

Figure 5.2: Potential inter-tidal habitat creation sites in 100 years, with re-alignment allowing natural evolution with buildings and landfill removed

- Where there was an adequate benefit-cost but it was more expensive to re-align than to hold the existing line, the site was categorised as **hold the line** at present.
- Where there was insufficient benefit-cost on the existing or re-aligned route, the site was classified as **abandonment**.
- Where the benefit-cost of the re-aligned route was better or the same as holding the existing line, **re-alignment** or **regulated tidal exchange (RTE)** through a tidal flap was recommended.

5.2.2 Privately maintained defences

During the course of the study it was found that around two thirds of defences in front of potential inter-tidal habitat creation sites are in private ownership and management. The extent of private ownership in the Solent has not previously been recognised by national experts devising policies and approaches to coastal management; this study helped to raise the profile of this important issue. It should be noted that defences maintained by Hampshire County Council and the Ministry of Defence were categorised as publicly funded, rather than privately maintained.

Initial assumptions based on national guidance had to be made about the possible future of private defences in order to complete an initial draft picture for the north Solent. Any of these assumptions can be changed for future management plans.

It was assumed that private owners would wish to continue maintaining their defences on a like for like basis as long as this was practical and they obtained the necessary consents prior to works. Coastal managers advised when such defences were likely to come to the end of their residual life, when maintenance was no longer an option. The current study assumed that these privately owned defences would be abandoned since extensive privately funded capital works might be prohibitively expensive. The majority of privately maintained defences had insufficient benefit-cost. Still, where it is judged likely, an OA could seek to adopt the line of defence when capital works are required.

To summarise, potential re-alignment and abandonment sites were assigned to an SMP time epoch (0-19, 20-49, 50-100 and 100 years+) during which the current defence was judged to reach the end of its residual life and therefore fail.

5.2.3 Re-aligning over a designated freshwater SPA

Of the 54 potential sites being considered, 28 covering 1089 ha were designated as Natura 2000 sites and SSSI landwards of sea walls. Such sites needed further consideration to ensure that any potential re-alignment or abandonment complied with the Habitat Regulations and other policy and procedures. Guidance on how to consider such sites has been provided in recent NE work (Burn and Collins, 2006).

DEFRA have advised that Natura 2000 sites should be defended 'as long as it is sustainable to do so'. This study has only been able to consider how long it would be economically viable to defend a site. Where re-aligning defences landwards would involve a knock-on adverse effect on freshwater habitats then the cost of replacing those habitats was added into the cost of re-aligning.

5.2.4 The influence of abandonment

It was assumed that, where a defence is abandoned by an OA, the inter-tidal habitat created cannot be used as mitigation or compensation to offset a damaging scheme. This was because there is no active intervention to 'secure' the new habitat and there is little certainty when the new habitat might be established. Similarly, it was assumed that sites with defences in private ownership could not be used by operating authorities to offset squeeze.

It is important to note that recent national guidance has suggested that in the future, inter-tidal habitat created through abandonment could help to mitigate or compensate for coastal squeeze under the Habitat Regulations. However, this study did not account for this.

5.3 Questionnaire results

Table 5.1 summarises the questionnaire findings on a north Solent-wide basis. It presents the total area that could be created through the three management options for the 54 sites, the area available to offset against future damaging schemes and also the area of replacement freshwater habitat required. This is over a 100 years timeframe.

	Management option			Total (ha)
	Re-align	Abandon	Hold the line	
Total potential area (ha)	552	686	787	2025
Area available to offset future damaging scheme (ha)	552	0	0	552
Area of replacement freshwater habitat required (ha)	79	328	0	407

Table 5.1: Potential inter-tidal habitat creation across the north Solent over the next 100 years

Figures 5.3 – 5.13 present the overall location and management option for each site. Table 5.2 explains the definitions used.

Definition	Explanation
Re-align	Equal or better benefit-cost to re-align than hold the line
Abandon_OA	No benefit-cost to hold the line or re-align
Abandon_private	
Hold the line	Better benefit-cost to hold the line than to re-align
Natural	No defence present so naturally occurring
Factored out	Either landfill, site under 0.5 ha or not feasible for socio-economic reasons (i.e. – major road)

Table 5.2: Definition explanations

* The following Figures show the maximum available area once buildings are removed. Indicative lines of secondary defence are depicted in Section 5.3 of the Main Report.

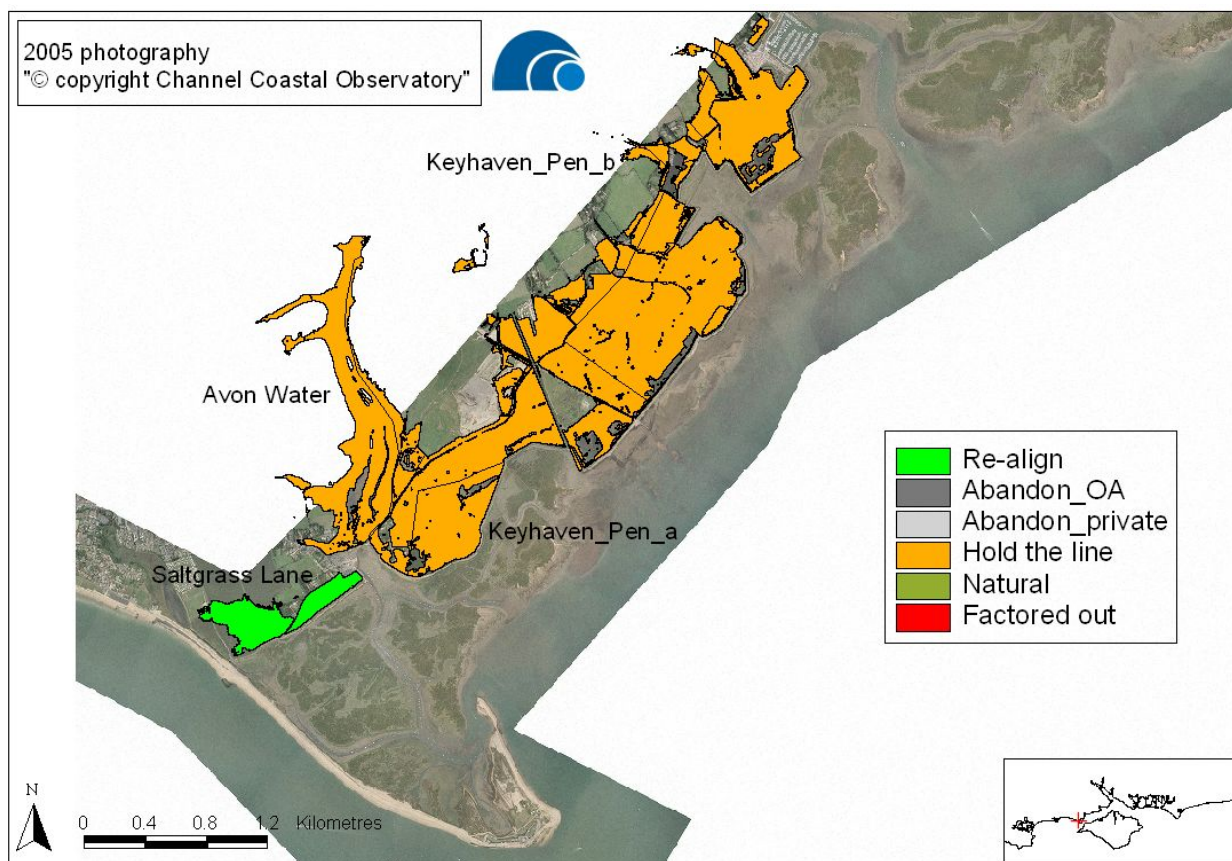


Figure 5.3: Potential habitat creation sites: Hurst Spit and Keyhaven*

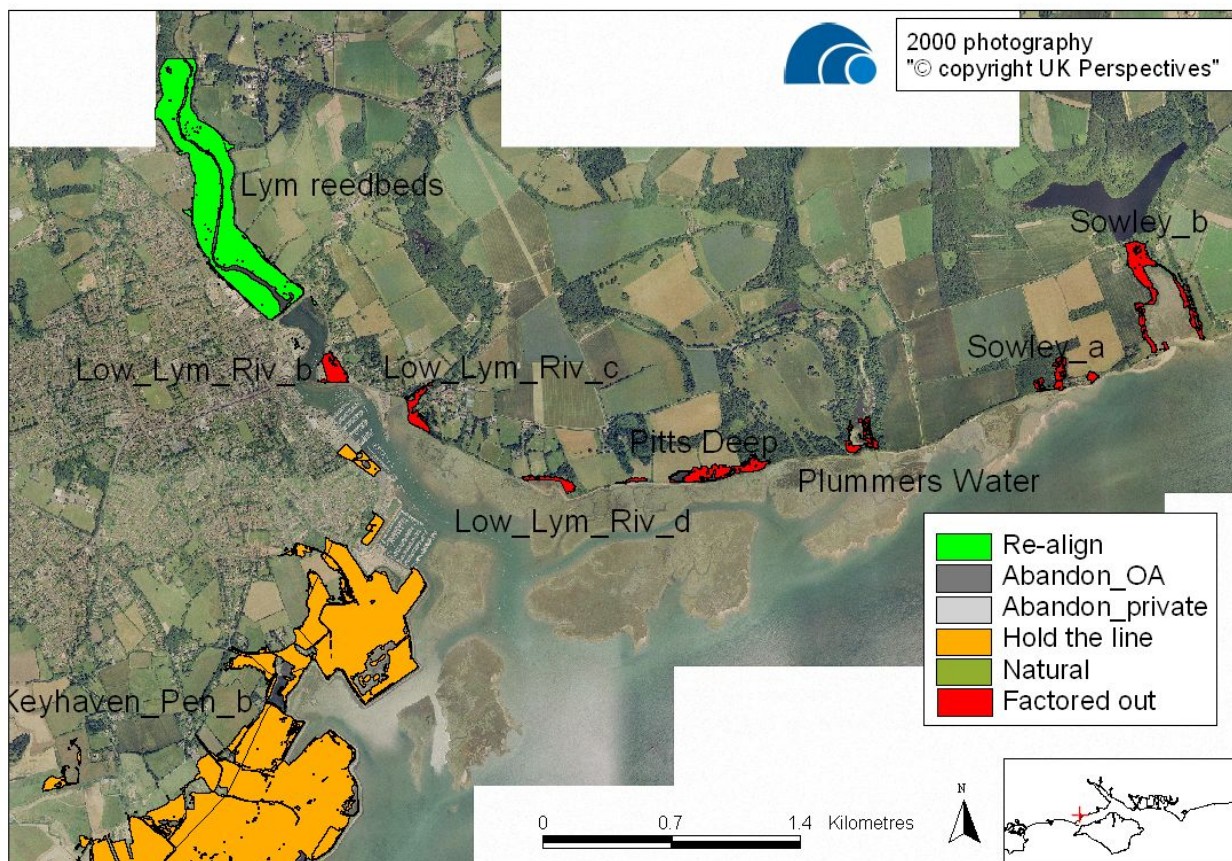


Figure 5.4: Potential habitat creation sites: Lymington and Pitts Deep/Sowley*

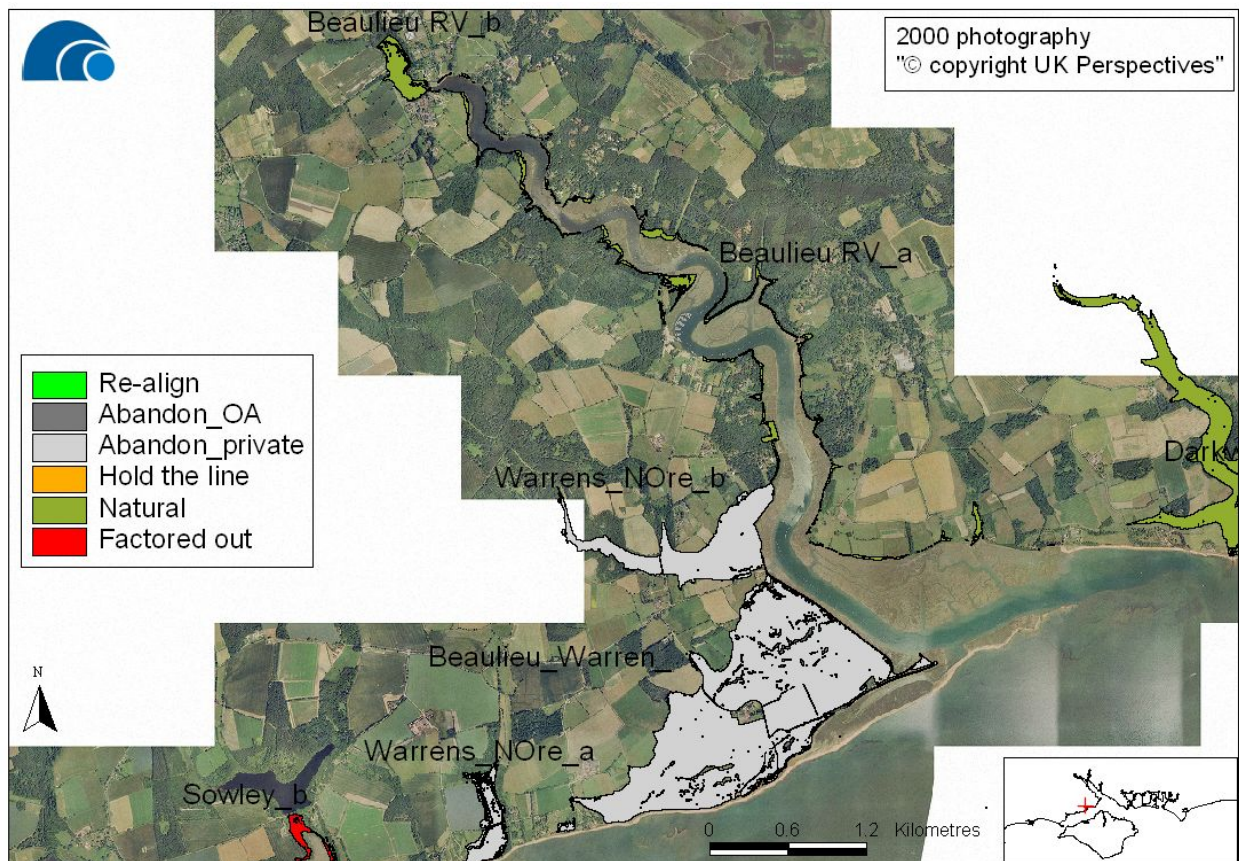


Figure 5.5: Potential habitat creation sites: Beaulieu River*

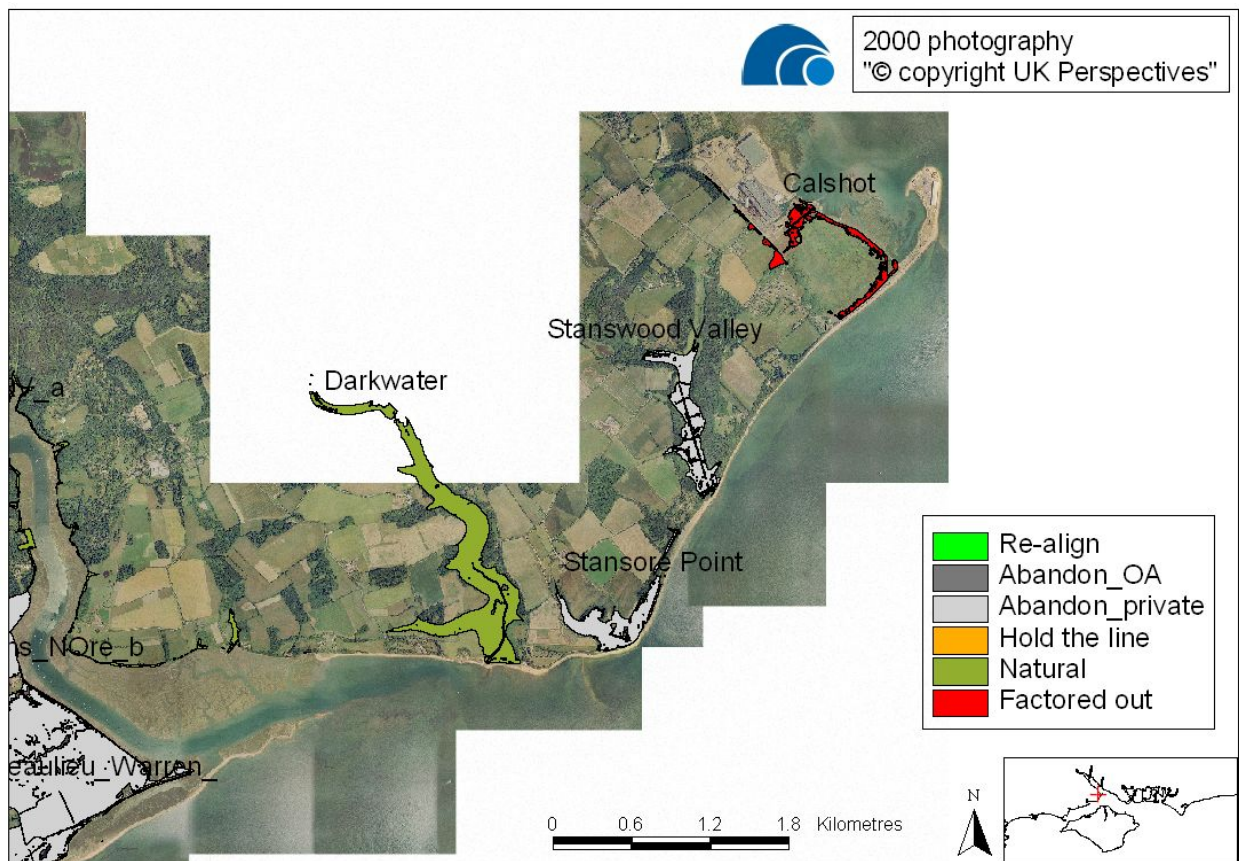


Figure 5.6: Potential habitat creation sites: Calshot*

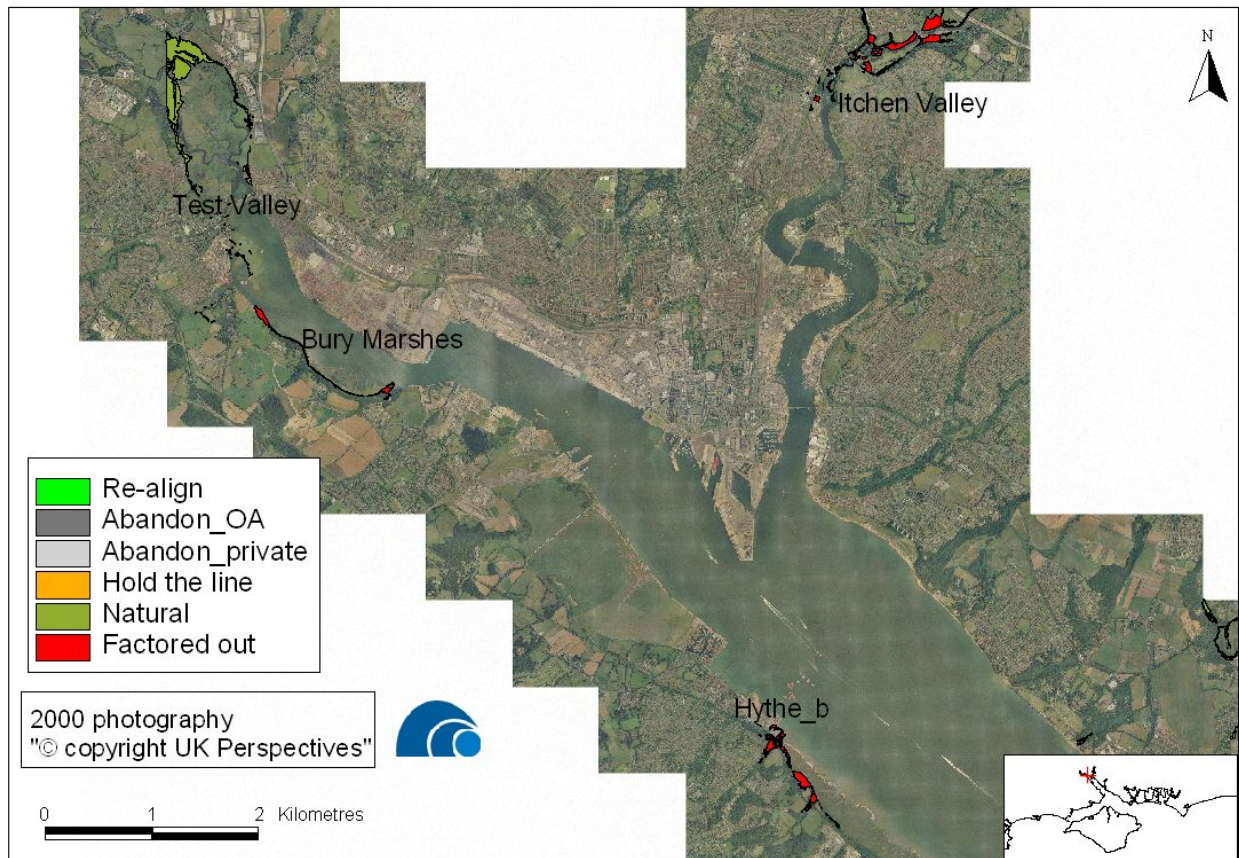


Figure 5.7: Potential habitat creation sites: N Southampton Water*

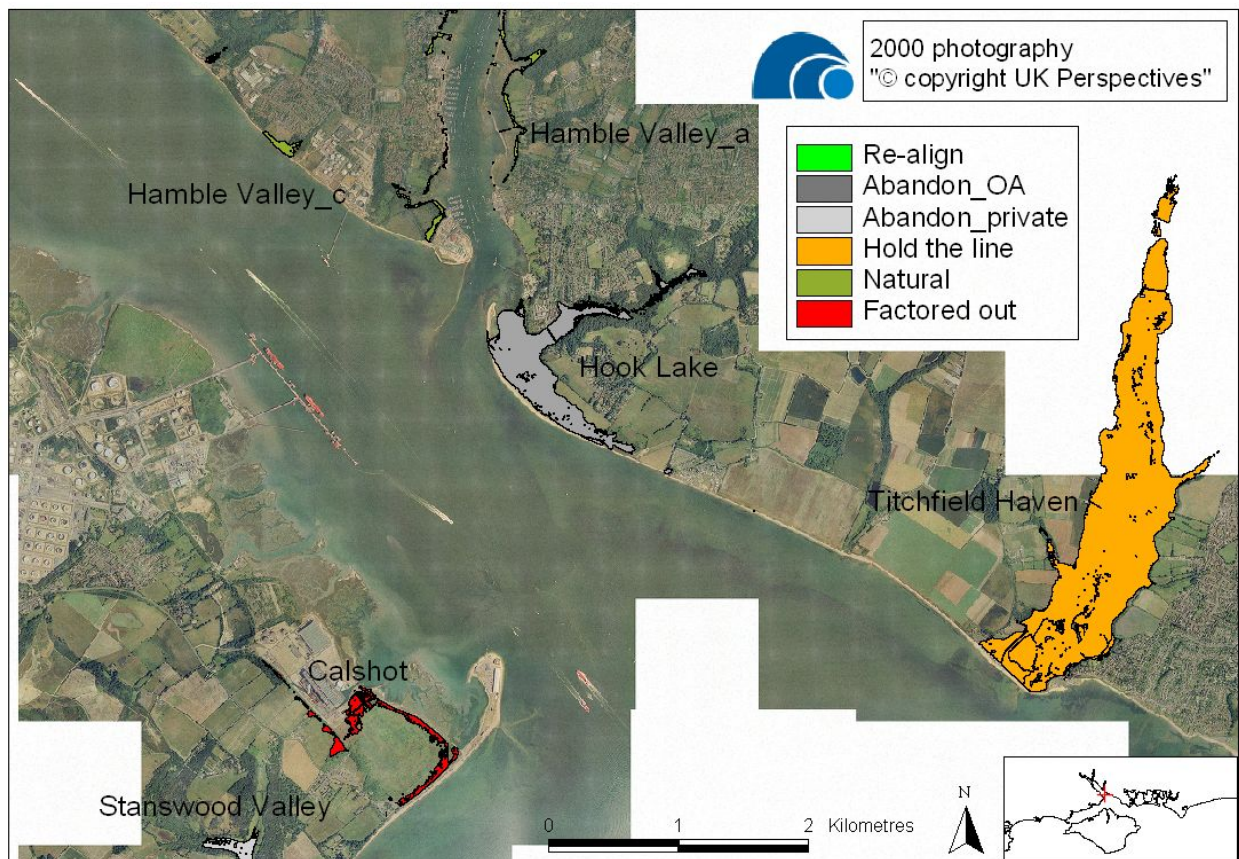


Figure 5.8: Potential habitat creation sites: S Southampton Water*

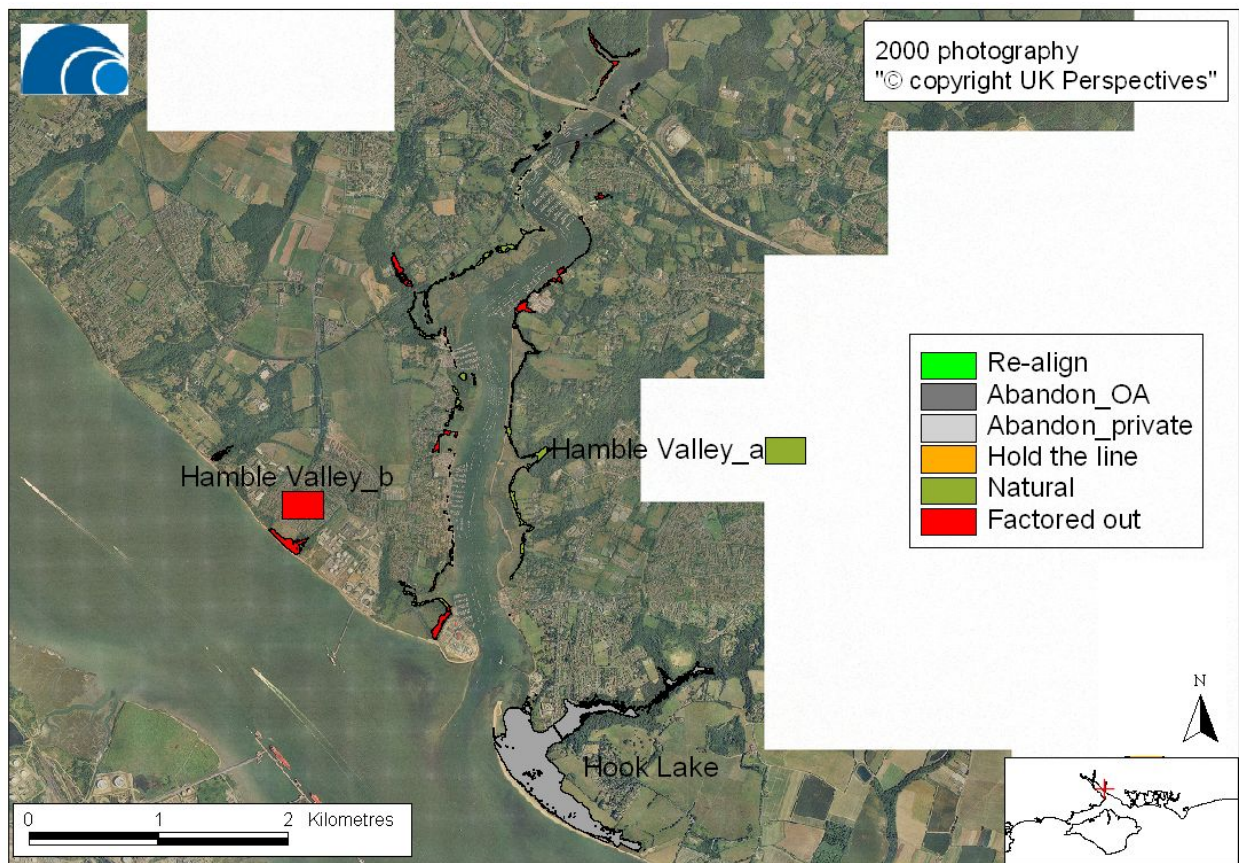


Figure 5.9: Potential habitat creation sites Hamble River*

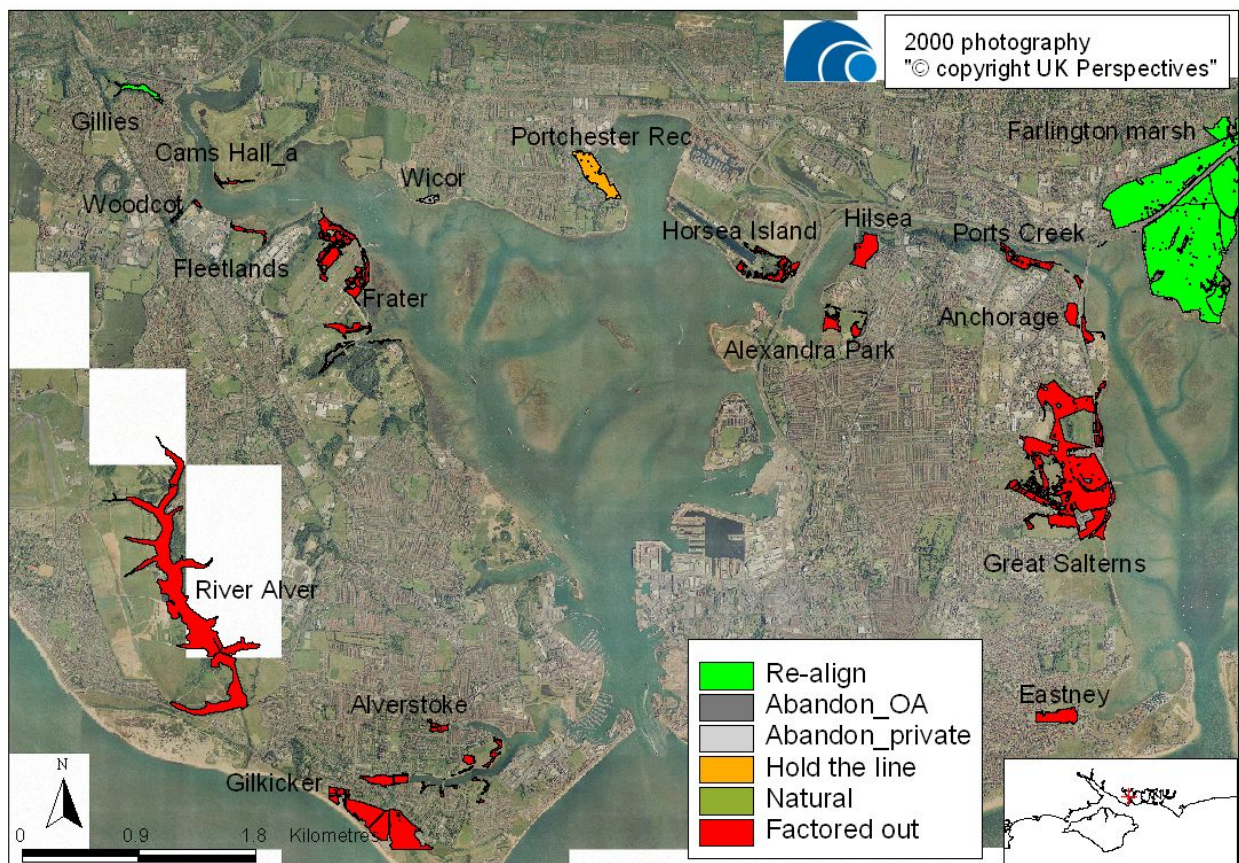


Figure 5.10: Potential habitat creation sites: Portsmouth Harbour*

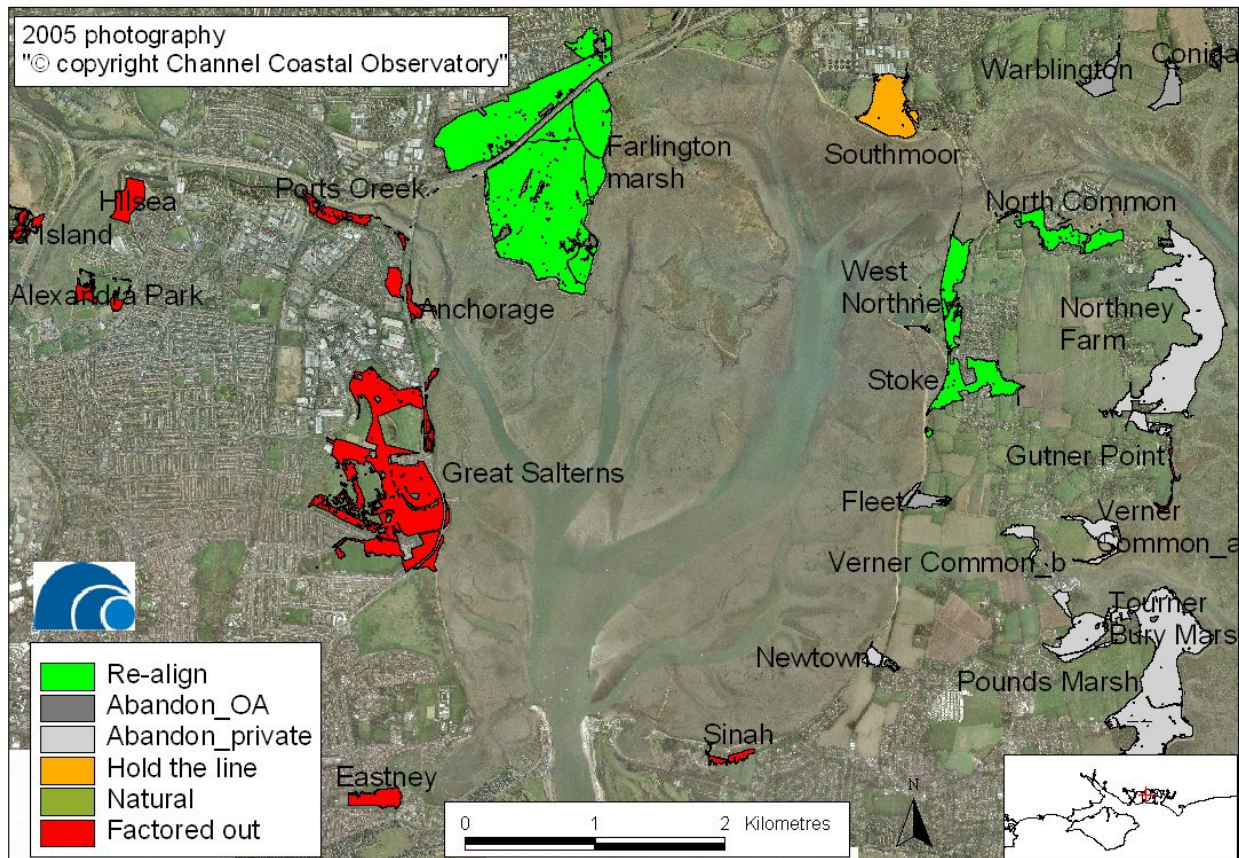


Figure 5.11: Potential habitat creation sites: Langstone Harbour*

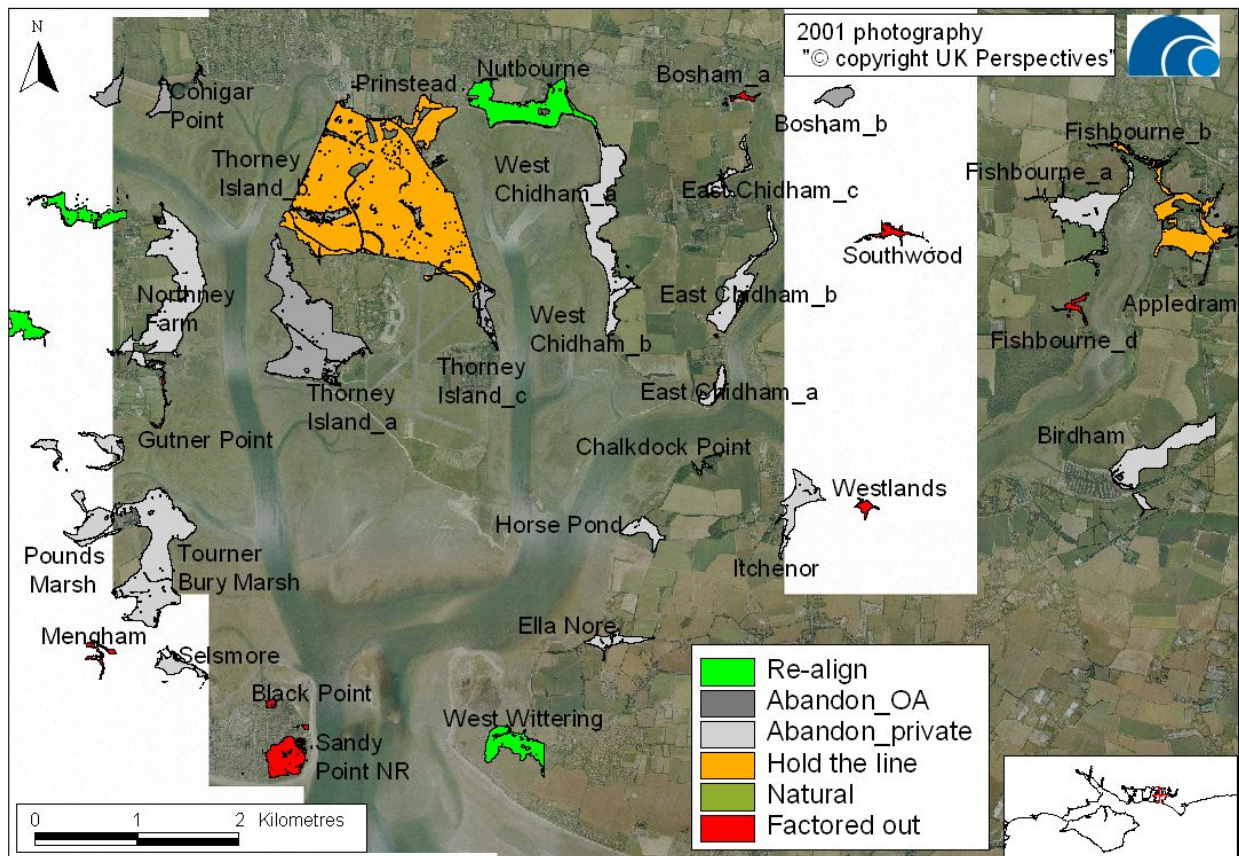


Figure 5.12: Potential habitat creation sites: Chichester Harbour*

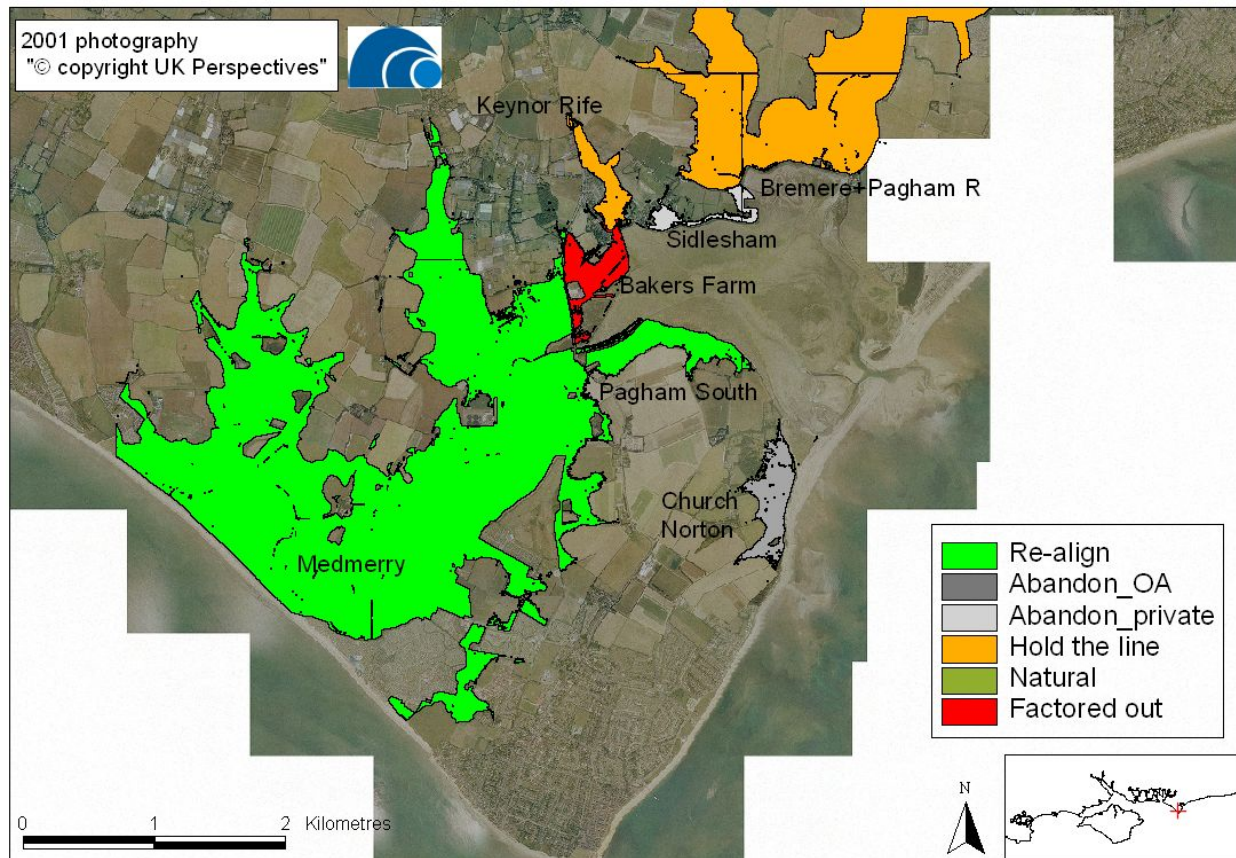


Figure 5.13: Potential habitat creation sites: Pagham Harbour*

5.4 Final ranking of potential habitat creation sites

A matrix was applied to rank the sites within each time epoch; this addressed more detailed issues such as land use, proximity of existing saltmarsh, licensed abstraction sites, historic buildings/scheduled monuments, archaeology, land ownership, rights of way and recreational use (see Appendix 3).

Sites were ranked in each epoch and within their potential management option (i.e. – managed re-alignment, OA abandon, private abandon and hold the line), using the matrix (Table 5.3). Sites located at the top of epochs 0-19, 20-49, 50-100 and 100+ are technically most favourable for re-alignment or abandonment as;

- the land use is either unused or low grade agricultural land
- there is no or little cultural heritage
- there are no or few licensed abstraction sites
- there is low recreational usage
- there are no rights of way
- the land is owned by one statutory body rather than a number of individual private landowners
- the site is greater than 10 ha in area. Those sites greater than 40 ha were weighted.

0-19	Ha	Score	20-49	Ha	Score	50-99	Ha	Score	100+	Ha	Score	Hold the line	Ha	Score	Naturally occurring	Factored out
West Northney	7	29	Pagham South	22.2	29	Stoke	4.6	28	Birdham	25	30	Southmoor	13.9	29	Beaulieu River_a	Alexandra Park
Medmerry	347	27	Thorney Island_c	11.9	24	Nutbourne	25.6	26				Prinstead	8.6	28	Beaulieu River_b	Alverstoke
Gillies	2.2	27	Itchenor	11.5	31	West Wittering	13.6	25				Appledram	10.7	27	Chaldock Point	Anchorage
Farlington Marshes	74	27	Tournerbury	44	29							Bremere and Pag Rife	196	27	Darkwater	Bakers Farm
North Common	4	26	Verner Common_b	2.4	28							Portchester Rec	8.1	26	Gutner Point	Bosham_a
Saltgrass Lane	15.9	24	Pounds Marsh	10.2	27							Fishbourne_b	9.8	26	Hamble_a	Bury Marshes
Lymington Reedbeds	35.6	24	Warren_Nore_b	44.3	27							Thorney Island_b	190	25	Hamble_b	Calshot
Conigar Point	4.1	30	Fishbourne_a	21.3	27							Keynor Rife	13.3	24	Hamble_c	Cams Hall A
Hook Lake	46	29	Beaulieu_Warren	193	27							Titchfield	170	23	Test Valley	Cams Hall B
Bosham_b	4.8	28	Warren_Nore_a	12.3	26							Key_Pen_b	101	23		Cams Hall D
Wicor	1	28	Newtown	1.6	25							Avon Water	40.7	23		Eastney
Thorney Island_a	63.3	28	East Chidham_a	4.7	24							Key_Pen_a	24	21		Fishbourne_d
Warblington	4.8	27														Fleetlands
Fleet	2.3	26														Frater
Church Norton	21.1	21														Gilkicker
Northney Farm	46	28														Great Salterns
Ella Nore	5.1	27														Hilsea
West Chidham_a+b	37	27														Horsea Island
Stanswood Valley	13.7	27														Hythe_b
Verner Common_a	6	26														Itchen Valley
Horse Pond	5.8	25														Lower Lym_b
Stansore Point	15.4	25														Lower Lym_c
Sidlesham	8	25														Lower Lym_d
East Chidham_c	4.7	24														Mengham
East Chidham_b	16.6	23														Pitts Deep
Selsmore	3.7	23														Plummers Water
																Ports Creek
																River Alver
																Salterns
																Sandy Point
																Sinah
																Sowley_a
																Sowley_b
																Westlands
																Woodcot

	Re-align (OA)
	Abandon (private)
	Abandon (OA)
	Hold the line (OA)
	Naturally occurring
	Factored out

Table 5.3: Epoch and ranking of potential habitat creation sites

Following this approach across the north Solent, in summary there are:

- 11 potential re-alignment sites covering an area of 552 ha
- 31 potential abandonment sites covering an area of 686 ha
- 12 sites identified as hold the line covering an area of 787 ha

The 11 potential re-alignment sites that could be used to offset damaging schemes (552 ha) (Table 5.3) are,

1. West Northney
2. Medmerry
3. Gillies
4. Farlington Marshes
5. North Common
6. Saltgrass Lane
7. Lymington Reedbeds
8. Pagham South
9. Stoke
10. Nutbourne
11. West Wittering

The 552 ha available for mitigation and compensation to offset inter-tidal squeeze was considerably less than the total potential re-alignment and abandonment options (1238 ha) (Table 5.1).

6 Balancing inter-tidal loss with potential habitat creation sites

6.1 Geographical pattern of sites

The spatial distribution across the north Solent of the questionnaire findings is presented in Figure 6.1. Ideally coastal squeeze should be offset as close to the location of habitat loss as possible (McMullon and Collins, 2003), and efforts should be made to mitigate for habitat losses within each European designated site. Where a potential habitat creation site falls within an SPA, the area is classed as mitigation for coastal squeeze, as opposed to compensation, if found outside the SPA. The balance of coastal squeeze versus potential mitigation / compensation in each SPA (Figure 1.6) is clarified in Table 6.1. The potential mitigation and compensation values are taken from the 552 ha of potential re-alignment sites only. Coastal squeeze was estimated over 100 years assuming maintenance of all existing sea defences causing coastal squeeze (Section 4.3).

SPA	SQUEEZE (ha)	POTENTIAL GAIN (ha)		Deficit (ha)
		Mitigation (inside SPA)	Compensation (outside SPA)	
Solent and Southampton Water (SPA)	136 - 163	41	11	83 - 112
Portsmouth (SPA)	172 - 206	0	2	170 - 204
Langstone and Chichester (SPA)	195 - 231	92	37	66 - 102
Pagham (SPA)	0	2	367	-369
Total: north Solent range	500 - 600	135	417	-52 - 48

Table 6.1: Coastal squeeze versus potential mitigation/compensation within each SPA

Table 6.1 shows that the SPAs in the north Solent (excluding Pagham Harbour), cannot provide enough mitigation to offset the inter-tidal coastal squeeze which results from the current defence configuration. Even when adjacent compensation sites are included, there is a deficit in all SPAs apart from Pagham Harbour. Pagham is an exception because not only is there no inter-tidal coastal squeeze predicted over the next 100 years but there is huge compensation potential from the Medmerry and Pagham South sites (Table 5.3). The compensation sites from the Pagham Harbour SPA (367 ha) have the potential to offset coastal squeeze elsewhere in the Solent. However, funding mechanisms may be complicated when re-aligning sites that are not directly linked to a damaging scheme.

The findings support the need for a coherent Solent-wide approach to offsetting inter-tidal coastal squeeze on a region wide basis.

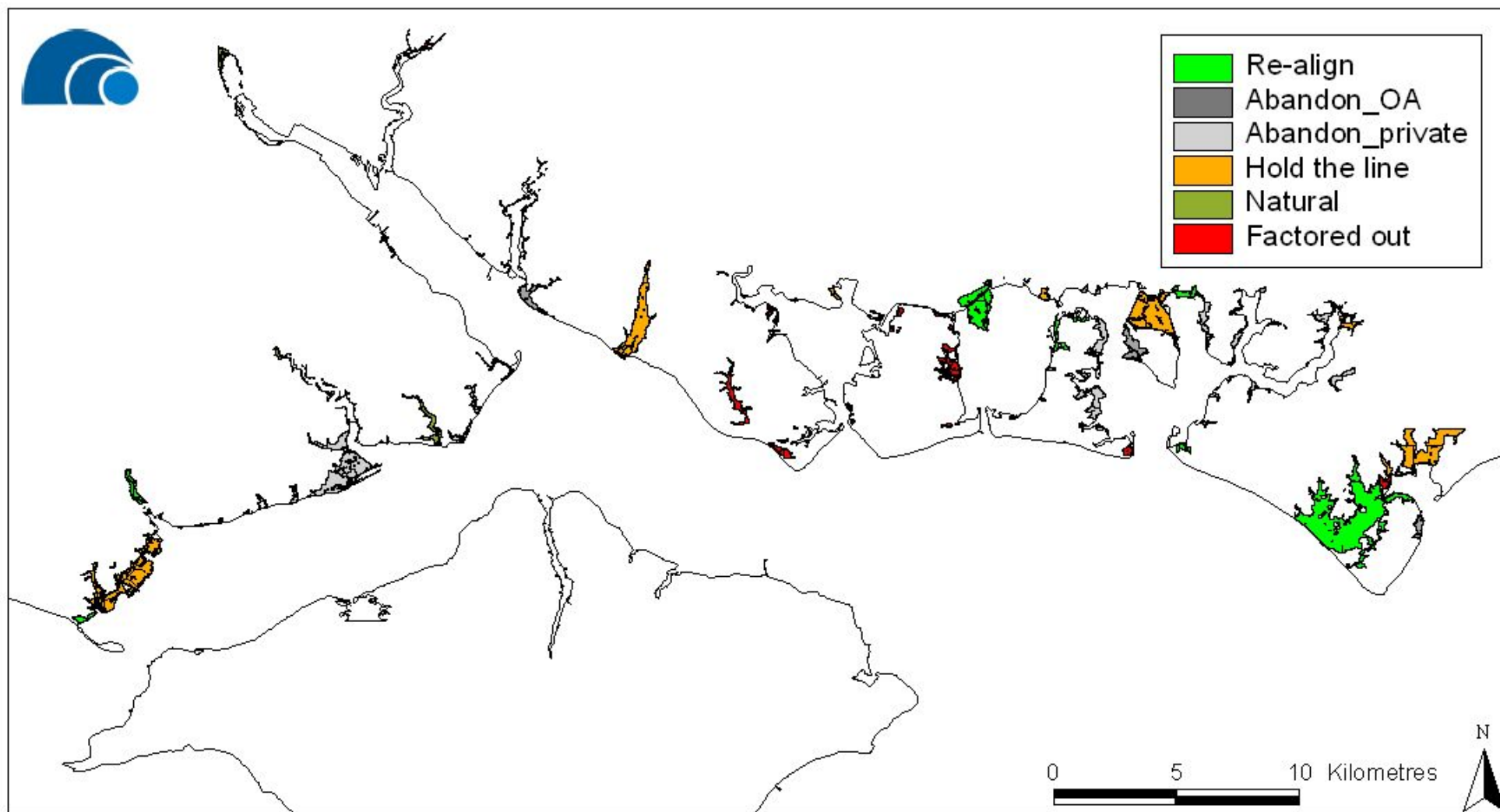


Figure 6.1: Overall north Solent management options

6.2 Balance of gains and losses through time

A suggested timeline for all potential habitat creation sites (2025 ha) is shown in Figure 6.2, using the assumptions made in this study. Potential managed re-alignment sites are balanced against the predicted inter-tidal coastal squeeze throughout the epochs. The coastal squeeze target reduces from approximately 600 ha to 42 ha throughout time, as the potential managed re-alignment sites (552 ha) are gradually implemented (Figure 6.2). Even though abandonment sites cannot currently be used for mitigation or compensation, the defences will no longer cause coastal squeeze, thus the coastal squeeze target could reduce further than shown in Figure 6.2 (Cope *et al.*, 2007b).

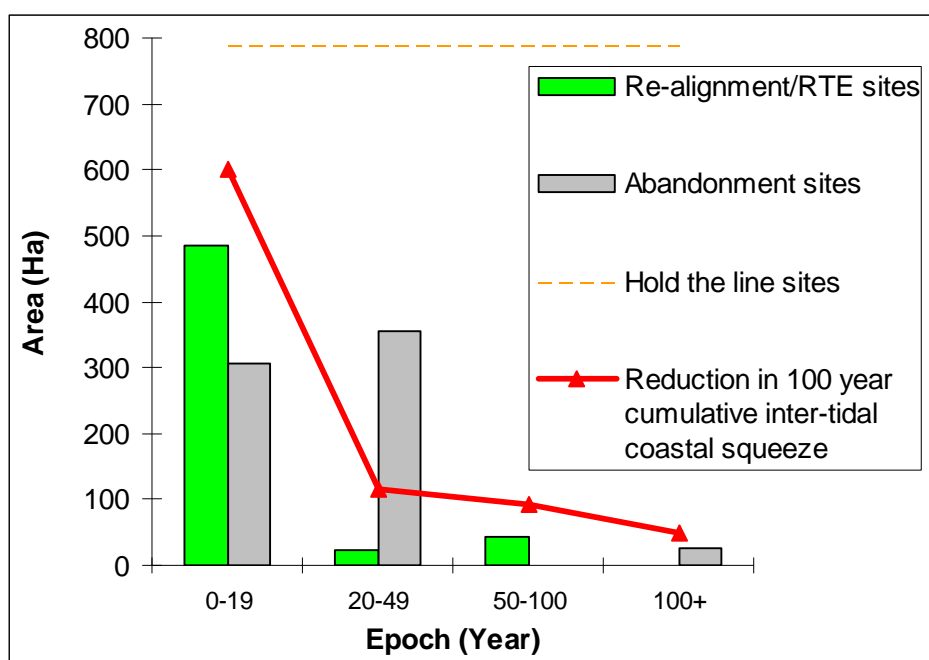


Figure 6.2: Epoch in which potential inter-tidal habitat creation sites may come online

The majority of sites fall into the 0-19 epoch when the defences come to the end of their residual life (Figure 6.2). The overall near balance of potential managed re-alignment gains and coastal squeeze losses, plus the early peak, is very much dependent upon the Medmerry site. Without this one potential re-alignment site, the north Solent will fall short of some 347 ha out of 500-600 ha required. OAs could seek to adopt some of the sites categorised as hold the line or abandonment to offset this shortfall. Those sites that do not require secondary defences and are non-designated should be addressed first.

6.3 Replacement freshwater habitat

All defences currently protecting designated Natura 2000 sites come to the end of their residual life within 50 years and are not 'sustainable' to defend beyond that time. Re-aligning or abandoning a defence over landward designations results in a requirement for 79 ha and 328 ha respectively, of replacement freshwater habitat (Table 5.1). The creation of this habitat is a legal requirement for OAs. Based on the estimate that it can take 50 years to re-create freshwater habitat, replacement needs to start now, in epoch 0-19.

7 Conclusions and recommendations

Key findings from the Solent Dynamic Coast Project are summarized in Table 7.1.

Key findings	Length/Area
Length of north Solent coastline	314 km
Length of north Solent defences	283 km
Mudflat area now	5549-6311 ha (CHaMP, 2003)
Saltmarsh area now	1042 ha
Total inter-tidal habitat loss over next 100 years	752 ha
Coastal squeeze requiring replacement inter-tidal habitat over next 100 years	500 - 600 ha
Overall potential inter-tidal gain under natural evolution over next 100 years	3883 ha (100 sites)
Sites of potential inter-tidal gain taken forward for further analysis	2025 ha (54 sites)
Sites identified for potential inter-tidal re-alignment	552 ha
Sites identified for potential inter-tidal abandonment	686 ha
Sites identified as potential hold the line	787 ha
Area of potential re-alignment sites that can be used as inter-tidal mitigation/compensation	552 ha
Area of freshwater habitat requiring replacement from potential inter-tidal re-alignment sites	79 ha
Area of freshwater habitat requiring replacement from potential inter-tidal abandonment sites	328 ha

Table 7.1: Key findings from the Solent Dynamic Coast Project (north Solent)

The following key findings arose from this study:

- 1 More than 50% of the flood defences in front of all potential habitat creation sites (re-alignment, abandonment and hold the line) in the north Solent will reach the end of their residual life in the next 20 years and a further 30% in the next 50 years.
- 2 Coastal squeeze requiring replacement inter-tidal habitat (500-600 ha) assumed all current defences will be maintained. This is a worse case scenario. Where defences are identified for managed re-alignment or abandonment in the North Solent SMP, they will no longer be contributing to coastal squeeze, thus the coastal squeeze target could reduce.

- 3 11 sites were identified for potential managed re-alignment (552 ha) over the course of the next 100 years, which are all likely to have adequate benefit-cost at the time of re-build.
- 4 The 11 key sites to focus on for managed re-alignment, in order of ranking are as follows; West Northney, Medmerry, Gillies, Farlington Marshes, North Common, Saltgrass Lane, Lymington Reedbeds, Pagham South, Stoke, Nutbourne, and West Wittering (Table 5.3).
- 5 It will not be possible to balance habitat gains and losses within each Natura 2000 site apart from the Pagham Harbour SPA. A balance across a 'north Solent' scale is the most appropriate.
- 6 The near-balance of inter-tidal loss and gain across the north Solent is only achievable because of the huge potential habitat creation at Medmerry, potentially contributing around 50% of the 500 – 600 ha required.
- 7 Based on the assumptions of this study, the north Solent would fall short of around 347 ha of compensation land without the Medmerry site.
- 8 Recent national guidance has suggested that in the future, inter-tidal habitat created through abandonment could, not only be used to offset the BAP target and help achieve the SSSI target but could mitigate or compensate for coastal squeeze under the Habitat Regulations. This study did not account for this.
- 9 OAs could seek to adopt some of the sites categorised as hold the line or abandonment to offset any shortfall. Those sites that do not require secondary defences and are non-designated should be addressed first.
- 10 This study indicates that potential changes to management practice will result in a legal requirement to replace 407 ha of freshwater habitat. 79 ha are from potential re-alignment sites and form a necessary element of the suggested approach to offset coastal squeeze in the Solent. 16 ha are from potential OA abandonment sites and 311 ha are from potential private abandonment sites. This requirement will not be an obligation for private landowners.
- 11 The cost of creating and maintaining new, designated freshwater habitat where existing habitat is subject to adverse effect from managed re-alignment requires much greater scrutiny within the SMP process. It is possible that the high cost of such a requirement could significantly alter the pattern of suggested managed re-alignments described in this study.
- 12 It can take up to 50 years to re-create designated freshwater habitat currently existing behind our seawalls. The fact that most of these sea walls may fail within 50 years puts this habitat at high risk in the Solent.
- 13 A substantial proportion (over 60 %) of the defences fronting potential habitat creation sites are managed by private landowners.

- 14 The HPI and LiDAR and tidal elevation interpretation are complementary tools for assessing historical inter-tidal trends and future change. In addition, the LiDAR and tidal elevation interpretation was a good technique for identifying potential inter-tidal habitat creation areas.
- 15 A sensitivity analysis will be required for the North Solent SMP in line with new Government guidance on sea level rise, because the old guidance for 6mm per annum guidance was applied in this investigation.
- 16 The interview procedure with the local coastal managers provided a valuable collaborative exercise between LAs, the EA, NE, County Councils and Harbour Authorities.

The SDCP project assigned sites to epochs on a site by site assessment to form a strategic approach to offsetting inter-tidal coastal squeeze. The potential managed re-alignment sites (552 ha) maybe politically controversial, particularly with landowners and may not be fully realised until a much later date, if at all. Further investigation and discussion is required prior to re-alignment of these sites. Implications on the geomorphology and hydro-dynamics of estuaries and harbours will have to be considered.

Unless abandonment sites can be used for mitigation or compensation, or additional funding is found to re-align sites that are hold the line, then there could be a shortfall of inter-tidal habitat creation in the north Solent. This is likely to be a particular problem, especially if certain sites identified for re-alignment are not implemented.

Findings from the SDCP and detail on individual potential sites will feed into the North Solent SMP. The SMP will decide whether sites are hold the line, managed re-alignment or abandonment (termed “No Active Intervention” in SMP), and will test this with full public consultation. The SMP will therefore confirm the actual coastal squeeze losses. It is valuable to have a unified approach to offsetting coastal squeeze across not only the north Solent but the Isle of Wight also and between all OAs. The EA southern RHCP will be the vehicle for delivery. Findings from the SDCP and Isle of Wight Mitigation Study will feed into the RHCP.

Aside from the SMP process, this study has highlighted the top 7 sites in the first epoch that require feasibility studies for realignment. The EA is currently trying to obtain funding to start these studies urgently.

It is important to recognise that this project has raised the administrative and political complexities of the Solent with national experts for the first time. As a consequence, the EA RHCP are involving LAs for the first time.

The work has been undertaken by the key statutory authorities. However, this study has not involved any decision making on the part of any statutory authority. The options suggested in this study are there to facilitate future debate and decision making as part of the SMP process. No landowners or wider stakeholders have been consulted as part of the project. These views will be sought as part of the SMP process. The SMP process will integrate all aspects of sustainable development, social, economic as well as environmental, prior to any final decisions on coastal management being made.

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http 2: <http://www.ukbap.org.uk/GenPageText.aspx?id=98>

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Glossary of terms

Accretion	Accumulation of sand, mud follicles or other beach material due to the natural action of waves, currents, wind and tide
Abandonment site (No Active Intervention)	Refers to potential habitat creation sites where there is no benefit-cost on the existing or re-aligned defence
Biodiversity Action Plan	A national action plan for a key habitat or species, approved by Government, as part of the overall UK Biodiversity Action Plan
Coastal Defence	The general term applied to coast protection and sea defence
Coastal Grazing Marsh	Periodically inundated pasture, or meadow with ditches which maintain the water levels, containing standing brackish or fresh water
Coastal Squeeze	Where a sea defence inhibits landward migration of designated inter-tidal habitat
Compensation	To offset coastal squeeze outside a European designation
CHaMP	A non-statutory management plan which identifies potential future changes to coastal habitats and potential compensation measures for any losses to a European designated site or group of sites

Erosion	The loss of land or encroachment by the sea through a combination of natural forces e.g. wave attack, slope processes, high groundwater levels
Floodplain	The low relief area adjacent to a river or the sea that is periodically inundated by floodwater
Geomorphology	The study of landforms and land forming processes
Habitat	The environment of an organism and the place where it is usually found
Hold the line	Maintain or upgrade level of protection provided by defences
Inter-tidal	Area between Lowest Astronomical Tide (LAT) and Highest Astronomical Tide (HAT)
Managed Realignment	Also referred to as Managed Retreat , is the setting back of coastal defences to achieve environmental, economic and/or engineering benefits. This process is usually undertaken in low lying estuarine areas to combat coastal squeeze
Mitigation	To offset coastal squeeze within a European designation
Mudflat	An area of fine sediments that is inundated at high tide but exposed at low tide
No Active Intervention	Not to invest in providing or maintaining defences
Operating Authority	The Environment Agency and Local Authorities
Regulated Tidal Exchange	Regulated exchange of sea water to an area behind fixed sea defences through engineered structures such as sluices, pipes or tidal gates to create inter-tidal habitat
Saltmarsh	Saline tolerant vegetation which establishes and grows within the inter-tidal area
Sea Defence	Construction engineered to reduce or prevent flooding by the sea
Sea level rise	General term given to the upward trend in mean sea level resulting from global climate change
Topography	The arrangement of the natural and artificial physical features of an area

List of abbreviations

AA	Appropriate Assessment
BAP	Biodiversity Action Plans
OA	Operating Authority
CCO	Channel Coastal Observatory
CDS	Coastal Defence Strategy
CHaMP	Coastal Habitat Management Plan
CRoW	Countryside and Rights of Way
DEFRA	Department for Environment and Rural Affairs
EA	Environment Agency
EN	English Nature
EU	European Union
GIS	Geographical Information System
HAT	Highest Astronomical Tide
HPI	Historical Photography Interpretation
LA	Local Authority
LiDAR	Light Detection and Ranging
LAT	Lowest Astronomical Tide
LTEI	LiDAR and Tidal Elevation Interpretation
MHWN	Mean High Water Neaps
MLWS	Mean Low Water Springs
NFDC	New Forest District Council
RHCP	Region Habitat Creation Programme
RTE	Regulated Tidal Exchange
SAC	Special Area of Conservation
SDCP	Solent Dynamic Coast Project
SINC	Site of Importance for Nature Conservation
SMP	Shoreline Management Plan
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest