Written Summary of the oral case put at the Issue Specific Hearing on the compensation site held on 11th September 2012 and Habitat Regulations matters relating to the main development site held on 12 September 2012 by the Royal Society for the Protection of Birds

24 September 2012

Planning Act 2008

In the matter of:

Planning Application for construction of the Able Marine Energy Park on the South Bank of the River Humber at Immingham, North Lincolnshire

Planning Inspectorate Ref:	**TR030001**
Registration Identification Ref:	**10015550**

Issue Specific Hearing: Compensation

1. The RSPB case has, from the outset, concentrated on whether the *compensation* proposed can replace the ecological function lost particularly in respect of Black-tailed Godwit ("BTG")[1].

2. By the end of the Issue Specific Hearing into the Compensation: (1) the original managed realignment proposal at Cherry Cobb Sands ("CCS") had been withdrawn; (2) the original wet grassland proposal at Old Little Humber Farm ("OLHF") had been withdrawn; (3) there were no details other than a site location plan of replacement wet grassland and thus no ability to assess whether it will deliver the required habitat or at what stage or of what quality; (4) the new indicative regulated tidal exchange ("RTE") proposal had been shown to be fundamentally flawed in a number of basic respects; and (5) there can rationally be no confidence that compensatory mudflat of sufficient quantum and quality can be provided at CCS within the fixed parameters of the site area and the location of the breach.

3. The compensation package will have to be re-formulated, assessed, subject to environmental impact assessment ("EIA"[2]) and appropriate assessment[3] and tested through the statutory processes.

4. There is no mechanism in the statutory scheme for: (1) extensions and changes to the red line; or (2) substantial changes to the Development Consent Order ("DCO") applications to be made before the Examining Authority (or at any time post – acceptance of the application by the Secretary of State). Even if it was held that there is some implicit power in the legislation to make substantial changes to the DCO application, it is now far too late to do so in a way which will allow the Examining Authority to test the new proposals (with the help of the RSPB) to ensure that they can technically and scientifically deliver the requirements for the compensation package that are a central and fundamental plank of a lawful DCO here.

5. The Applicant took a risk with the development of its compensation proposals – despite the concerns of the RSPB at the outset it proceeded on the assumption that more detailed modelling or minor iterations in design would make the compensation package work. That has proved not to be the case.

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1 Comments on the evolving *mitigation* proposals will be made in the document required on 12th October 2012.
2 Infrastructure Planning (Environmental Impact Assessment) Regulations 2009.
3 As required by Regulation 61, the Conservation of Habitats and Species Regulations 2010 (as amended).

6. The RSPB is now in the position where it has demonstrated that there can be no confidence on the information we have that the ecological function lost can be replaced within the areas proposed; nobody appears to seriously contend to the contrary; the Applicant accepts that it needs to draw on the expertise of the RSPB and Mr Dixon; and the compensation package must therefore go back to the drawing board before a lawful DCO could be granted.

The Importance of North Killingholme Marshes and North Killingholme Haven Pits

7. BTG feed in exceptionally high densities and in very high numbers on the areas of mudflat impacted by the Applicant's Proposals ("NKM"). There is an exceptionally close functional link with the (almost adjacent) NKHP which provides an ideal roost location. The importance of the "package" of NKM and NKHP is not disputed by the Applicant[4]. It is without doubt far and away the most important location for BTG in the key autumn moult period in the SPA.

The Integrity Test, IROPI and the Precautionary Approach

8. Loss of NKM and the "package" will plainly have a very substantial impact on the integrity of the SPA (in respect of BTG). The development destroys the key habitat[5] for a vast majority of BTG - itself a key species of the SPA.

9. That is why Imperative Reasons of Overriding Public Importance ("IROPI") has to be most rigorously tested in this case (RSPB Written Representations para 2.3). IROPI is always a high hurdle, but to "override" the exceptional harm here requires the most compelling justification – the greater the harm the greater the public interest needed to justify it.

10. Further given the importance of NKM and the significance of the harm, the precautionary approach has to be applied with very great care at each stage of the Habitats Regulations[6] analysis. In short, it is not permissible to risk significantly impacting on the BTG population here. Thus, where there is such risk one must err on the side of caution. This will include robustly testing the compensation to be as sure as one can be that it will work; and over-providing

[4] Mr Hatton's answers to questions from the RSPB on 11th September 2012.

[5] When the moult is complete and when the food resource is exhausted they use Pyewipe – but the fundamental point is that NKM is their preferred location in the moult period when the combination of excellent food resource and secure roosting site close by is of central importance (for the reasons given by Dr Prater in answer to questions from the Panel – 12th September 2012).

[6] Conservation of Habitats and Species Regulations 2010 (as amended).

compensation rather than risking under-provision to cater for uncertainities or timing issues (the compensation not being of sufficient quality at the time the harm is done to NKM).

The Ecological Function Lost

11. It is accepted by the Applicant that the correct approach is to consider the ecological function lost (as also endorsed by NE in its Answers to the Examining Authority's 2nd Written Questions, Annex I, pages 1-3).

12. The RSPB's analysis of the ecological function lost as summarised at paras 2.11, 2.12 and 2.14 of RSPB Written Representations 29th June 2012 is now common ground[7].

13. It is therefore necessary for any compensation package to secure the requirements in para 2.16 of RSPB Written Representations (again common ground).

14. That requires a package of measures – excellent feeding grounds and secure roosting (para 2.14) - "the Package". It is combination of those factors which makes NKM so important in the autumn moult period.

The Application's Compensation Proposals

15. The Application before the Examining Authority is that accepted by the IPC (now the Secretary of State) under s.55 the Planning Act 2008 (as amended) ("Planning Act") included as an essential part of the overall proposals:

    a. The managed realignment proposals shown in Application plans 216 (AME- 00216 rev A) and 217 (AME- 00217 rev A) ("the MR Proposals"); and
    b. The Old Little Humber Farm wet grassland proposals ("the OLHF Proposals").

16. The MR Proposals were correctly abandoned[8] on 3rd August 2012 with the Applicant accepting the criticism of that made by the RSPB[9]. In short they would not work here. On a rapidly accreting shore they would silt up rapidly and would not deliver the requisite quantum or quality

[7] Mr Hatton's answers to questions from RSPB on 11th September 2012.
[8] 3rd August 2012 - Able Comments on Written Representations WR9.1 para 1.1.3 and confirmed orally on 12th September 2012.
[9] RSPB Written Representations for the RSPB 29th June 2012: paras 2.20 – 2.35 and Annex C2 - Mark Dixon's evidence.

of habitat for BTG. The Examining Authority must necessarily conclude that a MR Proposals within the red line boundaries at CCS and within the applications other fixed parameters (location of breach etc.) is not possible.

17. The OLHF Proposals were too far from CCS and there were insuperable technical difficulties with that site. Those proposals were correctly abandoned on 12th September 2012.

18. The Compensation Package which was an essential and legally necessary part of the Application has been abandoned.

19. Any replacement MR Proposals would have to be developed elsewhere - on an eroding not an accreting shore, at a sufficient height/level (below 1.9m AOD) to ensure that the mud is continuously very wet; and of sufficient size to compensate for the number of birds at NKM.

20. Any alternative wet grassland scheme will have to ensure that the land is maintained wet to the necessary degree such as to deliver the ecological functioning package required, namely the need for supplementary and initial feeding function plus the lagoons and islands for the roosting function next to the created mudflats.

Legal Ability to amend the Application

21. The RSPB's legal submission is as follows:

    a. First, there is no power in the DCO process to significantly amend the proposals or to extend the site (the red line);
    b. Second, even if the RSPB is wrong on that, any such power cannot here be exercised consistent with the EIA Regulations and the Habitats Regulations requirements within the statutory timetable; and
    c. Third, even if that is wrong, it would plainly be conspicuously unfair to allow fundamental changes in the key part of the proposals on such an important issue (see above) to be substituted so late in the process.

22. No power to amend: the statutory scheme (including the time line for the examination) is premised on the requirement for applications to be fully worked up before they are made:

a. Before an application is made the pre-application processes have to be gone through. This involves consulting/publicising the "proposed application" (s.42(1) the Planning Act); s.47(1) and s.48(1) to see what changes need to be made to it before it is submitted. This pre-application stage is fundamental – through it the fully thought through proposals are meant to evolve;

b. In deciding whether the application to be made should be in the same terms as the "proposed application", the applicant has to have regard to the consultation responses (s.49(2));

c. So a "proposed application" is consulted on; and in the light of that consultation it is to be worked up into "the application" in order to overcome any problems identified through the pre-application stages. Thereafter throughout the legislation, the reference is to "the application";

d. The application is then submitted to the Secretary of State for acceptance under s.55.There are a number of statutory requirements before the Secretary of State can so accept: see s.55 itself and the IPC Application Regulations[10] reg 5(2)(i) – the land required for the development; reg 5(2)(o) - plans and drawings of the proposals including details of design, external appearance and preferred layout of structures etc...; reg 5(2)(g) and 5(2)(l) – impacts on habitats. It is plain that the statutory scheme therefore requires a fully worked up proposal to form "the application" – this is central to how the later stages of the process are required to work;

e. Further the application has to be worked up to a stage where it can be properly subject to EIA and appropriate assessment requirements. That necessarily requires the detail of the compensation proposals because the detail of those proposals can generate significant environmental effects themselves;

f. Once "the application" is accepted under s.55, the Examining Authority is appointed to test it. The Panel's functions (s.74) and procedural powers (s.77) do not include accepting substantial amendments to it or accepting a different proposal. The Panel's job is to examine "the application" accepted by the Secretary of State;

g. The procedures of the Examining Authority are then built on testing "the application" not a variant of it. It can only make recommendations in respect of the "application" not a variant of it;

h. There is thus no express statutory ability to amend the application; and

[10] The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009.

i. Further no such ability can be implied: (1) it is inconsistent with the obligations in respect of the pre-application stages and with the requirements for the application; and (2) it is inconsistent with the Examining Authority processes and fundamentally with the time line in s.98.

23. It will no doubt be said that the statutory scheme for normal planning applications does not expressly provide for amendments to them during the inquiry appeal process but such an ability is implied. Any such submission would be wrong because the statutory scheme has two essentially different elements which makes the implication of a power to amend impossible here – first the detailed pre-application stages and the matters the Secretary of State has to be satisfied of before he can accept an application; and second the timetables, powers and time limits of the ExA process.

24. *ES*: it may be said that those statutory differences do not prevent changes which can be properly subject to EIA and appropriate assessment requirements and testing within the Examining Authority processes. Even if that was right, it does not assist the Applicant here.

25. It is plain that any new proposals have to be worked up to a sufficient degree to give confidence that they would work and then those proposals would have to be subject to EIA and appropriate assessment requirements. Until one sees the detail it is impossible to tell whether the environmental impacts of them will be the same as previously assessed. No assumption can be made that an RTE with huge new bunds (100m long and 4m high) and with very different hydrological features (flows/channels/speeds of flow) would have the same effect as the former MR proposals which have been assessed. A new very large area of wet grassland will have inevitable significant impacts on the water regime over a wide area – as well as other potential significant environmental impacts. This is why the *detail* of OLHF had to be and was subject to site specific ES. The same will have to be the case for the new site.

26. The time line will not allow this process to be gone through, for the new EIA material to be subject to the public consultation processes, for the RSPB to provide its written response (which it is entitled to do and which would itself become part of the environmental information the Secretary of State would have to consider) and for the scheme and its environmental impacts to be tested.

27. The RSPB has been provided with no time line as to how the Applicant intends to comply with the EIA obligations in respect of any new worked up proposals. Through Mr Dixon, the RSPB has made clear that properly working up and testing the merits and impacts of compensation schemes is a very long process given the complexity of the issues and the need for confidence (on a precautionary basis, particularly necessary for this application due to the specific conditions within the Humber Estuary) that the proposals will work to replace the ecological function lost. The RSPB has wide ranging experience on this for example at Bathside Bay, Shellhaven and Didben[11]. At the first two, detailed working with the applicants resulted in proposals which were subject to ES and which were accepted by the RSPB well before the close of the respective inquiries. In the case of the latter, despite a very long process of trying to work up recharge proposals, the EIA work on those proposals (along with other work) when properly understood and tested showed that they would not work. These processes cannot be short cut.

28. *Conspicuous unfairness:* The issue specific hearing has now been held. The compensation proposals have had all the statutory and Examining Authority processes applied to them over the course of a year.

29. The RSPB has played an active role at all stages of the process to date meeting all deadlines and providing comprehensive evidence under significant time pressure (particularly due to the volume of additional information submitted by the Applicant on 29th June 2012 and again on 3rd August 2012 as well as the changing compensation proposals) (and at very significant cost) which has demonstrated that the proposals in the application will not work. It has been able to respond to the 3rd August 2012 proposals quickly showing the basic and fundamental flaws in them (see answer to Q22 of second round of questions).

30. After all that work we are two months from the end of the six month period with no proposals, no ES of them and no suggestion as to how any new proposals can be tested by it. It has been made clear that for the RSPB to be satisfied that a scheme will work will require very substantial input on a fully worked up scheme. It will not be bounced by time pressures into short circuiting that necessary process. It has proved easy for the RSPB to demonstrate the previous MR and new RTE proposals will not work here so fundamentally flawed were they. It will be much more difficult to test any new proposals to the stage where there can be confidence that will work.

[11] All new container port proposals similar to the Applicant's proposals here – Shellhaven was also known as London Gateway.

The New Proposals

Wet Grasslands

31. No details whatsoever of the new wet grassland proposals have been provided. All that we have is a plan showing the location of the site. There is no detail as to how it will be kept wet; the soil quality and the hydrological regime in the area. Nor is there any ES, or any drawings of what is proposed. Given: (1) the arrangement and levels of the land drains in the area; and (2) the nature of the soil – naturally free draining, there is an obvious and immediate most basic question as to how the site can be kept wet.

32. OLHF was promoted for a prolonged period despite the concerns of the RSPB. It was only at the end of the process that the Applicant finally recognised that it would not work – and that was after it had made substantial efforts to work up the proposals. The lesson is clear – proposals which may at first sight seem potentially acceptable on closer examination prove not to be. It is to be noted that that is what happened with the recharge at Dibden.

33. There can be no confidence that the new site can work to deliver wet grassland at all, never mind of the requisite quality.

RTE

34. Obviously this is the key to any lawful compensation package. The RSPB accepts that on an accreting shore, an RTE proposal is more likely to deliver long term sustainable mudflats than a MR Proposals. That is why it proposed in 2011 that an RTE be looked at. Its suggestion was rebuffed by the Applicant at that time (see NE Response to second set of questions – Annex 3, minutes of meeting with the Applicant of 9th August 2011, page 10 para 4.4.23). An RTE was looked at in July 2012 and proposals submitted *within a month* on 3rd August 2012.

35. The RSPB's answer to Q22 (second set of questions) demonstrates the basic and fundamental flaws in the proposals. Only one minor element of that detailed critique is questioned on behalf of the Applicant.

36. In short summary:

The Requirements

a. The Applicant's witness accepts that the proposals have not been formulated to meet the ecological needs of BTG. This is a simply a startling admission – he has been given the wrong brief. The purpose of the compensation is (predominantly) to cater for their needs (and other species who thrive on NKM);
b. There has been no consideration of what those ecological needs are;
c. BTG need deep, continuously very wet mud – it is that mud which generates the food resource on which they rely. They do not use and cannot benefit from shallow, dry mud (cp the species in issue at Bristol);
d. To secure such mud and the food resource in it, the mud has to be inundated almost every tide (meaning a level of below 1.9m AOD – MHWN) and be covered to a significant depth (say 0.5m – meaning below 1.4m AOD)[12]. Shallow water cannot be "held" for long periods because it will heat up or cool down with adverse impacts on the invertebrate resource;
e. BTG will not use steep sided banks of creeks (evidence of Dr Prater during the hearing on 12th September 2012).

The RTE Cells

f. Save for point e. above, the RTE cells meet none of these requirements:
    i. The levels in the RTE cells are such that no water at all will enter the site at and around the MHWN tides – the mud will dry out and fundamentally will not be of the requisite quality;
    ii. Even when water does enter it will be very shallow. If it is held (so as to ensure the site remains wet in MHWN conditions) it may heat up or cool down such as to adversely impact the invertebrate resources;
    iii. As Mr Dixon noted, shallow water may not contain sufficient invertebrate food resource;
g. In any event the RTE cells will silt up quickly over 10 – 15 years and there is no detail as to the Compensation Environmental Management and Monitoring Plan ("CEMMP") to demonstrate how that will be managed or what interventions will be possible/necessary in the medium term;

[12] And this is after the mud (15cm deep) has formed.

h. To overcome these problems, it is not simply about making the cells (much) deeper. Even putting aside the basic points that the deeper the cells the greater the rate of siltation and where does the huge volume of spoil go, having more water in the cells will require major engineering structures to control the huge water flows and the forces to which they give rise. We are not here talking about a simple culvert structure as the proposals assume;

i. Where deep mud and continuously wet mud is required, a cell approach has never been adopted before (cp Bristol where shallow mud only was required for surface feeders);

j. In any event, the proposals deliver (at most and before siltation) 1:1 replacement of that lost. There is no evidential basis upon which 1:1 can be justified. Paull Holme Strays ("PHS") supports a dramatically lower density of population of BTG than NKM and the only evidence shows that NKM supports a density of BTG hundreds of time that found elsewhere. Yet the Applicant's proposals require the Examining Authority to assume (on no evidence) that mudflat *of equal value to the best there is* will be provided here on an accreting shore in an untried and tested cell structure arrangement for the long term.

The Channel through the MR

k. The Applicant relies on the mud either side of the channel through the MR. That mudflat will be not be usable by BTG for the reasons given by Dr Prater. It cannot compensate for any of that lost at NKM.

Putting off detail until later?

37. It necessarily follows that there is no (even indicative) scheme before the ExA which it has been demonstrated can work.

38. Mr Dixon (the acknowledged expert before the Examining Authority on these *matters) accepts that it might be possible* to work up a scheme at CCS which could deliver the requisite quality of mud (although not the necessary quantum). He also says **(and this is fundamental**) that it might be that it simply proves impossible to work up a scheme which works in this location.

39. Mr Kieller for the Applicant has no experience of designing RTEs and simply ran his indicative proposals past a colleague in his office who has some experience of saltmarsh creation projects. He puts forward indicative proposals that plainly do not work.

40. There is no evidence before the Examining Authority to allow it to come to a conclusion that it can have requisite confidence that an RTE at CCS will work to deliver the necessary quality and/or quantum of mudflat.

41. Further the history here shows that delivery of mudflat here will be extremely difficult – the failed MR and RTE proposals; the rapidly accreting PHS; the lack of experience elsewhere of an RTE with small cells being long term sustainable for the requisite type of mud.

42. The legal test for confidence in the compensation is not met here. There is no evidence on which the ExA could be satisfied that it is met. The only evidence plainly demonstrates that there can be no confidence that the compensation package *will* work.

43. The position is wholly different from Bristol. The Applicant's team appears to be relying on the fact that the RSPB was content to work up the detail later at Bristol in support of its position that the detail here can be worked up later. That approach is misconceived –the circumstances are wholly different. At Bristol, all the nature conservation advisers including the RSPB had confidence (due to the impacts being accepted early on in the discussions between all the parties and the detailed information presented to them[13]) that the compensation proposals would work – on the facts there they did not need to see the fully worked up compensation proposals to be so satisfied. Here the reverse is the case – the acknowledged expert has no confidence the compensation scheme being proposed here will work and therefore the ability for a scheme to work has to be demonstrated at this stage.

44. In case this line is pursued by the Applicant, the full s.106 documentation in Bristol is to be provided (See Annex I attached). It demonstrates:

    a. The RSPB's key compensation requirement (arising from impacts on the SPA) was for a MR Proposals to provide a creek system for two species of birds which did not require deep or continuously wet mud (they are surface feeders and do not penetrate the mud to anything like the depth of BTG) and who could feed on relatively steep banks (for a temporary period whilst changes in the hydrology generated alternative mudbanks);

[13] The Applicant has presented similar arguments in relation to the Immingham proposals but again the RSPB was satisfied due to the acceptance of the impacts by the applicant and the detailed information it presented.

b. The impact on birds was very small – the 2 hectares of SPA which were to be lost to the development had a peak mean count of 34 birds (page 36 Annex 2) compared to the 2566 feeding BTG and 45 hectares at NKM;
c. The affected species had very different requirements in terms of habitat, food and locational requirements to BTG and their requirements were far less difficult to accommodate;
d. The delivery of the requisite quality of mud for them through an MR in a tidal creek system was tried and tested;
e. The location there was at worst a slowly accreting area – compare the rapidly accreting area at CCS;
f. On the basis of all the information provided, the RSPB (and all other bodies) were satisfied the compensation package would work and were content for the detail to be worked up later;
g. The position at Bristol is in all these respects completely different from that at CCS.

45. It may be said that how a scheme at CCS will work is a matter of detail which can be worked up later after the DCO is granted under the Compensation Ecological Mitigation and Monitoring Plan ("CEMMP").

46. Any such approach would be challenged. Over the course of much more than a year the Applicant has tried to work up compensation at CCS and OLHF. Each attempt has failed. This is an extremely challenging environment in which to deliver sustainable mudflat of the requisite quality and quantum. No nature conservation body has been satisfied with the proposals to date (rightly so). No expert in the field has said that an RTE will work to deliver the requisite quality of mud. No bird expert has given evidence that the RTE will meet the birds' ecological requirements. There is no "off the shelf" solution for an RTE/MR meeting these needs in this sort of location and the experience on this application to date shows just how difficult it is to work up a scheme which works.

47. Proceeding on the basis that the DCO can be confirmed with the details to be worked up later would be unlawful.

The CEMMP

48. The long term management and interventions in any MR/RTE are fundamental to its long term sustainability. The Examining Authority and the Secretary of State have to satisfy themselves that the DCO incorporates measures to secure that long term sustainability –because otherwise the compensation will not achieve its objectives.

49. At Bathside Bay and Shellhaven the CEMMPs were very comprehensive documents which went through numerous iterations over a prolonged period. They were necessarily legally, technically and factually complex. They had feedback loops (what happened if X was not achieved), detailed monitoring and oversight provisions. And they were all rigorously tested in advance of the close of the inquiry.

50. Here even after the close of the issue specific hearing on Compensation, there is no draft of a CEMMP. We would have expected one to have been provided with the application.

51. There is no opportunity for the RSPB to comment on any draft which will emerge. There is not even any definition of what the long term (how long?) objectives of a CEMMP would be.

52. There is no "off the shelf" solution for a CEMMP. The Examining Authority cannot proceed on the basis that the detail can be worked up later. There are fundamental points of principle which need to be satisfied at this stage – the compensatory objectives, how compliance with them is to be measured, how long term must the compensation be sustained; what is the feed back loop provision; how are the obligations secured – s.106/bond?

Next Steps

53. The RSPB repeats that, as it has done elsewhere, it will engage constructively with the Applicant on proposals that are presented. If those proposals work, it will say so and will work with the Applicant's to work up a CEMMP which secures the long term management of the compensation measures. If the proposals do not work, it will explain why. This is exactly the process which worked at Shellhaven and Bathside Bay. The RSPB will do the same here in respect of CCS and the wet grasslands.

54. However, it is not its role to develop proposals for compensation[14]. The ball is in the Applicant's court. The Applicant knows what is required and it must come up with a package to the requisite level of detail to give the requisite confidence that it will work to meet the compensation objectives.

55. Even putting aside the fundamental legal concerns expressed above as to the ability to make substantial changes now and the procedural propriety of doing so at such a late stage, any new package must be subject to EIA and appropriate assessment requirements and must be tested through the Examining Authority process. That means written representations, Examining Authority questions and answers and then an issue specific hearing[15] once the areas of dispute between the parties have become clear through the written procedure. It would be plainly contrary to the statutory scheme, the practice to date and natural justice for the Examining Authority to jump straight to an issue specific hearing on new proposals.

56. The RSPB naturally requires that it be given a fair opportunity in any revised timetable to be able to consider the package, give written comments on it and to cross examine (if necessary) in respect of it. Its view is that there is nowhere near sufficient time before the closing of the Examination for this to be done here in a fair way under which the merit of any new proposals can be tested.

David Forsdick
Landmark Chambers
24th September 2012

[14] If that was its role it would be highly unlikely to be looking to work up a compensation package at CCS - it is too challenging an environment and other locations (eroding shore) would be far easier and more likely to be effective.

[15] The Examining Authority rightly decided that an issue specific hearing was required into the compensation – any other approach would have been untenable. That Issue Specific Hearing has resulted in the package being withdrawn or being shown to be flawed. The need for any further package to be tested in an issue specific hearing is obviously overwhelming.

DATED 22nd December 2008

(1) FIRST CORPORATE SHIPPING LIMITED

(2) NATURAL ENGLAND

(3) THE ENVIRONMENT AGENCY

(4) THE ROYAL SOCIETY FOR THE PROTECTION OF BIRDS

MITIGATION, COMPENSATION AND MONITORING AGREEMENT

RELATING TO

THE BRISTOL DEEP SEA CONTAINER TERMINAL

CONTENTS

THIS AGREEMENT is made the twenty second **day of** December **2008**

BETWEEN:

(1) **FIRST CORPORATE SHIPPING LIMITED** (company registration number 2542406), trading as The Bristol Port Company, whose registered office is at 4 More London Riverside, London SE1 2AU ("FCS");

(2) **NATURAL ENGLAND** whose Head Office is at 1 High Street, East Parade, Sheffield S1 2GA ("NE");

(3) **THE ENVIRONMENT AGENCY** of Manley House, Kestrel Way, Sowton Industrial Estate, Exeter EX2 7LQ ("EA"); and

(4) **THE ROYAL SOCIETY FOR THE PROTECTION OF BIRDS** (a body incorporated by Royal Charter, registered charity number 207076 whose principal office is at The Lodge, Sandy, Bedfordshire SG19 2DL ("the RSPB").

1. BACKGROUND STATEMENTS AND ACKNOWLEDGEMENTS

1.1 FCS is the statutory harbour authority for the Port and Harbour of Bristol (excluding the City Docks and Portishead Docks) and has made applications under the Harbours Act 1964, the Coast Protection Act 1949 and the Food and Environment Protection Act 1985 for consents and authorisations in relation to the construction and operation of a deep sea container terminal at Avonmouth Docks, Bristol and for associated capital dredging operations and disposal of spoil.

1.2 The BDSCT Works include but are not limited to works for the reclamation of 33.5 hectares of intertidal habitat and 22 hectares of subtidal habitat.

1.3 Part of the intertidal and the subtidal habitats to be reclaimed as part of the BDSCT Works form, variously, part of:

1.3.1 the Severn Estuary Special Protection Area (the "SPA");

1.3.2 the Severn Estuary candidate Special Area of Conservation (the "cSAC");

1.3.3 the Severn Estuary Ramsar site (the "Ramsar Site"); and

1.3.4 the Severn Estuary Site of Special Scientific Interest (the "SSSI").

1.4 NE and FCS are each satisfied that the BDSCT Project will not have a significant effect on either the River Wye Special Area of Conservation or the River Usk Special Area of Conservation.

1.5 Each of FCS, NE and the RSPB considers that:

1.5.1 schedule 1 accurately sets out the effect that the BDSCT Project will have on the SPA, cSAC, Ramsar Site (the "European Sites") and the SSSI;

1.5.2 subject to the implementation of the Mitigation Plan and based on those residual effects summarised in parts 1 and 2 of schedule 1:

1.5.2.1 for the purposes of the Habitats Regulations, it cannot be ascertained that the BDSCT Works will not have an adverse effect on the integrity of the European Sites; and

1.5.2.2 the BDSCT Works have the potential to result in an adverse effect on the SSSI; and

1.5.3 subject to the implementation of the Mitigation Plan, the residual effects referred to in part 3 of schedule 1 are not likely to result in an adverse effect (including any adverse effect within the meaning of Regulation 48 of the Habitats Regulations) on any of the European Sites and the SSSI.

1.6 When deciding whether to grant consent or permission for works which may (notwithstanding any proposed mitigation) have an adverse effect upon the integrity of any European Site the Secretary of State may not grant the consent except having satisfied the provisions of Regulation 49 of the Habitat Regulations (that there are no alternative solutions and there are imperative reasons of overriding public interest) and Regulation 53 of the Habitats Regulations (that the Secretary of State is required to secure that any necessary compensatory measures are taken to ensure that the overall coherence of the Natura 2000 network is protected).

1.7 NE is concerned with the regulation and implementation of policies relating to the matters referred to in clauses 1.4 to 1.6 above and more particularly the effects of the BDSCT Project upon the Severn Estuary.

1.8 FCS, NE and the RSPB have agreed certain measures as appropriate mitigation of and compensation for the effects of the BDSCT Project as set out in schedule 1, including the identification of (as far as possible at this stage) the nature, extent and objectives of that mitigation, compensation and monitoring requirements.

1.9 FCS, NE and the RSPB have identified the TBPC Steart Site as a suitable location within which the Compensation Scheme might be implemented and its objectives met. EA has identified the opportunity for further large scale habitat creation and flood risk management in the Severn Estuary at the Steart Peninsula, adjacent to the TBPC Steart Site.

1.10 FCS, NE and the RSPB each considers that the implementation of the Compensation Scheme within the TBPC Steart Site (whether or not in conjunction with the EA Steart Peninsula Scheme) and the Mitigation Plan and the Monitoring Scheme in accordance with this agreement would secure the overall provision of adequate mitigation of and compensation for the effects of the BDSCT Project on the European Sites and the SSSI and would constitute compensatory measures sufficient to ensure that, despite any negative assessment of the implications of the BDSCT Project on the integrity of the European Sites for the purposes of the Habitats Regulations, the overall coherence of the Natura 2000 network is protected.

1.11 FCS, NE and the RSPB intend that the implementation of the measures referred to in clauses 1.8 and 1.10 shall be secured through:

1.11.1 this agreement, which provides for the agreement and implementation of the Mitigation Plan, the implementation of the Compensation Scheme and the agreement and implementation of the Monitoring Scheme (including the Compensation Monitoring); and

1.11.2 the Mitigation Plan, which shall prescribe mitigation measures to be effected in relation to the BDSCT Project;

1.11.3 the Monitoring Scheme, which shall prescribe:

1.11.3.1 monitoring to be carried out in respect of the effects of the BDCST Project;

1.11.3.2 monitoring to be carried out in respect of the effectiveness of the implementation of the Mitigation Plan; and

1.11.3.3 monitoring, known as the Compensation Monitoring, to be carried out in respect of the Compensation Scheme together, in some cases, with the Avonmouth Intertidal Area.

Details of the Monitoring Scheme shall be based on the Outline Monitoring Scheme annexed as annex 1.

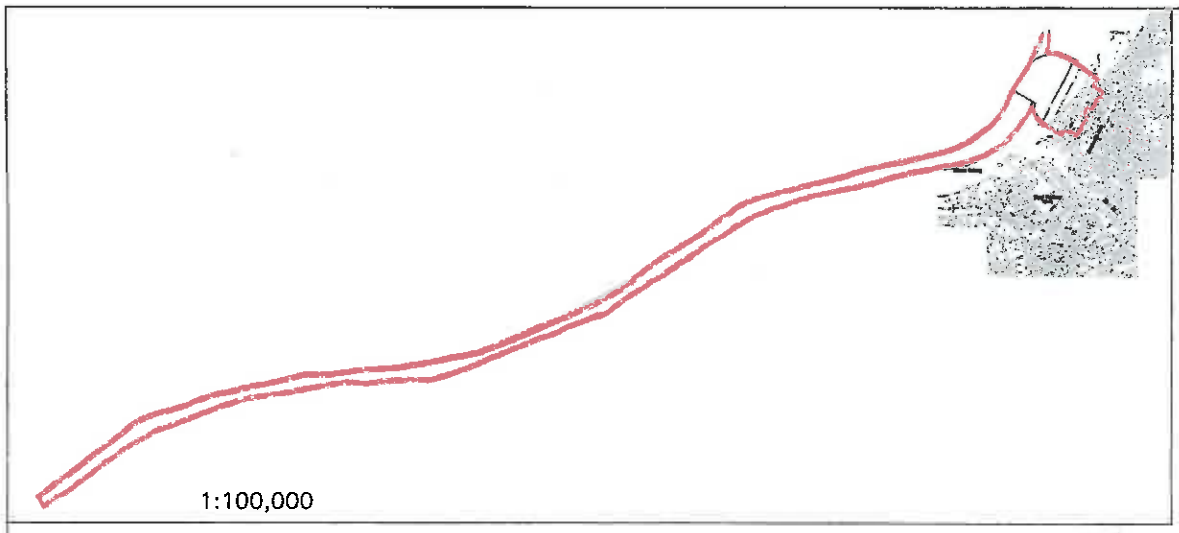
1.12 Subject to the next sentence, the Parties are entering into this agreement to secure that, subject to clause 4, should the Secretary of State grant the Consents then FCS as a statutory undertaker in relation to the BDSCT Project will be under a legal obligation to secure the achievement of the objectives of and implementation of the measures required by this agreement. EA is a party to this agreement for the purpose only of securing the agreement and implementation of the Monitoring Scheme and in relation to the establishment and proceedings of the Environmental Steering Group.

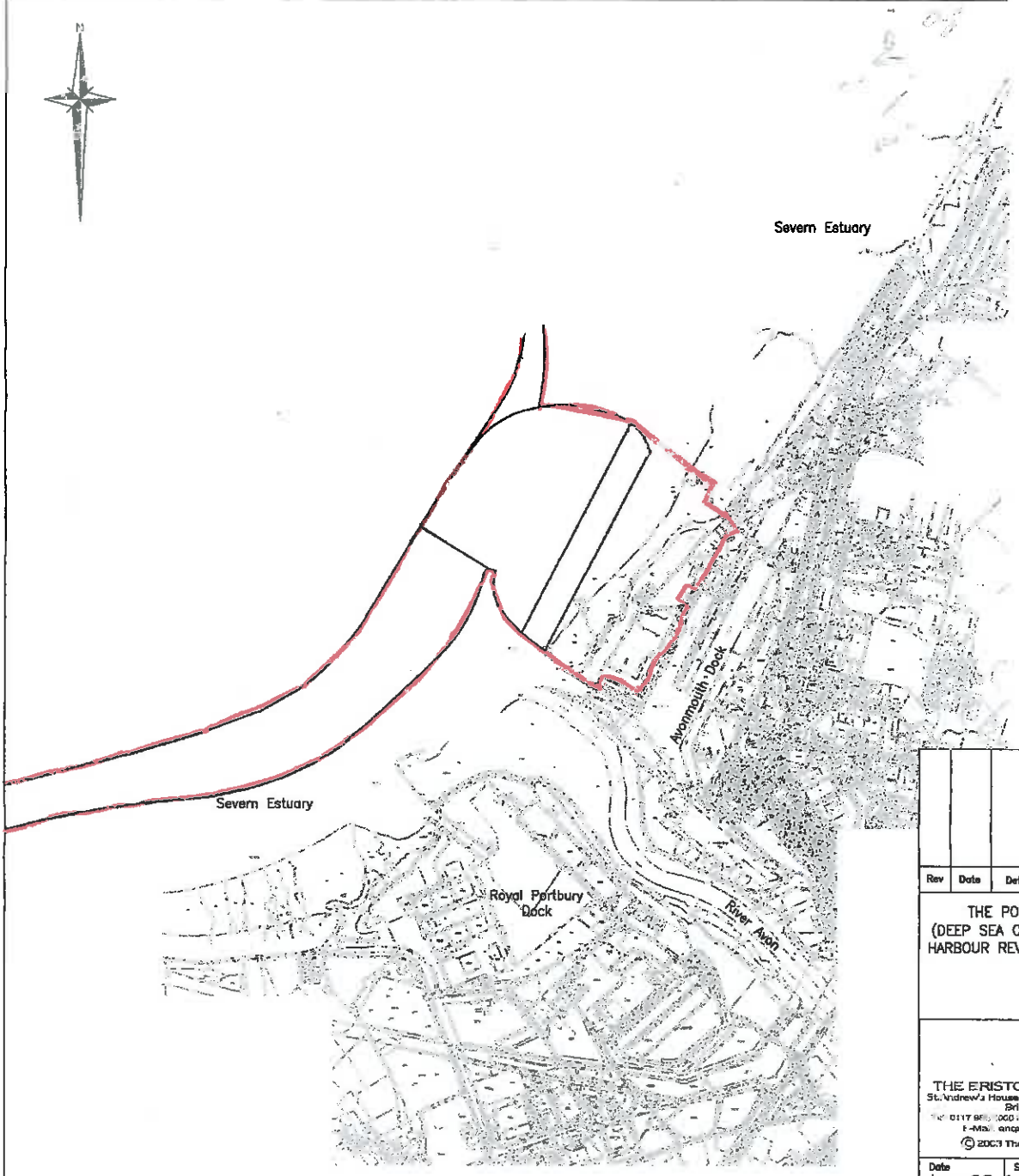
2. DEFINITIONS

In this agreement where the context so admits the following expressions shall have the following meanings:

"Avonmouth Intertidal Area"	means the areas of mudflat and saltmarsh habitat totalling approximately 80ha (to lowest astronomical tide) in aggregate lying upstream of the Avonmouth Site which are referred to in paragraphs 2.1 and 2.2 of part 1 of schedule 1 and which are predicted to be affected by the BDSCT Project in the manner summarised in paragraph 4 of part 2 of schedule 1 and which are discussed in section 3.2 of the Habitat Compensation Note;
"Avonmouth Site"	means that area at Avonmouth Docks and in its approaches on or in which the BDSCT Works are to be carried out and which is shown for illustrative purposes on plan 1 attached;
"BDSCT Project"	means the implementation of the BDSCT Works and the operation of the Terminal, including all associated maintenance dredging;
"BDSCT Works"	means FCS's proposals for works for the construction of a new deep sea container terminal at Avonmouth Docks, Bristol and all associated capital dredging operations and disposal of materials arising;
"Breach"	means the breach or breaches and/or reduction in height of the existing sea wall adjacent to the Managed Realignment Site in accordance with the Compensation Scheme and the Realignment Consents;

"Breakwater"	means the new breakwater to be constructed as part of the BDSCT Works;
"Caisson Placement"	means, during the construction of the Breakwater, the placement on the bed of the River Severn of the third caisson forming part of that construction;
"Compensation Monitoring"	means the monitoring of the Compensation Scheme, in accordance with paragraph 1.2 of part 1 of schedule 3;
"Compensation Scheme"	means the scheme, described in outline in part 1 and part 2 of schedule 2, for the provision of compensatory habitat (and which, in the event of a negative assessment of the implications of the BDSCT Project on the integrity of the European Sites for the purposes of the Habitats Regulations, would constitute compensatory measures sufficient for the purposes of Regulation 53 of the Habitat Regulations);
"Consents"	means the consents and authorisations for the BDSCT Works and the operation of the Terminal and other works and operations in accordance with the applications made by FCS set out in schedule 5 and shall include any subsequent consents revising or renewing those consents (and so including, without limitation, the HRO);
"Dispute Resolution Procedure"	means the procedure set out at clause 11 of this agreement;
"EA Steart Peninsula Scheme"	means a scheme to be designed, promoted, implemented and managed by EA for large scale habitat creation and flood risk management on land adjacent to the TBPC Steart Site;
"Environmental Statement"	means the environmental statement submitted with the application by FCS for the HRO on 22 July 2008;
"Environmental Steering Group"	means the group to be established under part 1 of schedule 6;
"European Site"	means a site as defined under Regulation 10 of the Habitats Regulations and the Ramsar Site in accordance with paragraph 6 of Planning Policy Statement 9 (August 2005);
"Force Majeure Event"	shall have the meaning given to it in clause 15;
"HRO"	means the order under section 14 of the Harbours Act 1964 comprised in the definition of "Consents";
"Habitat Compensation Note"	means the note entitled "Bristol Deep Sea Container Terminal – note on habitat compensation issues" dated December 2008 and produced by Royal Haskoning under reference 9R4093 attached at annex 2;





Rev	Date	Details	Drawn

THE PORT OF BRISTOL
(DEEP SEA CONTAINER TERMINAL)
HARBOUR REVISION ORDER 200[8]

THE BRISTOL PORT COMPANY
St Andrew's House St Andrew's Road Avonmouth
Bristol BS11 9DQ
Tel: 0117 930 0000 Fax: 0117 930 0845 Tele 41240
E-Mail: enquiries@bristolport.co.uk

Date	Scale	Drawn
June08	1:25,000	EJM

Drawing No.	
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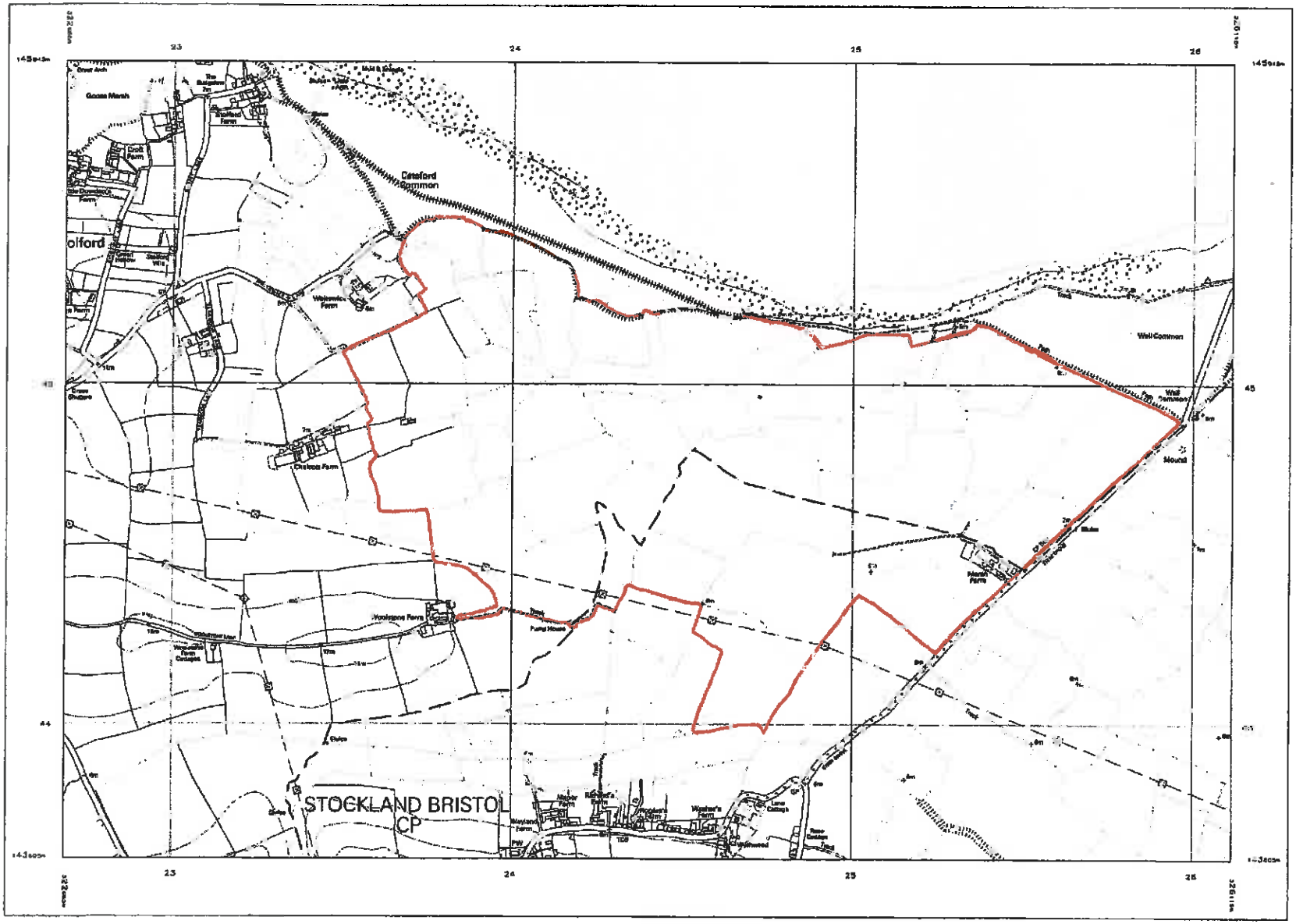
Ordnance Survey®

OS Landplan® Data



100 50 0 100 200 300 400 500
Metres

"Habitats Regulations"	means the Conservation (Natural Habitats &c.) Regulations 1994;
"Managed Realignment Site"	means the area within the TBPC Steart Site on which the Compensation Scheme is to be implemented and which is determined in accordance with clause 5.1 to be comprised in the Managed Realignment Site for the purpose of this agreement;
"Marine Works"	means those parts of the BDSCT Works which comprise the construction of the Breakwater and/or the reclamation at the Avonmouth Site of those areas of intertidal habitat referred to in paragraph 1 of part 1 of schedule 1;
"Mitigation Plan"	means the plan or plans detailing the mitigation measures in relation to the effects of the BDSCT Project to be developed by FCS in accordance with the Outline Mitigation Plan and agreed in accordance with schedule 4;
"Monitoring Scheme"	means the plan or plans detailing: (a) the monitoring measures in respect of the effects of the BDSCT Project; (b) the monitoring measures in respect of the effectiveness of the implementation of the Mitigation Plan; and (c) the Compensation Monitoring, to be developed by FCS and agreed in accordance with schedule 3;
"Natura 2000"	has the meaning set out in Regulation 2 of the Habitats Regulations;
"Outline Mitigation Plan"	means the table of outline mitigation measures set out in schedule 4;
"Outline Monitoring Scheme"	means the table of outline monitoring measures attached as annex 1;
"Parties"	means FCS, NE, EA and RSPB; and "Party" means any one of them;
"Realignment Application"	means any application for a Realignment Consent provided that such application is in accordance with the Compensation Scheme;
"Realignment Consents"	means the consents necessary for the implementation of the Compensation Scheme (whether alone or with other works) and shall include any subsequent consents revising or renewing those consents;

"TBPC Steart Site"	means land on the Steart peninsula within the area shown for illustrative purposes only edged red on plan 2 attached; and
"Terminal"	means the deep sea container terminal to be constructed as a result of the BDSCT Works and comprised within Works Nos. 1 to 6 (inclusive) of the draft HRO submitted by FCS to the Secretary of State on 22 July 2008.

3. INTERPRETATION

3.1 References to a Special Protection Area and to a Special Area of Conservation are to those phrases as they are defined in the Habitats Regulations.

3.2 Clause, schedule and paragraph headings shall not affect the interpretation of this agreement.

3.3 The schedules and annexes form part of this agreement and shall have effect as if set out in full in the body of this agreement. Any reference to this agreement includes the schedules and the annexes.

3.4 References to clauses and schedules are to the clauses and schedules of this agreement; references to paragraphs are to paragraphs of the relevant schedule.

3.5 Words in the singular shall include the plural and vice versa and a reference to one gender shall include a reference to the other genders.

3.6 A reference to a statute, statutory provision or subordinated legislation is a reference to it as it is in force, taking account of any amendment or re-enactment.

3.7 A reference to a statute or statutory provision shall include any subordinate legislation made under that statute or statutory provision.

3.8 References to "persons" include bodies corporate and unincorporated associations.

3.9 A reference to writing or written includes faxes but not e-mail.

3.10 Any phrase introduced by the terms including, include, in particular or any similar expression shall be construed as illustrative and shall not limit the sense of the words preceding those terms.

3.11 References to any Party and to any member of the Environmental Steering Group shall include that person's statutory successor.

3.12 References to the TBPC Steart Site includes a reference to any part or parts of the TBPC Steart Site.

3.13 Any covenant by FCS not to do an act or thing shall be deemed to include an obligation to use reasonable endeavours not to permit or suffer such act or thing to be done by another person where knowledge of the actions of the other person is reasonably to be inferred and any covenant by FCS to do an act or thing may be deemed to include an obligation to procure that the act or thing is done.

4. COMMENCEMENT

4.1 Except as provided by clauses 4.2, 4.3 4.4, the provisions of this agreement shall have effect from the date of this agreement.

4.2 FCS's covenants contained in clause 8 and paragraphs 1 and 3 of part 1 of schedule 3 shall have no effect unless and until the Consents have been duly granted in terms satisfactory to FCS and FCS has decided to implement the BDSCT Works pursuant to the Consents (but so that this shall not prevent FCS and the other Parties at any time after the date of this agreement from preparing and seeking to agree the details of the Monitoring Scheme in accordance with schedule 3).

4.3 FCS's covenants contained in:

4.3.1 clause 6 and paragraphs 1 and 2 of schedule 4;

4.3.2 clauses 7.1 and 7.2

shall have no effect unless and until the Consents have been duly granted in terms satisfactory to FCS and FCS has commenced the implementation of the BDSCT Works pursuant to the Consents (but so that this shall not prevent FCS and the other Parties at any time after the date of this agreement from preparing and seeking to agree the details of the Mitigation Plan in accordance with schedule 4 and the Monitoring Scheme in accordance with schedule 3).

4.4 FCS's covenants contained in clause 7.5 and schedule 2 shall have no effect unless and until both the Consents and the Realignment Consents have been duly granted in terms satisfactory to FCS and FCS has commenced the implementation of the BDSCT Works pursuant to the Consents.

5. MANAGED REALIGNMENT SITE AND REALIGNMENT CONSENTS

5.1 The Managed Realignment Site shall be such area within the TBPC Steart Site as FCS shall elect and on which the objectives of the Compensation Scheme set out in part 2 of schedule 2 can be met, FCS's election to be made by giving notice in writing to each of NE and the RSPB, referring to this clause.

5.2 FCS may at its own cost and in its sole discretion:

5.2.1 make applications for the Realignment Consents; and

5.2.2 submit further Realignment Applications and/or undertake any appeal as it sees fit, whether under a statutory appeal process or by way of judicial review, in order to obtain Realignment Consents satisfactory in all respects to FCS.

5.3 NE undertakes to FCS that until completion of the implementation of the Compensation Scheme at the Managed Realignment Site or, if later, the date on which the powers of development of the BDSCT Works granted to FCS by the HRO shall have expired in accordance with the terms of the HRO, it will:

5.3.1 not make any application for planning permission in relation to the TBPC Steart Site; and

5.3.2 (provided that the Realignment Application is duly made and is supported by all relevant and appropriate documentation to enable proper assessment of the proposal to implement the Compensation Scheme) not object to the local planning authority or the Secretary of State against or otherwise challenge:

5.3.2.1 the principle of any Realignment Application;

5.3.2.2 any appeal against a deemed refusal or actual refusal of an Realignment Application or a grant of a Realignment Consent subject to unacceptable conditions, in either case raising an objection to principle of the grant of any Realignment Consent; or

5.3.2.3 any appeal under section 288 of the Town and Country Planning Act 1990 or an application for judicial review in relation to any Realignment Consent, in either case challenging the principle of the grant of any Realignment Consent.

5.4 Each of NE and the RSPB will give all reasonable assistance and advice to FCS as FCS shall request in relation to ecological and technical design issues to help FCS ensure that the Managed Realignment Site meets the objectives of the Compensation Scheme set out in part 2 of schedule 2 (including in relation to the consequences of the implementation of the Compensation Scheme and including, without limitation and where in the opinion of that Party it is appropriate and consistent with their objectives to do so, by way of written representations in support of Realignment Applications) in order that the Realignment Consents on terms satisfactory to FCS can be granted at the earliest possible opportunity (and FCS will pay each relevant Party's reasonable and properly incurred costs in providing such assistance).

5.5 Each of FCS, NE and the RSPB recognise that there are sites other than the TBPC Steart Site which may represent suitable locations at which the Compensation Scheme might be implemented and its objectives met so as to secure, in conjunction with the implementation of the Mitigation Plan and the Monitoring Scheme in accordance with this agreement, the overall provision of adequate mitigation of and compensation for the effects of the BDSCT Project on the European Sites and the SSSI and compensatory measures sufficient to ensure that, despite any negative assessment of the implications of the BDSCT Project on the integrity of the European Sites for the purposes of the Habitats Regulations, the overall coherence of the Natura 2000 network is protected. At FCS's request, each of NE and the RSPB agree to act in good faith (in consultation with the Environmental Steering Group) in discussing with FCS the location and suitability of any alternative sites proposed by FCS and in entering into such variations to this agreement as may be necessary or appropriate in relation to the implementation of the Compensation Scheme on any such alternative site or sites in place of the TBPC Steart Site.

6. COVENANTS BY FCS ABOUT THE MITIGATION PLAN

Subject as set out in clause 4, FCS covenants with NE and the RSPB to carry out and comply with the obligations on its part contained in schedule 4 in relation to the agreement and implementation of the Mitigation Plan.

7. COVENANTS BY FCS ABOUT THE COMPENSATION SCHEME

7.1 Without prejudice to clause 4, FCS covenants with NE and the RSPB that it shall not commence implementation of that part of the Marine Works comprising either the construction of the Breakwater or the reclamation at the Avonmouth Site of any part of the area of intertidal mudflat referred to in paragraph 1.1 of part 1 of schedule 1:

7.1.1 until it has acquired sufficient proprietary interest in the Managed Realignment Site to enable it to carry out or procure the implementation of the Compensation Scheme on the Managed Realignment Site; and

7.1.2 until the Realignment Consents in relation to the implementation of the Compensation Scheme on the Managed Realignment Site have been obtained.

7.2 Without prejudice to clauses 4 and 7.1 but subject to clauses 7.3 and 7.4, FCS further covenants with NE and the RSPB that it shall not commence the Caisson Placement unless both the Breach has occurred and by the end of the eighth calendar month after the month in which the Caisson Placement occurs two winters (meaning in this context the minimum period of December to February inclusive) will have elapsed since the Breach.

7.3 Clause 7.2 shall not prevent the Caisson Placement occurring where the condition set out in clause 7.2 will not be met by reason of the implementation of the Compensation Scheme on the Managed Realignment Site having been or being delayed by reason of the occurrence of any Force Majeure Event.

7.4 FCS may at any time after the date of this agreement propose for agreement by each of NE and the RSPB an alternative element or stage of its proposed construction programme for the BDSCT Works to apply in substitution for the Caisson Placement for the purpose of clauses 7.2 and 7.3. FCS may only make such a proposal if the effect of the substitution would not prejudice the purpose of clause 7.2 in securing achievement of the objective of the Compensation Scheme set out in paragraph 1.4 of part 2 of schedule 2. If each of NE and the RSPB (after consultation with the members of the Environmental Steering Group) agree with FCS's proposal, then clauses 7.2 and 7.3 shall be read and construed for all purposes as if for the Caisson Placement there was substituted the alternative element or stage proposed by FCS and agreed by NE and the RSPB and each of FCS, NE and the RSPB shall enter into and endorse on this agreement a memorandum to that effect.

7.5 Subject as set out in clause 4, FCS covenants with NE and the RSPB to carry out and comply with the obligations on its part contained in schedule 2 concerning the implementation and management of the Compensation Scheme, in relation to the Managed Realignment Site.

8. COVENANTS BY FCS ABOUT THE MONITORING SCHEME

Subject as set out in clause 4, FCS covenants with NE, the RSPB and EA to carry out and comply with the obligations on its part contained in schedule 3 in relation to the agreement and implementation of the Monitoring Scheme (including the Compensation Monitoring).

9. COVENANTS BY FCS ABOUT THE ENVIRONMENTAL STEERING GROUP

FCS covenants with NE, the RSPB and EA to carry out and comply with the obligations on its part contained in schedule 6 in relation to the establishment and proceedings of the Environmental Steering Group.

10. COVENANTS BY OTHER PARTIES

10.1 Subject as set out in clause 4, each of FCS, NE and the RSPB covenants:

10.1.1 with one another to comply with their respective obligations (if any) contained in schedules 2, 3, 4 and 6 and the obligations on their respective parts contained in clauses 5, 11, 12, 15 and 16; and

10.1.2 with EA to comply with their respective obligations (if any) contained in schedules 3 and 6 and the obligations on their respective parts contained in clauses 11, 12, 15 and 16.

10.2 EA covenants with each of FCS, NE and the RSPB to comply with its obligations (if any) contained in schedules 3 and 6 and the obligations on its part contained in clauses 11, 12, and 15

10.3 Nothing in this agreement shall either fetter the statutory rights, powers and duties of NE or EA or require either of those Parties to act in any way inconsistently with its statutory duties.

11. DISPUTE RESOLUTION

11.1 The provisions of this clause 11 shall be the Dispute Resolution Procedure.

11.2 Without prejudice to any other provision of this agreement, the Parties shall attempt to resolve any lack of agreement, dispute or difference between them by discussion and agreement.

11.3 Save where the statutory duties of any Party or any other provisions or requirements provide otherwise the Parties agree to use reasonable efforts to avoid any publicity regarding any dispute or difference between them in the national or local press or by means of television, radio or internet newscasting or broadcasting.

11.4 In exercising the powers and rights and in observing the obligations and duties set out in this Dispute Resolution Procedure, the Parties shall at all times have regard to the need to resolve any dispute or difference with reasonable expedition and without incurring or causing others to incur unreasonable costs.

11.5 If any dispute or difference shall arise between the Parties under or in connection with this agreement concerning matters of ecology, matters of geomorphology or matters of engineering then any Party which is party to such dispute or difference may give written notice to the other parties to the dispute or difference stating that there is such a dispute in which event:

11.5.1 the Parties involved in the dispute (the "Disputing Parties) will meet within 14 days and endeavour to resolve the dispute; but

11.5.2 if no agreement is reached between the Disputing Parties within 60 days of their first meeting, the dispute will (unless all the Disputing Parties agree otherwise) be referred for determination by an independent expert (the "Expert") in accordance with the following provisions.

11.6 The Expert shall be an appropriately qualified person on whom the Disputing Parties agree or, if they cannot reach agreement within 14 days, who is appointed by:

11.6.1 in the case of a dispute concerning matters of ecology, the President of the Institute of Ecology and Environmental Management;

11.6.2 in the case of a dispute concerning matters of geomorphology, the President of the Geological Society;

11.6.3 in the case of a dispute concerning matters of engineering, the President of the Institution of Civil Engineers; or

11.6.4 in a case where the Disputing Parties cannot agree on the nature of the dispute within 14 days, the President of the Law Society of England and Wales.

11.7 The decision of the Expert shall (except in the case of manifest error) be final and binding on the Disputing Parties and shall not be capable of challenge, whether by arbitration, in court or otherwise, insofar as such waiver can validly be made. The Expert shall act as an expert and not an arbitrator.

11.8 Each Disputing Party shall be entitled to make written submissions to the Expert. If a Disputing Party makes any submission it shall also provide a copy to the other Disputing Parties and the other Disputing Parties shall have the right to comment on such submission. The Disputing Parties shall make available to the Expert all books and records relating to the issues in dispute and shall render to the Expert any assistance requested of the Disputing Parties.

11.9 The terms of engagement of the Expert shall include an obligation on the part of the Expert to establish a timetable for the making of submissions and replies and to notify the Disputing Parties in writing of his decision within 30 days from the date on which the Expert has been selected (or such other period as the Disputing Parties may agree).

11.10 The costs of the Expert and the proceedings shall be borne as directed by the Expert.

11.11 The Parties agree that where any dispute or difference between them is required to be referred for dispute resolution provided for by any protective provisions attached to any of the Consents, then the Dispute Resolution Procedure in this clause 11 shall not apply.

11.12 The Parties agree that where any dispute or difference between them arises wholly or partly out of the subject matter of this agreement then the entirety of that dispute or difference shall be determined in accordance with the Dispute Resolution Procedure set out in this agreement notwithstanding that any protective provisions under any of the Consents would otherwise apply or require the same to be referred to a different procedure for dispute resolution.

12. APPROVALS AND NOTIFICATIONS

12.1 Where in accordance with this agreement FCS or any other person is required to seek an approval, agreement or other decision from any other Party (not being a statutory consent) the provisions of this clause 12 shall apply.

12.2 The Party whose approval, agreement or other decision is sought shall not unreasonably withhold or delay any such approval, agreement or decision in relation to any matter provided for in this agreement.

12.3 If any such approval, agreement or decision of NE or the RSPB provided for under this agreement is not given within 21 days of a request for any approval, agreement or decision and such decision is not given following a further 14 days of negotiation between that Party and FCS, either Party may following the expiration of the said 14 days refer the matter for determination in accordance with clause 11.

13. INTERFACE WITH PROTECTIVE PROVISIONS

In exercising its rights in relation to any protective provisions under the Consents each Party shall each have regard to this agreement.

14. CONFIDENTIALITY

Nothing in this agreement shall require FCS to disclose to any other Party anything which in FCS's reasonable opinion needs to remain confidential for commercial or corporate reasons, such opinion and the reasons for it in relation to any document or information to be given in writing by FCS to the relevant Party at the time when the obligation to disclose the document or information would otherwise have arisen.

15. FORCE MAJEURE

15.1 A Party, provided that it has complied with the provisions of clause 15.4, shall not be in breach of this agreement, nor liable for any failure or delay in performance of any obligations under this agreement (and the time for performance of the obligations shall be extended accordingly) arising from or attributable to any of the following (each a "Force Majeure Event"):

15.1.1 Acts of God, including but not limited to fire, flood, earthquake, windstorm or other natural disaster (provided that for the purpose of FCS discharging any of its obligations under this agreement flood shall only be treated as being a Force Majeure Event if and to the extent that it materially prevents or inhibits such compliance);

15.1.2 Government decree, war, threat of or preparation for war, armed conflict or similar actions;

15.1.3 terrorist attack, civil war, civil commotion or riots;

15.1.4 where a change in law prevents a Party from carrying out its obligations;

15.1.5 fire, explosion or accidental or malicious damage;

15.1.6 unforeseen exceptional site or ground conditions;

15.1.7 exceptionally adverse or inclement weather conditions (provided that for the purpose of FCS discharging any of its obligations under this agreement weather conditions shall only be treated as being a Force Majeure Event if and to the extent that they materially prevent or inhibit such compliance); and

15.1.8 any other exceptional event, cause or circumstance outside the reasonable control of the Party claiming entitlement to rely on this definition, its contractors or agents, and which adversely affects its ability to perform any obligation relating to any works provided for in this agreement.

15.2 The corresponding obligations of any other Party (if any) will be suspended to the same extent as those of the Party first affected by the Force Majeure Event.

15.3 A Party that is subject to a Force Majeure Event shall use all reasonable endeavours to mitigate the effect of the Force Majeure Event to carry out its obligations under this agreement in any way that is reasonably practicable and to resume the performance of its obligations as soon as reasonably possible.

15.4 A Party that is subject to a Force Majeure Event shall not be in breach of this agreement provided that:

15.4.1 it promptly notifies the other Parties in writing of the nature and extent of the Force Majeure Event causing its failure or delay in performance;

15.4.2 it could not have avoided the effect of the Force Majeure Event by taking precautions which, having regard to all the matters known to it before the Force Majeure Event, it ought reasonably to have taken, but did not; and

15.4.3 it has complied with its obligation under clause 15.3.

16. WITHDRAWAL OF OBJECTIONS

16.1 The RSPB agrees to withdraw its objection to the HRO and (to the extent applicable) to any of the other Consents as soon as possible after the date of this agreement and in any event before noon on 23 December 2008, such withdrawal to be made in writing to the Secretary of State and copied to FCS.

16.2 If a public inquiry is for any reason convened to consider the HRO and/or any of the other Consents and/or FCS's proposals for the BDSCT Works or any part of them and any of the Parties shall make representations which are, in the reasonable opinion of FCS, contrary to the terms or spirit of this agreement, then all Parties agree that this agreement shall, to the extent (whether in whole or in part) that FCS shall elect (which election shall be made in writing to all other Parties) cease to have effect, but without prejudice to any antecedent breach.

17. NOTICES

17.1 A notice or other communication given to a Party under or in connection with this agreement or the Consents:

17.1.1 shall be signed by or on behalf of the Party giving it;

17.1.2 shall be sent to the other Party for the attention of the person, at the address or fax number specified in this clause (or to such other person or to such other address or fax number as that Party may notify to the other, in accordance with the provisions of this clause), any such change to take effect five business days after the notice is deemed to have been received or, if later, on the date specified in that notice; and

17.1.3 shall be:

17.1.3.1 delivered personally; or

17.1.3.2 sent by commercial courier; or

17.1.3.3 sent by pre-paid first class post or recorded delivery; or

17.1.3.4 sent by fax.

17.2 The addresses for delivery of a notice or other communication are as follows:

17.2.1 FCS:

17.2.1.1 address: St Andrew's House, St Andrew's Road. Avonmouth, Bristol BS11 9DQ

17.2.1.2 for the attention of: The Chief Executive

17.2.1.3 fax number: 0117 982 0698

17.2.2 NE:

17.2.2.1 address: Natural England, Block 3, Government Buildings, Burghill Road, Westbury-on-Trym, Bristol BS10 6NJ

17.2.2.2 for the attention of: Adrian Jowitt

17.2.2.3 fax number: to be confirmed

17.2.3 The RSPB:

17.2.3.1 address: Keble House, Southernhay Gardens, Exeter, Devon EX1 1NT

17.2.3.2 for the attention of: The Conservation Manager

17.2.3.3 fax number: 01392 453750

17.2.4 EA:

17.2.4.1 address: Environment Agency, Rivers House, East Quay, Bridgwater, Somerset TA6 4YS

17.2.4.2 for the attention of: Mr N Gupta

17.2.4.3 fax number: 01278 455218

17.3 If a notice or other communication has been properly sent or delivered in accordance with this clause, it will be deemed to have been received as follows:

17.3.1 if delivered personally, at the time of delivery; or

17.3.2 if delivered by commercial courier, on the date and at the time of signature of the courier's receipt; or

17.3.3 if sent by pre-paid first class post or recorded delivery, 9.00 am on the second business day after posting; or

17.3.4 if sent by fax, at the time of transmission.

17.4 For the purposes of this clause if deemed receipt under this clause is not within business hours (meaning 9.00 am to 5.30 pm Monday to Friday on a day that is not a public holiday in the place of receipt), the notice or other communication is deemed to have been received when business next starts in the place of receipt.

17.5 To prove service, it is sufficient to prove that:

17.5.1 if sent by pre-paid first class post, the envelope containing the notice or other communication was properly addressed and posted; or

17.5.2 if sent by fax, the notice or other communication was transmitted by fax to the fax number of the party.

17.6 The provisions of this clause 17 shall not apply to the service of any proceedings or other documents in any legal action.

17.7 A notice or other communication required to be given under or in connection with this agreement shall not be validly served if sent by e-mail.

18. ANCILLARY PROVISIONS

18.1 For the avoidance of doubt, the fact that a Party may not, in this agreement, confirm expressly that it agrees with any statement made by another Party shall not be taken as implying that such Party disagrees with the statement concerned or considers it to be untrue or inaccurate.

18.2 Nothing in this agreement is intended to, or shall be deemed to, establish any legal partnership or joint venture between the Parties, constitute any Party the agent of the other, nor authorise a Party to make or enter into any commitments for or on behalf of the other.

18.3 This agreement constitutes the whole agreement between the Parties relating to its subject matter and supersedes all previous agreements between the Parties relating to its subject matter.

18.4 If there is an inconsistency between any of the provisions of this agreement and the schedules and/or any documents annexed, the provisions of this agreement shall prevail.

18.5 No variation or waiver of this agreement shall be effective unless it is in writing and signed by the Parties (or their authorised representatives). The rights of the Parties to agree any variation, waiver or settlement under this agreement is not subject to the consent of any person that is not a Party.

18.6 If any provision of this agreement (or part of any provision) is found by any court or other authority of competent jurisdiction to be invalid, illegal or unenforceable, that provision or part-provision shall, to the extent required, be deemed not to form part of this agreement, and the validity and enforceability of the other provisions of this agreement shall not be affected.

18.7 This agreement may be executed in any number of counterparts, each of which when executed shall constitute an original of this agreement, but all the counterparts shall together constitute the same agreement.

18.8 A person who is not a Party shall not have any rights under or in connection with this agreement by virtue of the Contracts (Rights of Third Parties) Act 1999.

18.9 This agreement and any dispute or claim arising out of or in connection with it or its subject matter shall be governed by and construed in accordance with the law of England and Wales.

18.10 Subject to clause 11, the Parties irrevocably agree that the courts of England and Wales shall have non-exclusive jurisdiction to settle any dispute or claim that arises out of or in connection with this agreement or its subject matter.

IN WITNESS of which this agreement has been signed by the Parties on the date appearing on the first page.

SCHEDULE 1

PREDICTED RESIDUAL EFFECTS OF BDSCT PROJECT

PART 1 – ADVERSE EFFECTS ON SPA, cSAC, RAMSAR SITE AND SSSI

1. Direct loss at the Avonmouth Site of:

1.1 2.0ha of intertidal mudflat forming part of the SPA and the cSAC;

1.2 a further 11.5ha of intertidal mudflat forming part of the cSAC; and

1.3 a further 20.0ha of intertidal habitat (including 0.5ha saltmarsh) forming part of the SSSI.

2. Localised alteration of the hydrodynamic regime leading to short to medium term functional change, as a result of significant accretion of fine sediments above background rates, in the vicinity of the Avonmouth Site to:

2.1 60.0ha of intertidal mudflat and 5.0ha of atlantic saltmarsh forming part of the SPA, the cSAC and the Ramsar Site; and

2.2 a further 15.0ha of intertidal mudflat forming part of the cSAC.

PART 2 - IMPLICATIONS OF ADVERSE EFFECTS ON SPA, cSAC, RAMSAR SITE AND SSSI

Details of the nature and scale of and implications for the SPA, cSAC, Ramsar Site and the SSSI of the predicted residual adverse effects set out in part 1 of this schedule are as set out in the Environmental Statement and the Habitat Compensation Note and may be summarised as follows.

1. Direct loss of 2ha of intertidal mudflat above mean low water forming part of the SPA and the cSAC.

- Intertidal area is adjacent to mudflat area that at times supports significant numbers of waterbirds, including SPA designated species. Displacement of birds that utilise this area into adjacent areas would occur. Given that the intertidal area immediately upstream (the Avonmouth Intertidal Area) would also be affected (indirectly) by the reclamation works (see paragraph 4 below), then this direct loss of intertidal habitat could be of greater significance when considered in combination.

2. Direct loss of a further 11.5ha of intertidal mudflat forming part of the cSAC (between mean low water and lowest astronomical tide)

3. Direct loss of a further 20.0ha of intertidal habitat (including 0.5ha saltmarsh) above mean low water forming part of the SSSI.

- Very limited use by birds. Some SPA designated species are present, but tend to utilise man made structures as a roost site.

- Displacement of birds to alternative areas around the port or in estuary would be likely to occur. Given small numbers this would be unlikely to increase pressure on other areas.

4. Localised alteration of hydrodynamic regime leading to changes in fine sediment accretion over the Avonmouth Intertidal Area.

- Significant accretion above background rates over the Avonmouth Intertidal Area (being an area of approximately 80ha of cSAC designated intertidal mudflat down to lowest astronomical tide (including approximately 65ha SPA/Ramsar intertidal mudflat and saltmarsh)). Accretion is predicted to occur rapidly for a period of up to 3 years over the existing intertidal mudflat during and following the construction of the Breakwater and quay wall forming part of the BDSCT , resulting in the deposition of approximately 1-2m of mud over this area before stabilisation approximately 2 years later. Towards MLW and into the shallow subtidal greater accretion is expected and in total it is predicted that up to 7m of mud will accumulate in this area and closest to the Avonmouth Site with progressively less sediment moving upstream.

- Short term (up to 5 years) perturbation in the functional ecology of the Avonmouth Intertidal Area as a result of the rate and amount of accretion adversely affecting the ability of infauna to keep pace with deposition potentially resulting in mortality. Effect would be likely to diminish over time as accretion reduced and the infauna recolonised and formed a stable community (1-2 years following the predicted 1-3 year rapid phase of accretion).

- Area likely to be affected by accretion supports significant numbers of waterbirds during the winter period, and occasionally on passage, including species forming part of the SPA designated populations. The full value of the habitat will not be lost, but alterations in infaunal communities could result in a potential temporary reduction in prey availability. Birds that currently use the Avonmouth Intertidal Area could be displaced to other parts of the estuary during this period, thus increasing pressure on food resources and competition with other birds in these areas.

- Longer term increase (by approximately 40ha) in total area of mudflat at this location as a result of further accretion around mean low water.

- Longer term increase in extent of saltmarsh vegetation due to the accretion and increased height of part (5-10ha) of the upper intertidal area in the tidal frame.

PART 3 – OTHER EFFECTS ON SPA, cSAC, RAMSAR SITE AND SSSI

On the basis, where appropriate, that the Mitigation Plan is fully implemented and effective, the residual effects of the BDSCT Project summarised in this part 3 of schedule 1 are not likely to result in an adverse effect (including any adverse effect within the meaning of Regulation 48 of the Habitats Regulations) on any of the SPA, cSAC, Ramsar Site and SSSI. Details of the nature and scale of and implications for the SPA, cSAC, Ramsar Site and the SSSI of these predicted residual adverse effects are as set out in:

(a) the Environmental Statement;

(b) the Habitat Compensation Note;

(c) the technical note entitled "Bristol Deep Sea Container Terminal – subtidal *Sabellaria alveolata* reefs in the Severn Estuary" dated December 2008 by Richard M Warwick D.Sc, PhD; and

(d) the technical note entitled "Bristol Deep Sea Container Terminal – Natural Fish Resources Including Migratory Species in the Severn Estuary" dated December 2008 produced by Peter Henderson and Royal Haskoning

and, so far as they are material, may be summarised as follows.

Key activity/effect	Designated feature/objective
Reclamation of foreshore	
Loss of 22ha of subtidal habitat forming part of the designated cSAC, not forming part of the sandbanks cSAC or reef interests; constitutes approximately 0.03% of the total estuary cSAC subtidal feature and 0.04% of subtidal area, comprising muds with very limited infauna.	Extent of the estuary and extent, variety and spatial distribution of cSAC estuarine habitat communities.
Terminal construction and operation	
Increase in human activity and background airborne and underwater noise and vibration levels during construction (including piling, placement of caissons, infilling etc.).	Migratory passage of adult and juvenile fish through the Severn Estuary between the Bristol Channel and any of their spawning rivers, including the River Usk SAC and River Wye SAC
Increase in noise levels and human activity causing disturbance to and potential displacement of birds from roost sites and areas used for feeding in and around the port	Designated SPA, Ramsar and SSSI waterbird populations
Capital dredging of the approach channel turning circle and berths	
Hydrodynamic change associated with alteration of bathymetry and channel cross section caused by increase in water depth due to removal of sediment	Characteristic physical form (tidal prism/cross sectional area) and flow (tidal regime) of the estuary and extent, variety and spatial distribution of cSAC estuarine habitat communities
Potential alteration of subtidal habitat within	Extent, variety and spatial distribution of cSAC

the turning area as a result of sediment removal	estuarine habitat communities
Potential alteration of subtidal habitat, including loss of and damage to existing Sabellaria reef, if present, within the dredge footprint caused by removal of sediment from within the footprint of the proposed approach channel to attain navigable depth	Extent, variety and spatial distribution of cSAC estuarine habitat communities and total extent and distribution of Sabellaria reef and the physical and ecological processes that support Sabellaria reef habitat
Potential disruption to sediment feed to cSAC sandbanks feature and/or loss of mobile sediment resource caused by removal of sediment from within the footprint of the proposed approach channel to attain navigable depth	Characteristic range and relative proportions of cSAC sediment sizes and sediment budget and extent of the cSAC subtidal sandbanks.
Increase in background underwater noise and vibration levels during dredging	Migratory cSAC fish populations and other migratory species such as salmonids and eels, on their migration to/from the Severn and the Wye and Usk River SACs
Dispersal and disposal of capital dredged material	
Increase in tidal fluxes of sediment leading to additional intertidal accretion due to increased suspended sediment concentrations (SSC) during dredging	Extent, community composition and topography and morphology of cSAC intertidal mudflats and sandflats and Atlantic saltmeadows
Potential avoidance of areas of areas of high SSC and displacement of fish populations in area affected by increased SSC during dredging	Migratory passage of both adult and juvenile fish through the Severn Estuary between the Bristol Channel and any of their spawning rivers, including the River Usk SAC and River Wye SAC
Longer term fate of the release, dispersal and deposition of fines during dredging and disposal activities	Range and relative proportions of sediment sizes and sediment budget and extent, variety and spatial distribution of estuarine habitat communities within the site
Potential smothering or potential change in benthic assemblage caused by placement of sediment at an offshore disposal site in an area where material has not been previously deposited	cSAC estuarine habitat communities, including *Sabellaria* reef habitat if present within the footprint of the disposal site
Localised change in the bathymetry and potential hydrodynamic consequences caused by placement of sediment at an offshore disposal site in an area where material has not been previously deposited	Characteristic physical form (tidal prism/cross sectional area) and flow (tidal regime) of the estuary
Transport of fine sediment from the disposal site	Range and relative proportions of sediment sizes and sediment budget, extent and community composition of the cSAC subtidal sandbanks

Maintenance dredging of berths and turning circle	
Sediment plume and increased SSC during dredging and disposal activities	Water quality and ecology (including designated fish population of the Severn Estuary cSAC, the River Usk SAC and the River Wye SAC)
Deposition of sediment from the sediment plume over intertidal areas	Composition and diversity of cSAC benthic communities of intertidal mudflats and sandflats
Periodic disturbance of sediment within the footprint of the berths and the turning circle	Benthic communities within the cSAC designated habitat in the footprint of the turning circle and berths.
Maintenance dredging of the approach channel	
Periodic disturbance of sediment within the footprint of approach channel	Benthic communities within the cSAC designated habitat in the approach channel
Placement of sand at the deep water disposal site	Characteristic range and relative proportions of cSAC sediment sizes and sediment budget, extent and community composition of the cSAC subtidal sandbanks

SCHEDULE 2

COMPENSATION SCHEME

PART 1 – DESIGN

1. The Compensation Scheme shall comprise the creation of new habitat in accordance with the applicable Realignment Consents (which in turn will be in accordance with a scheme agreed between FCS, NE and the RSPB and based on, but not limited to, the preliminary modelling described at paragraph 7 of the Habitats Compensation Note), and in order so far as practicable to enable the fulfilment of the requirements of and the achievement of the objectives set out in part 2 of schedule 2, by measures including but not limited to:

1.1 re-profiling of the site as necessary;

1.2 construction of appropriate breaches in and/or reductions in the height of any existing flood banks and/or sea defences; and

1.3 design and construction of appropriate tidal creeks.

2. In circumstances where the Compensation Scheme is implemented within the TBPC Steart Site in conjunction with the EA's implementation of any part of the EA Steart Peninsula Scheme:

2.1 in determining the detailed design of the new habitats to be created under paragraph 1 (including, without limitation, the extent of necessary re-profiling of the site and the appropriate design of tidal creeks) there shall be taken into account the consequences and potential benefits of the Compensation Scheme being implemented within the TPBC Steart Site in conjunction with the EA's implementation of any part of the EA Steart Peninsula Scheme and the objective of enabling, so far as practicable within the requirements of the Compensation Scheme, the movement of tidal waters across the Managed Realignment Site and the area on which the EA Steart Peninsula Scheme is being implemented;

2.2 may include appropriate floodbanks, either solely or in conjunction with the EA, as advised by the EA to protect people and property to a specification approved by the EA and in line with EA guidance; and

2.3 the design of the Compensation Scheme may include any further measures affecting the TBPC Steart Site which may after the date of this agreement be agreed between FCS and EA in their respective discretions (and approved by the other Parties after consultation with the Environmental Steering Group) so as to facilitate the implementation by EA of the relevant part of the EA Steart Peninsula Scheme and (if applicable) so as not to prejudice EA's future ability to implement the remainder of the EA Steart Peninsula Scheme, in each case in so far as this is practicable within the requirements of the Compensation Scheme.

3. In circumstances where the Compensation Scheme is implemented within the TBPC Steart Site other than in conjunction with the EA's implementation of any part of the EA Steart Peninsula Scheme the detailed design of the Compensation Scheme:

3.1 shall include appropriate floodbanks, either solely or in conjunction with the EA, as advised by the EA to protect people and property to a specification approved by the EA and in line with EA guidance; and

3.2 may include any further measures affecting the TBPC Steart Site which may after the date of this agreement be agreed between FCS and EA in their respective discretions (and approved by the other Parties after consultation with the Environmental Steering Group) so as not to prejudice, so far as practicable within the requirements of the Compensation Scheme, EA's future ability to implement the EA Steart Peninsula Scheme.

PART 2 – NATURE, EXTENT AND OBJECTIVES

1. FCS shall carry out the Compensation Scheme so far as is reasonably practicable to enable the following objectives to be met:

1.1 the offsetting of any potential residual loss and reduction in functionality of the Avonmouth Intertidal Area to the SPA, cSAC and Ramsar site which is likely to result from the development of the BDSCT Works, as summarised in paragraph 4 of part 2 of schedule 1 and described in further detail in the Habitat Compensation Note;

1.2 the development of a managed re-alignment site on the Severn Estuary that offers the potential for the development of intertidal habitat and that will over time contribute to the overall form and ecological function of the Severn Estuary and its designated nature conservation interests and the overall coherence of the Natura 2000 network;

1.3 the provision, in total, of a minimum of 120ha of estuarine intertidal habitat comprising a mix of mudflat and saltmarsh and that is characteristic of the central English section of the Severn Estuary;

1.4 the Compensation Scheme being fully functional before the predicted damage to the Avonmouth Intertidal Area summarised in paragraph 4 of part 2 of schedule 1 and further described in the Habitat Compensation Note occurs (in this context, "fully functional" meaning that the Compensation Scheme should be fully operational and have been subject to tidal inundation for a minimum of two winters, and "winter" meaning the minimum period of December to February (inclusive));

1.5 within 10 years of becoming fully functional (as defined in paragraph 1.4), the Compensation Scheme site being of sufficient quality to qualify for designation as an extension to the SPA, cSAC and Ramsar site;

1.6 the provision for up to 5 years of an intertidal resource that has the capability to support an invertebrate and waterbird assemblage that is representative of the mudflats that occur in the Avonmouth Intertidal Area and central English section of the Severn Estuary;

1.7 the provision in the longer term of a mix of intertidal habitats with at least 20ha of intertidal mudflat;

1.8 the provision of a minimum of 5ha of intertidal saltmarsh habitat that is representative of typical saltmarsh vegetation communities that occur in the Avonmouth area and central English section of the Severn Estuary;

1.9 the provision of a habitat creation scheme that is sustainable in the long-term and where habitats are permitted to develop naturally without repeated ongoing management; and

1.10 the relocation of existing public rights of way to the rear of the new seawalls and the prevention of wildfowling on or over the intertidal areas created so as to limit disturbance of waterbirds and assist in securing the objective set out in paragraph 1.5 above.

2. The Compensation Scheme shall be designed so that the managed realignment site taken together with the Avonmouth Intertidal Area:

2.1 shall provide intertidal mudflat as a feeding resource for waders and waterfowl;

2.2 is (subject to paragraph 3 below) capable of supporting an assemblage of waterbirds comprising up to approximately 3,000 waterbirds during the winter (October-March) months including (in order of contributory significance), dunlin, redshank, mallard, gadwall, teal, shelduck, oystercatcher, curlew and ringed plover with occasional use by flocks of lapwing.

3. FCS shall carry out further bird count monitoring during the winter (October-March) months 2008/9 and 2009/10 in accordance with the methodology set out in annex 3 and shall report the results of that monitoring to the other Parties and to the Environmental Steering Group. In the light of that reporting and in particular the recorded mean peak populations of such counts and counts carried out in the winter (October-March) months 2006/7 and 2007/8 FCS, NE and the RSPB shall (after consultation with the Environmental Steering Group) agree an adjusted waterbird target for the Compensation Scheme and Avonmouth Intertidal Area taken together based on mean peak waterbird counts, which mean peak target shall apply for the purpose of paragraph 2.2 above in substitution for the peak figure stated there (which figure shall no longer apply).

PART 3 – TIMING

1. FCS shall implement the Compensation Scheme at the Managed Realignment Site in accordance with this agreement.

2. Following commencement of the implementation of the Compensation Scheme, FCS shall use reasonable endeavours to ensure the Breach is carried out as soon as is reasonably practicable after having regard to the Compensation Scheme and the objectives set out in part 2 of this schedule.

PART 4 – MANAGEMENT

1. Following the Breach FCS shall to the extent necessary to ensure compliance with legislation relating to health and safety be responsible for maintaining any structures and other infrastructure constructed as part of the Compensation Scheme.

2. FCS shall not, by virtue of this agreement, have any responsibility to NE, the RSPB or the EA for the maintenance of any sea wall or flood bank which may currently exist on or adjacent to the TBPC Steart Site as altered by the Breach or which may be constructed as part of the EA Steart Peninsula Scheme.

3. If any new sea wall or flood bank is constructed by FCS as part of the Compensation Scheme, then FCS shall be responsible for the maintenance of that sea wall or flood bank until any other appropriate body shall assume responsibility for that maintenance.

SCHEDULE 3

MONITORING SCHEME

PART 1 – AGREEMENT AND IMPLEMENTATION OF THE MONITORING SCHEME

1. Except to the extent that NE, the RSPB and EA may agree otherwise in relation to any particular monitoring measure, FCS shall not commence implementation of the BDSCT Works until it has prepared and agreed with the other Parties the details of a scheme of monitoring (the Monitoring Scheme) which shall comprise:

1.1 monitoring of the effects of the BDSCT Works in relation to the parameters and at the locations specified in the Outline Monitoring Scheme; and;

1.2 monitoring of the Compensation Scheme, where appropriate in conjunction with the Avonmouth Intertidal Area.

2. The details of the Monitoring Scheme to be agreed shall include methodologies, baselines, frequency and timescale of monitoring measures and shall be based on the Outline Monitoring Scheme. Any requirements of the Compensation Monitoring shall take into account any monitoring required by the Realignment Consents.

3. Except to the extent that the other Parties may (after consultation with the members of the Environmental Steering Group) agree otherwise, FCS shall, if it commences implementation of the BDSCT Works, implement the Monitoring Scheme).

4. In preparing and approving the Monitoring Scheme, or giving any approval under paragraph 3 above, each Party shall consult with and take into account the views expressed by each member of the Environmental Steering Group in accordance with schedule 6.

PART 2 – COMPENSATION MONITORING REPORTING

1. If and to the extent that the Compensation Scheme has been implemented, the details and findings of the Compensation Monitoring shall be reported in writing by FCS to the other Parties and at a meeting of the Environmental Steering Group not less frequently than once every twelve months throughout the relevant monitoring period. The report shall also be made publicly available as part of an Annual Monitoring Report published by the Environmental Steering Group.

2. In the reporting referred to in paragraph 1 above FCS shall set out:

2.1 the extent to which, as revealed by the Compensation Monitoring, the objectives set out in part 2 of schedule 2 are being achieved;

2.2 to the extent that such objectives are not being achieved, the actions that it proposes to take in order to overcome the issues identified; and

2.3 such other recommendations as FCS may consider should be carried out in light of the results reported and the objectives set out in part 2 of schedule 2 (including, without limitation, changes to or extension of the Compensation Scheme and the Compensation Monitoring)

and where the other Parties so approve (after consultation with the members of the Environmental Steering Group) the Compensation Scheme and the Compensation Monitoring shall be changed in accordance with FCS's proposals and

recommendations with such modifications as the Parties may (after consultation with the members of the Environmental Steering Group) approve and the terms of this agreement shall apply to such items as so-varied.

SCHEDULE 4

MITIGATION PLAN

1. FCS shall not commence implementation of that part of the BDSCT Works set out in column A in the table below until it has prepared and agreed with the other Parties the detail of the corresponding mitigation measures set out in column B, including, without limitation, the corresponding details and other matters set out in column C. Column D sets out the relevant designated and other interests to be protected by the corresponding mitigation measures. As its measures are developed, the Mitigation Plan shall be compiled into one document for ease of reference.

2. Except to the extent that the NE and the RSPB agree otherwise, in carrying out the BDSCT Works FCS shall implement the Mitigation Plan.

3. In preparing and approving the Mitigation Plan, or giving any approval under paragraph 2 above, FCS, NE and the RSPB shall consult with and take into account the views expressed by each member of the Environmental Steering Group in accordance with schedule 6.

OUTLINE MITIGATION PLAN			
A	***B***	***C***	***D***
Relevant part of the BDSCT Works	***Relevant monitoring and/or mitigation measures***	***Relevant details to be included***	***Relevant designated interests***
Site clearance activities	The provision during each breeding season of an area or areas of 2ha in aggregate of appropriate habitat for breeding ringed plover displaced by the carrying out of the BDSCT Works	Location of the habitat, which shall be within the Port estate but not the Breakwater; but which may be a different location or combination of locations in each breeding season Methodology for creation of the habitat Timing for creation of the habitat	Non-designated but regionally important breeding population
Demolition of the disused oil jetty	The provision of appropriately designed structures on the Breakwater to accommodate roosting birds displaced by the construction of the BDSCT, including redshank and ringed plover	Location and design of the roosting structures Management measures to be implemented in the vicinity of the roosting structures to minimise	SPA, Ramsar, cSAC and SSSI waterbirds

	ringed plover	disturbance to roosting birds	
Construction and operational activity adjacent to the Avonmouth Intertidal Area	The provision of a screen or bund at the upstream end of the new quay to be constructed as part of the BDSCT Works to minimise disturbance to water birds using the Avonmouth Intertidal Area by the construction of the BDSCT Works and the operation of the Terminal. Also to include appropriate measures to restrict or minimise potential disturbance due to human activity including access, noise and dust generation and the influence of lighting.	Location and design of the screen or bund; other measures to minimise human impacts	SPA, cSAC, Ramsar and SSSI waterbirds
Land reclamation/fill activities	The translocation of strandline vegetation and associated invertebrate communities	Location and methodology of the translocation, as advised by FCS's entomologist Timing for the translocation, as advised by FCS's entomologist but which shall in any event require implementation of the translocation before the commencement of any marine reclamation works	SSSI
Land reclamation/fill activities	The re-creation/translocation of ditch and bank invertebrate communities	Location and methodology of the translocation, as advised by FCS's entomologist Timing for the translocation, as advised by FCS's entomologist but which shall in any event require implementation of the translocation before the commencement of any land/marine	None

		reclamation works that could affect this area	
Piling activities	Methodology to be adopted by FCS in carrying out any piling activities comprised in the BDSCT Works which shall be designed to minimise any potential impacts of piling activities on estuarine and migratory fish and any potential disturbance to water birds	Adopting an appropriate soft start methodology Avoidance of piling during the night and during statutory severe weather wildfowling bans on the Severn Estuary FCS will give proper consideration to undertaking any percussive piling works in relation to the construction of the new quay within the 2ha intertidal area comprised in the cSAC and the SPA so as to avoid such percussive piling during the months of December to February (inclusive), but only to the extent that this is practicable without causing delay to the construction programme for the works	cSAC: migratory fish species – twaite shad, sea lamprey, river lamprey SPA, cSAC, Ramsar and SSSI waterbirds that may be utilising adjacent areas of intertidal mudflats
Construction activities (excluding any dredging/disposal activities)	Methodology to be adopted by the construction contractor to ensure adherence during construction works to the EA's Pollution Prevention Guidelines for working on construction sites (PPG6) and other relevant EA Guidelines	Development of an Environmental Action Plan (EAP) to be provided to contractors and which incorporates all necessary statutory and/or good practice guidelines	SPA, Ramsar, cSAC and SSSI
Reclamation works and construction of the Breakwater	Measures to ensure the continued presence of freshwater flow across the Avonmouth Intertidal Area	Monitoring of intertidal morphology during construction and period of rapid accretion over Avonmouth Intertidal Area Where appropriate,	SPA, cSAC and Ramsar waterbirds, particularly feeding/preening waterfowl, notably gadwall and teal

		removal of any sediment causing a significant blockage to continued flow presence across the intertidal area	

SCHEDULE 5

CONSENTS

1. An order under section 14 of the Harbours Act 1964 which, inter alia, authorises FCS to carry out the BDSCT Works, except for the disposal of dredged arisings.

2. Consent under the Coast Protection Act 1949 and the Food and Environment Protection Act 1985 for dredging and the disposal of dredged arisings under reference 2097.

3. Consent under the Coast Protection Act 1949 and the Food and Environment Protection Act 1985 for marine construction works bearing statutory reference 2010.

SCHEDULE 6

ENVIRONMENTAL STEERING GROUP

PART 1 – PROCEEDINGS

1. FCS shall, as soon as practicable after the Consents are granted (and at the latest within six months of that date) establish the Environmental Steering Group, which shall comprise the Parties, the other persons set out in part 2 of this schedule and such other persons as the Environmental Steering Group may from time to time agree to invite to participate, which invitation may (as the Environmental Steering Group deems appropriate) be limited to involvement in specific areas of interest and/or for specific periods only.

2. The terms of reference of the Environmental Steering Group shall include:

2.1 the review of alternative proposals made by FCS under clause 7.4;

2.2 the review of the detailed mitigation measures to be contained in the Mitigation Plan and proposals for any derogations by FCS from the Mitigation Plan pursuant to paragraph 2 of schedule 4;

2.3 the review of any measures to be included in the detailed design of the Compensation Scheme pursuant to paragraphs 2 and 3 of part 1 of schedule 2;

2.4 the review, for the purpose of paragraph 3 of part 2 of schedule 2 (nature, extent and objectives of the Compensation Scheme) of the results of the additional bird count monitoring undertaken by FCS during the winters of 2008/9 and 2009/10 and consideration in the light of that reporting and counts carried out in the winters of 2006/7 and 2007/8 of an appropriate adjusted waterbird target for the Compensation Scheme and Avonmouth Intertidal Area for the purpose of paragraph 2.2 of part 2 of that schedule;

2.5 the review of the detailed monitoring measures to be contained in the Monitoring Scheme (so including the detailed requirements of the Compensation Monitoring);

2.6 the review of the details and findings of all monitoring carried out under the Monitoring Scheme (so including the Compensation Monitoring);

2.7 the review, pursuant to paragraph 2 of part 2 of schedule 3 of proposals and recommendations made by FCS in relation to modifications to the Compensation Scheme and the Compensation Monitoring and the consideration of further modifications to the same;

2.8 the review, pursuant to clause 5.5 of any proposals for alternative sites on which the Compensation Scheme might be implemented;

2.9 based on the reviews carried out in accordance with paragraphs 2.1 to 2.8 of this schedule, to advise FCS on any matters arising; and

2.10 to produce and make available to the public an annual monitoring report summarising the findings of the monitoring undertaken under the Monitoring Scheme.

3. FCS shall arrange that the Environmental Steering Group shall meet at least once a year after the Consents are granted. FCS shall be responsible, at its own cost, for

providing a venue for those meetings (which may be at FCS's own premises at the Port of Bristol) and shall be responsible for preparing and circulating an agenda for and minutes of the meetings but otherwise the ordinary expenses of members of the Environmental Steering Group, including travel and attendance at meetings, will be borne by those members.

4. The business of the Environmental Steering Group may also be conducted (in addition to proceedings at meetings) through correspondence in writing, telephone and by email.

5. The Environmental Steering Group shall be disbanded on the completion of the programme of monitoring measures required by the Monitoring Scheme, or at such earlier time as the members of the Environmental Steering Group shall agree.

PART 2 – ADDITIONAL PERMANENT MEMBERS

MEMBER	CONTACT AND ADDRESS DETAILS
The Countryside Council for Wales	Dr S C Howard Arweinydd Tîm - Caerdydd a Chasnewydd/Team Leader, Cardiff and Newport Cyngor Cefn Gwlad Cymru/ Countryside Council for Wales Uned 7, Cwrt Castleton, Lôn Fortran, Llaneirwg, Caerdydd, CF3 0LT Unit 7 Castleton Court, Fortran Road, St Mellons, Cardiff CF3 0LT Ffon/TEL : 02920 772400 FAX : 02920 772412 Mobile 07818 097613 E-bost/E-MAIL: s.howard@ccw.gov.uk
Bristol City Council (in respect of Terrestrial Ecology issues only)	Helen Hall Nature Conservation Officer Dept of Culture and Leisure Services Bristol Park Colston 33 Colston Avenue Bristol BS1 4AU
Avon Wildlife Trust	Sian Parry Avon Wildlife Trust 32 Jacobs Wells Road Bristol BS8 1DR

Signed for and on behalf of)
FIRST CORPORATE SHIPPING LIMITED)

[redacted]

Signed for and on behalf of)
NATURAL ENGLAND)

Signed on behalf of)
THE ROYAL SOCIETY FOR THE)
PROTECTION OF BIRDS)
acting by a director)
in the presence of:)

[redacted]

[redacted]

Signed as an agreement by)
[redacted])
as the Attorney for and on behalf)
of **THE ENVIRONMENT AGENCY**)
in the presence of :-)

[redacted]

[redacted]

ANNEX 1

OUTLINE MONITORING SCHEME

OUTLINE MONITORING PLAN

ID	Description of Monitoring	Purpose of Monitoring	Outline Monitoring Methods	Location	Frequency/Timescale*
HYDRODYNAMIC, SEDIMENT AND GEOMORPHOLOGICAL MONITORING					
1	Subtidal and intertidal bathymetry surveys	To monitor the effects of BDSCT and to verify modelling predictions	Vessel based multibeam bathymetry	- Terminal, including the Avonmouth and Portbury intertidal areas - Deep water channel in the vicinity of the Bridge - Bridgwater Bay, fronting Managed Realignment Site - Disposal sites and surrounding area	Pre-construction baseline survey Annual surveys during construction and 2 surveys spread over a period of up to 3 years post construction
2	Airborne topography/bathymetry survey of intertidal areas	To monitor the effects of BDSCT, to verify the modelling predictions and to measure the development of the proposed compensation scheme	LiDAR and aerial photography, including fixed point photography to indicate profile and habitat evolution. Ground truthing with vessel-based bathymetry and selected cross sections. To include monitoring of the topography/bathymetry of the Avonmouth intertidal area and influence of changes on outfalls/rhines**	- Terminal, including the Avonmouth and Portbury intertidal areas - Bridgwater Bay fronting Managed Realignment Site - Managed Realignment Site (after breach)	2 LiDAR surveys (March/September) and 4 ground truth/profile surveys per year Pre-construction baseline surveys Annual surveys during construction and 4 surveys spread over a period of up to 5 years post construction**
3	Characterisation of dredging and disposal activities	To characterise dredge and disposal activities and verify modelling predictions	Vessel mounted vertical profiling, measuring suspended sediments/turbidity, conductivity, temperature, depth, dissolved oxygen, water samples, turbidity & ADCP. Measurements taken outside the plume (baseline) and traversing the plume	In vicinity of dredge and disposal operations during initial phase of each type of dredging	2 days plume characterisation monitoring during the early stages of each of the following activities: agitation, trailer and cutter suction dredging and disposal activities***
4	Characterisation of dredged mudstone and behaviour of material at the disposal site	To characterise dredge and disposal activities and verify modelling predictions	Sampling of dredged mudstone from barges, including particle size distribution, localised bed sampling within disposal site, vessel mounted ADCP & bathymetry of disposal locations	Sampling of part loaded barges at the dredge site, sampling of barges on route to disposal site and bed sampling around dredge and disposal activities	Characterisation monitoring undertaken during initial mudstone dredging and then again if operations change
5	Hydrodynamic monitoring	To verify modelling predictions	Deployment of two bed frames with ADCP and turbidity sensors	One near deep water disposal site and one near Terminal	Pre-construction baseline monitoring with 1 month deployment at both locations
6	Water quality monitoring over intertidal areas	To monitor the effects of BDSCT and verify modelling predictions	Water sampling for a range of contaminants during dredging or disturbance of silts in the footprint of the works	In vicinity of Terminal during dredging of fines	3 sampling campaigns during construction
7	Sediment sampling to characterise the sea bed	To monitor the effects of predicted sediment processes on the invertebrate fauna over affected mudflat areas and measure the development of and potential impacts of the proposed compensation scheme in line with the objectives set out in Schedule 2 of the MCMA	Grab sampling, with particle size analysis (and organic content - Stuart only) linked to items 8 and 9	- Avonmouth and Portbury intertidal areas - Bridgwater Bay (selected sites, including front of Managed Realignment Site and subtidal accretion area) - Disposal site - Managed Realignment Site (after breach)	Annual surveys during construction and over a period of up to 5 years post construction - link to items 8 and 9
ECOLOGICAL MONITORING					
8	Intertidal invertebrate assemblage	To monitor the effects of predicted sediment processes on the invertebrate fauna over affected mudflat areas and measure the development of and potential impacts of the proposed compensation scheme in line with the objectives set out in Schedule 2 of the MCMA	Grab sampling, or other appropriate technique, recording species diversity, biomass and abundance - link to sediment sampling and particle size analysis above	- Avonmouth and Portbury intertidal areas - Selected sites in Bridgwater Bay, notably in front of Managed Realignment Site - Managed Realignment Site (after breach)	Pre-construction baseline Avonmouth and Portbury intertidal areas Annual surveys during construction and over a period of up to 5 years post construction
9	Subtidal invertebrate assemblage	To monitor the effects of the disposal of dredged sediment and potential changes within Bridgwater Bay	Grab sampling, or other appropriate technique, recording species diversity, biomass and abundance - link to sediment sampling and particle size analysis above	Disposal site	Pre-construction baseline*** 3 annual surveys following cessation of disposal spread over a period of up to 5 years post construction
				Bridgwater Bay subtidal mud area	Pre-construction baseline 1 survey during construction and 2 surveys spread over a period up to 5 years post construction
10	Habitat mapping and saltmarsh vegetation surveys	To monitor the effects of predicted sediment processes on the formation and development of saltmarsh vegetation as a result of the BDSCT. Measure habitat development at the compensation scheme in line with the objectives set out in Schedule 2 of the MCMA	Mapping of the distribution of intertidal and transitional habitats, including survey of saltmarsh distribution and species composition - link with LiDAR and aerial photography surveys above	Avonmouth intertidal area	Annually, during construction and for a period of up to 5 years post construction
				Within and in the vicinity of Managed Realignment Site	Annually following breach of compensation site and for a period of up to 10 years post breach
11	Intertidal waterbird usage	To monitor the effects of the BDSCT on usage of areas of importance for waterbirds. To measure the success of mitigation measures and the proposed compensation scheme in line with the objectives set out in Schedule 2 of the MCMA	3 counts per month (one high tide, one low tide and one mid tide (falling and/or rising tides)). Counts to be undertaken to co-ordinate with either Spring or Neap tide conditions. With the exception of Avonmouth intertidal area where there will be 4 counts in total, including an additional low water count.	- Avonmouth and Portbury intertidal areas - Managed Realignment Site, including 3km length of intertidal area fronting the Managed Realignment Site (WeBS data used for Bridgwater Bay to provide context)	Monthly counts during overwinter (Oct-Mar) and passage (July-Sep and April-June) periods in advance of construction, during construction and for a minimum of 5 years post construction
			2 counts per month (one high tide and one low tide)	Existing intertidal within footprint of Terminal	Monthly counts during overwinter period (Oct-Mar) in advance of construction
12	Terrestrial waterbird usage (roosting and breeding birds in Avonmouth)	To monitor the effect and success of proposed mitigation measures	1 count per month (high tide) during the overwinter and passage periods.	Breakwater and other potential roost sites	Monthly counts during overwinter (Oct-Mar) and passage (July-Sep and April-June) periods in advance of construction, during construction and for a minimum of 5 years post construction
			4 surveys during breeding season	Selected areas for breeding ringed plover	Breeding surveys during construction and for a period of up to 5 years post construction
13	Terrestrial invertebrate assemblage	To monitor the effect and success of mitigation measures	Invertebrate sampling, recording species diversity and abundance (focused largely, but not exclusively, on the coleopteran interest)	- Relocated strand line debris	At appropriate intervals over a period of up to 5 years post relocation / creation.
			Invertebrate sampling, recording species diversity and abundance (focused largely, but not exclusively, on the aculeate hymenopteran assemblage)	- New bank habitat	
14	Terrestrial ecology	To monitor the effect and success of proposed mitigation measures	Monitoring of Ditander translocation (plant presence and abundance)	- plant (Ditander) translocation site in port estate	At appropriate intervals over a period of up to 5 years post relocation / creation.
SITE INVESTIGATION					
15	Site investigation of sediment/soil in BDSCT footprint for engineering / construction purposes	To provide information necessary for detailed design, tender and contract award for terminal construction and capital dredge and disposal operations	Borehole and vibrocore site investigation, with laboratory testing to characterise seabed materials, including particle size analysis	BDSCT footprint and navigation channel	Pre-construction baseline
BATHYMETRIC SURVEY FOR SAFETY OF NAVIGATION					
16	Additional bathymetric surveys and sediment sampling for navigation purposes	To ensure safety of navigation and verification of modelling predictions	Vessel based multibeam bathymetry and sediment sampling	To include BDSCT navigation channel, mouth of River Avon, anchorage areas in Newport Deep and other port approaches as agreed with other harbour authorities	Pre-construction baseline Surveys during construction and for a period following cessation of dredging and disposal (timing and frequency of surveys to be agreed with other Harbour Authorities)
AGGREGATE RESOURCE MONITORING					
17	Sea bed sediment sampling for monitoring aggregate resource (link to BDSCT marine aggregate mitigation plan)	A component of the BDSCT marine aggregate mitigation plan and verification of modelling predictions	Sea bed sampling programme, including vibrocore sampling for baseline survey and grab sampling during construction	Aggregate dredge licence and application areas (some additional potential aggregate resource areas included in baseline survey)	Pre-construction baseline Surveys during construction and up to 5 years following cessation of dredging and disposal (timing and frequency of surveys to be agreed with Aggregate Dredge Companies)
MANAGEMENT AND CO-ORDINATION OF MONITORING PROGRAMME					
18	Management and co-ordination of monitoring programme, including analysis and dissemination of results to Environmental Steering Group	To ensure the development and maintenance of an effective monitoring programme, efficient exchange of information, and development of required monitoring plans through effective consultation with key environmental stakeholders	- Detail and programme of monitoring plan to be agreed with Environmental Steering Group - Ecological survey work and data analysis to be independent of "SPC - Dissemination of survey data and results to Environmental Steering Group, including meetings to review results and adjusting programme accordingly (see Notes ** and *** below)		Meetings with Environmental Steering Group as required (minimum 1 per year) Annual reporting of results

Notes:

* Frequency and timescale of monitoring will be adapted in response to the review of monitoring results and agreement of the Ecological Steering Group e.g. overall monitoring timescale is proposed to be up to 5 years post construction, and will then be subject to review by the ESG depending on the outcome of monitoring work

** Monitoring of the topography/bathymetry of the Avonmouth intertidal area will provide an indication of the potential effects of accretion on the outfalls/rhines and flows across the intertidal area. If significant accretion is recorded which adversely affects freshwater flows, then this will be discussed with the ESG and suitable measures to avoid or reduce potential impacts implemented, as necessary. Such measures, may include the removal of any sediment causing a significant blockage to continued flow presence across the intertidal area, if appropriate.

*** Monitoring of suspended sediment levels during the characterisation of dredging and disposal activities will be used to verify modelling predictions. If suspended sediments are significantly above the predicted levels, thus increasing the potential for significantly increased turbidity and accretion above background levels, then this will be discussed with the ESG and suitable measures to avoid or reduce potential impacts considered and implemented, as necessary. Such measures, may include the survey of the distribution of the known *Zostera* beds and migratory fish populations in the River Severn and, if considered appropriate, the Rivers Wye and Usk.

**** The pre-construction survey of the disposal site will indicate the presence/absence of *Sabellaria* reef. If *Sabellaria* populations are recorded that would constitute 'reef' habitat (using the adopted CCW/NE criteria) then this will be discussed with the ESG and suitable measures to avoid or reduce potential impacts implemented. Such measures may include modification to the extent and area covered by the disposal site, if appropriate.

Requirement for additional monitoring for the Stuart compensation / managed realignment scheme will be identified through the Stuart Environmental Impact Assessment process and will be incorporated in the BDSCT monitoring plan

Requirement for additional monitoring for BDSCT capital and future maintenance dredging may be identified through the FEPA/CPA consent process and will be incorporated in the BDSCT monitoring plan

Requirement for additional monitoring of hydrodynamic parameters may be identified through the ongoing implementation of the Water Framework Directive

ANNEX 2

HABITAT COMPENSATION NOTE

BRISTOL DEEP SEA CONTAINER TERMINAL
Note on habitat compensation issues

FINAL NOTE

18th December 2008

9R4093

A COMPANY OF

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Document title	BRISTOL DEEP SEA CONTAINER TERMINAL – Note on habitat compensation issues
Document short title	Note on habitat compensation issues
Status	Final
Date	18th December 2008
Project name	Bristol Deep Sea Container Terminal
Project number	9R4093
Client	The Bristol Port Company
Reference	9R4093/R/301721/Exet

CONTENTS

1 INTRODUCTION

This note sets out contextual information relating to the potential requirement for the provision of compensatory habitat (under the Habitats Regulations) associated with the proposed development of the Bristol Deep Sea Container Terminal (BDSCT) and in particular the reclamation work comprised in those proposals.

The information and views presented in this note are based on the assessment work undertaken for the BDSCT and outcomes from the consultation process so far undertaken with key regulatory bodies. In particular, following submission of the Harbour Revision Order application and its associated Environmental Statement on the 22nd July 2008, Natural England have provided DfT with a letter setting out their initial position with respect to the BDSCT and its potential effects on designated nature conservation interests. The extract from the letter (dated 14th August 2008) provided below sets out Natural England's position with respect to the potential need for compensatory measures:

"As there will be direct loss of habitat and impacts on the key wildlife it supports, the development would compromise the conservation objectives set out in our Regulation 33 advice covering the SPA and Ramsar interest, and the objectives set out in our interim advice pertaining to the SAC interest. We must therefore advise that our interpretation of the impacts is that there would be an adverse affect on the Natura interest and consequently a package of compensatory measures would be required if the Secretary of State determined that there were no alternatives and that there were imperative reasons of over-riding public interest. We have therefore engaged with the port and its consultants to establish the parameters for a compensation, mitigation and monitoring agreement along the lines of those agreed at Bathside Bay, London Gateway and Immingham Outer Harbour. Dialogue with the port is ongoing and we hope to reach a satisfactory conclusion before Public Inquiry this Autumn."

This note has therefore been produced as a means of setting out the information required to establish the requirements relating to potential habitat compensation requirements and as a mechanism for their formal agreement. The content of the note is structured as follows:

- Introduction;
- Overview of BDSCT development timetable in relation to compensation agreement process;
- Review of key effects associated with the BDSCT;
- Review of ecological interests affected by key effects;
- Identification of habitat replacement requirements;
- Presentation of information on the effectiveness of habitat replacement schemes to deliver intertidal habitat;
- Review of proposed habitat replacement sites in the Severn Estuary and initial work undertaken at the selected site;
- Summary of issues associated with the delivery of intertidal habitat in the Severn Estuary;
- Development and presentation of objectives for the proposed habitat replacement measures; and
- Conclusions and references.

2 TIMETABLE FOR THE DEVELOPMENT OF BDSCT

The Bristol Port Company (TBPC), relevant Regulators and other parties have discussed the need for compensatory habitat associated with BDSCT. This includes the overall requirement (objectives, nature and extent) for any compensation and the programming of the provision of any such compensation *vis a vis* the programme for implementation of the BDCST scheme. This agreement needs to be reached in advance of the start of any Public Inquiry that may be called so that the relevant legal agreements can be put in place to deliver the necessary compensatory requirement. TBPC is also keen to involve other nature conservation interests in these discussions to ensure that all views are taken into account. In relation to this the proposed programme for the submission of the application for the principal consent to undertake the development of BDSCT (a Harbour Revision Order) and subsequent components of the process is set out below.

- Submission of Harbour Revision Order to the DfT on 22nd July 2008.
- Statutory 42 day consultation process following submission.
- Public Inquiry (if required) scheduled for January 2009 (with pre-inquiry meeting in November).
- Decision on HRO in the first half of mid-2009.
- Construction on BDSCT planned to start January 2010.

3 PROJECT EFFECTS AND COMPENSATION REQUIREMENT

3.1 Summary of key effects on nature conservation interests associated with the BDSCT

Table 1 provides a broad assessment of the predicted effects of the reclamation work required for the construction of the BDSCT on the cSAC and designated SPA interests. A summary of the scale of the predicted effects and the potential compensatory requirement is provided in Table 2. Figure 1 shows the location of the footprint of the container terminal in relation to the Severn Estuary cSAC and SPA.

Table 1. Assessment of predicted effects of the reclamation work for construction of the BDSCT on designated SPA and cSAC interests.

Predicted effect	Consequence of effect	Impact on designated nature conservation features	Significance of impact and potential mitigation measures
Loss of intertidal mudflat (cSAC/SPA) above Mean Low Water (MLW) in the reclamation footprint	Loss of intertidal habitat and associated benthic communities	Direct loss of small area (2ha) of cSAC intertidal habitat above MLW.	Existing intertidal area is degraded and does not support unique communities (low abundance/diversity/biomass). However, area forms part of the total intertidal resource of the cSAC.
	Loss of intertidal area that may provide habitat for waterbirds, including species that may form part of the designated SPA/Ramsar populations.	Direct loss of small area (2ha) of SPA designated habitat	Intertidal area by itself supports very small numbers of birds, but is contiguous with mudflat area that supports significant numbers of waterbirds, including SPA designated species. Although the area involved is small, this area would no longer be available and displacement of birds that utilise this area into adjacent areas would occur. This area forms part of the total intertidal resource of the SPA.
Loss of cSAC intertidal mudflat between MLW and Lowest Astronomical Tide (LAT) in the reclamation footprint	Loss of intertidal habitat and associated benthic communities	Direct loss of 11.5ha of cSAC intertidal habitat between MLW and LAT.	Existing intertidal area is degraded and does not support unique benthic communities (low abundance/diversity/ biomass). However, area forms part of the total intertidal resource of the cSAC and its loss may therefore constitute an adverse effect on the integrity of the cSAC. Available ornithological data indicates that use of the intertidal area within the footprint of the reclaim is low, suggesting that its capacity as a resource for feeding birds is very limited.
Loss of SSSI designated intertidal mudflat/ saltmarsh between MLW and HAT in the reclamation footprint.	Loss of intertidal habitat and associated benthic communities.	Direct loss of 20ha of intertidal area in the reclamation footprint (including 0.5ha saltmarsh). Area supports small numbers of waterbirds that may contribute to SPA designated populations (e.g. redshank).	Very limited use of this intertidal area by birds. Some SPA designated species are present, but tend to utilise man made structures as a roost site. Displacement of birds to alternative areas around the port or in estuary would be likely to occur. Given small numbers this would be unlikely

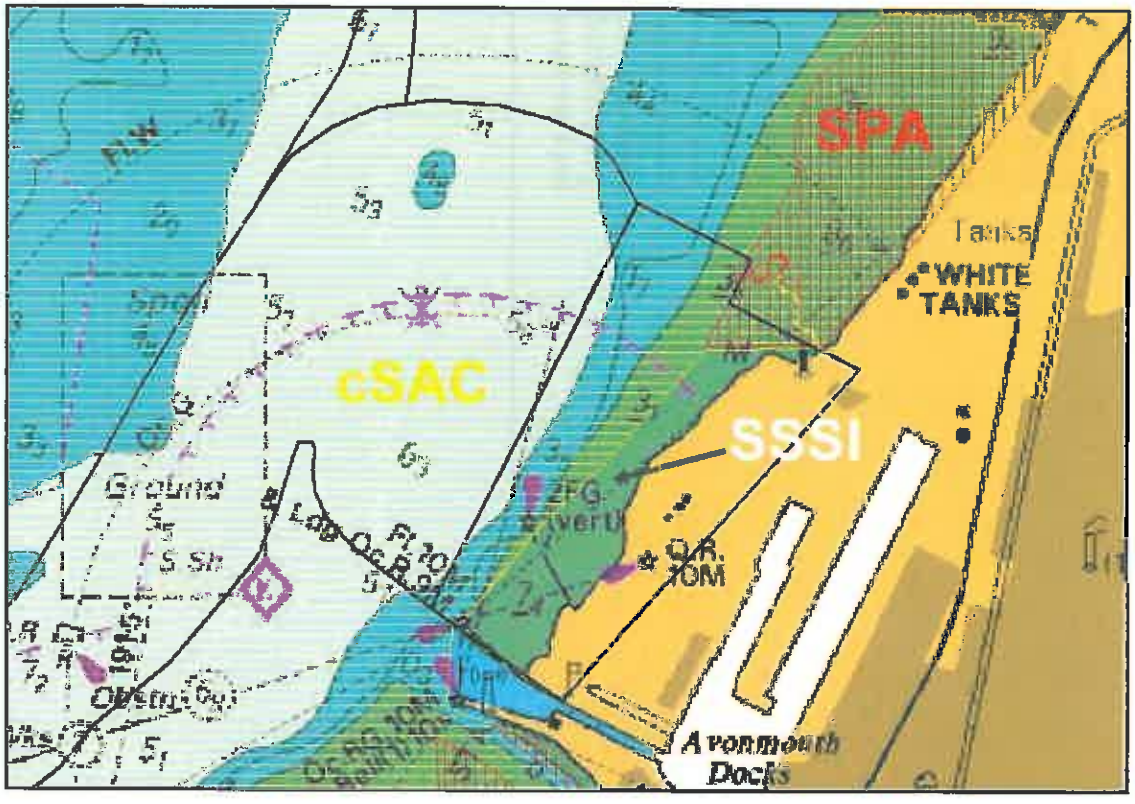
			to increase pressure on other areas. However, the works would result in the loss of intertidal mudflat that forms part of the overall resource within the estuary. An adverse effect on waterbird populations as a result of displacement cannot be ruled out, particularly in combination with the predicted and associated change to the adjacent intertidal immediately upstream of the reclamation.
Loss of subtidal area in the reclamation footprint.	Reduction in overall area of subtidal habitat and associated benthic communities within the Severn Estuary.	The subtidal area forms part of the designated cSAC and comprises muds with very limited infauna. The affected area does not constitute part of the sandbanks cSAC interest, but could contribute to the overall form and function of the estuary. Direct loss of 22ha of subtidal habitat.	Within the context of subtidal habitat in the estuary, the area subject to reclaim is not considered to be of any particular ecological significance, given its location adjacent to the port in an area where activities have been ongoing for many decades. However, the area does form part of the overall estuary feature of the cSAC.
Localised alteration of hydrodynamic regime leading to changes in fine sediment accretion over intertidal areas adjacent to the development site (see Figures 2-4).	Significant increase in rate of fine sediment accretion and deposition of mud over areas of intertidal mudflat upstream of the reclamation area.	Short to medium term functional change as a result of significant accretion above background rates to an area of approximately 80ha (cSAC) and 65ha (SPA/Ramsar) intertidal mudflat and saltmarsh upstream of the reclamation. Accretion is predicted to occur rapidly for a period of 2-3 years following the start of construction of the breakwater and quaywall, with the initial deposition of approximately 1-2m of mud, particularly on the lower intertidal area, before stabilisation after approximately 4-5 years. In total it is predicted that up to 7m of mud will accumulate over the section of mudflat closest to the terminal with progressively less sediment moving away from the	Ornithological survey data indicates that the area likely to be affected by accretion supports significant numbers of waterbirds during the winter period, including species forming part of the SPA designated populations (e.g. dunlin and redshank). Although there would not be a loss of habitat from the cSAC and SPA, the predicted short term (1-5 years) alteration in physical properties of the area could potentially lead to a decrease in invertebrate populations and reduce available food resources for waders and waterfowl. Any adverse change to the existing extent and mix of intertidal mudflat and saltmarsh could be partially offset by the predicted generation of additional mudflat at MLW. However, the potential function of this new area of mudflat with regard to supporting benthic communities of value to birds is difficult to predict with certainty. Overall the net effect of localised changes to the hydrodynamic regime and associated accretion is such that adverse effects on SPA/Ramsar waterbird

	terminal. The rate and amount of accretion may adversely affect the ability of infauna to keep pace with deposition, resulting in mortality. The new form of the intertidal area may alter the composition of the existing benthic communities and possibly adversely affect available food resources for birds. In the longer term, the total area of mudflat at this location is predicted to increase by approximately 40ha as a result of further accretion around MLW. The extent of saltmarsh vegetation would also be expected to increase due to the greater height of the upper intertidal area in the tidal frame.	populations cannot be ruled out.

Table 2. Summary of predicted effects and potential compensatory requirement (excluding any potential multiplier – see Section 5 and Table 4).

Predicted Effect	cSAC	SPA
Direct permanent loss in reclaim footprint (intertidal above MLW)	2ha	2ha
Direct permanent loss in reclaim footprint (intertidal between MLW-LAT)	11.5ha	
Potential compensation requirement for direct loss of intertidal habitat (cSAC and SPA combined)	**13.5ha of intertidal**	
Accretion over intertidal upstream of reclaim – functional change	Approx 80ha (75ha mudflat, 5ha saltmarsh)	Approx 65ha (60ha mudflat, 5ha saltmarsh)
Total potential compensation requirement for intertidal habitat (cSAC and SPA combined)	**93.5ha of intertidal (including 5ha of saltmarsh)**	
Permanent loss of intertidal SSSI habitat	20ha SSSI intertidal (inc. 0.5ha saltmarsh)	
Total potential habitat replacement requirement	**113.5ha of intertidal (inc. 5.5ha saltmarsh)**	

Figure 1. Chart showing footprint of proposed container terminal in relation to Severn Estuary cSAC and SPA.



In addition to the effects described in Table 1, the potential impacts arising from dredging and disposal activities have been assessed as being unlikely to have adverse impacts on the wider Severn Estuary cSAC and SPA features to the extent that compensation measures would be required. This includes the following key potential impacts:

- Disturbance to marine benthic habitats from capital dredging works;
- Disposal of dredged sediments at a deep water site within the estuary;
- Fine sediment transport and deposition as a result of dredging and disposal activities;
- Small scale changes in tidal prism and tidal propagation, as a result of channel deepening; and
- Operational port activities, including maintenance dredging.

These impacts are described in the Bristol Deep Sea Container Terminal Environmental Statement which was submitted with the HRO to the DfT on the 22nd July and are listed in the Mitigation, Compensation and Monitoring Agreement (MCMA). Further clarification of potential impacts on migratory fish populations and *Sabellaria* reef habitat (both cSAC designated features) has also been given in the form of two separate notes provided to the statutory nature conservation agencies and other relevant parties in November 2008. The note on migratory fish sets out information on the likely effects of the BDSCT, particularly the potential impacts of dredging and construction work. On the basis of this information and that contained in the ES, the conclusion is drawn that the works would not adversely affect migratory fish populations either in the Severn Estuary or the River Wye SAC or River Usk SAC, both of which are tributaries to the Severn Estuary.

This note therefore concentrates on providing clarification and further comment on the key impacts of the proposed development that have the potential to cause adverse impact with respect to designated nature conservation features of the SPA/Ramsar site and the cSAC. These are namely:

- Localised modification of hydrodynamic processes around the BDSCT leading to predicted morphological change to the upstream mudflat; and
- The reclamation of intertidal area within the footprint of the BDSCT

The following section provides further information and analysis of the predicted development of the intertidal area upstream of the BDSCT. This area is important as it has been shown to support significant numbers of waders and waterfowl during the winter months and the predicted morphological change could lead to functional ecological change. The impact of the reclamation, i.e. direct loss of mudflat habitat, is further discussed in Section 4.

3.2 Predicted morphological development of intertidal area upstream of the BDSCT

As highlighted in Table 1, one of the key effects of ecological significance is the predicted accretion of significant amounts of sediment upstream of the proposed BDSCT. The ES provides outputs from the hydrodynamic modelling work (Figures 2-4) which show the potential extent and level of fine sediment accretion over the intertidal area immediately upstream of the container terminal covering a 30 month period. It should be noted that the timeframe for the modelling is based upon the premise that the terminal is in place from Day 1. In reality, it is likely that accretion over the area would be progressive during construction

and the full effect, as illustrated in Figures 2-4, would not occur until completion of the terminal. This aspect is further discussed in Section 5.

Further analysis of the change to the morphology of this intertidal area is provided in Figure 5, which shows cross sections of the bed level at the centre of the sectors used for the bird counts undertaken for the area (see Figure 10). A further assessment of potential variability in intertidal exposure, and therefore availability of mudflat to feeding birds, has also been undertaken to cover the period of morphological change. For each epoch modelled, the area exposed has been calculated during a spring-neap tidal cycle. Figure 6 shows the results for the whole spring-neap cycle and Figures 7 and 8 the results for a single spring and neap tide, respectively.

Figure 2 – Accretion and morphological development of mudflat upstream of BDSCT after 1 month.

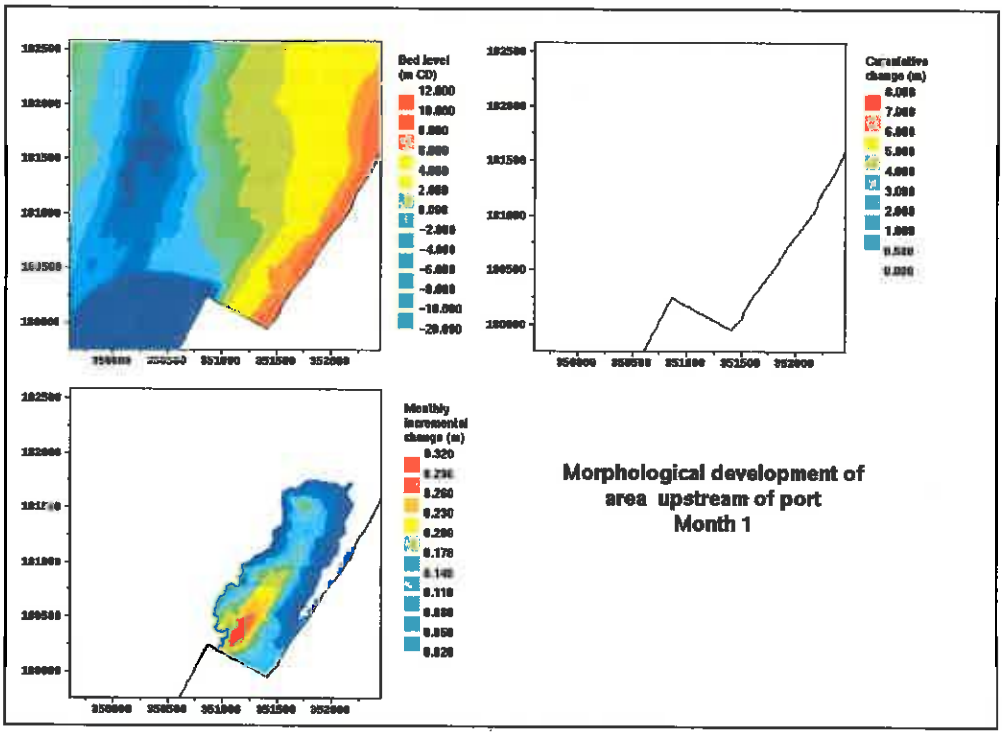


Figure 3 – Accretion and morphological development of mudflat upstream of BDSCT after 12 months.

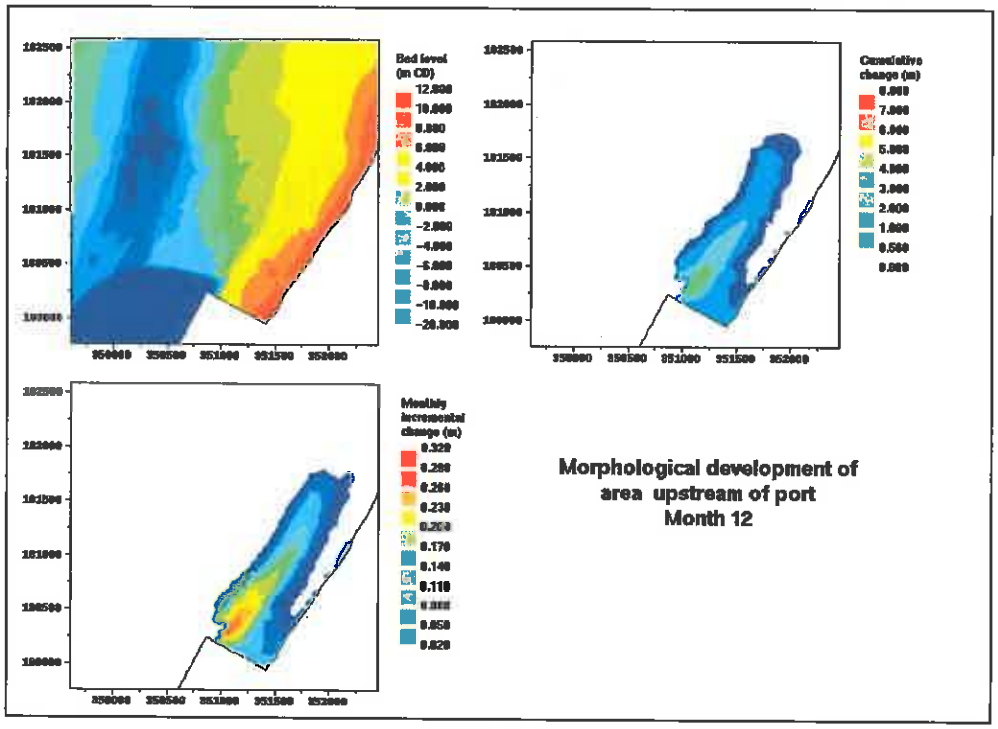


Figure 4 – Accretion and morphological development of mudflat upstream of BDSCT after 30 months.

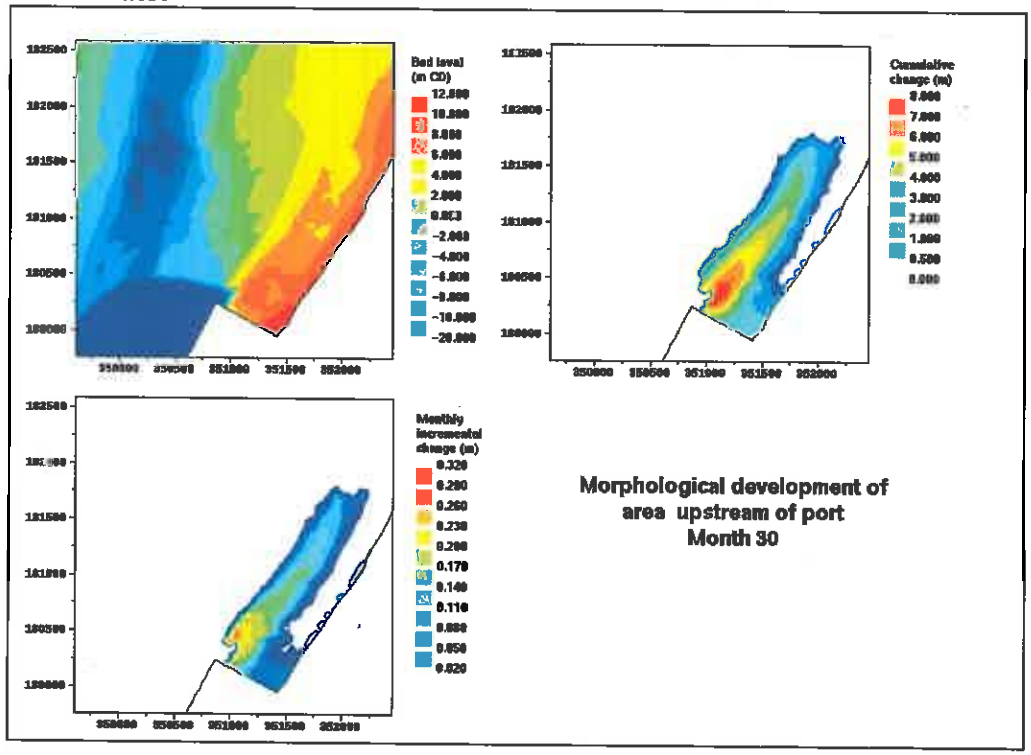


Figure 5. Predicted morphological development of the mudflat upstream of the BDSCT. Profiles taken for 30 month time series at centre of bird observation sectors.

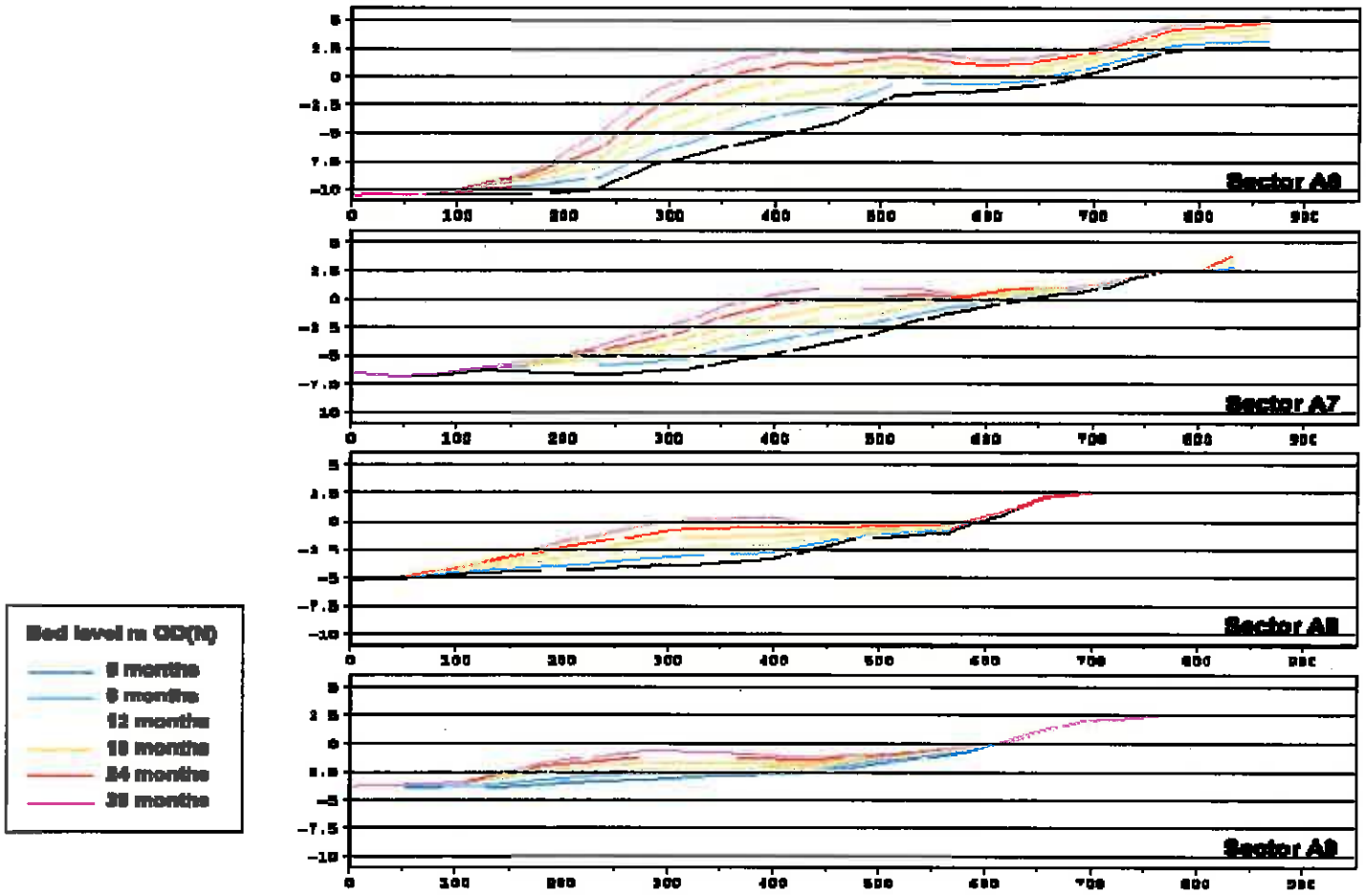


Figure 6. Variation in intertidal exposure (spring–neap cycle) for predicted morphological change over mudflat upstream of the BDSCT.

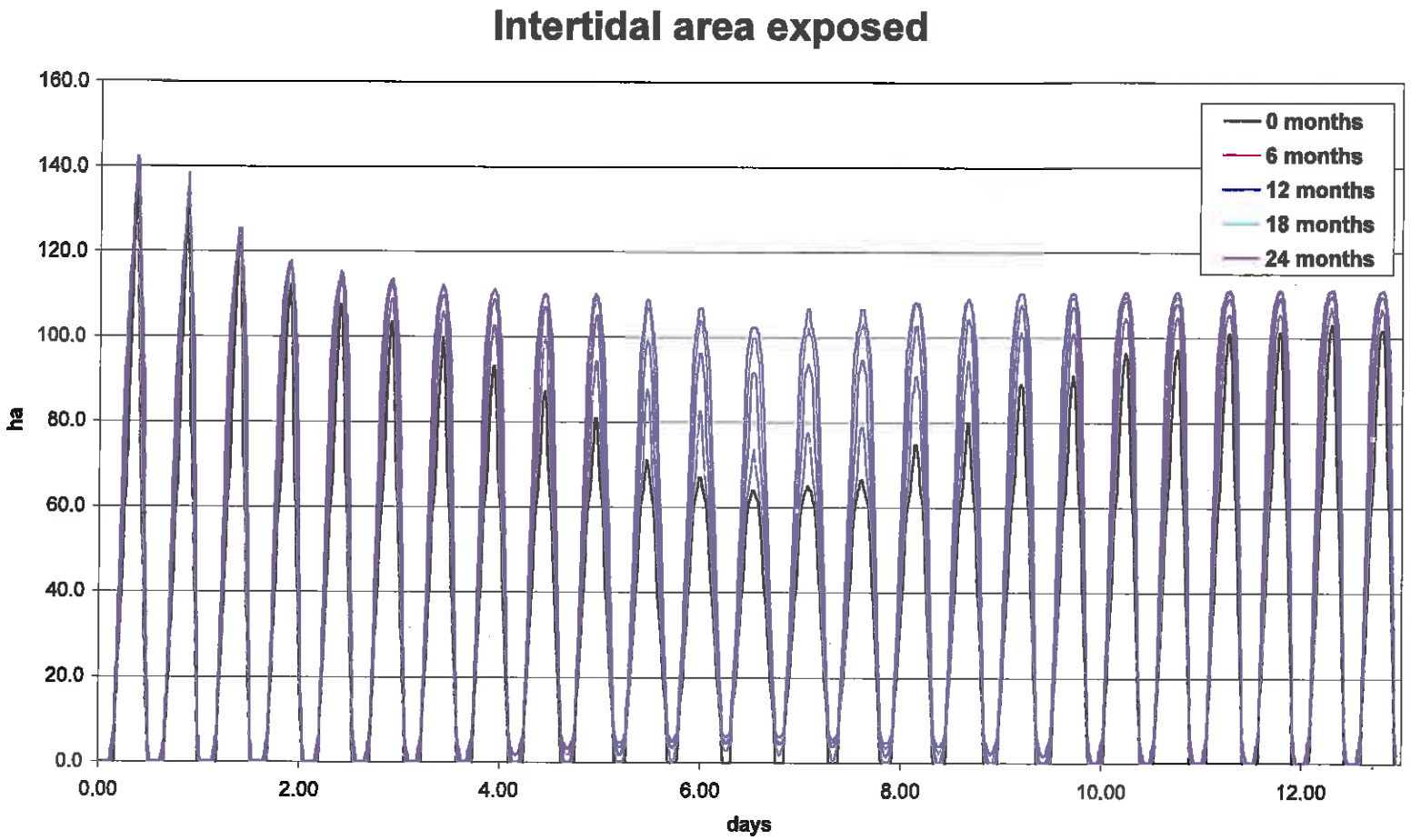


Figure 7. Variation in intertidal exposure during predicted morphological change over mudflat upstream of the BDSCT, large spring tide

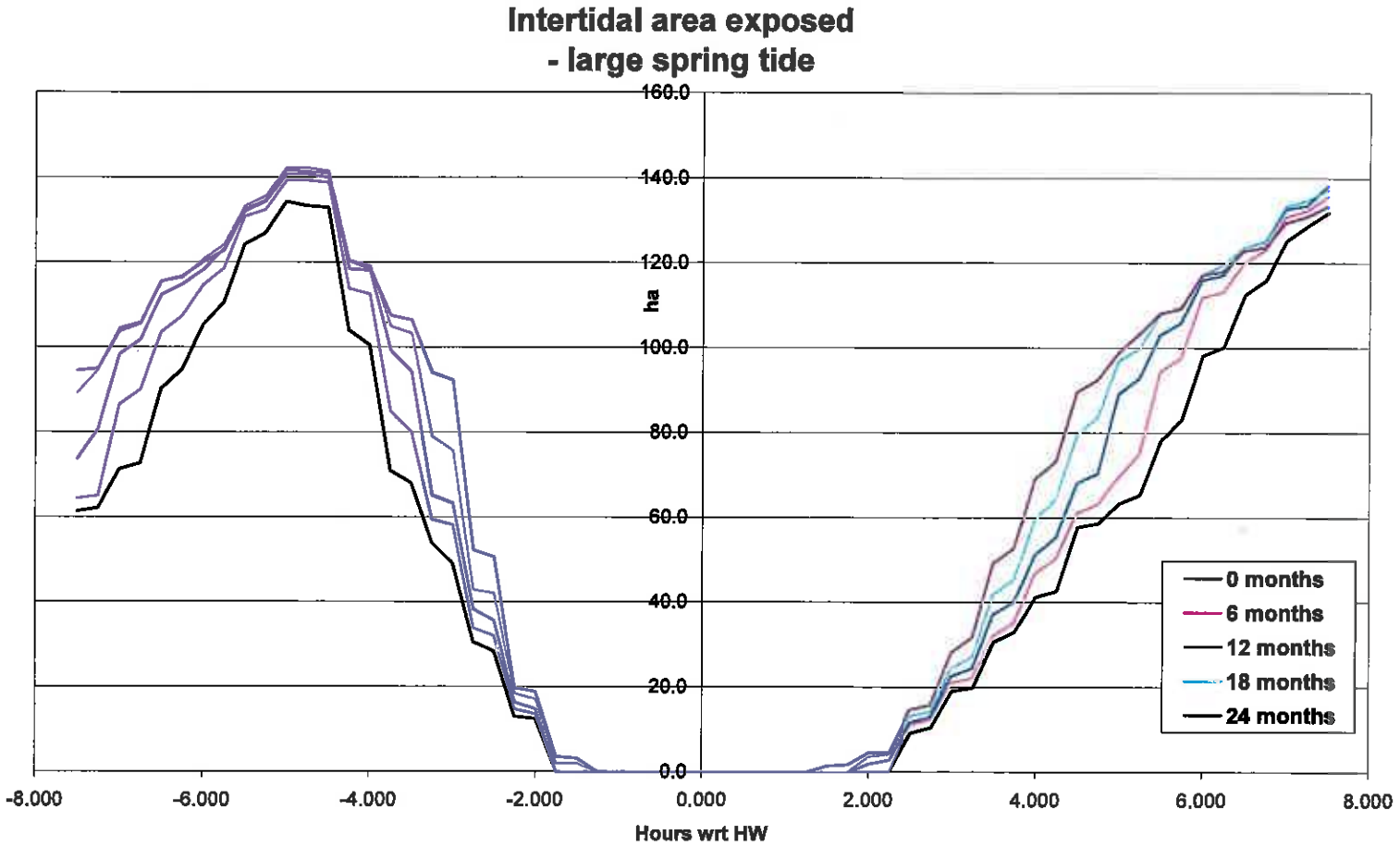
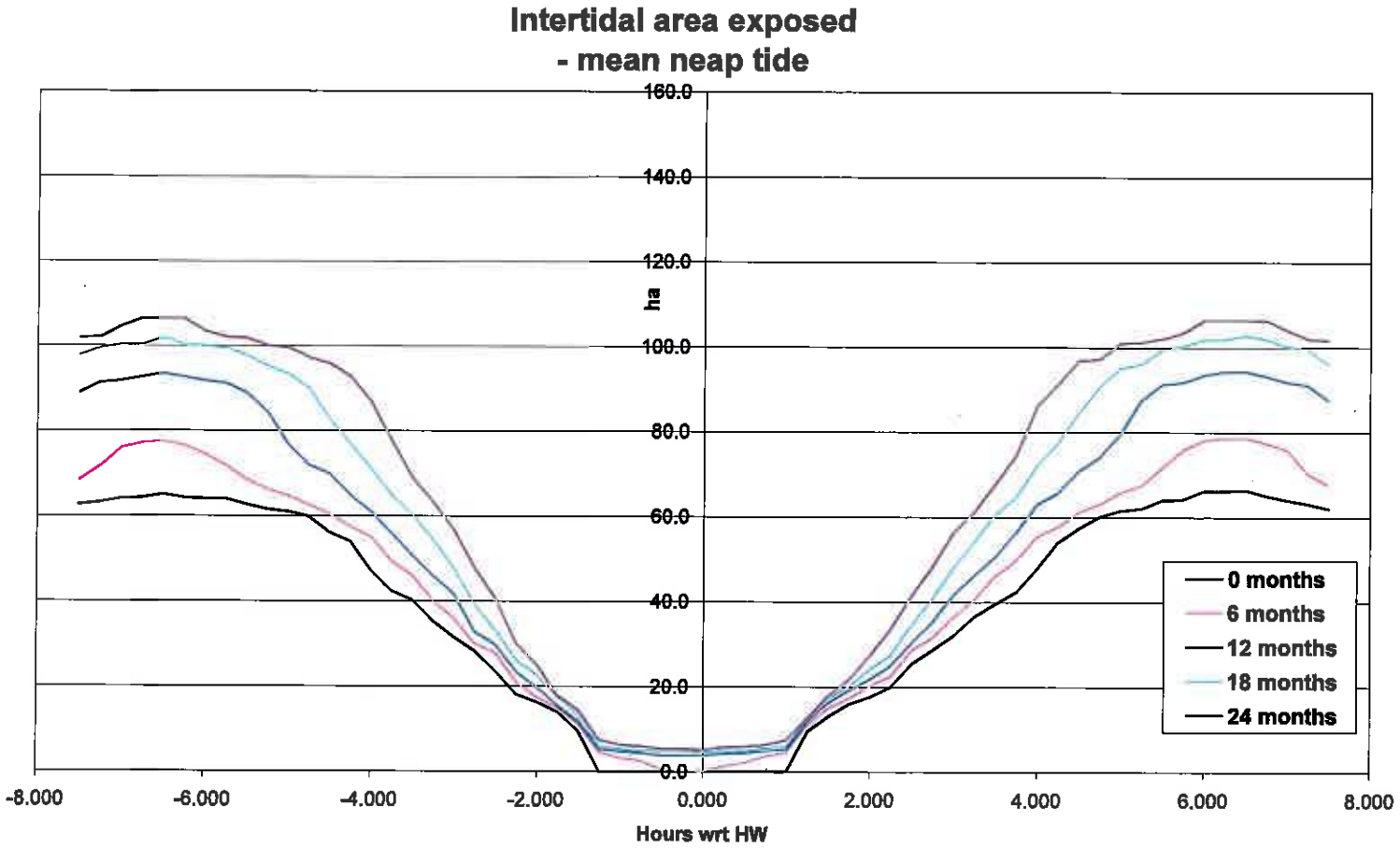


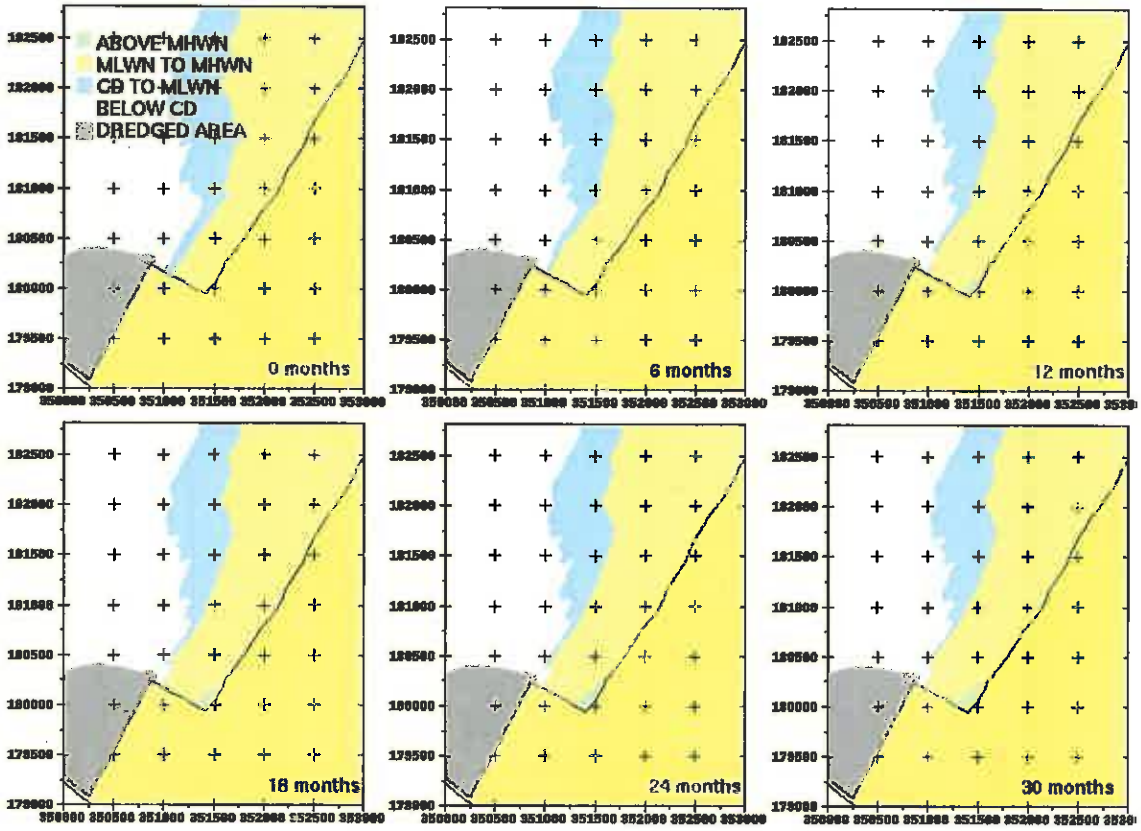
Figure 8. Variation in intertidal exposure during predicted morphological change over mudflat upstream of the BDSCT, mean neap tide



The results of the modelling analysis presented in Figures 6-8 confirm the indications of change shown in the profiles presented in Figure 5, that the largest effect of the morphological change predicted to result from the development of the BDSCT is for bed level in the lower intertidal area and shallow subtidal to be significantly raised. In terms of areal extent, this effect results in an increase in area exposed, particularly during neap tide periods with the maximum area exposed increasing from approximately 65 ha to 105 ha (see Figures 7-8). Less change in area exposed is shown for the large spring tide conditions simulated although an increase in area exposed and duration of exposure (for a given area) remains.

In Figure 9, the predicted vertical accretional change has been translated through to area change in relation to position within the tidal frame. While not immediately obvious, what this graphic demonstrates is that with the predicted vertical accretion, the height of the mudflat would still fall within the range of MLWN to MHWN, as currently exhibited by the bulk of the intertidal mudflat present at the site. This is largely because the main volume of accretion is predicted to occur towards MLW and in the shallow subtidal, rather than over the higher parts of the existing intertidal. What is also indicated is that the vertical accretion would lead to the raising of an area of the intertidal in the lee of the terminal and in a thin strip along the upper shore to above Mean High Water Neaps (MHWN). Given this predicted increase in height within the tidal frame, this area above MHWN would be expected to develop into saltmarsh (where flow from the outfall / rhine allows). This area of potential saltmarsh growth is estimated at approximately 5-10ha.

Figure 9. Time series of upstream mudflat showing post construction development in relation to the tidal frame.



The effect of the accretion in changes to area above various levels can also be demonstrated graphically, as shown in Figure 10. The data in Fig.10 have been derived

by summing up the area within an envelope containing the area of potential change and comprises the modelled results for area above CD, MLW and MHWN (the height at which salt marsh may develop).

Figure 10. Extent of intertidal change area in accretionary zone upstream of the BDSCT development

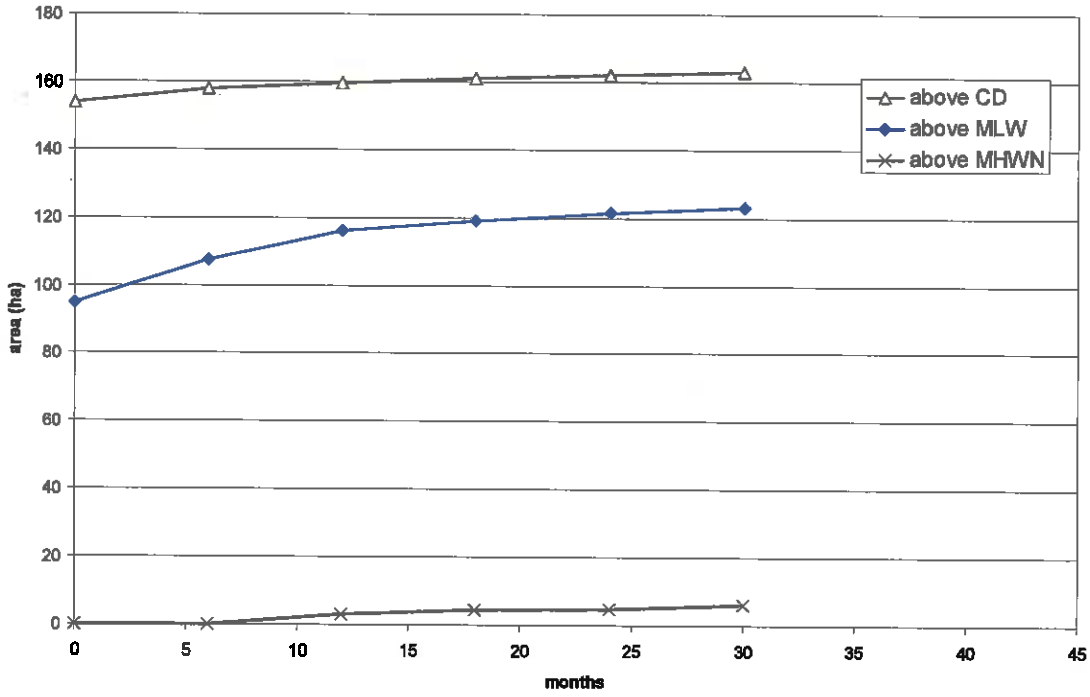


Figure 10 shows a rapid rate of change in area above MLW for approximately 20 months before the rate of increase levels off. The plot also provides further confirmation that an area of approximately 5-10ha of existing intertidal area would be likely to convert to saltmarsh.

An estimation of the point at which significant change is likely to cease has been made by plotting the rate of change in area, then fitting an exponential curve to the modelled results. For example Figure 11 shows the variation in the rate of change in area above Chart Datum.

This analysis shows significant change in the area above Chart Datum would be likely to cease after about 40 months. Similarly the area of mudflat above MLW would be close to equilibrium after about 24 months. For bed levels above MHWN pioneer salt marsh could develop where lower energy wave conditions predominate, i.e. in the lee of the reclamation. Elsewhere although the modelling does show a thin strip of area adjacent to the coast accreting to a level above MHWN it is unlikely to become salt marsh due to incident wave conditions which are predicted to be largely unchanged.

Figure 11 Rate of change of intertidal area above Chart Datum in accretionary area

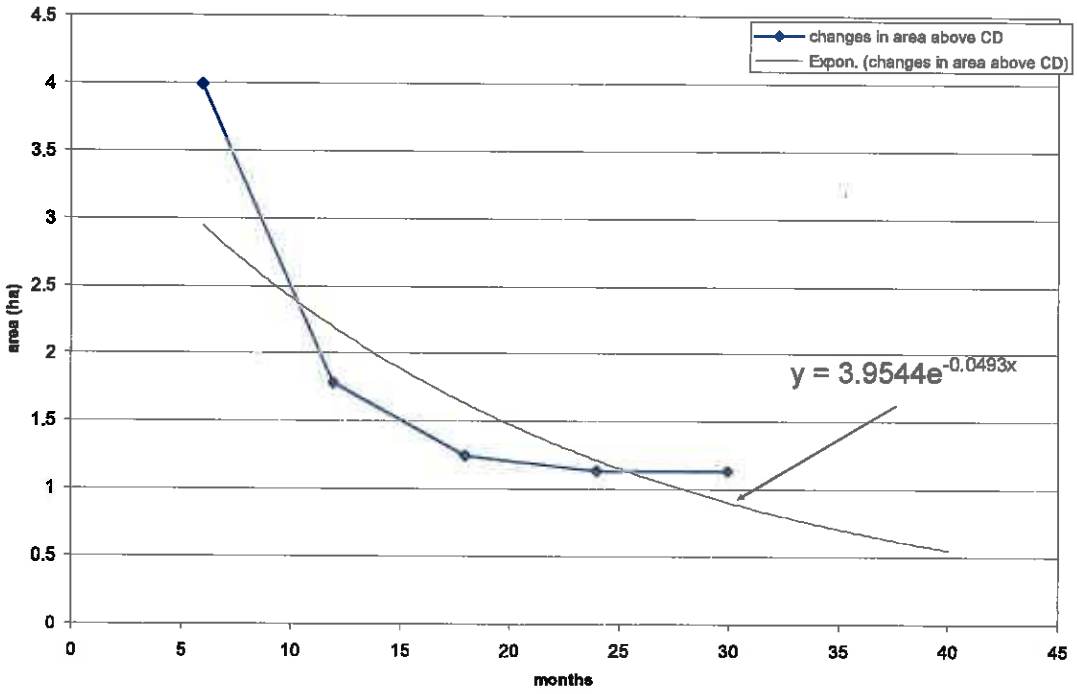


Table 3 summarises the increase in area over the affected intertidal above selected heights. The results from the model are presented up to month 30, beyond that extrapolation is used based on the curves calculated from the model results.

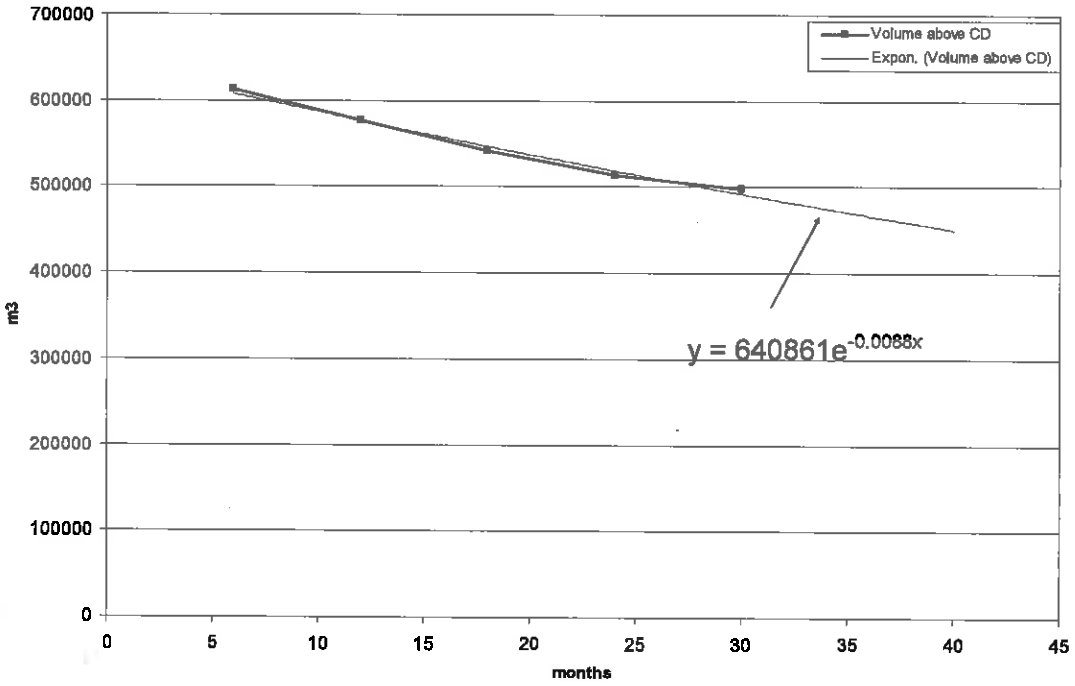
Table 3 Change in area of intertidal to the NE of the proposed BDSCT

Month	Area above CD (ha)	Area above MLW (ha)	Area above MWL (ha)	Area above MHWN (ha)
6	4.0	12.7	2.8	0.0
12	5.8	21.1	4.7	3.2
18	7.0	24.1	10.0	4.6
24	8.2	26.6	16.9	4.7
30	9.3	28.5	27.2	6.2
36	13.9	35.6	Extrapolation	
42	17.3	39.8		
48	19.8	42.4		

The end point of the morphological change has been calculated using the same procedure as above on data for the total volume of the intertidal area (Figure 12). The rate of change in volume appears to take much longer to reach a new equilibrium. This calculation shows the overall increase in accretion will have run its course after 230 months, with the vast majority of this accretion occurring towards MLW and what is now

a shallow subtidal part of the estuary (i.e. not on over the existing intertidal, where significant accretion is predicted to occur only for a period up to 3 years, as shown in Figures 2-4 and Figure 14).

Figure 12 Variation in total volume in accretionary area upstream of the BDSCT



Using the results from the calculations of the intertidal area exposed over a neap-spring tidal cycle (as shown in Figures 7-12) it is also possible to determine the change in area during the first 24 months of accretion as a function of exposure time. The results of this analysis are presented in Table 4. The figures contained in Table 11 demonstrate that the predicted morphological development of the mudflat area over the first two years leads to a significant increase in the amount of mudflat exposure time, largely as a result of the increase in total area of mudflat. This increase in exposure time may have important ecological implications, a factor that is discussed in Section 5, along with other aspects of the predicted evolution of this upstream mudflat area.

Table 4. Estimation of change in available intertidal resource expressed as ha/hr for mudflat to the north of the BDSCT following construction

		Two week Spring-Neap cycle			
Duration from baseline	0 months	6 months	12 months	18 months	24 months
Hectare hours	14300	15700	17700	19400	20800
% Increase	0%	11%	25%	37%	47%

These predicted changes in the intertidal morphology of the mudflat upstream of the BDSCT, have significant implications with regard to the functional ecology of the area, as discussed in the ES. These aspects are further discussed below in Section 5 and related in greater detail to potential habitat replacement requirements.

4 ECOLOGY OF THE AFFECTED AREAS

4.1 Benthic ecology

The intertidal area within the reclaim and to the north of the old oil jetty comprises of approximately a 5m strip of shingle and rubble, the lower section of which is colonised by the ephemeral green algae *Enteromorpha*. Beyond this rubble, a wide mudflat extends out to low water. Just to the north the top of the shore is marked by piping and beneath this are gravel and rubble with large amounts of drift material and other debris. The rest of the foreshore consists of medium sized boulders which have been placed here as a form of flood defence.

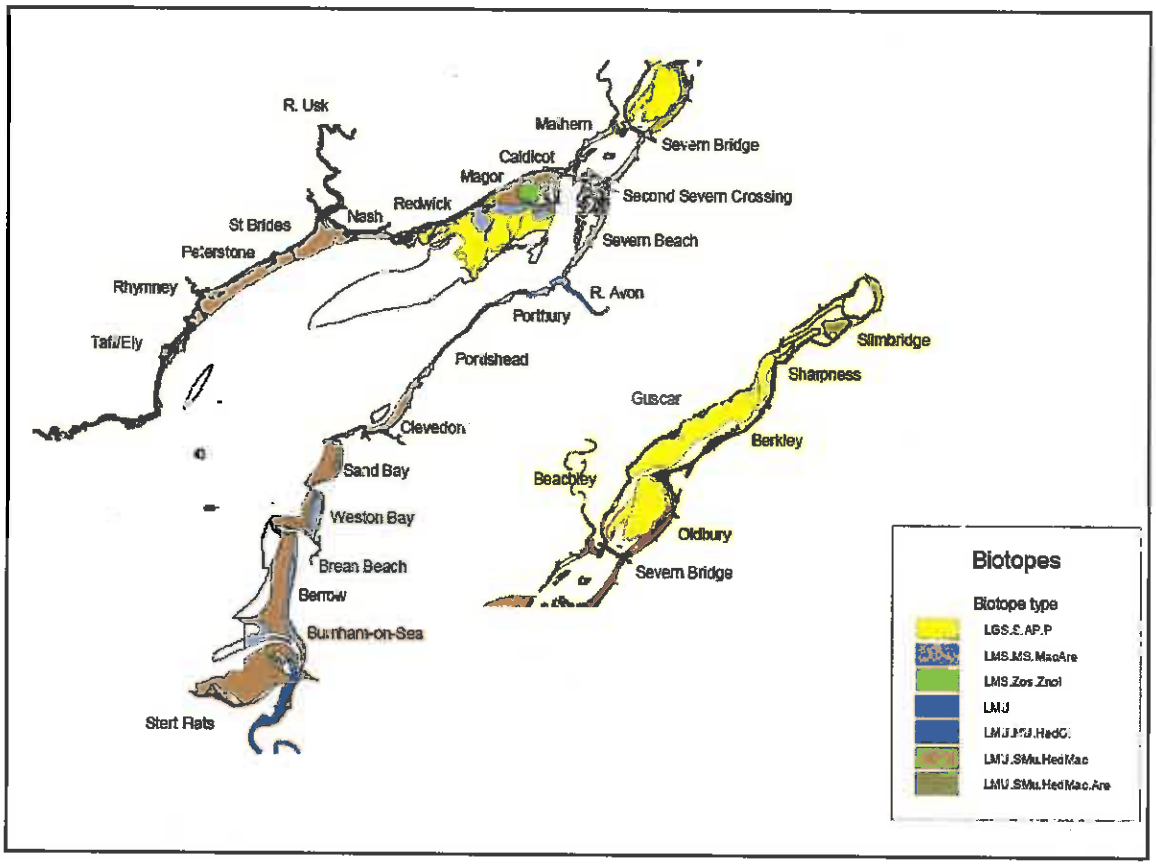
The piping at the top of the foreshore, with its associated gravel base extends to the Topomix Tarmac depot. From here the upper section of the shore is covered with well established *Spartina* dominated saltmarsh. This extends for approximately 40m in a seaward direction, with pioneer marsh being present at the seaward edge. The intertidal consists of extensive mudflats which slope away from the saltmarsh, with occasional patches of gravel and rock at the lower edges of the mud. This swathe of saltmarsh ends approximately 15m south of the Holes Mouth outfall. Between the saltmarsh and the outfall, the foreshore consists of mud and rock at the upper levels with mudflat extending out to low water (approximately 50m).

Survey data (Environmental Statement, Section 11) demonstrates that the potentially affected (both directly and indirectly) intertidal mudflat that forms part of the cSAC and SPA supports an infaunal community (annelid-bivalve) that is typical of the fine mud shores in the Severn Estuary. Survey data indicates that the mudflat falls within the *Hediste – Macoma* (LMU HedMac) biotope type (see Figure 13).

Intertidal sediments within the footprint of the terminal are generally impoverished with only small numbers of the polychaete worm *Nephtys* and occasional individuals of the bivalve *Macoma* being present. At extreme low water, sampling indicates that species diversity and faunal abundance increases, suggesting that conditions are more amenable for infauna towards extreme low water.

The most diverse and abundant intertidal communities occur to the north of the terminal footprint. Here, the muds support high numbers of the polychaetes, *Hediste diversicolor* and *Streblospio shrubsolii* and the mud snail *Hydrobia ulvae*. The highest levels of infaunal diversity and abundance recorded during survey work were found in samples located just to the north of the predicted accretion area. These samples contained between 17 and 20 different species, with notably high abundances of *H. diversicolor* and *Hydrobia ulvae*. *Typosyllis* and *S. shrubsolii* were also present in relatively high numbers, as was *Macoma balthica*.

Figure 13 – Biotope map for the Severn Estuary



The LMU HedMac biotope type is typical of estuarine situations and occurs commonly in Britain (JNCC 1997). The community is dominated by polychaete worms together with *Macoma balthica*. The most abundant large polychaete is typically *Hediste diversicolor*, with smaller species including *Eteone longa*, *Nephtys hombergii*, *Tharyx marioni* and *Arenicola marina*. Oligochaete worms are often common or abundant as is the amphipod *Corophium volutator*. The surface of the mud may be covered with green algae such as *Enteromorpha* spp or *Ulva lactuca* and there is often a black anoxic layer close to the surface (JNCC 1997).

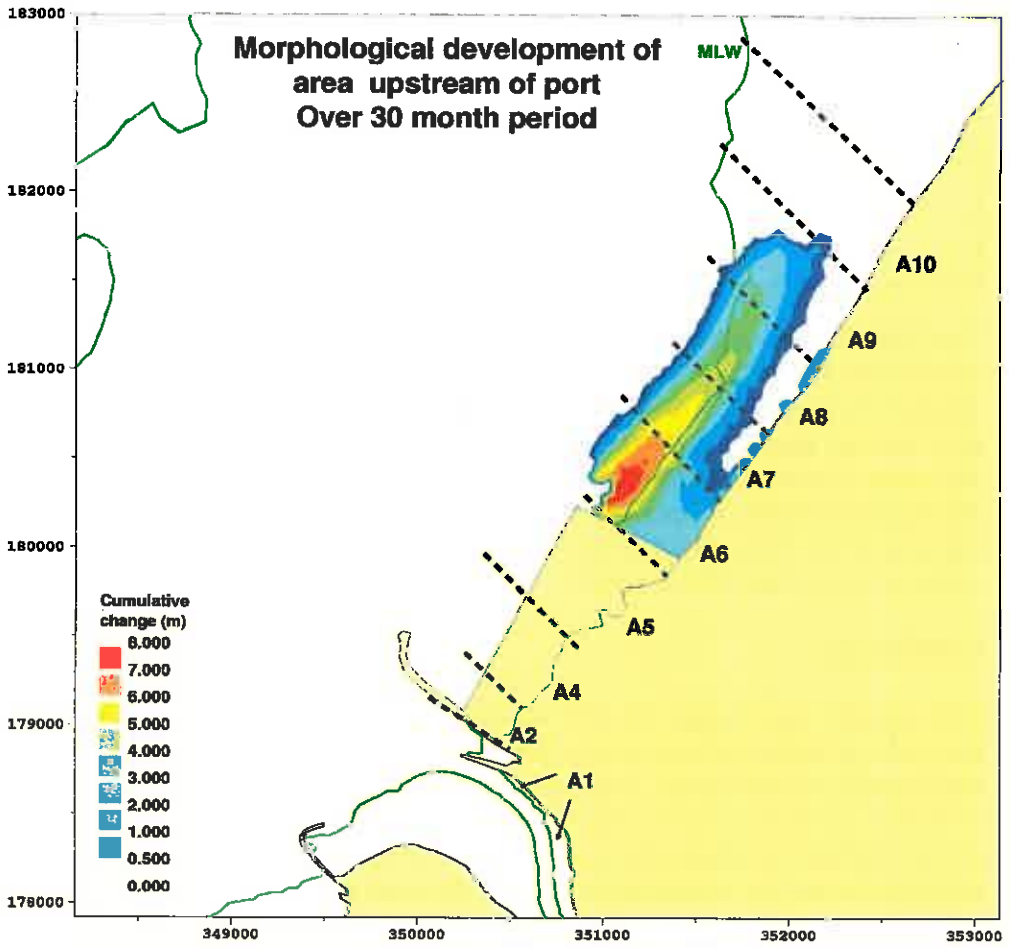
4.2 Ornithology

Site specific count data for the winter periods 06-07 and 07-08 provides a good indication of waterfowl and wader usage across the intertidal area from the existing port northward to Holes Mouth. In general terms, the intertidal area within the footprint of the container terminal supports very low numbers of waterfowl and waders with greater use of the intertidal progressively northwards. For counts of individual species the situation is similar to that for overall abundance, with most species showing an increase in mean abundance northwards along the port frontage. The following section provides a more detailed description of waterbird use for each of the individual sectors surveyed along the port frontage. The location of the survey sectors is shown in Figure 14 and the mean number of birds recorded per count survey is shown in Table 5.

Table 5. Mean number of birds per species of waterfowl and wader counted per survey for all winter period surveys undertaken during 2006-2008.

Sector		1	2	3	4	5	6	7	8	9
Species (mean count over all counts)	SHELDUCK	7.5	0.5	0	0.4	0.2	2.3	4.9	2.6	2.6
	MALLARD	14	0.6	0	0.3	2.1	9.6	14.5	19.7	7.6
	GADWALL	0	0	0	0	0	0.6	1.2	10.9	2
	TEAL	2.2	0	0	0	0	4.4	3.9	14	3.9
	CURLEW	2.4	0.6	0	0.2	0.6	2.3	2.6	2.4	2
	REDSHANK	2.9	2.8	0	0.8	0.9	1.5	6.3	41.6	2.7
	DUNLIN	0	0.1	0	0	0.2	16	67.3	99.4	10
	RINGED PLOVER	0.9	2.2	1.3	2.1	0.4	1.7	0.1	0	0.4
	OYSTERCATCHER	0.8	0.2	0	0.1	0.1	0.4	1.2	2.5	3.8

Figure 14. Overlay of predicted area of accretion associated with development of the BDSCT in relation to count sectors used in ornithological surveys.



4.2.1 Use of intertidal within the footprint of the reclaim

Sector 1 - narrow intertidal mudflats of the Avonmouth (Port) side of the River Avon from South Pier to Nelson Point

Observations during the winter period indicate that generally the area supports low numbers of waterfowl although at times the sector does support reasonable numbers of shelduck (peak of 40) and redshank (peak of 37). Occasional use of the South Pier is made by large numbers (1000-1250) of black-headed gulls and the South Pier is sometimes used as a roost site by small numbers of ringed plover and oystercatcher.

Sector 2 - North Pier and small area of intertidal between this structure and the old jetty (Sector 3).

Count data from 06-07 and 07-08 indicates that usage of this area by waterfowl and waders is generally low with 1-2 individuals of shelduck, curlew and mallard generally being present and making use of the intertidal area. The main species of interest in this area is redshank (peak count in 2007/08 of 30) which roosts on the wooden horizontal supports of North Pier. Monitoring counts undertaken since 2001/02 indicates that the number of redshank using this roost site has increased steadily.

Sector 3 – disused jetty

The disused jetty acts as a roost site for gulls and cormorants, but in particular herring gull, with 30-40 birds occurring here regularly. Typically 5-8 cormorants use the structure, although numbers appear to be higher during the summer months (on the basis of the counts undertaken in 2007) with up to 20 birds present. Ringed plover also occasionally use the jetty as a roost at high tide, with a maximum of 47 recorded here in January 2007. It is apparent from the count data that the disused jetty often accounts for a significant proportion of the total number of birds recorded from the area (i.e. intertidal + structures) within the footprint of the reclaim area for the proposed container terminal.

Sector 4 – mudflat between the old jetty and the Intermol Terminal

Usage of this area of mudflat is limited to occasional use by a few shelduck (between 2-4 individuals), 1-2 curlew, mallard (2-6 birds) and oystercatcher (1-2 birds). Ringed plover may use the upper intertidal and the hardstanding as a roosting area at high tide and a peak of 42 birds were observed here in December 2006. Similarly, redshank may also make some use of the hardstanding for roosting with a peak of 11 birds recorded here in December 2007. Gulls also regularly use this section for roosting and loafing with herring gull and black-headed gull numbers typically in the region of 10-30 individuals.

Sector 5 - *intertidal area between the Intermol Terminal and the southern side of Avonmouth Pill*

As with Sector 4, overall usage by waterfowl and waders is low. The mudflats appear to only be consistently used by 1-2 curlew and mallard (peak of 44, but typically 2-6 individuals) with very occasional use by shelduck (peak of 6) and dunlin (peak of 5). Redshank and ringed plover may make use of the upper intertidal and adjacent hardstanding as a roost, with a peak of 30 redshank recorded in December 2007.

These birds may then make use of the foreshore for feeding around Avonmouth Pill (Sector 6). Black-headed gulls are the most regular and commonest bird species making use of this section of the Avonmouth frontage, with numbers generally in the 10-40 range

4.2.2 Use of intertidal upstream of the proposed terminal

Upstream of the proposed terminal, the intertidal mudflat supports a higher diversity and abundance of wintering waterbirds and, on the basis of data collected for the project, this area clearly supports birds in numbers that are of significance within the context of the SPA. This is shown graphically in Figure 15.

It is notable that the distribution of waterbirds is also reflected by the distribution and abundance of likely infaunal prey items which are far more abundant in the intertidal upstream of the proposed terminal location.

Sector 6 - *Avonmouth Pill (the Kings Weston outfall) and adjacent intertidal*

Count data from 06/07 and 07/08 indicates that in general the mudflats here support relatively low numbers of birds (mean 42 waterfowl) with use by higher numbers of some species (e.g. 400 dunlin in February 2008). The main species that consistently use this area are mallard (mean of 9.6 birds and peak of 110), small numbers of shelduck (mean of 0.9 birds and peak of 14), curlew (mean of 1.8 and peak of 7) and ringed plover (mean of 1.7 and peak of 13). Dunlin were recorded a total of five times during the 36 counts undertaken over the two winter periods with a mean of 16 and peak of 400. Redshank are regular users of the area but in generally low numbers (mean of 1.5 birds and peak of 20 over all counts). Avonmouth Pill attracts occasional use by gadwall (recorded five times with a peak of 10) and teal (mean of 4.4 birds and peak of 100). Previous monitoring of this area over the high tide period supports the general picture of usage described above and indicates that the upper intertidal and adjacent hardstanding are used as a roost area by ringed plover and redshank.

Sector 7 - intertidal area from north of Avonmouth Pill to the southern side of Holes Mouth

Winter use of Sector 7 during 06-07 and 07-08 varied significantly with a mean of 10 waterfowl in 06-07 and 174 in 07-08. The large difference in mean usage between 06-07 and 07-08 can be largely attributed to the presence of a flock of 1600 dunlin on the mudflat on the 18/02/08. It is possible that this flock of dunlin were flying around the local area as they were also recorded as being present in Sector 8 during the same count. Otherwise, usage of the mudflats in this sector is low by all species with only consistent use by curlew (mean of 2.6 and peak of 7), shelduck (mean of 4.7 and peak of 30), and mallard (mean 14.5 and peak of 100).

Sector 8 – intertidal area around Holes mouth

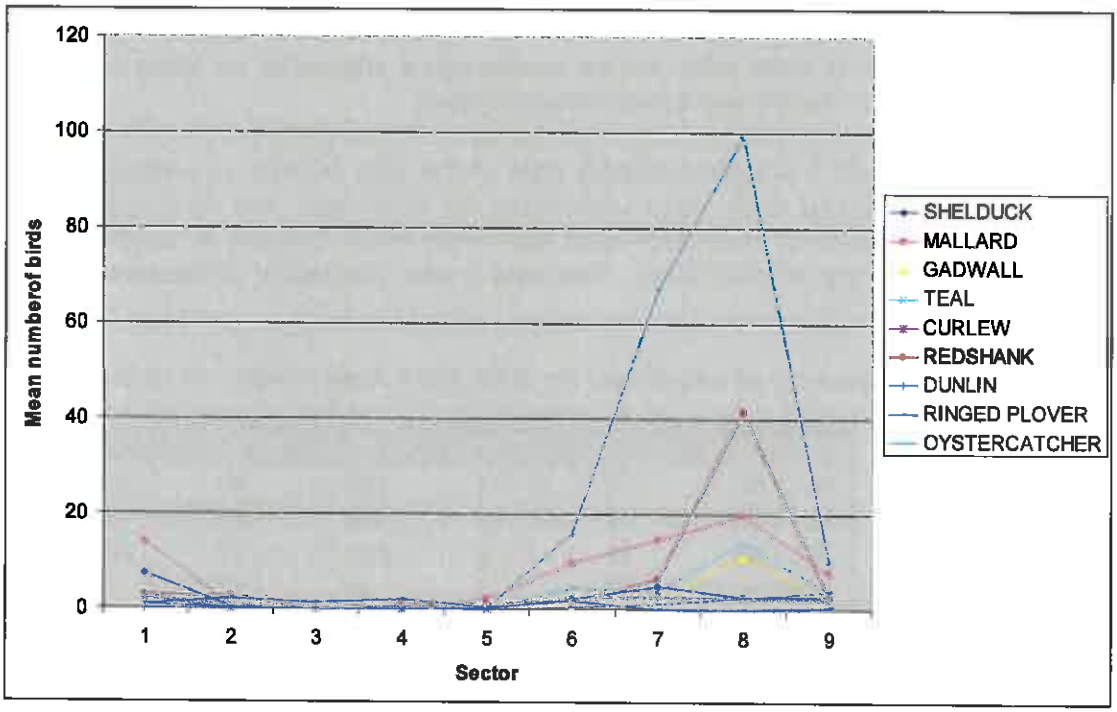
The intertidal mudflats around Holes Mouth consistently support the highest numbers and diversity of birds along the entire frontage, with counts generally registering several hundred and sometimes over a thousand birds. Again, as with Sector 7, overall numbers are boosted by the presence of flocks of dunlin (up to 1100 on the 18.02.08 and 700 on the 05.03.08). This sector also supports the highest species diversity of all of the count sectors along the Avonmouth frontage. Redshank use the mudflats in good numbers, with a mean of 42 birds and peak of 160, with most birds being recorded on a

rising tide. The mudflats also provide a good feeding ground for shelduck, curlew, mallard and teal. This sector is notable for its use by gadwall (peak of 62 and mean of 11) and teal (peak of 140 and mean of 14) which feed around the outfall stream from the STW at Holes Mouth. Gulls also congregate around the outfall stream, particularly black-headed gull which is often present in flocks of several hundred during rising tides.

Sector 9 - mudflat north of Holes Mouth

Bird usage of the intertidal area upstream of Holes Mouth declines significantly, probably reflecting a change in substrate type (coarser sediment) and overall availability of potential prey items. All of the species that make consistent use of Sector 8 occur here but in lower numbers. The increase in the number of oystercatcher using this sector (mean of 3.8, peak of 36) in comparison with sectors 7 and 8 is notable and is likely to reflect the coarser grained and rocky nature of the substrate in this sector.

Figure 15. Plot showing the mean number of birds of each species counted over the winter periods 06-07 and 07-08 (total of 36 counts) utilising mudflat areas in and around the proposed BDSCT. Sectors 2-5 are within the footprint of the terminal, Sectors 6-9 comprise the area of intertidal north of the terminal over which significant accretion is predicted to occur.



In the ES, data is presented and discussed in Section 12.5 with respect to individual count sectors, in order to understand bird usage in relation to the predicted change in accretion pattern over the intertidal area to the north of the proposed terminal.

Tables 12.16 and 12.17 provide a summary of the usage of each of the sectors by all waterbirds and, through the use of means, an indication of the comparative use of sectors across the entire area of the mudflats at Avonmouth. This relative use is then described in more detail for each sector, along with comparison with the peak counts for selected species.

Section 12.5.3. and Table 12.20 provide analysis of the mean peaks for individual (key) species in relation to the WeBS mean peaks for the Severn Estuary as a whole. This provides an indication of the contribution that each sector makes, for each species as a percentage of the peak populations. Table 12.20 demonstrates that some of the sectors (notably 8 and 9, as discussed above) at times support numbers of some species that are significant at the SPA level (>1% of SPA population).

Determining usage across the entire area of the intertidal mudflat at Avonmouth can be gained through addition of the percentages of SPA populations given in Table 12.20 of the ES. However, although such an approach provides an indication of use by birds it tends to overemphasise the actual contribution that the mudflat area does make. The additional work below provides further analysis of the data presented in the ES in order to determine bird usage across the entire mudflat area rather than an individual sector by sector analysis. Particular emphasis is given to determining usage of the mudflat to the north of the proposed terminal (sectors 6-9 combined) as this area has been shown to be of significance for a number of species.

4.2.3 Integrated analysis of use of sectors 6-9, accretional area upstream of the BDSCT

Figure 14 provides a plot of the predicted area of accretion upstream of the BDSCT in relation to the ornithological count sectors. This shows the extent of the accretion across the existing area of mudflat, and together with the available bird data, allows assessment of likely effect on the ornithological interest to be made (as described in Section 12 of the ES and further detailed below).

Tables 6 and 7 provide summary data of the total number of waterfowl and waders observed during each count undertaken for 2006-2007 and 2007-2008 respectively. Only 15 counts for 2006-2007 have been used in this analysis as Sectors 7-9 were not counted during October 2006. This data is also graphically represented in Figures 16 and 17.

Table 6. Summary of count data for 2006-2007; total number of birds (Sectors 6-9)

	A6	A7	A8	A9	A6-A9
16.11.06	10	11	192	88	301
23.11.06	7	2	70	15	94
28.11.06	23	5	430	11	469
07.12.06	32	0	46	12	90
13.12.06	12	18	8	18	56
18.12.06	37	8	783	320	1148
23.01.07	51	19	29	17	116
25.01.07	27	21	576	8	632
31.01.07	8	0	548	327	883
15.02.07	405	13	137	0	555
23.02.07	8	11	61	10	90
28.02.07	22	6	13	10	51
12.03.07	11	15	69	4	99
13.03.07	10	12	107	5	134
14.03.07	9	9	149	9	176
Total all counts					4894
Mean					326

Table 7. Summary of count data for 2007-2008; total number of birds (Sectors 6-9)

	A6	A7	A8	A9	A6-A9
02.10.07	0	36	4	4	44
04.10.07	6	51	122	0	179
25.10.07	3	15	62	2	82
6.11.07	14	408	141	97	660
14.11.07	13	17	43	17	90
30.11.07	120	39	112	48	319
04.12.07	47	97	339	10	493
11.12.07	18	225	350	39	632
21.12.07	171	384	368	102	1025
10.01.08	99	77	34	36	246
15.01.08	6	17	100	3	126
18.01.08	26	19	177	35	257
11.02.08	18	132	70	19	239
18.02.08	135	1611	1269	25	3040
26.02.08	10	25	8	14	57
05.03.08	26	10	781	32	849
11.03.08	4	52	28	10	94
18.03.08	35	23	72	54	184
Total all counts					8616
Mean					479

Figure 16. Graph showing number of waterfowl and waders recorded during counts undertaken 2006-2007 (sectors 6-9 combined).

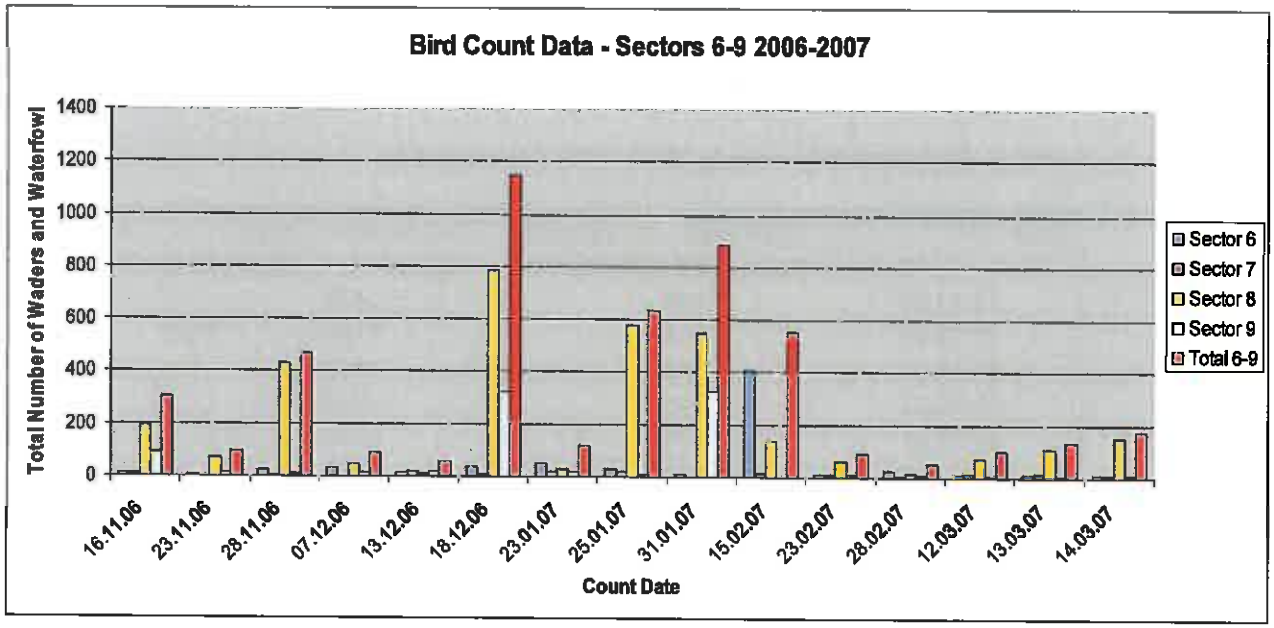
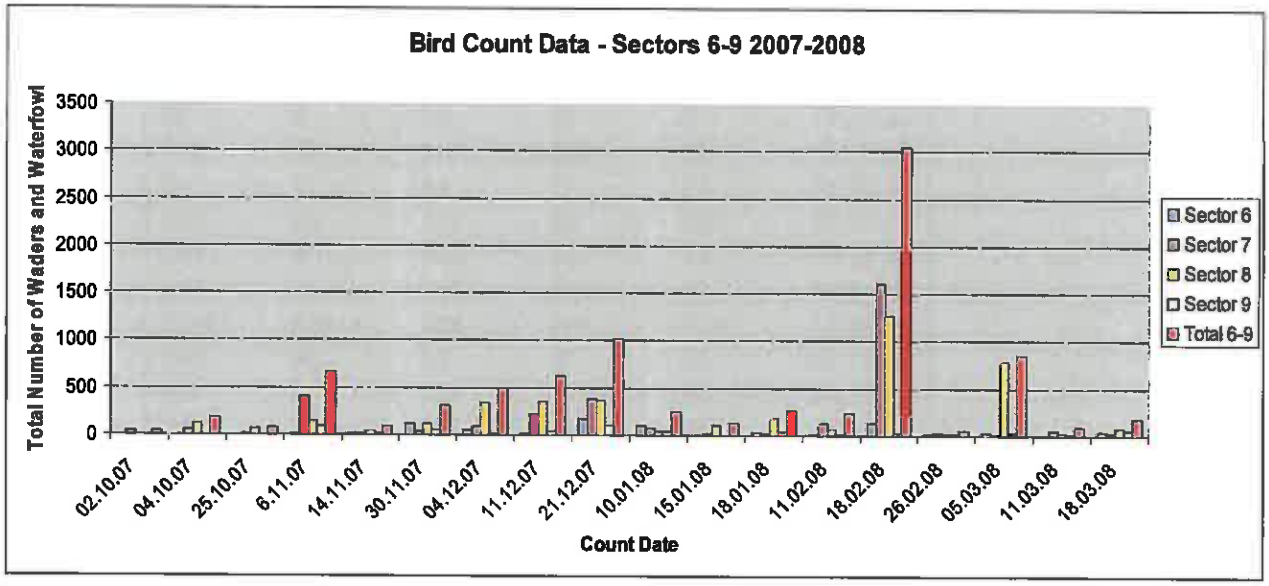


Figure 17. Graph showing number of waterfowl and waders recorded during counts undertaken 2007-2008 (sectors 6-9 combined).



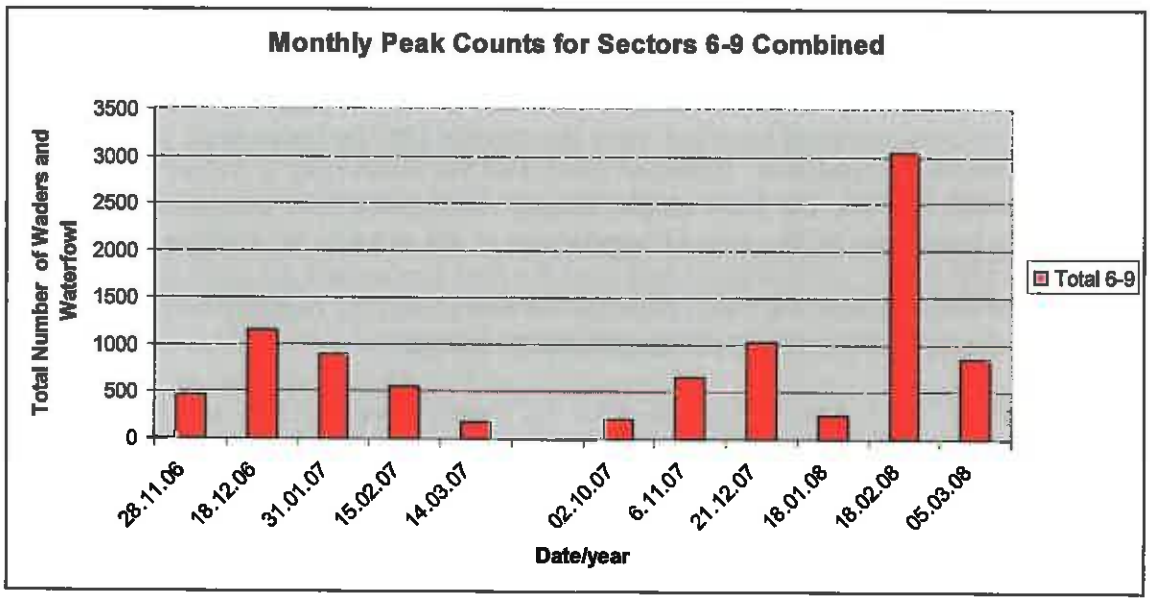
Analysis of this data, as reported in the ES, clearly demonstrates that, at times the mudflat area to the north of the proposed BDSCT supports significant numbers of wintering waterfowl and waders. Sector 8 appears to provide the greatest resource for birds particularly in 06-07, followed by Sector 7, which was used to a greater extent by birds during 07-08.

- Peak usage for sectors 6-9 was 1148 birds in 2006-2007 and 3040 birds in 07-08. Mean usage (across all counts) was 326 in 2006-2007 and 479 in 07-08;
- Taking peak monthly counts (as shown in Table 8 and Figure 18), the mean peak monthly count was 647 in 06-07 and 1006 in 07-08; and
- Advancing the WeBS type approach to data analysis, the 2 year mean peak is 2094 birds for sectors 6-9 (combined).

Table 8. Peak monthly counts 2006-2008 (Sectors 6-9)

Date	Total birds Sectors 6-9	Total birds Sectors 2-5	Total birds all sectors	Peak - Sectors 6-9	Peak - All Sectors
28.11.06	469	7	476		
18.12.06	1148	16	1164	1148	1164
31.01.07	887	11	898		
15.02.07	555	19	574		
14.03.07	176	13	189		
Mean peak	**647**		**660**		
02.10.07	204	23	227		
6.11.07	660	1	661		
21.12.07	1025	91	1116		
18.01.08	257	4	261		
18.02.08	3040	11	3051	3040	3051
05.03.08	849	3	852		
Mean peak	**1006**		**1028**		
Mean peak (06/07-07/08)				**2094**	**2108**

Figure 18. Monthly peak counts for sectors 6-9 combined (winter months 2006-2007 and 2007-2008)



Taking into account bird usage across the entire area of intertidal that could be either directly affected or influenced by the proposed container terminal (i.e. sectors 2-9 inclusive) the mean peak is little changed from that for Sectors 6-9, and is 2108 birds. This, again, reflects the relatively limited use of Sectors 2-5 by birds.

Comparison of the mean peak for the intertidal mudflat within sectors 6-9 (2094 birds) with the entire Severn Estuary (as available from WeBS data) indicates that the area supports 3% of the total SPA/Ramsar assemblage mean peak of 68,769 birds for the period 02/03 – 06/07).

Table 9. Comparison of mean peaks for individual bird species using sectors 6-9 with Severn Estuary populations (2002-03/2006-07).

Species	Peak 06/07	Peak 07/08	Mean peak	02/03 – 06/07 WeBS mean peak (Severn Estuary)	% SPA Population (mean peak)	% SPA Population (peak)
Shelduck	18	46	32	3492	0.9	1.3
Gadwall	64	33	49	255	19	25
Teal	65	270	168	3949	4.3	6.8
Mallard	44	240	142	3334	4.3	7.2
Oystercatcher	8	36	22	N/A		
Dunlin	650	2800	1725	21430	8.0	13.1
Lapwing	830	1	416	13193	3.2	6.3
Curlew	25	15	20	2974	0.7	0.8
Redshank	130	218	174	2312	7.5	9.4
Ringed plover	15	13	14	N/A		

The data presented in Table 9 can be compared with the original analysis given in Table 12.20 of the ES, which was undertaken on a sector by sector basis. Although the levels

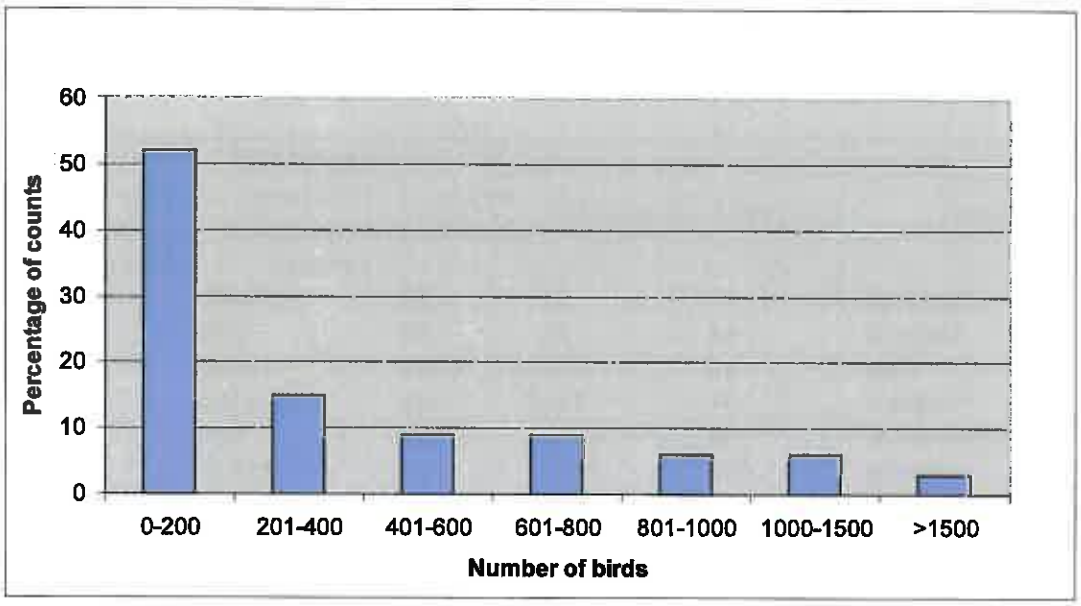
of abundance and significance in relation to the estuary as a whole are similar between the two approaches, taking usage across the entire mudflat (Table 9 above) provides a better reflection of the contribution that this area makes at the estuary level rather than summing the percentage contribution of mean peaks for each of the individual sectors.

The mean peak and peak for each of the key species listed in Table 9 have been compared with the numbers recorded for the Severn Estuary as a whole. Analysis of the peak numbers recorded using the mudflat with the mean peak for the estuary is not directly comparative. However, given that the mean peak is based only on two winters worth of data, the peak vs the estuary mean peak does provide an indication of the greatest use of the area in comparison to the estuary as a whole. With the ongoing collection of ornithological data over the next two winters (i.e. prior to the proposed start of construction), the mean peak can be refined and the contribution of the mudflat (in the context of the estuary) will become better defined.

While the two year mean peak for the mudflat area provides an indication of the total number of birds that the area of mudflat may support, this figure may not be fully representative of 'typical' use of the mudflat area by the overall bird assemblage at Avonmouth. This 'typical' usage is perhaps better represented by an overview of all of the counts over the two winter periods for which surveys have been undertaken. In this context it should be noted that the occasional use of sectors 6-9 by large flocks of dunlin is typical of the behavioural and foraging ecology of this species. Further counts, to be undertaken over the next two winter periods, will further define the usage of sectors 6-9 by dunlin.

Examination of the monthly count data shows that usage is variable and that for at least 50% of the counts undertaken the total number of birds was below 200 per count and for 85% of the counts the number of birds was below 800 (see Figure 19).

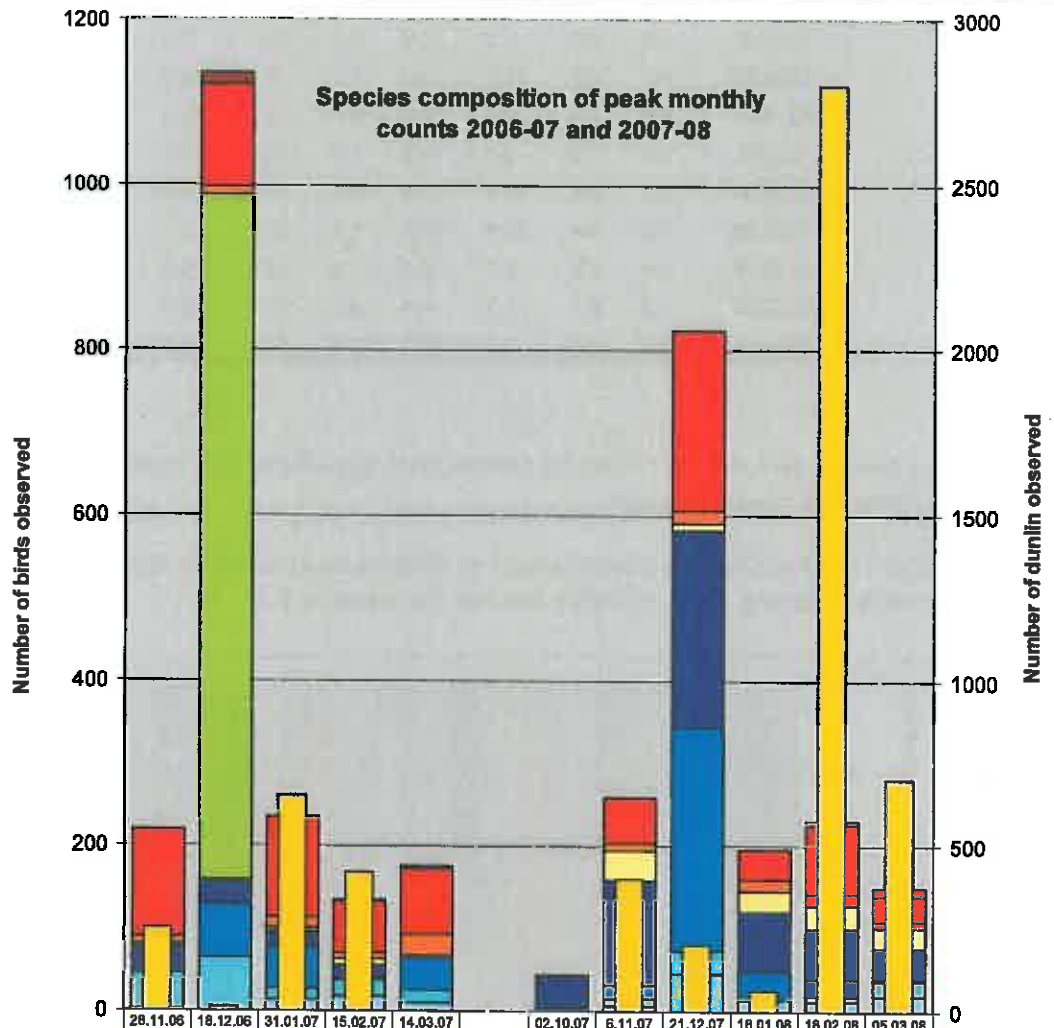
Figure 19. Percentage of counts with reference to number of birds recorded from sectors 6-9 combined.



In terms of the assemblage present at the site, Figure 20 provides a breakdown of species composition (absolute numbers of waders and waterfowl recorded) for the peak monthly counts. The dominance of dunlin is clearly demonstrated. It should be noted

that the very high count of over 3000 birds on the 18th February may have included a large flock of dunlin that moved between two sectors during the count. This data is also presented in Table 10 and Figure 21 as the percentage contribution that each species makes to the assemblage. Using this method of presenting the data, again, demonstrates the dominance of dunlin, but also shows that at times, waterfowl, notably mallard and teal, may dominate the assemblage when dunlin are absent or occur in smaller numbers.

Figure 20. Species composition of peak monthly counts 2006-2007 and 2007-2008.



	28.11.06	18.12.06	31.01.07	15.02.07	14.03.07		02.10.07	6.11.07	21.12.07	18.01.08	18.02.08	05.03.08
Ringed plover		15		4	3						4	9
Redshank	130	123	122	61	80		4	55	218	36	84	30
Curlew	9	9	13	7	25			10	15	14	13	8
Lapwing		830										
Oystercatcher	4	2	4	8	3			36	8	25	29	26
Mallard	30	28	19	16			36	127	240	72	61	37
Teal		86	51	1	40			16	270	33	20	2
Gadwall	45	64	14	20	15		1	10	27	2	6	18
Shelduck	1		12	18	10		3	6	46	14	13	19
Dunlin	250	12	650	420				400	200	61	2600	700

Count Date (monthly) and total number of each species recorded

Table 10. Percentage contribution to the wader and waterfowl assemblage made by individual species recorded for the peak monthly counts (2006-2007 and 2007-2008).

	Percentage contribution to assemblage by each species – Sectors 6-9									
Count Date	Su	Ga	T	Ma	Oc	Dn	L	Cu	Rk	Rp
28.11.06	0.2	9.6	0.0	6.4	0.9	53.3	0.0	1.9	27.7	0.0
18.12.06	0.0	5.6	5.7	2.4	0.2	1.0	72.3	0.8	10.7	1.3
31.01.07	1.4	1.6	5.8	2.1	0.5	73.4	0.0	1.5	13.8	0.0
15.02.07	3.2	3.6	0.2	2.9	1.4	75.7	0.0	1.3	11.0	0.7
14.03.07	5.7	8.5	22.7	0.0	1.7	0.0	0.0	14.2	45.5	1.7
02.10.07	6.8	2.3	0.0	81.8	0.0	0.0	0.0	0.0	9.1	0.0
6.11.07	0.9	1.5	2.3	19.3	5.5	60.7	0.0	1.5	8.3	0.0
21.12.07	4.5	2.6	26.4	23.4	0.8	19.5	0.0	1.5	21.3	0.0
18.01.08	5.4	0.8	12.8	28.0	9.7	23.7	0.0	5.4	14.0	0.0
18.02.08	0.4	0.2	0.7	2.0	1.0	92.4	0.0	0.4	2.8	0.1
05.03.08	2.2	2.1	0.2	4.4	3.1	82.4	0.0	0.9	3.5	1.1
Mean %	2.8	3.5	7.0	15.7	2.2	43.8	6.6	2.7	15.2	0.4

Su = Shelduck, Ga = Gadwall, T = Teal, Ma = Mallard, Oc = Oystercatcher, Dn = Dunlin, L = Lapwing, Cu = Curlew, Rk = Redshank, Rp = Ringed plover.

Figure 21. Percentage contribution of individual species to the bird assemblage recorded during peak monthly counts for sectors 6-9

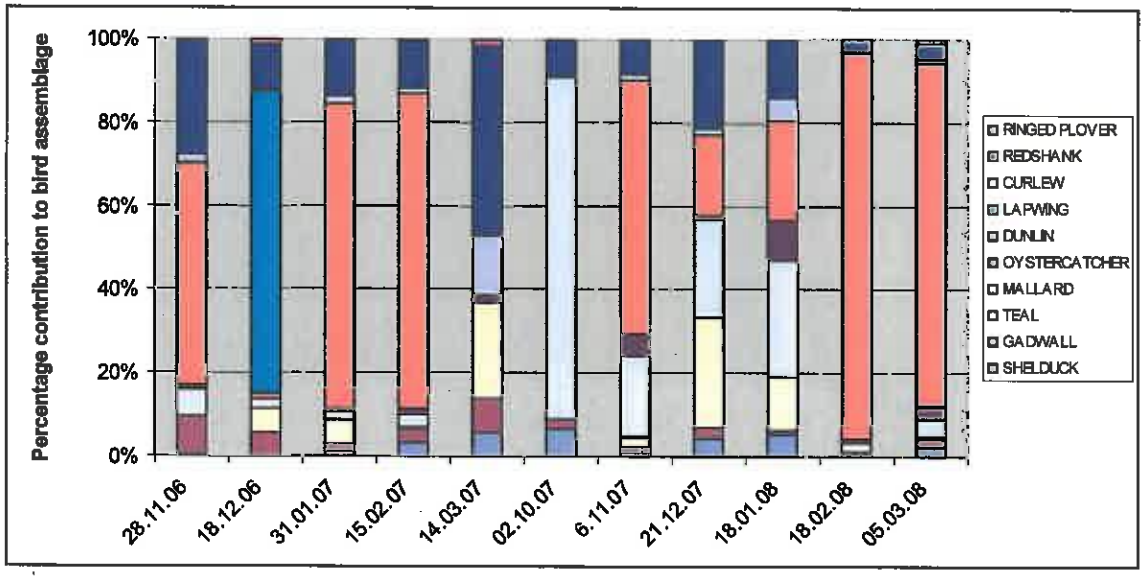


Table 11 provides a summary of the three methods of representing the bird data as a way of showing the relative importance of each of the main species with respect to the SPA and the overall assemblage. This comparison indicates the significant contribution that dunlin and redshank make to the assemblage as well as the importance of the mudflat with regard to supporting populations of these species at the SPA (estuary) level. The importance of the area for teal and mallard is also highlighted. The prominence of mallard as a contributor to the overall assemblage reflects the fact that at

times when overall numbers of birds using the area are low this species remains faithful to the area. Although gadwall numbers form a relatively small component of the total assemblage (3.5%) the mudflat supports up to 25% of the SPA population, clearly demonstrating the importance of this area for this species. Observation of this species and other waterfowl at the site indicates that specific use of the freshwater flow from the Sewage Treatment Works (STW) that runs across the mudflat at Holes Mouth (sector 8) is made. Gadwall are also known to make use of the freshwater pools at the STW and it maybe that the same birds are involved at both sites.

The high mean peak of lapwing (2nd behind dunlin) does not represent the contribution that this species makes to the assemblage and it is considered that the mean peak overplays its recorded usage of the mudflat. The contribution that lapwing makes to the assemblage (6.6%) is also considered to be unrepresentative on the basis of the counts undertaken to date as lapwing was only recorded once over all of the counts during 06-07 and 07-08. It is considered highly likely that by ensuring habitat availability for the species that regularly use the existing mudflat that conditions for occasional use of the area by lapwing would be maintained.

Table 11. Comparison of three different methods of representing species composition of intertidal mudflat to the north of the proposed BDSCT.

Species	Mean Peak	Rank	Percentage (SPA Popn[1])	Rank	Percentage (assemblage)	Rank	Mean Rank	Species importance (based on mean rank)
Dn	1725	1	8-13.1	2	43.8	1	1.3	Dn
L	416	2	3.2-6.3	6	6.6	5	4.3	Rk
Rk	174	3	7.5-9.4	3	15.2	3	3	Ma
T	168	4	4.3-6.8	5	7.0	4	4.3	Ga
Ma	142	5	4.3-7.2	4	15.7	2	3.7	T
Ga	49	6	19-25	1	3.5	6	4.3	L
Sh	32	7	0.9-1.3	7	2.8	7	7	Sh
Oc	22	8	N/A	9	2.2	8	8.3	Oc
Cu	20	9	0.7-0.8	8	2.7	9	8.7	Cu
Rp	14	10	N/A	10	0.4	10	10	Rp

[1] Percentage contribution is based on the highest peak count obtained during the winter periods 06/07 and 07/08. This contribution will be refined and provided as a mean peak following the collection of additional winter/passage data.

4.2.4 Functional requirements of the recorded wader and waterfowl assemblage

Using the data presented in Section 4.2.3 and as presented in the ES, the waterbird assemblage in and around the existing port and their functional habitat use can be divided into several basic components. This usage is summarised in Table 12 and information on the functional requirements of key species are provided in the ES at Section 12.4.4.

Table 12. Functional components of habitat utilised by wader and waterfowl assemblage

Functional use of habitat	Species / component of assemblage	Prey items	Distribution
Feeding			
Intertidal – fine muds	Dunlin, redshank, shelduck	Small crustaceans, shallow infaunal worms, surface organisms (e.g. Hydrobia)	Intertidal mudflat to the north of proposed BDSCT (sectors 7-9)
	Curlew	Infaunal worms (e.g. ragworm) and bivalves	Intertidal mudflat to the north of proposed BDSCT (sectors 6-9)
Intertidal – coarse sediment	Oystercatcher	Bivalves	Intertidal mudflat to the north of proposed BDSCT (sectors 8-9)
Intertidal mud – freshwater flow from STW across foreshore	Gadwall, teal and mallard	Birds may be preening/drinking rather than actively feeding, but possibly feeding on algae on mud surface	Intertidal mudflat to the north of proposed BDSCT (sectors 7-8)
Roosting			
Man made structures within the port	Redshank, ringed plover	N/A	Disused pier, jetty and breakwater (sectors 2-3). Some use of upper shore hardstanding sectors 4-9.

4.2.5 Potential ecological replacement requirement

Using the analysis of the bird data undertaken in the ES and the summed data/analysis for sectors 6-9 above, a basic assessment of ecological requirements for habitat replacement related to the BDSCT scheme can be made. The summary presented below takes into account the identified use of the entire intertidal area potentially affected by the BDSCT scheme, i.e. the area within the footprint of the terminal and the mudflat to the north, and as summarised in Table 12. For the present time, the requirements take into account the variability in numbers recorded over the two winters for which data are available. With further counts planned for the winter of 2008/2009 and prior to construction in 2010, the target requirement with regard to bird numbers may be better and subsequently redefined.

As documented in the ES and above, the vast majority of the ornithological interest of the area is associated with the intertidal mudflat north of the terminal and therefore replacement requirements are effectively focused on providing for any adverse change to the ecological function of this area. The functional issues associated with predicted changes to the upstream mudflat are considered further in Section 5, but for the

purposes of the scheme as a whole, the points below highlight the indicative habitat compensation requirements that need to be provided:

- Habitat that is capable of supporting on a regular basis an assemblage of waterbirds comprising up to approximately 3000 waterbirds during the winter (October-March) months including (in order of contributory significance), dunlin, redshank, mallard, gadwall, teal, shelduck, oystercatcher, curlew and ringed plover with occasional use by flocks of lapwing

Considering the ecological requirements of the bird assemblage present at Avonmouth, the habitat provision needs to comprise:

- Intertidal mudflat as a feeding resource for waders and waterfowl;
- Structural elements and/or habitat (man made or natural) that can be used by small numbers of roosting waders (redshank and ringed plover); and
- The continued presence of freshwater flow across intertidal mudflat that may be of importance for feeding/preening waterfowl, notably gadwall and teal.

Sections 5 and 6 present further information on the predicted change likely to result from the development of the BDSCT with regard to intertidal habitats and the bird assemblage that this habitat supports. Discussion is then provided on how this change equates to habitat replacement requirements and the most appropriate mechanism for providing this replacement need.

5 ASSESSMENT OF FUNCTIONAL AND HABITAT REPLACEMENT REQUIREMENTS

5.1 Assessment of functional requirements

5.1.1 Direct loss of habitat

The construction of the container terminal would result in the permanent loss of habitat that is of known use by waterfowl, waders and gulls. Effectively, based on count data undertaken since 2001, it is apparent that the usage of the reclaim area can be split into two types: use of the mudflats by foraging birds and use of existing structures and hardstanding by roosting birds around high tide periods.

Reclamation for the construction of the container terminal would lead to the permanent loss of intertidal mudflat and a small area of saltmarsh that currently fronts the existing port facilities. Of the 33.5ha of intertidal area that would be lost due to reclamation, 22ha is above Mean Low Water (MLW) and 11.5ha between MLW and Lowest Astronomical Tide (LAT).

All of the intertidal area that would be lost is designated for its nature conservation interest in this instance, benthic (mudflat) communities and the birds that make use of this resource. Of this area, 2ha falls within the boundary of the designated Severn Estuary SPA and the remainder of the intertidal area down to MLW is designated as SSSI and forms part of the Severn Estuary SSSI.

As is evident from the ornithological data, bird usage of the intertidal area to be reclaimed is low, with no waterfowl or wader species occurring in significant numbers on a regular basis (i.e. making consistent use of the area for feeding or roosting). This low usage is considered largely to be a result of the semi-enclosed nature of parts of the frontage, the low infaunal abundance and biomass (i.e. available food resource) and

previous disturbance to the foreshore that make it unsuitable for use by waterfowl and waders. In terms of the Annex 1 and nationally and internationally important waterfowl species cited as part of the Severn Estuary SPA, the following were recorded within the area of intertidal that would be reclaimed (data taken from low water counts undertaken between 2006 and 2008):

- Shelduck;
- Curlew;
- Dunlin; and
- Redshank

Of these species, only shelduck (mean peak of 5) and curlew (mean peak of 4) appear to make regular use of the intertidal as foraging habitat and even then the total number of birds involved is very small with typically only 1-2 curlew being present and 2-3 shelduck. Dunlin may very occasionally be present (recorded only 4 times over the 36 winter counts) with a peak mean of 4 birds). Within the context of the estuary populations and the designated SPA populations these numbers are considered to be very low and represent no more than 0.1% of the mean peaks for these populations as a whole. Other waterfowl and wader species that use the site (non-SPA designated populations) do so in small numbers with only mallard occasionally being present in numbers greater than 10 individuals.

The mean peak use of this intertidal area was 34 birds over the 06/07 to 07/08 period. In the context of the estuary population (67,675, WeBS core counts, 01/02 – 05/06) this total represents approximately 0.05% of the total waterfowl and wader population. Taking into account the total usage of sectors 2-5 (i.e. intertidal + structures), the mean peak usage represents approximately 0.1% of the total estuary population.

The loss of intertidal area within the footprint of the proposed terminal would lead to the displacement of waterbirds that utilise this area during the winter and at other times of the year. Birds that use the existing intertidal for feeding would have to relocate to other intertidal areas within the estuary in order to forage. Birds that use the site for roosting may have to seek alternative sites, if the developed facilities did not offer similar conditions to those already provided.

From a simplistic perspective habitat loss may lead to a reduction in food availability that in turn may lead to movements of birds to other sites and therefore increase the density of birds in the process (Goss-Custard 1993, Sutherland & Goss-Custard 1991). With an increase in density, food resources may become depleted or competition between birds for available food increases (often both may arise). If potential food intake is affected, the quality of the habitat to support birds may be reduced. As habitat is removed (or disturbance levels increase) there may be no effects on bird numbers until a threshold density is reached. At this point, due to the effects mentioned above, the potential for mortality of some individuals may be increased, particularly under adverse conditions such as cold winter weather.

Determining the likely effect of the loss of the intertidal area in relation to displacement effects is complex, given the wide variety of other factors that come into play and the variability in these factors. However, in this instance it is considered that the potential for habitat loss to have an impact on bird populations outside of the immediate area of impact (i.e. through displacement of the affected birds) is not significant. This conclusion is based on the following aspects:

- The usage by waterfowl and waders of sectors 2-5 is very low. The total number of birds that would be displaced from the intertidal area (i.e. as a feeding resource) probably involves less than 20 birds that make regular use of the entire area for feeding; and

- Adjacent mudflats at Portbury and in the Holes Mouth and Severnside area are known to support much greater infaunal food sources than the intertidal fronting the port. Consequently, given the small number of birds that would be displaced and the fact that alternative and productive areas of foraging habitat are available nearby it is unlikely that foraging pressure in these areas would be increased beyond a threshold at which bird mortality would be likely to be increased;

Taking into account the above, from a functional perspective, it is considered that the loss of this intertidal area would be unlikely to have a discernible effect upon estuarine ecology. However, given that the loss would be permanent it is accepted that the total area of habitat and extent of intertidal habitat would be diminished. In this case it can therefore also be argued that in order to ensure that the totality of habitat is maintained that replacement of the area should be undertaken. Also, given that part of the area is of international designated status, habitat replacement should take into account the need to maintain designated features, enable conservation objectives to be met and be aligned to regulatory requirements (see Section 5.2 for discussion on the scale of habitat replacement).

Use of man-made structures

Within the footprint of the proposed container terminal there are three man-made structures – South Pier, North Pier and the old jetty (count sector 3) as well as the rubble and hardstanding that forms the edge to the upper intertidal. All of these areas provide roosting and loafing habitat for several species of waders, notably redshank and ringed plover and gulls and cormorants. The development of the container terminal would result in the loss of these structures and therefore the loss of this roosting function. In this regard the main species that would be affected by the development are redshank and ringed plover, two species that are important within the context of the Severn Estuary SPA.

Both redshank and ringed plover occur in numbers that could be considered to be significant within the context of the estuary and the SPA. For redshank, up to 30 birds have been recorded using North Pier, and the peak mean for sectors 2-5 (24) represents approximately 1% of the total estuary peak mean. While it is apparent that the port frontage may support up to 1% of the total estuary mean peak population, the use of this area is not consistent.

Wintering ringed plover appear to make regular use of the structures and port frontage, birds having been recorded on approximately 30% of all of the winter counts undertaken. Most birds were recorded during the high tide counts, with an average of 9 birds present (peak 47), compared with 8 birds (peak 14) on a falling tide. This data and observations undertaken at the time of the counts suggest that this area may be used as one of a number of roost sites for this species around the port. Counts undertaken since 2001/2002 clearly demonstrate that the port represents one of the main wintering roost areas for this species in the estuary. On the southern side of the River Avon, Portbury Pier, St. George's Wharf, Chapel Pill and a small high-level beach at the Causeway, are known to act as high tide roost sites for this species with Portbury Pier regularly supporting a peak of around 25 birds and St George's Wharf 18 birds (Landmark

Consultants 2006). The total number of birds using the port area at any one time is not known and it may be that a number of sites within the port are used by the same birds with usage dependent on the level of disturbance or other factors (e.g. weather) affecting the various sites.

The Severn does not support nationally important numbers of ringed plover during the winter months and there is no published whole estuary count for this species. Winter counts from various sections of the former Avon area of the Severn indicate that Severnside normally supports <20 birds and the Clevedon-Yeo Estuary coastal section 10-15 birds (Avon Bird Report 2006). This suggests that the port area may support one of the highest, if not the highest, winter aggregations of ringed plover on the estuary. The current population threshold for national importance for this species is 330 (WeBS) which suggests that if the Severn were nationally important, that the port supports in the region of 14% of a nationally important population level.

The Severn Estuary is, however, of international importance for ringed plover on passage, with a five year (01/02 – 05/06) peak mean of 662 birds. Of the counts undertaken during August 2007, a mean of 3 birds were recorded and peak of 17. On the basis of WeBS data this suggests that this area may at times support approximately 3% of the estuary passage population, although it is recognised that given the limited counts undertaken during this period that usage of the site on passage could be greater.

As with the intertidal mudflat fronting the existing port facilities, birds that currently utilise the port piers and old jetty could be displaced to adjacent or other areas of the estuary as a result of the construction of the new container terminal. The potential consequences of this displacement will vary depending on the species involved.

For redshank, available data indicates that several other areas around the port facilities support small roosting populations suggesting that suitable locations elsewhere in the vicinity would be available for birds displaced from North Pier. Monitoring since 2001 (Landmark Consultants 2005 and 2006) shows that there are established roosts that are used by redshank (northern side of the River Avon, Molasses Pill (River Avon) and Chapel Pill) close to Portbury Dock. None of these sites would be directly affected by the proposed port development and given their distance from likely sources of disturbance (see Section 12.4.3 of the ES) these sites would be likely to remain unaffected during construction and through into operation. Birds that currently use the roost at North Pier and also the hardstanding and upper intertidal further towards Avonmouth Pill (Kings Weston Outfall) would therefore have alternative potential roost sites to relocate to following loss of these roost areas. Count data from all of the roost sites indicates that the number of birds fluctuates significantly and while these sites are clearly well established it is possible that birds move between sites or to other parts of the estuary away from the port. Even so, given the number of birds involved (i.e. approximately 1% of the mean peak estuary population), displacement has to be as a significant impact as it cannot be guaranteed that birds would successfully relocate.

The situation discussed above for redshank is also considered to largely apply with regard to ringed plovers that roost on the structures and which would be displaced by the development of the container terminal. The mean peak count for the port area is 31 (range of 23-42) with the majority of these birds occurring at a combination of Chapel Pill, the Causeway and Portbury Pier. For these birds it is apparent that there is significant fluctuation from site to site around the port as co-ordinated counts indicate that high numbers of birds are never recorded from individual sites at the same time (Landmark Consultants 2006). This suggests that as movement between sites may

occur that any birds displaced from a roost may be able to relocate to another appropriate site within the port complex.

The construction of the new breakwater as part of the terminal complex would also offer potential replacement roost habitat and could function in a similar manner to the pier structure at Portbury which supports a regular winter roost for this species.

Given the relatively small number of ringed plover recorded on passage (peak of 17), it is considered that there would still be adequate sites that would still function as potential roost sites within the vicinity of the port and that would be able to accommodate any birds displaced by the development of the terminal. The overall conclusion with regard to ringed plover is that although displacement from some existing roost sites will occur, other existing sites and new areas created by the development would provide adequate habitat for the continued presence and maintenance of the wintering and passage population at the port.

5.1.2 Functional change to intertidal habitat north of the BDSCT

During the construction of the new terminal, the construction of the breakwater and terminal locally alter tidal current flow which would in turn lead to the increased deposition of fine sediment over the intertidal area to the north. In summary a period of rapid accretion over the existing intertidal is anticipated for up to 3 years following construction of the upstream bund (predicted as up to 30cm per month), slowing to a gradual accretion in the medium term (no discernible change 20 years after construction). This effect is most likely to impact upon the intertidal area immediately adjacent to the terminal and progressively reduce northwards towards Holes Mouth. In total, increased accretion would be predicted to occur over an area of approximately 80ha, which represents about 0.4% of the total intertidal resource of the estuary. The predicted accretion will have an impact on the existing benthic resource in this area and therefore, in turn, on the birds that exploit this resource.

The effects of increased sediment deposition on benthic invertebrates

Natural sedimentation rates vary widely both within and between habitats and depend on numerous environmental factors. Most shallow benthic habitats in estuarine and coastal systems are subject to deposition and resuspension events on daily or even tidal time scales and many organisms have physiological or behavioural methods of dealing with sediments that settle on or around them, ranging from avoidance (e.g., motile organisms such as fish) to tolerance of attenuated light and/or anaerobic conditions caused by partial or complete sediment burial. However, above certain thresholds, natural perturbations in sedimentation rates (e.g., due to seasonal increases in suspended sediment loads, resettlement, or storms) may adversely affect organisms resulting in changes in distribution, abundance or mortality.

As described above the biotopes observed close to the terminal footprint support species which are adapted to live in fine muds and silts. The dominant species in this location were the polychaetes *H. diversicolor* and *S. shrubsolii* and the mud snail *H. ulvae*.

The nature as well as the depth of the sediment being deposited has a substantial influence upon physiological or behavioural response. Several studies have examined the effects of the burial of invertebrates by sediment. Maurer *et al.* (1981a, 1981b) carried out experiments on the lethality of sediment overburden on selected

macroinvertebrates. They concluded that many motile epibenthic and infaunal animals could withstand the instantaneous deposition of a light overburden of sediment (about 1 cm), especially when the overlying sediment was native to their habitat. Many of the macrofauna that live in areas of sediment disturbance are well adapted for burrowing back to the surface following burial. Studies by Maurer *et al* (1978) showed that some benthic animals could migrate vertically through more than 30cm of deposited sediment, and this ability may be widespread even in relatively deep waters. The experiments undertaken by Maurer *et. al.* (1978 and 1981b) were conducted on a number of typical intertidal genera and species, including the polychaete *Hediste*, which forms an important component of the HedMac biotope type. Saila et. al. (1972 – as reported in Maurer *et. al.* 1981b) provide experimental evidence to show that the polychaete *Streblospio benedici* was able to reach the surface through 6cm of deposited fine sediment. This genus of polychaetes is also commonly recorded from the intertidal mudflats of the Severn Estuary and is likely to form an important prey item for birds such as dunlin and redshank.

Many of the invertebrates that currently occur on the lower part of the mudflats are typical of unconsolidated muds and live in the upper parts of the sediment column where oxygen levels are higher. If the sediments become consolidated through cohesion, which is more likely if greater exposure of the muds occurs (i.e. if raised in tidal frame), then the invertebrates tend to form permanent U-shaped burrows through which oxygenated water is drawn when the tide covers the mudflats. Such communities are more typical of salt marshes and there is likely to be some change in the relative proportions of the component species potentially living deeper in the sediment than previously.

If cohesion of the sediment surface, and consequent alteration of invertebrate burrowing behaviour, does not occur to any great extent then the benthos could be affected through the change in elevation of the mudflat surface. The intertidal area in the region of Holes Mouth and to the north would be predicted to experience significantly less accretion (approximately 2-3m towards MLW over 30 months) than the area closest to the reclaim wall where in the region of 7-8m of accretion is predicted. With 2-3m of accretion over the envisaged time period, if accretion is uniform it is considered that most infauna would be able to adapt to sediment deposition. The change in intertidal height within the tidal frame could, however, alter the composition, diversity and biomass of the affected area due to change in its level of exposure.

As referred to above, intertidal benthic communities typical of muds and saltmarsh habitats are subject to (and reflect) frequent depositional, resuspension and erosional events. During the main period of accretion and prior to consolidation of deposited fine sediment, events during which sediment becomes resuspended (e.g. rough weather, spring tides etc.) may lead to an increase in the amount of sediment available for redeposition over the intertidal area upstream of the BDSCT. While more fine sediment may be available for transport during the accretionary period, it is considered that this increased availability would be unlikely to have significant further potential to alter the characteristics of the benthic intertidal community. This would largely be due to the following:

- The frequency and magnitude of conditions under which sediment could be resuspended and redeposited would not be altered with respect to existing conditions;

- The fundamentals of the suspension/redepositional processes would not be altered, including aspects such as the amount of sediment that could be carried in suspension;

- The consolidation processes of the deposited sediments will remain the same.

Available data indicates that intertidal deposition is very variable.

Intertidal bed frame measurements taken at Woodspring Bay (west of Portishead Point, reported in Whitehouse et al (1998)) showed up to 22mm of mud deposited during a single spring tide. Furthermore thin rivulets of fluid mud were seen flowing off the intertidal during the ebb phase suggesting large near bed concentrations and fluxes on and off the intertidal areas.

The existing benthic communities are adapted to this variability in rates and amounts of deposition.

Implications of potential changes to the invertebrate fauna on the ecological function of the mudflat

On the basis of available information (as reported above) the predicted rate of sediment deposition may be within tolerable limits for some or potentially many of the species present within the mudflat. However, the effective 'stress' that could be caused by repeated and prolonged (from the perspective of infaunal organisms) accretion during the initial phase of sediment deposition could lead to a depletion in abundance and diversity and disturbance to the existing stable community that has developed at the site.

Although it is difficult to establish with any certainty the likely effects of increased sedimentation over the intertidal area it is considered that the predicted increase in sedimentation and elevation in the tidal frame could shift the morphological state of the mudflat to one that has an effect on its ecological function.

This change in function consists of the consequential response of the infauna to predicted changes in sedimentation/elevation and the resultant effect on waterfowl populations. In this respect, the infaunal communities are considered solely as a food resource for waterfowl and therefore any long-term changes to the invertebrate populations (i.e. the resource) could impact upon the waterfowl populations that currently utilise the mudflats. From a purely physical perspective, the predicted elevation of the mudflat is not considered to have any adverse effects on waterfowl feeding behaviour.

Although many waterfowl have preferred prey items, generally they will feed in areas of relatively high invertebrate biomass, as this is more efficient. Therefore, given the potential decrease in the invertebrate biomass where the most significant accretion is predicted to occur it would be expected that bird feeding value could be reduced. This reduction would probably be most prevalent during the 3 year period of most rapid accretion over the existing area of intertidal during and following breakwater and quay wall construction. Clearly, the raised mudflat would still have a feeding value and therefore it will retain ecological interest and function with respect to wintering waterfowl. This value would be likely to differ across the intertidal area, with the most affected area, closest to the terminal wall, experiencing the greatest change and therefore greatest potential reduction in value.

It is likely that there would be a range of exploitable invertebrate species present within this area despite any potential decrease in biomass. Biomass could also eventually recover to pre-development levels within 1-2 years after the period of rapid accretion, if the basic physical morphology of the mudflat (e.g. height in the tidal frame) is within the limits in which the conditions for infaunal colonisation and growth are maintained.

Following the predicted reduction in the rate of accretion, stabilisation of the mudflat and a return to conditions in equilibrium with the estuary would be expected. At this point, or during this process of stabilisation, recruitment and recolonisation of the mudflat so that available niche space became reoccupied would occur. We know from studies of new managed re-alignment sites and colonisation of disposed dredged sediment that this process can be relatively rapid and occur within the space of 1-2 years. In this instance, as the mudflat would not be completely depleted of infauna, these processes would be ongoing throughout the transition to the new mudflat state but would not lead to a stable community structure until accretion had fallen to levels in keeping with background rates.

This temporal change in the invertebrate community present at the site would also have implications for waterfowl and wader use of the area, as discussed above. Use could be diminished during the response and adjustment period of the mudflat to the increased accretion and return to a stable state, but following this and with stabilisation at a new state, the mudflat would be likely to have a similar functional capacity to its existing state. The process of alteration of elevation in the tidal frame of the area will play a key role in the eventual composition, diversity and abundance of the infaunal community that develops at the site and this aspect needs to be superimposed upon the short-term disturbance that would be caused by the rapid accretion.

Given that the area of mudflat undergoing the greatest amount of accretion would still fall within the height range of the existing mudflat (see Figure 9), it would also be expected that it would either retain or come to possess the same or similar functionality as the existing mudflat.

The predicted progressive change in accretion over the intertidal area coincides to a large degree with the recorded bird usage of the site, with fewer birds using the area closest to the northern edge of the proposed terminal and increased usage further to the north where less accretion is predicted. This relationship is graphically demonstrated in Figure 10 where the count sectors are superimposed over the predicted area of accretion. Analysis of the accretion footprint suggests that within count sector 6 the amount of accretion would be in the region of 2-3m over the bulk of the existing intertidal, increasing to 3-5m at MLW. Moving northwards into count sector 7 predicted accretion reduces to between 0.5-2m over the main intertidal area, increasing to 3-4m at low water. A similar picture is repeated for sector 8, although here the lower half of the intertidal is predicted to accrete 2-3m and the upper part 0-0.5m. These predicted intertidal levels would still result in the emersion and immersion of the mudflat area within sectors 7-9 within the lower half of the tidal frame (see Figure 9).

In relation to the above, the overall morphological change that is predicted to occur at the site is also of importance with regard to the eventual and likely distribution of infaunal communities in the area, and therefore the potential ecological function of the intertidal, particularly with regard to acting as a resource for feeding waterbirds. Calculations suggest that over a period of 48 months during and following construction of the breakwater, that an additional 40ha of mudflat above MLW would accrete in this area (see Table 3). This predicted increase in the area of intertidal, mainly within the

region of MLW, could ameliorate the predicted reduction in suitable feeding habitat that may occur towards the top of the intertidal as a result of accretion and the potential development of saltmarsh habitat within this area. This additional area can be viewed as a potential feeding resource for birds that use the intertidal area and can perhaps be best expressed as a change in resource availability through calculation of intertidal area exposed over time (see Table 4). It should be noted, however, that the predicted increase in resource availability does not necessarily translate through to a similar percentage increase in usage by birds. This is due to differential behaviour in the use of exposed intertidal area by different species. As an example, species such as dunlin tend to feed towards MLW and follow the rising or falling tide. As the extent of MLW along the increased area of intertidal would not significantly increase, then the effective resource for this species would not differ greatly between the existing and predicted situation. Other species, such as redshank, curlew and shelduck, tend to exploit available prey over a wider area and for these species the predicted additional resource availability could sustain greater numbers of birds or enhance survival of existing populations.

It should be stated here though that this additional area, although beneficial, is not being viewed as mitigation for the potential loss of feeding value to waterbirds that currently use this intertidal. This is due to the possible uncertainties in modelling the situation, particularly with regard to effects on sediment dynamics and behaviour, and the ecological response to the predicted accretionary process.

A summary of the main potential hydrodynamic and sedimentary changes predicted to occur over the intertidal area to the north of the BDSCT and their ecological consequences are provided in Table 13. The basic conclusion that can be gained is that there could be a short term (up to 5 years) decrease in the capacity of the intertidal area to support existing ecological interests (invertebrate infauna and birds that utilise this resource). This is likely to have potentially adverse impacts on SPA and Ramsar waterbirds. Beyond this period it is considered that the additional predicted accretion could be beneficial with regard to providing a greater extent of resource within the estuary. The implications of this with regard to the overall provision of habitat replacement are discussed further in the following sections.

Table 13. Summary of the ecological effects of predicted morphological change to the intertidal area upstream of the BDSCT

Predicted change in mudflat	Effect on infauna	Effect on bird assemblage	Habitat function	Overall impact
Rapid accretion towards MLW	Potential short term (up to 5 years) decrease in biomass as fauna is 'stressed' by rapid increase in rate of sediment deposition	Potential short term (up to 5 years, allowing for recolonisation and stabilisation) decrease in availability of preferred prey items for some bird species, notably dunlin and redshank.	Decrease in potential carrying capacity of mudflat	-ve, short term
Increase in availability of fine sediment	Short term increase in magnitude of depositional events as greater amounts of fine sediment would be available for resuspension and deposition. This may increase 'stress' on infaunal inverts leading to a decrease in abundance and biomass	Potential short term (up to 5 years) decrease in availability of preferred prey items for some bird species, notably dunlin and redshank.	Decrease in potential carrying capacity of mudflat	-ve, short term
Increase in elevation of mudflat	Elevation above MLW in the order of 1-2m may lead to increased consolidation of muds and affect the composition and abundance of the infauna. Potential decrease in biomass at higher levels of the mudflat	Potential shift in composition of infauna may lead to an alteration in the availability of certain prey items for some bird species, notably redshank.	Decrease in potential carrying capacity of mudflat	- ve, longer term (> 5 years)
Increase in extent of mudflat area	Predicted 40ha increase in the area of mudflat would increase the available area for colonisation and establishment of typical fine mud intertidal infauna	Increase in the available feeding resource, particularly for species such as redshank and shelduck.	Increase in potential carrying capacity of mudflat	+ve longer term (> 5 years)
Mudflat profile change	Decrease in slope of mudflat may increase overall zone of 'wet' fine sediment that supports more abundant infauna.	Shallow slope of mudflat may increase period over which mud is 'wet' and therefore increase the duration of invertebrate activity and therefore potential availability of organisms as prey items.	Increase in attractiveness of area for feeding waterbirds	+ve, longer term (> 5 years)
Accretion above MHWN leading to saltmarsh growth	In total, an area of 5-10ha of existing mudflat may convert to saltmarsh as a result of accretion. Mudflat areas adjacent to saltmarsh tend to be more productive and support greater infaunal biomass. It would be unlikely that the existing infaunal community along the upper shore would be significantly altered through this increase in saltmarsh growth (as some saltmarsh is already present).	Potentially, the available feeding resource could be greater due to increased infaunal productivity. Saltmarsh at the upper part of the shore may also provide additional roosting habitat and feeding area for some species (e.g. redshank and waterfowl).	Small shift in the balance and mix of intertidal habitat in immediate area. Increase in saltmarsh habitat, which, due to coastal squeeze, is being lost from the estuary. Intertidal function maintained.	+ve, long term (> 5 years)

5.1.3 Summary

On this basis of the above discussion a number of points can be drawn out that are of significance when considering the functional aspects of the overall potential habitat compensation requirements. These are:

- The ecological function of the intertidal area that would be permanently lost is considered to be limited. However, given its designated status and the fact that the area forms part of the overall extent of the estuarine system, it should, as a minimum, be replaced;

- The mudflat upstream of the proposed terminal would not be lost. However, in the short term, up to 5 years, its functional capacity to support waterbirds could be diminished as a result of disturbance to the existing invertebrate communities. The extent of this functional change and its impact on waterbird usage (i.e. prey resource loss) of the intertidal area cannot be determined with any certainty and there is a need to compensate for this predicted loss of capacity within the estuary system during this period. The most appropriate mechanism to provide for this resource loss is to develop additional habitat within the estuary that would allow for initial invertebrate colonisation and use as a feeding resource by waterbirds for at least this period of disturbance and potential displacement from the existing area of intertidal habitat;

- Stabilisation and functional (ecological) recovery of the intertidal area upstream of the proposed terminal is predicted to occur over a period lasting up to 5 years during and following construction of the breakwater and quay wall. It is expected that the area would return to full functionality, although potentially its overall resource value could be altered in respect of existing conditions. Predicted morphological development of the intertidal area indicates that the overall resource (in terms of area and duration of availability – see Table 4) would increase due to accretion. Potentially, the intertidal area could therefore provide a greater resource than it does at present. These factors therefore suggest that the area would return to or potentially exceed its existing capacity (in relation to waterbird resource use) and the effective need for a compensation resource would therefore be diminished post stabilisation; and

- Any habitat created will need to form a functional component of the intertidal habitat of the Severn Estuary, support infaunal communities that are representative of the wider biotopes and communities that occur within the estuary and provide substrate conditions that will support a range of bird species that form part of the designated SPA populations of the Severn Estuary;

5.2 Scale of required habitat replacement

In respect of the issue of development proposals that affect a designated European site (such as an SPA and/or SAC) and require that habitat compensation is provided in order for the development to proceed, the Habitats Directive provides only limited guidance on the nature of the compensation required. The European Commission's guidance note on Article 6 of the Habitats Directive (European Commission 2000) states that measures should be undertaken to:

Compensate or offset the negative impacts of a project – corresponding precisely to the negative effects of the species or habitat concerned.

No specific information is given on the issue of the scale of compensation that is required.

It is instructive to look at how this issue has been dealt with by other port developments that have been through the planning process in the UK where habitat compensation has been required through the Habitats Regulations.

At Felixstowe extension of the port facilities led to the loss of 16.5ha of mudflat. This was compensated for by the creation of 16.5ha managed realignment at Trimley adjacent to the port, a replacement ratio of 1:1.

At Bathside Bay, proposals have been put forward for the provision to compensate for the loss of mudflat and saltmarsh habitat that supports SPA designated bird populations at a ratio of 1:1.7. This will be provided at Little Oakley some 5km from Bathside Bay and adjacent to the Hamford Water SPA (i.e. outside of the affected Stour and Orwell Estuaries SPA).

At London Gateway, there would be no loss of habitat directly from within the SPA, but an area of adjacent mudflat (Mucking Flat) would be affected by increased accretion and potential functional change as a result of the development of the port. For this scheme, it was determined that a habitat compensation ratio of 1:1 would be sufficient given that:

- There was no direct loss of habitat from within the SPA;
- The area affected by increased accretion would not be lost from the SPA;
- Habitat compensation could be achieved within the same estuary system.

Other available guidance regarding this issue is also pertinent. In relation to the managed realignment of river or coastal flood defences to compensate for the effects of sea-level rise, Defra guidance is that the government will normally take Natural England's advice as to the area of compensatory habitat required. Natural England have indicated that this will typically be in the ratio of 1:1 when dealing with losses due to sea level rise and where that compensation is provided in advance (Defra - Managed Realignment: Land Purchase, Compensation and Payment for Alternative Beneficial Land Use).

On the Humber Estuary, the Environment Agency employs a policy of 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 from defence improvement works (Hemingway *et. al.* 2008).

Again, on the Humber, the Immingham Outer Harbour scheme promoted by Associated British Ports (ABP), would result in the loss of 22.5ha of mudflat habitat (outside of the SPA). This was determined to represent an adverse effect on the SPA and compensatory measures were required. ABP have therefore undertaken to provide a minimum of 25.5ha of compensatory mudflat habitat through the creation of two separate managed realignment schemes on the estuary. These two schemes would result in a total of 67.5 ha of intertidal habitat being created with the aim of both meeting the compensatory requirement and also contributing to the longer term sustainable management of the estuary.

In relation to the loss and change of designated habitat associated with BDSCT, it is apparent that as a minimum that a ratio of 1:1 should be applied. Taking the example of London Gateway, where functional habitat change (i.e. no direct habitat loss) is predicted to occur as a result of the works, the same condition can be applied to the predicted accretional change to the mudflat upstream of the BDSCT. This area within the SPA would not be lost as a result of the development but its potential to support the bird populations that it currently supports could be adversely affected, particularly in the short term. It is therefore considered that as this mudflat area would remain following construction and through into operation that a ratio of 1:1 intertidal habitat replacement would be sufficient.

For the intertidal habitat within the footprint of terminal and that would be lost from the estuary as a result of the development, it is considered that a ratio of 1:1.5 should be applied to the area designated as SPA and cSAC. The remainder of the intertidal area designated as SSSI is known to support an impoverished benthic infauna and low numbers of birds that utilise this area. It is considered that this area should be mitigated for by the creation of intertidal habitat at a ratio of 1:1.

Taking these ratios into account, the figures presented in Table 2 can be slightly altered as presented in Table 14.

Table 14. Revised summary of predicted effects and potential compensatory requirement taking into account habitat replacement ratios.

Predicted Effect	cSAC	SPA	Habitat total with ratio applied
Potential compensation requirement for direct loss of intertidal habitat (cSAC and SPA combined)	13.5ha of intertidal		20ha
Accretion over intertidal upstream of reclaim – functional change	Approx 80ha (75ha mudflat, 5ha saltmarsh)	Approx 65ha (60ha mudflat, 5ha saltmarsh)	As previous
Total potential compensation requirement for intertidal habitat (cSAC and SPA combined)	**93.5ha of intertidal (including 5ha of saltmarsh)**		**100ha of intertidal (including 5ha of saltmarsh)**
Permanent loss of intertidal SSSI habitat	20ha SSSI intertidal (inc. 0.5ha saltmarsh)		As previous
Total habitat replacement requirement	**113.5ha of intertidal (inc. 5.5ha saltmarsh)**		**120ha of intertidal (including 5.5ha saltmarsh)**

6 EVIDENCE FOR THE DELIVERY OF INTERTIDAL HABITAT REQUIREMENTS FROM MANAGED RE-ALIGNMENT SITES

Where habitat replacement schemes aim to create a specific area of habitat, it is important to understand the functions that the habitat sustains. Intertidal mudflats and saltmarsh are extremely variable in terms of their ecology. Within estuary systems, invertebrate populations are generally patchily distributed both spatially and temporally

(e.g. annual and seasonal variations), which in turn has a significant control on the distribution of waterbirds that depend on these invertebrates as a food resource. Large differences occur between species groups, with some species forming long term and relatively stable colonies, such as mussels *Mytilus edulis*, and as a consequence birds that feed on these prey items such as oystercatcher may show very limited distribution from year to year. However prey species of birds such as redshank (e.g. *Corophium volutator*) can show very large spatial and temporal differences which results in these birds moving around an estuary to take advantage of abundance variations in their prey. These ecological differences need to be taken into account in the siting and design of habitat creation schemes in order to ensure that the replacement habitat spans the natural variation found in the affected habitat.

In relation to the above aspects and the overall habitat replacement requirements associated with the BDSCT scheme it is pertinent to consider the potential development of a managed realignment site on the Severn to determine whether it would have the potential to provide the necessary functional habitat requirements.

Previous sections have identified that there are two components to the identified effects on intertidal habitats associated with the BDSCT. These are:

- Direct loss of 33.5ha of intertidal habitat; and
- Functional change to 80ha of intertidal mudflat.

With regard to the first of these requirements it is considered that the mitigation and compensation need relates to the provision of mudflat as a habitat, as it has been identified that the existing bird usage of the area that would be lost is very limited.

For the second component, the requirement is for the provision of an intertidal resource that would offset the short term (up to 5 years) loss of functional capacity that could result as a result of accretion and morphological change to the mudflat upstream of the proposed BDSCT. This intertidal resource would need to support the characteristic waterbird populations for which the affected intertidal area is important for this period. In the medium-longer term (>5 years) a potential reduction in the ability of the replacement habitat area to provide this function may be permitted as long as recovery and stabilisation of the intertidal area to the north of the BDSCT were to occur. This habitat/functional relationship between replacement habitat and effects is shown graphically in Figure 22.

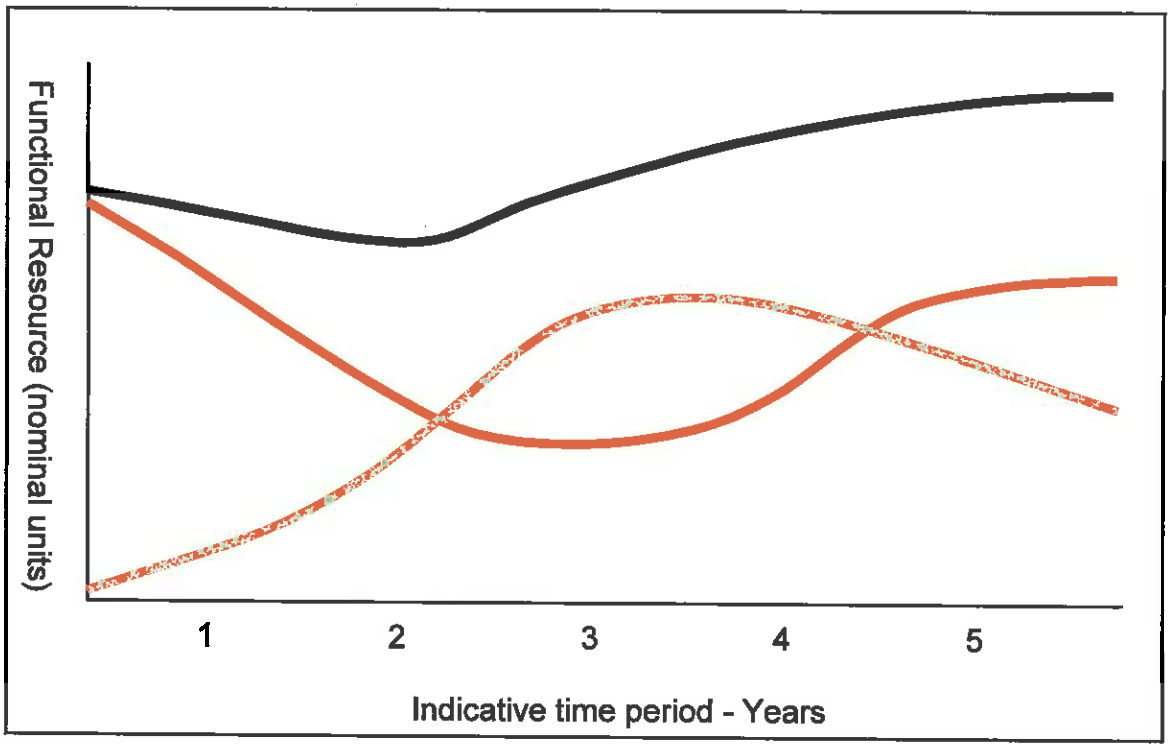
Both components would be best met through a single, large-scale managed re-alignment scheme which formed an integrated and functional element of the Severn Estuary.

In considering the ability of managed re-alignment to meet the identified habitat replacement requirements it is useful to look at available data from existing schemes. Of critical importance to ensuring whether a site can fulfil the functional requirements are:

- Rate of colonisation and development of invertebrate communities that could act as a food resource for waterbirds;
- Scale and location of the managed re-alignment site, particularly in relation to areas of existing ornithological importance; and
- Topography and morphology of the re-alignment site and potential mix and extent of habitat types (e.g. saltmarsh, mudflat and coastal grassland/grazing marsh).

These aspects are considered in greater detail in the following sections, where the emphasis is placed on the function of invertebrate communities as a resource for birds rather than as an interest feature in their own right.

Figure 22. Theoretical development of overall functional resource, where function is considered as the capacity to provide habitat that supports typical estuarine mudflat invertebrate communities and the waterbirds that utilise this resource. The green line represents the contribution provided by habitat replacement; the red line represents the functional development of the area of mudflat to the north of the BDSCT and the black line the overall resource in relation to the estuary system as a whole.



6.1 Colonisation and development of intertidal invertebrate communities in habitat creation sites

The dynamics of colonisation is dependent upon a number of key factors. These include:

- Proximity to existing areas of habitat:
- Mobility and dispersal characteristics of species;
- Life history and preferred habitats of species.

Mobile species such as the crustacean *Corophium volutator* may colonise and establish populations quite rapidly as they regularly leave the sediment and swim in the water column. Generation times for this species are also short (<1 year) and reproduction takes place over much of the summer. By contrast, the establishment of normal populations of other species that are not mobile, only breed during a short period of the year, and are relatively long lived may take considerably longer. For example, larger individuals of the bivalve species *Scrobicularia plana*, *Mya arenaria* and the cockle *Cerastoderma edule* may only be present several years after habitat creation, as adults are essentially non-mobile, colonisation of new areas can take place only by the settling

of larvae from the plankton, which takes place only once a year, and individuals take several years to grow to the size at which they are eaten by waterfowl.

The longest potential delays will occur for species that lack a planktonic larva and have limited powers of dispersal. Levin *et al* (1996) observed delayed colonisation of a created saltmarsh site in North Carolina by taxa that lacked a planktonic larva, and the almost complete absence of oligochaetes even after four years. This was attributed this to their lack of any dispersive phase.

It may also take rather longer for invertebrate populations to establish if sediments are initially unsuitable. For example, invertebrate colonisation of a new area of mudflat at Seal Sands in the Tees estuary, took longer than theoretical minimum durations possibly due to the over-compaction of substrates during construction and protection from wave action (Evans *et al* 1998, 2000). For saltmarsh sites, the time taken for invertebrates to recolonise can be particularly long. These long delays in the development of normal invertebrate populations may reflect the lower exposure to disturbance by waves and currents of sediments on saltmarshes as compared with those lower in the intertidal zone.

There is some evidence that colonisation of mudflats by invertebrates can take place rather faster than saltmarshes. After experimental defaunation of large areas on Balgzand, in the Dutch Waddensea, most species recolonised within 12 months, with seasonally breeding species settling into the experimental treatments during the first breeding season (Beukema *et al* 1999). At two sites in Maine, control and created sites showed similar diversity, abundance and species composition after two years (Ray *et al* 2000). However, in the experimental defaunation studies at Balgzand, it was three to four years before biomass recovered to normal values.

At the 20ha Tollesbury managed re-alignment site in Essex the sea wall was breached in August 1995. At this time, the surface of the site ranged from less than 1.0 m above OD adjacent to the original sea wall to 2.5 m above OD adjacent to the new sea wall constructed prior to realignment (Reading *et al*. 1999). Appreciable accretion of sediment occurred after the site was breached, with average accretion rates in excess of 2 cm/yr during the first 3 years (Reading *et. al*. 1999). The lower parts of the site, below the level of high water of neap tides, did not vegetate over, unlike the higher parts that developed at least a partial cover of vegetation dominated by *Salicornia* sp. Three years after breaching, invertebrate communities were more diverse in the realigned area than in the surrounding mudflats, probably reflecting an increase in the variety of sediment types (Reading *et al* 1999).

At Orplands (A) re-alignment site, Essex, large bivalves had not colonised after 4 years despite substantial populations being present on the adjacent estuary. At the created mudflat at Teesmouth, both shorebirds and their invertebrate prey colonised in the first winter (Evans et al. 1998, 2001). It was found, however, that successful recolonisation by three of the main invertebrate prey species, *Corophium*, *Nereis* and *Hydrobia*, required a lead in time of about three years (Evans 1998).

Orplands A and Tollesbury are low in the tidal frame and have experienced rapid accretion since the breach. This has led to the build up of soft muddy sediments at the seaward edge of the realignment sites, which have been colonised by invertebrates that are mobile or have planktonic larval phases (Reading *et al*. 1999). The increase in invertebrate numbers at these sites is broadly in line with what would be predicted through knowledge of life history traits. Mobile species, and those that have a

planktonic larval phase, such as *Nereis*, other polychaetes and *Hydrobia*, have colonised the muddy sediments, whereas bivalves and other species that have no planktonic larval phase, such as oligochaetes, had either not colonised or took several years to appear. The first benthic invertebrates to colonise Tollesbury in appreciable numbers were *Hydrobia ulvae*, *Macoma balthica*, *Eteone longa*, *Nepthys hombergi*, *Nereis diversicolor*, *Pygospio elegans*, *Spio filicornis* and various unidentified oligochaetes, all known wader prey species. In the following years, species such as *Mya arenaria* and *Abra tenuis* colonised. Invertebrate species diversity in the Tollesbury realignment site increased from 14 species in 1995 to 19 in 1998.

The infaunal species which rapidly colonised benthic habitat at Tollesbury dominate the invertebrate community of the mudflat upstream of the BDSCT and also form the main component of the recorded intertidal biotope present at Steart. This suggests that if conditions are suitable within a re-aligned area at Steart that colonisation and the establishment of an invertebrate community with a similar species structure to that of existing mudflats in the area could be relatively rapid (1-2 years).

Similarly, in the Humber Estuary at Paull Holme Strays, invertebrate recolonisation occurred fairly rapidly (within two years). Although it was not a fully mature system and abundance of species was low, this scheme shows the potential for success. Invertebrate density was concentrated in and around the breaches in the flood defences. This was due to large accretion on the site which provided suitable substrate for species migration from surrounding areas. However it should be noted that a breach in the flood defence should take place before a keystone species recruitment event, to maximize the potential for immediate colonisation and establishment.

In 2004, the oligochaetes, *Paranais litoralis,* dominated the benthic fauna. However, in 2005, there was a distinct shift in dominance of terrestrial species and early colonising species to those more typical of an estuarine environment (Mazik *et al.*, 2007), with increased dominance of *Hediste diversicolor*, Collembola and *Hydrobia ulvae* in 2006 and 2007. Colonisation appears to have taken place predominantly around the western breach where the communities now closely resemble those on the upper shore mudflats outside the site in terms of their composition but not their abundance (Mazik *et al.*, 2007). However, general diversity does still appear to be greater outside the site than inside, with 18 of the 25 species recorded also found to be present inside the realignment. Factors such as tidal inundation, particle size and organic content are considered as important influences on colonisation and community development, with sites inside the realignment being higher in organic matter and siltier than those outside it. As such, this is reflected by species such as *H. diversicolor* characterising sites within the realignment, with a greater number of nematode worms outside the realignment. Colonisation is additionally restricted in areas of low or excessively high accretion (Mazik *et al.*, 2007).

It was also evident that as the accretion and inundation of the site increased so too did the structure and abundance of species. The site progressed from a generalist type habitat, dominated by terrestrial species, to one that was a more favourable habitat, with good representation from estuarine species (Mazik *et al.*, 2007). French *et. al.* reported that newly established sites in Australia would not contain the same species assemblage as undisturbed sites. However, the species present can be considered to be successional, meaning that the site would become more complex and stable over time. The success of the realigned site depends on the proximity to established natural communities which contain the desired species.

At 440ha, Alkborough Flats situated on the south bank of the Humber Estuary at the confluence of the Rivers Trent and Ouse is the largest coastal realignment site to be completed as part of the Humber Management Plan to date. The initial report showed that early colonising invertebrates were being utilised by waterfowl for feeding (Hemingway *et. al* 2008). This was one year after the breach in the flood defence.

6.2 Use of sites by birds

Biological monitoring data from managed re-alignment sites provides information on the colonisation process and use of newly created habitat by waterbirds (Atkinson *et. al.* 2001 and Atkinson *et. al.* 2004).

Two of the most intensively monitored sites are Tollesbury and Orplands, both on the Blackwater Estuary in Essex. These sites were among some of the first specifically developed in the UK to replace intertidal habitats. Data indicates that both sites witnessed major changes in their bird communities during the year following the breach and a general shift towards an avifauna dominated by waterbirds. At Tollesbury, large numbers of passerines were recorded during the first winter as seed-rich debris was washed up on the tide line. Following the establishment of a waterbird-dominated assemblage during the second winter, fewer changes occurred but did include the colonisation and increase in numbers of ringed plover and red knot. A similar pattern was seen at Orplands (A), with the rapid establishment of a waterbird community followed by smaller annual changes from the second winter onwards as sediments and the number and size of benthic invertebrates changed.

At Orplands during the 1994/95 winter preceding the breach the two realignment sites held similar bird communities that were most similar to the adjacent saltmarsh. During the winter following the breach, both realignment sites showed an increase in the number of waders using the site and held bird communities that were intermediate between those of the adjacent mudflats and saltmarsh. The first waders to use the sites were redshank, grey plover and dunlin, species that prefer fine mud sediments. In the third winter the realignment sites diverged. Being higher in the tidal frame than Orplands A, Orplands B quickly vegetated over and the bird fauna reverted to one similar to the surrounding saltmarsh, whereas Orplands A showed an increase in usage by waterbirds associated with intertidal mudflats. From two winters after the breach the assemblage on Orplands A closely resembled that using the mudflat in front of the realignment site.

After 5 years the waterbird assemblages at Orplands A and Tollesbury appeared similar to those using similar muddy habitats in the surrounding estuary (Atkinson *et. al.* 2004). At Tollesbury dark-bellied brent goose and common shelduck colonised in the first year and numbers did not change significantly between years. Dunlin and redshank colonised the site in the first year but higher numbers were recorded in 1996–98 (one year after breach of the site). Following colonisation during the first winter, grey plover and curlew numbers varied greatly between winters. The numbers of lapwing and golden plover which predominantly used the Tollesbury site for roosting were lowest during the first winter and increased in the following years. Atkinson *et. al.* (2001) suggest that the spread of the bivalve *Macoma* across the site and rapid increase in numbers during the fourth winter after the breach may explain an increase in usage by red knot during the fourth winter.

There was a clear change in the bird assemblage between the first two winters and smaller changes during the following years. Although the magnitude of the changes

was different, the direction of the change was broadly similar across all tidal states. There were some apparent differences in usage between the re-alignment site and the estuary. Oystercatcher numbers were high on the surrounding estuary, especially during the passage and winter periods, but they only tended to use the realignment area during spring and summer. The usage made of the realignment site by ringed plover and black-tailed godwit was erratic.

The low usage made of the areas by oystercatcher and red knot was probably due to a combination of little sandy habitat and few large invertebrates in the realignment areas. At Tollesbury use by redshank was delayed until mid to late winter and suggests that habitats outside the realignment areas may be preferred, perhaps as a result of the relatively enclosed nature of the site being associated with a higher perceived predation risk. A similar situation was found to occur at the Seal Sands realignment site on the Tees (Evans *et al.* 2001). Noted differences between bird assemblages in the realignment sites and the Blackwater Estuary have been attributed to a greater diversity of habitats being present within the estuary. Atkinson *et. al.* (2004) noted that even after 4 or 5 years, the waterbird and invertebrate assemblages on these sites were still evolving.

The main conclusion made by Atkinson *et. al.* (2004) in their review of re-alignment sites was that waterbird assemblages quickly establish on newly-created intertidal habitats. At all three key sites (Tollesbury, Orplands and Seal Sands), the waterbird assemblage underwent large changes during the first year or two after creation. Changes in subsequent winters were smaller although were still occurring at each of the sites five to seven years after creation.

Monitoring data from managed realignment sites on the Humber Estuary have been reviewed by Hemingway et. al. (2008). Generally, the information derived from these schemes indicates that the process of colonisation and usage by birds is consistent with the results of other projects in the UK.

At Paull Holme Strays, whilst there was a relatively rapid colonisation by wildfowl, the wader assemblage had taken some time to develop. In the first winter the foraging assemblage was extremely species poor, as might be expected, given the limited prey availability. However, the assemblage developed, with flocks of Dunlin, Bar-tailed Godwit (*Limosa lapponica*) and Grey Plover (*Pluvialis squatarola*) recorded foraging on the site during the third winter, these species having been absent during the initial winter following breaching (Hemingway *et. al* 2008)

Unlike the observed trend for the movement of the macrobenthic community towards one resembling that of adjacent 'existing' mudflats, the wildfowl and wader community using the site as a feeding resource have not exhibited such a clear trend. Hemingway et.al. (2008) suggest that this may be due to the influence of a range of external factors aside from food availability. Following an initial relatively swift development towards a characteristic bird community for the site (three years post breaching), there have been substantial increases in the numbers of Redshank using the managed realignment site as a feeding resource, Dunlin numbers have remained stable, and the abundance of other active benthic feeding birds such as Black-tailed Godwit and Curlew have, if anything, fallen from the levels of 2006. The reasons for this possible reduction (or at least non-concomitant increase) in some bird species at the site are unclear, but may reflect a variety of external factors, including relative population levels using the Paull Holme Strays area in the context of regional, or even national population trends, as well as other factors such as weather conditions and disturbance (Hemingway et. al. 2008).

One unexpected gain from the creation of the site has been the development of an Avocet (*Recurvirostra avosetta*) colony within the realignment area.

Analysis of the bird assemblage on the realignment site compared to that of the existing intertidal frontage shows a gradual development towards an assemblage characteristic of the area (Cutts & Hemingway, 2008). Importantly, initial analysis of data from adjacent intertidal sites on the estuary suggests that currently the majority of species colonising Paull Holme Strays have simply undertaken adventitious emigration movements from previously habitually used areas into the realignment site (Cutts & Hemingway, 2008).

Chowder Ness managed realignment scheme was breached in July 2006. After one year a total of 13 waterbird species were found to be using the newly created intertidal area at Chowder Ness, with the majority of usage being concentrated on the disturbed ground. Lapwing, Dunlin and Redshank were present, and the most abundant species observed included Golden Plover, Lapwing, Dunlin, Black-headed Gull and Curlew. All target species established for the site were observed with the exception of black-tailed godwit which was not seen in any of the monitored intertidal areas either on or off-site (Hemingway *et. al* 2008).

At Welwick, surveys conducted between September 2006 and March 2007 showed a total of 29 waterbird species with the realignment site having developed as a major roosting site for a number of wading birds at high water. Following high water, the majority of wading birds were subsequently observed moving onto the fronting or adjacent intertidal areas as the tide receded. As the site developed over winter, increasing numbers of Grey Plover, Redshank, Dunlin and Curlew were observed foraging from high to low water, with wildfowl species also being well represented in the realignment site, particularly Shelduck. With the exception of Black-tailed Godwit which was not observed in any of the intertidal areas monitored either on or off-site, all target species established for the site were observed (Hemingway *et. al* 2008).

Alkborough Flats is being utilised by waterfowl for feeding and roosting. During the winter of 2007/8, the Alkborough site regularly supported several hundred Shelduck, together with over 100 Wigeon (*Anas penelope*) and over 1,000 Teal. An interesting wader assemblage has also developed, with over 100 Avocet and Black-tailed Godwit feeding on the site during autumn passage. In addition, over the winter, the site has been used as a roost by flocks of Golden Plover in excess of the national importance qualifying threshold, as well as by over 2,000 Lapwing. Dunlin and Redshank have also been recorded within the feeding assemblage on the site (Hemingway *et. al* 2008).

Outside of the UK, the few US studies have concluded that, in terms of bird usage, functional equivalence of man-made marshes with natural marshes may or may not occur and much of this is due to differences in habitat between the two types of site. In most cases macrofauna (including birds) colonise quickly and the assemblage reaches maturity in a short space of time, often less than three years (Simenstad & Thom 1996). Differences in habitat are often cited as reasons why bird assemblages are not the same in restored and reference marshes. In Galveston, Texas, species richness and diversity was higher in the natural marshes due to the presence of migratory waterfowl, wintering shorebirds and saltmarsh specialists (Melvin & Webb 1998). Peaks and troughs in bird abundance on natural saltmarshes were strongly related to seasonal migration chronology, whereas those in restored areas did not. This indicated that natural marshes provided habitat that was not available in nearby created salt marshes.

All the studies reviewed by Atkinson *et. al.* (2001 and 2004) indicate that waterbirds will colonise new areas of intertidal habitat. However in almost every case, differences between restored and natural bird assemblages are present. Some species, such as redshank, occur in higher densities on new habitat than on natural habitat whereas other species such grey plover do not. Some of these differences are probably due to the immaturity of the new site, whereas others have reached an alternative stable state which is likely to persist. The causes for these differences are mostly due to habitat characteristics which impinge on food supply or some aspect of a species' behaviour. Significantly, Atkinson *et. al.* (2004) note that the outcome of a habitat replacement scheme is not always predictable, but that greater success to deliver requirements can be achieved if specific efforts are made. Habitat replacement schemes should therefore take an experimental approach but also have clear criteria to determine success.

7 PROPOSED HABITAT CREATION SITES

Following a review undertaken by TBPC of potential managed realignment sites within the Severn Estuary, three sites (Steart, Awre and Slimbridge) of sufficient scale for further investigation were selected. A pre-feasibility study covering these sites has been undertaken, the broad results of which are reported below.

7.1 Steart

The Steart Peninsula is located in the outer Severn Estuary in Bridgwater Bay, on the west bank of the River Parrett. The proposed realignment site is located towards the east of the Peninsula between the villages of Steart and Stolford. The existing site is agricultural, predominantly grazing and arable with some grass ley and poultry houses.

Realignment of the existing defences at Steart is being promoted by the EA. Natural England and the EA have stated that land at Steart is the best opportunity for large-scale habitat creation in the Severn Estuary. Steart is the most developed of the possible schemes being considered by BPC, with some initial design work and environmental studies already undertaken at the site. This work includes the design and appraisal of a number of managed realignment options, consultation with landowners and some baseline studies.

The EA are promoting a 350ha realignment option, although a possible longer-term 750ha scheme that would include the majority of the peninsula has also been considered. For the purposes of providing compensatory habitat, BPC would be looking to undertake a scheme comprising up to 150ha at Steart. Potentially this could be a stand alone scheme or could form part of the wider 350ha option being promoted by the EA. In the case of the latter, BPC's compensation scheme would form a clearly defined and identifiable part of the overall scheme at Steart.

7.2 Awre

Awre is located in the upper Severn Estuary on a peninsula of low-lying floodplain land on the west bank of a meander. The proposed realignment site is across the estuary from Frampton-on-Severn and upstream and on the opposite bank from Slimbridge and largely consists of low-lying agricultural land (mostly permanent grassland, grazing, dairy and arable, with some fields with orchards/trees). It is predominantly Grade 2 farmland (Defra Agriculture Farmland Classification) with small settlements inland on higher ground. The total area of the available site is 185 ha.

The Awre managed realignment scheme is from a technical /engineering perspective the most straightforward of all of the schemes under consideration because there is no need to construct a new seawall due to high ground to the rear of the site. However, there are potential landowner issues at Awre which would need to be addressed if this site were to be progressed...

7.3 Slimbridge

Slimbridge is located in the upper Severn Estuary on a low lying floodplain adjacent to Frampton Sand and The Noose. The proposed realignment site is south of Frampton-on-Severn and downstream and on the opposite bank from Awre. The site largely consists of low-lying agricultural land (mostly grassland and grazing) with freshwater ponds and ditches adjacent to a wetland conservation reserve.

A very significant constraint at Slimbridge is that around 90ha of the site within the proposed realignment area is already designated as part of the Severn Estuary SPA (consisting of freshwater grazing land) and so additional compensation might be required in order to replace this area. The freshwater habitat affected by a realignment could be recreated to the west of the site (around 85 ha is available), thus maintaining the overall area and type of designated habitat already present at the site. Technically this is a straight-forward solution to this issue, although the potential for the re-creation of freshwater grazing marsh capable of supporting SPA designated populations and the legislative issues surrounding compensation for existing SPA designated habitat would effectively preclude realignment at this site. Furthermore, there are potential landowner issues at Slimbridge which would need to be addressed if such a scheme were to be progressed.

7.4 Habitat creation opportunities within the context of the Severn Estuary

The primary tool used to predict the type of intertidal habitat likely to develop at a realignment site is the frequency of tidal inundation. Tidal inundation frequency is a function of three factors: the elevation of the site, tidal frame and the size and depth of the breach.

If the intention is to create mudflat then the surface elevation of the realignment site must be low enough to allow regular tidal inundation. However, if the aim is to create saltmarsh then the surface elevation relative to the tidal frame must be sufficient to limit the frequency of inundation, thereby allowing halophytic vegetation to colonise and develop. A survey carried out in the southeast of England concluded that for saltmarsh habitat to establish on a realigned site a minimum elevation of 2.1m AOD (Above Ordnance Datum) was required, which translated as 400-500 inundations per annum (Burd, 1995). However, due to local variations in tidal regime sites may vary in the frequency of inundation. For example, a marsh surface elevation of 2.1m AOD in the Blackwater Estuary, Essex, experiences 380 inundations per annum whilst the same AOD along the Thames experiences 490 inundations per year (Burd, 1995).

A high level tidal inundation analysis has been undertaken to determine what type of intertidal habitat would be likely to develop at all three sites following breaching of the sea defences. The results (shown in Table 15) indicate that the frequency of tidal inundation of the sites (using average surface height) would fall well below the number required to generate mudflat habitat. This does not mean that some mudflat would not be generated as there are likely to be areas of lower elevation within each site (e.g. notably at Steart within the proposed 350ha site) and creeks constructed within the sites would also provide mudflat area. However, even if mudflat were generated, given the

very high sediment loadings in the estuary, it is likely that over time vegetation colonisation would occur and areas, unless artificially maintained at the right elevation, would progress to saltmarsh. For all of the three sites, a tidal inundation frequency of approximately 450 annually would require a surface elevation of between 4-5m AOD.

Table 15 Number of tidal inundations per annum (Total 711) for specified ground level

	Average surface height	4m	5m	6m	7m	8m	9m
Steart	5.0 – 8.0m	466	291	103	37	12	12
Awre	6.8 – 9.0m	556	393	201	82	33	11
Slimbridge	7.5 – 9.0m	556	393	201	82	33	11

A series of equations have been developed as part of the Severn Estuary CHaMP which can also be used to predict the potential distribution of a number of habitat types within the estuary (Severn Estuary CHaMP, 2006). The results are only based on elevation in relation to the tidal frame and fetch, they do not take into account site specific parameters and future management practices.

The following equations were developed to predict the potential distribution of lower and upper saltmarsh within the Severn Estuary (Standard error of regression parameters are given in brackets):

$$\text{Lower limit} = -1.925 + (1.965 * \text{MHWN}) - (0.02 * \text{Fetch})$$
$$(0.211) \quad (0.062) \quad (0.02)$$

$$\text{Upper limit} = 1.797 + (0.827 * \text{MHWS})$$
$$(0.303) \quad (0.046)$$

*Fetch = distance (in km) across open water from the point of origin of the transect in the direction of the bearing transect (subject to a maximum of 10km).

The potential for the creation of mudflat was estimated using the lower limit saltmarsh equation (as the upper mudflat potential) and MLWS taken as the lower limit for mudflat development. The results are shown in Table 16. The calculations were based on predicted tides at Steart and Awre/Slimbridge.

It can be seen for Steart that given the existing tidal levels that lower saltmarsh / upper mudflat would be restricted to areas of the site with an elevation of 3.63 m AOD. This level, within the 150ha scheme, only occurs seaward of the seawall and confirms that extensive mudflat habitat would be unlikely to permanently develop at Steart with this option, unless artificial lowering of the site were undertaken and maintained, requiring ongoing management of the site. It also suggests that lower saltmarsh habitat may also not develop and more than likely a mid range mix of saltmarsh species may predominate over the long-term.

Table 16. Upper and Lower Limits for potential Saltmarsh and Mudflat Development for the three candidate realignment sites based on the Predicative Equations developed as part of the Severn Estuary CHaMP.

Limits	Steart (mAOD)	Awre (mAOD)	Slimbridge (mAOD)
Surface Elevation (average)	5-6	7-8	7-8
Upper Saltmarsh Limit	6.78	7.81	7.81
Lower Saltmarsh Limit / Upper Mudflat Limit	3.63	5.45	5.45
Lower Mudflat Limit	-4.67	-1.63	-1.63

The predicative equations also confirm that mudflat is unlikely to develop at either the Awre or the Slimbridge sites as the land elevation is too high relative to tidal conditions. Like Steart a mix of mid range saltmarsh species would be more likely develop.

7.5 Progression of a managed realignment scheme

On the basis of the initial work undertaken by TPBC, the pre-feasibility work and discussions with the Environment Agency and Natural England, it was determined that land at Steart provided the most suitable opportunity for the creation of intertidal habitat via realignment of the coastal defences.

The possibility of developing a realignment scheme at Slimbridge has, effectively, been excluded from further consideration. This is because significant damage to the existing SPA would occur through realignment at Slimbridge and from a regulatory perspective this could not be progressed, as it is apparent that there are alternative solutions (e.g. Steart and/or Awre) that would cause less damage to SPA designated interests.

The Environment Agency has already undertaken a significant amount of work in relation to realignment at Steart and subsequent to the pre-feasibility study TBPC have been engaged in active discussion with the EA about the possibility of developing a scheme or joint scheme with the EA at Steart.

Royal Haskoning and HR Wallingford have been commissioned by TBPC to undertake the environmental scoping study for Steart (due for submission to the Local Planning Authorities and for consultation by the end of 2008). A full EIA for the scheme at Steart will then be undertaken and all necessary consents and licences applied for during 2009 (including planning application).

The following section documents the initial modelling work that has been undertaken for proposed realignment at Steart in order to determine the hydrodynamic and potential habitat characteristics of the site.

7.6 Preliminary modelling work for the proposed realignment site at Steart

7.6.1 Model setup

Using Environment Agency supplied LiDAR data and drawings outlining the present possible realignment schemes at Steart, an existing flow model of the Severn Estuary was amended to include the 152 ha and 350 ha schemes. This pilot modelling study was undertaken to give initial indications as to the likely hydrodynamic conditions (current speed, inundation time, etc) within the Steart sites and the potential for the proposed realignment to alter the hydrodynamic conditions in their approaches and in Bridgwater Bay.

The breach widths used during the modelling exercise were selected according to a general 'rule-of-thumb' which indicates that for the breach not to impede the total draining of a site it should have a width (metres) in the order of at least 1.9 times the area of the realignment site. This width is larger than many of those seen in practice as it increases the amount of wave energy entering the site and that is incident on any realigned engineered defences. The bed depths of the defences at the breach sites were reduced to match those behind the breaches for the LIDAR dataset. The model was run for spring tide conditions.

7.6.2 Effect of realignment on currents in Bridgewater Bay

The pilot model results presented below firstly show the area of the frontage which might be influenced by the realignment sites. Figures 23 and 24 show the temporal variation in tidal current in Bridgwater Bay in proximity to the realignment site. The red line shows the existing conditions and the black line those with the sites when operational.

The largest changes are shown at time of peak ebb, as water from the realignment site empties across the intertidal frontage. Tidal currents simulated in the area are large enough to begin to erode a drainage channel for the site, depending on the strength of the intertidal sediments in the area. During the flood tide the intertidal area fronting the breach is already inundated as the site fills, resulting in less effect on the currents outside of the site. Figures 25 and 26 show the footprint of difference in peak current speed resulting from opening of the breaches.

7.6.3 Inundation regime within the sites

For the layouts tested with unaltered bed levels within the sites the topography of both sites, sloping towards the south, result in much of the area remaining inundated for the whole spring tidal cycle. The peak and minimum water depths for the two sites are shown in Figures 27 and 28. The minimum water depth plots can be considered as the basis for an initial estimate for the depth of an engineered drainage channel of 0.8-1.0m that would be required to drain lower areas within the sites. Such a channel is likely to require extension outside of the breach locations. The drainage properties of any channels within the site would be best studied through the use of detailed numerical modelling.

The Ecological options report for Steart (EA, 2007) showed the potential for habitat types based on tidal inundation frequency and duration calculated from the tide gauge record at Hinkley Point for the years 2000 – 2004. This analysis is reproduced as Figure 29. This figure may be regarded as representing habitat conditions that would be likely to occur for the most inundations possible as it assumes no loss in high water levels into

the site. The design of the size and form of the breach would be a key input in avoiding attenuation of the tide within the site.

7.6.4 Sedimentation regime within the sites

To inform consideration of the morphological development of the sites, plots of peak bed stress are shown in Figures 30 and 31. Peak bed stress is an indicator of the behaviour of a muddy bed. Continual net deposition can be expected for bed stresses less than 0.1 N/m^2, no net deposition or erosion is possible for peak bed stress greater than 0.4 N/m^2. In between these values a mix of net deposition or erosion can occur, depending on the bed material present and the potential for consolidation of any freshly deposited material. The areas shown for net deposition or no deposition indicated by the plots of peak bed stress are summarised in Table 17.

Table 17. Predicted areas of deposition and erosion within potential realignment areas at Steart

	Area of initial net deposition (ha)	Area of no initial deposition (ha)	Area of mix of deposition and erosion (ha)	Area not inundated for tide tested (ha)
152 ha site	51	24	77	0
350 ha site	77	100	131	42

These figures show the likely behaviour of the sites during the early stages following breach. They also assume no effects of existing vegetation on the ability of the site to trap sediment. Modelling of the morphological change within the site would be needed to establish the longer term (years) distribution of bed levels.

The sites allow an exchange of tidal waters of 3 $x10^5$ (150 ha site) to 5 x 10^5 (350 ha site). With an estimated suspended sediment concentration of 500 mg/l the tidal exchange would be expected to supply up to 20 cm of accretion per year in the low stress areas identified in Figures 30 and 31, which is in line with that observed at the realignment site at Porlock Weir, downstream of Steart.

7.6.5 Engineering of the site to increase water exchange and optimise the development of mudflat habitat

The potential effect of engineering the site to increase the exchange of water has been investigated by inserting a schematic arrangement of channels within the 150ha site (Figure 32). The height of the channels was set at +5m OD(N), approximately equal to the minimum elevation within the site. Figure 33 shows the ability of the channels to drain the site, with the minimum depths plotted reducing to near zero throughout the site and the area that dries completely significantly increased. The channel themselves are not shown to dry out due to the effect of the restricted flow simulated across the intertidal areas fronting the site. Figure 34 shows the effect of the 150 ha site with channels on the peak currents in the area. The effect is of a similar scale to that for the unengineered site. The distribution of peak bed stress for the site with channels is shown in Figure 35. The improved draining of the site leads to increased peak currents and so an increased area of higher bed stresses. The main effect is to reduce the area

of bed stress low enough to allow deposition to 44 ha of the site. The simulated area of bed stresses high enough to exclude deposition was similar to the unengineered option.

The area of intertidal mud provided by a creek system could be optimised by ensuring that the excavated creeks are relatively wide with a shallower profile. Other options that are available to generate additional mudflat within the realignment site area include:

- Reprofiling of the site (i.e. excavation) to increase the area below MHWN. In the case of Steart, the removal of approximately 1-2m depth of material within a selected area would increase mudflat development. If excavation work were to be undertaken close to the breach site then wave activity may promote maintenance of mudflat in the longer term; and

- Reduce the height of the flood defence along the frontage. This has a number of benefits, notably it increases energy levels within the site and improves the potential that mudflat habitat would be maintained. A reduction in the height of the defences (rather than a simple breach) also promotes greater connectivity of the site with the estuary and enables the site to respond more easily to wider changes within the estuary.

Both of the above options have been utilised at other managed realignment sites (notably Welwick and Chowder Ness on the Humber Estuary) in order to increase the area of mudflat habitat within the sites.

7.6.6 Further modelling work

The hydrodynamic modelling work is being progressed as part of the development of the Environmental Impact Assessment for the proposed realignment site at Steart. The next stage of work will provide data on likely intertidal habitat evolution within the site and assess habitat function in respect of alternative breach options. This work will be made available to interested parties as it is produced.

Figure 23. Time series of tidal current magnitude around 152 ha site, spring tide

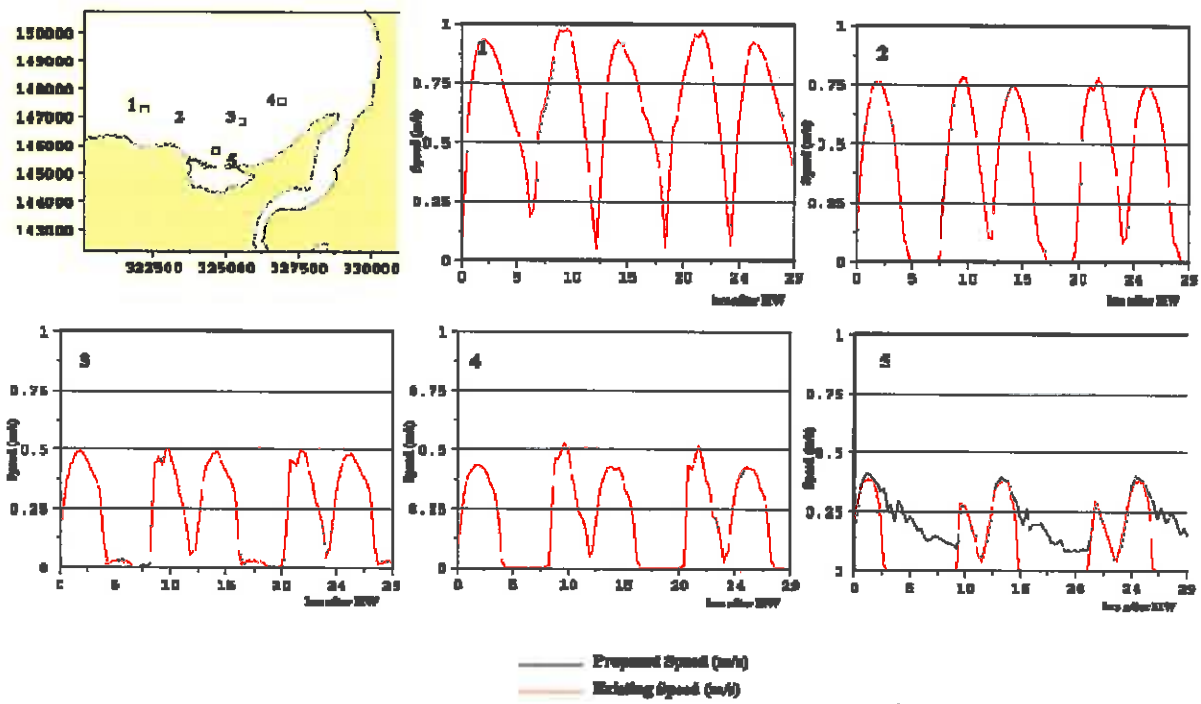


Figure 24. Time series of tidal current magnitude around 350 ha site, spring tide

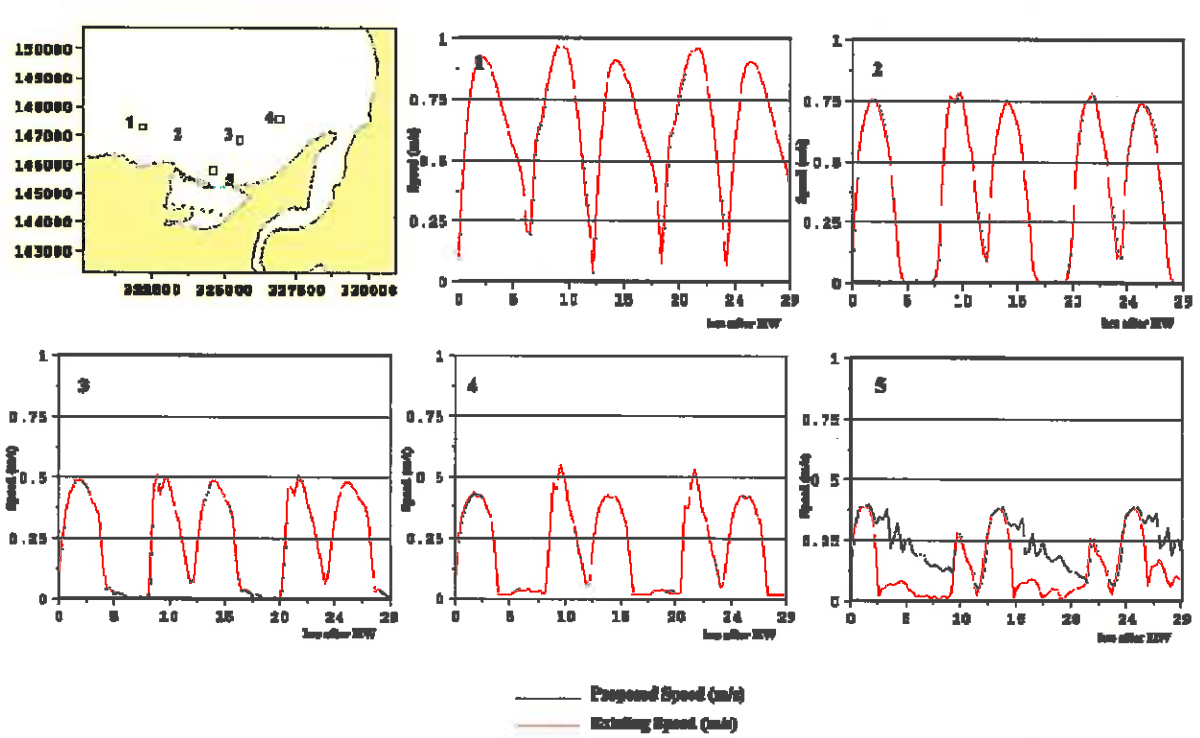


Figure 25. Change to peak current magnitude due to 152 ha site, spring tide

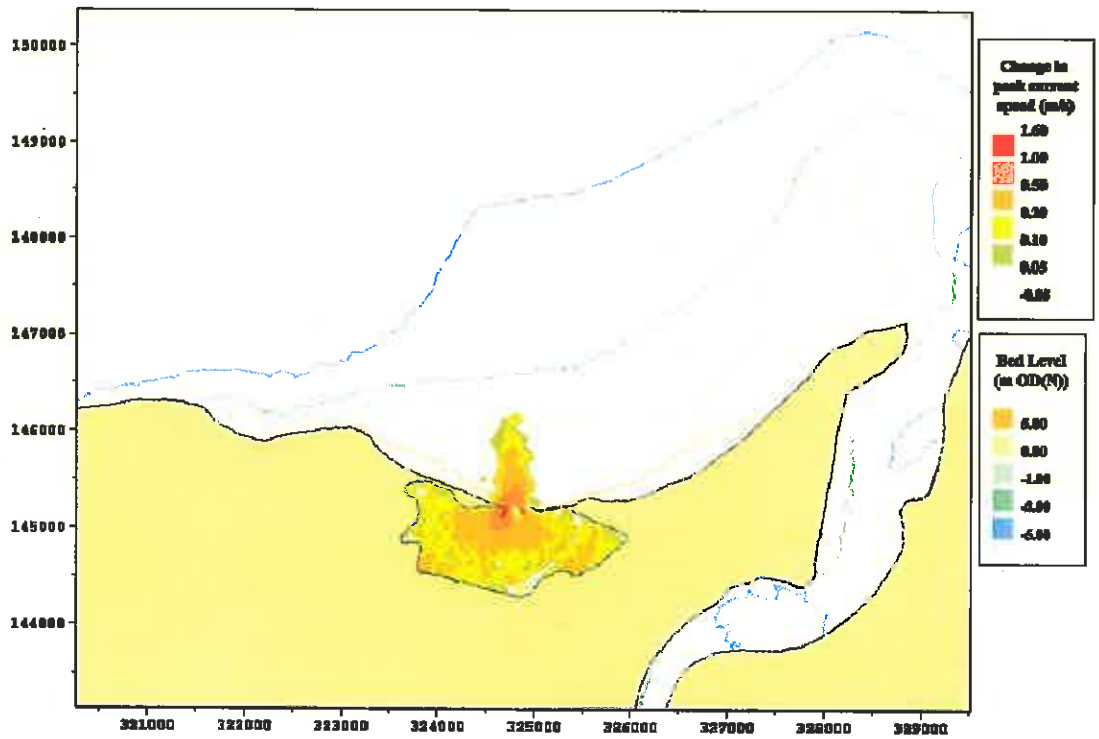


Figure 26 Change to peak current magnitude due to 350 ha site, spring tide

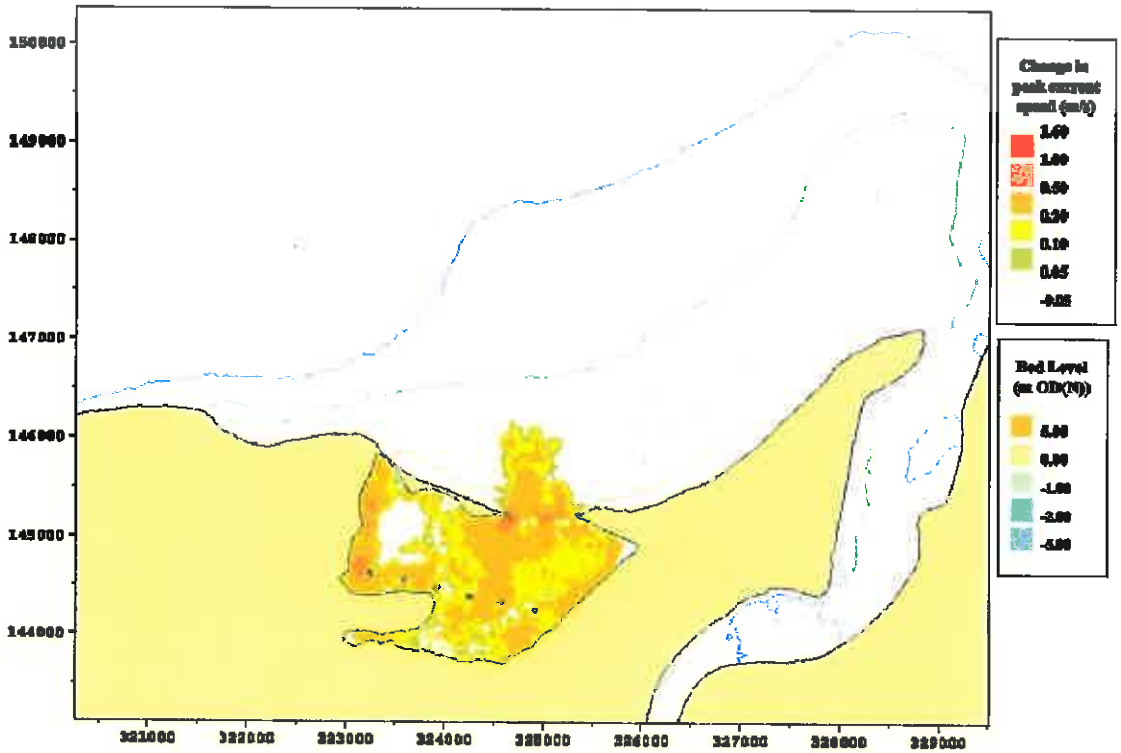


Figure 27. Maximum and minimum water depths within 152 ha site, spring tide

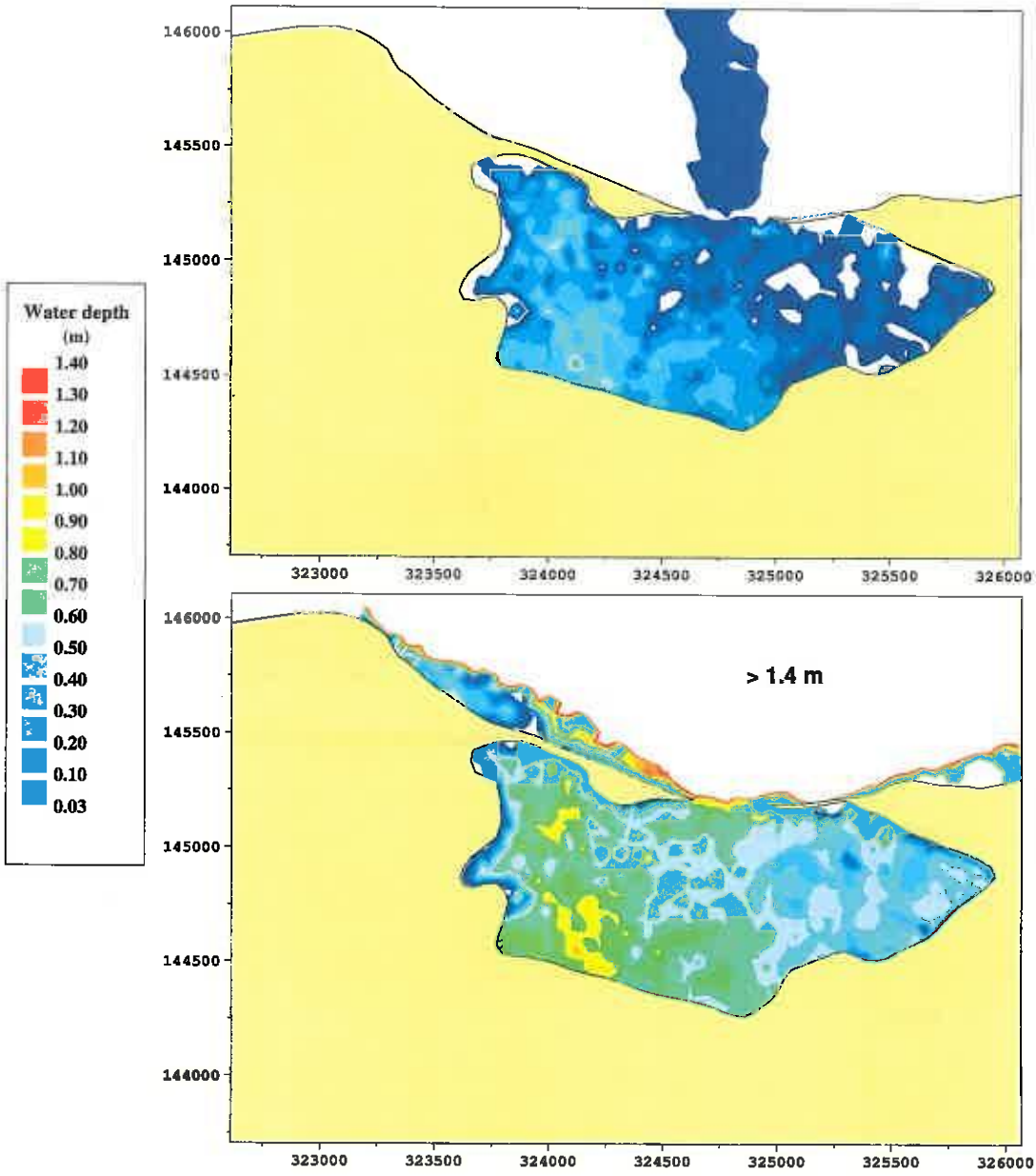


Figure 28. Maximum and minimum water depths within 350 ha site, spring tide

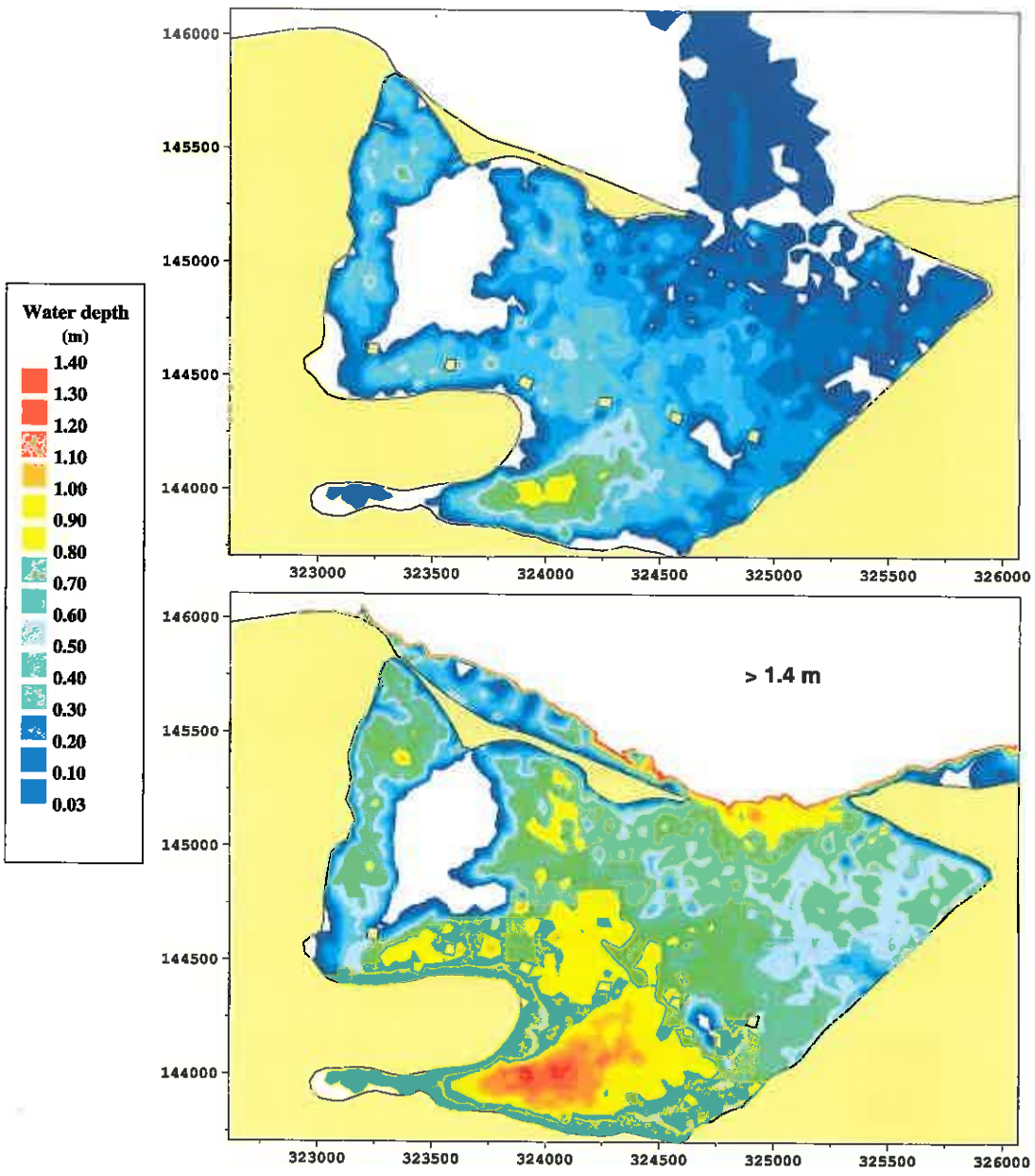
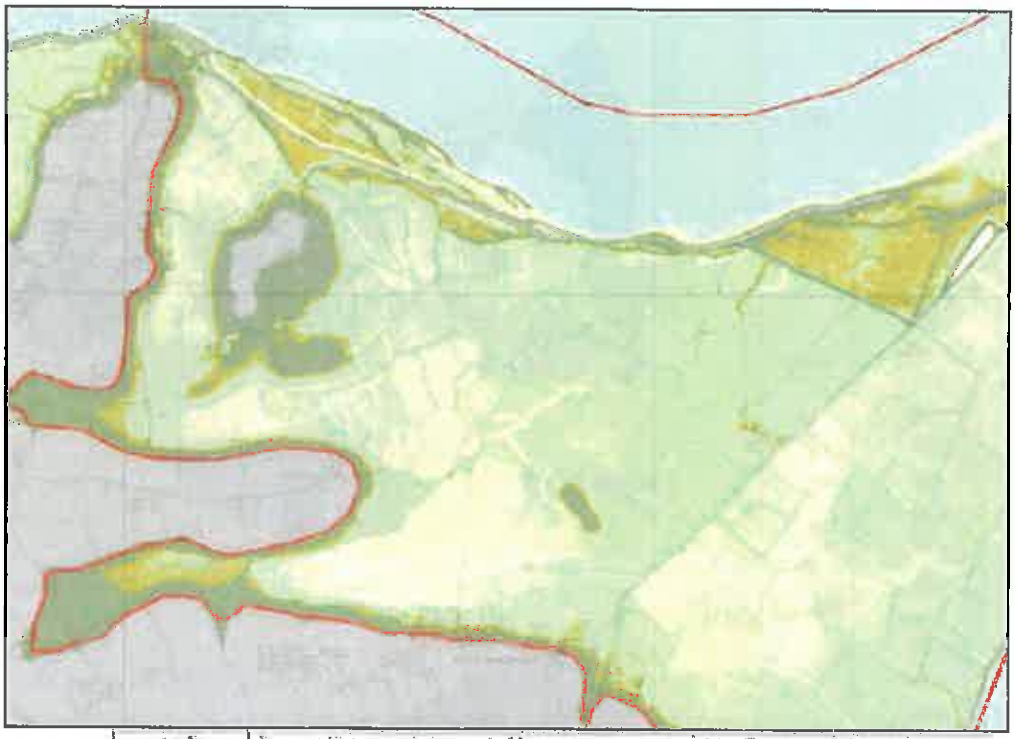


Figure 29. Habitat types based on inundation regime (from Environment Agency Ecological options report)



Legend	m AOD	Dorset Estuary Saltmarsh Vegetation (SVC communities)	No. Events per annum	Duration per annum (hrs)
	-5.5–4.5	Mudflat		
	4.5–5.5	low saltmarsh *Spartina anglica* (SM6) & *Puccinellia maritima, Suaeda maritima, Salicornia* (SM13*)	175	244
	5.5–6.2	low saltmarsh *Spartina anglica* (SM6) & *Puccinellia maritima, Suaeda maritima & Salicornia* (SM13*)	175–54	244–53
	6.2–6.5	mid saltmarsh *Puccinellia maritima* (SM13*)	54–24	53–21
	6.5–8.0	high saltmarsh *Festuca rubra* (SM16*)	24	21
	8.0–8.9			

Established saltmarsh levels adopted from information in Leach *et al.* (1997).
* SVC communities full name: CORINE biotope 15.3 mid sea shore: Atlantic salt meadow vegetation – glaux maritima (SM6)' priority habitat

Figure 30. Peak spring tide bed stress - 152 ha site

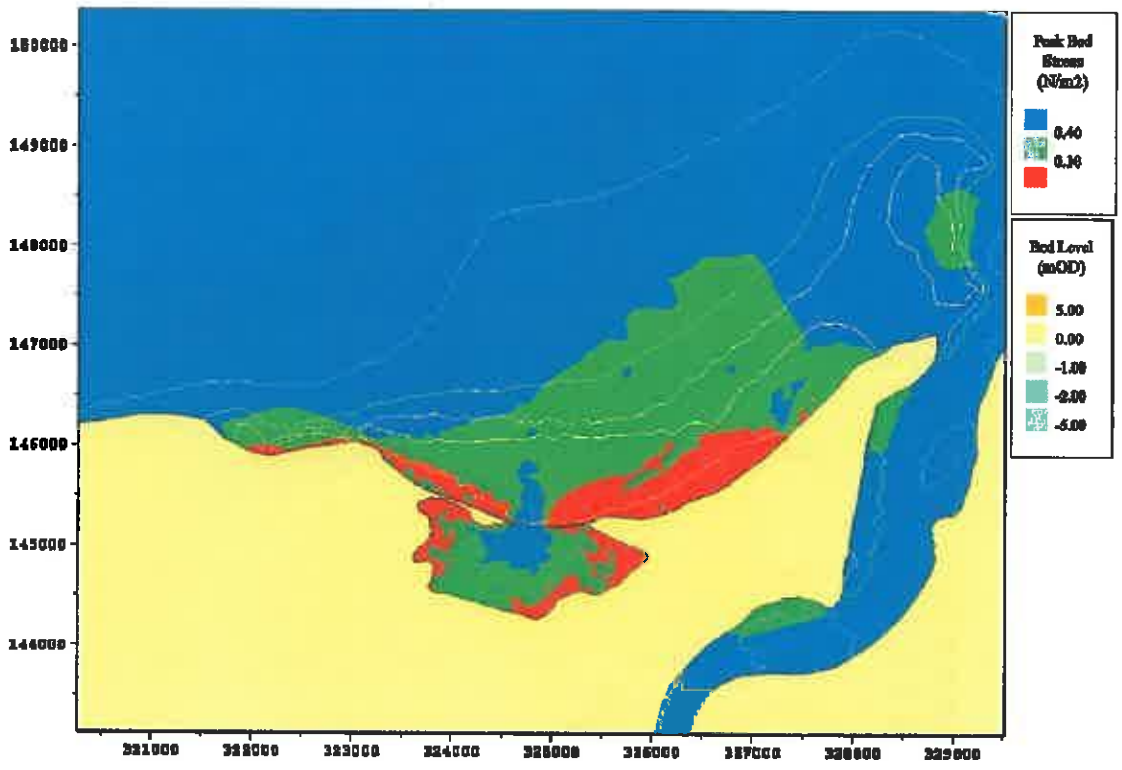


Figure 31. Peak spring tide bed stress - 350 ha site

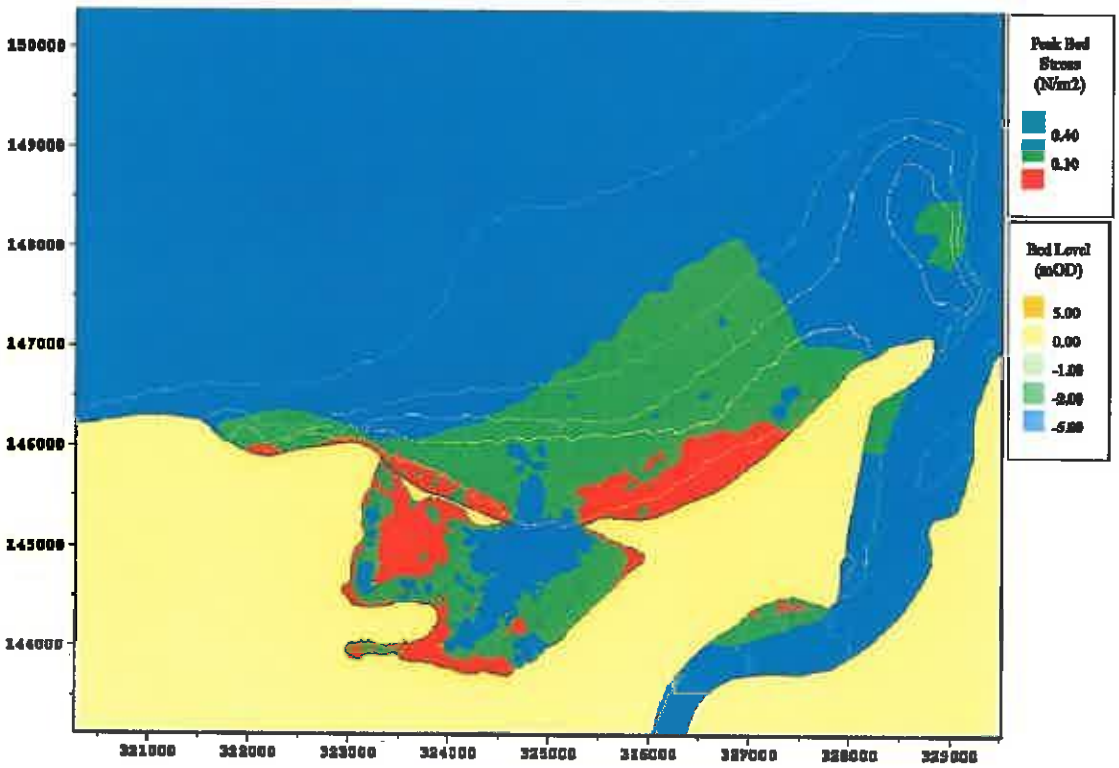


Figure 32. Bathymetry of 152 ha site with and without schematic channels

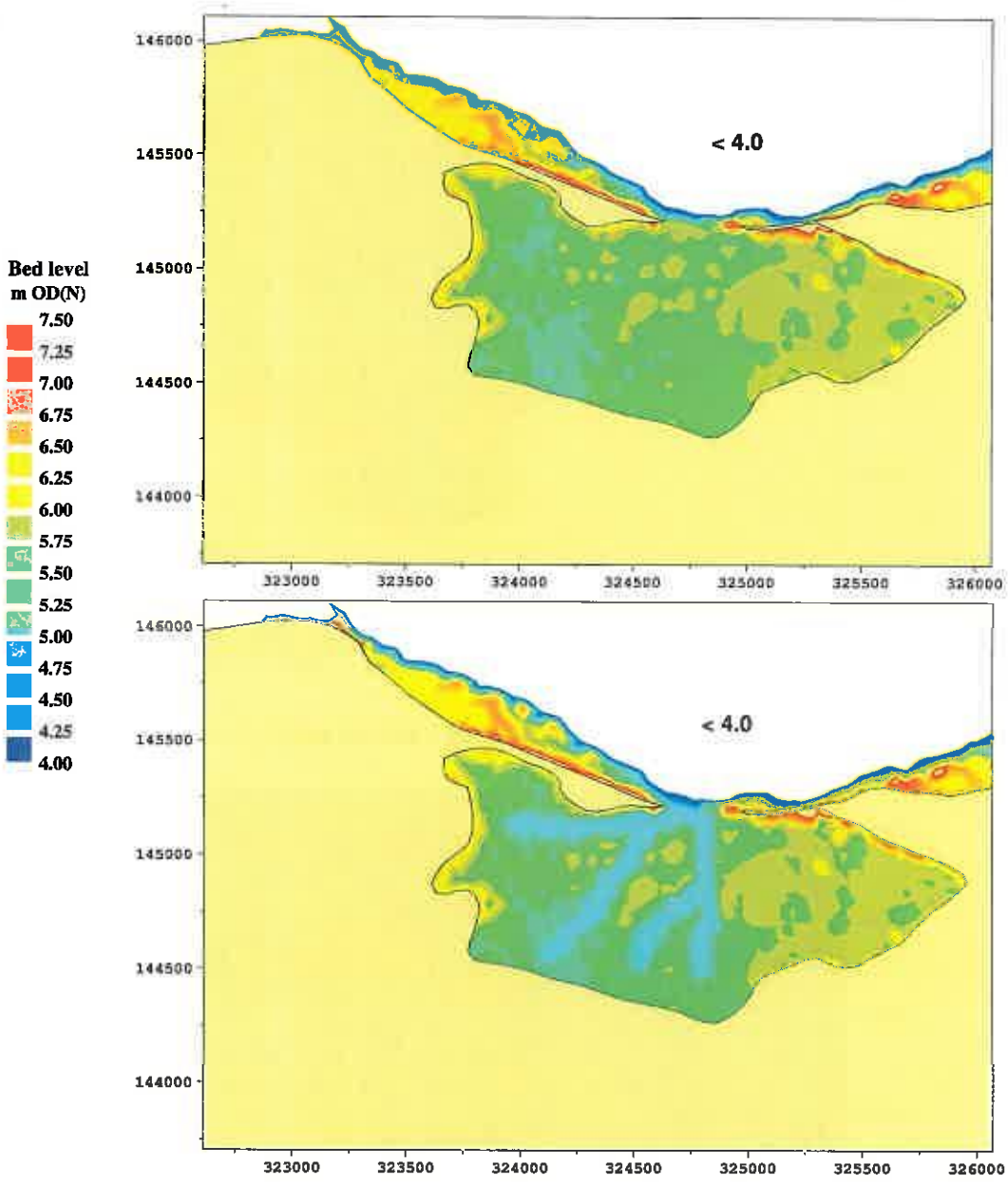


Figure 33 Maximum and minimum water depths within 152 ha site with channels, spring tide

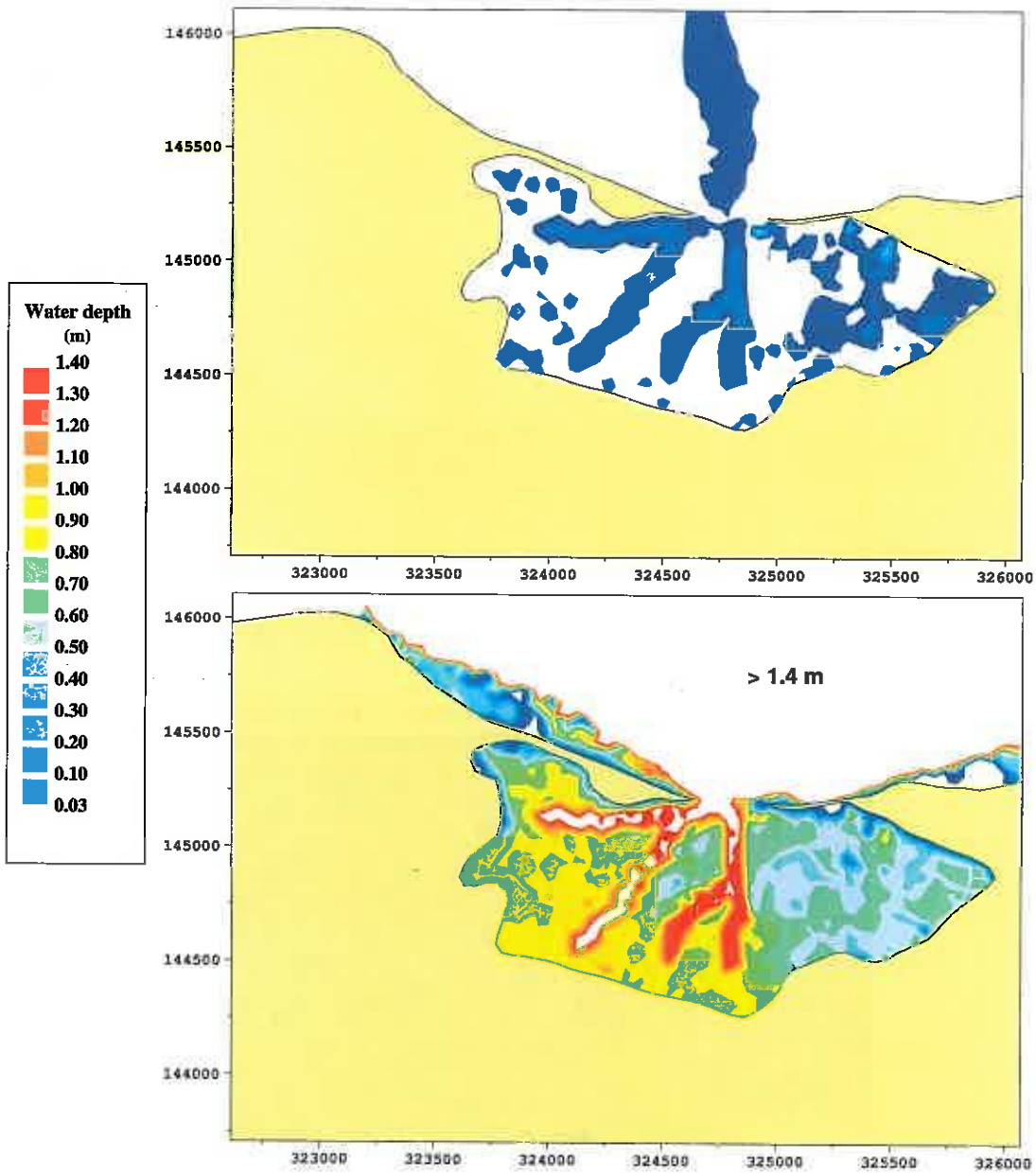


Figure 34 Change to peak current magnitude due to 152 ha site with channels, spring tide

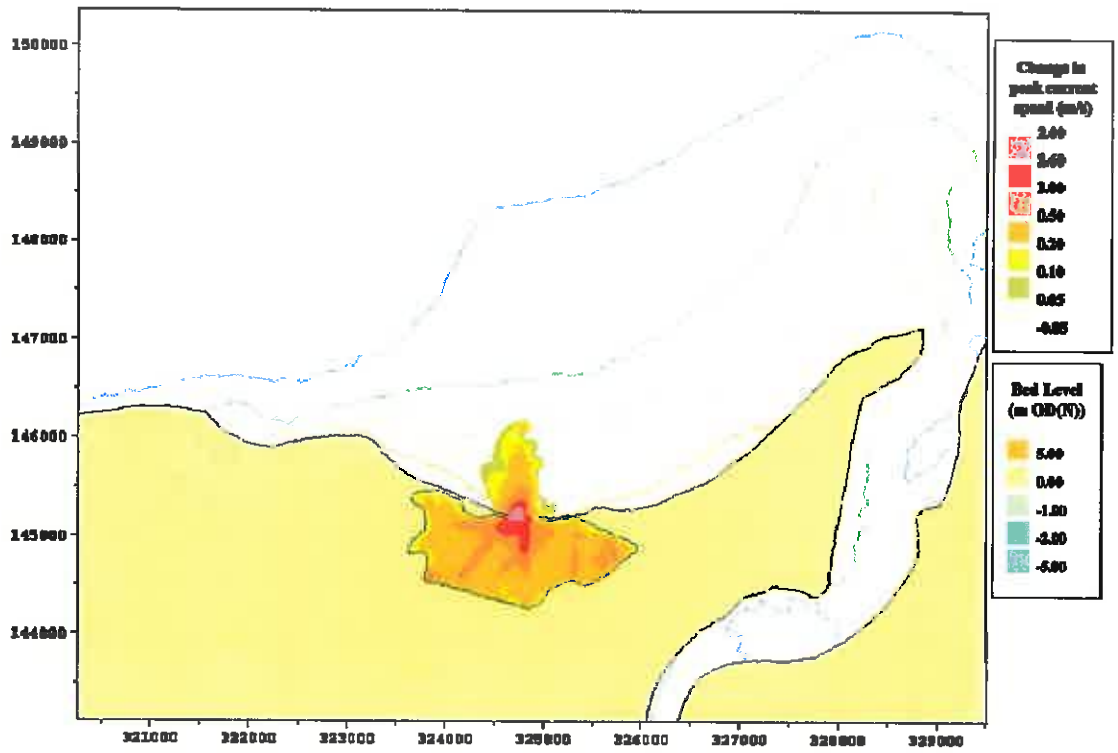
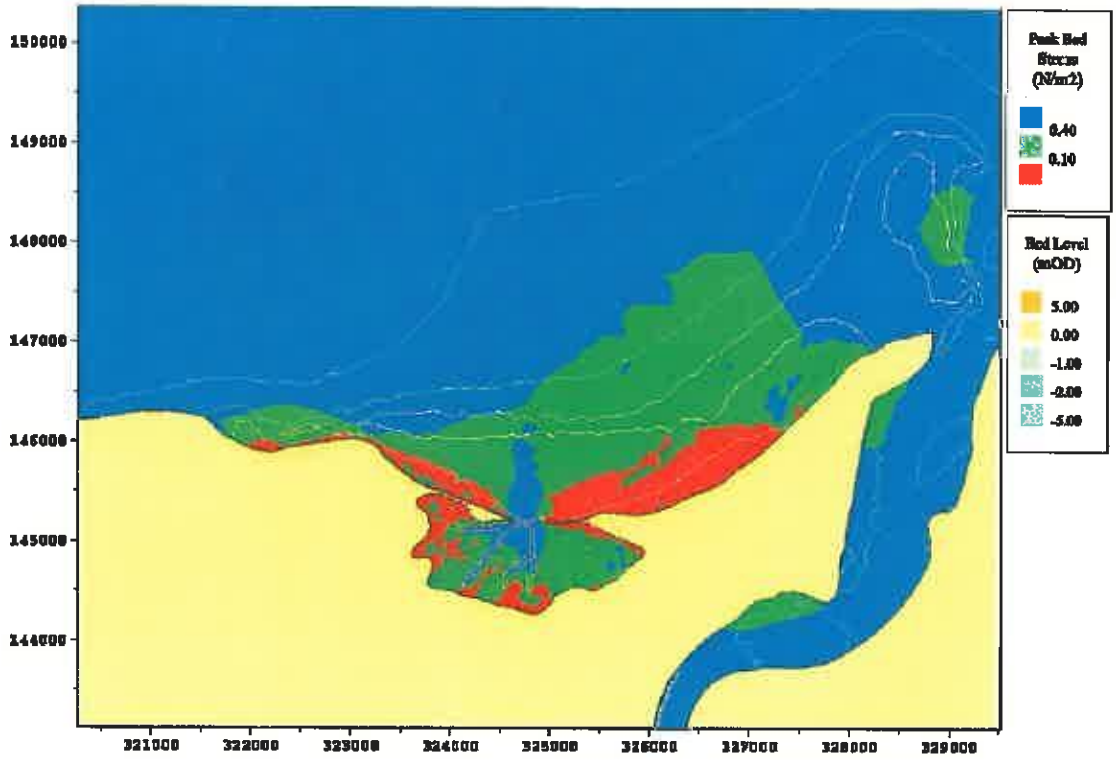


Figure 35 Peak spring tide bed stress around 152 ha site with channels

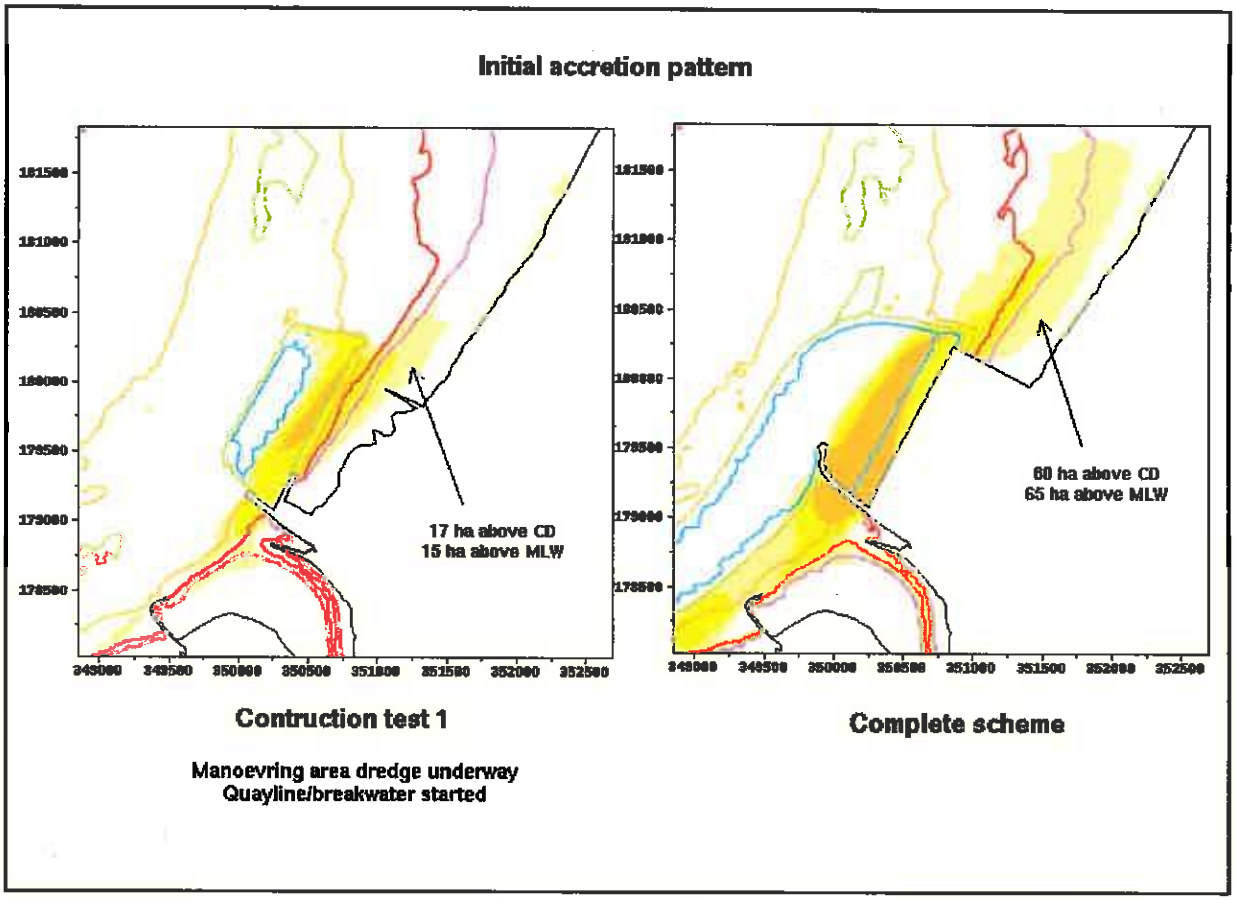


8 TIMING OF COMPENSATION NEED IN RELATION TO POTENTIAL PROJECT EFFECTS

Analysis and assessment of the predicted effects of the development of BDSCT demonstrate that the construction of the breakwater for the terminal has the greatest influence on the local hydrodynamic regime and hence sediment transport and accretion/erosion. The timing of breakwater construction is therefore the key issue when considering the likely onset of significant accretion upstream of the terminal, the impact that this may have on birds that utilise this area and therefore the appropriate timing for the provision of any required compensatory habitat.

The current timescale for development of the BDSCT places the start of breakwater construction (placement of first breakwater caisson in position on the seabed) at approximately 20 months after the start of construction. The breakwater caissons would be placed in position in phases and would be complete in approximately 18 months (38 months after the start of construction). It is reasonable to assume that the impact of the breakwater on hydrodynamic processes would be progressive (i.e. in line with the construction process), so that the effects of this structure on hydrodynamic processes significant enough to affect sediment accretion over the upstream intertidal would not occur for at least 8 months following the start of breakwater construction (i.e. 28 months from the start of construction). Figure 36 represents the situation approximately 28 months after the beginning of construction. However, it is predicted that it would take a further 8-12 months until accretion would start to reach a rate and cover an area at which a potentially adverse effect on intertidal fauna and birds would be likely to occur (see Figures 2-4). Therefore, potential adverse effects on the upstream intertidal area would be likely to occur 36 to 40 months after construction of the marine works was initiated. It should be noted that the small (2ha) of intertidal SPA and cSAC mudflat that falls within the direct footprint of the container terminal reclaim area would be lost approximately 9 months after the start of construction. This timeframe therefore provides the context in which to determine the appropriate timing for any required compensatory habitat to be developed.

Figure 36. Predicted accretion over the upstream intertidal area as a result of partial construction of the terminal and breakwater. This situation represents a period approximately 8 months after the start of construction of the breakwater (28 months after start of construction). The predicted area of accretion covers approximately 15ha, to a depth of about 20cm of sediment.



With regard to the potential compensation site there is a requirement to provide habitat that has the capacity to provide some ecological functionality in line with the onset of significant upstream accretion. There are a couple of key factors that are pertinent to determining when in the construction timeframe habitat creation at the potential compensation site would need to be initiated in order to deliver some functionality.

As discussed above, it is apparent that following breach, colonisation of intertidal area within a managed realignment site may occur within one year and appreciable numbers of invertebrates may occur within two years. The main period during which colonisation, via planktonic larvae, will occur is during the early summer to mid-autumn. Thus to promote the establishment of a community with reasonable numbers of individuals requires that any newly created habitat is open to colonisation during this period.

Another factor requiring consideration is that any proposed compensation site that is currently in agricultural use may have been subject to the application of significant amounts of fertiliser and possess high nutrient levels. Reducing the potential effect of these nutrients on high rates of initial algal growth following inundation, which may interfere with colonisation processes, may be achieved through flushing of the site with tidal and fresh water. This may be optimised during the winter months and therefore obtaining an initial period of site 'winterisation' prior to the onset of the key period of colonisation activity may be beneficial.

With respect to the proposed compensation site at Steart, these factors translate to the following construction timing in relation to the BDSCT construction programme (as discussed above) and predicted adverse effect on the upstream intertidal:

- Breach of the realignment site to be undertaken to allow for inundation over a minimum of two winters (a winter being defined as the minimum period of December-February) and at least one spring/summer prior to two thirds of the breakwater structure (equating to placement of the third breakwater caisson) at the BDSCT being completed.

9 ISSUES ARISING IN RELATION TO DELIVERING COMPENSATORY HABITAT

Given the above discussion in relation to the development of the BDSCT, its predicted effects on SPA and cSAC features and the characteristics of potential realignment sites within the context of estuary processes the following conclusions are drawn with regard to the provision of compensatory habitat:

- There is an identified short-medium term (up to 5 years) requirement to provide for additional mudflat habitat within the estuary as a result of potential change to the functional ability of the mudflat upstream of the BDSCT to support numbers of waterbirds at existing levels;

- There is an identified longer term compensatory requirement to provide for the loss, as a result of the development of the BDSCT, of a minimum of 20ha of intertidal mudflat habitat;

- Initial modelling work for a prospective realignment site in the Severn Estuary at Steart, suggests that given high sediment loadings within the estuary, fine sediment deposition would be rapid and would be likely to lead to the rapid accumulation of sediment. This accretion and the subsequent development of mudflat habitat within parts of the realignment site would be sufficient to offset the loss of any capacity that could occur as a result of the period of functional change to the mudflat upstream of the BDSCT;

- Given land levels and potential high rates of accretion initial mudflat would progress in the medium term (>5 years) to saltmarsh habitat. Large areas of mudflat could only be maintained in the longer term through continued and artificial intervention and management (e.g. lowering of land levels following inundation). Such action, besides being technically extremely difficult, would also disrupt infaunal colonisation processes and reduce the attractiveness of the site for feeding waterbirds. In other words, such a managed realignment site if required to maintain a significant area of mudflat would not be sustainable and its maintenance would work against the processes and natural functioning of the estuary.

- It is, however, considered that with the provision of a creek system, appropriate design of breach and potentially some initial reprofiling of the site, that hydrodynamic conditions could be produced that would enable an appropriate area of mudflat habitat to be maintained in the longer term within a realignment site at Steart.

- Any realignment site that is developed, regardless of the intertidal habitat that would be generated, would occupy and be part of the functional component of the Severn

Estuary. This situation is considered to be preferable to one in which a habitat is created that would effectively be out of step with ongoing processes within the estuary, and which would be difficult to maintain. The potential creation of saltmarsh vegetation (as opposed to mudflat) should also be viewed in light of the fact that saltmarsh habitat within the estuary is currently being lost and is being replaced by intertidal mudflat, although there is evidence that vertical erosion of mudflat is also occurring (e.g. the Severn Estuary CHaMP predicts that by 2025 13% of saltmarsh habitat will be lost in the Severn Estuary from 2005 levels).

- Any intertidal habitat created adjacent to the estuary would provide suitable habitat conditions that would support appropriate populations of a range of estuarine bird species. As an example, redshank are known to utilise creek systems within saltmarsh as feeding habitat. Saltmarsh may also provide suitable sites for the development of high-mid tide roosts.

- Intertidal mudflat would remain upstream of the terminal and its total area is predicted to increase in the medium to long term. Although potentially its functionality and value for wintering birds could be altered in the short term (up to 5 years), this mudflat would still undoubtedly be utilised by migratory and resident waterbirds and its full value would therefore not be lost. Taking this into account, it is considered that together, the area of affected intertidal and proposed realignment site should provide sufficient functionality to maintain designated intertidal SPA and cSAC interests over the duration of the predicted effects to the intertidal resources of the estuary.

10 OBJECTIVES FOR DEVELOPMENT OF HABITAT COMPENSATION

Taking into account the information presented in the previous sections and In light of the predicted impacts of the BDSCT on designated nature conservation sites within the Severn Estuary, the following objective is proposed:

Principal Objective: To develop a managed re-alignment site on the Severn Estuary that offers the potential for the development of intertidal habitat and that will over time contribute to the overall form and ecological function of the Severn Estuary and its designated nature conservation interests and the overall coherence of the Natura 2000 network;

Sitting within this objective are a number of sub-objectives that relate to the functional aspects and dynamics of the predicted changes and impacts of the scheme. These are:

Sub-Objective 1: To provide, in total, a minimum of 120ha of estuarine intertidal habitat comprising a mix of mudflat and saltmarsh and that is characteristic of the central English section of the Severn Estuary;

Sub-Objective 2: To provide, in the short term (up to 5 years) an intertidal resource that has the capability to support an invertebrate and waterbird assemblage that is representative of the mudflats that occur in the Avonmouth area and central English section of the Severn Estuary;

Sub-Objective 3: To provide in the longer term a mix of intertidal habitats with at least 20ha of intertidal mudflat.

Sub-Objective 4: To provide a minimum of 5ha of intertidal saltmarsh habitat that is representative of typical saltmarsh vegetation communities that occur in the Avonmouth area and central English section of the Severn Estuary;

Sub-Objective 5: To design a habitat creation scheme that is sustainable in the long-term and where habitats are permitted to develop naturally without repeated ongoing management

Specific information on the overall target/objective for maintaining the potentially affected waterbird assemblage is provided in Section 4.2.5.

11 CONCLUSION

It is apparent that the potential for intertidal habitat creation exists within the Severn Estuary, and that an appropriate area should be secured that could provide for the creation of habitat to compensate for the predicted effects on SPA and cSAC interests in relation to the BDSCT project.

This note has reviewed available information to further clarify both the potential impact of the BDSCT, with particular reference to SPA designated features, the effectiveness of potential measures to deliver intertidal habitat replacement and the means by which suitable compensatory measures could be developed in the Severn Estuary. In summary, two key conclusions can be drawn from this process of review and re-analysis as set out in the note:

- The potential compensatory habitat requirement consists of two components: a short term need to replace the loss of resource capacity that could occur as a result of morphological and ecological change to the mudflat upstream of the proposed BDSCT and; a longer term requirement that is required to replace the intertidal mudflat that would be lost as a result of the construction of the container terminal; and

- That the creation of a significant area of new intertidal habitat within the estuary, comprising mainly of saltmarsh vegetation in the medium to long term, when taken in combination with the altered mudflat habitat at Avonmouth, would have the potential to maintain the designated SPA and cSAC interests potentially affected by the BDSCT. Potentially, given the predicted functional response and development of the intertidal area upstream of the BDSCT, the overall intertidal resource could be increased leading to longer term biodiversity gain.

It is proposed that this note, or the information contained in it, should contribute to the development of a Statement of Common Ground (SoCG) and a Mitigation Compensation and Monitoring Agreement (MCMA) for the BDSCT scheme. The SoCG and MCMA will then be agreed with relevant parties as part of the consent process for the scheme.

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ANNEX 3

BIRD COUNT METHODOLOGY

BRISTOL DEEP SEA CONTAINER TERMINAL
Methodology for Ornithological Surveys

FINAL

18 December 2008

ROYAL HASKONING

BDSCT - PROPOSED ORNITHOLOGICAL SURVEY METHODOLOGY

1. Continuation of surveys of the Avonmouth Site, Avonmouth Intertidal Area and Portbury Intertidal

Surveys of the ornithological use of the Avonmouth Site, Avonmouth Intertidal Area and foreshore at Portbury are being continued and will be progressed, in the first instance, for the following two winter periods (i.e. October-March, 08/09 and 09/10) and the respective spring (April-June) and autumn (August-September) passage periods, up until construction commences. Pre-construction survey work will be continued if the scheme is delayed, unless otherwise instructed following consideration of data requirements by the Environmental Steering Group. Given that that periods effectively cover almost the complete calendar year, for the sake of completeness counts will be undertaken every month throughout the calendar year. The additional data generated through these counts will:

- Provide a longer term time series that will help to refine our understanding of usage of these areas by waterbirds;
- Further define the potential impact of the BDSCT on the bird fauna; and
- Provide more data on the use of the Avonmouth Intertidal Area, in particular, by species such as dunlin.

As stated above, this proposed programme covers the ongoing period from submission of the HRO for the BDSCT to the start of construction. It is proposed that the surveys will be continued during construction and post-construction of the BDSCT (as set out in the Mitigation, Compensation and Monitoring Agreement). However, some modification to the survey areas and methodology may be required due to the initiation of construction works. Therefore, prior to construction starting, the monitoring results and methodology would be reviewed by the Environmental Steering Group (ESG) and the programme and methods altered accordingly to take account of any identified requirements.

Three counts per month of all sectors (see **Figures 1-3**) are already undertaken, covering High Tide, Low Tide and a falling tide. Following discussion with the RSPB several changes to the existing survey approach were recommended that would enable a better definition of use of the intertidal area, and in particular count sectors 6-9 (the Avonmouth Intertidal Area) to be gained. The proposed changes to the survey programme were as follows:

- Separate spring and neap tide counts (where practical);
- Through the tide (TTT) counts; and
- Co-ordination of counts with the WeBS core counts for the Severn Estuary.

Following further analysis it is apparent that TTT counts are not possible during the winter months due to insufficient daylight hours. The proposed TTT would therefore be replaced by a mid-tide count that would be undertaken on either a falling or rising tide. In order to accommodate these changes the survey programme has been altered as set out below:

- The High Tide count is aligned to coincide with the WeBS core count. This will be undertaken using the same method as for WeBS and be undertaken therefore on the spring tide series;
- The Low Tide count would be undertaken as previously, with the sectors being surveyed in the period from two hours before to two hours after low tide. The maximum number present of each species will be recorded by sector. Because of daylight constraints in winter, this will have to be during a neap tide series or at least on a low part of the spring tide series;
- The current falling tide count would be altered to become a mid-tide count that would alternate between a falling and rising tide and Spring or Neap tides where practical.

In recognition of the importance of sectors A6-A9 (i.e. the Avonmouth Intertidal Area) and the predicted morphological development of this area, it would be useful to gain further data on usage of the area during periods of low water (as much of the predicted mudflat change will take place towards MLW). It is therefore also proposed that an additional low tide count covering only sectors A6-A9 would be undertaken.

For the period up to the beginning of construction this would therefore result in all sectors being counted three times a month (low, mid and high tide) and sectors A6-A9 four times a month (low x 2, mid and high tide). It is not proposed to fully separate Spring and Neap tide counts but the mid tide counts would be undertaken to coincide with Neaps and Springs, as far as practical allowing for available daylight hours. The two low water counts for Sectors A6-A9 would also be undertaken to cover both Spring and Neap tide conditions.

To facilitate completion of the surveys to the above requirements a simple table will be produced that identifies which count type will take place on each month and for which tidal state. Past data could also be re-analysed to determine the tidal conditions at the time of the count and this information combined with future counts to build up a picture of bird usage at these different states of the tide.

As stated above, prior to construction starting the monitoring programme would be reviewed by the ESG and any required changes would be implemented during the following construction and post-construction periods.

2. Surveys at Steart and Bridgwater Bay

Prior to construction and breach of the TBPC Steart site, bird usage of the area will need to be defined so as to inform the EIA process. Given likely predicted effects at the site it is important that bird usage of the existing intertidal area fronting the site is characterised along with usage of the realignment site itself. Survey requirements have therefore been spilt into two components as set out below. One of the potential weaknesses of waterbird surveys of managed realignment sites elsewhere in the UK has been the reliance on low tide counts to inform waterbird use of set back areas. One of the key post-breach survey requirements at the BDSCT compensation site will therefore be to ensure good coverage of waterbird use in the mid to upper tidal frame as well in order to provide a more complete picture of use the compensation site.

During and immediately following production of the EIA for the managed realignment scheme a new monitoring programme will be developed and agreed with the ESG. This

programme will provide data to document bird usage during the construction and post-construction period. It is considered likely that the survey approach will be the same as or similar, in terms of timing in relation to tidal states, to that proposed for the existing intertidal area, as set out below in 2.1.

2.1 Foreshore and intertidal

Low Tide: WeBS low tide count sectors BV692 and BV693 (see **Figure 4**) will be surveyed in the period from two hours before to two hours after low tide and the maximum number present of each species will be recorded by sector. The primary purpose of the surveys will be to record waterbirds, although other species of interest will be recorded at each visit (e.g. EC Birds Directive Annex I species). For the duration of the national WeBS low tide counts (note, these only occur every 5 years, between November and February), surveys will be conducted on or very near to the nominated (by BTO) WeBS survey dates.

Mid Tide: this will use the same count sectors as for low tide and the same approach as for the Avonmouth Intertidal Area (i.e. alternate rising and falling tides).

High Tide: The relevant WeBS high tide (Core Count) sector is 13411 (see **Figure 5**). This covers a much wider area than would be required to inform the compensation project. The data for 13411 will, in any case, be available from WeBS. Therefore, the survey effort will be focused on the foreshore area within the low tide sector BV693 and cover a frontage of approximately 3km in length. Surveys will be on a monthly basis in the period August to May, as above. As the WeBS synchronized counts will take place in the morning, it will be possible normally to undertake some 'through the tide' counts following from the HW counts at least for the start of the falling tide. Surveys will be undertaken on a monthly basis and will cover the autumn passage, winter and spring passage periods (i.e. the entire calendar year).

2.2 Inland fields at the TBPC Steart Managed Realignment Site and the realigned area

The survey approach will be somewhat dependent on access arrangements to the land and may be varied accordingly.

Inland fields viewable from the sea wall and approach road will be surveyed and all waterbirds (and other species of interest) recorded. Fields further inland and included within the TBPC Steart Site will be surveyed as and when access can be arranged. Two counts will be made monthly; one tied into the WeBS count dates for spring tides and the other at high water neaps. Once land is in TBPC ownership then it may be possible to gain greater access to the area and for more targeted counts to be undertaken (e.g. any areas of standing water).

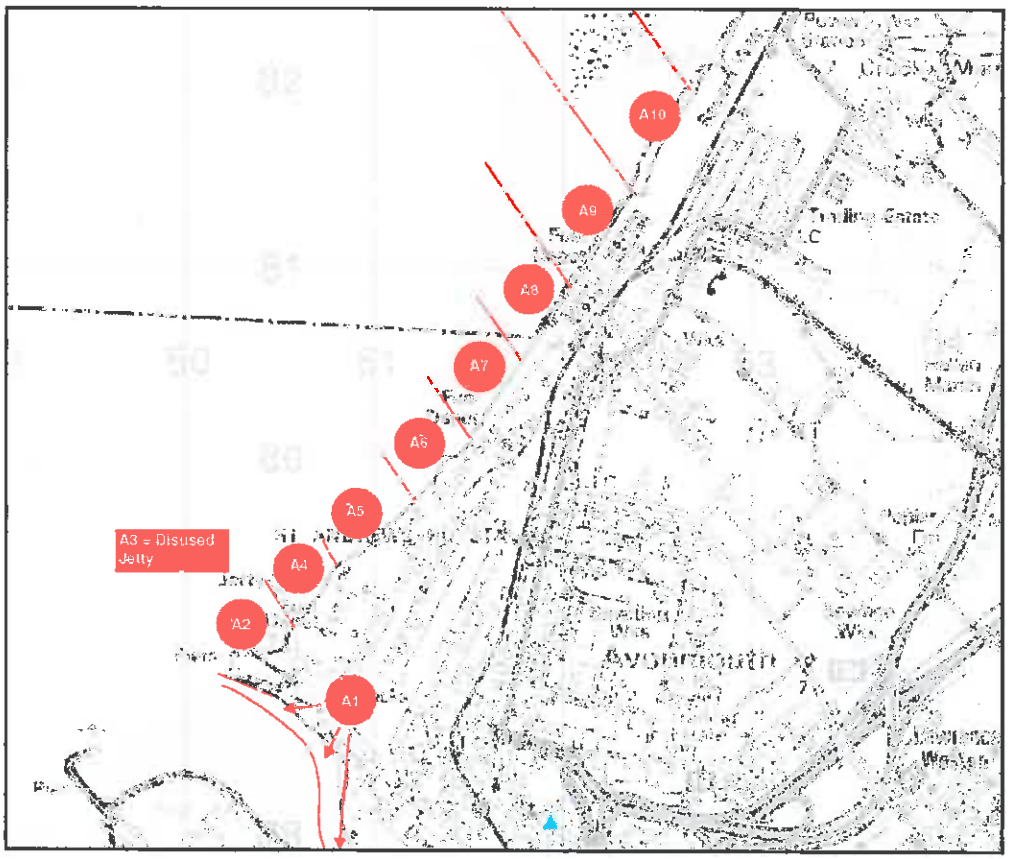

Figure 1. Survey area covering the footprint of the proposed container terminal (count sectors 2-5) and Avonmouth Intertidal Area (count sectors 6-9).

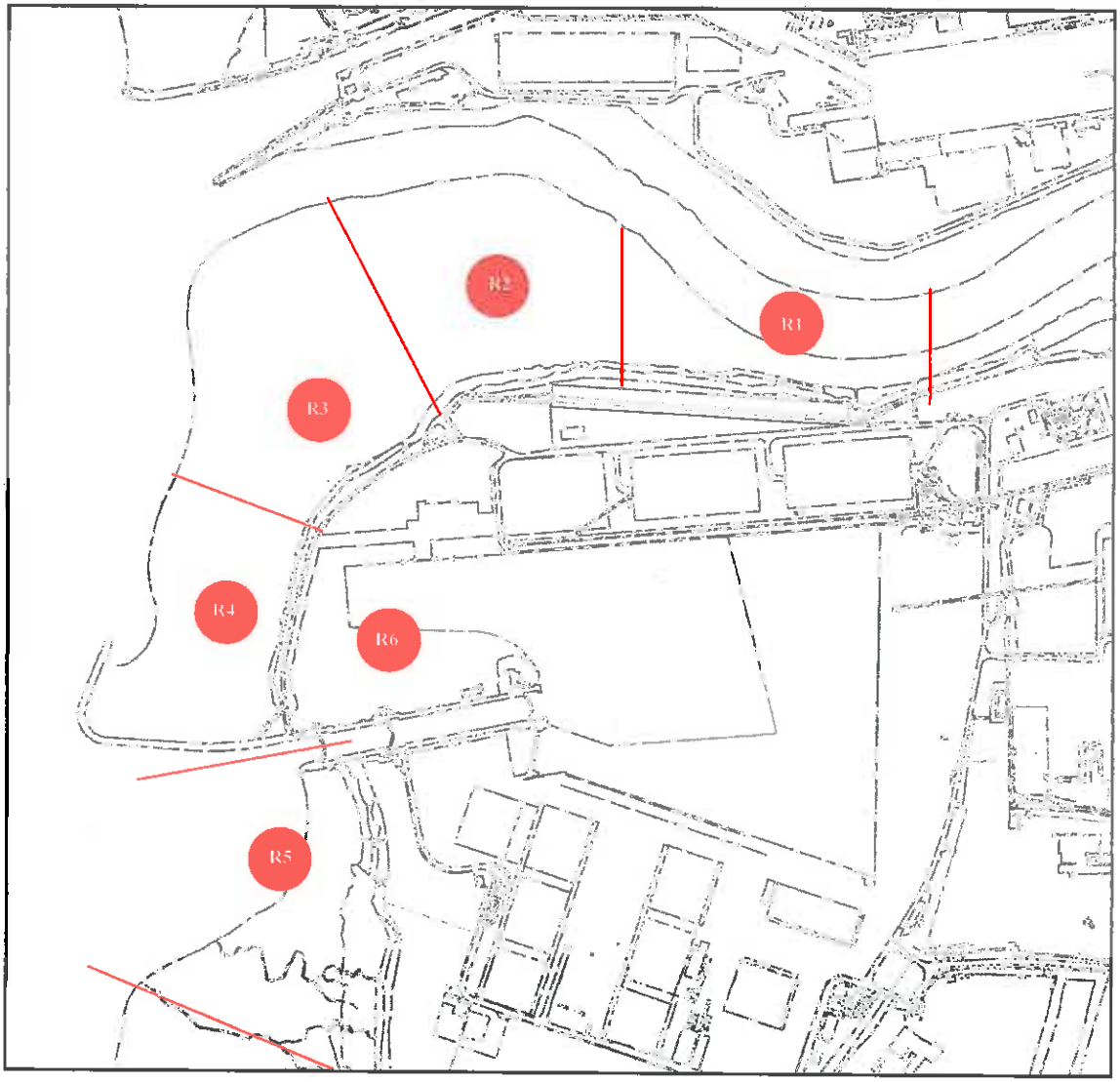

Figure 2. Survey sectors covering the intertidal and port area at Royal Portbury Dock, St. George's Wharf.

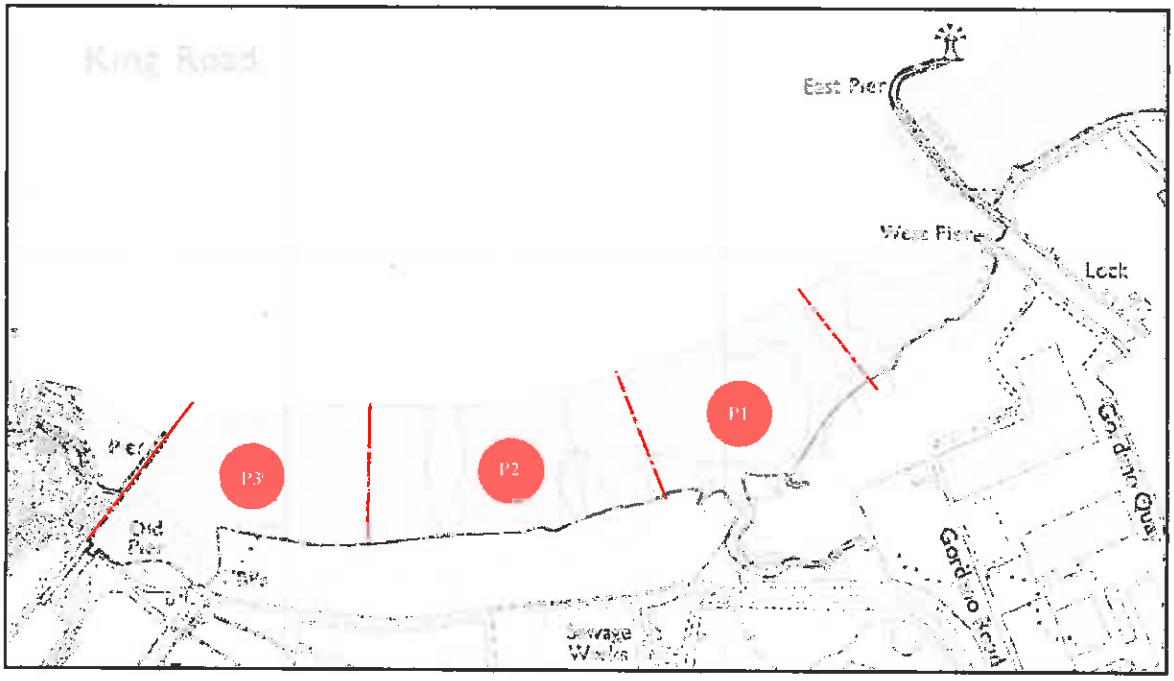

Figure 3. Survey sectors covering the intertidal area at Portbury.

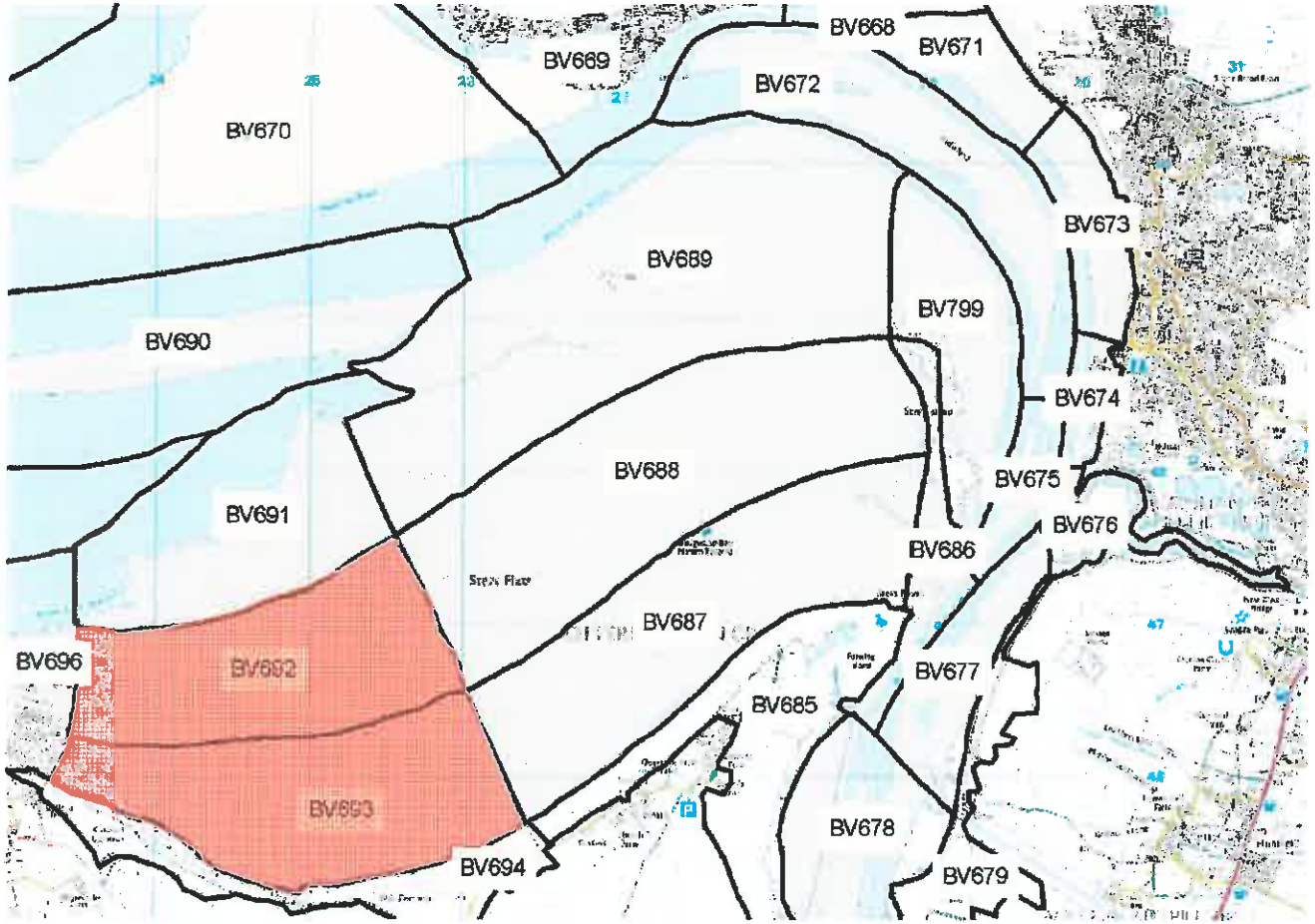

Figure 4. Low tide count sectors at Bridgwater Bay / Steart

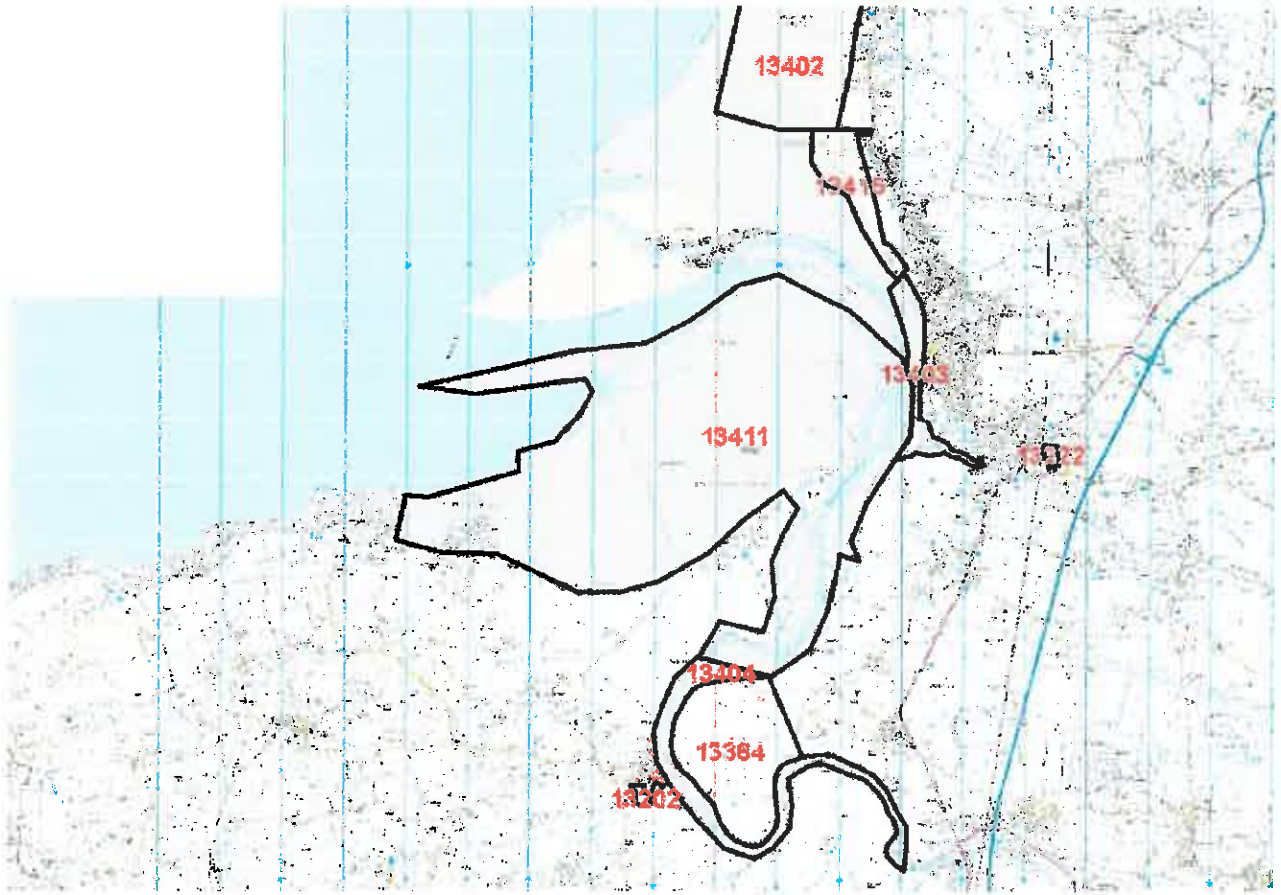

Figure 5: Core count sectors at Bridgwater Bay / Steart