Solent disturbance and mitigation project: Phase I report

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Summary

This is the final report for Phase I of the *Solent Disturbance and Mitigation Project*, funded by the members of the Solent Forum and conducted by Jonathan Cox Associates, Footprint Ecology, Neil Ravenscroft, Biodiversity by Design and Bournemouth University.

The project was initiated by the Solent Forum in response to concerns over the impact of recreational pressure on features of the Solent SPA, SAC and Ramsar Sites. Of particular concern is the likely effect of increased visitor pressure and recreational use on these sites arising from proposed new housing development within reach of the Solent shores. The report reviews the policies in the South East Plan for new housing within the local authority areas bordering the Solent SPA, SAC and Ramsar Sites and changes to the Plan that have been proposed by the Secretary of State to protect and enhance biodiversity. Phase I of this project has (i) collated existing data on the distribution of housing and human activities around the Solent, (ii) assessed stakeholder opinion of the importance of recreational disturbance on birds through a series of workshops and interviews, (iii) collated data on bird distribution and abundance around the Solent and (iv) outlined the range of mitigation measures that could potentially minimise the impacts of increased recreational disturbance caused by increased housing in the Solent area.

The report highlights the high current human population living within a short distance of the Solent shoreline. There are high levels of housing around the shoreline, with particularly high densities in the urban areas of Southampton and Portsmouth. Future development is likely to result in a large increase in the residential population, particularly in the vicinity of Southampton, Portsmouth and Fareham. The Solent provides locations for a wide range of recreational activities. In contrast to the long-term datasets on bird population sizes, there seems to be little systematic monitoring of recreational access and little information to determine how patterns of access have changed over time and how they may change in the future. The population trends of most bird species wintering in the Solent reflect the trend in the respective national population. Several species, particularly wildfowl, have increased greatly in the Solent since the 1980s, mainly in Solent and Southampton Water SPA. Information on breeding birds is less comprehensive and available only for specific sites. In order to determine how new housing might change visitor levels in the future it will be necessary to separate local visitors from tourists, categorise visitors according to the activities undertaken at sites and take into account the variation between sites in terms of attractiveness and suitability for different activities.

Two other phases of the project are planned and are currently being further developed with phase 1 providing the background information for these future phases. Phase II will assess the current impact of current visitor numbers and activities on the survival rates of shorebirds throughout the Solent. Phase III will predict the impact of future changes in housing density and assess associated mitigation measures on the number of people visiting the Solent, and the associated impact on the survival rates of shorebirds. The timescale for phases II and III is uncertain, as funding has not yet been secured.

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Acknowledgements

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Figures

1 Introduction

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Phase I of this project has (i) collated existing data on the distribution of housing and human activities around the Solent, (ii) assessed stakeholder opinion of the importance of recreational disturbance on birds through a series of workshops and interviews, (iii) collated data on bird distribution and abundance around the Solent and (iv) outlined the range of mitigation measures that could potentially minimise the impacts of increased recreational disturbance caused by increased housing in the Solent area.

Section 2 of the report summarises the planning context for the project, including the features of importance within the Solent, and the likely future impact human pressures on the system. Section 3 summarises the ways in which human disturbance can influence birds with specific reference to the Solent and the habitats it contains. Section 4 outlines existing visitor data for the Solent that measure the number of people involved in different activities on different sections of coast. Section 5 gives a summary of existing evidence for impacts of disturbance on birds, derived from a series of workshops and interviews conducted during Phase I of the project. Section 6 gives a summary of the data on bird distribution and abundance around the Solent (derived from WeBS counts). Section 7 summarises the potential mitigation measures that may potentially offset the possible increased disturbance of birds due to increased housing developments around the Solent.

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2 Planning context for the project

This project was initiated by the Solent Forum's Nature Conservation Group in response to concerns over the impact of recreational pressure on features of the Solent SPA, SAC and Ramsar Sites. There is a need to assess the likely effect of increased visitor pressure and recreational use on these sites arising from proposed new housing development within reach of the Solent shores.

Housing policy around the coast of the Solent is guided by housing allocations identified in the South East Plan[1]. The South East Plan is the term given to the Regional Spatial Strategy (RSS) by the South East England Regional Assembly. The draft Plan was published in 2006 following extensive public consultation. The draft plan was debated before an independent panel at an Examination in Public (EiP) held between 28th November 2006 and 30th March 2007. The report of the EiP Independent Panel was published in August 2007. The Secretary of State published Proposed Changes to the South East Plan in July 2008 and it is envisaged that the final Plan will be adopted in spring 2009.

Policies have also been adopted in the South East Plan for the conservation of biodiversity and the protection of internationally important wildlife sites.

This section of the report reviews the policies in the South East Plan for new housing within the local authority areas bordering the Solent SPA, SAC and Ramsar Sites and changes to the Plan that have been proposed by the Secretary of State to protect and enhance biodiversity.

2.1 Housing policy for the Solent region

2.1.1 South East Plan housing allocations

Policy SH5 of the South East Plan identifies housing allocations for South Hampshire over the 20 year period 2006-2026. Provision is made for a total of 80,000 homes over this period. The total and average numbers of houses to be developed per annum, is identified also provided in policy SH5 and is reproduced in Table 1.

The Sussex Coast sub-region of the South East Plan borders the eastern end of the Solent and in particular the Sussex coast of Chichester Harbour within Chichester District. Housing allocation for the Sussex Coast sub-region are identified in policy SCT5. For Chichester District, this proposes an average annual development of 355 houses for the plan period 2006-2026 giving a total of 7,100 new dwellings.

The Isle of Wight is treated as a Special Policy Area within the South East Plan. This reflects its 'unique characteristics' and the specific economic and social issues it faces. Housing development on the Isle of Wight is provided for in policy IW2 of the Plan. This envisages at least 10,400 additional homes over the 20 years of the plan period at a rate of 520 dwellings per annum.

Housing allocations for Chichester District and the Isle of Wight are included in Table 1 to provide a comprehensive summary of the housing allocations identified in the South East Plan for the local authorities bordering the Solent's internationally important wildlife sites (SPA, SAC and Ramsar). These are also illustrated in Maps 5 and 6 and Figure 1.

Table 1: Housing allocations within districts bordering the Solent identified within the South East Plan

South Hampshire	Dwellings Per Annum (DPA)	*TOTAL
East Hampshire (Part)	60	1200
Eastleigh	354	7080

[1] http://www.southeast-ra.gov.uk/southeastplan/plan/view_plan.html

Fareham	186	3720
Fareham SDA	500	10000
Gosport	125	2500
Havant	315	6300
New Forest (Part)	77	1540
North East / North of Hedge End SDA	300	6000
Portsmouth	735	14700
Southampton	815	16300
Test Valley (Part)	196	3920
Winchester (Part)	337	6740
Total for South Hampshire Sub-region	***4000***	***80,000***
Isle of Wight (from policy IW2)	520	10,400
Chichester District	480	9,600
Total		**100,000**

* Totals may not add up due to rounding errors

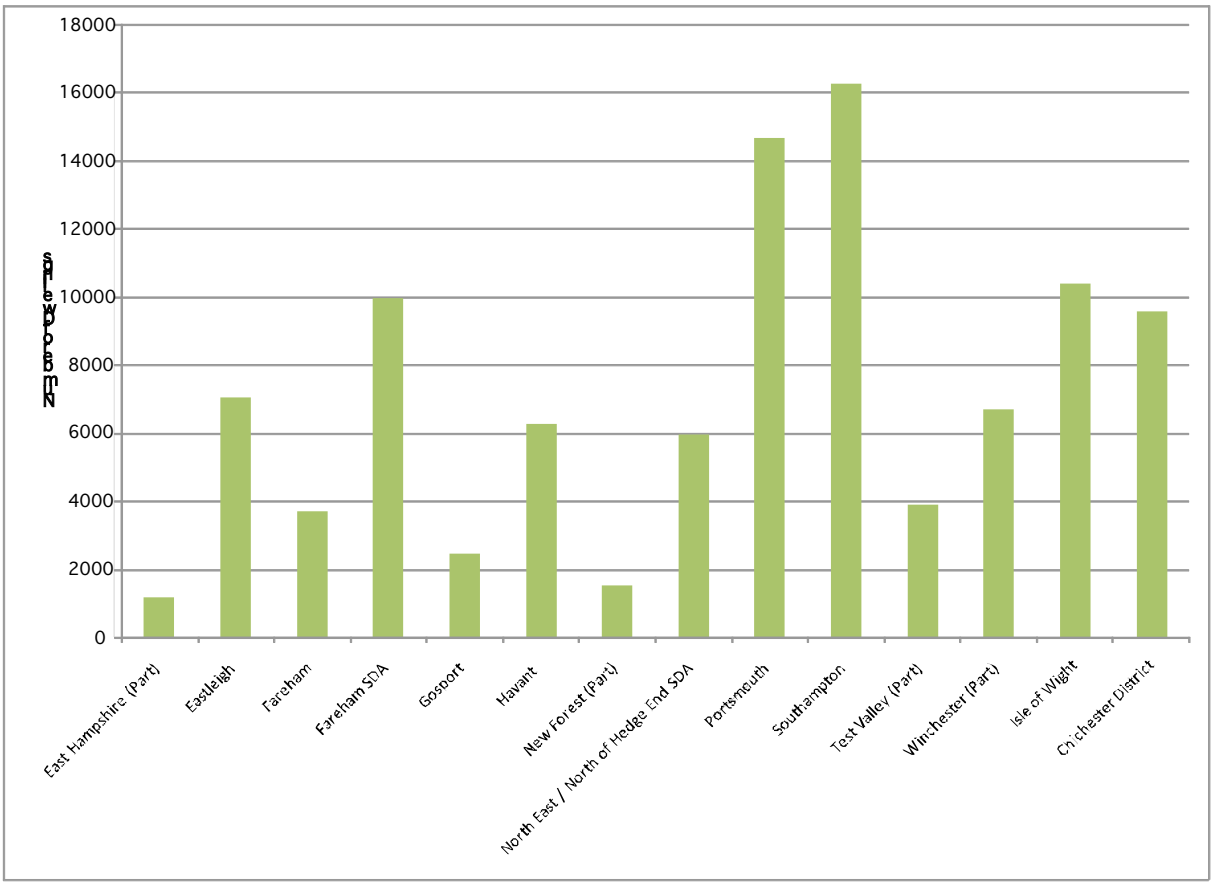


Figure 1 Housing allocations for districts bordering the Solent within the South East Plan

2.1.2 Strategic Development Areas (SDAs)

Although the focus of development in South Hampshire will be on urban regeneration and use of brownfield sites, the South East Plan also considers it necessary to develop some greenfield sites within this sub-region. The Plan envisages the development of two new settlements termed Strategic Development Areas (SDAs) within South Hampshire, one associated with Southampton and the other with Portsmouth. A total of 16,000 new homes are allocated for the SDAs (Table 1; Figure 1). These are expected to provide a range of house types, social facilities and employment opportunities. A feature of the SDAs will be the establishment of public transport links with neighbouring city and town centres, transport hubs and existing or planned major employment locations.

Implementation of housing policy will be through Local Development Frameworks (LDFs) being developed by individual planning authorities. Coordination between local authorities including the development of the two SDAs is being facilitated by the Partnership for Urban South Hampshire (PUSH). PUSH is a voluntary sub-regional local authority partnership consisting of 10 Hampshire local authorities and the County Council (Map 6).

2.1.3 Habitat Regulations Assessment

The draft SE Plan was subject to Appropriate Assessment in accordance with the UK Habitats Regulations[2]. This identified potential adverse effects arising from the policies in the Plan on a number of internationally important wildlife sites, including the SPA, SAC and Ramsar Sites within Solent. In particular, the Appropriate Assessment could not conclude that the increased recreational pressure that is likely to arise from development will not have a significant impact and as a consequence, it considered there to be a risk of adverse effect on the integrity of the Solent European Marine Sites.

The EiP heard a significant quantity of evidence on the nature conservation and biodiversity implications of the Plan's policies and in particular the implications of the plan for international wildlife sites. Of particular concern was the potential affect of increased recreation pressure on nature conservation. This issue was of particular concern in relation to the Thames Basin Heaths SPA but is also of relevance to the Solent's international wildlife sites. Methods proposed for mitigating or offsetting recreational pressures have focussed on a twin track approach with the use of alternative natural green spaces to divert recreational pressure away from sensitive sites, in combination with management measures to control and direct recreational use of sites away from sensitive locations or times of year.

[2] Hughes, J., Wilson, S. & Riley J. (2006) Appropriate Assessment of the Draft South East Plan. Scott Wilson and Levett-Therivel. Report to South East Regional Assembly

Following the EiP, the Secretary of State has published proposed changes to the South East Plan[3]. An important new policy in the proposed changes is a new cross-cutting policy CC8 for Green Infrastructure. Policy CC8 is reproduced in Box 1. It has been adopted as a key element in offsetting adverse effects on internationally important wildlife sites through the provision of alternative green space.

Box 1: New cross-cutting policy included in the proposed changes to the South East Plan

POLICY CC8: GREEN INFRASTRUCTURE

Local authorities and partners should work together to plan, provide and manage connected and substantial networks of accessible multi-functional green space. Networks should be planned to include both existing and new green infrastructure. They should be managed with the primary aim of maintaining and improving biodiversity, but should also delivering recreational and cultural benefits and ensure that an improved and healthy environment is available for the benefit of present and future communities.

The provisions of this policy apply region-wide. However, the successful designation and management of Green Infrastructure will be particularly important in areas designated as regional hubs, in areas close to sites of international ecological importance and in areas identified for significant growth (Strategic Development Areas).

[3] http://gose.limehouse.co.uk/portal/rss/pcc/consult?pointId=91233#document-91233

Policy CC8 should also be considered in the context of the proposed new policy NRM5 for biodiversity conservation. This is reproduced in Box 2. It was proposed largely as a consequence of the findings of the Appropriate Assessment of the South East Plan and provides further policy backing for the need to adopt measures to offset likely adverse impacts of recreational pressure on the Solent's international wildlife sites.

Box 2: New policy for conservation and improvement of biodiversity

POLICY NRM5: CONSERVATION AND IMPROVEMENT OF BIODIVERSITY

In the development and implementation of plans and strategies, local authorities and other bodies shall avoid a net loss of biodiversity, and actively pursue opportunities to achieve a net gain across the region by:

i. **providing the highest level of protection for internationally designated sites and ensuring that nationally designated sites are given a high degree of protection (Diagram NRM2)**

ii. **seeking to ensure that damage to county wildlife sites and locally important wildlife and geological sites is avoided, including areas outside the boundaries of Natura 2000 sites where these support the species for which that site has been designated**

iii. **ensuring that unavoidable damage to wildlife interest is minimised through mitigation, that any damage is compensated for, and that such measures are monitored**

iv. **ensuring appropriate access to areas of wildlife importance, identifying areas of opportunity for biodiversity improvement and setting targets reflecting those in Box NRM3. Opportunities for biodiversity improvement, including connection of sites, large-scale habitat restoration, enhancement and re-creation in the areas of strategic opportunity for biodiversity improvement (Diagram NRM3) should be pursued**

v. **influencing and applying agri-environment schemes, forestry, flood defence, restoration of mineral extraction sites and other land management practices to:**

- **deliver biodiversity targets**
- **increase the wildlife value of land**
- **reduce diffuse pollution**
- **protect soil resources**

vi. **promoting policies that integrate the need to accommodate the changes taking place in agriculture with the potential implications of resultant development in the countryside**

vii. **requiring green infrastructure to be identified, developed and implemented in conjunction with new development**

viii. **identifying sites of international nature conservation interest (Natura Sites and Ramsar wetlands – see Diagram NRM2) sensitive to the pressures or recreation or urbanisation and, as appropriate, working with Natural England and other stakeholders to:**

- **set buffer zones around sensitive sites**
- **provide alternative recreation land as mitigation for any possible adverse impact**

2.1.4 Features of international importance within Solent SPA, SAC and Ramsar Sites

Table 2 shows the interest features of the Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) within the Solent region.

Table 2: SPA and SAC designations and interest features relating to the Solent.

Solent & Southampton Water SPA	*Solent & Isle of Wight Lagoons SAC*	*Solent Maritime SAC*
Breeding	**Annex i habitats**	**Annex i habitats**
Common tern	Coastal Lagoons	Estuaries
Little tern		Spartina swards
Mediterranean gull		Atlantic salt meadows
Roseate tern		Sandbanks slightly covered by water all the time
Sandwich tern		Mudflats and sandflats not covered by seawater at low tide
Over winter		Coastal lagoons
Black-tailed Godwit		Annual vegetation of drift lines
Dark-bellied Brent Goose		Perennial vegetation of stony banks
Ringed plover		Salicornia and other annuals colonising mud and sand
Teal		Shifting dunes along the shoreline ('white dunes')
Waterfowl assemblage		**Annex II species**
		Desmoulin's whorl snail

Chichester and Langstone Harbours SPA	*Portsmouth Harbour*
Breeding	**Over winter**
Little tern	Dark-bellied Brent Goose
Sandwich Tern	
Over winter	
Bar-tailed Godwit	
Black-tailed Godwit	
Dunlin	
Grey Plover	
Redshank	
Ringed Plover	
Dark-bellied Brent Goose	
Little Egret	
Waterfowl assemblage	

3 Review of impacts of recreation on birds

This section provides a review of the impacts of recreational access to the species and habitats that occur within the Solent. We focus on the designated interest features and types of access relevant to the Solent.

The conservation interest of the Solent is defined above. Interest features of international importance are highlighted in Table 2 and provide the focus for this section, but we also extend our account to cover species recognised within SSSI citations.

In considering the impacts of recreational access we cover all types of human activity (see section 4 for an overview of the types of recreational activity), both shore based and water based. Disturbance to birds is a particular issue that was identified prior to commencing this report and so this review is divided into one section on disturbance to birds and a second section covering other impacts.

3.1 Disturbance to birds

Human disturbance of birds has become a key issue for both conservationists and researchers in recent years. Disturbance can be defined as any human activity that influences a bird's behaviour or survival. There are a wide variety of studies which describe disturbance effects (Hill et al., 1997 , Nisbet, 2000, Woodfield and Langston, 2004). The range of studies is potentially bewildering, demonstrating a range of different impacts, in different circumstances, to different species. There is still contention about the applicability of the methods of study and the impacts on bird populations (Gill, 2007).

Most studies of disturbance demonstrate behavioural effects, such as birds changing their feeding behaviour (e.g. Burger, 1991, Fitzpatrick and Bouchez, 1998, Thomas et al., 2003a, Verhulst et al., 2001) taking flight (e.g. Burger, 1998, Stalmaster and Kaiser, 1997, Blumstein et al., 2003 , Fernandez-Juricic et al., 2001, Fernandez-Juricic et al., 2005, Webb and Blumstein, 2005, Blumstein, 2003) or being more vigilant (Randler, 2006, Fernandez-Juricic and Schroeder, 2003). Other studies have focused on physiological impacts, such as demonstrating changes in the levels of stress hormones (Remage-Healey and Romero, 2000, Tempel and Gutierrez, 2003, Walker et al.) or monitoring changes in heart rate (Nimon et al., 1996, Weimerskirch et al., 2002). While behavioural and physiological studies show an impact of disturbance, it is usually difficult to understand whether the disturbance does actually have an impact on the population size of the species in question. For example, the fact that a bird takes flight when a person approaches is to be expected and a short flight in unlikely to have a major impact on the individual in question, let alone the population as a whole.

Certain impacts of disturbance are perhaps more likely to have a population impact. Direct mortality resulting from disturbance has been shown in a few circumstances (Yasue and Dearden, 2006, Liley, 1999) and many (but not all) studies have shown a reduction in breeding success where disturbance is greater (e.g. Arroyo and Razin, 2006, Ruhlen et al., 2003, Bolduc and Guillemette, 2003, Murison, 2002). There are also many examples of otherwise suitable habitat being unused as a result of disturbance (Gill, 1996, Kaiser et al., 2006, Liley et al., 2006a, Liley and Sutherland, 2007). Very few studies have actually placed disturbance impacts in a population context, showing the actual impact of disturbance on population size (but see Liley and Sutherland, 2007, Mallord et al., 2007, Stillman et al., 2007, West et al., 2002).

Studies have shown disturbance effects for a wide range of activities besides simply people, for example aircraft (see Drewitt, 1999), traffic (see Reijnen et al., 1997 for a review), dogs (Banks and Bryant, 2007, Lord et al., 2001) and chainsaws (Tempel and Gutierrez, 2003, Delaney et al., 1999). Some types of disturbance are clearly likely to invoke different responses. In very general terms, both distance from the source of disturbance and the scale of the disturbance (noise level, group size) will both influence the response (Beale and Monaghan, 2004b, Delaney et al., 1999). Studies that have compared different types of

disturbance usually show a weaker behavioural response to vehicles than people on foot (Pease et al., 2005, Rees et al., 2005) and to people without dogs rather than people with dogs (Lord et al., 2001).

Many authors define a definitive distance beyond which disturbance is assumed to have no effect and this is then used to determine set-back distances or similar (Rodgers and Smith, 1995, Rodgers and Smith, 1997, Stalmaster and Kaiser, 1997, Fernandez-Juricic et al., 2001, Fernandez-Juricic et al., 2005, Fernandez-Juricic et al., 2004). It is inappropriate to set such distances as responses to disturbance vary between species (Blumstein et al., 2005) and between individuals of the same species (Beale and Monaghan, 2004a). Particular circumstances, such as habitat, flock size, cold weather or variations in food availability will also influence birds' abilities to respond to disturbance and hence the scale of the impact (Rees et al., 2005, Stillman et al., 2001). Birds can also modify their behaviour to compensate for disturbance, for example by feeding for longer time periods (Urfi et al., 1996). Birds can become habituated (Walker et al., 2006, Nisbet, 2000, Baudains and Lloyd, 2007) to particular disturbance events or types of disturbance, and this habituation can develop over short time periods (e.g. Rees et al., 2005). The frequency of the disturbance event will determine the extent to which birds can become habituated, and therefore the distance at which they respond.

Population impacts are not necessarily relative to the scale of disturbance (Liley and Sutherland, 2007, Mallord et al., 2007), i.e. small changes in disturbance can result in disproportionately large impacts and vice versa. As described previously, behavioural responses may not necessarily describe the impact of disturbance at a population scale, with behavioural responses not necessarily reflecting the true impact of disturbance. Therefore, while the use of a single set-back distance is an appealing and simple approach to limiting the effects of particular works, the approach is flawed and will not necessarily ensure disturbance effects are avoided.

Rather than rely on set distances, it is instead necessary to consider the species' ecology, use of an area and other factors that may influence the scale of the disturbance. This information can then be used to identify what kinds of disturbance, at which locations, are likely to have an impact.

3.2 Disturbance to wintering birds

During the non-breeding season, the main impacts of human disturbance on birds is interruption to foraging and, to a lesser extent, roosting (Woodfield and Langston, 2004). There is a body of research suggesting that responsiveness to disturbance is a species-specific trait (Yasué, 2005). The extent to which disturbance affects the actual distribution of birds within a site will vary according to the species involved, the availability of other resources and the birds' own state. If birds are under stress, for example during cold winter weather when food resources are scarce, they may be less easily disturbed than at other times (Burton, 2007, Stillman and Goss-Custard, 2002), they may simply not be able to afford to stop feeding.

There may also be seasonal variation within a species' responsiveness to disturbance, as individuals alter their threshold in response to shifts in the basic trade-off between increased perceived predation risk (tolerating disturbance) and the increased starvation risk of not feeding, i.e. avoiding disturbance (Stillman and Goss-Custard, 2002). Towards the end of winter, migratory birds need to increase feeding rates to provide energy for migration to breeding grounds. As winter progresses, Eurasian oystercatcher energy requirements increase and their feeding conditions deteriorate. To survive they spend longer feeding and so have less spare time in which to compensate for disturbance. Later in winter, birds approach a disturbance source more closely and return more quickly after a disturbance. Their behavioural response to disturbance is less when they are having more difficulty surviving and hence their starvation risk (avoiding disturbance) is greater (Stillman and Goss-Custard, 2002). It is thus important to measure subtle behavioural changes in foraging rates along with key ecological variables in order to assess the true impact of human disturbance on migratory shorebirds (Yasué, 2005).

Shorebirds are often considered highly susceptible to disturbance because of their very obvious flight responses to humans and because they use areas that are generally subject to high levels of human recreational use. Many species may appear to avoid human presence (e.g. Ravenscroft et al., 2008) but this may not reduce the number of animals supported in an area. Assessing the influence of disturbance on the relationship between animal distribution and resource distribution provides a means of assessing whether numbers are constrained by disturbance (Gill et al., 2001b). A variety of studies have examined the impacts of disturbance on the behaviour of estuary waders in particular. Some studies have sought to extrapolate findings to make inferences about population effects. Shorebird survival on non-breeding grounds is a factor in population limitation.

Disturbance from people walking along estuary footpaths / sea walls appears to have an adverse impact on the distribution of estuary birds. For example numbers of four species (brent goose *Branta bernicla*, common shelduck *Tadorna tadorna*, dunlin *Calidris alpina* and common redshank *Tringa totanus*) decreased with increased proximity to a footpath access point on weekends, when use was likely to have been greatest (Burton et al., 2002). Similarly, recreational use (particularly dogs running off the lead) of shorebird foraging areas reduced foraging time of sanderlings *Calidris alba*, according to a study in the United States (Thomas et al., 2003b). Walkers were the most common potential disturbance event recorded in a study on two Suffolk estuaries (Ravenscroft et al., 2008).

In contrast, another study on the Suffolk estuaries, that looked at the effects of disturbance on wintering black-tailed godwits *Limosa limosa* found that the presence of footpaths had no effect of the numbers of birds supported by adjacent intertidal areas once bivalve food supply had been taken into account (Gill et al., 2001a). However, caution was suggested in extrapolating these findings to other species or other life-cycle stages, particularly because fieldwork was only conducted on weekdays, when recreational disturbance can be assumed to have been lower (Woodfield and Langston, 2004).

In one of the few studies specifically focusing on disturbance to birds within the Solent, Thompson (1994), contacted WeBS surveyors and collated all records of disturbance events observed during low tide counts during the 1993 – 1994 winter. Disturbance to birds was recorded as occurring during 30% of the WeBS visits made, and in the majority of cases the source of the disturbance was human activity on the shore, including dog walkers, walkers, bait diggers and kite flyers. Overall there were few observations where the severity of the disturbance was classified as high ("birds constantly moving around in response to disturbance") but the types of activity involved were varied, including fishermen trying to cross a saltmarsh, kite flying, a dog off a lead, windsurfers, a walker on the foreshore and walkers and children playing on the saltmarsh. The duration of the disturbance also varied, but in only four cases (out of 37) was a time of more than 30 minutes recorded.

Three studies have examined the impact of disturbance on Eurasian oystercatchers wintering on European estuaries (West et al., 2002, Goss-Custard et al., 2006, Coleman et al., 2003). Research at a French estuary shows the important of factoring in environmental variables to assessments of the fitness impacts of disturbance. Modelling shows that oystercatchers can be disturbed up to 1.0–1.5 times per hour before their fitness is reduced in winters with good feeding conditions but only up to 0.2–0.5 times per hour when feeding conditions are poor (Goss-Custard et al., 2006).

Experimental disturbance of wintering oystercatchers on an estuary in Devon altered behaviour and reduced foraging success, without causing them to fly (Coleman et al., 2003). At the same site, another study used a behaviour-based model to predict the impact of human disturbance (West et al., 2002). The model predicted that numerous small disturbances would be more damaging (in terms of bird survival and thus population size) than fewer, larger disturbances. When the time and energy costs arising from disturbance were included, disturbance could be more damaging than permanent habitat loss. However, preventing disturbance during late winter, when feeding conditions were harder and this migratory bird's energetic demands higher, practically eliminated its predicted population consequences (West et al., 2002).

Using their individual-based model on the Wash estuary, West *et al*. (2007) explored the over winter survival of a range of species (black-tailed godwit, bar-tailed godwit *Limosa lapponica*, Eurasian curlew *Numenius arquata*, Eurasian oystercatcher, red knot *Calidris canutus*, redshank, dunlin *Calidris alba* and ringed plover) in relation to disturbance, habitat loss and changes in prey abundance. Birds began to starve, when autumn, estuary-wide food biomass density was below about 5 g AFDM m_2 and survival rates fell below 90% at 4 g AFDM m_2. The system as a whole was predicted to be relatively insensitive to habitat loss. Black-tailed godwits were the most sensitive species, but their survival was not affected until 40% of the feeding grounds were removed. The survival of all species in the model remained high at fewer than 20 disturbances/hour. Although actual disturbance rates on the Wash were not measured during this study it is unlikely that present-day rates of disturbance represent a threat to the survival of the bird species modelled (West et al., 2002).

Waders with high roost-site fidelity and minimal interchange between roosts have been thought likely to be at risk from human disturbance (Rehfisch et al., 2003). However, a recent study produced no evidence that terrestrial human activity impacts on roosting waders, e.g. by preventing roosts from forming or causing roost-sites to move. Roosting waders studied in the coastal United States included two species with wintering populations in the UK (ruddy turnstone *Arenaria interpres* and red knot *Canutus canutus*) and one species with a European counterpart (American oystercatcher *Haematopus palliatus*): terrestrial disturbance did not appear to be a factor for any species (Peters and Otis, 2007).

Human disturbance of thousands of migrating shorebirds at Delaware Bay in the United States has declined sharply since a variety of management actions were introduced in the 1990s. Signs were placed on shorebird foraging beaches, dog-walkers were encouraged to keep dogs on the lead, spatial restrictions on access were introduced, and viewing platforms constructed. These were complemented by enforcement activities, such as patrols of key beaches and the issuance of summonses for infractions (Burger et al., 2004).

Following modelling of wintering Eurasian oystercatchers on a Devon estuary, researchers recommended that to almost entirely eliminate the predicted population consequences of disturbance, site managers should prevent disturbance to the birds during late winter, when feeding conditions were harder and this migratory bird's energetic demands higher (West et al., 2002). The model used has been designed to be easily applied to other scenarios, species, locations and issues (West et al., 2002).

3.3 Disturbance to breeding birds

There have been relatively few studies of the effects of disturbance to breeding gulls and terns. These groups have been highlighted as a focus for future work in the UK (Liley and Slater, 2007).

In Portugal low breeding success of little terns *Sternula albifrons* has previously been shown to be associated with human activities (Calado, 1996). More recent work has shown that little terns have shifted away from nesting on sandy beaches and instead they are using man-made salt lakes ("Salinas"), a shift thought the be linked to human disturbance and habitat loss (Catry et al., 2004). Detailed nest monitoring in Portugal has evaluated the influence of human disturbance on breeding success of little terns and the interaction with the seasonal variation in the birds' breeding biology (Medeirosa et al., 2007). The percentage of nests producing hatched chicks varied in different years and habitats. The main causes of hatching failure also varied between years and habitats, but included predation, flooding and human activities. The presence/absence of protective measures (warning signs and wardening) was the most important predictor of nesting success, with birds being up to 34 times more likely to succeed when such measures were in place.

Terns may lift off the colony when disturbed, for example by boats (Burger, 1998). In one intensively studied colony of common terns *Sterna hirundo* in the US, reproductive success had declined to zero, perhaps due to excessive personal watercraft activity (Burger, 2003). The terns lifted off the colony more frequently when watercraft raced round the colony (on an

island) than when craft remained in the main shipping channel. Monitoring of breeding success during a period of management of boat access suggests that a combination of education, public meetings, increased signage, enforcement, and designated zones for watercraft resulted in the greatest increase in reproductive success.

Studies have shown that human disturbance to beach-nesting birds can lead to trampling of eggs and chicks (Ruhlen et al., 2003), greater thermal stress to eggs (Weston and Elgar, 2005), greater predation rate of chicks and eggs (Bolduc and Guillemette, 2003) and reduced foraging times (Yasue and Dearden, 2006).

Trampling of eggs and chicks seems to be more frequent on beaches than other habitats (Ruhlen et al., 2003, Woodfield and Langston, 2004, Weston and Elgar, 2005). This may be because, particularly on a beach with the sea on one side, it is generally impractical to limit people to footpaths and the narrow linear habitat offers little physical space for segregation of birds and people (Woodfield and Langston, 2004).

On the Norfolk coast, territory choice in ringed plovers and Eurasian oystercatchers involves a trade-off between habitat quality (e.g. beach composition and width) and visitor numbers (Tratalos et al., 2005).

Work by Liley (Liley, 1999, Liley and Sutherland, 2007) focused on a 9-km-long section of Norfolk coastline and found that ringed plovers avoided areas of high human disturbance and additionally suffered breeding failure through accidental trampling. Modelling, using game theory to explore the effects of disturbance on density-dependence, enabled predictions of the population consequences of hypothetical disturbance levels. If nest loss from human activity were prevented, for example by fencing nests, the plover population was predicted to rise by 8%. A complete absence of human disturbance would cause a population increase of 85%. However, if visitor numbers were to double, the population was predicted to decrease by 23%. Wide beaches support higher densities of breeding ringed plovers than narrow beaches and therefore locating access points away from the widest sections of beach is likely to result in the largest possible population per length of coastline (Liley and Sutherland, 2007).

Two different studies have recorded predation of ringed plover chicks by dogs (Liley, 1999, Pienkowski, 1984).

Additional site-based research on the Norfolk coast has looked at the impact of visitor numbers on ringed plovers in relation to climate change (Coombs, 2007). The thesis is that warming temperatures will cause an increase in visitor numbers to the coast. At Holkham beach, current visitor levels already significantly reduce available habitat suitable for breeding ringed plover. Moreover, it is predicted that the increase in coastal visitor numbers that is a likely consequence of climate change will lead to further areas of habitat becoming unsuitable by 2080. The extent of suitable non-vegetated habitats may decrease by up to 73%, foredunes by 51% and yellow dunes by 55%. Parallel work at Cley beach nearby demonstrates that plover territories are currently restricted to the back of the beach where few visitors walk and that a further increase in visitor levels will not adversely affect the suitability of the habitat for the plovers (Coombs, 2007).

As a result of her work, Coombes recommended a series of measures to minimise biodiversity impact. These included restricting access to a single entrance point, creating defined paths through habitats to limit wandering, and restrictions on access to particularly sensitive areas (Coombes, 2007).

Human disturbance reduced Eurasian oystercatcher fledgling success by reducing foraging time and allocation of prey to chicks (Verhulst et al., 2001). For the closely related American Oystercatcher, which may shed light on its European congener, evidence is conflicting. In one study, disturbance by humans on foot had very little effect on incubating American oystercatchers, accounting for just 4% of events when adults left the nest (McGowan and Simons, 2006). In another study, however, human approaches on foot within ≤137 m (but not at greater distances) reduced the frequency of reproductive behaviours, replacing them with vigilance, locomotion or display. During brood rearing, pedestrian activity near

oystercatchers did not influence birds' reproductive behaviour; however, pedestrian activity far from oystercatchers increased the frequency of reproductive behaviour. The 8% of nesting attempts that failed because of human activity (handling the eggs and chronic disturbance) were located in areas of higher visitor presence (Sabine III et al., 2008). The authors recommended that conservation managers: minimise pedestrian activity near nests (≤137 m) during incubation; increase set-back distances (to >137 m) during brood rearing; and consider closing beaches in high traffic areas (Sabine III et al., 2008).

3.4 Impacts of access and disturbance to other key features

3.4.1 Coastal Vegetated Shingle

The most susceptible communities on shingle are those with abundant lichens. These are susceptible to trampling damage, especially in dry weather, when they are particularly easy to damage (Doody and Randall, 2003). Doody and Randall suggest that even the passage of one person walking (or cycling) on an established vegetated shingle ridge can "leave 'footprints', which may never be repaired". In addition trampling results in compaction of the surface which affects the seed bank making it more difficult for some species to germinate. Where access management has taken place, such as the control of visitors, flora can recover (Doody and Randall, 2003). At Orfordness in Suffolk biennial survey data of driftline vegetation, collected since 1996, has shown a recovery of the sea pea *Lathyrus japonicus* population that had largely disappeared from the site due to damage and disturbance caused by illegal access by vehicles and pedestrians. The recovery has coincided with the National Trust restricting access (see Orfordness case study in Doody and Randall, 2003).

At Browndown SSSI, on the Solent, small enclosures, established to protect the scarce flora, are effective, but where people are forced to walk round the fence, all vegetation has disappeared, creating rings of bare shingle around each exclosure (Liley et al., 2006d). Other impacts besides trampling at this site include litter, illegal fires (burning scrub and heath vegetation) and eutrophication from dog fouling. These issues are exacerbated by military training, with the site being used for beach landings. The work highlights the intense pressures that can be present on small sites surrounded by high human populations.

Localised shingle extraction can take place where public access occurs. This may be by individuals who remove small quantities for personal use or larger scale operations for sale (Doody and Randall, 2003). The extent of these activities in the UK (or the Solent) is not known (Doody and Randall, 2003), and, if taking place within a SSSI not covered by common rights, such extraction is illegal.

Boat access on shingle beaches can cause damage and loss of vegetation, especially where boats are frequently pulled up the beach in the same location (Doody and Randall, 2003).

Any vehicle use on vegetated shingle can be very damaging, as even relatively minor incursions into the intact vegetated shingle ridges can break up the vegetation. Wheel tracks created by vehicles during the 1940s at Dungeness, for example, remain clearly visible today (Doody and Randall, 2003).

Doody and Randall (2003) advocate access management on shingle sites to minimise trampling levels. They suggest that interpretation and education materials are important and also advocate set routes to minimise the area walked over and boardwalks to allow people to walk across shingle areas without impact. Visitor exclosures, signage and wardening measures are all effective in reducing disturbance impacts where breeding terns or waders are present (e.g. Ikuta and Blumstein, 2003, Medeirosa et al., 2007).

Shingle is an important habitat for invertebrates in the UK, supporting a large number of rare or scarce species (see Doody and Randall (2003) and Shardlow (2001) for reviews and lists). Disturbance has a negative impact on the majority of invertebrates (Shardlow, 2001), an assessment supported by Kirby (2001): "public access to shingle habitat is probably always damaging to some extent". Off-road vehicle access has been identified as a threat to invertebrates on some sites (Alexander et al., 2005b).

The looping snail *Truncatella subcylindrica* has been recorded from south Hampshire including Langstone Harbour, Southampton Water[4] and is associated with shingle and rotting vegetation. Physical disturbance of the habitat by walkers and vehicles, even at a low level, has been identified as a threat to this species (Alexander et al., 2005b).

Strandline invertebrates are sensitive to the removal of tidal debris and there are some particular species associated with tide line debris and shingle. Management should aim to reduce public disturbance of drift material or the collection of drift wood and avoid any attempts to "tidy up" the material (Alexander et al., 2005b, Whitehouse et al., in prep).

3.4.2 Mudflats, Sandflats and Lower Beach Habitats

The main interest in these habitats are invertebrates, including both surface living species (such as flies, sandhoppers and beetles) and burrowing species (such as molluscs and worms).

Trampling of mudflats leads to changes in invertebrate community structure (Chandrasekara and Frid, 1996). The mechanical disturbance of trampling can bury animals living on the surface and also bring deep burrowers to the surface. Footsteps can also destroy animal burrows and physically crush or damage animals below the surface. Trampling also alters the surface topography of the mudflats, which can indirectly affect recruitment and spatial distribution of microalgae (Wynberg and Branch, 1994) and macrofauna (see Rossi et al., 2007 and references therein). Furthermore, compaction of the sediment might alter the exchange of nutrients and oxygen between the sediment and the overlying water, change sediment accumulation rate and, again, modify population dynamics and distribution of animals in the mudflat (Rossi et al., 2007).

In a study of trampling effects on mudflats in the Netherlands, trampling had clear impacts on the macroinvertebrate fauna (Rossi et al., 2007). Trampling resulted in reduced abundance of the adults of a clam species, the Baltic macoma *Macoma balthica* and cockles *Cerastoderma edule*. It was believed that footsteps directly killed or buried the animals, provoking asphyxia. Conversely, for the macomoa trampling indirectly enhanced the rate of recruitment, while small-sized cockles did not react to the trampling. The number of small animals showed little change because trampling occurred during the growing season and there was a continuous supply of larvae and juveniles. In addition, trampling might have weakened negative adult-juvenile interactions between adult cockles and juvenile clams, thus facilitating the recruitment. This work suggests that during the growing season recovery can be fast, but in the long-term it might lead towards a shift in community dynamics, possibly affecting ecosystem functioning.

Work on nematodes in mudflats has shown that nematode abundance and species composition to be reduced on trampled plots, but that recovery is rapid (36 hours), suggesting that the nematodes respond to the trampling by burrowing more deeply and soon return (Johnson et al., 2007).

The effects of varying intensities of human trampling on sandy beach macrofauna were investigated experimentally in South Africa (Moffett et al., 1998). Vigorous beach games (volleyball) resulted in damage to the four species (two mussels, a mysid shrimp and an isopod) studied. One of the mussel species was particularly vulnerable to the trampling, with 18% of individuals damaged in the treatment with the highest intensity of trampling. The results indicated that few members of the macrofauna were damaged at low trampling intensities but substantial damage occurred under intense trampling.

Sandhoppers on lower beaches have been a focus for a number of studies. Declines in densities of sandhoppers on sandy beaches in Poland have been attributed to tourist pressure and the number of people on the lower beaches (Weslawski J.M. et al., 2000), with similar results in Spain and Brazil (Veloso et al., 2008). Veloso found higher densities sandhopper in protected areas where access was controlled, in both countries. Different species were

[4] Distribution from Marlin: http://ukmpas.org/species/larval_distrib_Truncatellasubcylindrica.htm

involved in Spain and Brazil and the beaches differed in the variation in access through the year, yet impacts of access were found at both locations. Ugolini et al (2008) found a negative correlation between sandhopper abundance and the number of people at given locations. The people were counted from very specific areas (within 150 m of the sandhopper sampling locations) across a range of different beaches. They also included a number of other variables, included substrate size and trace metals in their analysis and conducted experimental trampling of sandhoppers. Their work shows a clear and very strong trampling effect for this invertebrate group. Some evidence from Spain demonstrates differences in the morphology of sandhoppers on busier beaches (Barca-Bravo et al., 2008), with greater asymmetry among sandhoppers at the site with the most tourist and urban pressure.

The reduction in invertebrates on tourist beaches is likely to be a result of direct mortality from trampling and also through habitat modification, which on many heavily used beaches may include beach cleaning. A study of coastal systems in the Mediterranean and Baltic (Gheskiere et al., 2005) shows that upper beaches heavily used by tourists are characterised by a lower proportion of total organic matter, lower densities of invertebrates, lower diversities (including absence of certain insects and nematodes) and higher community stress compared to nearby non-tourist locations. The proportion of total organic matter was found to be the single most important factor for the observed differences in the faunal assemblage structure at tourist versus non-tourist beaches.

In both sand- and mud-dominated habitats, the intensity of the trampling is important (Chandrasekara and Frid, 1996, Moffett et al., 1998), with relatively little damage at low trampling intensities.

3.4.3 Saltmarsh

Comparative studies of trampling impacts on different coastal habitats indicate that saltmarsh is the most resistant habitat, relative to sand dunes, coastal grasslands etc. (Andersen, 1995, Coombes, 2007, Lawesson, 1998). Although apparently more resilient, there is clear evidence that access can cause damage. Even annual visits to fixed sample points can cause visible changes to the vegetation (Boorman, 2003). The marshes which are the most liable to damage from trampling are those with poorly drained soils made up of fine sediments (Boorman, 2003). Pioneer saltmarsh may also be particularly vulnerable. Pioneer saltmarsh at Holkham is crossed by people visiting the beach, who fan out after crossing the dunes near a main access point. An extensive network of bare paths is visible (Liley, 2008) through the vegetation.

Trampling damage directly affects the saltmarsh vegetation. Any damage to the vegetation cover of the saltmarsh carries with it the risks of erosion damage over a much wider scale. It will also have an impact on the soil fauna with possible consequences for the functioning of the marsh ecosystem as a whole (Boorman, 2003).

There is little information on samphire *Salicornia europea* gathering (but see Adnitt et al., undated). The activity was apparently recorded in only 9 of the 155 estuaries covered by the Estuaries Review of the UK and there are no recorded impacts either on the vegetation or on other nature conservation interests from the current, low intensity activity associated with hand collection. By its nature, collection of the material can only take place at low tide and in the late summer, before the main wintering bird populations appear (Adnitt et al., undated).

Some mild trampling exposing areas of bare mud may be of benefit to some flies associated with saltmarsh, these include the cranefly Dicranomyia complicata (RDB2) (Alexander et al., 2005a). Path construction on the upper saltmarsh has been identified as a threat to species in this transitional zone, and to freshwater seepages and their associated species (Alexander et al., 2005a).

As with other coastal habitats, saltmarshes feature a terrestrial invertebrate assemblage associated with accumulated tidal debris and driftwood. Management should aim to reduce public disturbance of drift material or the collection of driftwood and avoid any attempts to "tidy up" the material.

3.4.4 Coastal Lagoons

Saline lagoons are shallow areas of saline water—natural or artificial—wholly or partially separated from the sea by sandbanks, shingle, rocks or other hard strata or by man-made structures. They can be tideless or tidally restricted such that they retain a proportion of their water at low tide and may develop as brackish, fully saline or hyper-saline water bodies (Bamber et al., 2001, Anon, 1995).

The main threats to coastal lagoons are from (Cadbury et al., 2001, Covey and Laffoley, 2002, Johnston and Gilliland, 2000, Symes and Robertson, 2004):

- coastal defence works;
- development pressures and landfill;
- sea level rise;
- changes in the sea water/freshwater balance;
- water pollution and particularly eutrophication;
- natural succession.

The following human activities have been identified as potentially damaging to saline lagoons and their wildlife (Bamber et al., 1993, JNCC, 2007, Saunders et al., 2000):

- Fishing;
- Bait digging, bait collection and shellfish collection for food with associated trampling and disturbance;
- Modification of inlets/outlets associated with leisure developments;
- Drainage, dumping and litter pollution;
- Dumping and spillages of toxins into inlets or directly, including algicide and pesticide applications to reduce perceived toxic blooms or mosquito infestations;
- Discharges of sewage from coastal developments including caravan sites or non-point pollution with nutrient from agricultural or other land into inlets or directly;
- Disturbance from people and pets to breeding/wintering/passage birds;
- Introduction of alien species;
- Boating, dinghy sailing, canoeing and personal water crafts from launching, anchoring and moorings; and
- Sub-aqua and snorkelling.

Some activities can have indirect effects. One example is soil erosion from people, horses and vehicles, which causes run-off with subsequent turbidity in adjoining lagoon water columns. Another example is the use of adjoining beaches resulting in litter and eutrophication from faeces (Saunders et al., 2000).

4 Summary of current existing visitor data

Information relating to visitors was sourced through requests to relevant local authority staff, through the Solent Forum and through the interviews / workshops (see Section 5). We requested raw data, survey reports and details of on-going work, as appropriate, relating to visitor surveys, visitor questionnaires, visitor counts (such as car park counts, automated counters, direct counts or similar), boat use and moorings. All people who supplied information are given in the acknowledgements.

An audit of coastal access to the Hampshire Coast was commissioned by Hampshire County Council in 2007 (Geodata Institute, 2008) and collates spatial datasets related to the provision, constraints and opportunities related to coastal access. The survey focuses on a buffer that extends 1 km inland and down to the Mean Low Water line. This survey does collate information that includes Wildfowling areas, coastal habitats, a launch point survey, standard map layer with all open spaces, permissive access areas, accessible foreshore habitat, but unfortunately most of these data could not be made available by Hampshire County Council.

4.1 Current human population surrounding the Solent

There are 1.7 million residential properties within 50km of the Solent shoreline (Figure 2) and Maps 3 & 4. Assuming typical occupancy rates (UK average is 2.4 people per household[5]), then this means that over 3 million people are likely to reside within 50km of the Solent shore. Residential development is currently particularly focused close to the shoreline, with 600,000 residential properties lying within 5km of the shoreline.

A similar pattern is evident with respect to the European Sites, with high levels of residential development concentrated within 5km of the boundary (Figure 3). Comparison of the three harbours (Figure 3) shows that Portsmouth Harbour has the highest levels of residential development surrounding the SPA boundary and Chichester Harbour has the lowest amounts of development nearby.

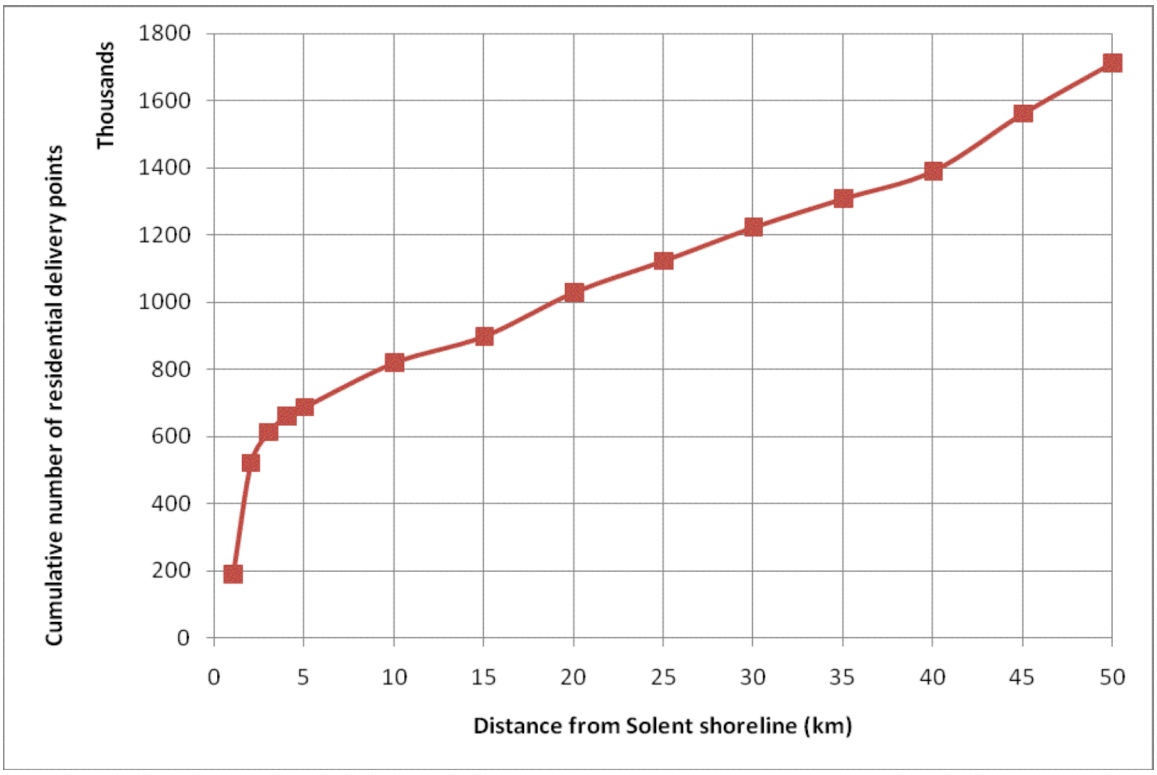


Figure 2: Cumulative number of residential properties surrounding the Solent at different distances from the shoreline

[5] From the office of national statistics, average from 2001 national census

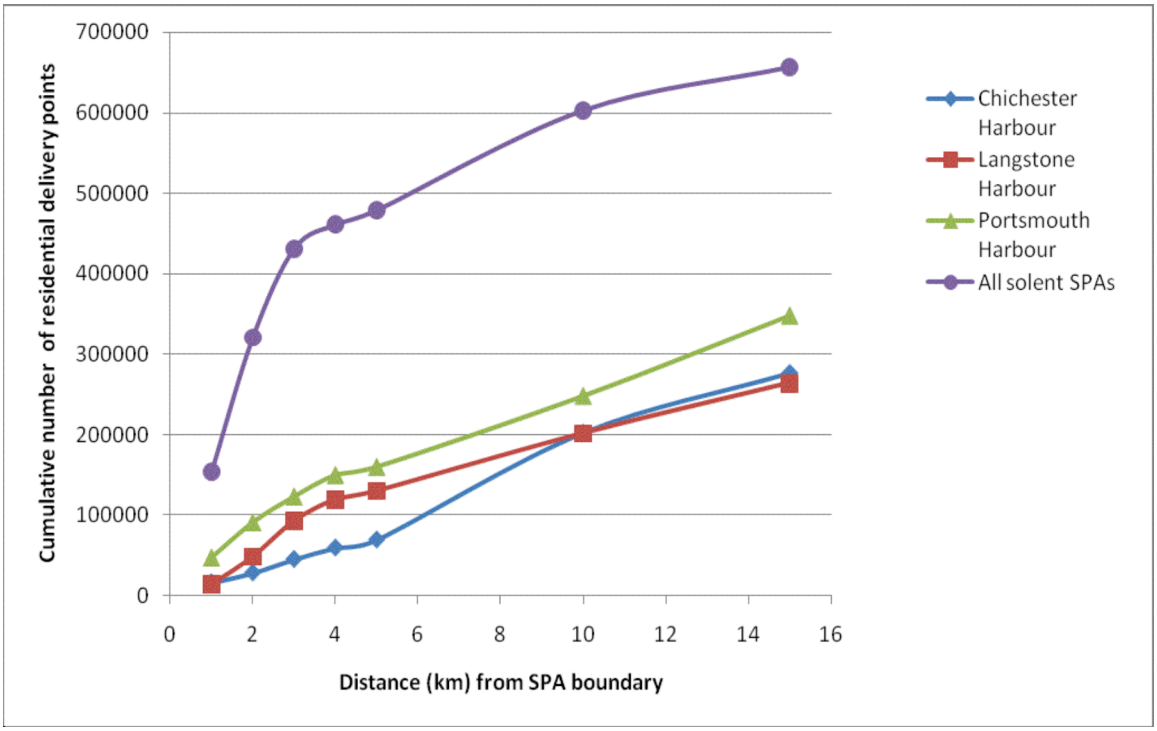


Figure 3: Cumulative number of residential properties surrounding the SPA boundary (all SPAs in purple, individual harbours in other colours).

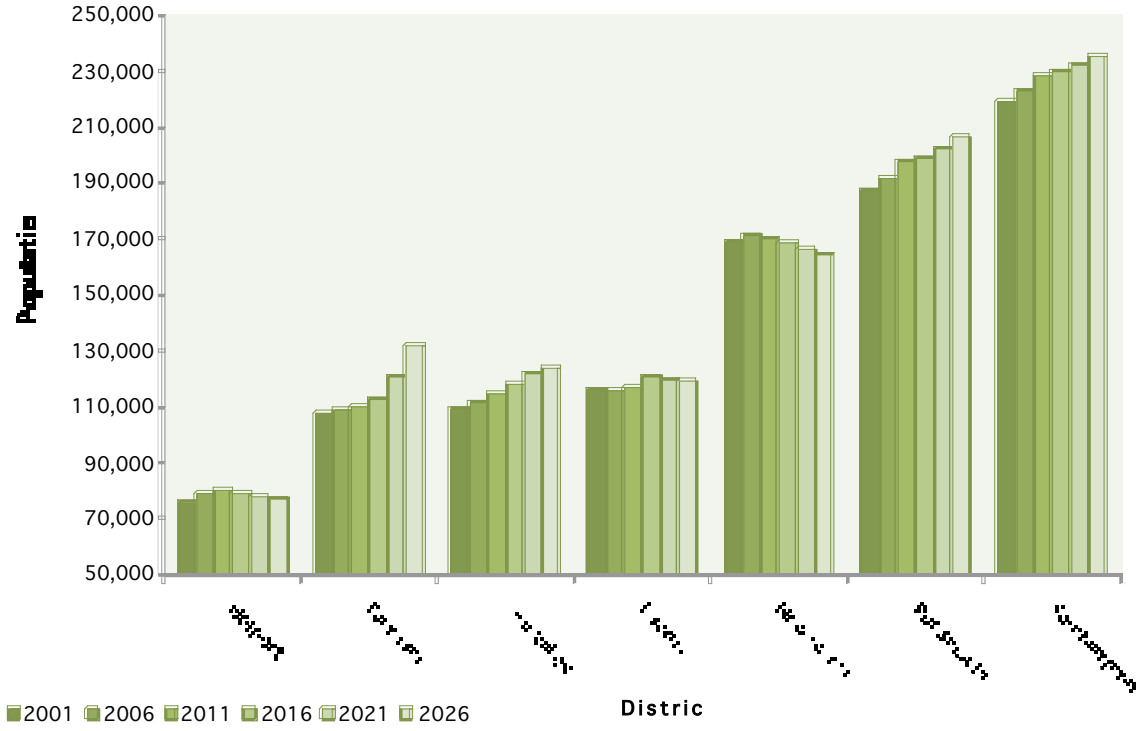
Demographic changes within Hampshire for the period to 2026 are summarised by the County Council (Hampshire County Council, 2007). The report predicts profound changes to Hampshire's demography, with a population growing by over 100,000 people to 1,792,000 by 2026. This will be accompanied by a shift in the age structure of Hampshire's population, leading to higher proportions of older people relative to young people.

The number of dwellings is predicted to increase by 540,000 to 850,000 by 2026. Data for individual Local Authority Areas[6] (see Figure 4, which shows both population change and changes in the number of dwellings for selected districts) shows that the highest percentage increase in dwellings will be in Fareham (34% increase) and Test Valley (27% increase). Actual increases will be highest in Southampton, Portsmouth and Fareham.

Changes in household composition as a result of continued social and economic influences are predicted to leading to more people living on their own, and an increase in one person households most apparent amongst those in their 30's, 40's and 50's (Hampshire County Council, 2007). These trends will have many implications that include more people spending more time in retirement, potentially increasing the proportion of the population with leisure time and likely to be undertaking leisure activities that might include visits to the coast.

The spatial distribution of new housing, by District, is also summarised in Maps 5 & 6. More detailed maps for the south-Hampshire sub-region are provided by PUSH (see Figure 3.3 in TEP, 2008). This map highlights Southampton, Portsmouth and Fareham as likely to see a particularly large increase in residential development.

[6] Raw data provided online by Hampshire County Council and downloaded 24/11/08: http://www3.hants.gov.uk/district_level_output.xls



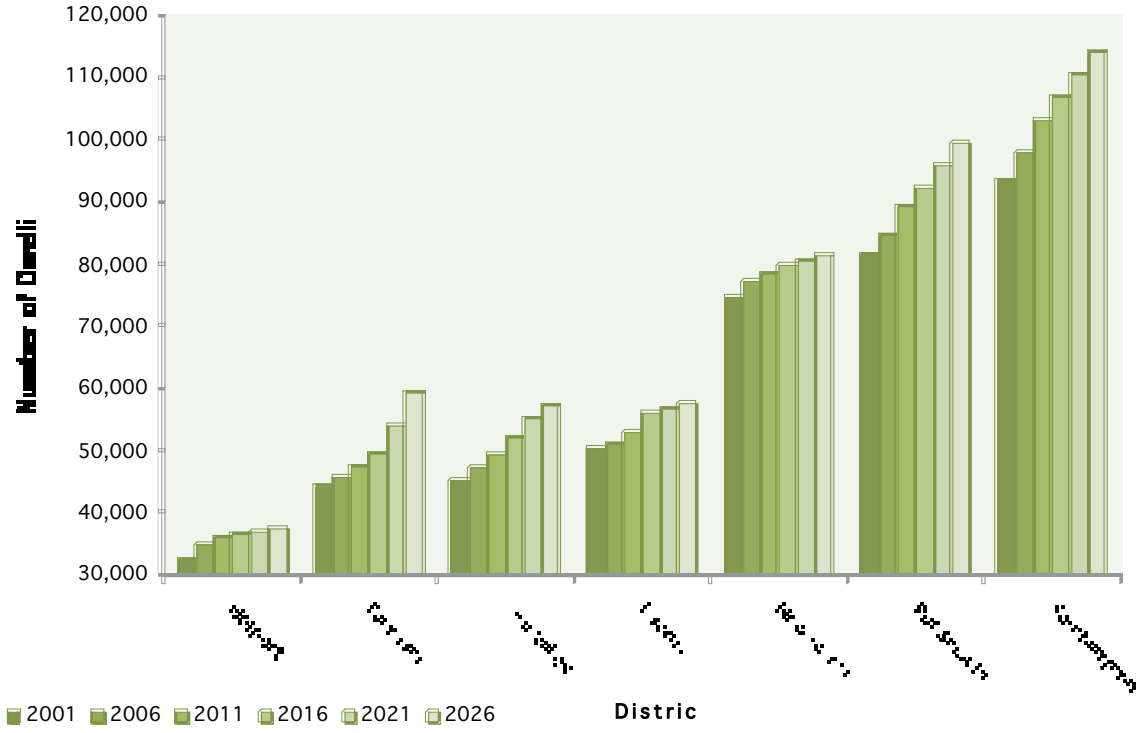


Figure 4: Population change and changes in the number of dwellings for different district for the period to 2026. Data from Hampshire County Council (http://www3.hants.gov.uk/district_level_output.xls).

4.2 Access Provision

4.2.1 Extent of shoreline access

The total length of the Solent shoreline (Hurst Castle to Selsey Bill, including the northern shore of the Isle of Wight and the Rivers Itchen, Hamble, Medina and Newton) is approximately 460km in length. Most of the coastline has access of some sort, though this varies markedly, ranging from way-marked routes and long distance paths to informal, de facto access.

In Map 9 we highlight low tide WeBS sections (i.e. the sections used for the bird counts) were there is no direct foot access (i.e. public rights of way or public highways within or within 100m of the WeBS section). We assume that sections with public rights of way or highways within 100m (the two shades of red) are those where access can occur. It can be seen that few areas of shoreline are without access (green sections). Parts of the western sides of Southampton Water have no access (e.g. Dibden, Fawley refinery and Marchwood naval base) and also parts of the north shore of the Isle of Wight. Otherwise the only other sectors without access are those that away from the shoreline (such as the central areas of the eastern harbours).

4.2.2 Car parking

Car parks and designated on-road parking (i.e. with parking bays painted on the road surface) were mapped using OS 1:50,000 OS base maps, through local knowledge and through the use of aerial photography. Car park capacity was estimated from aerial photographs, as the measure can be a useful approximate indication of visit levels (Liley et al., 2006b). A total of 135 car parks were located (Map 7, Table 3), with an approximate total of 15,175 car parking spaces, the mean (+1 se) car park size was 113.3 and the median car park size was 76. The greatest total number of car parking spaces is in the West Sussex portion of the Solent coastline; however this was due to it having the biggest car park at Wittering, on the eastern side of the mouth of Chichester Harbour. Here the capacity is approximately 2,500 cars. After that, Portsea Island has both the greatest number of car parking spaces (17.5 % of the total around the Solent) and by far the greatest number of car parks (17.7 % of the total around the Solent). The coast at Fareham and Gosport and that on Isle of Wight, west of the Medina, both have 14 car parks each although the number of available car parking spaces in Fareham and Gosport is double that on the western side of the Isle of Wight. This reflects the urban nature of Fareham and Gosport, compared to that section of the Isle of Wight. Interestingly a similar number of both car parking spaces and car parks are observed on the Solent coastline in west Hampshire/New Forest, a predominantly rural area, as observed in Fareham and Gosport. This may reflect the tourist nature of the New Forest and the demand for parking by visitors travelling from outside the area.

Car parking capacity may indicate levels of current use and even attractiveness of sites (Liley et al., 2006b), however other features such as management of the car park and the extent of car park charges may also determine levels of use (Liley et al., 2008). Such measures would be useful data to collect in future work / phases of the project.

The rivers tended to have the fewest number of car parks and car parking spaces. Of the three main harbours Portsmouth Harbour has the fewest car parks (5) which have, on average, 63 spaces each. Whilst Chichester Harbour has the greatest number of car parks (12) and with an average of 117 spaces each. This shows that the car parks around Portsmouth Harbour tend to be smaller than those around Chichester Harbour.

Of the 135 car parks recorded around the Solent, 90 (67 %) are within 200 m of a European Protected site, and these hold c. 9,872 car parking spaces, 65 % of the total around the Solent.

Map 8 shows, at 5 minute intervals up to 40 minutes, the approximate time taken to drive, from within Hampshire or the Isle of Wight to a car park on the Solent coast[7]. It shows that the M3, A3(M) and M27, due to the faster average speed achievable compared to local or urban roads, extends the area which is less than 40 minutes drive from a Solent coastal car park. In terms of the number of people that fall within these time bands, the surrogate measure of the number of dwellings can be used. This is shown in Figure 5. It shows that the majority of dwellings, 598,591, are within 10 minutes drive of a Solent coastal car park. Using the UK average household occupancy of 2.4, this equates to 1.44 million people living within a 10 minute drive of a Solent coastal car park.

[7] drivetime isochrones calculated using the ITN road network, provided under licence by Hampshire County Council, and routefinder software.

Table 3: Number of car parks and car parking spaces within different regions of the Solent shoreline. NOTE All values are estimated from aerial photographs.

	Number of car parks	Number of spaces	% of total spaces
Chichester Harbour (excludes West Wittering)	12	1,399	9.2
Isle of Wight Coast (East of Medina)	9	786	5.2
Isle of Wight Coast (West of Medina)	14	873	5.8
Langstone Harbour (including channel at entrance)	11	638	4.2
Portsmouth Harbour	5	315	2.1
River Beaulieu (to Bucklers Hard)	1	160	1.1
River Hamble (to Burridge)	4	300	2.0
River Itchen (to Woodmill)	1	65	0.4
River Medina	1	80	0.5
River Newton	3	50	0.3
Solent Coast - Fareham and Gosport	14	1,553	10.2
Solent Coast - Hayling Island	8	1,274	8.4
Solent Coast - Portsea Island	24	2,654	17.5
Solent Coast - West Hampshire/New Forest Coast (Calshot to Keyhaven)	13	1,262	8.3
Solent Coast - West Sussex (including West Wittering)	3	2,900	19.1
Southampton Water (Fawley to Totton)	12	866	5.7
Total	135	15,175	100.0

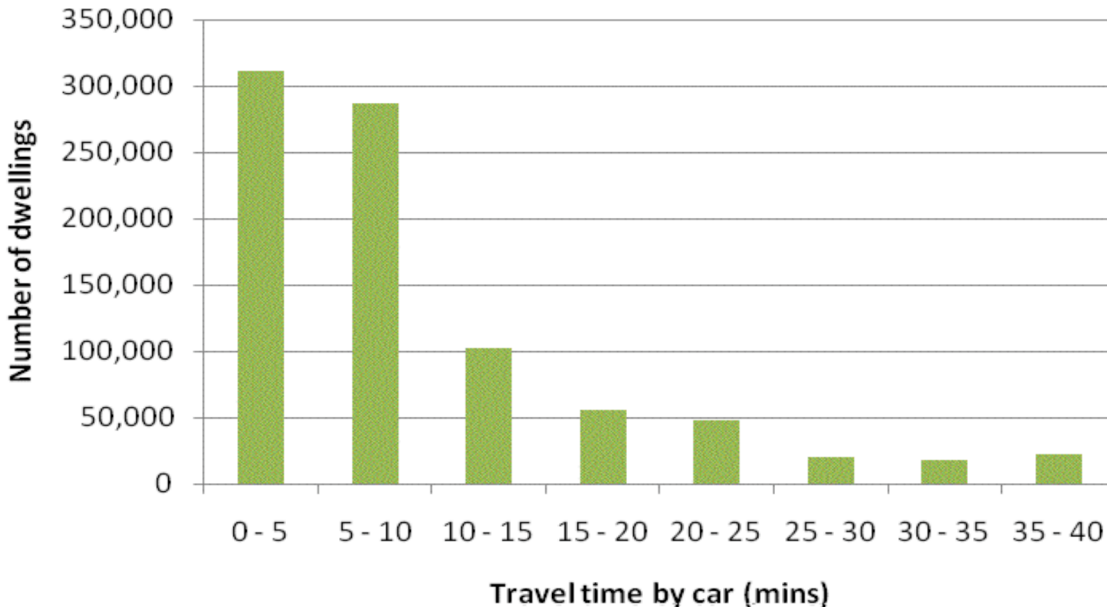


Figure 5 Number of dwellings in Hampshire and on the Isle of Wight within each travel time band by car from car parks around the Solent coastline

4.2.3 Access facilities and restrictions for boats etc

There is little recent information on the distribution of moorings, marinas and etc and the extent of different zoning schemes. A number of reviews and surveys were conducted in the mid 1990s (see Hampshire County Council, 1995, Koch-Ribeirio, 1994, Solent Forum, 1994), but these appear not have been repeated more recently.

Map 10 shows the distribution of public slipways and marinas along the Solent shoreline, the map being generated using the data in (Hampshire County Council, 1995), and checked using recent aerial photographs. In total 29 marinas and 114 slipways have been mapped. There is a marked contrast between the eastern and western arms of the Solent. To the west of the mouth of Southampton Water, along both the Isle of Wight shoreline and the mainland there are relatively few launching points, with only 14 % of the slipways and 10 % of the marinas. By contrast, the eastern arm (to the east of Gilkicker Point and the Medina Estuary), including the harbours, contains a much higher density of both slipways (46%) and marinas (45%).

Examples of restrictions to water-based recreational activity, such as jet skiing, waterskiing and windsurfing, are shown in Table 4 and on Map 11. It shows that all of the harbours and many of the stretches of coastline already have restrictions or a ban on some recreational water-based activities. Restrictions can be in the form of specific zones for specific activities, only with a license or only with written permission from the responsible authority. These bans and restrictions are predominantly for safety reasons; however some may have been introduced in response to nature conservation concerns.

Table 4 Examples of recreational access restrictions on the water around the Solent

	Jet ski	Waterski	Canoe	Windsurf	Kite Surf
Chichester Harbour[8]	Yes	Restrictions - specified zones with written permission only	Yes	Yes	No
Fareham and Gosport Coast[5]	Restrictions - license and specified zones only	Restrictions - license and specified zones only	Yes	Restrictions - license and specified zones only	
Isle of Wight (East of Medina)[9]	No	Restrictions - license and specified zones only		Restrictions - license and specified zones only	
Langstone Harbour[10]	Restrictions - specified zones with written permission only	Restrictions - specified zones with written permission only	Yes	Yes	No
Portsea Island Coast[5]	Restrictions - license and specified zones only	No	Yes	Restrictions - license and specified zones only	
Portsmouth Harbour[5]	No	No	Yes	Restrictions - license required	
River Hamble / Hamble Harbour[11]	Restrictions - launching only	No	Restrictions - do not use central channel		No

[8] http://www.conservancy.co.uk/uploads/user_documents/CHCByelaws.pdf
[9] http://www.qhmportsmouth.com/leisure-pwc/
[10] http://www.langstoneharbour.org.uk/byelaws/byelaws.htm
[11] http://www3.hants.gov.uk/hambleharbour.htm

4.2.4 Types of access

The types of access that take place along the Solent shoreline are varied. A complete audit of all clubs and activities is beyond the scope of this report. We summarise the main activities and their scale in Table 5.

Table 5: Types of recreational activity taking place on the Solent and level of use. Table based on "Towards strategic guidance for the Solent, recreation chapter" published on the Solent Forum website[12] and dated 1996.

Activity	Significance of the Solent	Comments
Angling	Regional	In 1996 there were an estimated 40,000 active sea anglers in the region. The activity takes place in many places around the coast, throughout the year, with seasonal variations according to fish lifecycles. Local fishing websites recommend at least 46 sites along the Solent shore (relatively evenly spread along the entire coast)[13] It is predominantly informal and shore-based, although there are significant numbers who use their own boats, or make use of organized trips. c. 64 different charter boats are listed on the Solent fishing club website[13]. Bait digging takes place in a number of intertidal areas, both by private individuals and professional diggers.
Bird watching and nature study	Local /Regional	Sites such as Titchfield Haven, Langstone Harbour, Keyhaven, Chichester Harbour are popular with birdwatchers. There are five local RSPB groups (none on the Isle of Wight).
Canoeing	Regional /National	In 1996 it was estimated that there were c.10,000 canoeists living in Hampshire and the Isle of Wight, and that many more visit. Calshot in particular has a national reputation for sea-canoeing.
Cycling and mountain biking	Local / Regional	Cycling along the shore is expected to mainly occur along roads and bridleways. Most will be ad hoc, informal. There are 4 cycling touring club groups along the Solent shore. There is an annual Solent cycling challenge, with a route that encompasses both the Isle of Wight and mainland[14] There is "significant" unauthorised cycle use on coastal footpaths in Chichester Harbour (Rowsell, *pers. comm.*)
Dinghy Sailing	National /International	In 1996 there were some 60 dinghy sailing clubs within the Solent, each with its own racing programme, and organizing over 100 open events including national and international championships annually. In the same year it was estimated that there were 10,000 boats based in, or kept in parks around the Solent.
Horseriding	Local	Limited access means that there are few opportunities for horseriding on the coast. The main facility is the Hayling Billy Coastal Path.
Kite Surfing	Regional	Popular locations include Calshot, Hillhead, Lee on Solent, Stokes Bay, Hayling[15]
Personal Watercraft (Jet skis)	Regional	There are a number of sites within the Solent which are a focus for personal watercraft, including Eastney, HMS Daedalus, Calshot and Colwell Bay. There are no inland water alternatives in the Region.
Power boating	National /International	Recreational powerboating takes place throughout the Solent, and mainly within the Western and Eastern channels and in Southampton Water. Power boat racing also takes place as a specialist activity and the Solent hosts national and international level competitions.
Rowing	Regional	The River Itchen is a focus for rowing in the Solent, with 5 clubs - each with a club house and boat storage. There are also rowing clubs in Lymington and Southsea, and at Ryde, Shanklin and Newport on the Isle of Wight. The clubs hold a regatta programme.

[12] http://www.solentforum.hants.org.uk/rectour/sgsrectour.htm
[13] http://www.solent-fishing-guide.co.uk/AllBeaches.asp
[14] http://www.cyclingchallenge.org.uk/index.html
[15] http://www.seaspritesports.com/beachbreaks.php

Activity	Significance of the Solent	Comments
Sub-aqua diving	Local /Regional	The limited visibility in the Solent reduces its attraction to divers. Nevertheless in 1996 it was estimated that there were over fifty active clubs in the Region. There are some sites which are preferred for beginners diving and the Solent forts and some wrecks are also used.
Sunbathing, Sitting	Local	Passive activities are an important, though often undocumented part of Solent recreation. In good weather large numbers of people enjoy sitting outdoors on beaches and other sites, and people are happy to sit in cars the year round - and in all weathers.
Surfing	Local	There are few good surfing sites in the Solent due to the sheltered waters. The activity has been recorded at Hayling Island, and on the SW coast of the Isle of Wight.
Swimming	Local /Regional	This is a popular activity from the Region's bathing beaches during the summer. Monitored bathing sites are shown in Map 11.
Walking & Dog walking	Local	Walking takes place around the Solent. Coastal sites are well used for activity ranging from active rambling, through to dog walking and short strolls. There are long distance footpaths - the Solent Way and the Isle of Wight Coast Path - on both sides of the Solent, running along the coastline for much of their length.
Water-skiing	Regional	Water-skiing is focused around a number of areas of water which have been designated for water-skiing in the Region.
Wildfowling	Regional	Wildfowling takes place in the Region. Regulated wildfowling is carried out by five wildfowling clubs affiliated to the British Association for Shooting and Conservation.
Windsurfing	Regional /National	There are a number of important sites for Windsurfing in the Region, some of which are of national importance. There are few clubs, but high levels of informal use. Hayling has a particular reputation and hosts an annual round the island event.
Yachting	National /International	In 1996 it was estimated that there were well over 100 active clubs, at least 100,000 participants and over 25,000 yachts berthed in harbour moorings and marinas. Survey data from 1994 (Solent Forum, 1994) estimates 4500 – 5000 boat nights per annum at each of the large marinas (e.g. Lymington). An active race programme is co-ordinated by the clubs through the Solent Cruising and Racing Association. Cruising is very popular, in particular to harbours in the Western Solent. The Solent regularly hosts yachting events of international importance, such as Cowes Week, and the Whitbread Round the World Race. In 1996 it was estimated that there were at least 500 event days per year, each with between 50-1500 participating yachts.

4.3 Questionnaires / Visitor surveys

We summarise results from visitor surveys at particular locations around the Solent shoreline. Locations are listed in alphabetical order. Only surveys directly addressing people on the coast are included.

4.3.1 Browndown

A relatively small scale visitor survey was conducted in 2006 (Liley et al., 2006d), involving 94 questionnaires with visitors and standardised counts of people entering and leaving the MOD owned beach. Counts and questionnaires were conducted on three different dates, during one of which the red flag was flying (signifying no public access was permitted on that day). A total of 303 people and 146 dogs were counted entering the site, equating to 7.5 people and 3.5 dogs per hour. Most people entered at the Lee-on-Solent end of the site. High numbers of visitors still entered the site when the red flag was flying compared to non red flag days.

A high proportion (31%) of interviewees were retired and most visitors (70%) were visiting to walk their dogs. Visitors typically visited very regularly (76% of interviewees visited at least once per week) and lived locally. Most (74%) travelled to the site by car, and approximately one-fifth (22%) of people walked to the site. Virtually all visitors came from Fareham, Gosport, Stubbington or Lee-on- Solent, essentially the area bordered by the motorway to the north, Titchfield Haven to the west and Portsmouth Harbour to the east. The visitors were therefore very local, with very few having travelled further than 8km (Figure 6 and Map 12).

Characteristics that interviewees scored as of highest importance in attracting them to the site included the fact that Browndown was by the sea, its views and the scenery and the lack of restriction on where it was possible to walk. The wildlife, the plants and the presence of the Solent Way were given comparatively low scores. The ability to let dogs run off the lead was scored very highly by dog walkers.

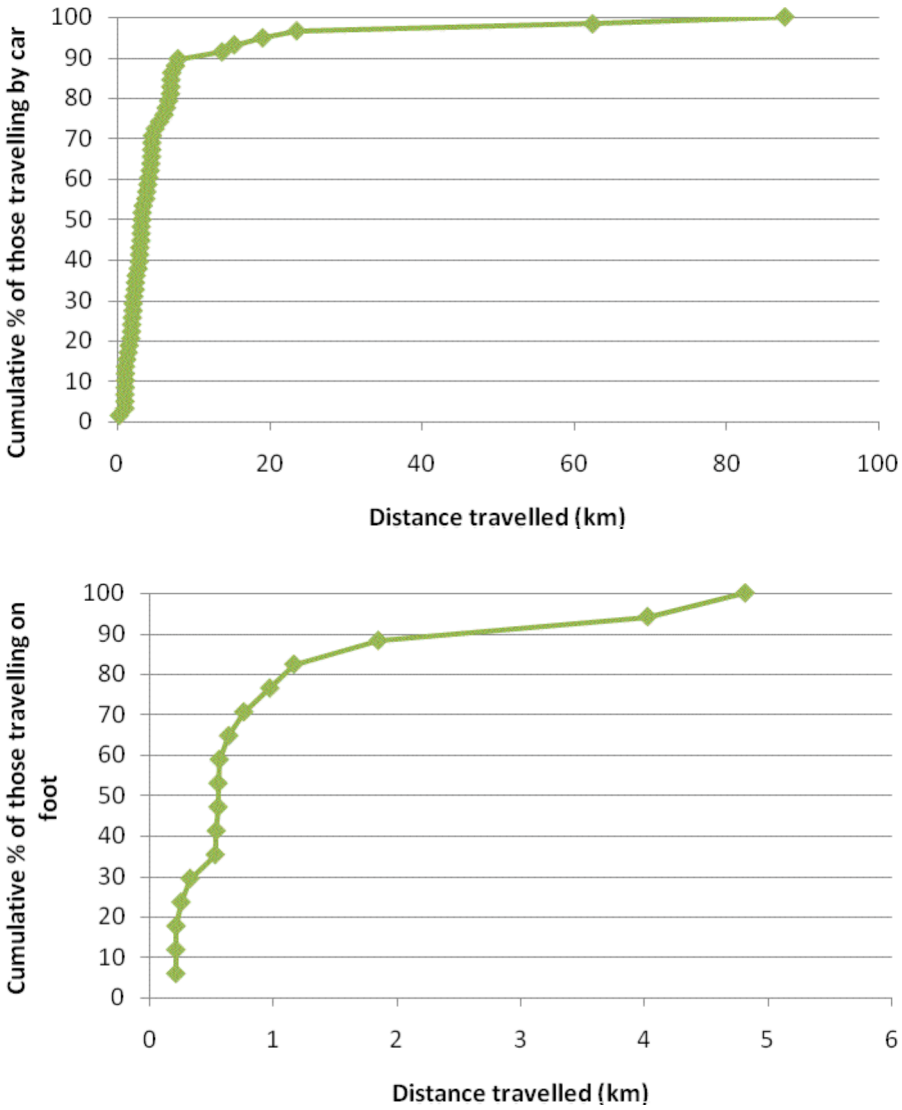


Figure 6: Distance travelled to reach the site for visitors interviewed at Browndown and travelling by car (top) or on foot (lower) taken from Liley et al. (2006).

4.3.2 Chichester Harbour

There have been a series of visitor surveys conducted in the harbour, involving questionnaires with visitors. The most recent (Chichester Harbour Conservancy, 2008), was conducted across ten different locations between August 2007 and February 2008 repeated the method used in previous years (1994 – 2003).

The results showed that the majority of people visiting the AONB were over 40 (88%) with nearly half of all visitors' being retired (44%). Most were local, having travelled less than 5 miles to their destination (56%). Although the majority (61%) came by car, nearly a third (28%) had come on foot. Most visitors had come to the AONB for walking or dog walking (35%), other popular activities were studying nature or bird watching, visiting a pub or teashop or boating and sailing.

The survey did not involve direct counts and did not collect full postcodes. Respondents were asked a range of questions about their perceptions of the Harbour, their understanding and knowledge of the work of Chichester Harbour Conservancy, visitor spending etc.

4.3.3 Hayling Island

Havant Borough Council conducted 508 interviews with visitors to Hayling Island, between July and August 2008. Results from this work[16] showed that about half of all visitors were local (from Hayling Island or other Portsmouth postcodes). Many of the interviewees gave postcodes from a wide geographical spread (Map 12, Figure 7), reflecting the relatively high proportion of tourists interviewed at this site (a marked contrast to Browndown, see Figure 6).

The majority of visitors arrived at the seafront by car, most came during the morning and visitors were largely visiting for the beach. Less than a fifth (17%) of visitors were visiting to walk their dog. A third (33%) of all people interviewed were over 60.

[16] Raw data and summary of results provided by Julie Boschi, Havant Borough Council.

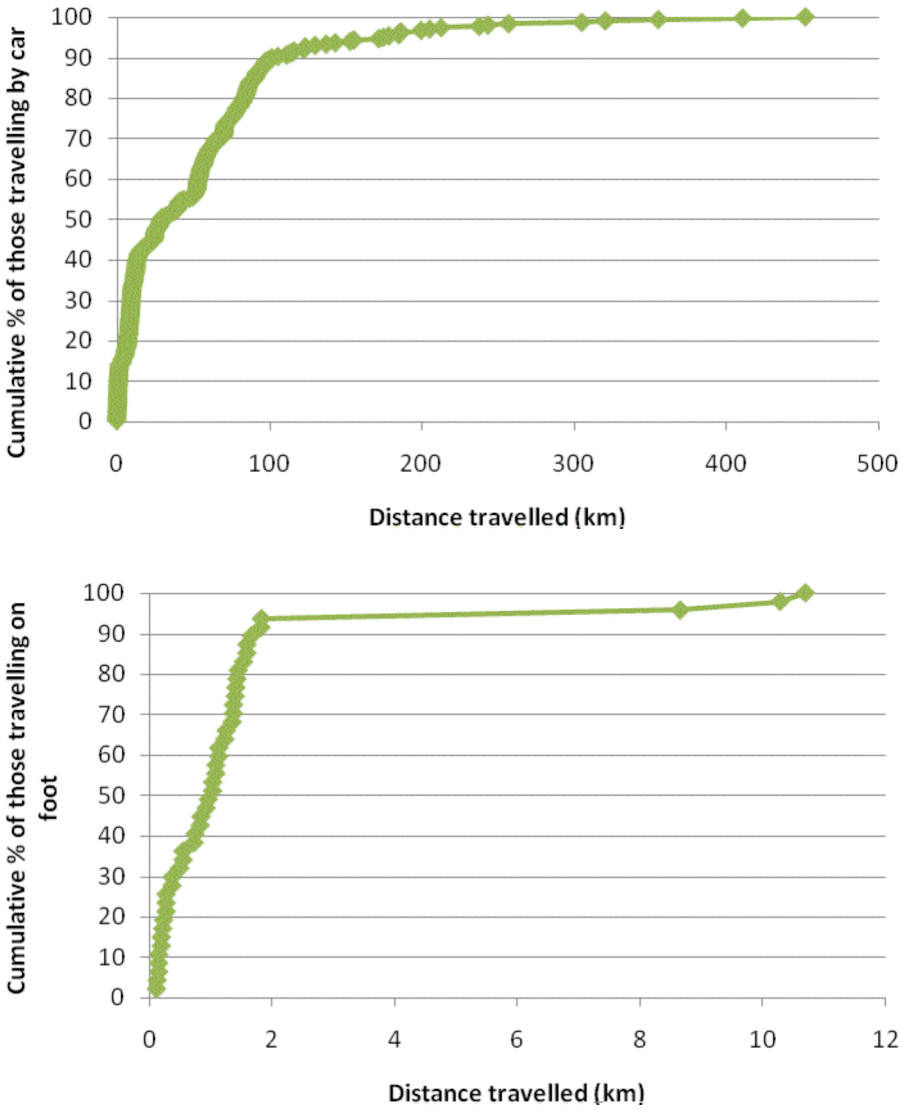


Figure 7 Distance travelled to reach the site for visitors interviewed on Hayling Island seafront and travelling by car (top) or on foot (lower) NOTE The data for visiting travelling on foot has been truncated at 27km, with 26 responses removed who said they had travelled up to 500 km on foot and were therefore assumed to be tourists staying locally.

4.3.4 New Forest

The New Forest Visitor Survey (Tourism South East Research Services and Geoff Broom Associates, 2005) , conducted as part of the PROGRESS project, was largely focused on the interior of the National Park, rather than the coastal strip. The survey was very comprehensive, and captures considerable amounts of information on visitor patterns to the general area. 3838 face-to-face interviews were conducted from a range of different survey points (62 different locations). Most visitors (60%) were day visitors who tended to arrive by car, with 25% of all visitors visiting for the day from outside the New Forest, mostly from Hampshire and including locations such as Southampton, Eastleigh and Chandlers Ford. The other 40% of visitors were staying tourists, utilising the campsites, guesthouses and hotels within the park.

Visitors spent an average of 1.9 hours on site, and the most common reason given for visiting was walking the dog (24% of interviewees). A household survey was also conducted, with

2,164 households responding to a postal survey. The majority (87%) of households had visited the New Forest for leisure purposes in the last 12 months.

Further work in the New Forest (Sharp et al., 2008) has used the PROGRESS data to explore the potential for increases in access levels as a result of new development, and then to explore the implications for Annex I birds within the Park. Most day visitors and a large proportion of the total number of visitors came from within 20 km of the National Park boundary, with the likelihood of a household visiting show a decline with distance away from the Park boundary. The study estimates that housing development in the period 2006-2026 within 50 km of the New Forest would result in an additional 1.05 million person visits per annum. Much of these additional visits would be as a result of development relatively close to the National Park boundary, with an estimated 764,000 of this total coming from within 10 km of the boundary. Development at a distance of 10-20 km from the National Park boundary would account for 168,000 visitor days per annum. Regular visitors (i.e. those who visit at least weekly) tend to be mainly dog walkers and most come from within 7 km of the National Park boundary.

4.3.5 2002 Solent Visitor Monitoring Survey

Visitor monitoring work was conducted at Lymington / Keyhaven, Lepe Country Park and Fort Victoria in 2002 in order to develop a monitoring strategy for the entire Solent. This work in 2002 (Southern Tourist Board, 2002) involved 736 face-to-face interviews. Older age categories represented the majority of visitors (35% of groups interviewed contained at least one person over the age of 65). The proportion of staying tourists varied at each site: at Lymington 65% of groups had come directly from their home; at Lepe Park 80% were day visitors from home and at Fort Victoria just over half (56%) were day visitors. Just under half (47%) of all visitors spent between 1 and 2 hours on the site and 82% of all groups interviewed had travelled by car.

The survey also addressed the quality of local facilities, likes and dislikes about the different locations and potential improvements. Postcodes were included in the questionnaire but no analysis is presented on the distance travelled by the people interviewed.

4.4 Visitor Rates (terrestrial habitats)

There is relatively little comparable data available to allow changes in the numbers of visitors to sites to be determined or allow direct comparisons between sites .

For the New Forest the PROGRESS work involved direct counts which were then extrapolated to give estimates of 13.3 million person visits per annum.

Hampshire County Council have automated counters on footpaths at seven different locations. These provide hourly and daily visitor totals are comparable. The location of these and a summary of total visits flows are shown in Table 6.

Table 6: Annual totals of visits from automated counters managed by Hampshire County Council. Data are rounded to the nearest 100. The totals should be treated as approximate guides only, as each location varies as to how visitors move through the site, extent of double counting etc.

Site	Yearly count (April 07- March 08)
Lymington Seawall	208,200
Bunny Meadows	120,100
Pennington Lane	86, 000
Keyhaven Marshes	71,300
Hayling Billy	48,200
Oxey Barn	57,500
Swanwick shore	52,500

4.5 Cowes week

Of particular note, and included here as a section in its own right, is Cowes Week, which now stages up to 40 daily races for over 1,000 boats and is the largest sailing regatta of its kind in the world. Various shore based events and entertainment coincide with the sailing. Recent estimates[17] for attendance at the event include some 8,500 competitors (ranging from Olympic and world class professionals to weekend sailors) and in excess of 100,000 spectators.

4.6 Discussion

This section highlights the high current human population living within a short distance of the Solent shoreline. There are high levels of housing around the shoreline, with particularly high densities in the urban areas of Southampton and Portsmouth. Future development is likely to result in a large increase in the residential population, particularly in the vicinity of Southampton, Portsmouth and Fareham.

The Solent provides locations for a wide range of recreational activities. We estimate 1.44 million people live within a ten minute drive of a car park along the Solent coastline. There seems to be little systematic monitoring of recreational access and little information to determine how patterns of access have changed over time and how they may change in the future.

Access patterns are complex, as the simple comparison between the home postcodes of visitors at Hayling Island and Browndown shows. Tourists will make up a significant proportion of visitors at some sites. Sites around the Solent coast vary in their attractiveness to tourists, suitability for particular kinds of access and accessibility to the local population. The proportion of tourists to local people and the types of activities undertaken will therefore vary between sites.

The western shore, around Lymington and Keyhaven is close to the New Forest and has a relatively small local population. A high proportion of visitors here are likely to be tourists or day visitors travelling a considerable distance. To the east of Southampton Water there are much higher densities of housing and at many sites local people are likely to account for a higher proportion of visitors. Sites such as Hayling Island have holiday accommodation and attract staying tourists. The open sandy beach at Wittering must draw day visitors and staying tourists from a wide radius given the size of the car park.

In order to determine how new housing might change visitor levels in the future it will be necessary to separate local visitors from tourists, categorise visitors according to the activities undertaken at sites and take into account the variation between sites in terms of attractiveness and suitability for different activities.

Enhanced access provision to coastal areas through the Marine Bill is likely to result in changes to access patterns in the area, and these changes may take some time to develop.

[17] Taken from http://www.cowesweek.co.uk/web/code/php/main.php?section=home

5 Expert opinion regarding existing impacts of recreation on birds

5.1 Background and approach

The project has three phases. The first of these included the following elements:-

- Planning context
- Summary of existing visitor data for the Solent.
- Evidence for existing impacts of disturbance, including types of disturbance and particular locations where disturbance is an issue.
- Existing bird data: distribution, population trends of wintering shorebirds and wildfowl, distribution of breeding bird species of interest.
- Other biological data that contributes to assessment of impacts and the database available for further research (e.g. benthic invertebrate densities, vegetation communities etc.).
- Mitigation: A review of potential mitigation options, including the use of Green Infrastructure (GI) and management schemes to offset and mitigate potential adverse effects on designated wildlife sites within the Solent.
- Options for further research (Phases II and III).

To provide information in relation to these elements, the project brief required that local knowledge should be collated and pooled to provide a rapid review of expert opinion in relation to these elements. To gather this information, a series of interviews and workshops were held with local people associated with the management of coastal sites around the Solent. Others were also contacted via email and provided information by post or electronically. This information contrasts with the review of published literature given in section 3 in that it is based on local expert opinion. However, where possible, the views of local experts have been cross referenced to the published evidence base summarised in section 3.

The following people contributed to the data gathering:-

Workshop 1: Held at Testwood Lakes on 24th September

Bob Chapman	Hampshire Wildlife Trust
Jess Pain	Hampshire Wildlife Trust
Peter Durnell	Hampshire County Council, Lymington – Keyhaven Marshes
Alison Fowler	Hampshire County Council, River Hamble
Sarah Wiggins	Natural England
Lyndsay McCulloch	Southampton City Council

Workshop 2: Held at Dell Quay, Chichester Harbour Conservancy Education Centre on 3rd October 2008

Alison Fowler	Chichester Harbour Conservancy
Ed Rowsell	Chichester Harbour Conservancy
Andrew Parfit	Hampshire County Council, Hayling Island
Tina Cuss	Fareham Borough Council
Chris Cockburn	RSPB, Langstone Harbour Warden

Isle of Wight Interviews
Keith Marston and Roger Herbert Medina Valley Centre (1st October 2008)
David Hunnybun Isle of Wight ornithologist and author of 'Birds of the Isle of Wight' (8th October 2008)

Titchfield Haven and Hamble Estuary Workshop (to be held on 16th October 2008)
Barry Duffin Hampshire County Council, Titchfield Haven/Hamble River
Richard Levett Hampshire County Council, Titchfield Haven/Hamble River
Richard Sharp Eastleigh Borough Council, Hamble River

New Forest National Park Authority Interview
Ian Barker, Sarah Manchester and Saira Evans New Forest National Park Authority (7th November 2008)

In addition, information has been provided by Susan Hawley, Isle of Wight Estuaries Officer and Katherine Rowberry, Environment Officer, Langstone Harbour Board.

5.2 Method of data collection

At each workshop or interview a brief presentation was given providing an overview of the project and the purpose of the workshop or meeting. A questionnaire was produced to guide the discussion and ensure a consistent approach to gathering information from participants. Location and type of recreational and other pressures were identified together with notes of features affected, these were subsequently mapped using GIS.

5.3 Summary of outcomes

5.3.1 Dogs, walkers, cyclists and horse riders

There is pedestrian access to much of the Solent shoreline, either via coastal footpaths or permissive rights of way. For example, there is pedestrian access to virtually all of the Langstone Harbour shore and most of the shoreline of Chichester Harbour and Portsmouth Harbours. Footpath access is also open along much of the eastern side of Southampton Water from Chessil Bay in Southampton in the north to Gosport in the south. This section of coast is punctuated by the Hamble Estuary with its range of recreational activities and access provision. On the western side of Southampton Water there are some localised access points, for instance at Goatee Shore, Eling, Hythe Marshes and Ashlett Creek. However, there are also considerable reaches with restricted access for instance in front of Fawley refinery, Dibden Bay and Marchwood naval base. Access in the western Solent is also more restricted with significant sections of the large coastal estates between Lymington and the entrance to Southampton Water being either closed to public access or with restricted access, for example the Beaulieu Estate where access to the shore is permitted via permit only. However, there are notable hot spots for coastal access along this section of shore, for instance at Lepe Country Park (managed by the County Council) and Calshot recreation centre (Hampshire County Council). The coast from Hurst Spit east to the Lymington river entrance is also open to public access along sea walls constructed around the perimeter of coastal grazing marshes.

Public access to the Isle of Wight shore of the SPA and SAC is very variable, with some sections where access is open as for instance at Ryde Sands, others with access to estuary edge paths such as around the Medina Estuary and Yar Estuary and others where there is little or no access such as at Newtown Harbour and between Castle Point (East Cowes) and Kings Quay shore (west of Wootton Creek).

It was the opinion of coastal managers that the effects of public access on SPA and SAC interest features is very variable and seems to depend upon a number of factors. The most significant of these appear to be:-

- Path type or position (sea walls or other artificial structures, natural paths on coastal grassland or woodland, upper foreshores composed of shingle or sand)

- Intertidal sediment types (mud flats, sand flats, mixed sediment shores, saltmarsh)
- Intertidal width

5.3.2 Summary of effects on wintering and passage waterfowl

Contributors to the workshops expressed the view that feeding waterfowl appear to be more tolerant of walkers and dog walkers where access is provided via a sea wall or other defined structure and in particular where these front soft muddy sediment shores. Where people and dogs remain on sea walls or other defined coastal paths intertidal feeding waterfowl appear to become habituated to their presence (see section 3.1) and there is little or no observed disturbance response (at both low and high water). However, it may be that birds are maintaining a minimum distance from the sea wall or path that would otherwise be used for feeding in the absence of walkers. Further research is needed to determine if this apparent tolerance is in fact influenced by a disturbance or avoidance response.

Where people and dogs leave the defined coastal path to walk on the intertidal birds tend to exhibit far more obvious disturbance responses.. This is most likely to occur where the foreshore is composed of sand or mixed sediments upon which walkers and dogs can roam widely This sort of situation was reported to occur on the eastern side of Southampton Water between Weston Shore and the Hamble and much of the northern shore of the Isle of Wight including Thorness Bay and the coast between Bembridge and Wootton Creek.

Much of the shore of Chichester, Langstone and Portsmouth Harbours is composed of soft muddy sediments and this limits levels of disturbance to waterfowl on the foreshore. However, there are sections of Chichester Harbour with extensive sand flats with potential for public access – for instance Pilsey Sands.

As mentioned in section 3.2, although birds show disturbance responses to walkers and dogs, it will be important to assess the influence of disturbance on relationship between bird distribution and resource distribution to determine if numbers are actually constrained by disturbance.

5.3.3 Effects of walkers and dog walkers on breeding coastal birds

Breeding coastal birds can be particularly vulnerable to human disturbance and dog walkers in particular (see section 3.3). Attendants at the workshops expressed the view that greatest conflict occurs with shingle nesting birds, in particular the Annex I terns and typical species of vegetated shingle especially ringed plover and oystercatcher. This is generally supported by the evidence reviewed in section 3.3. Significant problems were referred to from Hurst Spit, Hook Spit (entrance to Hamble Estuary) and Thorness Bay (Isle of Wight). Other locations are only accessible by boat and are mentioned below.

5.3.4 Kite surfers

Kite surfing is a new sport and in many places was thought to cause no obvious disturbance to wintering waterfowl. However, problems were reported as occurring where kite surfing takes place near to winter wader roosts or where there are concentrations of diving birds (e.g. grebes or eider duck). Natural England also expressed the view that kite surfing can be a problem where it allows access to otherwise remote areas of intertidal habitat, especially with onshore winds when kites will tend to drift over feeding/roosting birds. The most acute problems of disturbance from kite surfers were reported as occurring in Mount Lake (inside of Hurst Spit) and on the Meon foreshore (Titchfield Haven). At Mount Lake considerable disturbance was reported to affect high water wader roosts on saltmarshes although this tends to be concentrated at weekends. On the Meon foreshore, concern was expressed over the disturbance effects of kite surfers on feeding great crested grebes. In both instances, it will be important to undertake further work to identify whether observed behaviour responses to disturbance have consequent implications for bird survivability and habitat usage.

5.3.5 Canoeing and dinghy sailing

The ability of canoes/kayaks and dinghies to penetrate into saltmarsh creeks was considered to cause considerable levels of disturbance to high water wader roost sites in a number of locations in the Solent. This was reported as a particular problem in many parts of Chichester and Langstone Harbours, the Hamble estuary, Lymington estuary, Medina estuary, Newtown Harbour and Thorness Bay – indeed anywhere where there are mature saltmarshes and narrow estuary creeks. In the Medina estuary, problems have occurred with sailing schools using the saltmarshes to land groups of sailors, causing disturbance to high water wader roosts. As with disturbance to feeding birds, it will be important to assess the relationship between disturbance responses of roosting waterfowl and the numbers of birds able to utilise the available habitat.

5.3.6 Yachts/motorboats, water borne visitors including moored boats

Boats give access to otherwise inaccessible sections of the coast for people and dogs. This can be a particular problem for coastal nesting birds. Problems from this form of access were reported to occur at Newtown Harbour on the Isle of Wight where little terns *Sterna albifrons* have been repeatedly disturbed from their nest sites by people landing on the eastern spit despite the presence of no landing signs and information provided to moored boats from the National Trust's harbour master.

Movement of boats along the coast was not generally considered to be a significant source of disturbance other than when it creates a wash across the intertidal. Attendants at the workshops felt this was likely to cause particular disturbance to birds specialised in feeding along the waters edge such as dunlin or redshank.

Moored boats are thought to have an effect on the use of estuaries by birds. The most significant effects occur with mud moorings in which boats ground at low tide. This not only masks the intertidal but also there is thought to be an avoidance effect on the birds feeding around the grounded boats. Swing moorings where boats remain afloat throughout the tidal cycle were thought to have less of an influence, but again, there may be an avoidance effect on diving birds and birds swimming on the water.

Some motor boats cause disturbance to birds from the noise of their engines. This was reported as being of particular concern at the entrance to the Hamble estuary where testing of powerful motor boats creates considerable noise disturbance at times.

5.3.7 Bait diggers and shellfish collectors

Digging bait for sea angling is widespread on the Solent coast. A code of conduct for bait collection has been produced by the Solent European Marine Site (SEMS) Project. The code has been designed to encourage sustainable bait collecting and limit impacts of bait collection on interest features of the Solent's SPA, SAC and Ramsar sites. Where bait digging or collection is undertaken by individual bait diggers for personal use the impacts are considered to be localised and of limited intensity, especially if guidance in the Code is observed. However, there are localised areas of the Solent's foreshore where bait collection is alleged to be undertaken by commercial teams of diggers. These commercial teams dig the foreshore more intensively and are thought to cause a much greater damage to foreshore structure and its invertebrate fauna.

The effects of bait digging on intertidal habitats have been well researched and are reviewed in Fowler (1992)[18]. In summary, intensive bait digging results in a reduction in the population of larger invertebrates and may result in the loss of certain long lived species. The presence of bait diggers can also act to disturb feeding wading birds although birds can become habituated to their presence and will return to feed around bait diggers.

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[18] Fowler, S.L. 1992. Survey of bait collection in Britain. Joint Nature Conservation Committee Report No. 107. JNCC, Peterborough

Intensive levels of bait digging were considered a problem in the following areas of the Solent:-
Lepe Beach
Cracknore Hard (Test Estuary)
Chessil Bay (Itchen Estuary)
Porchester Castle (Portsmouth Harbour)
Fareham Creek (Portsmouth Harbour)
Kendals Wharf (Langstone Harbour)
NE corner of Langstone Harbour
Dell Quay (Chichester Harbour)
Medina Estuary (Isle of Wight)
Thorness Bay (Isle of Wight)

Collection of shellfish for personal or commercial use is also widespread in the Solent. At high water shellfish dredging boats cross the intertidal to gather oyster *Ostrea edulis* and American hard-shell clams *Mercinaria mercinaria*. Although causing considerable damage to foreshore habitats, this is not considered a recreational activity in the context of this study. Recreational or semi-commercial shell fish gathering occurs on foreshores at low water in a number of locations. Where undertaken intensively this can cause loss of target species but in general most collection is thought to be at sustainable levels. Shellfish gathering like bait digging can cause disturbance to feeding wading birds but as with bait diggers, birds are thought to become habituated to their activity. The most frequently gathered species are cockle *Cerastoderma edulis* and winkles *Littorina* spp. In the Medina Estuary the recently arrived clam *Tapes decussata* is also being targeted. Shellfish collection was reported as occurring at significant levels on the Hill Head foreshore, West Hayling foreshore, Medina Estuary, Thorness Bay and Bembridge Ledges.

5.3.8 Sea anglers

Recreational sea angling occurs throughout the Solent. The view expressed at the workshops was that most angling causes no problems to the Solent's nature conservation interests. However, adverse effects to the SPA, SAC and Ramsar sites can include disturbance to both wintering and breeding birds and death or injury from discarded fishing tackle (Meon foreshore). Wading birds at high water roosts and breeding sea birds associated with shingle deposits were considered particularly vulnerable. Anglers tend to penetrate into otherwise undisturbed and remote areas of the Solent shore including the outer edges of saltmarshes and associated chenier banks as well as shingle spits and beaches. Angling also frequently occurs at night as well as during the daytime, this may have effects on night-time feeding birds.

Locations where angling has been identified as causing concern include:-

- Wader roosts in the Medina estuary
- Wader roosts and chenier banks at Hythe and Tanners Lane (east of Lymington)
- Discarded fishing tackle at Meon Foreshore (grebes and eider found hooked up)
- Disturbance to breeding birds at Hook spit and Pitts Deep (east of Lymington)

5.3.9 Egg collectors

The eggs of black-headed gulls are collected under license on saltmarshes in the western Solent, at the entrance of the Beaulieu and Lymington estuaries. This is largely a commercial exercise, although most gull egg collectors undertake this activity as a traditional activity to supplement other income. Egg collecting is limited in time and stops before most migrant terns return to the Solent in mid May. Concern was expressed at the workshops that egg collecting may be having a disturbance effect on breeding Mediterranean gulls. These is an Annex I species for which the Solent and Southampton Water SPA has been classified.

5.3.10 Wildfowlers

Wildfowling is a traditional activity in the Solent and attendants at the workshops considered that it was undertaken at sustainable levels. Wildfowling activity has declined dramatically over the last 50 years and is now restricted to a few well regulated clubs. Records of the numbers and species of birds shot (bag returns) are maintained by the clubs and submitted to the various regulatory authorities. Most activity takes place at or before dawn during the winter months. Wintering birds are known to be very intolerant to the noise of gun shots. Studies in the Stour and Orwell[19] showed high levels of bird disturbance from gun shots. However, wildfowling activity is localised and the number of shots relatively small in the context of other disturbance events.

Wildfowling clubs operate in the following areas of the Solent:- Chichester Harbour; Langstone Harbour; Pylewell Foreshore (New Forest)

5.3.11 Air craft (helicopters, micro-lights, para-gliders)

Occasional passage of low flying aircraft including helicopters, micro-lights and para-gliders can cause significant levels of disturbance to wintering waterfowl although frequency of such events is low. Low flying aircraft are thought to use the coastline to aid in navigation or is particularly attractive to these craft and therefore concentrates their activity over protected bird sites.

Low flying aircraft were considered to be a particular issue in the western Solent.

5.3.12 Hovercraft

Hovercraft movements over water are generally not thought to cause much disturbance to birds as it is assumed it is considered to be a boat. However, movement of hovercraft over intertidal flats was reported as causing significant levels of disturbance. This was identified as a particular concern on the eastern side of Southampton Water where small hovercraft were recorded causing disturbance to wintering waterfowl 10-15 times a year.

[19] Ravenscroft, N., Parker, B., Vonk, R. and Wright, M. (2007) Disturbance to waterbirds wintering in the Stour-Orwell estuaries SPA. A report from Wildside Ecology to the Suffolk Coast and Heaths Unit.

6 Existing data on bird populations

6.1 Summary

- Data on the importance of the Solent and the distribution of birds within it was sourced primarily from the Wetland Bird Survey (WeBS).
- The Solent supports a wintering population of around 150,000 birds, over half of which occur in Chichester and Langstone Harbours. Relatively large autumn passage populations also occur in each SPA. Several species occur in numbers of national or international significance but the Solent is particularly important for dark-bellied brent goose. Important numbers of breeding terns also occur.
- The population trends of most species wintering in the Solent reflect the trend in the respective national population. Several species, particularly wildfowl, have increased greatly in the Solent since the 1980s. By contrast, many waders (and shelduck) exhibit long-term declines. The brent goose population has remained stable despite a recent national decline.
- There is evidence of local shifts in the location of some winter populations within the Solent, especially from Chichester and Langstone Harbours SPA to Solent and Southampton Water SPA (pintail, shoveler and black-tailed godwit). Furthermore, most species that have declined strongly in the Solent have done so primarily in Chichester and Langstone Harbours SPA (e.g. shelduck, ringed plover, dunlin, bar-tailed godwit), and those species that have increased strongly in the Solent (wigeon, teal, pintail, shoveler, black-tailed godwit) have done so primarily in Solent and Southampton Water SPA.
- Data on breeding birds is less systematic, but available for most years for the principal sites in the Solent. Tern populations are stable or increasing overall, and local increases are apparent in Langstone Harbour.

6.2 Sources of data

Information on the status of populations of principal waterfowl species in the Solent species was prepared WeBS data supplied by the British Trust for Ornithology (BTO). WeBS is the principal source of data on the numbers and trends of wintering birds in the UK. It commenced in 1947 and in recent years counts have been made monthly, principally from September to March, at around 2000 wetland sites throughout the UK (although usually at estuaries and large still waters, Musgrove *et al* 2007). WeBS consists of two types of data primarily: 1) Core Counts – synchronised monthly counts at all sites (usually at or around high tide in estuaries); and 2) Low Tide Counts – a limited selection of estuaries are counted each year.

Additional data on the winter distribution of waterfowl around the Solent was obtained from the Brent Goose Strategy of Hampshire and Isle of Wight Wildlife Trust (Wicks 2002) and from the ongoing Wader Roost Strategy (D. King pers. comm.). These strategies aimed to identify important sites for birds outside intertidal habitats.

No systematic survey data for breeding birds were found that provided information across the whole Solent. Data from the 1984 national survey of breeding ringed plover was not available and that from the 2007 national survey is not ready. Availability of the latter is anticipated in 2009. Counts data of the numbers of breeding gulls and terns is available for the principal sites within the Solent, from the following sources: Hampshire County Council, RSPB, Chichester Harbour Conservancy, National Trust and Natural England.

6.3 Presentation

6.3.1 Winter Core counts

Core count data was used to assess the populations of birds in the Solent and its SPAs and the trends in these populations. The mean winter populations of principal waterfowl species in the Solent were plotted from 1980 to the present (Figure 8) using Core Count data (where data was available – poor quality count data were excluded). Trends were assessed visually from

this data, by comparison with data from the same timescale published for national populations (Musgrove *et al* 2007) and by using Alerts data published by the BTO. The WeBS Alerts System (MacLean & Austin 2008) has been developed to provide a standardised method of measuring changes in wintering waterbird numbers at different temporal scales, accounting for regional and national fluctuations in bird populations. Alerts are triggered for populations that have undergone major declines over 5, 10 or 25 years, chosen to represent short, medium and long-term trends.

6.3.2 Winter Low Tide Counts

The distribution of wintering waterfowl in the Solent was represented using data from WeBS Low Tide Counts (data on the distribution of birds at high tide i.e. from Core Counts was obtained but unfortunately not in a format that enabled mapping within the timescale of this study). Coverage of the Solent at low tide has occurred in separate years as follows: Beaulieu estuary 1996/97; Chichester Harbour 2005/06; Langstone Harbour 2003/04; North-West Solent 2004/05; Portsmouth Harbour 2002/03; Southampton Water 2000/01; Medina estuary 1995/96; and between 1992/93 and 1999/00 for remaining areas on the north coast of the Isle of Wight.

6.4 Status of bird populations in the Solent

Two SPAs qualify for classification under the EC Directive on the Conservation of Wild Birds (EC/79/409) as they support a wintering waterfowl assemblage of more than 20000 birds (Solent & Southampton Water SPA and Chichester & Langstone Harbours SPA). The most recent Core Count data suggests that the Solent supports a total wintering population of around 150,000 birds (Table 7), over 53% of which occur in Chichester and Langstone Harbours. Furthermore, the Solent supports large autumn passage populations (31-37% of winter populations in each SPA).

Table 7 The mean peak winter populations of birds in the Solent 2002-2007.

SPA	Mean peak population 2002-2007		
	Autumn	Winter	Spring
Solent & Southampton Water	19201	51794	7718
Portsmouth Harbour	6152	20050	1390
Chichester & Langstone Harbours	29896	79639	6231
Total	55249	151483	15339

All three SPAs qualify for classification under the EC Directive on the Conservation of Wild Birds (EC/79/409) as they support populations of European importance of wintering birds listed on Annex 1 of the Directive (populations that exceed 1% of the international population). Each SPA also supports a number of populations of species that exceed the thresholds of National importance (1% of the British population) (Table 9).

The Solent, and in particular Chichester and Langstone Harbours, supports large proportions of the estimated international populations of dark-bellied brent goose and black-tailed godwit in winter (Table 8 and Table 9). At their peak, the population of brent geese in Chichester and Langstone Harbours in the last five winters represented about 13% of the National population and 6.5% of the International population. It is estimated that the Solent as a whole supports about 10-13% of the world population of brent geese and about 30% of the UK population during the winter (Wicks 2002).

Table 8 Number of species exceeding the thresholds of national and international importance during passage and winter in each SPA in the five year period 2002-2007.

	National	International

SPA	Autumn	Winter	Spring	Autumn	Winter	Spring
Solent & Soton Water	5	10	1	1[a]	2[b]	1[c]
Portsmouth Harbour	1	2	0	0	1[d]	0
Chichester & Langstone	11	13	1	3[e]	3[f]	0

[a] black-tailed godwit, [b] brent goose, black-tailed godwit, [c] brent goose
[d] brent goose
[e] brent goose, black-tailed godwit, redshank, [f] brent goose, black-tailed godwit, dunlin

Solent and Southampton Water SPA and Chichester and Langstone Harbours SPA also qualify for classification as they support breeding populations of European importance of various gulls and terns: common tern, little tern, roseate tern, Sandwich tern and Mediterranean Gull in the former; and little tern and Sandwich tern in the latter.

Table 9 National and International importance of the SPAs for the principal shorebirds wintering in the Solent. Figures given indicate the percentage of the species' qualifying level represented by the five year mean peak count e.g. 50% indicates that the five year mean peak count is half that required for the site to qualify as nationally or internationally important.

		% National Thresholds			% International Thresholds		
Species	**SPA**	**Autumn**	**Winter**	**Spring**	**Autumn**	**Winter**	**Spring**
Dark-bellied	Solent & Soton Water	122%	650%	222%	60%	319%	109%
brent goose	Portsmouth Harbour	41%	310%	0%	20%	152%	0%
	Chichester & Langstone	225%	1307%	N/A	110%	641%	N/A
Shelduck	Solent & Soton Water	14%	91%	47%	4%	24%	12%
	Portsmouth Harbour	0%	20%	1%	0%	5%	0%
	Chichester & Langstone	16%	168%	N/A	4%	44%	N/A
Wigeon	Solent & Soton Water	71%	180%	N/A	19%	49%	N/A
	Portsmouth Harbour	7%	10%	0%	2%	3%	0%
	Chichester & Langstone	49%	70%	N/A	13%	19%	N/A
Teal	Solent & Soton Water	122%	233%	N/A	47%	89%	N/A
	Portsmouth Harbour	2%	10%	0%	1%	4%	0%
	Chichester & Langstone	50%	94%	N/A	19%	36%	N/A
Pintail	Solent & Soton Water	48%	206%	7%	22%	96%	3%
	Portsmouth Harbour	0%	0%	0%	0%	0%	0%
	Chichester & Langstone	44%	116%	3%	21%	54%	1%
Shoveler	Solent & Soton Water	42%	215%	N/A	16%	80%	N/A
	Portsmouth Harbour	0%	3%	0%	0%	1%	0%
	Chichester & Langstone	47%	86%	16%	18%	32%	6%
Ringed	Solent & Soton Water	113%	85%	21%	51%	39%	10%
plover	Portsmouth Harbour	13%	20%	0%	6%	9%	0%
	Chichester & Langstone	119%	137%	31%	54%	62%	14%
Grey	Solent & Soton Water	112%	185%	21%	24%	39%	4%
plover	Portsmouth Harbour	1%	8%	0%	0%	2%	0%
	Chichester & Langstone	359%	442%	22%	76%	94%	5%
Dunlin	Solent & Soton Water	20%	141%	7%	8%	59%	3%
	Portsmouth Harbour	1%	117%	0%	1%	49%	0%
	Chichester & Langstone	115%	554%	15%	48%	233%	6%
Black-tailed	Solent & Soton Water	459%	826%	N/A	147%	264%	N/A
godwit	Portsmouth Harbour	278%	154%	57%	89%	49%	18%
	Chichester & Langstone	805%	557%	291%	257%	178%	93%
Bar-tailed	Solent & Soton Water	2%	6%	9%	1%	3%	5%
godwit	Portsmouth Harbour	0%	2%	0%	1%	0%	0%
	Chichester & Langstone	64%	158%	71%	33%	82%	4%
Curlew	Solent & Soton Water	75%	93%	N/A	13%	16%	N/A
	Portsmouth Harbour	23%	30%	7%	4%	5%	1%
	Chichester & Langstone	199%	128%	52%	35%	23%	9%
Redshank	Solent & Soton Water	61%	71%	N/A	26%	30%	N/A
	Portsmouth Harbour	52%	71%	13%	22%	31%	6%
	Chichester & Langstone	238%	211%	N/A	102%	90%	N/A
Turnstone	Solent & Soton Water	61%	63%	N/A	20%	21%	N/A
	Portsmouth Harbour	9%	33%	0%	3%	11%	0%
	Chichester & Langstone	135%	76%	64%	45%	25%	21%

6.5 Populations, distribution and trends of principal wintering species

Table 10, Figure 8 and Figure 9 show the population sizes of the principal waterfowl species in the Solent.

Table 10 Mean winter (November to February) populations of the principal waterfowl species in the Solent 2002/03-2006/07.

Species	Solent & Soton Water	Portsmouth Harbour	Chichester & Langstone	Total
Dark-bellied brent goose	5041	2105	11083	18229
Shelduck	485	96	899	1479
Wigeon	5933	303	2351	8586
Teal	3911	122	1430	5463
Pintail	451	0	216	666
Shoveler	228	1	85	314
Ringed plover	208	23	319	549
Grey plover	798	19	1905	2722
Dunlin	6432	3856	25517	35806
Black-tailed godwit	910	149	497	1556
Bar-tailed godwit	16	3	685	704
Curlew	1186	312	1504	3001
Redshank	693	690	1998	3380
Turnstone	245	103	268	616

6.5.1 Brent goose (Map 13; Figure 8a)

Over the last five winters, the Solent has supported a mean winter population of 18000 brent geese, 11000 or 61% of which occurred in Chichester and Langstone Harbours. Here, available low tide data shows the greatest concentrations of birds on Farlington Marshes in Langstone, and around Chichester, Thorney and Bosham Channels in Chichester Harbour. This concurs broadly with data from the Brent Goose Strategy that also shows important concentrations of birds on Hayling and Portsea Islands (Map 28). Elsewhere, there are small concentrations of birds around the mouths of the Hamble, Beaulieu and Lymington.

No Alerts have been triggered for this species in Solent and Southampton Water and Chichester and Langstone Harbours SPAs, and the mean wintering populations in the Solent has been relatively stable since 1983 (Figure 8), despite a decline in the national population since the early 1990s (Musgrove *et al* 2007). However, the number of geese over-wintering in Portsmouth Harbour has declined sufficiently to trigger medium-term Alerts.

6.5.2 Shelduck (Map 14; Figure 8b)

At low tide, the greatest concentrations of birds occur around Farlington Marshes and the western shore of Hayling Island in Langstone Harbour, plus Thorney Channel in Chichester Harbour. Elsewhere, generally small numbers occur around Southampton Water, north-west Solent and the estuaries of the Isle of Wight, with a concentration of birds in the Newton River. Only a small proportion of the Solent population occurs in Portsmouth Harbour (6.5%).

The overall trend is one of strong decline in the Solent, and in particular in Chichester and Langstone Harbours (Figure 8), despite a largely stable national population (Musgrove *et al* 2007). Alerts have been triggered for the medium and long-term for this SPA (as the

proportions of the regional and national WeBS totals hosted by this site have decreased) and over the medium term for Solent and Southampton Water SPA. Overall, there has been a 33% decline in numbers in Chichester and Langstone Harbours SPA since designation and a corresponding decline of 20% in Solent and Southampton Water SPA.

6.5.3 Wigeon (Map 15; Figure 8c)

The shores around Southampton Water and the north-west Solent are the most important areas in the Solent for wigeon (Solent and Southampton Water SPA supports 69% of the mean wintering population in the Solent), especially on the Hythe foreshore and around the Rivers Test and Beaulieu, and there are also significant concentrations at the heads of channels in Chichester Harbour, Thorney Island, and Farlington Marshes in Langstone.

No Alerts have been triggered for this species, and the overall trend is one of strong increase (Figure 8), especially in Solent and Southampton Water SPA. The national population of wigeon has been increasing steadily since the beginning of WeBS (Musgrove *et al* 2007). The overall population in the Solent has doubled from around 4000 birds in the 1980s to the current population of around 8500 birds.

6.5.4 Teal (Map 16; Figure 8d)

Teal are concentrated in similar areas to wigeon, with the majority found around Southampton Water and the north-west Solent (Hythe, River Test and Beaulieu) (72% in Solent and Southampton Water SPA). Elsewhere, there are significant numbers on Farlington marshes in Langstone, Thorney Island in Chichester, and in the Yar and Newton on the Isle of Wight.

The population in Solent and Southampton Water SPA has been of international significance in previous years. No Alerts have been triggered for this species, and the overall trend is one of increase in both Solent and Southampton Water and Chichester and Langstone Harbours SPAs. The national population of teal has increased greatly over the past 40 years and continues to expand (Musgrove *et al* 2007).

6.5.5 Pintail (Map 17; Figure 8e)

Flocks of pintail are very localised in the Solent. The principal concentrations occur on Farlington Marshes in Langstone Harbour, Thorney Island in Chichester Harbour, on the Hythe foreshore and at Pylewell and the Lymington River. No birds are found in Portsmouth Harbour.

No Alerts have been triggered for this species and the overall trend in one of long-term increase in the Solent (Figure 8), while the national population has remained more stable (Musgrove *et al* 2007). Numbers have doubled in recent years in Solent and Southampton Water SPA and in the last two winters this SPA has supported more birds than Chichester and Langstone Harbours SPA.

6.5.6 Shoveler (Map 18; Figure 8f)

The population is relatively small and practically all birds are found on Farlington Marshes in Langstone Harbour, with small numbers on the Hythe foreshore, the mouth of the Beaulieu and the Yar estuary. No Alerts have been triggered for this species and the overall trend in one of increase in the Solent (Figure 8), particularly in Solent and Southampton Water SPA, in tandem with an increasing national population (Musgrove *et al* 2007).

6.5.7 Ringed plover (Map 19; Figure 8g)

Birds are well-spread around the Solent at low tide, but notable concentrations occur at Pennington Marshes near Lymington, at the mouth of the Hamble, and on the foreshore at Havant, with smaller numbers around most of Chichester and Langstone Harbours SPA. Notable flocks occur around the north coast of the Isle of Wight, especially at Ryde and

Bembridge Harbour. Large numbers occur in the Solent during autumn passage and the autumn population of Solent and Southampton Water exceeds the winter population (mean autumn 5 year peak is 372 birds).

Following increases in the population up until the early 1990s, numbers have decreased sufficiently to trigger medium Alerts in both Solent and Southampton Water SPA and Chichester and Langstone Harbours SPA and a long-term Alert in the former. Numbers in the Solent overall have decreased from a mean winter population of over 1000 birds in the 1990s to about 500 birds currently (Figure 8). This corresponds with a similar underlying decline in the national population of ringed plover since the early 1990s (Musgrove *et al* 2007).

6.5.8 Grey plover (Map 20; Figure 8h)

The majority of birds occur in Chichester and Langstone Harbours at low tide (70%), particularly around Chichester Channel and the western shores of Hayling Island. Concentrations occur elsewhere in the lower reaches and mouths of the Hamble, Itchen, Beaulieu, Lymington and Newton Rivers.

No Alerts have been triggered and the Solent population increased to the early 1990s and has declined since, mirroring the pattern in the national population (Musgrove *et al* 2007).

6.5.9 Dunlin (Map 22; Figure 8i)

Chichester and Langstone Harbours support the majority of the population at low tide (71%), particularly the Thorney Channel, but there is also a significant concentration in Portsmouth Harbour and smaller numbers of birds around the mouths of most estuaries at low tide.

Medium-term Alerts have been triggered for both Solent and Southampton Water SPA and Chichester and Langstone Harbours SPA as there has been a steady decrease in numbers in the Solent since the early 1990s (from around 50000 birds to 30000). The national population has declined steadily since the start of WeBS and is currently at its lowest level since monitoring began in the 1970s (Musgrove *et al* 2007).

6.5.10 Black-tailed godwit (Map 23; Figure 8j)

Solent and Southampton Water SPA supports the majority of the population of the Solent at low tide during the winter period (mean 910 birds, 58%). Chichester and Langstone Harbours SPA are an important staging post during autumn passage, and an average peak of 1207 birds has occurred during the last five autumns (the mean winter population is 497 birds), eight times the threshold of national importance.

Although there are no Alerts for this species, the population has almost doubled since designation. Black-tailed godwit have increasing as a wintering species and there is strong increase in the national trend (Musgrove *et al* 2007). Recent data suggest a decline in Chichester and Langstone Harbours SPA (from around 1000 birds to 400) and a corresponding increase in Solent and Southampton Water SPA (from around 250 birds to over 700) (Figure 8).

6.5.11 Bar-tailed godwit (Figure 8k)

Practically all birds occur in Chichester and Langstone Harbours. There are no Alerts for the species, although the mean winter population in Chichester and Langstone Harbours SPA appears to be declining (Figure 8), in line with a recent drop in the national population (Musgrove *et al* 2007).

6.5.12 Curlew (Map 24; Figure 8l)

Curlew are well-distributed around the Solent, but notable concentrations occur at low tide in Chichester Channel, Portsmouth Harbour, the mouth of the Beaulieu and the south shore of Southampton Water.

The populations in all three SPAs appear to be stable (Figure 8), despite fluctuations and a recent drop in the national population (Musgrove *et al* 2007).

6.5.13 Redshank (Map 25; Figure 8m)

Redshank are well-distributed around the Solent at low tide. Although the majority (59%) occur in Chichester and Langstone Harbours, a relatively large proportion of the Solent population occurs in Portsmouth Harbour (20%) (compared with other species). The autumn population in Chichester and Langstone Harbours SPA is slightly larger than the winter population and this passage population has in recent years exceeded the threshold of International importance.

No Alerts have been triggered for this species and the population in the Solent appears relatively stable (Figure 8) (as is the national population, Musgrove *et al* 2007), although since 1990 there are indications of a shift in population from Solent and Southampton Water SPA to Portsmouth Harbour as numbers have increased in the latter whilst decreasing in the former.

6.5.14 Turnstone (Map 26; Figure 8n)

Birds occur in small concentrations around most of the Solent at low tide, in particular around the mouth of the Hamble. Large numbers occur on passage during autumn, especially in Chichester and Langstone Harbours (mean 5 year autumn peak is 672 birds, mean winter population 268 birds).

No Alerts have been triggered for this species and the population in the Solent appears relatively stable (Figure 8), with a slight decrease since the late 1980s followed by a recent increase (identical to the pattern in the national population, Musgrove *et al* 2007).

6.6 Populations, distribution and trends of principal breeding species

6.6.1 Terns (Figure 9)

Numbers of pairs of Sandwich and common terns have both increased in the Solent in recent years, the former exceeding 400 pairs and the latter 500 pairs in two of the last five years. Numbers of little terns, although they have fluctuated, have remained stable overall since 1993. Between 1 and 3 pairs of roseate terns have bred around the Solent in most years since 1993 (none in 1999, 2001 and 2002).

The principal breeding areas in the Solent are in the vicinity of Lymington (Keyhaven to Pylewell) (in Solent and Southampton Water SPA) and around Chichester and Langstone Harbours, including islands in the harbours (e.g. Stakes Island and Pilsey Island). The recent increased populations of Sandwich and common terns in the Solent are due primarily to increases in these species in Chichester and Langstone Harbours SPA. Numbers of little terns have remained largely stable in both SPAs. In most years, all roseate terns that have bred in the Solent have occurred in Solent and Southampton Water SPA (one pair in Chichester and Langstone Harbours in each of 1998 and 2006).

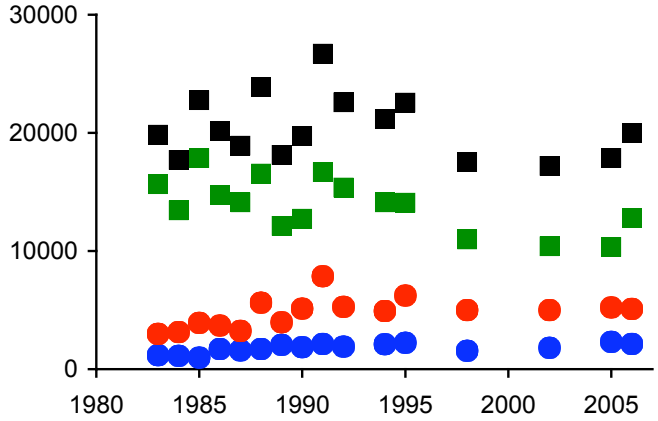
Within Chichester and Langstone Harbours SPA, there have been large decreases in the numbers of terns breeding in Chichester Harbour e.g. 20-30 pairs of Sandwich terns, 20-70 pairs of common terns and 20-40 pairs of little terns bred typically in the 1980s and early 1990s, but between 2004-2006 two pairs of common terns were the only birds recorded. By contrast, total pairs of terns in Langstone Harbour have increased, from 100-200 to 400-500 over the same time period.

6.6.2 Gulls

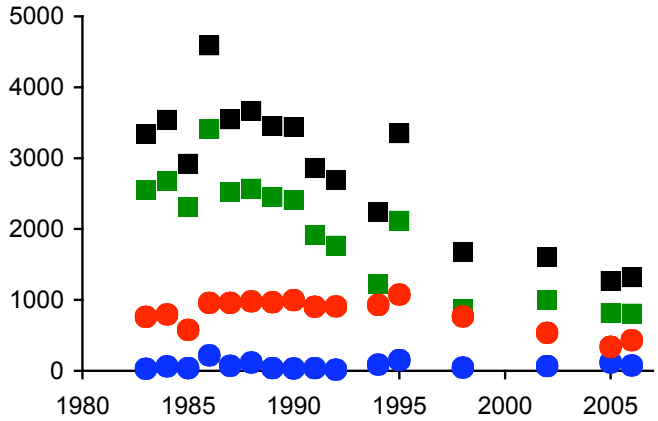
Similar changes have occurred among gulls in Chichester and Langstone Harbours SPA. Langstone Harbour has seen large increases in the populations of breeding gulls and in 2006 nearly 5000 pairs of black-headed gulls were recorded compared with less than 100 in most years before 1996. Numbers of Mediterranean gulls have also increased since the 1990s, as they have nationally, to current levels of about 250 pairs. By contrast, black-headed gulls now breed erratically in Chichester Harbour despite a population exceeding 1000 pairs in most years before 1996.

Figure 8: Mean winter populations of principal waterbirds in the Solent 1983-2007. Black is the Solent overall, red Solent and Southampton Water SPA, blue Portsmouth Harbour SPA and green Chichester and Langstone Harbours SPA.

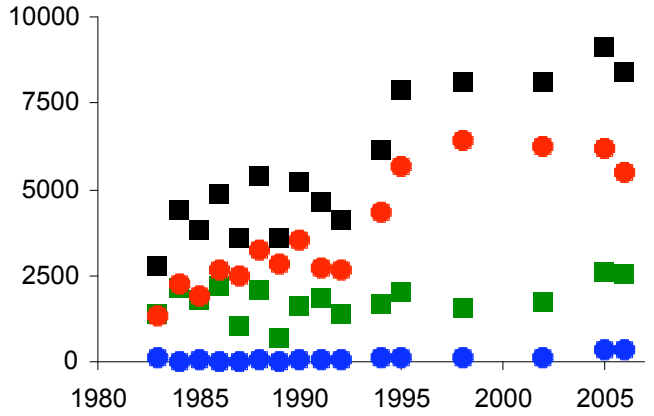
(a) Brent Goose



(b) Shelduck



(c) Wigeon



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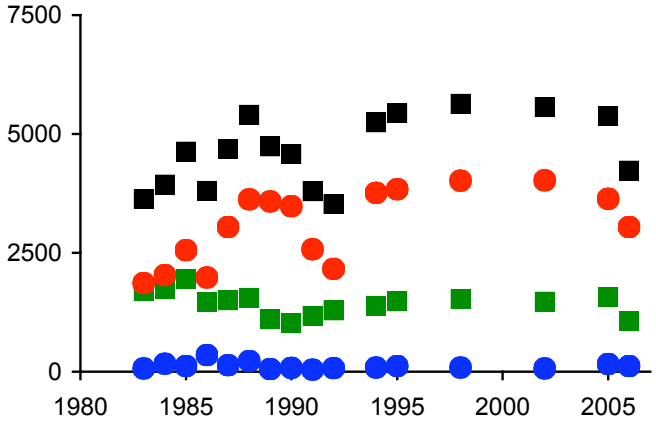

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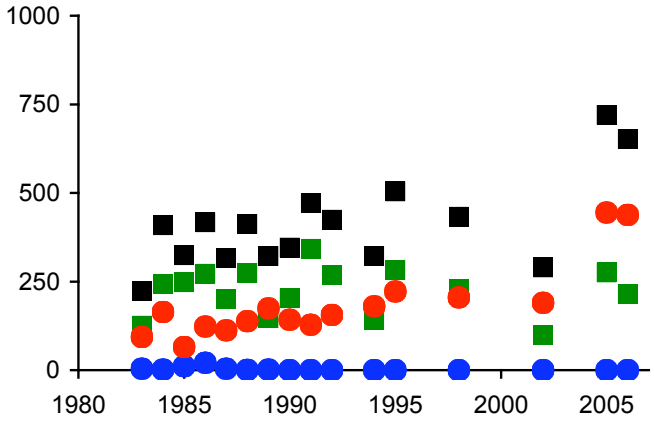
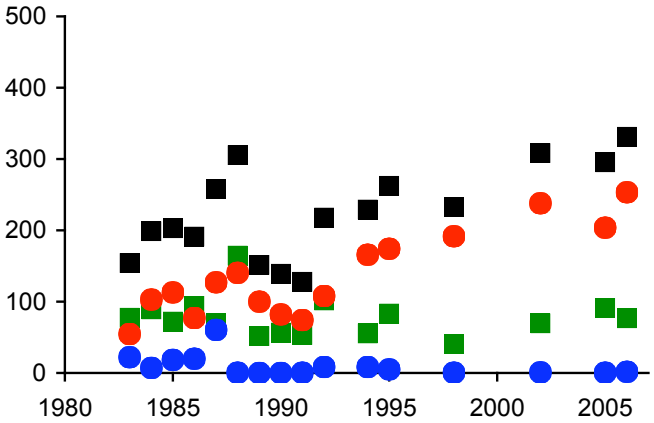
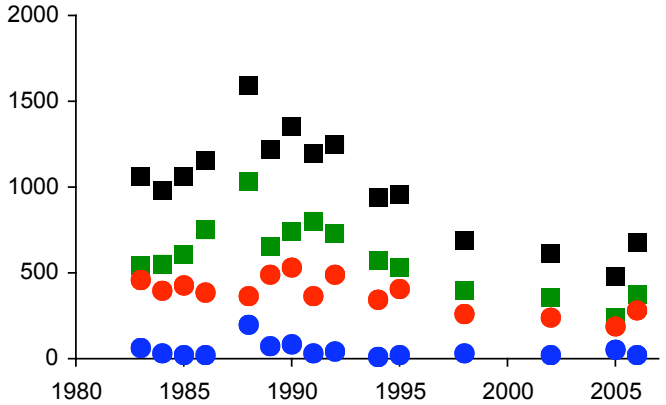


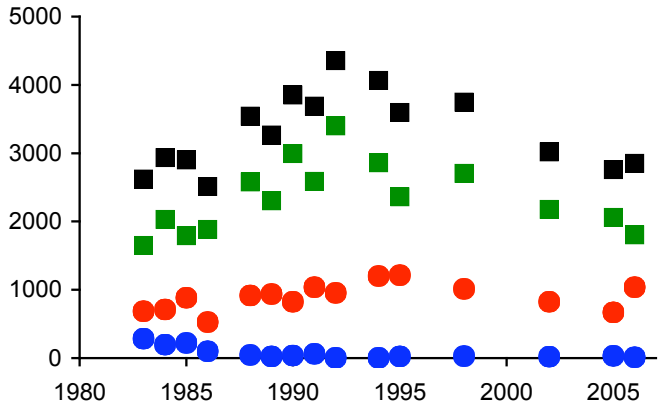
(f) Shoveler



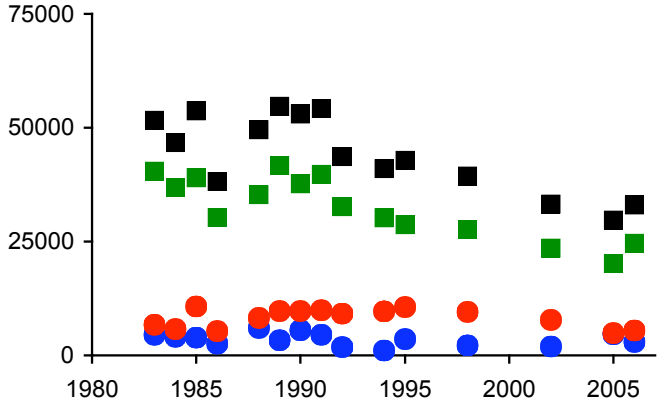
(g) Ringed Plover



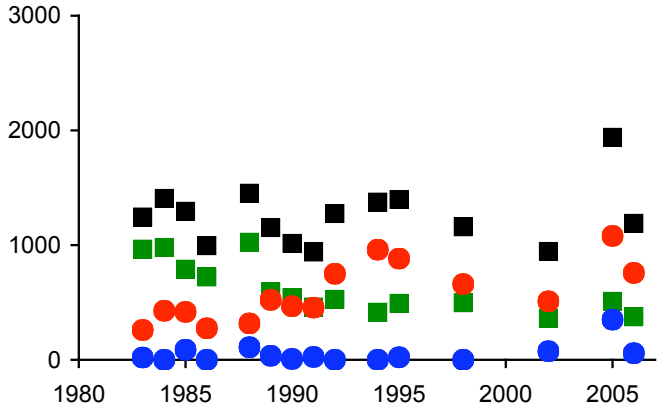
(h) Grey Plover



(i) Dunlin



(j) Black-tailed godwit



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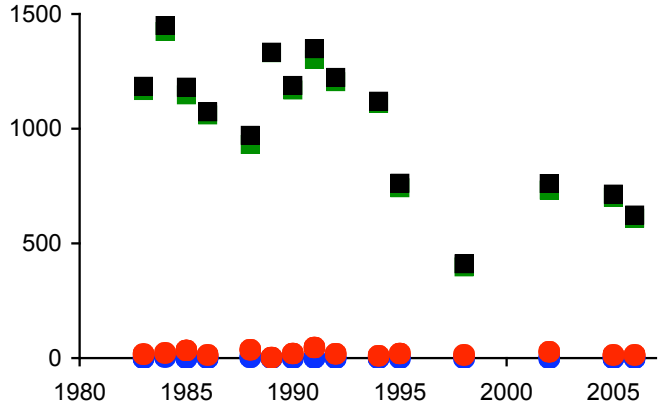
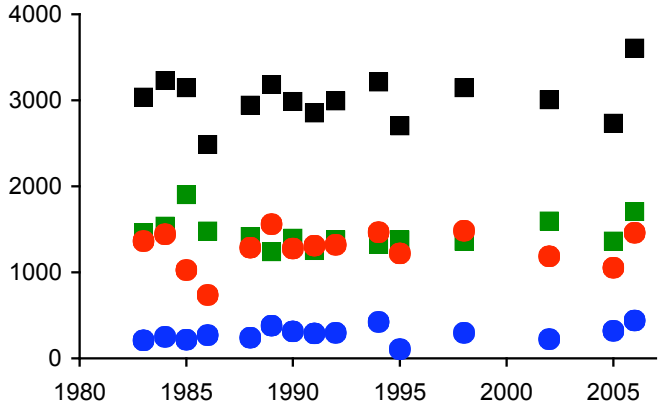
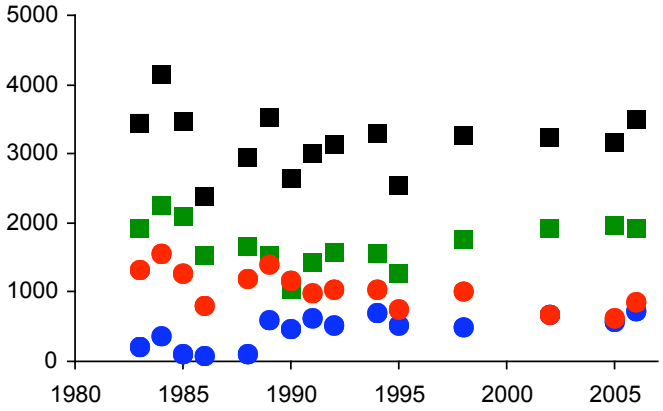


(l) Curlew



(m) Redshank



(n) Turnstone

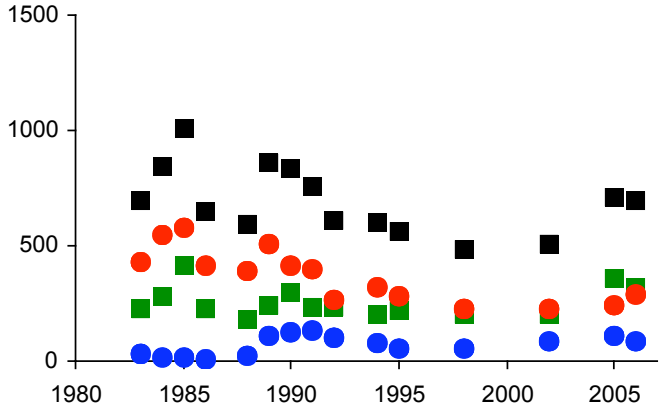
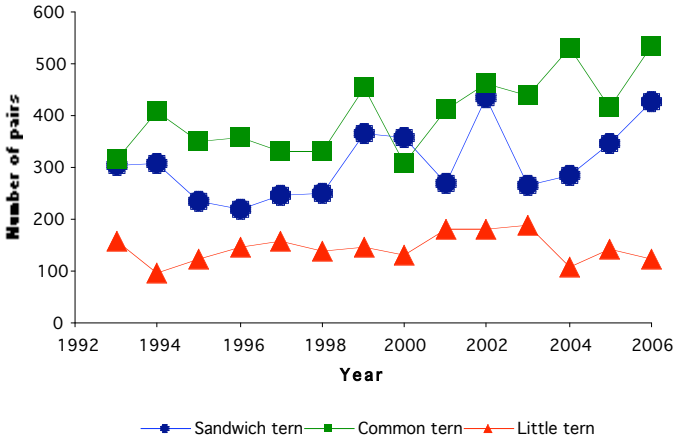
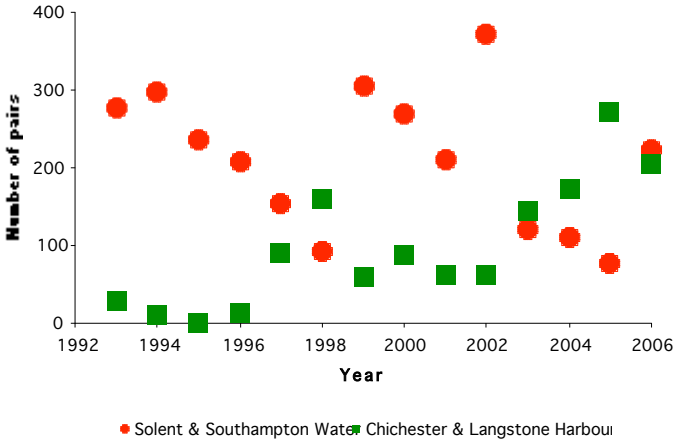


Figure 9: The numbers of breeding pairs of terns at principal sites in the Solent 1993-2006.

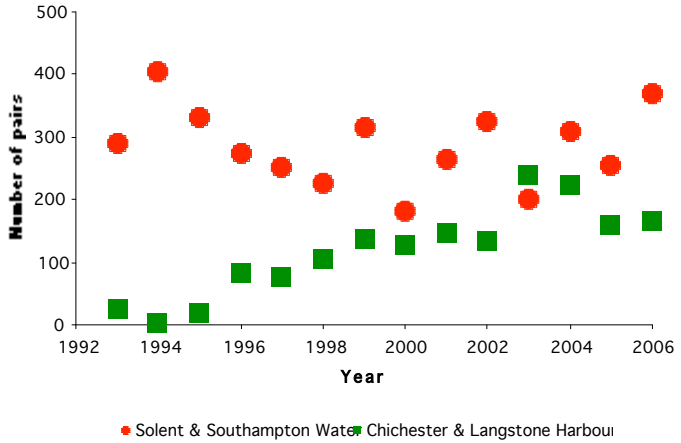
a) Total populations



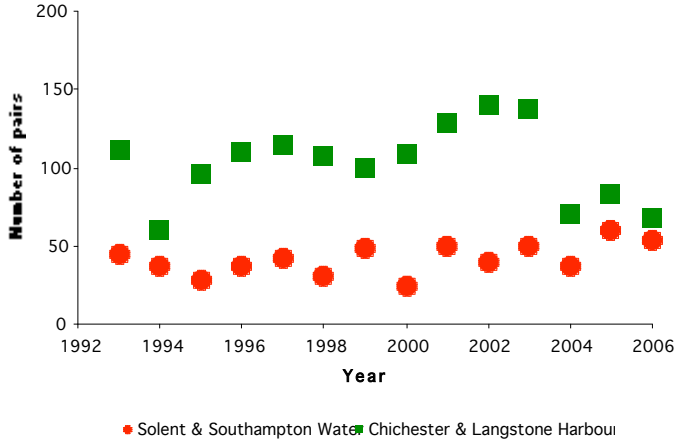
b) Sandwich tern



c) Common tern



d) Little tern



7 Mitigation to offset the potential impact of disturbance

7.1 Overview

The various authorities and agencies around the Solent have obligations under the Habitats Regulations to achieve favourable conservation status for the component SSSIs/Natura 2000 sites/Ramsar sites. This obligation has become increasingly difficult to fulfil given the adverse effects of increasing development pressures and climate change on the qualifying and supporting interests of these sites.

Local Authorities and regulators are now also subject to the Biodiversity Duty under the Natural Environment and Rural Communities Act 2006 and are also obligated under PPS9 to seek ecological enhancement through their planning and development control activities. Given the diffuse nature of the many disturbance impacts on the Solent's ecological features, and the often potentially conflicting policies relating to the coast in terms of encouraging recreational access, deciding how to meet these obligations is a major challenge for local authority, regulator and developer alike.

The present project should constitute a key step towards the creation of tools to aid in these planning and development control processes. The focus is on recreational disturbance and visitor pressure brought by proposed residential development. Nevertheless, the output should be useful in relation to all types of development and potential disturbance sources. Specifically it should assist in:

- Future strategic land allocations and principle-setting in relation to development in the region as a whole to help meet requirements under future Strategic Environmental Assessment of updates to the Regional Spatial Strategy (South East Plan) and Local Development Documents and the draft Appropriate Assessment of the South East Plan.

- Officer responses to specific development proposals, especially as regards determining a rational basis for developer contributions to strategic reductions in disturbance.

The results of the present work could also be a step along the way towards what could ultimately become a *Solent Disturbance Management Strategy* and contribute to a Strategic Planning Document on the issue.

Developers should also benefit through better formulation of development proposals and by avoiding expending time and money in applications that may never be favourably received. All of this should generally streamline the planning process, and to make any system of offsetting transparent and overtly fair. This is another key aim of current government policy and research currently being funded by DEFRA.

7.2 Sensitivity and Risk Mapping

Recreational movements of people emanating from a new housing development and their particular activities offsite are often not readily subject to reasoned and focused mitigation proposals. This is because insufficient is known about where, how far and how frequently people are likely to travel. Further work is therefore necessary to identify recreational access patterns, in relation to the distribution of housing, across the Solent region. This could allow the generation of predictive models, following work conducted in Dorset (Clarke *et al*., 2008, Liley *et al*., 2008). Such models would allow visitor rates to coastal sites along the Solent to be predicted under different scenarios of mitigation measures and housing. Combined with further ecological work it should therefore be possible to determine where new housing will lead to increased impacts on the fitness of key bird species. Such work will be complex, costly and take some time to complete.

7.3 Techniques to Reduce Disturbance

Potential techniques to reduce disturbance to the ecological features of the Solent and what is known of their effectiveness are summarised from work to date in Table 11. These measures all vary in their cost and likely effectiveness. Not all are necessarily appropriate for all sites. Many require careful design, planning, testing and implementation in order to be effective.

For example the provision of alternative green space has been suggested as a means by which visitor pressure can be reduced on Internationally Important sites within the Thames Basin Heaths and Dorset Heaths. Emerging work from Dorset has shown that the heaths are particularly used by dog walkers and that, in context with other types of sites, it is the heaths that provide large areas of open countryside (Clarke *et al*., 2008, Liley *et al*., 2008). Unfortunately, the amount of existing green space surrounding people's homes seems to have no impact on the extent to which people visit the heaths. The conclusion is therefore that new green space, if intended to divert people from the heaths, needs to be specifically targeted and designed and be different to the existing green space sites (Clarke *et al*., 2008). Future research relating to the Solent should predict and test different alternative sites (in terms of design and location), and consider them in combination with other mitigation work. It is beyond the scope of the present study to identify, in detail, which package of measures listed in Table 11 will ultimately prove effective.

Table 11: Potential mitigation measures relevant to disturbance on the Solent

Mitigation measure	Notes / description
Off site	
Provision of alternative sites	Currently little evidence has been collated to demonstrate effectiveness. Provision may need to be combined with other measures such as education and on-site management on the designated site. Likely to need to be carefully designed and targeted so as to provide a viable alternative. Targeting for dog walkers would need to ensure dog friendliness (Edwards and Knight, 2006) and suitable routes (e.g. Liley et al., 2006b, Liley *et al*., 2006c). For water-based activities gravel pits or similar may need careful landscape design and particular types of infrastructure. Further work needs to be done on the specific qualities of green space most valued by people. For example it has been shown that untrained observers are capable of determining which landscapes have greater biodiversity, and that the health and well-being benefits experienced increase with the biodiversity content of green landscapes (Fuller *et al*. 2007).
Education	Potential to promote non-designated sites, for example through web / leaflets listing dog friendly sites. Local media, papers etc can provide a means to highlight conservation importance of sites and encourage responsible access.
Changing by-laws at particular locations	Allowing dogs off leads etc in particular locations that are not sensitive for nature conservation or other reasons may increase their attractiveness to dog walkers.
Review of parking charges	Cheap or free parking at particular locations may encourage visitors. Reduced parking fees in the early morning may be particularly effective in encouraging dog walkers.
On site, shore-based	
Wardening	Wardens can provide face to face contact and can directly intervene when they observe particular activities (such as dogs off the lead on mudflats). They can have an educational role, showing people wildlife etc.
On-site education	Ensuring visitors are aware of the conservation importance of sites should help encourage responsible access.
Landscape design and careful design of routes	Planting, screening, careful routing, provision of access infrastructure (boardwalks, marked paths, steps etc) can all influence visitor flows within sites and the potential of people to cause disturbance. Subtly directing people along the inside of borrow-dykes or below seawalls can mean they are invisible to birds on the mudflats.
Architectural Design	Much can be done with architecture near to the mudflats to reduce potential impacts, including considerations of layout and massing, arrangement of glazing and balconies and lighting design.
Control of parking	Limiting car park spaces or closing car parks in particular locations is likely to be contentious, but is likely to be effective in reducing visitor numbers.
Modification of parking charges	Changing parking charges to reflect a higher cost during particular times of year or times of day may encourage people to choose alternative locations.
By-laws	Bans on dogs, the requirement for dogs to be on leads or fines for dog fouling may encourage dog walkers not to use particular areas.
Control of Strategic Events	Particularly disturbing events such as firework displays or concerts near the foreshore can be subject to more stringent planning control.
On site, water-based	
Careful provision of facilities	Provision of public slipways, trailer & vehicle access to shore etc. in predetermined locations where boat access is likely to be away from bird interest.
Pro-active work with clubs and groups	Self-policing is ideal as it is low cost and self regulating – example would be water-skiing club revoking membership for anyone caught speeding (Defra, 2004).
Education	Information on access points, speed limits, zoning etc easily accessible to all, through leaflets, web etc. Reasons for zoning etc should be carefully explained.
Zoning	Designated areas for particular activities.
Permits / vessel registration	System of permits or similar to limit numbers and maintain records. Should enable a mailing list of particular users to be maintained.
Policing	Policing of watercraft zoning, speed limits etc, with fines or other penalties for infringement
Bylaws	Bylaws to control particular activities and set speed limits
Monitoring and Scientific Study	Strictly speaking monitoring and scientific study is not direct mitigation. However, in recent years developers have secured agreements to undertake detailed monitoring of waterfowl from the SPAs/Ramsar sites to increase our knowledge base to inform future management and land allocations and this has been a practical alternative to other mitigation proposals in cases where the science was simply insufficient for the mitigation to be designed with any confidence in effectiveness or value for money and grounds for refusing development were thin (e.g. inland sites used by Brent Geese remote from the intertidal zone of the Solent).

Disturbance reduction techniques were discussed in workshops and interviews with key stakeholders and coastal managers during Phase 1.

Stakeholders and coastal site managers were asked about possible disturbance reduction techniques to avoid or mitigate impacts on nature conservation interests arising from recreational use of the Solent's international wildlife sites (SPA, SAC and Ramsar sites). The following sections summarise the views expressed by stakeholders and coastal site managers.

7.3.1 Provision of green infrastructure and alternative coastal green space

It was thought that some sections of the coast are more robust than others and could be better promoted to increase recreational use. Clearly, such an approach would need further research to demonstrate if such apparently robust coastal sections are in fact able to tolerate increased use without causing adverse effects.

Most of those with responsibility for recreation and access felt it better to influence recreational use through incentive and positive messages rather than negative messages such as 'don't do this' or 'do this instead of that'.

Some suggested enhancements at existing coastal access sites include:

- Provision of better car parking – ideally with views of the coast.
- Creation of circular walks from car parks, for example the Strawberry Trail promoted as a series of walks around the upper Hamble Estuary.
- Linking the coast with inland green spaces, for example inland of Brownwich and Chilling shore on land managed by Hampshire County Council.

Sites where improved access facilities might be possible to provide include:

- Lepe Country Park (New Forest)
- Calshot (New Forest)
- Milfored on Sea/Hordle Cliffs (New Forest west of Hurst Spit)
- Brownwich and Chilling shore (Fareham)
- Royal Victoria Country Park
- Stokes Bay and linkages with the proposed Alver Valley Country Park
- Holly Hill Woodland Park/Wendleholm (Hamble)

It was generally felt that alternative green space away from the coast is unlikely to be attractive, as people who have chosen to visit a coastal location are unlikely to go to an inland site as an alternative. However it was pointed out that there are a few locations where open land extends inland of the coastline and could be linked with the coast to create a larger accessible coastal landscape. The restored Efford Landfill site at Pennington on the New Forest Coast was thought to be a good example of such a site. Other suggestions included land at HMS Deadalus in Fareham/Gosport and possibly land at Broadmarsh (Langstone). Natural England also expressed the view that the general feeling of alternative green space being unattractive to visitors might not apply equally to local dog-walkers - attractive green space closer to their homes may encourage them to use alternative non-coastal locations some of the time.

It was considered that there is a danger in promoting alternative green space inland of the coast, as this could lead to conflict with their use as terrestrial habitat by SPA bird species, for example, sports pitches and playing fields used by Brent Geese around Portsmouth Harbour.

Links will need to be made with the Green Infrastructure Strategy being developed through PUSH to ensure an holistic approach to the provision of alternative green space to offset effects to both coastal and terrestrial Natura 2000 sites.

Further research will ultimately be needed to determine how effective alternative green space provision will be in diverting recreational pressures away from coastal sites. It seems likely that this will be more effective in relationship to some coastal activities than others and on the

accessibility of the coast to each housing location. However, some form of alternative green space provision through the implementation of a Green Infrastructure Strategy will be essential.

7.3.2 Visitor management

The consultees' perception was that walkers and dogs could cause much less disturbance to birds when they follow a predictable route, for example, the sea wall between Lymington and Keyhaven which takes in excess of 250,000 visitors a year without any immediately apparent adverse effects on bird use. In such cases it is of course very difficult to determine the extent to which the use by the birds would be different in the absence of any human activity, or whether the birds do actually avoid the upper shore areas. Comparisons of waterfowl presence and feeding rates at those times of day with fewest people compared with the same parameters measured under similar tidal and weather conditions with people present could help to elucidate this. A similar situation was noted to occur at Farlington Marshes. In both instances, large areas of well-wardened/managed, publicly owned, coastal land is provided and this was noted to create a feeling of openness that is attractive to visitors.

In more confined situations, simple techniques have been developed to segregate wildlife from people. For example, in Portsmouth, the Parks Department have used chestnut paling fences to separate people from feeding Brent Geese with significant success, again giving the birds some predictability of human and dog behaviour.

These techniques were noted to be effective to some degree, but may not be fully effective. For example, signs are regularly erected in association with temporary fencing to deter access to Hook Spit, at the entrance to the Hamble. These reduce disturbance to allow Ringed Plover and Oystercatcher to breed but Little Terns have not attempted to nest here since the early 1990s, perhaps because residual disturbance is still too high.

Fencing in conjunction with ditches has been used to deter access to Hook Links. This has apparently proven to be very successful and the area is now used by 'good numbers' of Brent Geese, Pintail, Wigeon, Teal, Lapwing, Black-tailed Godwits and Curlew.

For specialist user groups, Codes of Conduct or information leaflets were reported to have proven very successful. On the Medina Estuary on the Isle of Wight a leaflet has been used to deter use of high-water wader roost sites by dinghy sailing clubs and sailing schools. It was considered by the consultees that similar approaches might work to offset impacts of canoeing and kite surfing.

Improvement of habitat associated with the coast was also considered to be a viable alternative mitigation measure. This might include reduction in Fox predation or disturbance of breeding coastal birds in areas where the public have no access; or incentives to farmers to provide goose feeding fields or high water wader roost sites (though this needs to be repeated, continuous and very intensive to be effective year on year).

Zoning and management of coastal areas for different recreational uses were also considered to have both existing and potential roles in reducing recreational impacts. On the foreshore, zoning is already used to deter dog walkers from some beaches in the summer. It was considered that extending this sort of control into the winter could have significant benefits in terms of disturbance reductions.

In phase III, available evidence on the efficacy of different mitigation measures would be examined from the (ever-increasing) literature, further comments solicited from consultees. The evidence and its interpretation would then be compiled and summarised into a mitigation strategy.

7.3.3 Balance of approaches

The relative balance of alternative green space provision and visitor management that will prove effective in a given instance will vary from development to development depending upon its location and the predicted impacts arising from it.

7.4 Making Decisions on Land Allocations and Planning Permissions

The first test for any development allocation or proposal is whether it should be allowed to proceed or not. If not then any disturbance-related impact is clearly avoided. In Phase III, categories of avoidance of disturbance impact would be identified including:

- Not scheduling land for residential or other development likely to cause disturbance to relevant ecological features
- Refusing development permissions
- Accepting development at reduced densities, below the threshold considered likely to cause significant disturbance.

In Phase III of the present project, suggestions would be made in the form of initial guidance and rules - perhaps in the form of a decision tree - as to the sorts of situations in which one of the above avoidance courses should be followed at planning with rationale - essentially those instances where there would be significant doubt of ever achieving successful and effective mitigation or offsetting.

7.5 Making Decisions on Mitigation

If a development proposal is allowed to proceed then this may be because it is a development of 'strategic importance' which is predicted to result in net adverse effects on Natura 2000/Ramsar site integrity, but which is carried forward for imperative reasons of overriding public interest in the case of there being no alternatives. In this case suitable compensation (offsetting) must be devised (see Section 7.6 below).

Alternatively it may be allowed to proceed on the basis that effective mitigation can be devised. In such as case a developer must construct mitigation proposals that will decrease the risk of more people and their activities reaching the Solent to the point at which any adverse effect on Natura 2000/Ramsar site integrity could not be reasonably attributable to the development.

For clarity, the term mitigation is used here to refer to any measures that would result in measurable reductions in adverse effects on the qualifying interests of the Solent European sites and Ramsar Site from potential sources of disturbance that could be directly and reasonably attributed to a given development. This categorisation of potential sources of impact would be a key component of the output of Phase III.

7.6 Mitigation for Residual Impacts (Compensation or Offsetting)

Residual impacts (after full implementation of mitigation measures) to Natura 2000/Ramsar sites invoke procedures under the Habitats Regulations whereby developments are then only allowed to proceed for imperative reasons of overriding public interest, and only if there are no alternatives. Both scenarios might be considered uncommon with respect to housing development. However, in the case of large strategic housing allocations the case for these conditions being met is likely to be made more frequently given government housing policy and the many other constraints on developable land.

The results of the Phase III of the present study should be able to help inform where and how offsetting in such circumstances might be best achieved.

A map, to a first level of resolution, would be produced showing some of the potentially relevant key areas where offsetting could be occur in terms of creation of enhanced or of new habitat.

The Environment Agency is currently undertaking relevant work through its Regional Habitat Creation Project (RHCP) to identify sections of the coast where coastal realignment or changes in the management of land drainage structures could permit landward migration of

the coastal zone. This work is being undertaken to offset impacts of coastal defence works and predicted losses of coastal habitat due to sea level rise. There is perhaps potential for habitat creation schemes to offset development impacts to be jointly funded in partnership with the Environment Agency and this option would be discussed in Phase III.

Also in Phase III, the main types of intervention required to create or restore habitats in apparently suitable known sites outside of the European or Ramsar Sites, to a quality capable of sustainably accommodating species characteristic of the existing designated sites of the Solent, would be listed. The aim would be to permit costing as part of further work (costs would not be provided within the scope of the present study).

A first attempt would also be made to collate the data on characteristics of specific sites and the species that might be most readily accommodated by appropriate habitat modifications.

Potential mechanisms by which work on these sites could actually be undertaken, and how and when funds could be saved and used would also be suggested for review by the Forum.

7.7 Reducing the Effects of Existing Disturbance

Where existing levels of disturbance are identified as potentially placing species conservation status or Natura 2000/Ramsar Site integrity at risk, (e.g. in the case of breeding birds) then there is a case for works to be carried out to mitigate the effects of *existing* disturbance sources. Predictive modelling from Stages II and III would identify areas where high visitor numbers potentially conflict with the goals of maintaining favourable conservation status of the relevant Natura 2000/Ramsar sites.

Where residual adverse impacts can be assessed as likely to occur as a result of a development in terms of disturbance to the Solent interests, but not to a level that integrity could be threatened, they may or may not be addressed as part of cumulative impact assessment of other plans or projects.

However, some of these negative if not individually significant impacts will not be covered by cumulative assessments and moreover, there is now a strong policy basis for net enhancement by development schemes under the terms of PPS9, and the associated government circular and Good Practice Guide.

In Phase III, therefore, a first attempt would be made to suggest a system of developer contributions towards strategic measures to reduce existing disturbance sources around the Solent or their effects, based on the nature, size and location of any development (essentially an 'enhancement fund'). This could form the basis for a Strategic Planning Document for the Solent on the subject, following models suggested on estuaries elsewhere in the UK and abroad. Such a system would need to appear fair and proportionate to the characteristics of each individual development.

7.8 Predicting Effectiveness of Mitigation of Future Development Scenarios

All of the above could be carried out without any reference to actual or potential development proposals around the Solent. Clearly, although there are current figures for future housing quantum in the general area and allocation areas, these can be changed by government and can never be considered definitive.

Nevertheless, one or two examples can and would be provided in outline in Phase III to show how the disturbance model produced in the present project could be used to assess the potential impacts of a given level of housing in a given area.

Further possible development site assessments and the undertaking of a Solent-wide assessment of the 80,000 house scenario based broadly on the known strategic housing area allocations in the current South East Plan could then be carried our as part of a further stage of funded work.

7.9 Impact Assessment and Mitigation Implementation Protocols

Impact assessment protocols of the key interests at risk are already well-furnished under the Habitats Regulations through the system for Appropriate Assessment. This applies both to strategic planning documents and individual development proposals. For individual developments, the scope of Appropriate Assessment is currently agreed on a case by case basis with Natural England.

Phase III of the present project, however, could lead to guidance on assessing potential impacts of disturbance within strategic assessments of plans and policies. It would also be written to contribute towards internal guidance ultimately produced by Local Authorities and Natural England on the factors to consider (and in what detail) when assessing disturbance effects of individual developments; and on how to make the decisions as to which other developments should be considered for in-combination assessments. The advice would to an extent be geo-referenced to particular sub-areas of the Solent.

As regards securing the implementation of effective measures, ultimately, it is for the Local Government Authorities and Statutory regulators to devise administrative implementing and funding mechanisms. Nevertheless, to frame the debate, possible administration mechanisms for the implementation of mitigation and enhancement measures and any legal problems likely to pertain (e.g. over restricting access) would be *outlined* in Phase III. This work would entail further discussions with key Local Authority staff, regulators and other third parties.

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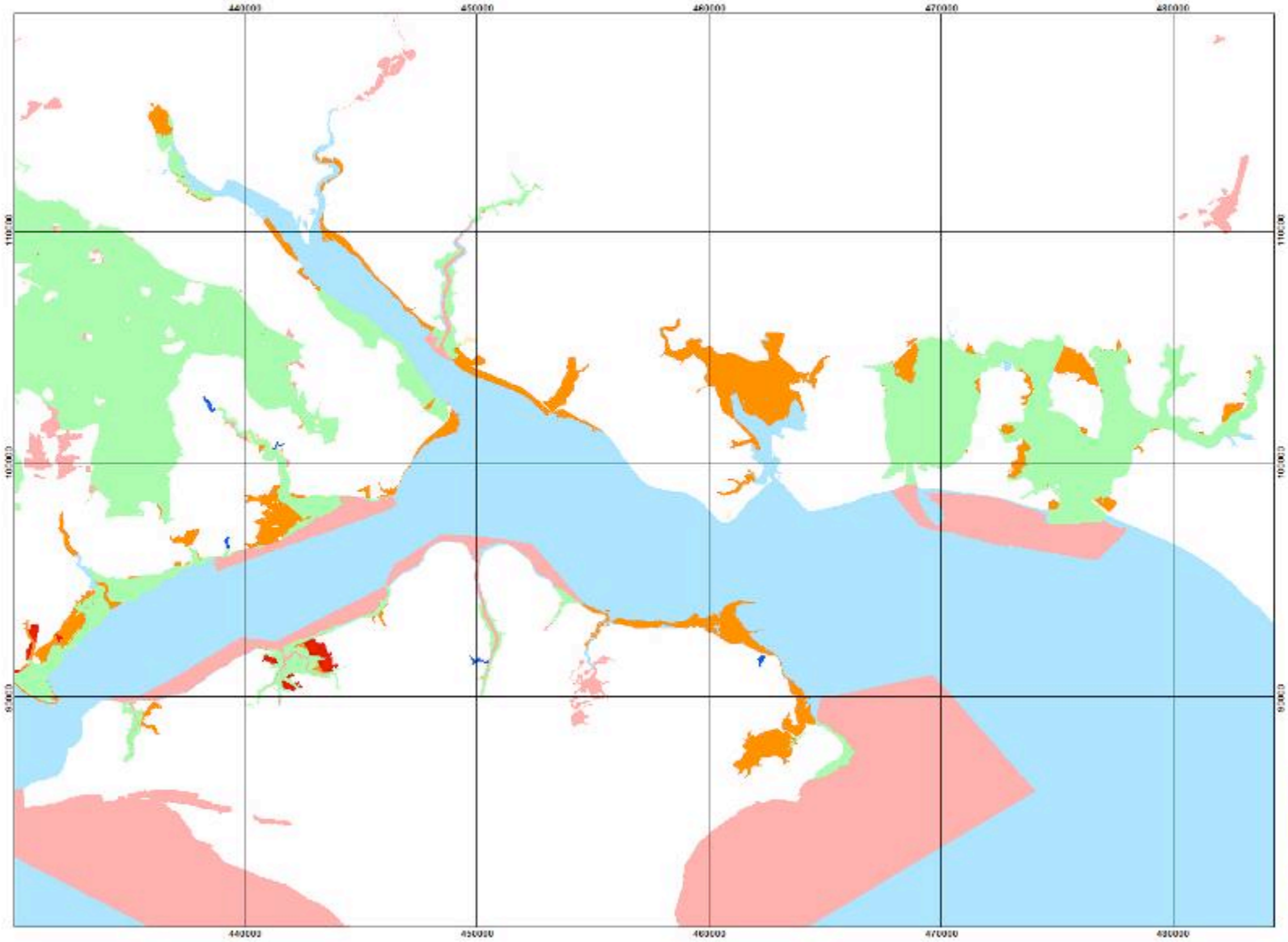
9 Maps

Map 1: International nature conservation designations in and around the Solent

Solent disturbance and mitigation project: Phase I

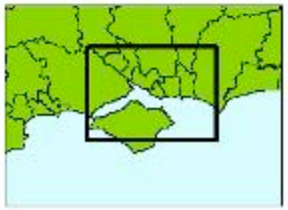


11 November 2008

Scale 1:231500

Designation(s)

- SPA only
- SAC only
- Ramsar only
- SPA and SAC
- SPA and Ramsar
- SAC and Ramsar
- SPA, SAC and Ramsar



Map 2: National nature conservation designations in and around the Solent

Solent disturbance and mitigation project: Phase I

11 November 2008

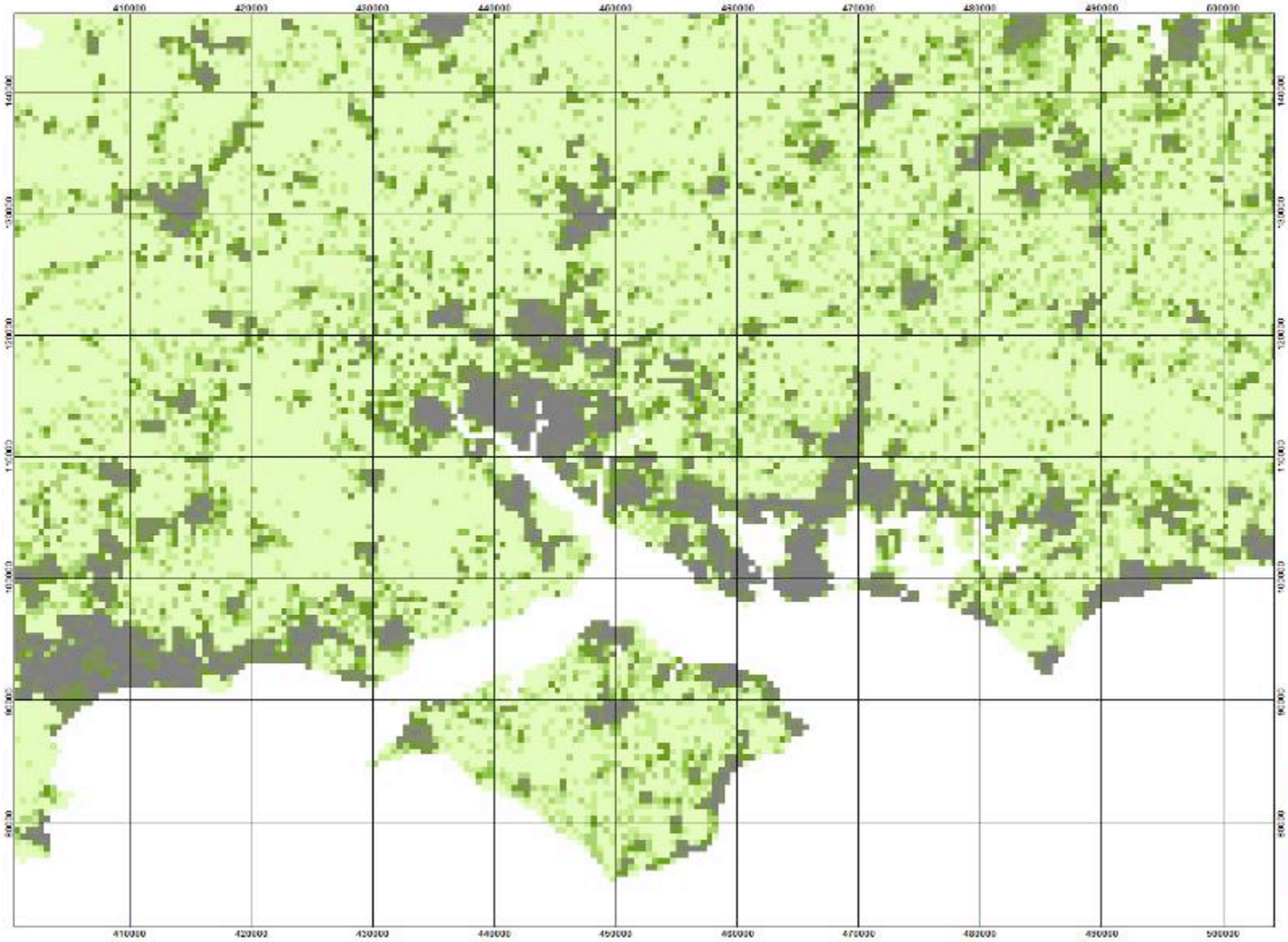
Scale 1:236000

National Park

SSSI

Map 3: Current spatial distribution of housing around the Solent

Solent disturbance and mitigation project: Phase I



20 November 2008

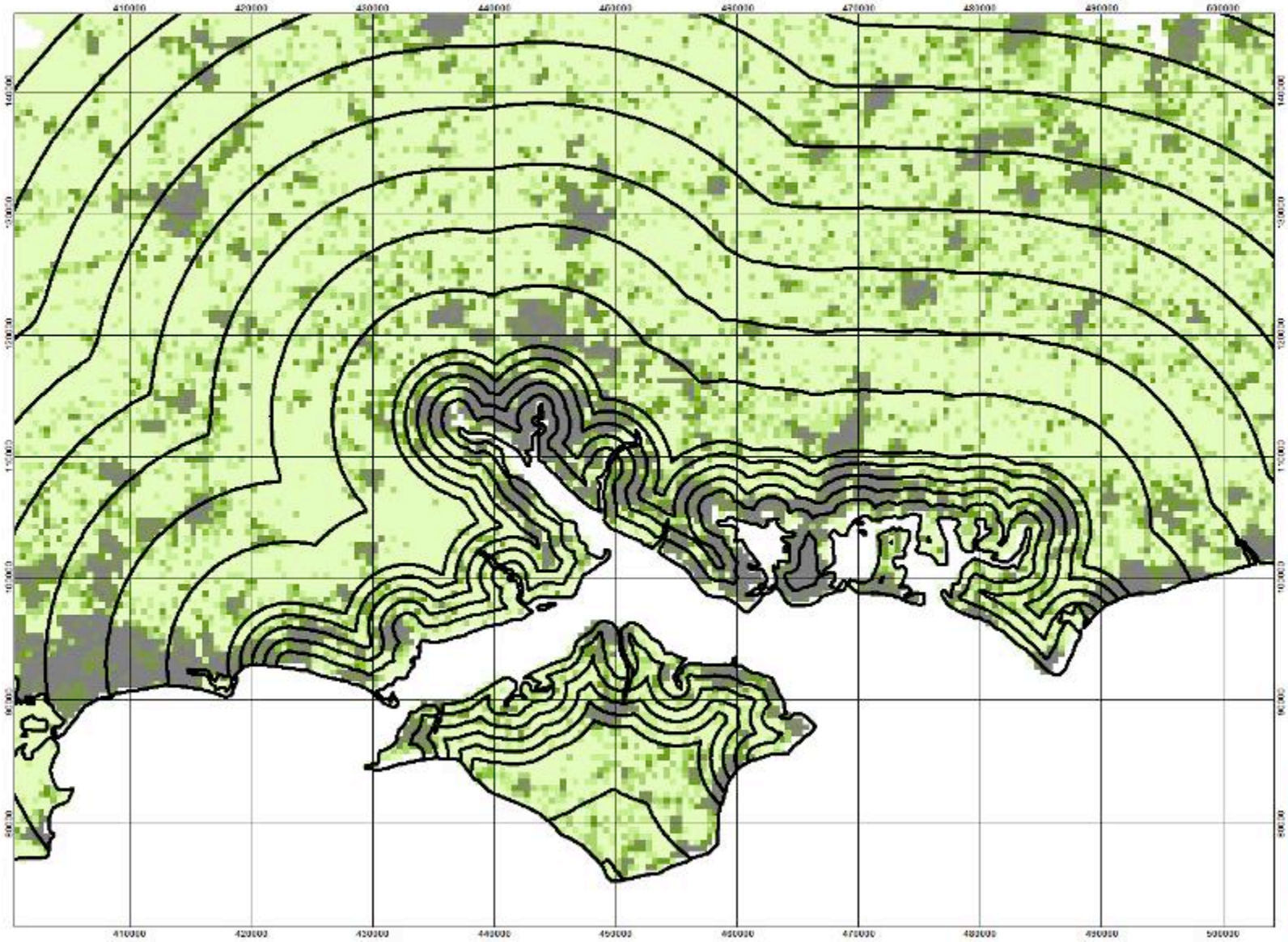
Scale 1:442500

Number of homes

- 500 to 3,000
- 100 to 499
- 40 to 99
- 30 to 39
- 10 to 29
- 1 to 9
- 0

Map 4: Current spatial distribution of housing around the Solent and distance bands from the coastline

Solent disturbance and mitigation project: Phase I



20 November 2008

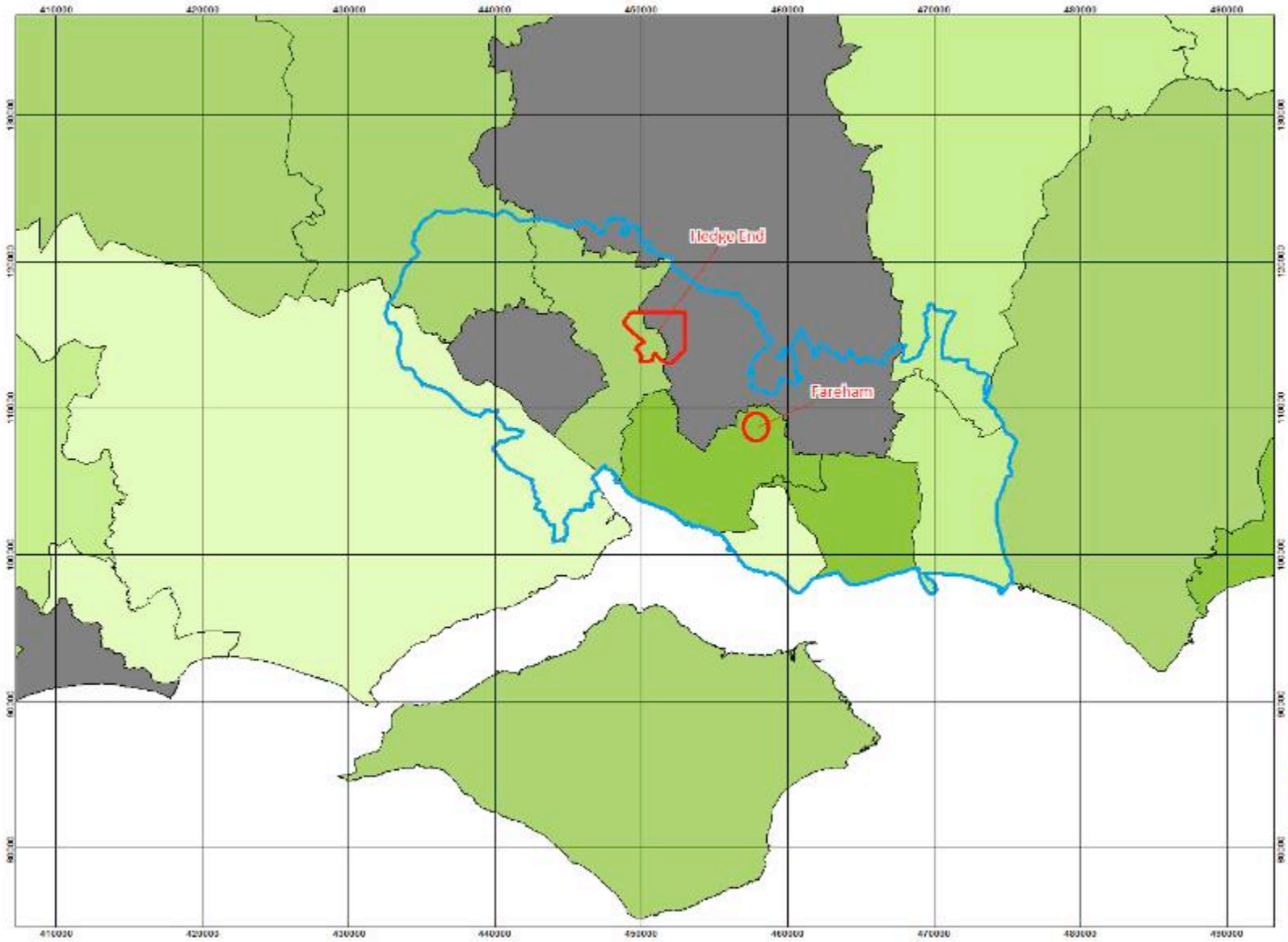
Scale 1:442500

Number of homes

- 500 to 3,000
- 100 to 499
- 40 to 99
- 30 to 39
- 10 to 29
- 1 to 9
- 0

Map 5: RSS per annum housing allocations for each district, South Hampshire sub-region (PUSH) and SDAs

Solent disturbance and mitigation project: Phase I



25 November 2008

Scale 1:366700

RSS housing increase (pa)

- 750 to 895
- 550 to 749
- 400 to 549
- 250 to 399
- 100 to 249

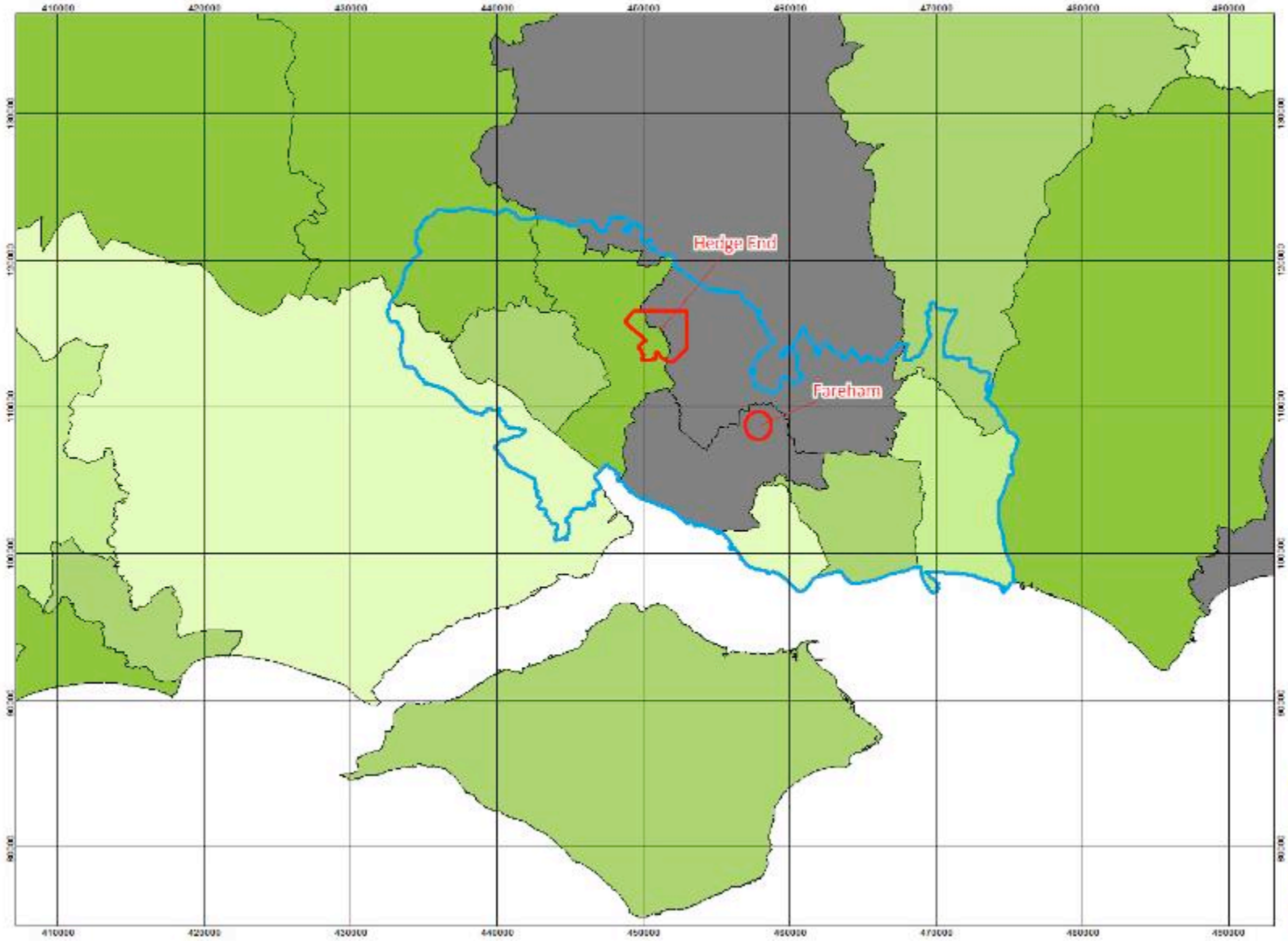
SDAs *

South Hampshire sub-region (PUSH)

* Housing allocation for Hedge End SDA divided equally between Eastleigh and Winchester districts

Map 6: RSS percentage increase in housing for each district, South Hampshire sub-region (PUSH) and SDAs

Solent disturbance and mitigation project: Phase I



25 November 2008

Scale 1:366700

% increase in housing

- 25 to 32
- 18 to 24
- 15 to 17
- 10 to 14
- 0 to 9

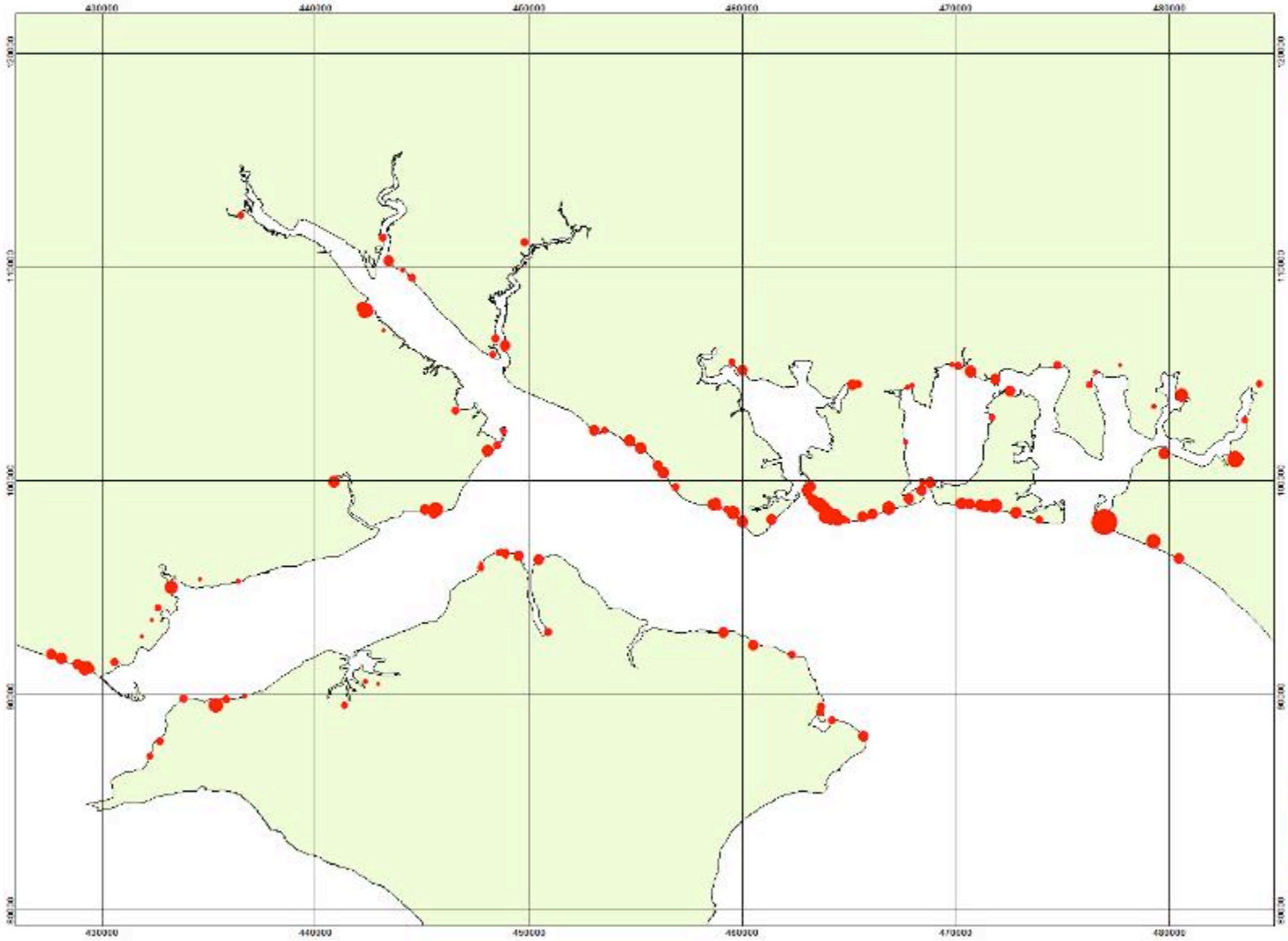
South Hampshire sub-region (PUSH)

SDAs *

* Housing allocation for Hedge End SDA divided equally between Eastleigh and Winchester districts

Map 7: Car parks around the Solent shoreline

Solent disturbance and mitigation project: Phase I



25 November 2008

Scale 1:251500

No. of car parking spaces (approx.)

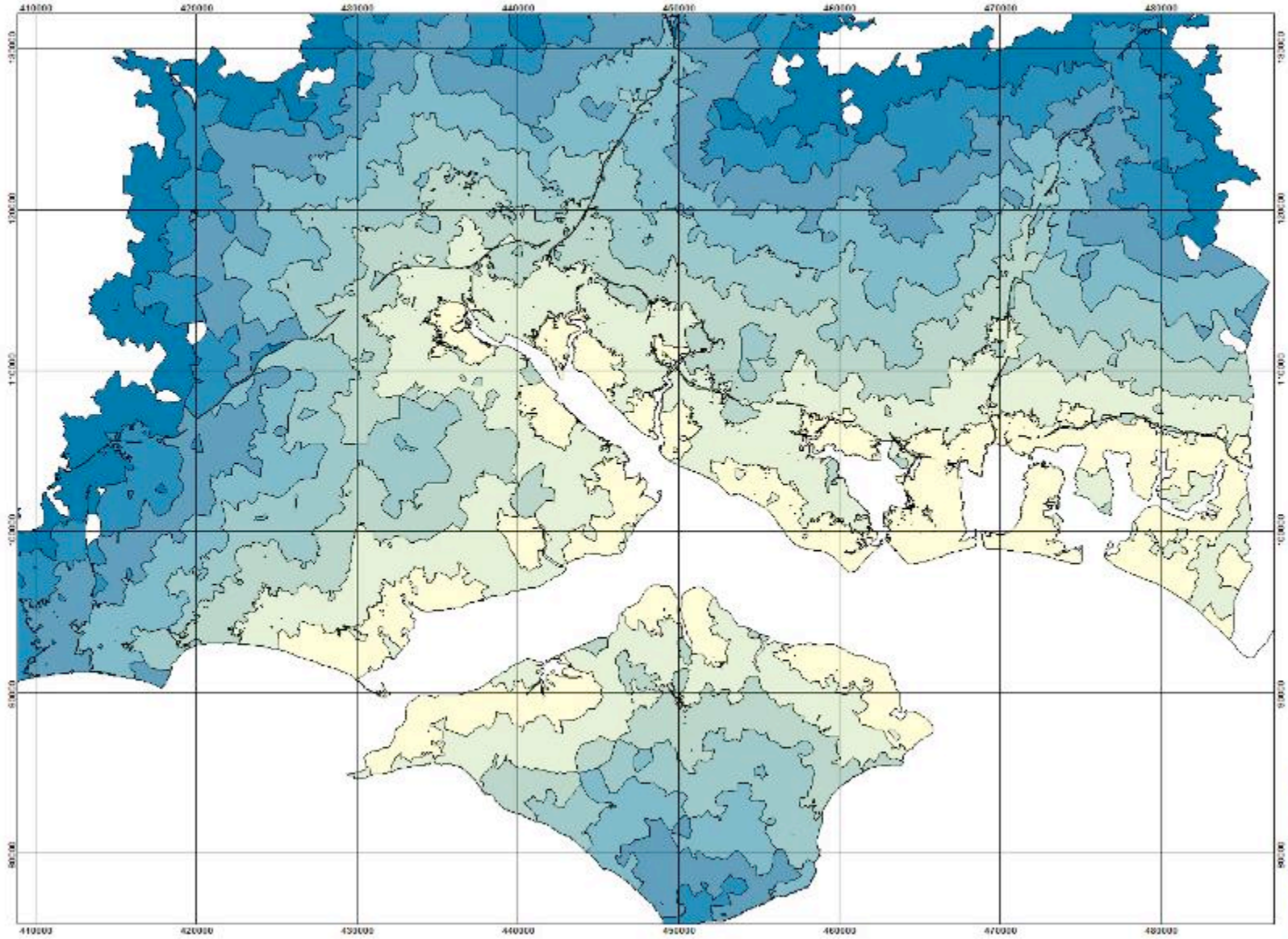
2,500

1,250

250

Map 8: Travel time from car parks around the Solent (see map 7)

Solent disturbance and mitigation project: Phase I



25 November 2008

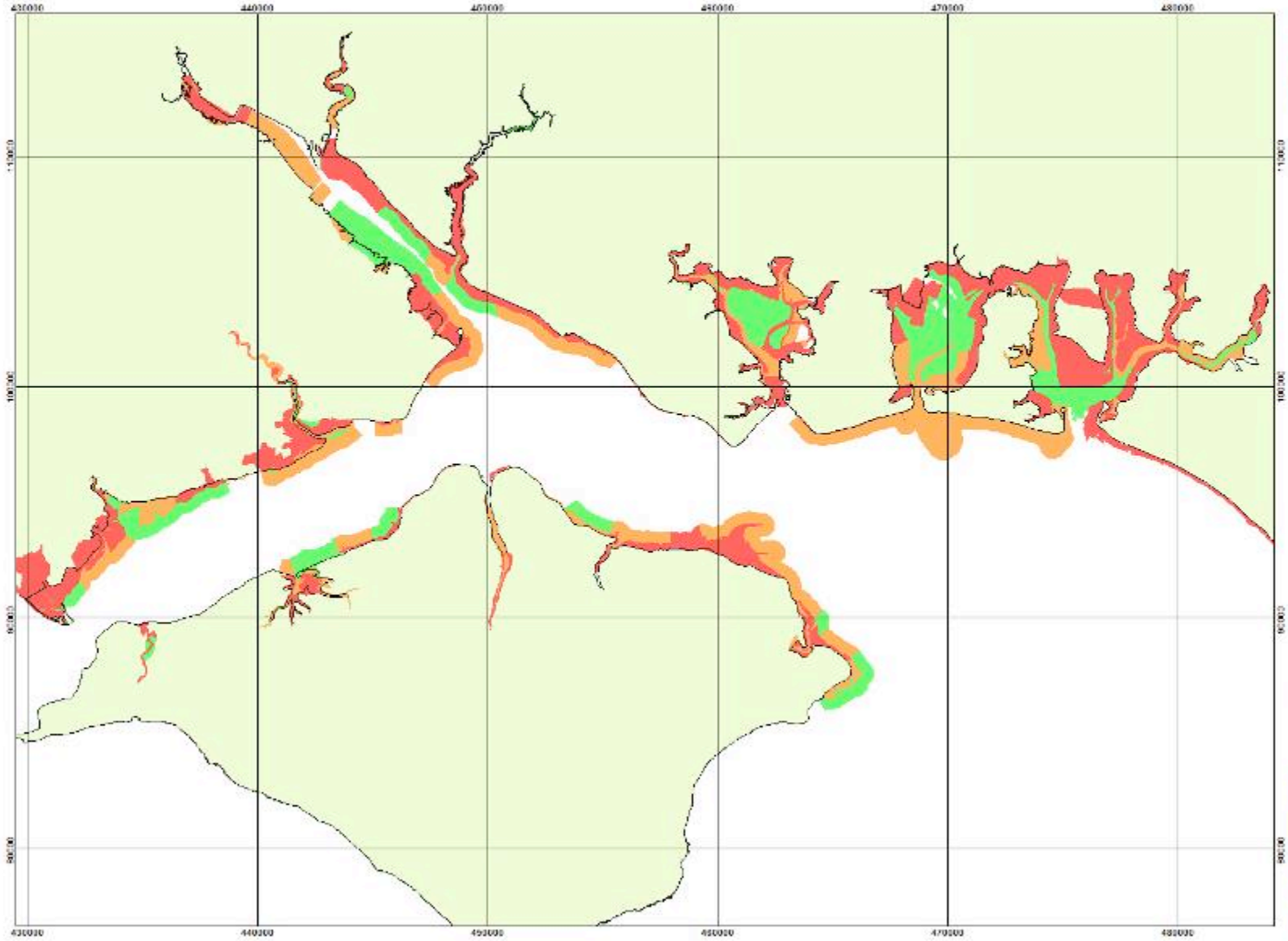
Scale 1:333500

Travel time from car park

- 5 mins
- 10 mins
- 15 mins
- 20 mins
- 25 mins
- 30 mins
- 35 mins
- 40 mins

Map 9: WeBS low tide count sections and access around the Solent shoreline

Solent disturbance and mitigation project: Phase I



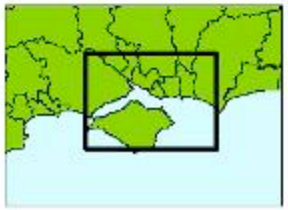
25 November 2008

Scale 1:233300

Level of foot access *

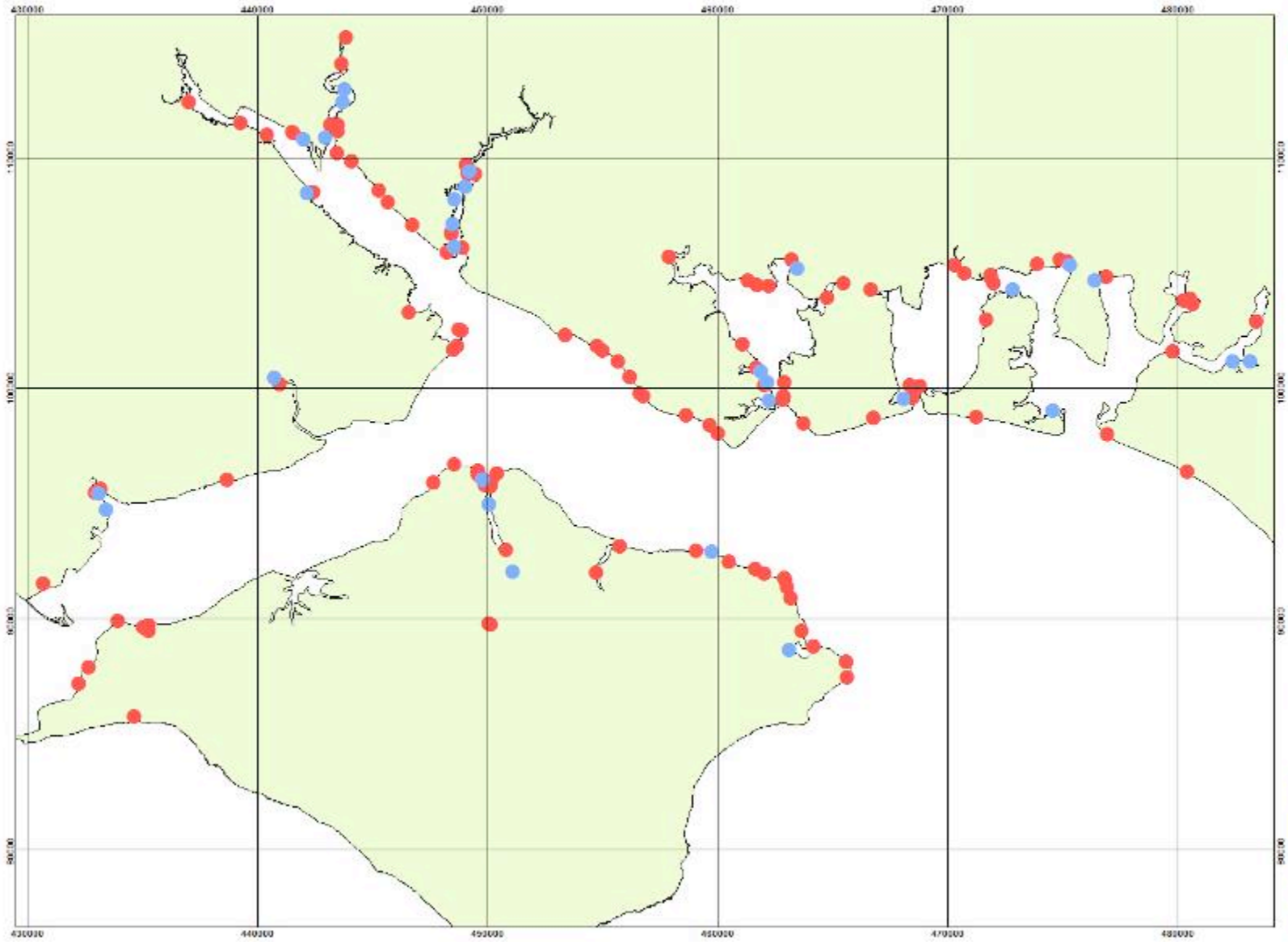
- Within section
- Within 100m of section
- No direct access

* Defined as a public highway or a public right of way



Map 10: Marinas and public slipways around the Solent shoreline

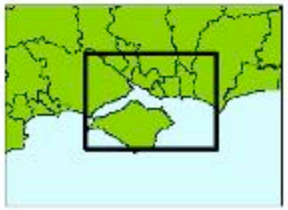
Solent disturbance and mitigation project: Phase I



25 November 2008

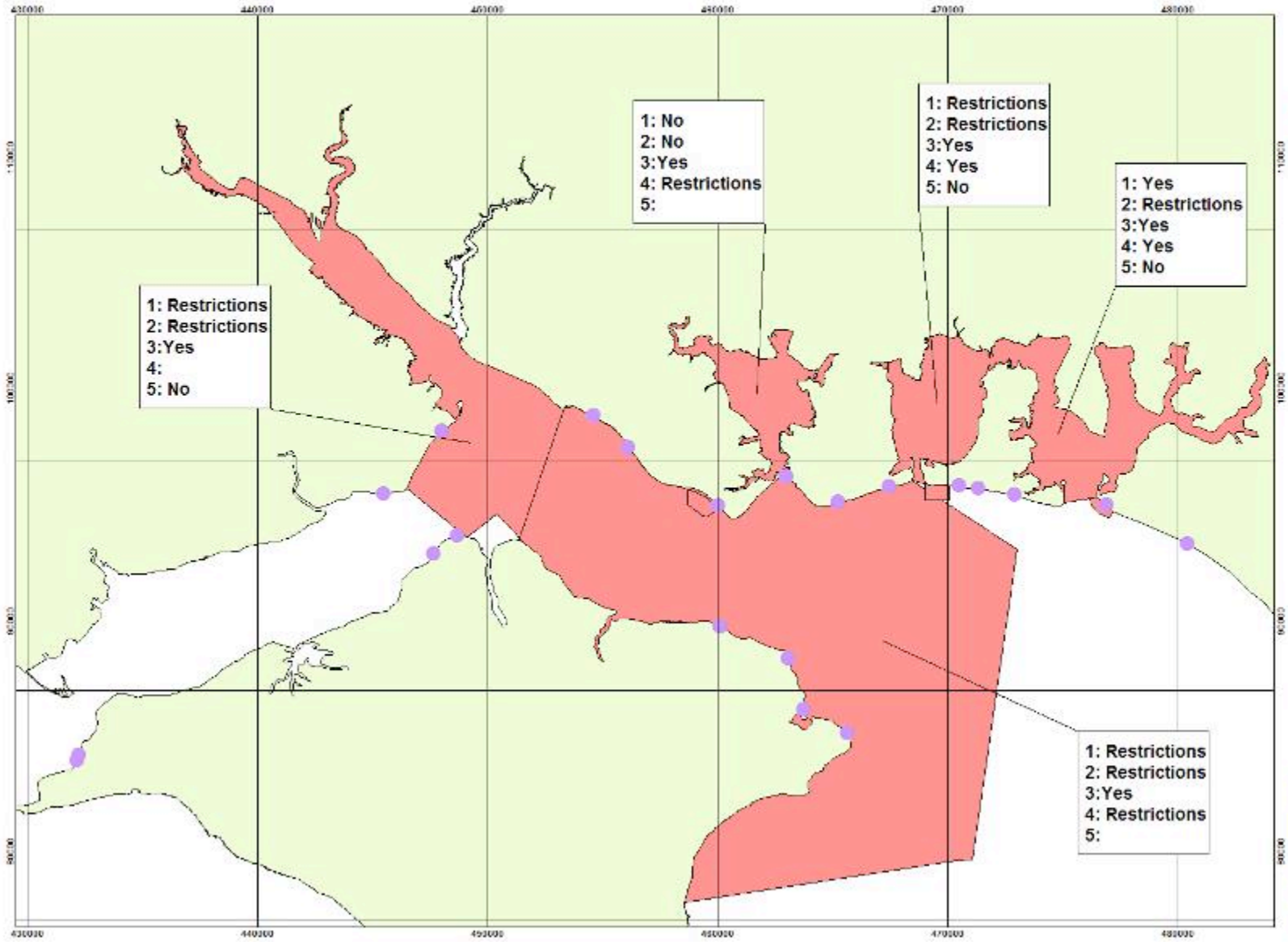
Scale 1:233300

- Marina
- Public slipway



Map 11: Monitored bathing sites and examples of recreational access restrictions around the Solent shoreline

Solent disturbance and mitigation project: Phase I



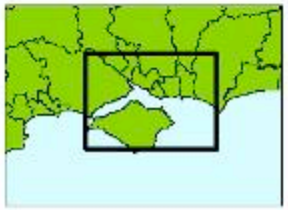
25 November 2008

Scale 1:233300

EA monitored bathing sites

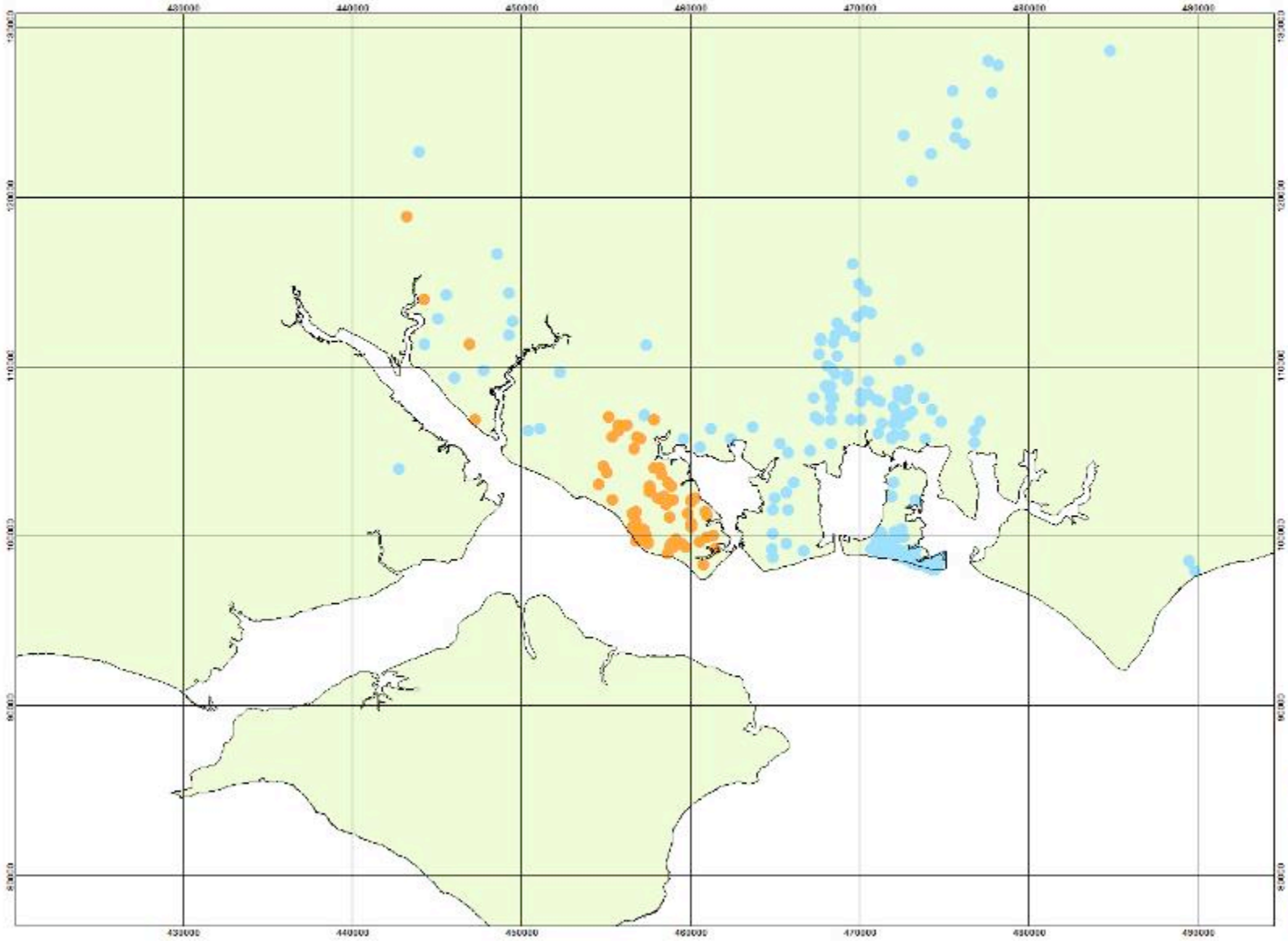
Recreational access restrictions

1: Jet ski
2: Water ski
3: Canoe
4: Windsurf
5: Kite Surf



Map 12: Home postcodes of respondents to visitor questionnaires at Browdown and Hayling Island

Solent disturbance and mitigation project: Phase I



25 November 2008

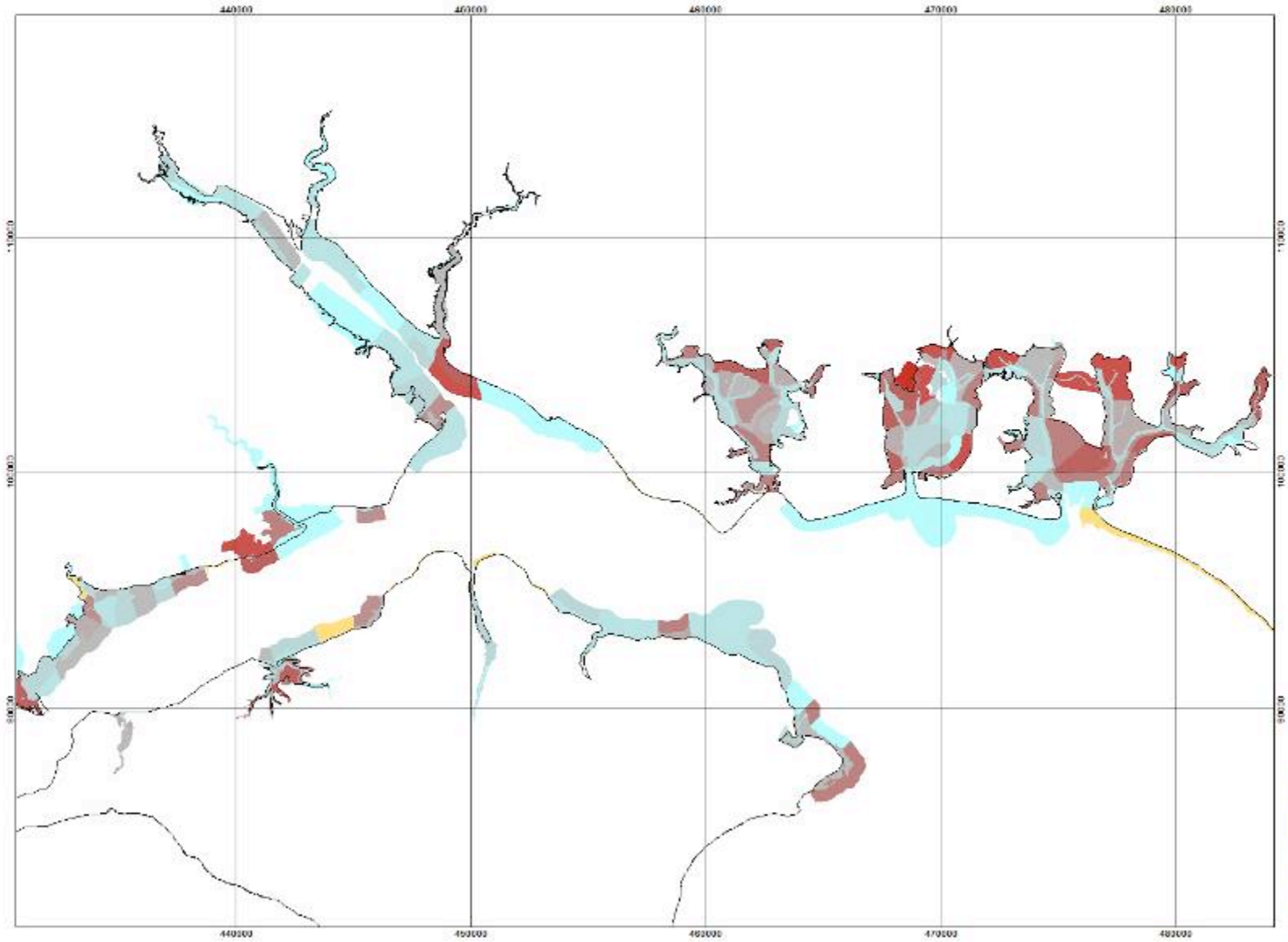
Scale 1:317152

Respondents home postcode

- Browndown
- Hayling Island

Map 13: Low tide WeBS data for dark-bellied brent goose

Solent disturbance and mitigation project: Phase I

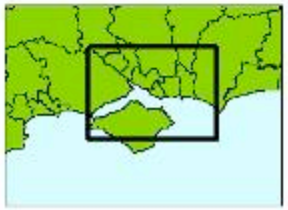


25 November 2008

Scale 1:228500

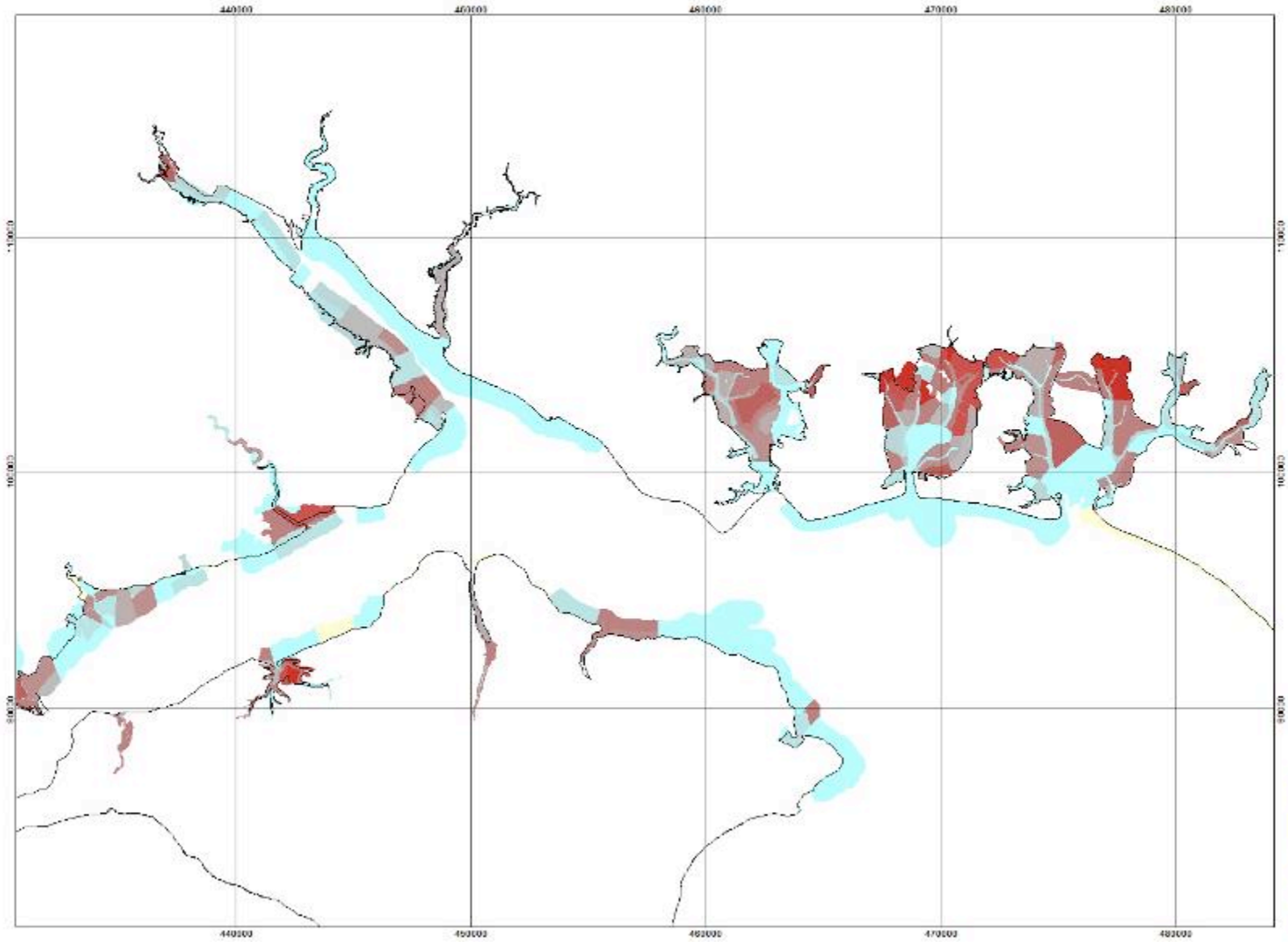
Number of birds

1,160 to	1,160
220 to	1,159
120 to	219
80 to	119
60 to	79
50 to	59
25 to	49
10 to	24
1 to	9
0	
No data	



Map 14: Low tide WeBS data for shelduck

Solent disturbance and mitigation project: Phase I

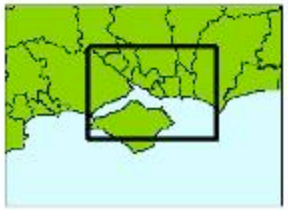


25 November 2008

Scale 1:228500

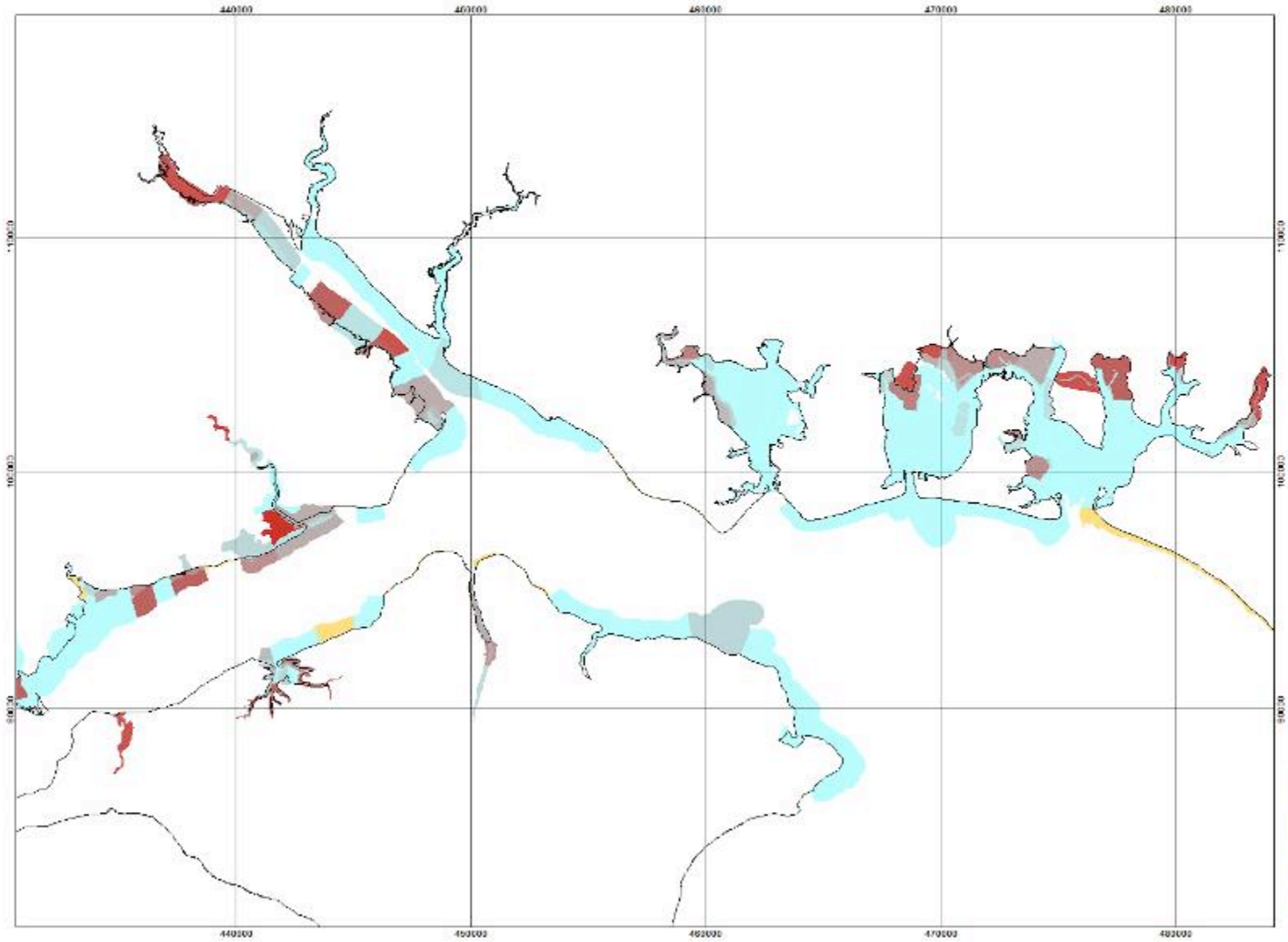
Number of birds

- 45 to 120
- 25 to 44
- 15 to 24
- 8 to 14
- 5 to 7
- 4
- 3
- 2
- 1
- 0
- No data



Map 15: Low tide WeBS data for wigeon

Solent disturbance and mitigation project: Phase I

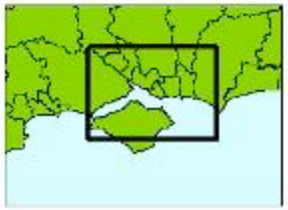


25 November 2008

Scale 1:228500

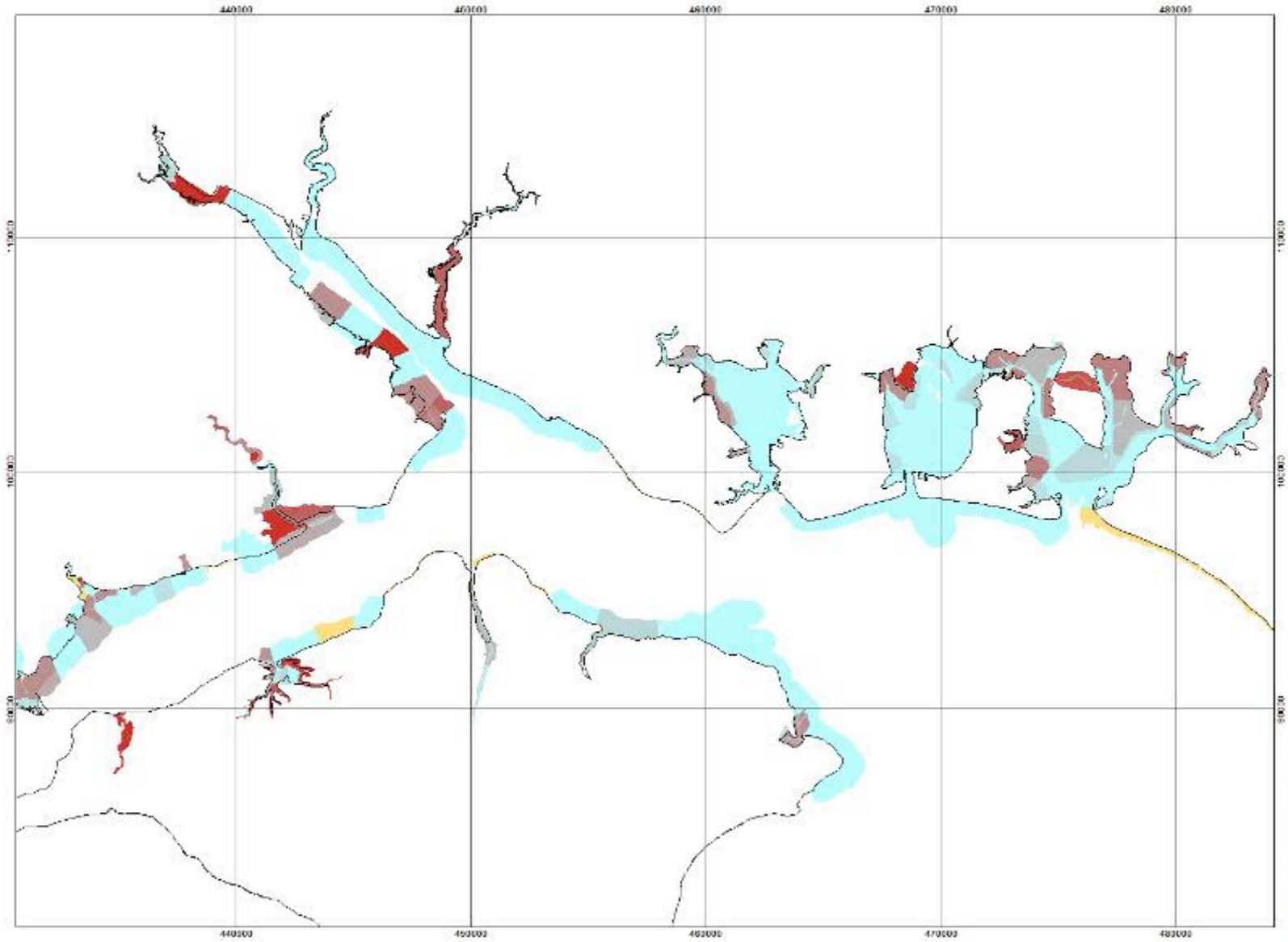
Number of birds

- 400 to 900
- 150 to 399
- 75 to 149
- 50 to 74
- 24 to 49
- 12 to 23
- 8 to 11
- 3 to 7
- 1 to 2
- 0
- No data



Map 16: Low tide WeBS data for teal

Solent disturbance and mitigation project: Phase I

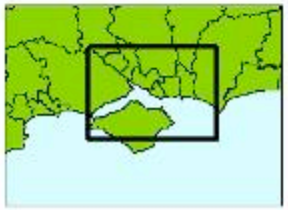


25 November 2008

Scale 1:228500

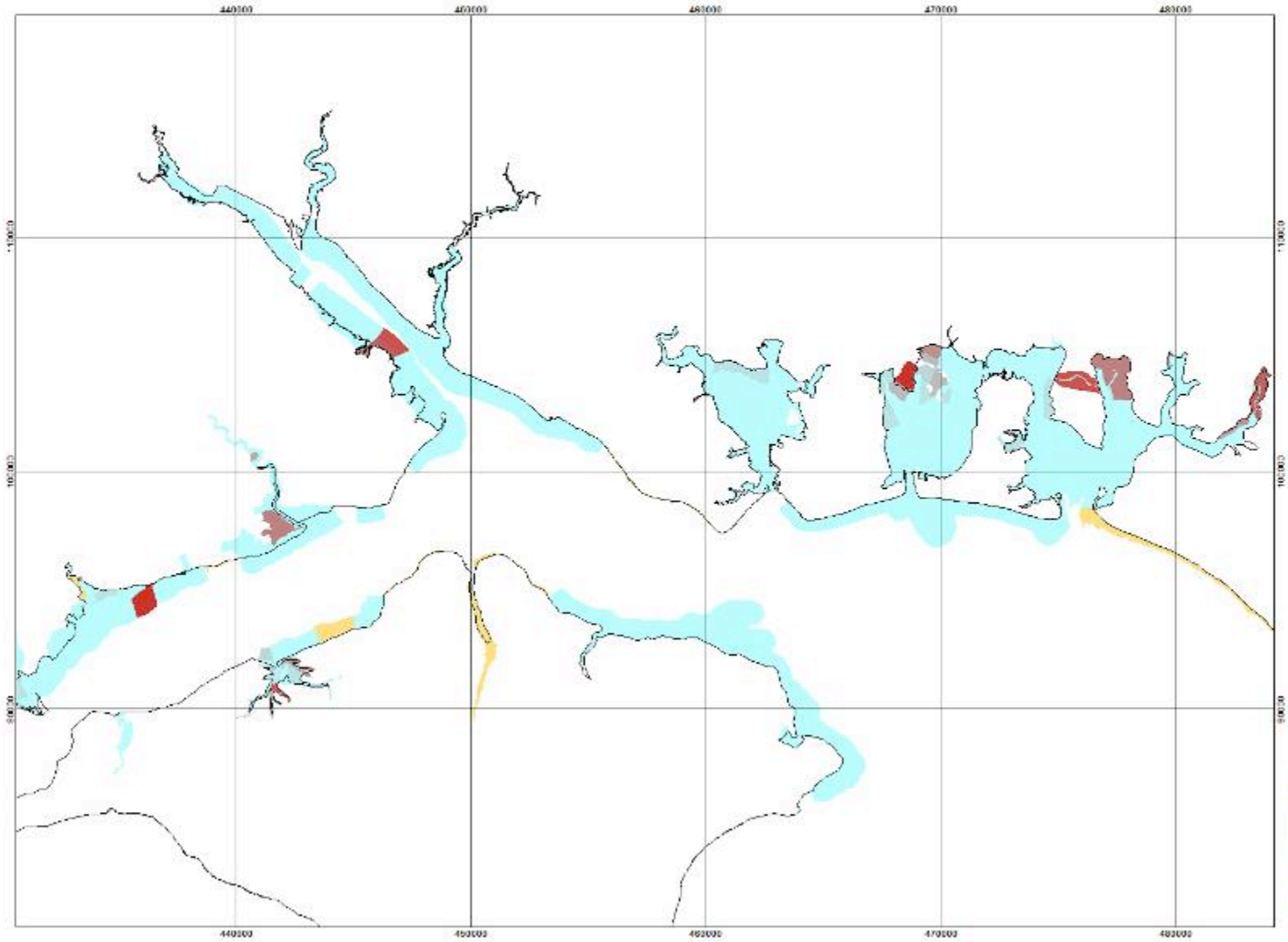
Number of birds

- 150 to 400
- 75 to 149
- 35 to 74
- 20 to 34
- 10 to 19
- 7 to 9
- 4 to 6
- 2 to 3
- 1
- 0
- No data



Map 17: Low tide WeBS data for pintail

Solent disturbance and mitigation project: Phase I

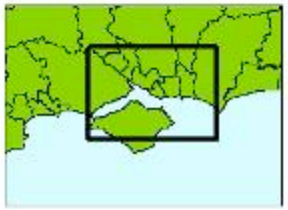


25 November 2008

Scale 1:228500

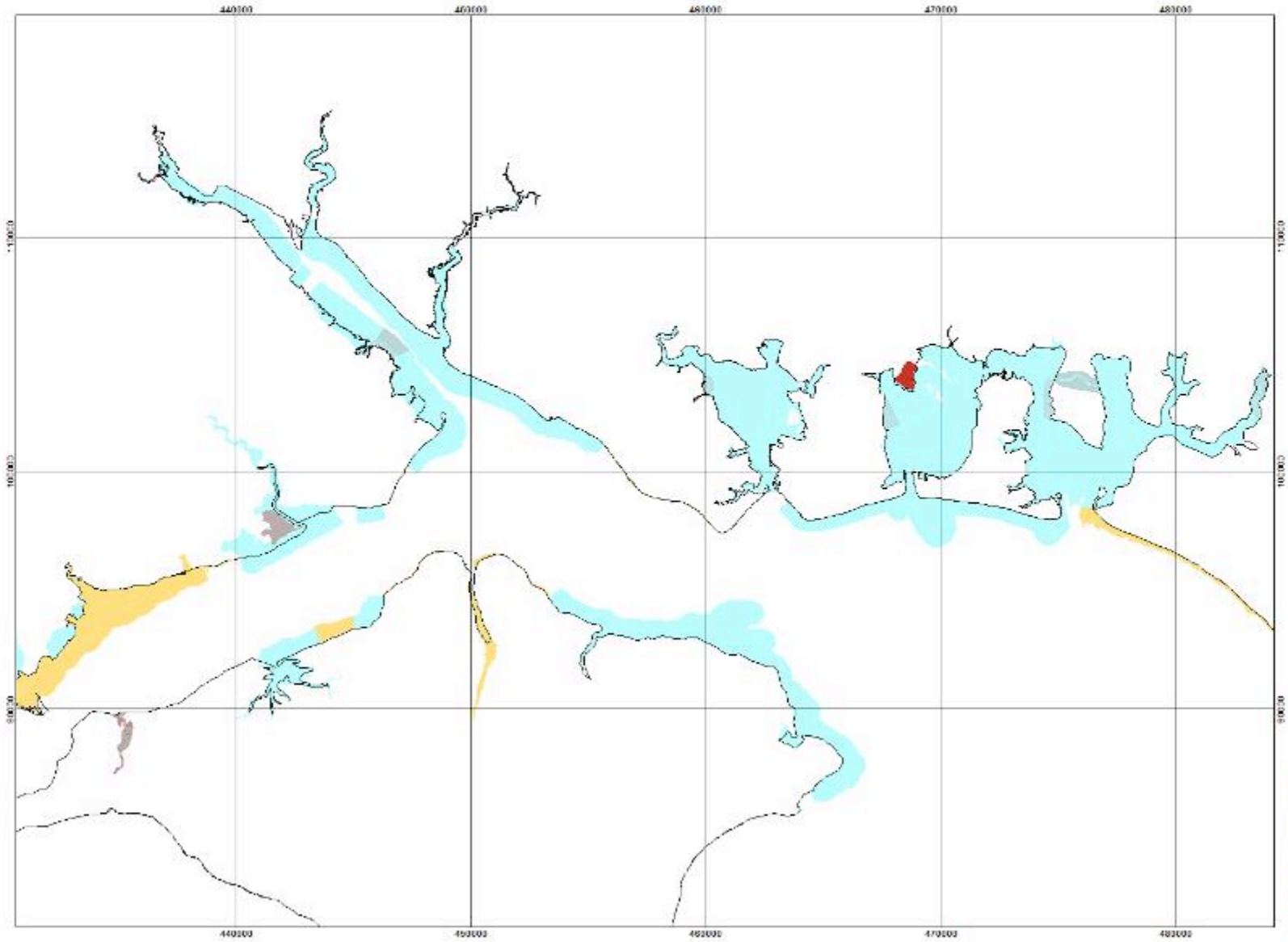
Number of birds

- 35 to 50
- 20 to 34
- 15 to 19
- 8 to 14
- 6 to 7
- 4 to 5
- 3
- 2
- 1
- 0
- No data



Map 18: Low tide WeBS data for shoveler

Solent disturbance and mitigation project: Phase I

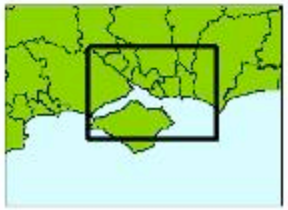


25 November 2008

Scale 1:228500

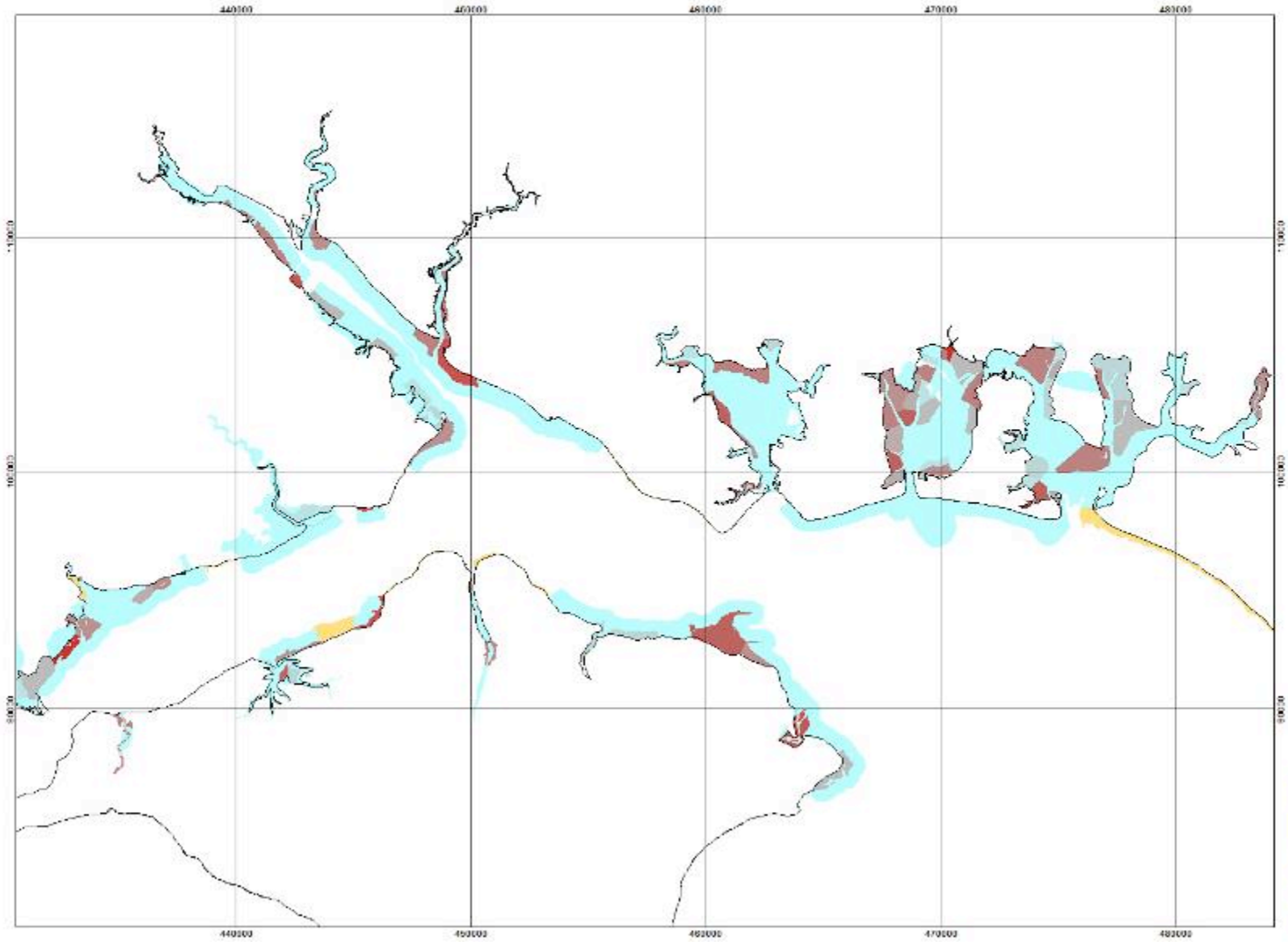
Number of birds

- 40 to 50
- 30 to 39
- 25 to 29
- 20 to 24
- 15 to 19
- 10 to 14
- 5 to 9
- 2 to 4
- 1
- 0
- No data



Map 19: Low tide WeBS data for ringed plover

Solent disturbance and mitigation project: Phase I

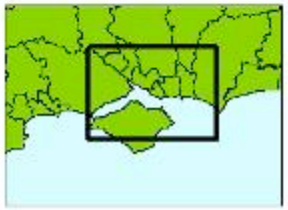


25 November 2008

Scale 1:228500

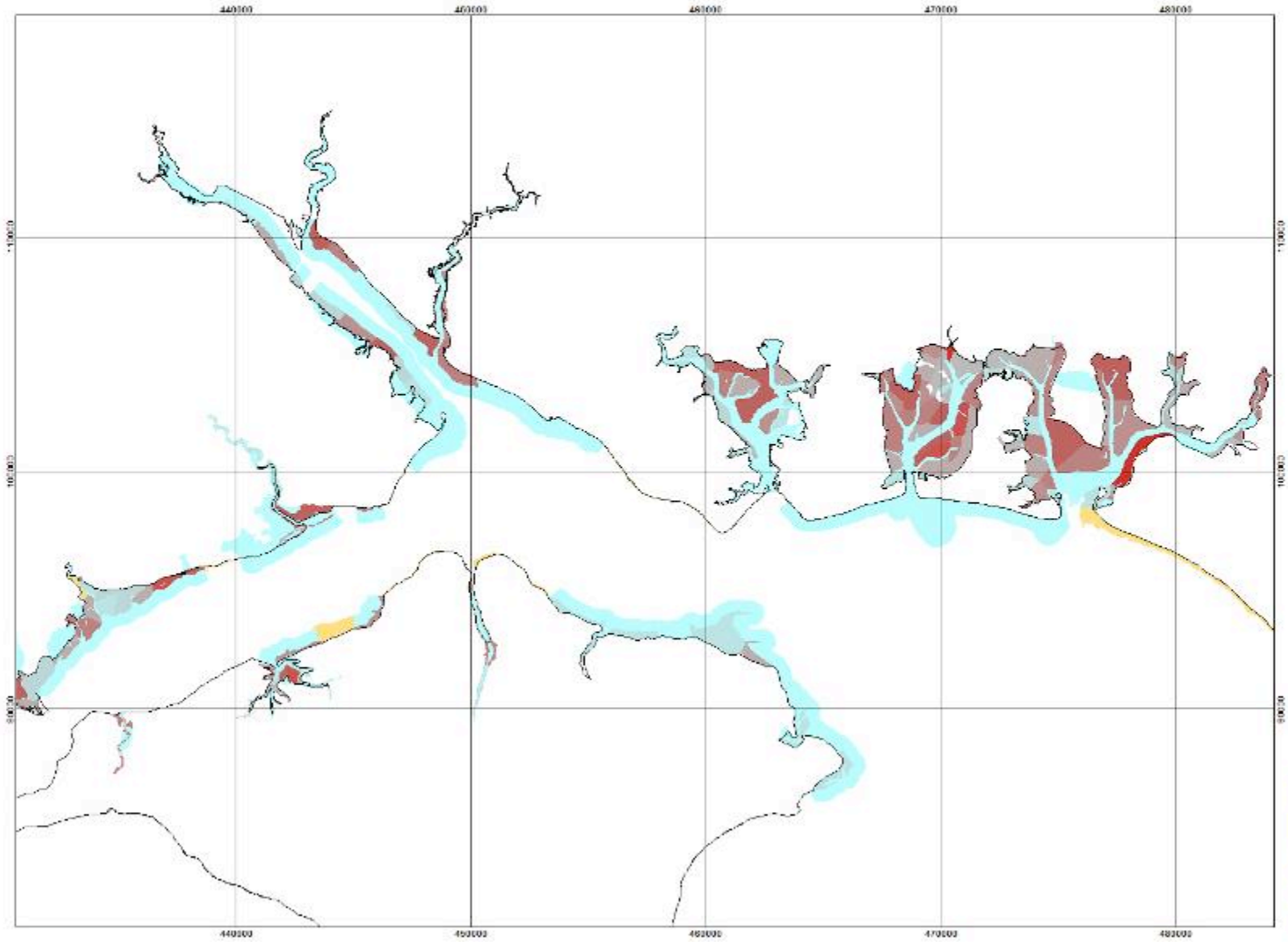
Number of birds

- 40 to 70
- 20 to 39
- 10 to 19
- 7 to 9
- 5 to 6
- 4
- 3
- 2
- 1
- 0
- No data



Map 20: Low tide WeBS data for grey plover

Solent disturbance and mitigation project: Phase I

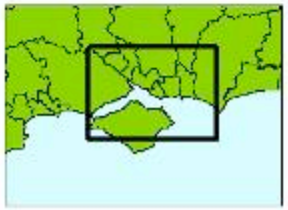


25 November 2008

Scale 1:228500

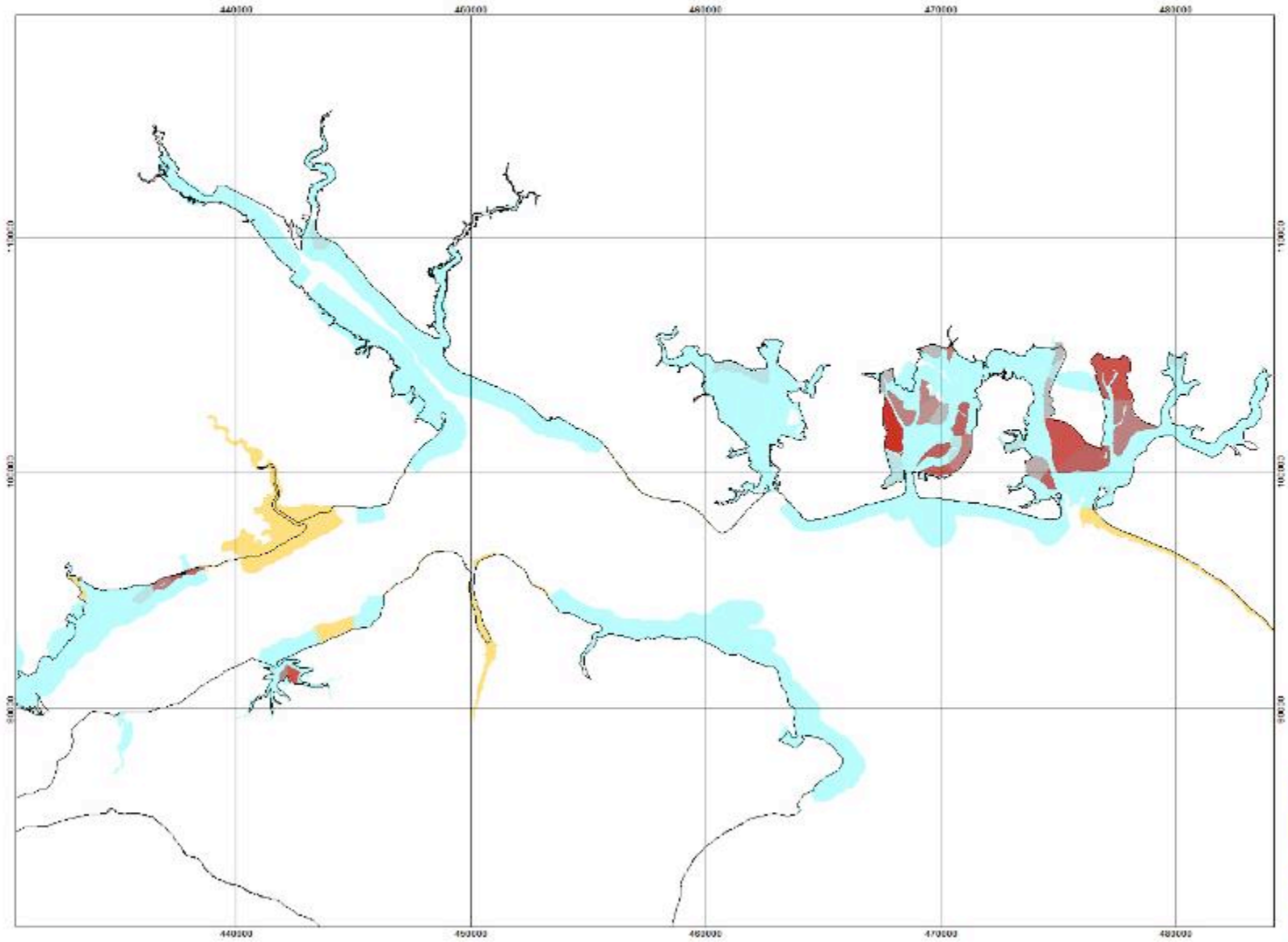
Number of birds

- 80 to 200
- 40 to 79
- 20 to 39
- 12 to 19
- 8 to 11
- 5 to 7
- 3 to 4
- 2
- 1
- 0
- No data



Map 21: Low tide WeBS data for knot

Solent disturbance and mitigation project: Phase I

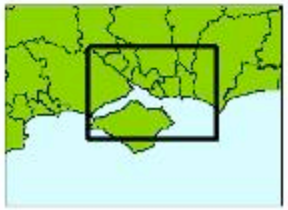


25 November 2008

Scale 1:228500

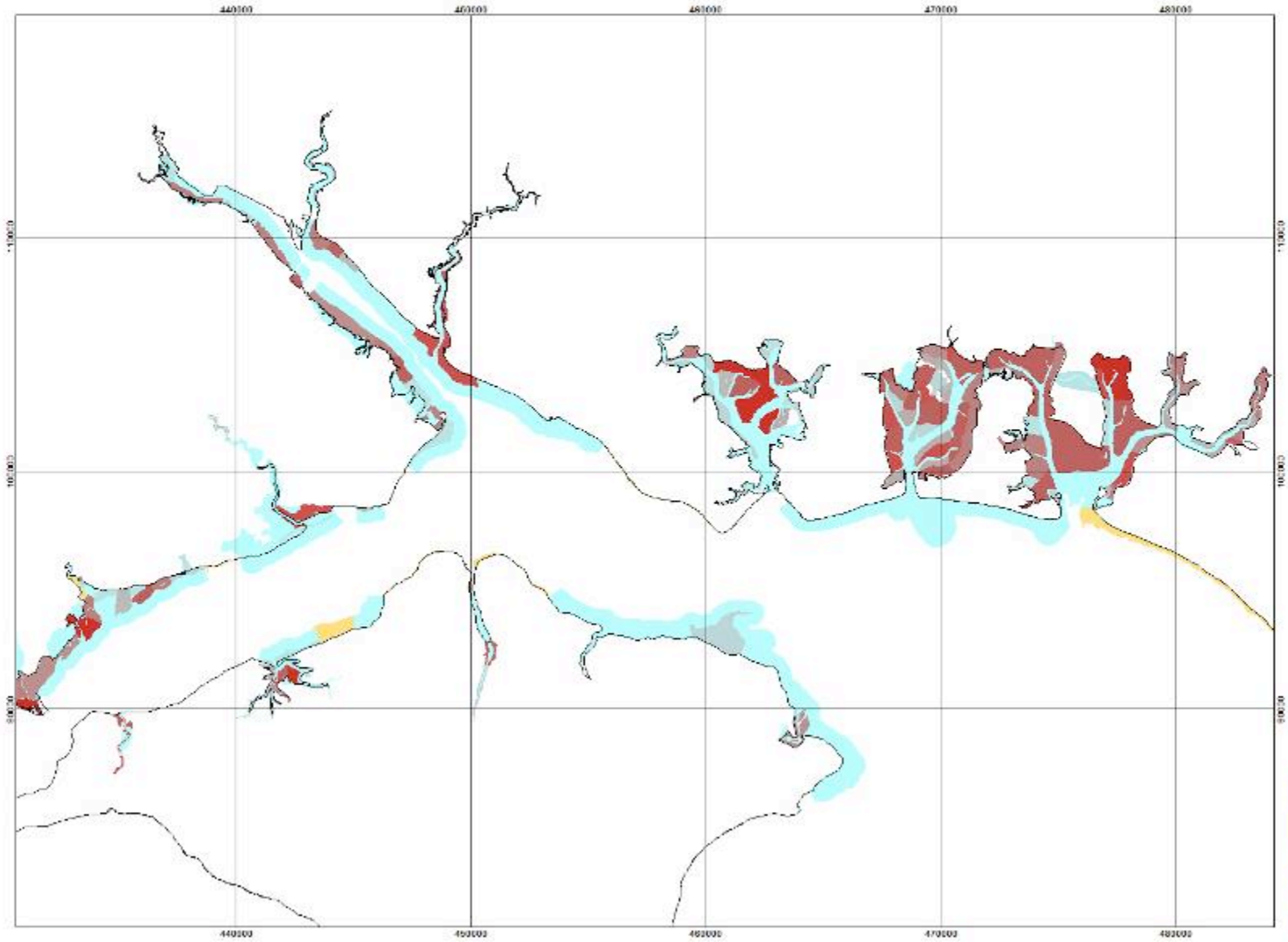
Number of birds

- 150 to 250
- 100 to 149
- 50 to 99
- 25 to 49
- 15 to 24
- 10 to 14
- 5 to 9
- 1 to 2
- 0
- No data



Map 22: Low tide WeBS data for dunlin

Solent disturbance and mitigation project: Phase I

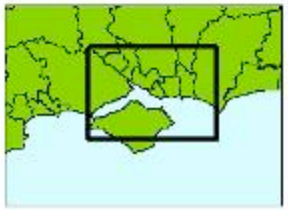


25 November 2008

Scale 1:228500

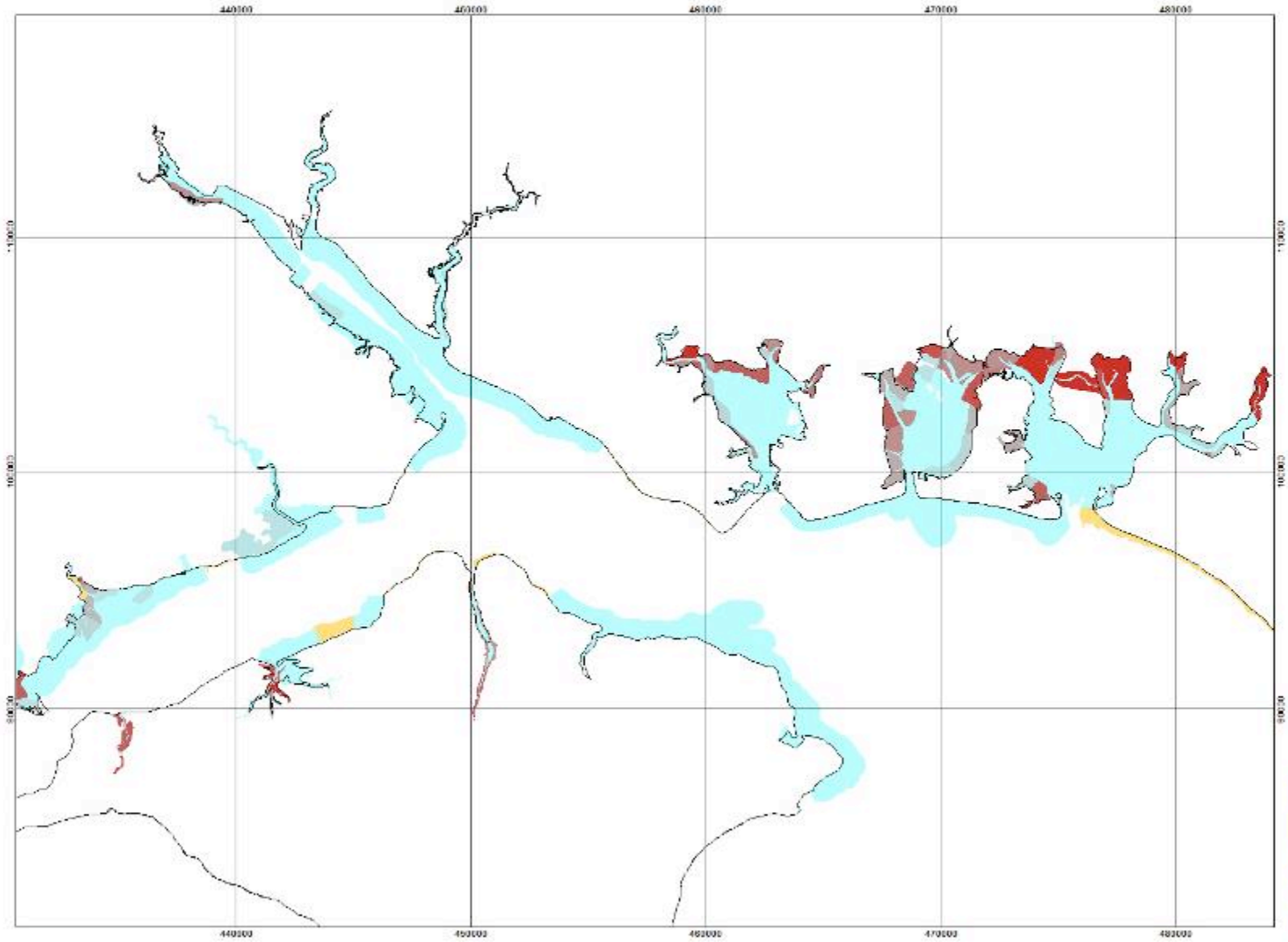
Number of birds

- 1,000 to 2,500
- 500 to 999
- 250 to 499
- 150 to 249
- 100 to 149
- 60 to 99
- 30 to 59
- 10 to 29
- 1 to 9
- 0
- No data



Map 23: Low tide WeBS data for black-tailed godwit

Solent disturbance and mitigation project: Phase I

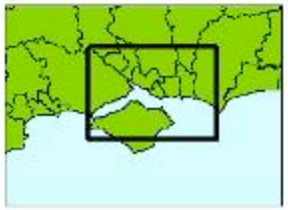


25 November 2008

Scale 1:228500

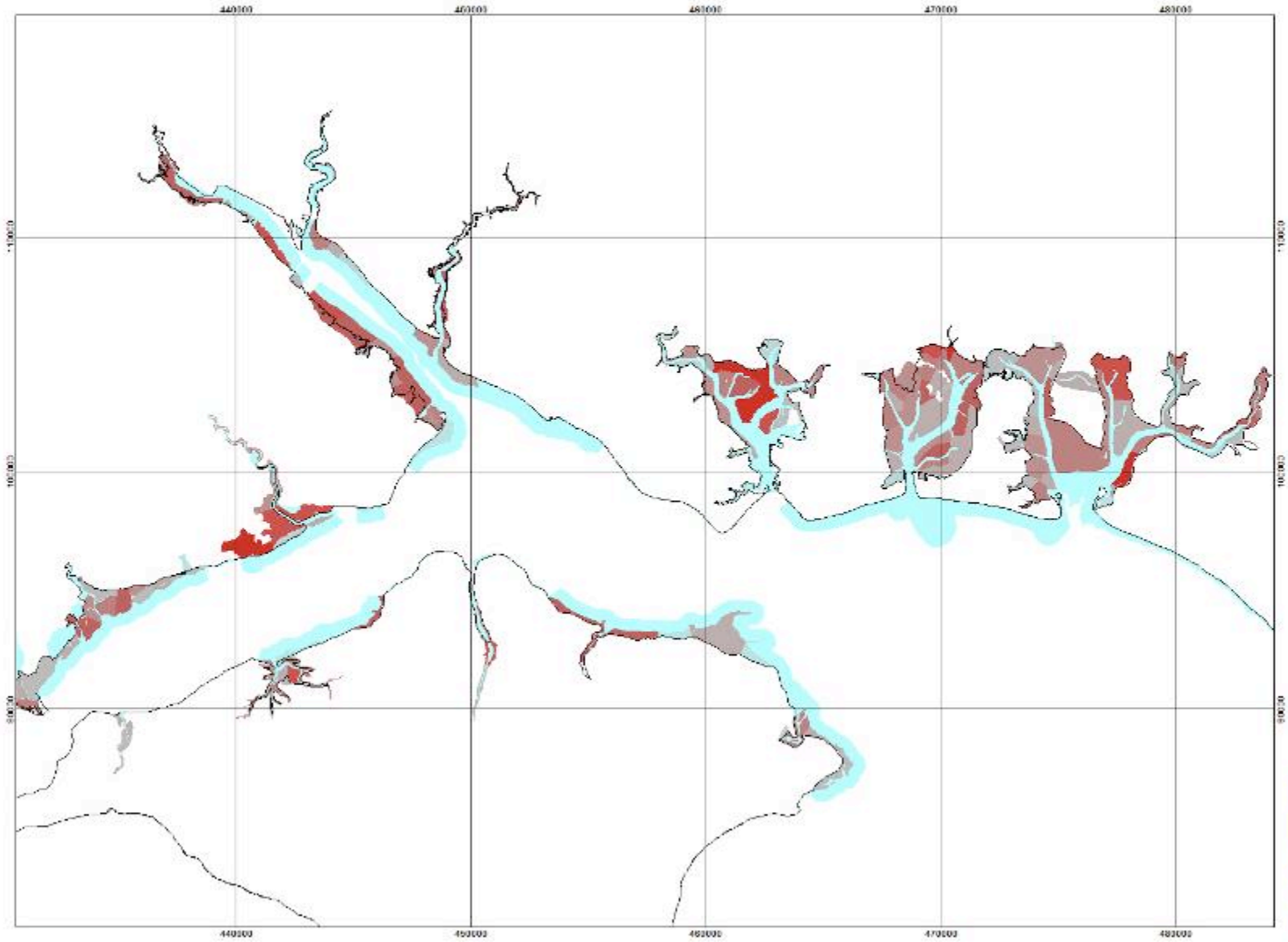
Number of birds

- 45 to 75
- 20 to 44
- 15 to 19
- 9 to 14
- 6 to 8
- 4 to 5
- 3
- 2
- 1
- 0
- No data



Map 24: Low tide WeBS data for curlew

Solent disturbance and mitigation project: Phase I

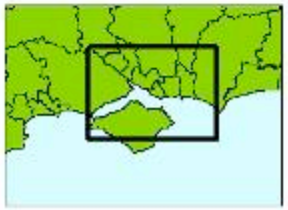


25 November 2008

Scale 1:228500

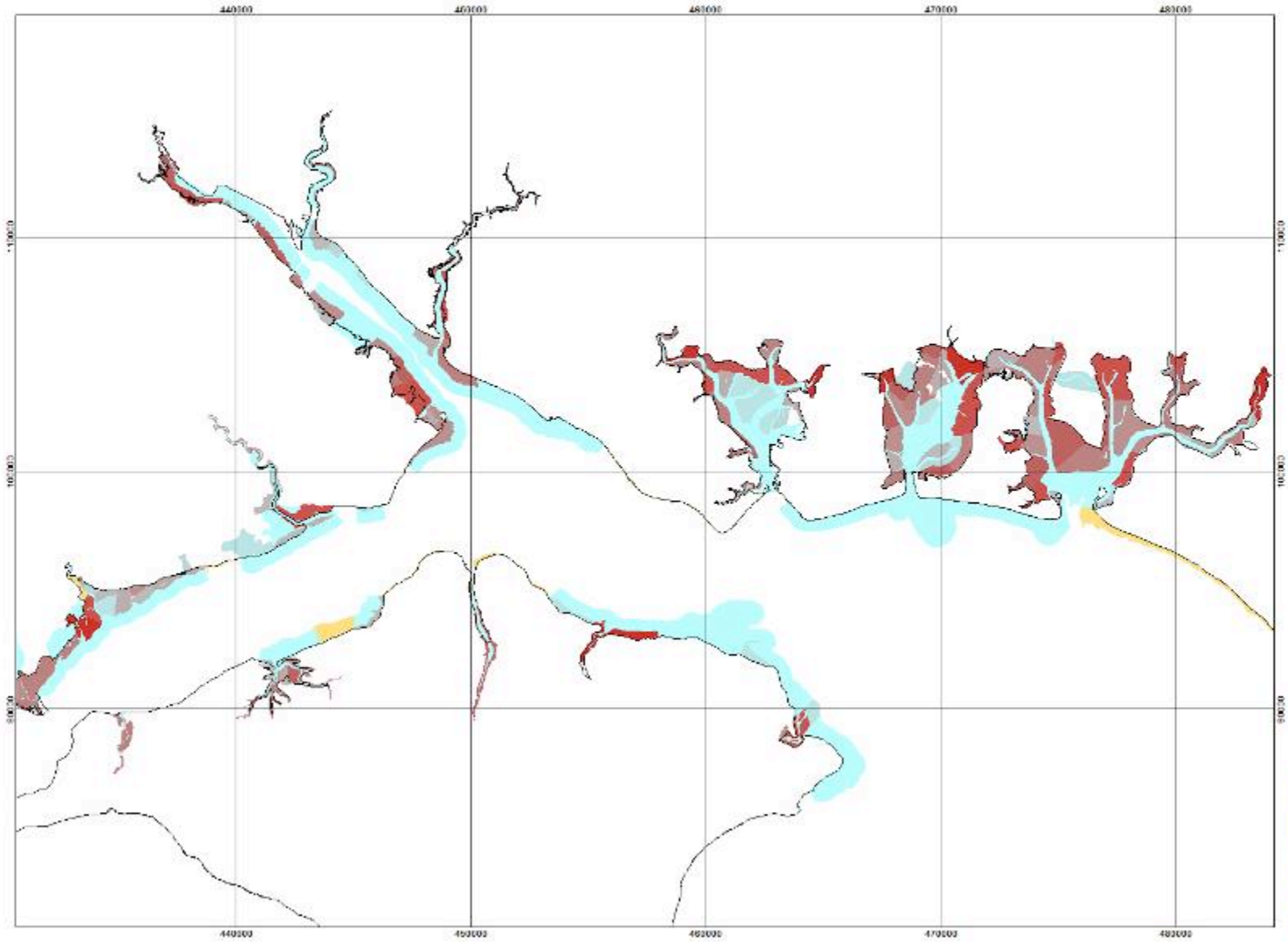
Number of birds

- 60 to 110
- 40 to 59
- 20 to 39
- 12 to 19
- 8 to 11
- 5 to 7
- 3 to 4
- 2
- 1
- 0



Map 25: Low tide WeBS data for redshank

Solent disturbance and mitigation project: Phase I

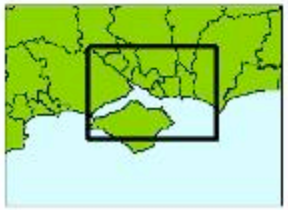


25 November 2008

Scale 1:228500

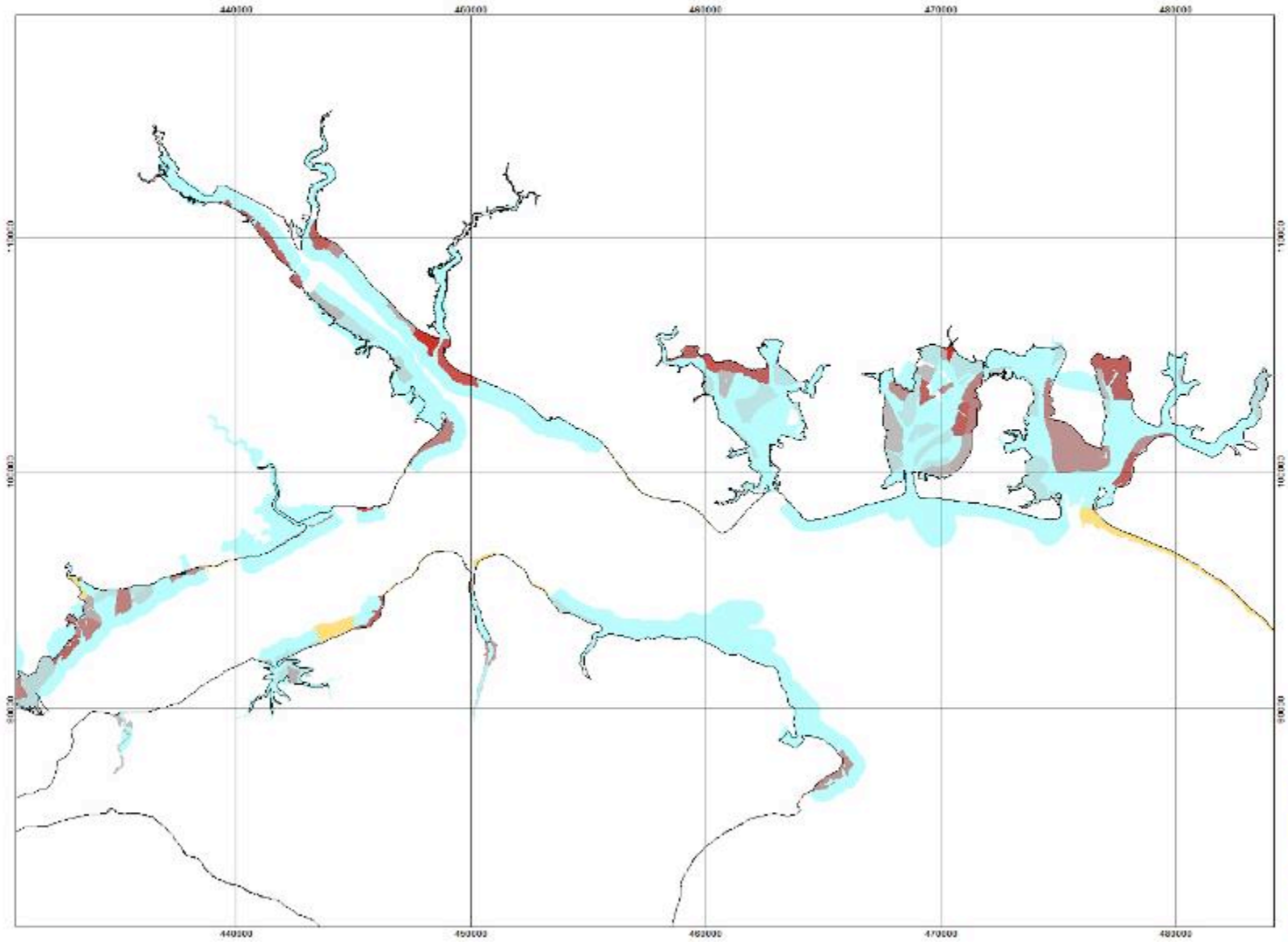
Number of birds

- 50 to 100
- 25 to 49
- 15 to 24
- 9 to 14
- 6 to 8
- 4 to 5
- 3
- 2
- 1
- 0
- No data



Map 26: Low tide WeBS data for turnstone

Solent disturbance and mitigation project: Phase I

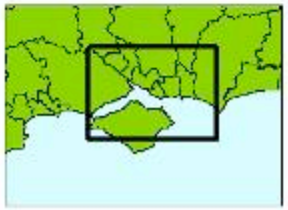


25 November 2008

Scale 1:228500

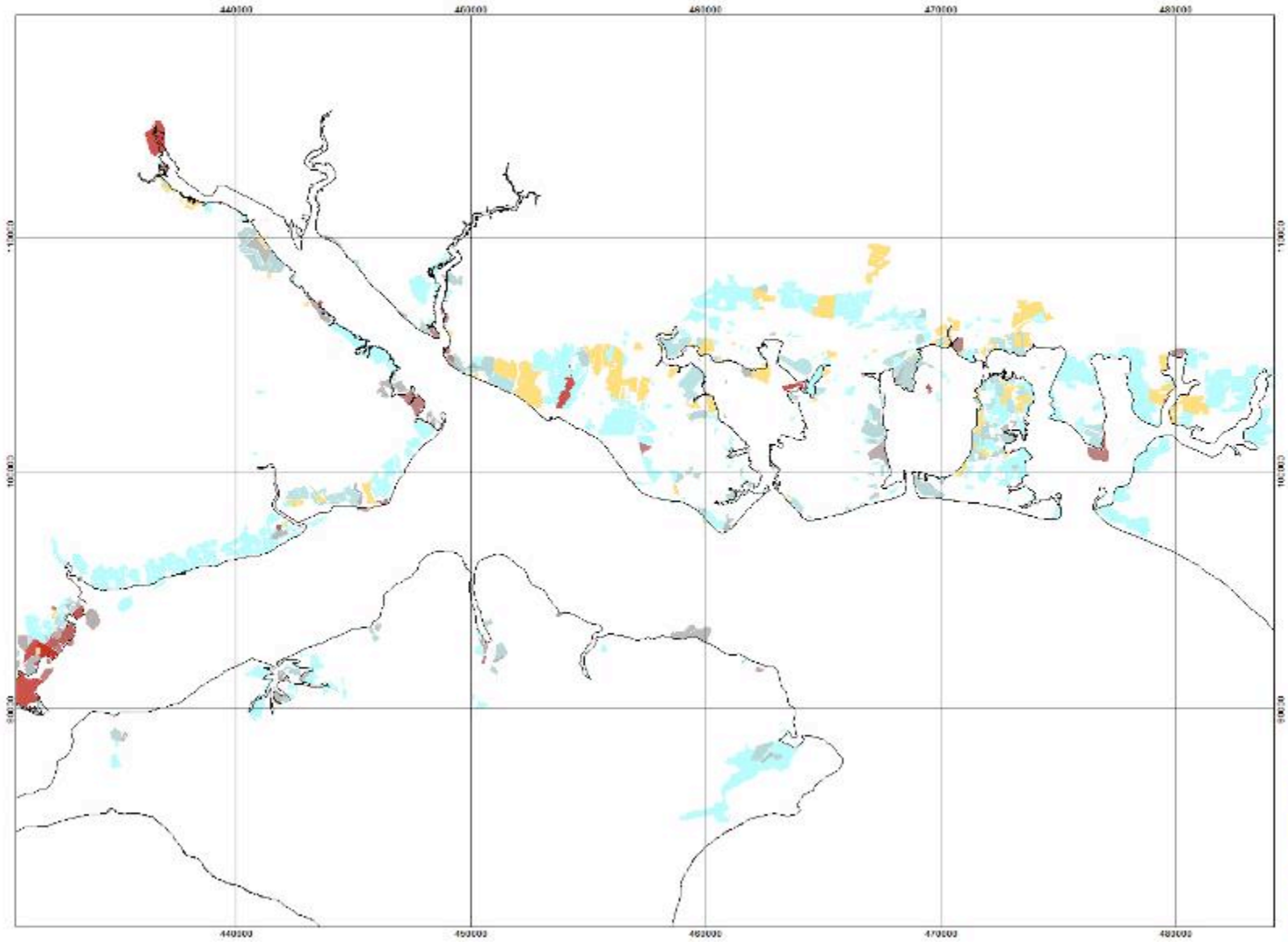
Number of birds

- 40 to 60
- 25 to 39
- 12 to 24
- 8 to 11
- 5 to 7
- 4
- 3
- 2
- 1
- 0
- No data



Map 27: Brent goose strategy mean number of species recorded

Solent disturbance and mitigation project: Phase I

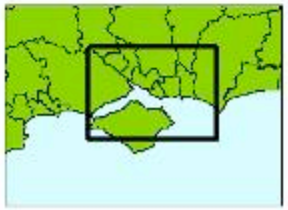


25 November 2008

Scale 1:228500

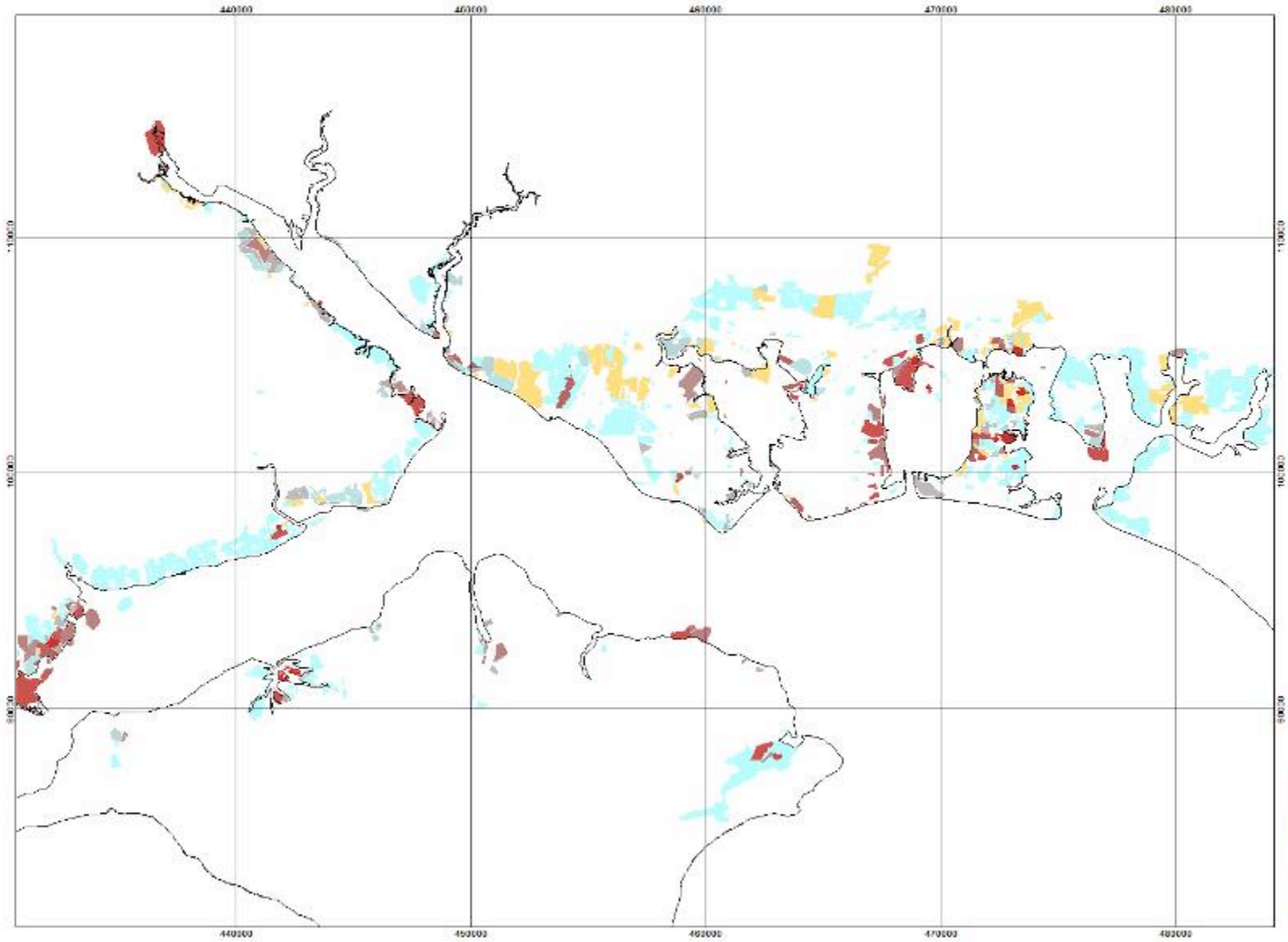
Mean number of species

- 13 to 16
- 10 to 12
- 7 to 9
- 5 to 6
- 4 to 5
- 3 to 4
- 2 to 3
- 1 to 2
- 0 to 1
- 0
- No data



Map 28: Brent goose strategy mean number of birds recorded

Solent disturbance and mitigation project: Phase I



25 November 2008

Scale 1:228500

Mean number of birds

- 600 to 2,500
- 300 to 600
- 150 to 300
- 100 to 150
- 75 to 100
- 50 to 75
- 25 to 50
- 10 to 25
- 1 to 10
- 0
- No data