, marshes and transitional grassland.

Scheme Design

The RTE involved the installation two 6m sluices approximately 3km apart within the new sea dike. The average water exchange volume is 1,500,000m³ with maximum flow velocities through sluice of 5.5m/s. Seawall construction used material from the site dug up to a depth of 20m. A 2-3m deep 'ring' creek

connects the two sluice gates and the excavated material was used to create a sandy peninsula.

After testing several sluice combinations for some years, the Holmer sluice was redesigned in 1994 so it could act as a year-round in and outlet sluice (like the other sluice). Both sluices are now kept open at all times (they essentially act as culverts), except during storm surges. The layout of the RTE is indicated in the images below.



Observations and Lessons Learnt

Monitoring of the site was carried out for ten years post construction and mainly focused on fauna (birds, invertebrates, plankton, fish), although monitoring of water and sediment quality was also carried out.

Invertebrate community composition was found to be similar to the fronting intertidal after approximately six years. The relatively long duration of this establishment period compared to other sites was firstly attributed to the size of the area, but more importantly to the sub-optimal, varying conditions over the first years of the site's existence (i.e. testing of various tidal regimes and malfunctions of the sluice

gates).

Shorebirds generally declined at the site, whereas most species elsewhere in the German part of the Wadden Sea increased or were stable over the same period. It was concluded that the loss of feeding areas due to the land claim could not be compensated in the immediate surroundings of the study site, along with a reduction in tidal range, reduced invertebrate densities and enclosure of the site by tall embankments. The islands in the lagoon however have apparently become established breeding colonies for several rare birds including Avocet, Oystercatcher, Skylark and Plover. Herbivorous species such as Wigeon and Barnacle Goose have increased in the RTE area and Redshank use the area to feed at high tide.

The system is sensitive to prolonged periods of low water levels. The following recommendations were made for a successful on-site water/tide level management:

- Enable maximum, simultaneous, water exchange through both gates;
- Enable natural tidal rhythm throughout the whole year;
- Enable uncontrolled water exchange to lengthen the life of the sluice technology; and
- Simulate a storm surge once or twice a month during the winter months - by damming water over a maximum of three tidal cycles

These recommendations aim to ensure that the area does not suffer from oxygen starvation or extensive algae coverage, and supports a range of habitats and fauna.

From an ecological point of view the scheme has been a success in creating a variety of habitats within the site, despite not creating like for like habitat to those lost and the difficulties with regards to low water levels outlined above. The ecological character of the site is indicated by its designations. The whole polder was declared a nature reserve in 1992; and is now highly designated, forming part of the following Wadden Sea sites: Ramsar, Special Protection Area, and Special Area of Conservation.

References

ABPmer Online Marine Registry (2014) Database of international shoreline adaptation and habitat creation projects (latest update 23 July 2014) [Online] Available from www.omreg.net [Accessed 30 July 2014]

Restoring Europe's Rivers website. Case Study: Beltringharder Koog Regulated Tidal Exchange Scheme. http://riverwiki.restorerivers.eu/wiki/index.php?title=Main_Page

Case Study – South Bay Salt Pond Restoration

Site Name: South Bay Salt Pond Restoration	Location: San Francisco Bay, California
Size: 6,000ha	Date of Creation: 2008 - ongoing

Project Background and Objectives

The initial goal of the project is to restore half of the South Bay Salt Pond Restoration (3,000ha) to tidal marsh with the other 50% in managed ponds. Restoration of the South Bay salt ponds aims to provide an opportunity to begin to reverse trends in declining tidal marsh habitats across San Francisco Bay which has caused declines in populations for marsh-dependent fish and wildlife. A secondary aim of the project was to reduce flood risk, with tidal marsh restoration increasing flood flow capacity.

The specific goals listed by the project were:

- Restore and enhance a mix of wetland habitats;
- Provide wildlife-oriented public access and recreation; and
- Provide for flood management in the South Bay.

Funds for the acquisition were provided by federal and state resource agencies and several private foundations. The South Bay Salt Ponds were acquired in 2003 from Cargill Inc. Shortly after the property was acquired, the California Department of Fish and Game, the US Fish and Wildlife Service and the California Coastal Conservancy launched a four-year public process to design the restoration plan. The final plan was adopted in 2008 and the first phase of restoration started later that year.

Target Habitats and Species

Over 6,000ha of diked ponds were aimed to be restored gradually to both tidal and non-tidal marsh, replenishing the Bay ecosystem. The project aimed to create areas of various wetland habitats including:

- Tidal mudflat;
- Tidal marshes;
- Managed ponds;
- Salt ponds;
- Freshwater marshes and riparian corridors; and
- Lagoons.

No specific species were targeted during the design of the project although it hoped to reverse the decline in recent years of many species of bird, fish and other wildlife that are marsh-dependent. These include many species of special status in California. Notable bird species include the Snowy Egret, Great Egret, Black-crowned Night Heron, Great Blue Heron and the California Clapper Rail.

Habitats Created

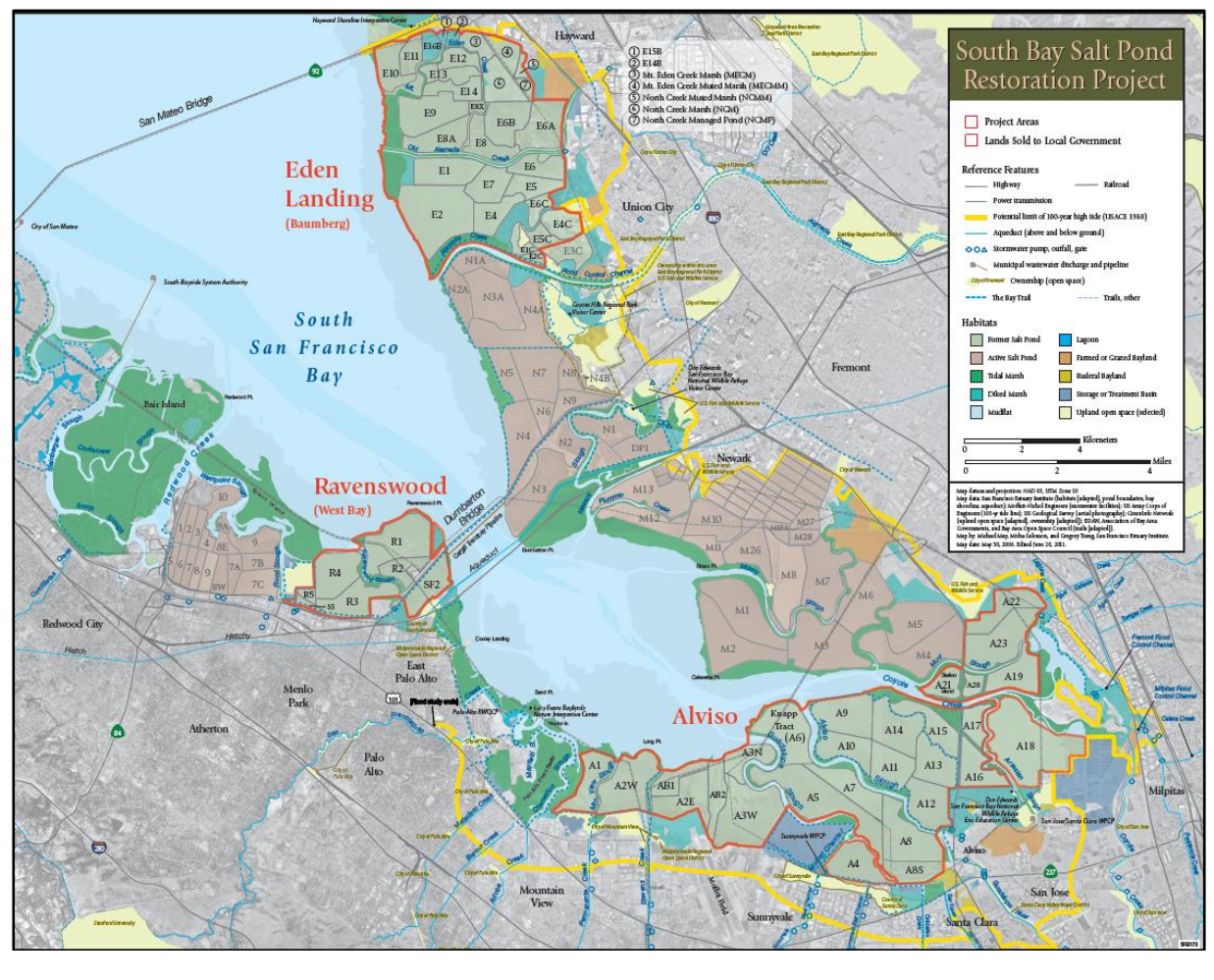
Information from the South Bay Salt Pond Restoration Project Annual Report 2013 estimated that to date 1,200ha of the formal industrial salt ponds had been opened to the Bay to create wetlands.

The habitats listed above have been created at the site to varying extents. Information is relatively limited however, the project has so far created:

- 255ha of tidal habitat;
- 96ha of pond habitat;
- 134ha of tidal saltmarsh and tidal channel habitat;
- 97ha of shallow ponds with 50 nesting islands for shorebirds;
- Connected 567ha of ponds to the bay, creating new marsh and shallow water habitat;
- 63ha pond with 30 nesting bird islands; and
- 34ha of habitat for Snowy Plovers.

Scheme Design

There is limited detailed information on the scheme design and implementation available in the public domain. An overview of the scheme is presented in the image below.



Observations and Lessons Learnt

The South Bay Science Program aims to monitor the site in order to provide a scientific basis for adaptive management.

Annual monitoring reports are published with regards to the ecology of the site, water quality, sediment monitoring and fish usage of the site. Monitoring of the island ponds is also carried out along with monitoring of specific bird species usage of different areas of the site. These monitoring reports are available on the South Bay Restoration website.

It is recognised that there is a need to balance ecological and flood risk components of a scheme such as the South Bay Salt Pond Restoration Project. It is possible to achieve both the creation of ecologically important habitats and areas of flood risk management. However, detailed design planning is required, along with often detailed modelling of the effects of the scheme. Complex landscaping is also required during site construction.

References

South Bay Salt Pond Restoration Project, 2013. 2013 Annual Report.

San Francisco South Bay Salt Pond Restoration website. <http://www.southbayrestoration.org/>