Document Control

Title	**Solent Maritime SAC – Intertidal Hand gathering from a vessel and shore based hand activities**
Sussex IFCA Reference	CH_SAC_013 & CH_SAC_015 (intertidal mudflats and sandflats not covered by seawater at low tide tLSEs merged for AA)
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Revision History

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This document has been distributed for information and comment to:

Date	Action	Comments
30/11/18	Phone call with AA at NE, suggested pushing deadline to new year due to time limitations.	IFCA agreed with proposed dealine extension.

Fisheries in EMS Habitats Regulations Assessment for Amber and Green risk categories

European Marine Site:	**Chichester Harbour – part of Solent Maritime SAC**
Qualifying Feature(s):	**Mudflats and sandflats not covered by seawater at low tide**
Generic sub-feature(s):	**Intertidal mud; Intertidal mud and sand; Seagrass; Intertidal mixed sediments**
Site sub-feature(s):	**Intertidal mud; Intertidal mud and sand; Intertidal mixed sediments**

Fishing activities assessed:

Gear type(s):	**Intertidal handworking from vessel** **Intertidal handworking from land** **Bait collection (digging with forks)**

Sussex IFCA reference
CH_SAC_013 & 015

1. Introduction

1.1 Need for an HRA assessment

In 2012, the Department for Environment, Food and Rural Affairs (Defra) announced a revised approach to the management of commercial fisheries in European Marine Sites (EMS). The objective of this revised approach is to ensure that all existing and potential commercial fishing activities are managed in accordance with Article 6 of the Habitats Directive.

This approach is being implemented using an evidence based, risk-prioritised, and phased basis. Risk prioritisation is informed by using a matrix of the generic sensitivity of the sub-features of EMS to a suite of fishing activities as a decision making tool. These sub-feature-activity combinations have been categorised according to specific definitions, as red, amber, green or blue.

Activity/feature interactions identified within the matrix as red risk have the highest priority for implementation of management measures by the end of 2013 in order to avoid the deterioration of Annex I features in line with obligations under Article 6(2) of the Habitats Directive.

Activity/feature interactions identified within the matrix as amber risk require a site-level assessment to determine whether management of an activity is required to conserve site features. Activity/feature interactions identified within the matrix as green also require a site level assessment if there are “in combination effects” with other plans or projects.

Site level assessments are being carried out in a manner that is consistent with the provisions of Article 6(3) of the Habitats Directive. The aim of this assessment is to determine whether management measures are required in order to ensure that fishing activity or activities will have no adverse affect on the integrity of the site.

The purpose of this site specific assessment document is to assess whether or not in the view of Sussex IFCA, Intertidal handworking from land or vessel and bait collection activities have a likely significant effect on the Mudflats and sandflats not covered by sea at low tide of the Solent Maritime SAC, and on the basis of this assessment whether or not it can be concluded that the handworking from a vessel will not have an adverse effect on the integrity of this EMS. The assessment focuses only on the particular area of the SAC that falls within Chichester Harbour, with ‘Mudflats and Sandflats not covered by seawater at low tide’ being the only feature that overlaps with the assessed activity.

1.2 Documents reviewed to inform this assessment

- Natural England’s risk assessment Matrix of fishing activities and European habitat features and protected species[1]
- Reference list[2] (Annex 1)
- Natural England’s consultation advice (Annex 2)
- Site map(s) – sub-feature/feature location and extent (Annex 3)
- Fishing activity data (map(s), etc) (Annex 4)

[1] See Fisheries in EMS matrix: http://www.marinemanagement.org.uk/protecting/conservation/documents/ems_fisheries/populated_matrix3.xls

[2] Reference list will include literature cited in the assessment (peer, grey and site specific evidence e.g. research, data on natural disturbance/energy levels etc)

- Detailed LSE Assessment (Annex 5)
- Natural England's Conservation Advice Package (https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030059&SiteName=Solent%20Maritime%20SAC&SiteNameDisplay=Solent%20Maritime%20SAC&countyCode=&responsiblePerson=&SeaArea=&IFCAArea=&NumMarineSeasonality=&HasCA=1)

2. Information about the European Marine Site

2.1 Site overview

The Solent European marine site is comprised of the Solent Maritime SAC and the Solent and Southampton Water SPA and Ramsar site, Portsmouth Harbour SPA and Ramsar site and Chichester and Langstone Habour SPA and Ramsar site. Chichester Harbour is part of the Solent Maritime SAC and Chichester and Langstone Harbours SPA.

The Solent Maritime SAC is a complex cluster site encompassing a major estuarine system on the south coast of England.The Solent and it inlets are unique in Britain and Europe for their unusual tidal regime, including double tides and long periods of tidal stand at high and low tide, and for the complexity and particulary dynamic nature of the marine and estuarine habitats present within the area. There is also a wide variety of marine sediment habitats influenced by a range of salinities, wave shelter and intensity of tidal streams, resulting in a uniquely complex site. As a result, the Solent Maritime SAC is a unique suite of functionally linked estuaries and dynamic marine estuarine environment, as shown in Figure 2.1, below.

Figure 2.1: Solent Maritime extent – shaded in pink

The site has the largest number of small estuaries in the tightest cluster anywhere in Great Britain, with examples of coastal plain estuaries (Yar, Medina, King's Quay Shore and Hamble) and bar-built estuaries (Newton Harbour, Beaulieu, Langstone Habour, Chichester Harbour). It is located in

one of the only major sheltered channels in Europe, lying between a substainial island (Isle of Wight) and the mainland.

Sediment habitats with the estuaries include extensive areas of estuarine flats, and intertidal areas often supporting eelgrass *Zostera* spp. And green algae, saltmarshes and natural shoreline transitions, such as drift line vegetation. Many of the intertidal areas within the Solent European marine site are important for a number of nesting and feeding birds.

The mudflats range from low and variable salinity in the upper reaches of the esturaries to very sheltered almost fully marine muds in Chichester and Langstone Harbours. The intertidal and shallow subtidal waters of these support a number of important fish nursery areas. Saltmarsh forms a crucial habitat within the Solent ecosystem, including Atlantic salt meadows which contain a range of lower, mid and upper saltmarsh habitats, pioneer saltmarsh and cordgrass.

The Solent Maritime SAC covers 11325.09ha of which Chichester Harbour forms 7400 ha (Figure 2.2) and includes both marine and estuarine areas.

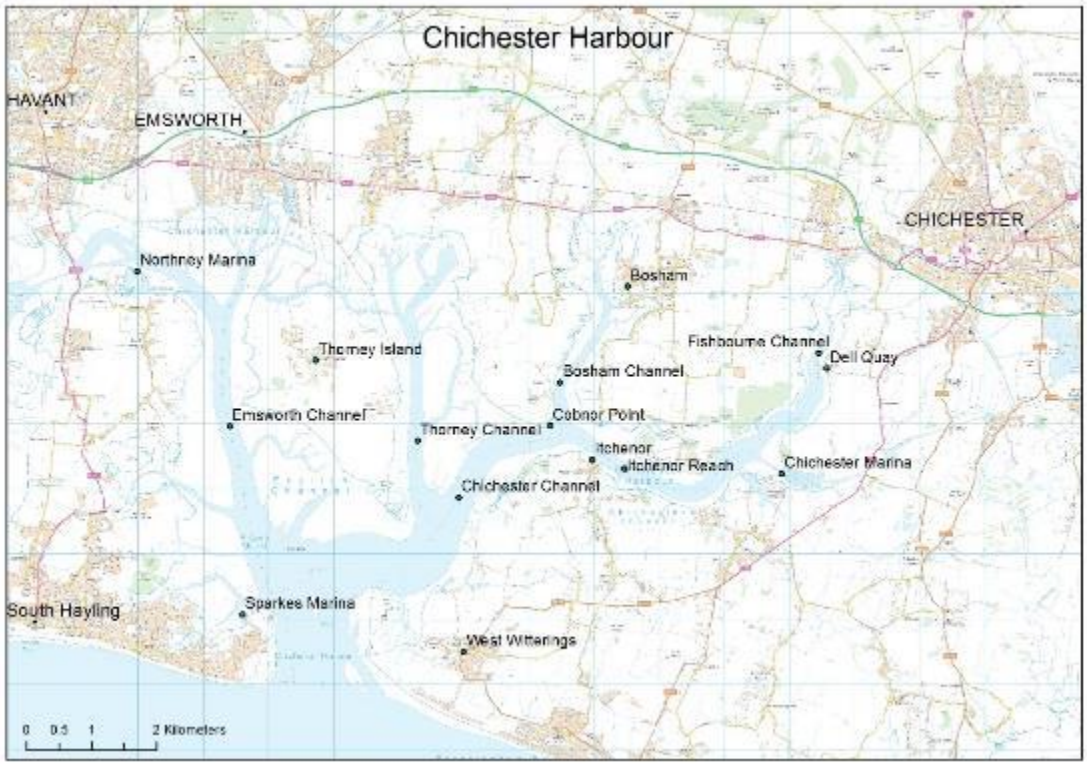

Figure 2.2: Chichester Harbour – part of the Solent Maritime SAC. Appropriate Assessment focus area.

The Solent EMS is a cross boundary site, shared between Sussex and Southern IFCA. Sussex IFCA jurisdiction goes up to the Emsworth channel, however historically when Sussex IFCA was a sea fisheries committee, it managed the entire harbour therefore many of the byelaws still cover the area of Chichester Harbour that now falls within Southern IFCA's District. On 30th July 2014 an agreement was made under section 167 of the Marine and Coastal Access Act 2009, between Sussex and Southern IFCAs, that Sussex IFCA will be responsible for the management and making of byelaws within the part of Chichester Harbour which falls within Southern IFCA's District. This HRA therefore covers the whole of Chichester Harbour.

2.2 Local physical conditions: Chichester Harbour

Exposure
The predominant winds throughout the year are from the south-west and west, with the strongest winds occurring in winter. The south coast is very exposed when there are strong southerly winds and during westerly gales winds of 80 knots have been recorded between the Isle of Wight and Dover (Barne *et al.*, 1998).

Tidal currents
In the Atlantic Ocean tidal streams are weak, but as the tidal wave reaches the shallower seas of the UK the speed of the tidal streams greatly increases. The waves and tidal currents within Chichester Harbour are of relatively low energy when compared to the conditions on the open coast. The mean neap tide range in Chichester Harbour entrance is 2.1m (HR Wallingford, 2011).

Temperature and salinity
Sea surface temperatures in this region are strongly influenced by the movement of water along the English Channel. Relatively warm water occurs in the Channel during winter months with February temperatures ranging between 6.5°C and 8°C. During the summer months temperatures for the central English Channel are on average between 16-16.5°C and temperatures progressively increase towards the shoreline. Salinity values are high along the centre of the English Channel due to the eastward movement of Atlantic waters. Salinity values decrease along the Sussex coast but remain above 34.5g/kg except in areas at river mouths, due to the influx of freshwater (Barne *et al.,* 1998). Chichester Harbour is predominantly saline with little freshwater input.

Depth
Water depth within the harbour is shallow, ranging from 0-10m.

Water and sediment quality
The overall water quality for Chichester Harbour in relation to the Water Framework Directive according to the Environment Agency's Water bodies Catchment Data Explorer, is considered to be in 'Moderate' condition. This overall water body classification can be separated in to Ecological and Chemical categories, of which they are considered to be in 'Moderate' and 'Good' condition respectively (Environment Agency, 2016). This quality can, however, be affected after periods of extended or heavy rains and especially if a Storm Water Discharge is in progress (HR Wallingford, 2011; Anon, 2015). Likely sources of pollution (aside from storm water discharge) include runoff from the surrounding landscape, including animal waste, and industrial activities. Sampling data indicates that there is minimum contamination of sediments within the Harbour with CEFAS data indicating that sediment quality is good with levels of most metals and PCBs at or below CEFAS Action Level 1 (Cefas, 2001).

Benthic sediments and ecology
Chichester Harbour is a shallow marine basin characterised by mud flats, sand banks and shingle beaches and there is a varied underlying geology of clays, sands and chalk.
Fine material is the predominant sediment type within Chichester Harbour, it is derived from the erosion of existing mudflats and the shoreline within the harbour (HR Wallingford, 2011). The dominant transport pathways of sediments is seaward creating a major sediment store that extends 3-4km offshore, known as the Chichester Tidal Delta.

The mud flat environments of the harbour support a rich diversity in invertebrates along with beds of algae, particularly *Zostera* spp. Intertidal mud flats provide important roosting and resting areas for both overwintering and local bird populations. Shallow sandy sediments are located near the harbour entrance and provide important nursery grounds for fish and feeding areas for birds. Native oysters were once widely distributed throughout the subtidal channel environment of the harbour,

historically there has been relatively intensive fishing effort and this is reflected by decreasing stock size in both the harbour and wider Solent area (Kershaw and Pratt, 2013).

2.3 Overview and qualifying features

Estuaries (subtidal component of the Estuaries)

- Subtidal coarse sediment (does not occur in Chichester harbour)
- Subtidal sand
- Subtidal mud
- Subtidal eelgrass *Zostera marina* beds (does not occur in Chichester Harbour)

Subtidal sandbanks which are slightly covered by seawater all of the time

Sub features:

- Subtidal mixed sediment
- Subtidal sand
- Subtidal coarse sediment (does not occur in Chichester Harbour)

Mudflats and sandflats not covered by seawater at low tide:

- Intertidal mud
- Intertidal muddy sand
- Intertidal mixed sediments
- Intertidal *Zostera* beds

Atlantic Salt meadows:

- Atlantic salt meadows, *Salicornia*

2.4 Conservation Objectives

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving Favourable Conservation Status of its Qualifying Features, by maintaining or restoring;

- The extent and distribution of qualifying natural habitats and habitats of qualifying species
- The structure and function (including typical species) of qualifying natural habitats
- The structure and function of the habitats of qualifying species
- The supporting processes on which qualifying natural habitats and the habitats of qualifying species rely
- The population of the qualifying species and,
- The distribution of qualifying species within the site

The high level conservation objectives for Solent Maritime SAC are available online at: http://publications.naturalengland.org.uk/publication/5762436174970880

3. Interest feature(s) of the EMS categorised as 'Red' risk and overview of management measure(s) (if applicable)

A red risk interaction between towed (demersal) fishing, dredges (towed and other), intertidal handwork and bait collection and eelgrass/ seagrass beds were identified and subsequently addressed through the creation of the **'Chichester Harbour European Marine Site (Specified Areas) Prohibition of Fishing Method' Byelaw**. The byelaw prohibits the use of towed gears,

digging, collection and hand gathering of marine fisheries resources in specified areas of Chichester harbour, in order to protect Seagrass (Zostera spp) and therefore prevent damage or deterioration to the Solent European Marine Site. It is also prohibited to possess, use or retain any instruments within the specified area that may be used to hand gather or dig for sea fisheries resources.

See Sussex IFCA website for further management measure details:
http://www.sussex-ifca.gov.uk/index.php?option=com_content&view=article&id=143&Itemid=205

4. Information about the fishing activities within the site

4.1 Bait collection and hand gathering

Intertidal fisheries occur for the collection of bivalves (cockles/clams), annelids (worms), winkles, Shellfish (oysters, crabs) and macroalgae. This activity typically occurs at a small scale with fishers hand gathering or working with hand tools within the intertidal, either alone or in small groups. The intertidal gathering activities within the Sussex IFCA district largely occur on sediment shores, with some piddock and limpet collection known to occur on rocky shores within the district. Table 4.1 summarises the methods most commonly used by bait and hand gatherers in Sussex

Intertidal handworking from vessels and shore-based hand gathering involves fishermen, both commercial and recreational, travelling by boat or on foot via public access points to an area of the harbour that is favoured for digging and/or hand gathering. If collecting by boat, the gatherers will beach the vessel and get out with a bucket, spade and/or fork and dig for bait or collect winkles, clams, cockles and shellfishBait and hand gathering activity is known to have occurred for many years, but sightings have only started to be recorded and interviews officially conducted since 2012.

Lugworms (*Arenicola spp*.) and rag worms (*Nereis* and *Nephtys spp*.) are traditionally collected using a fork (and occasionally spade) to hand dig over the lower shore of a beach where dense worm beds are present. Sediment is either turned over methodically, or in areas where species are more sparsely located, diggers will search for burrows or worm casts of individuals or dig several small test holes. All holes and trenches are generally backfilled.

Boulder turning for winkles is also known to occur, this activity is simply the process of combing the lower shore and lifting boulders to find and collect winkles. This activity has a very low impact on the intertidal sediments, but even so fishers are encouraged to replace boulders and the non-target species attached, to the location where they were found, being careful to place any boulders algae side up to minimise the impact to algal species and their associated epibiota.

Table 4.1. The methods most commonly used by bait and hand gatherers in Sussex

Method	Description
Bait digging	Bait digging involves manually turning over the sediment to extract target species and is usually carried out with a garden fork. Burrowing polychaetes and bivalves may be extracted in this way. Fowler (1999) described digging by professional and experienced bait diggers to take the form of digging trenches that are backfilled, whereas less experienced diggers produce scattered holes that are not backfilled with mounds of spoil left at the sediment surface
Bait pumping	A method used in the UK for collecting the commonly used black lugworm (*Arenicola defodiens)* from sandy shores. The pump is placed over the worm's faecal cast and suction created by the pump pulls the sediment and residing worm to the surface. Bait pumps may also be used to collect razor shell (*Ensis* spp).

Hand Raking	A method used most commonly for the collection of cockles and clam species from intertidal shores. Areas of ground are combed through with a garden rake and placed into a sieve where sediment is removed, and the bivalve species are collected.
Salting	The introduction of salt as an irritant elicits an escape response of *Ensis* spp. from its burrow. This may involve pouring a concentrated brine solution into the burrow or spreading salt on the sediment surface or pouring salt into the burrow
Hand gathering	Some organisms may be hand-picked for consumption or collection as bait, particularly epibenthic species. This can include the hand harvest of macro algae and boulder turning for winkles, for example.
Crab tiling	Structures such as tiles and tyres are placed on the sediment surface or at an angle in the sediment to attract vulnerable moulting crabs by the provision of a shelter, under which they may burrow.
Push netting	Shrimp nets are pushed along the sand in the shallow water to catch prawns and shrimps. The nets are strung between a solid T-bar frame, often made from wood.

4.2 Hand gathering management in Chichester Harbour

The 'EMS Prohibition of Fishing Method Byelaw' prohibits gathering and digging over known seagrass beds within the area of Chichester Harbour which falls within the Sussex IFCA district. Seagrasses are considered highly sensitive to physical disturbance, including that caused by trampling and digging, activities associated with intertidal handworking. Relatively low levels of clam harvesting disturbance have been shown to have negative impacts on seagrass density further supporting the need to restrict such activities on seagrass beds within Chichester Harbour.

The Sussex IFCA 'Hand gatherers code of conduct' (https://www.sussex-ifca.gov.uk/recreational-fishing) provides a guideline for bait collectors to follow that most will adhere to, this includes observing local byelaws, sustainable collection, replacing spoil, and rules to keep diggers and others safe, such as not digging around moorings or pontoon pilings. It was estimated that in the UK over 1000 tonnes of bait worm alone are collected annually (Watson et al., 2007), however, it is impossible to accurately quantify nationally/regionally because so little is officially recorded.

4.3 Location and activity level

4.3.1 Historical bait collection within Chichester Harbour

A report compiled by Fowler (2001) detailed bait collection surveys that had been undertaken for The Solent and Poole Bay. These historical surveys provide detail on the level of activity throughout Chichester Harbour, it states in 1985 that "Moderate intensity of bait digging, probably including commercial collection, having some amenity on birds and invertebrate populations, but not at levels which caused concern". Fowlers results suggested the number of commercial bait collectors declined from 200 to 50 in the study area between the 1970s and 1980s. This decline is said to be attributed to "over-exploitation of bait beds" where fewer diggers were present due to the increased effort (Fowler 2001).

A collation of information from the 1990's gathered from questionnaires and surveys undertaken by researchers revealed that digging was occurring around the areas of Northney, Emsworth and Prinstead. But was rare between Nutbourne and West Chidham. There was also regular digging around Bosham, some of which was commercial. The most heavily used area was Fishbourne Channel from Old Park Wood and Chichester Yacht basin to Dell Quay. Regular digging was also said to occur between Birdham and Itchenor, as well as between Itchenor and West Wittering, some of which was commercial. Fowlers report also included more recent bait collection information which revealed in the 2000's, popular areas include the east coast of Hayling Island and Warblington. Harbour-wide collection noted but concentrated mostly on or near public access

points on the Eastern side of the harbour. The report states that the Solent Area Bait Diggers Association (SABDA) detail important digging sites as Dell Quay, Coppers point, Cobnor point, Upper Bosham channel and Wades cut (Fowler 2001). See Annex 4 for a map of known bait and hand gathering locations within Chichester Harbour.

4.3.2 Recent bait collection within Chichester Harbour – 2012 to present

Since 2012, officers at the Sussex IFCA have been documenting sightings of bait and hand working activity across the district which has provided information on the range of locations within Chichester Harbour. Additionally, SxIFCA received over 20 reports from the public of hand gathering in Chichester Harbour in 2020, these reports are a vital part of the intelligence gathering process with regards to location and timings. Officers are then able to target certain areas for patrol, interviewing diggers to ascertain the species and quantities being gathered.

Another part of the Inshore Fisheries and Conservation Officers (IFCOs) role when interviewing hand gatherers is education; If individuals are found to have undersized clam, these are returned to the dug location, and IFCOs will brief diggers/hand gatherers on the classification of the beds as there are health related concerns from the consumption of untreated bivalves and shellfish taken from the harbour. A report was filed in May 2018 containing details of the intertidal hand gathering of oyster. Aside from byelaw offences surrounding the method of collection of oyster (detailed here), there are further concerns of the health implications following the human consumption of untreated oyster.

Data indicates that activities are undertaken for both recreational and commercial purposes. It can be difficult to distinguish between bait collecting and hand gathering that is done on a commercial basis and that done on a recreational basis. Fundamentally this is down to whether or not the target species is collected by or on behalf of the individual directly intending to use the bait or consume the shellfish, or whether it is to be sold or exchanged for another's use. It is not always possible to determine from the collection technique or practice alone, but commercial operators will likely be more resource intensive, often working in groups or using machinery.

Due to the character of the fisheries being dispersed across sometimes relatively remote coastline, many of the fisheries are largely unrecorded and unregulated. Hand-gathering for marine resources within Sussex's intertidal areas is extensive, occurring across the district and throughout the year. Concentrated areas of reported shellfish hand gathering activity occur around Chichester Harbour and the Adur Estuary, with the highest number of bait collection information reports concerning Chichester Habrour and Rye. The number of information reports relating to hand gathering have increased over time, particularly relating to shellfish gathering.

Within Chichester Harbour, there are between 6 and 10 known commercial bait collectors that operate on a regular basis, however, due to the challenges surrounding the intelligence gathering process, it is difficult to accurately assess the true number of commercial or recreational bait collectors. IFCOs are conducting routine patrols of the area and most regularly there are between 3 and 8 bait diggers being observed working on a single tide in the most popular areas. These individuals when interviewed are collecting up to 20kg of clams, or up to 2kg of worms, stating personal use. However, an Intelligence Report indicated that approximately 12 to 15 diggers were seen loading bait in to a marked commercial vehicle within Chichester Marina.

Information reports from both the public and the Chichester Harbour Conservancy in 2019/20 suggest that the location of handworking from land or by boat in Chichester Harbour is largely focused around Nutbourne & Prinstead Channels which feed in to Thorney channel; Emsworth channel; Thorney Island; Pilsey island which is accessed either by sea or through an army base on Thorney island; Chichester Marina and Chidham, all accessible from several locations by land

or boat. Other known hand gathering locations documented throughout the EMS, are Dell quay, Northney marina, Copperas Point, Westlands, Birdham pool, and Longmere point (IFCO Intel). This information has been collected by interviews and sightings data, see the map within Annex 4.

The frequency in which hand gatherers and bait collectors operate could occur daily throughout the site in the summer months, and at any time of day or night. Bait collecting/hand gathering usually occurs during a 3 or 4 hour period, with individuals appearing ~1.5 hour before low water to follow the tide out, and then moving back towards the shore with the advancing tide (IFCO intel). Diggers and hand gatherers may visit a location for several days collecting between 1 and 5 kg each time until it is not worth digging anymore, then leave it to recover before returning. Others will collect up to 20kg in a day, three or four times a month, and some will only collect when they require bait (IFCO Intel).

Watson et al., (2007, 2012, 2015, 2016) found that Dell Quay was the most heavily fished of the three locations surveyed (Dell Quay, Pagham Harbour and Fareham Creek). Over 51 tides, there were 160 incidences of bait digging observed (mean = 3 diggers/ tide, range 0 – 14 people/ tide). Each digger spent 88minutes on average digging, taking on average 1.4kg worms/ hr digging. 95% collectors did not refill the holes they had dug. Dell Quay was accessed both by rowing boat and by foot. The area dug was mapped and the impact of digging on the sediment quantified. The impact to the local bird population was also considered.

5. Test for Likely Significant Effect (LSE)

The Habitats Regulations assessment (HRA) is a step-wise process and is first subject to a coarse test of whether a plan or project will cause a likely significant effect on an EMS[3]. For a detailed audit of the LSE assessment please refer to Annex 5.

In this assessment, the features ‘Mudflats and sandflats not covered by seawater at low tide’ are being looked at. The features ‘Estuaries’, ‘Subtidal sandbanks’ and ‘Saltmarsh’ are not being considered as these were screened out due to a lack of interaction with the activity.

5.1 Assessment of LSE of Mudflats and Sandflats not covered by seawater at low tide.

Table 5.1 LSE assessment summary for bait collection and intertidal handworking (access from land and access from vessels) on the sub-features of this site:

- **Intertidal mud**
- **Intertidal mud and sand**
- **Intertidal mixed sediments**

1. Is this activity/activities directly connected or necessary to the management of the site for nature conservation?	No

[3] Managing Natura 2000 sites: http://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm

2. What potential pressures such as abrasion/physical loss by gear type(s) are likely to affect the interest feature	Table 5.1.1 in Annex 5 demonstrates the potential pressures from this activity that the intertidal sediments are sensitive too, however to summarise this includes: 1. Abrasion / disturbance of the substrate on the surface of the seabed 2. Introduction or spread of non- indigenous species 3. Penetration and/or disturbance of the substrate below the surface of the sea bed including abrasion 4. Physical change (to another type of seabed) 5. Removal of non-target species 6. Removal of target species (mud only) *The pressures listed in red font are considered to be of high to medium risk (the pressure is commonly induced by this activity at levels that need to be considered further as part of an assessment. The other pressures are considered to be low risk (unless there are evidence based cases or site specific factors that increase the risk, or uncertainty on the level of pressure on a receptor), this pressure generally does not occur at a level of concern and should not require consideration as part of the assessment.*
3. Are the qualifying features potentially exposed to the pressure (s)	1) Yes the pressure abrasion/disturbance of the substrate on the surface of the seabed' could impact on the following attributes: a) Extent and distribution b) Presence and spatial distribution of the features and sub features communities c) Species composition of component communities d) Presence and abundance of structural and influential species e) Sediment composition and distribution f) Substrate composition and distribution (Estuary only) g) Sediment contaminants 2) Introduction or spread of non-indigenous species will have no impact (see 5.1.1 in Annex5). 3) Yes the pressure 'penetration and/ or disturbance of the substrate below the surface the seabed including abrasion' could impact the following attributes a) Extent and distribution b) Presence and spatial distribution of the features and sub features communities c) Species composition of component communities d) Presence and abundance of structural and influential species e) Sediment composition and distribution f) Substrate composition and distribution (Estuary only) g) Sediment contaminants h) Topography 4) No the pressures 'physical change (to another seabed type)' will have no impact. 5) Yes the pressure 'Removal of non- target species' could impact the following attributes

	a) Presence and spatial distribution of the features and sub features communities b) Species composition of component communities c) Presence and abundance of structural and influential species 6) Removal of target species will have no impact (see table 5.1.2 in Annex 5). For further details please see Annex 5 table 5.2	
4. Potential scale of pressures and mechanisms of effect/ impact (if known)	Information gathered through observations and interviews with diggers since 2016 has led to a better understanding of the activity on the site, this is considered in more detail in section 6.	
5. Is the potential scale or magnitude of any effect likely to be significant	**Alone** Yes (within Sussex IFCA jurisdiction) Comments: The true scale of activity across this site is unknown, and these features are potentially sensitive to the pressures that this activity exerts. This activity/habitat interaction is going to be taken to an Appropriate Assessment.	**In-combination** No - See Section 8.

5.2 Have NE been consulted on this LSE test? If yes, what was NE's advice?

Natural England are in agreement that bait and hand gathering activity is required to be taken to a full appropriate assessment, with an in-combination effect. For further detail, see sections 6 and 8.

6. Appropriate Assessment

6.1 Potential risks to features

Hand working from a vessel, shore based intertidal hand working and bait collection have been taken to appropriate assessment due to gaps in data held on site specific activity, as well as the potential impact on site features, which prevented the conclusion of no likely significant effect.. Through the appropriate assessment data collection process (see section 4.3.2), collation of bait collectors/hand gatherers recorded interviews and observation reports from the public/organisations working within the harbour, such as the Chichester Harbour Conservency , have assisted with the in filling of these gaps in knowledge. Reports published in the past have also provided useful information regarding historic bait collection at the site (see section 4.3.1).

Using the sightings data collected and the information gathered from bait collectors' & hand gatherers themselves, it has been documented that digging activity occurs more frequently in the intertidal areas around Thorney Island. However, it is known to occur throughout the harbour where access from land is possible (see Annex 4). Management is in place to protect the seagrass beds within Chichester Harbour, and these are the only areas where bait digging and hand gathering are currently not permitted - see Sussex IFCAs 'Chichester Harbour European Marine Site (Specified areas) prohibition of fishing method Byelaw'.

The information collected by Sussex IFCA since 2012 has indicated a further decline in the number of commercial intertidal hand workers in the harbour when compared to the numbers cited by Fowler (2001). Fowlers survey references a decline in commercial activity from 200 to 50 intertidal hand workers in the 1980s, stating this level of activity is of 'moderate concern'. Sussex IFCA currently know of 10 commercial workers that regularly visit the area in 2019.

Given the presently unregulated nature of hand gathering, there is no mechanism to manage the potential overexploitation of target species within hand gathering fisheries. The absence of any regulatory mechanism means the existing fishery relies on fishing effort being limited by demand and the availability of resource. This open access arrangement may be appropriate in many instances, however effort management and spatial restrictions may be beneficial in sensitive areas and those experiencing high levels of exploitation.

Commercial scale hand gathering in Chichester Harbour is also thought to be illegally reaching the human food chain and has potentially serious public health concerns from contaminated shellfish. Hand gathering has been known to occur in shelfihs beds where harvesting for human consumption is banned on the grounds of the risk it poses if consumed untreated. There is also evidence that some hand gathering activities may also have links to 'gang crime' managed by the Gandmasters Licencing Authority and modern day slavery.

Total Ecosystem Management of the Intertidal Habitat (TEMITH) commissioned work

To support the Authority's existing activity evidence base within Chichester Harbour further development of a model using Earth Observation data developed under the TEMITH project was commissioned and associated analyses. The TEMITH project aimed to design and prototype a solution to monitor pressures in the intertidal habitat in the Solent region using Earth Obseration data in addition to existing sources of information. For example, sediment scarring resulting from different activities can be readily observed using aerial imagery. The mapping of sediment disturbance attributed to digging disturbance enables the utilisation of this method to further understanding of bait and hand collection activity within areas.

Visualising the distribution and extent of digging disturbance over broad geographic scales can help to characterise the potential impacts of the associated activities, particularly in relation to protected features of conservation concern. The utility of this method to better monitor this activity over large spatial scales and compliment the existing activity evidence base within Chichester Harbour was clearly recognised by the Authority.

Outputs from the commissioned work have provided additional evidence in support of Sussex IFCAs own information gathered on the location of bait collection and hand gathering, providing a more robust evidence base on activity location and extent within Chichester Harbour. Key areas of exploitation identified align with those identified through information reports and patrol data collection. Refinement and development of the model has helped overcome 'false positives', making this a potential key tool for future activity monitoring rather than solely relying on more resource-intensive ground data collection.

The inclusion of temporal comparisons (2016, 2020 whole harbour; 2013, 2016, 2020 Dell Quay only) within the project were essential to reveal temporal changes in exploitation across the whole harbour. Maps for single timepoints provide a snapshot of activity, however there remain questions of the representativeness of that timepoint. For this project the harbour-wide distribution of digging disturbance was mapped for two years to build an understanding of its spatio-temporal extent. The commissioned report contains full details and accompanying activity maps (White *et al*., 2021).

The potential pressures exerted by bait and hand gathering activity are discussed below:

Pressures

The main impact pathways through which this fishing activity may affect the qualifying features for which Chichester Harbour is protected are, physical abrasion of the substrate, penetration of the substrate and removal of non-target species. Each of these potential pressures are considered below in relation to how they might impact all the sediment features and sub-features specific to the site. The qualifying features for which this site is being considered is 'Mudflat and sandflats not covered by seawater at low tide', which is split in to the sub-features 'Intertidal Mud', 'Intertidal mixed sediments' and 'Intertidal mud and sand'. It is the impact to these sub-features on which bait and hand collection is being assessed. The remaining features for the site include, 'Subtidal sandbanks' and 'Estuaries', which consists of the sub-feature 'subtidal sediment communities', have been screened out at the first stage of the HRA process as the activities do not interact.

Abrasion & Penetration

Bait digging and hand gathering causes disturbance to sediments when the instruments used to dig or rake come in to contact with the surface. When collecting winkles, hand gatherers will turn over boulders, rocks and pebbles, this can lead to damage by abrasion to the epifaunal species in the areas being combed. There is also abrasion cause by forks being used to dig in to the substrate in search for bait worm, and rakes grooming the surface for cockles/clams. Although the area is subject to natural disturbance, with diurnal tides and long tidal stands mean that sediment movement is likely to be high in the area, the effects on sediments from digging and hand gathering may have further reaching impacts than commonly known (Watson et al., 2017). This, coupled with disturbance from bait collection, can lead to changes in sediment composition. Mixed sediments are affected when human activity and tidal flow are combined, with fine sediments lost and stones uncovered, meaning very slow recovery and changes in bioavailability of sediment-bound pollutants (Fowley 1999; Watson et al., 2016). Backfilling of dug out holes is common practise amongst bait diggers as mitigation to minimise this impact, as detailed in the aforementioned Sussex IFCA bait digging code of conduct. Fowler (2001) also states the impacts

of bait digging can be greatest on sheltered intertidal habitats, particularly inlets and harbours, where muddy sediments that have been overturned are slow to recover from disturbance. Volkenborn et al., (2007) found that bait digging caused changes in sediment properties as a result of lugworm *(Arenicola marina)* removal. These worms contribute to the maintenance of permeable sand, and sediment permeability was lower in areas where there were no Lugworm, this was a result of lack of subsurface irrigation, the knock on effect of this was increased concentration of ammonium, phosphate, silicate and sulphide in the pore-water.

Removal of non-target species

The changes in granulometry, mentioned above, that affect the benthic infaunal communities can also result in changes in assemblages, this can in turn affect the type and amount of prey available to birds and other species in an area (Cooper et al., 2011). Bait diggers operating within the harbour are collecting within a designated European Marine Site, which is home to protected migratory and wintering birds species. Watson et al., (2015) & Watson et al., (2017) noted that wading bird populations were disturbed by collectors on the shore and are affected by reductions in prey availability. It was also noted that there was a "willingness of collectors to walk long distances across intertidal flats", with a recorded incidence of a digger walking up to 1.6km, this not only increases trampling on protected sediments, but also the likelihood of bird disturbance. The impact to the features of the Special Protection Area have been assessed separately and are detailed in the Chichester and Langstone Harbour SPA Habitats Regulation Assessment document.

It has been documented in areas where bait digging occurs that the cockle populations may be negatively affected, this was studied on the North Norfolk coast (Jackson and James 1979) and backed up by Shackley et al., (1995) when studied in South Wales. The population declines were a result of fishers backfilling their dug holes/trenches and burying the cockles in too deep a sediment for the invertebrate to readjust itself to survive. Recolonisation of cockle beds was occurring after roughly 3 months of no digging, but the population structure was still showing differences from undisturbed areas. Farrell (1998) also described a reduction in numbers of cockles in experimentally dug areas of Chichester Harbour. Watson et al., (2017) noted in a comprehensive study in to bait collection on intertidal sediments that dug sediment has lower organic content, and that digging changes the macrofaunal community and decreases community dispersion.

Long-lived, infrequently recruiting species such as large bivalves, acorn worms, or burrowing echinoderms will take much longer to become re-established after removal or destruction during digging (e.g. Beukema 1995, Dyrynda and Lewis 1994). The complete loss of the large sedentary worm *Amphitrite johnstoni* and *Harmathoe imbricata* (which is commensal – living in the same burrow) from areas dug experimentally in Chichester Harbour was noted by Farrell (1999). Numbers were still extremely low compared with the control undisturbed site a year after digging.

Impact to targeted species

The size-/age-structure of target species will be affected by collection when the largest organisms are taken (Watson et al., 2016). There can also be incidental mortality of under-sized bait species during the collection operations and as a result of changes to habitat (Fowler 2001). Brown and Wilson (1997) also noted that densities of polychaetes, as well as other taxa, were significantly reduced in two studied areas, one of low digging intensity and one of high digging intensity, when compared to an undug control area. Watson et al., (2007) noted that the abundance of ragworm in dug areas was consistently lower than un-dug areas. There was however a significantly higher density of organism in dug areas, but the mean weight was significantly lower. This means when larger worms are removed from an area, smaller species are quick to move in.

Evidence to the contrary summarised by Farrell (1999) noted that bait collection appeared to result in an increase of small individuals of king ragworm (*Nereis virens)* in Chichester Harbour. Farrell suggested this might have resulted from decreased rates of predation (cannibalism) because larger worms were being removed from the population. Most bait species are fecund and widespread and usually recolonise quite rapidly from adjacent unexploited populations. Farrell (1999) stated that "it is rare for bait collection to be so intense that stocks of target species are severely depleted".

6.2 Site Condition

Condition assessments of designated sites are compiled by Natural England. These are derived by applying 'Common Standards Monitoring Guidance' to a subset of attributes of site features, as outlined in the site's conservation advice document. European Marine Site condition assessments are available here:

https://designatedsites.naturalengland.org.uk/Marine/MarineSiteDetail.aspx?SiteCode=UK0030059&SiteName=solent&countyCode=&responsiblePerson

Table 6.1 within Annex 6 summarises the condition assessments of the Intertidal SAC units that occur within Chichester Harbour. These assessments indicate that intertidal habitats are in an unfavourable condition. The key aspects outlined, which are thought to be significantly affecting the habitats condition, relate to sea level rise, coastal squeeze, high nutrient levels and diffuse pollution impacts. Fishing is not highlighted as a causal factor for the unfavourable condition of these intertidal areas.

6.3 Existing Management Measures

- **Vessel Length** byelaw – prohibits commercial fishing vessels over 14 metres from the Sussex IFCA district. The reduction in vessel size also restricts the type of gear that can be used, with vessels often using lighter towed gear and restricted to carry less static gear.
- **Bass Nursery Areas** – fishing for bass or fishing for any fish using sand-eels as bait by any fishing boat within designated areas is prohibited between 30 April and 1 November. The whole of Chichester Harbour is encompassed in this legislation, the line being drawn from Eastoke Point to Chichester Bar Beacon and then to Cakeham Tower.
- **Fixed Engine Byelaw** - No fixed engines, other than fyke nets, may be used between 1st May – 30th September, north of a line drawn across the entrance to Chichester Harbour (from East Head to Sandy Point). Furthermore, between 1st October and 30th April the following year, no person shall place any fixed engine across or partly across a channel or creek between the start of the last hour before low water and the end of the first hour after low water. Additionally, should the channel or creek or part thereof become dry at low water, you cannot place or maintain a fixed engine during the period between the start of the last hour before the tide leaves the channels and the end of the first hour after the tide has begun to reenter the same channel or creek.
- **Chichester Harbour European Marine Site (Specified Areas) Prohibition of Fishing Method Byelaw** - No person shall a) use any bottom towed fishing gear in the specified areas; b) hand gather in the specified areas; c) dig in the specified areas; or d) possess, use or retain any instrument within the specified area that may be used to hand gather or dig for sea fisheries resources. To protect known Seagrass (Zostera spp) beds in the harbour and therefore prevent deterioration to the Solent EMS.
- **Sussex IFCA 'Fishing Instruments' Byelaw** - prohibits scallop dredging inside of 3nm at any time of year and restricts what gears can be used inside of the district.

- **Vessels to be navigated with care and caution Byelaw** – Chichester Harbour Conservancy Byelaw prohibits the damage of moorings by other vessels (restricts the navigation of vessels to the outside of moorings areas).
- **Speed of vessels Byelaw** – Chichester Harbour Conservancy – restricts speed of vessels within the harbour to 8 knots.
- **Sussex IFCA Marine Protected Area Byelaw** – shore-related management measures are in place within Beachy Head West MCZ and Pagham Harbour MCZ and SPA, under Schedules 2 and 3 respectively. Both sites have intertidal hand gathering bag limits with additional spatial and species specific restrictions.
- **Sussex IFCA Nearshore Trawling Byelaw –** prohibits trawling district-wide in specified areas of the nearshore area, including the whole of Chichester Harbour
- **Sussex IFCA Oyster Permit Byelaw –** manages oyster dredging within the harbour with pre-season stock assessments conducted to assess if adequate stock on the ground to open the fishery and areas of the harbour closed to the fishery to protect EMS habitat features
- **The Sussex IFCA** 'Hand gatherers code of conduct' (https://www.sussex-ifca.gov.uk/recreational-fishing)

Other regulations include minimum sizes, mesh sizes, catch composition and total allowable catch as dictated by European legislation.

6.4 Summary of Impacts

Table 6.1 Impacts summary for 'mudflats and sandflats not covered by sea at low tide'.

Sub feature (s)	Attribute	Target	Potential pressure[4] (such as abrasion, disturbance) exerted by gear type(s)[5]	Level of exposure[6] of feature to pressure	Mitigation measures[7]
Intertidal mud, Intertidal mud and sand, Intertidal mixed sediment	Extent and distribution	Maintain the total extent and spatial distribution of intertidal mudflats and sandflats not covered by seawater at low tide.	**Abrasion** Pressure would be exerted on intertidal habitats through harvesting of target species by hand or with apparatus such as rakes and forks. Further, abrasion is associated with the movement of people ('trampling') or indeed any vehicles used for access or participation in the fishing activity, and can result in damage to infauna and epifauna as well as sensitive habitats such as seagrass. Where vessels are used to provide access the pressure is likely to be associated with any anchors, which can	Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting information on the assessed activities since 2012, which indicated regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that extent and distribution of the sites subfeatures are not likely to be adversely affected by the pressures Abrasion, Penetration and Removal of non-target species.	There is currently no management in place for bait and hand collecting activity within Chichester Harbour, with the exception of the prohibition of activity taking place on known Seagrass beds (Zostera spp.), as stated in the Chichester Harbour European Marine site (specified areas) prohibition of fishing method byelaw, and the district-wide hand gatherers code of conduct.
	Distribution: presence and spatial distribution of mudflat and sandflat communities	Maintain the presence and spatial distribution of mudflat and sandflat communities.	cause damage to the seabed surface and subsurface layers upon deployment/recovery and due to dragging, or the	Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting	Management to enable the recording and regulation of bait and hand gathering

[4] Guidance and advice from NE.
[5] Group gear types where applicable and assess individually if more in depth assessment required.
[6] Evidence based e.g. activity evidenced and footprint quantified if possible, including current management measures that reduce/remove the feature's exposure to the activity.
[7] Detail how this reduces/removes the potential pressure/impact(s) on the feature e.g. spatial/temporal/effort restrictions that would be introduced.

Sub feature (s)	Attribute	Target	Potential pressure[4] (such as abrasion, disturbance) exerted by gear type(s)[5]	Level of exposure[6] of feature to pressure	Mitigation measures[7]
			vessel (including e.g. the propeller/wash) itself may cause abrasion if it comes into contact with the seabed in shallow water. **Penetration** Pressure would be exerted on intertidal habitats through harvesting of target species by hand or with apparatus such as rakes and forks. Further, abrasion is associated with the movement of people ('trampling') or indeed any vehicles used for access or participation in the fishing activity, and can result in damage to infauna and epifauna as well as sensitive habitats such as seagrass. Where vessels are used to provide access the pressure is likely to be associated with any anchors, which can cause damage to the seabed surface and subsurface layers upon deployment/recovery and due to dragging or the vessel (including e.g. the propellor/wash) itself may cause abrasion if it comes into contact with the seabed in shallow water.	information on the assessed activities since 2012, which indicated regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that the presence and spatial distribution of mudflat and sandflat communities of the sites subfeatures are not likely to be adversely affected by the pressures Abrasion, Penetration and Removal of non-target species. Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting information on the assessed activities since 2012, which indicated regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that Species composition of component communities of the sites subfeatures are not likely to be adversely affected by the pressures Abrasion, Penetration and Removal of non-target species.	activities is therefore proposed, in the form of a district-wide intertidal hand gathering bag limit for all gatherers to control effort and the requirement for a hand gathering permit if gatherers wish to exceed this, including additional bespoke restrictions for relevant MPA sites to protect features. For Chichester Harbour, additional bespoke restrictions could include spatial restrictions around important bird areas and seal haul out/breeding sites, outside of known key bait and hand gathering areas. See section 7 for further details
	Species composition of component communities	Restore the faunal quality of this feature to Good Status (a minimum mean IQI score of ≥ 0.64), with no sustained deterioration within the status.			

Sub feature (s)	Attribute	Target	Potential pressure[4] (such as abrasion, disturbance) exerted by gear type(s)[5]	Level of exposure[6] of feature to pressure	Mitigation measures[7]
	Presence and abundance of structural and influential species	[Maintain OR Recover OR Restore] the abundance of listed species*, to enable each of them to be a viable component of the habitat.	**Removal of non-target species** Bycatch (i.e. discarded catch) is associated with almost all fishing activities and is related to factors such as the gear type and its design (i.e. its selectivity), the targeted species and effort. There are significant concerns over the impacts of discards on marine ecosystems, including changes in population abundance and demographics of affected species and altered species assemblages and food web structures. However, discards also provide important food resources for some scavenging species, including seabirds. Similarly to their use at sea, nets and pots deployed from the shore, along with other shore-based activities such as angling, shellfish collection by hand (e.g. undersize target species damaged or exposed to predation, desiccation or freezing) and even bait digging can result in bycatch of fish, invertebrates and birds. Although many fish captured by anglers are released (approaching 100	Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting information on the assessed activities since 2012, which indicated regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that Presence and abundance of structural and influential species of the sites subfeatures are not likely to be adversely affected by the pressures Abrasion, Penetration and Removal of non-target species.	
	Sediment composition and distribution	Maintain the distribution of sediment composition types across the feature (presence / absence of areas mapped in GIS), compared to an established baseline, to ensure continued structural habitat integrity and connectivity.		Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting information on the assessed activities since 2012, which indicated regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that Sediment composition and distribution of the sites subfeatures are not likely to be adversely affected by the pressures Abrasion, Penetration and	

Sub feature (s)	Attribute	Target	Potential pressure[4] (such as abrasion, disturbance) exerted by gear type(s)[5]	Level of exposure[6] of feature to pressure	Mitigation measures[7]
			percent for some species), there can be substantial post release mortality as well as more subtle sub	Removal of non-target species.	
	Structure: species composition of component communities	Status (a minimum mean IQI score of ≥ 0.64), with no sustained deterioration within the status.	lethal effects on growth and fitness. Release mortality in recreational fisheries is analogous to bycatch discards in commercial fisheries, an internationally recognized conservation problem.	Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting information on the assessed activities since 2012, which indicate regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that species composition of component communities of the sites subfeatures are not likely to be adversely affected by the pressures Abrasion, Penetration and Removal of non-target species.	
	Sediment contaminants	Restrict surface sediment contaminants (<1cm from the surface) to below the OSPAR Environment Assessment Criteria (EAC) or Effects Range Low (ERL) threshold. For example, mean cadmium levels should be maintained below the ERL of 1.2 mg per kg.		Evidence suggests that some areas of the site are more intensely worked than others, and although Sussex IFCA has been collecting information on the assessed activities since 2012, which indicated regular commercial activity levels are lower than historic records suggest, it is not feasible to accurately state that Sediment contaminants of the sites subfeatures are not likely to	

Sub feature (s)	Attribute	Target	Potential pressure[4] (such as abrasion, disturbance) exerted by gear type(s)[5]	Level of exposure[6] of feature to pressure	Mitigation measures[7]
				be adversely affected by the pressures Abrasion, Penetration and Removal of non-target species.	

7. Conclusion[8]

The information collated through the Appropriate Assessment process on intertidal bait and hand gathering activity, confirms activity occurs regularly throughout the year across the intertidal areas of the SAC, with activities undertaken for both recreational and commercial purposes. Information reports indicate that concentrated areas of reported shellfish hand gathering activity in the Sussex IFCA district occur around Chichester Harbour and the Adur Estuary. The highest number of bait collection information reports in the district also concern Chichester Harbour, as well as Rye.

Comparison with historic activity data suggests the level of commercial bait collection and hand gathering activity within Chichester Harbour has decreased over time. However, gaps in understanding regarding the level of activity in the site remain despite ongoing efforts to address these. Due to the character of the fisheries often being dispersed across sometimes relatively remote coastlines and associated challenges surrounding the evidence gathering process, many of the fisheries are largely unrecorded and unregulated and it is difficult to accurately assess the true number of gatherers who work on a recreational or commercial scale within the district. As part of the Authority's ongoing evidence collection process, new methods have been explored for gathering widespread spatio-temporal data on hand gathering. National guidelines on what constitutes low, medium or high levels of activity and associated impact thresholds have also not been yet been established. Due to these gaps in understanding and the potential risks to features from this activity type, the Authority is currently unable to conclude no adverse effect on the extent, distribution and quality of the site features.

Management to enable the recording and regulation of bait and hand gathering activities is therefore proposed in the form of a district-wide intertidal hand gathering bag limit for all gatherers to control effort and the requirement for a hand gathering permit if gatherers wish to exceed this, including additional bespoke restrictions for relevant MPA sites to protect features. For Chichester Harbour, additional bespoke restrictions could include spatial restrictions around important bird areas and seal haul out/breeding sites, outside of known key bait and hand gathering areas. As well as aiming to ensure that hand gathering activity has no adverse effect on site integrity leading to its deterioration, proposals will support the sustainable management of these fisheries within the Sussex IFCA district.

Managament proposals will also provide consistency in coastal MPA site's management within the District, with bag limits currently in place at Beachy Head West Marine Conservation Zone (MCZ) and Pagham Harbour SPA/MCZ. The stipulated volumes for these sites, detailed below, are based on a quantity which would respect the needs of recreational gatherers collecting for non-commercial, personal consumption needs. Within these sites, any person is prohibited to remove in any one day, more than:

- 5 edible crab, *Cancer pagarus*
- 20 crabs in total of any species other *Cancer pagarus*
- 1kg of any bivalve or gastropod mollusc spp.
- 1kg prawns
- 1kg worms
- 2kg of intertidal algae

It is Sussex IFCA's duty as a competent and relevant authority to manage damaging activities that may affect site integrity and lead to deterioration of the site. Sussex IFCA will continue to monitor bait collection and hand gathering effort and location through sightings data and information from

[8] If conclusion of adverse affect alone an in-combination assessment is not required.

IFCOs, partners and the wider public, as well as continued exploration of novel monitoring techniques such as the TEMITH commissioned work and information gathered through any potential permit scheme. Any management of this activity will need to be on an iterative basis, depending on the outcome of further research.

Assessments will be reviewed and updated should there be any significant changes to the nature of existing activity, or if new evidence relevant to this gear/feature interaction becomes available, such as national work on bait collection impacts and levels which may trigger a review of assessments.

8. In-combination assessment[14]

If conclusion of potential adverse effect alone, an in-combination assessment is not required. Refer to section 7.

9. Summary of consultation with Natural England

Natural England are in agreement that this activity should be taken to a full Appropriate Assessment, and that in-combination effects should be considered if required.

10. Integrity test

Due to gaps in understanding regarding the level of activity within the site and national guidelines on what constitutes low, medium and high levels of activity and associated impact thresholds, together with the potential risks to features from this activity type, it is concluded that intertidal hand gathering and bait collection may have an adverse effect on the integrity of the Chichester Harbour units of the Solent Maritime SAC.

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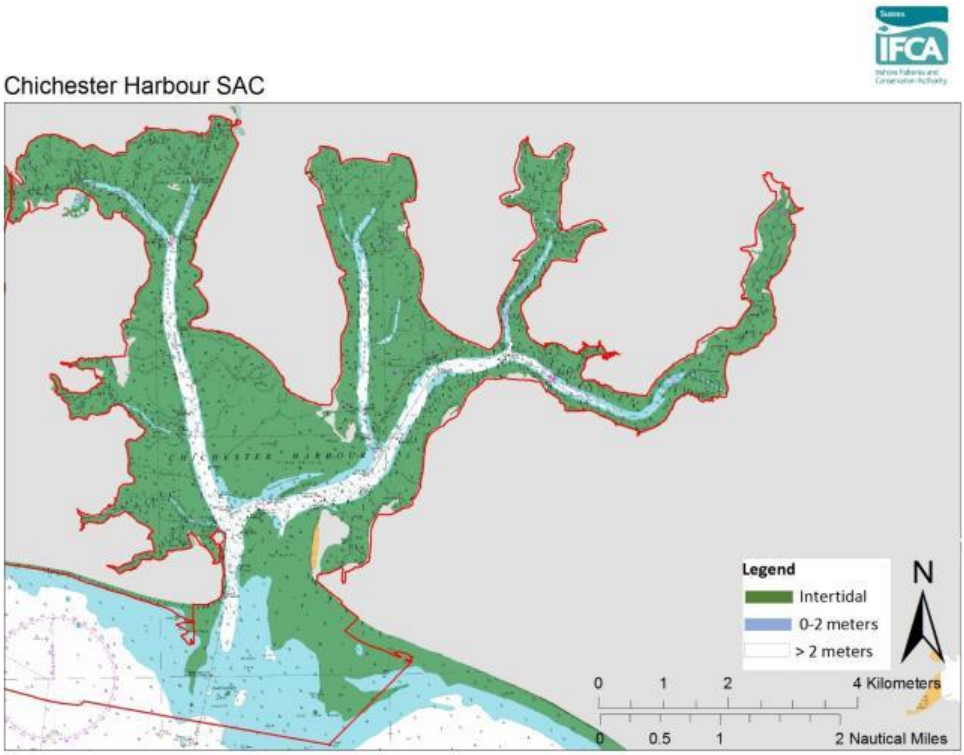
Annex 2: Natural England’s consultation advice

NE agreed that this activity needed to be taken to Appropriate Assessment. Formal comments on this document are pending.

Annex 3: Site Maps

3.1 Chichester Harbour – Part of the Solent Maritime Special Area of Conservation (SAC)



3.2 Habitat map for Chichester Harbour

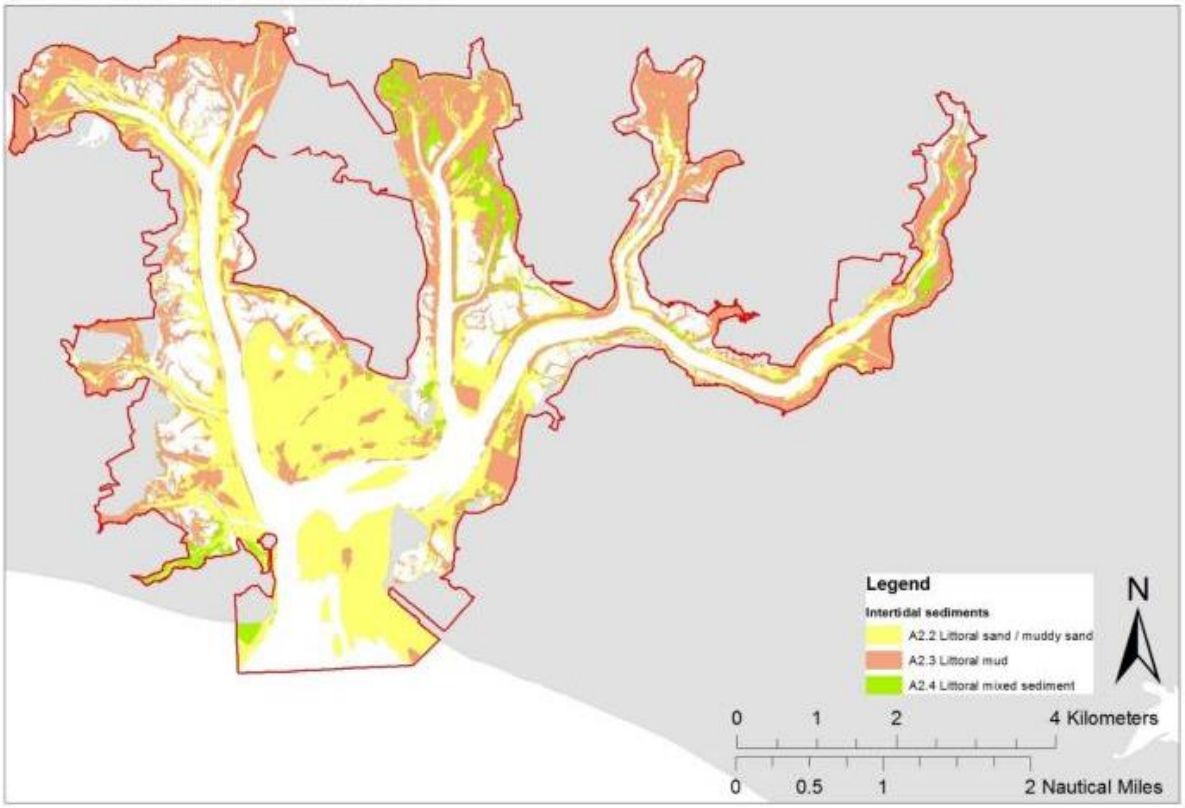
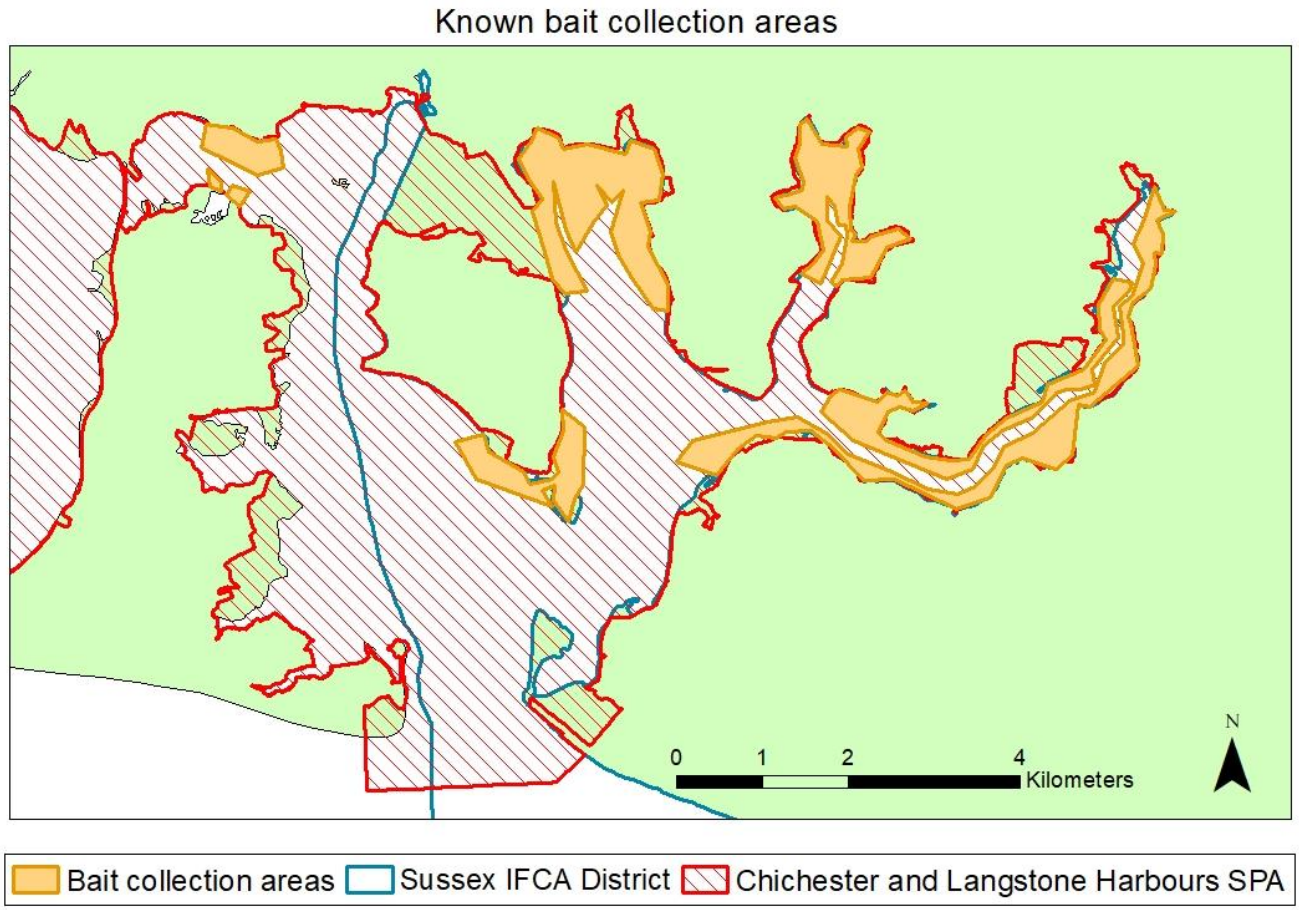


Figure 3.2: This map is showing the areas of intertidal habitat type within Chichester Harbour. Littoral sand and muddy sand are found just inside the harbour mouth, this then changes to littoral

mud in the channels and close to the shoreline. Littoral mixed sediment is fairly **sparse** within the harbour, with small areas in Emsworth, Thorney and Fishbourne Channels, it is also found just inside the harbour mouth.

Annex 4: Fishing activity maps



Chichester Harbour known bait collection and hand gathering locations.

Annex 5 – Detailed LSE assessment

5.1 : Identifcation, and screening for pressures (sensitivity scores) – Acitivity-caused pressure/feature interaction.

This is taken from the advice on operation sections of Natural England's MPA conservation advice for the Solent Martime SAC. This table lists the standard pressures that this activity exerts and shows whether the features and sub features are sensitive (S), not sensitive (NS), there is no direct impact (blank), or there is insignificant evidence to assess (IE). Sensitivity scores/flags are at the benchmarks standard reference points. This is the first stage assessment/screening of impact of this activity. This is an intial exercise to remove any of those pressures exerted by hand working that are clearly not an issue for the intertidal sediments of the Chichester Harbour component of the Solent Maritime SAC.

Table 5.1.1 –Justification for pressure –

The pressures listed in red font are considered to be of high to medium risk (pressure is commonly induced by this activity at levels that need to be considered further as part of an assessment). The other pressures are considered to be low risk (unless there are evidence based cases or site specific factors that increase the risk, or uncertainity on the level of pressure on a receptor, this pressure generally does not occur at a level of concern and should not require consideration as part of the assessment.

Pressure	Justification
Above water noise	Noise arises from many activities in the marine environment which can evoke a disturbance response in marine mammals and birds. The presence of people, as well as vessels and all-terrain vehicles used to access fisheries, may result in an increase in above water noise. However, the magnitude of the pressure will depend on the nature, scale, intensity and duration of the activity. Further, the impact of such disturbance on birds may be considered better captured by the pressure 'visual disturbance'.
Abrasion/disturbance of the substrate on the surface of the seabed	Pressure would be exerted on intertidal habitats through harvesting of target species by hand or with apparatus such as rakes and forks. Further, abrasion is associated with the movement of people ('trampling') or indeed any vehicles used for access or participation in the fishing activity, and can result in damage to infauna and epifauna as well as sensitive habitats such as seagrass . Where vessels are used to provide access the pressure is likely to be associated with any anchors, which can cause damage to the seabed surface and subsurface layers upon deployment/recovery and due to dragging, or the vessel (including e.g. the propellor/wash) itself may cause abrasion if it comes into contact with the seabed in shallow water.
Collision BELOW water with static or moving objects not naturally found in the marine environment (e.g., boats, machinery, and structures	Pressure relates to vessels associated with this sub-activity and their movement. Collision with fishing gear (e.g. nets) can also occur but the consideration of this would be better done through the pressure 'Removal of non-target species'. Vessels are documented to have collided with mobile marine

Pressure	Justification
	species (particularly mammals). Almost all vessel sizes and classes have been involved in collisions with marine mammals, including cargo ships, recreational vessels, and research vessels. Species can collide with the propeller or other parts of the hull. The most lethal and serious injuries are caused by large ships (e.g. 80 m or longer) and vessels travelling at speeds faster than 14 knots . Most minor injuries, by contrast, involved collisions with vessels less than 45m long. Collisions are rarely reported for vessels doing less than 10 km/hour.
Deoxygenation	Intensive bait digging can result in exposure of anoxic sediment layers , leading to reduced oxygen availability in surface sediments. High numbers of structures associated with activities such as crab tiling may change patterns of water movement over intertidal habitats and hence changes in sediment characteristics, such as a shallower oxygenated zone . The spatial and temporal persistence of any change will depend on factors such as the intensity of the activity and levels of natural disturbance.
Hydrocarbon & PAH contamination. Includes those priority substances listed in Annex II of Directive 2008/105/EC.	Pressure primarily relates to vessels/vehicles associated with this sub-activity and their movement, but potentially also mobilisation of contaminated sediments. The primary chemicals of environmental concern in vessel oil and fuel are polycyclic aromatic hydrocarbons (PAHs). Deliberate discharges of oil or oil/water mixtures from ships are prohibited within the North West European Waters Special Area, established by the International Maritime Organization under MARPOL Annex I in 1999. This includes all waters around the UK and its approaches. However, accidental discharges still occur. Information on accidental discharges of oil from ships and offshore platforms is compiled annually by the Advisory Committee on Protection of the Sea (ACOPS) on behalf of the Maritime and Coastguard Agency. Although the majority of incidents are minor, several incidents occur annually that lead to the actual or potential release of significant amounts of oil (typically from large shipping vessels and tankers). Further, sediment disturbance by fishing activities could result in the remobilisation of contaminants/substances. However, the likelihood and severity of any impact depends upon factors such as the type and degree of existing contamination, the sediment type and intensity of activity. In many cases, natural disturbance may contribute the majority of contaminated sediment resuspension.
Introduction of light	Pressure relates to vessels and potentially gear associated with this sub-activity e.g. operational and navigation lighting. Marine birds are frequently attracted to or become disorientated by artificial light sources, which can result in collision and therefore injury or death. Disturbance caused by light from vessels may also be of concern, particularly where significant levels of activity occur in close proximity to sensitive bird habitats including coastal inshore waters

Pressure	Justification
	[3195; 4399]. However there are also concerns about the potential wider impacts of light pollution in the aquatic, particularly coastal, environment on the behaviour, reproduction and survival of marine invertebrates, amphibians and fish.
Introduction or spread of non-indigenous species	Aquatic organisms may be transferred to new locations as biofouling on vessels and gear and can be harmful and invasive in locations where they do not naturally occur; 2798; 4338; 4339]. All craft have some biofouling, even if recently cleaned or anti-fouled.
Litter	Marine litter is items made or used by people and deliberately discarded or unintentionally lost into the sea and on beaches. Despite international legislation such as Annex V of the International Convention for the Prevention of Pollution from Ships, 1973 , maritime activity is still a major source of litter. Fishing is an important source of marine litter. For example, 14 % of the litter identified during the UK Beachwatch survey (2006) was fishing related, net loss in UK fisheries has been estimated at 36 km per year and surveys across 32 sites in European waters (continental shelves to canyons) found that derelict fishing gear was the second most abundant item encountered (34 % of total). Various types of litter result from fishing in general including galley waste, fish boxes, floats/buoys, nets, ropes, lines, pots, weights and micro-plastic particles resulting from disintegration of plastic gear . Impacts of such litter include entanglement of marine wildlife including mammals and birds, ingestion and ghost fishing. Ghost gears can also damage benthic habitats (through abrasion, 'plucking' of organisms or meshes closing around them, and the translocation of seabed features). Alongside existing legislation, potential mitigation measures are discussed in various sources of literature.
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	Pressure would be exerted on intertidal habitats through harvesting of target species by hand or with apparatus such as rakes and forks. Further, abrasion is associated with the movement of people ('trampling') or indeed any vehicles used for access or participation in the fishing activity, and can result in damage to infauna and epifauna as well as sensitive habitats such as seagrass. Where vessels are used to provide access the pressure is likely to be associated with any anchors, which can cause damage to the seabed surface and subsurface layers upon deployment/recovery and due to dragging, or the vessel (including e.g. the propellor/wash) itself may cause abrasion if it comes into contact with the seabed in shallow water.
Physical change (to another seabed type)	Activities such as bait digging could cause this pressure through the displacement/removal of intertidal substrate . However, the magnitude of the pressure will depend on the nature, scale, intensity and duration of the activity.
Removal of non-target species	Bycatch (i.e. discarded catch) is associated with almost all fishing activities and is related to factors such as the gear

Pressure	Justification
	type and its design (i.e. its selectivity), the targeted species and effort. There are significant concerns over the impacts of discards on marine ecosystems, including changes in population abundance and demographics of affected species and altered species assemblages and food web structures. However, discards also provide important food resources for some scavenging species, including seabirds. Similarly to their use at sea, nets and pots deployed from the shore, along with other shore-based activities such as angling, shellfish collection by hand (e.g. undersize target species damaged or exposed to predation, desiccation or freezing) and even bait digging can result in bycatch of fish, invertebrates and. Although many fish captured by anglers are released (approaching 100 percent for some species), there can be substantial post release mortality as well as more subtle sublethal effects on growth and fitness. Release mortality in recreational fisheries is analogous to bycatch discards in commercial fisheries, an internationally recognized conservation problem.
Removal of target species	Shore-based fishing activities include bait collection, shellfish collection by hand, rod and line angling and the use of pots and nets from the shore. These activities target a range of crustacean, fish and bivalve species. Targeted species may themselves be of conservation importance, or may form part of the biotope or the wider community composition associated with designated features/sub-features.
Visual disturbance	The movement of vessels, vehicles and people, as well as that of gear, can create visual stimuli which can evoke a disturbance response in mobile species such as marine mammals, seabirds and coastal birds. However, the magnitude of the pressure will depend on the nature, scale, intensity and duration of the activity, plus other factors such as species present and age, weather conditions and degree of habituation to disturbance source.

Table 5.1.2 Screening of pressures

Pressure	Intertidal mud	Intertidal sand and muddy sand	Intertidal mixed sediment	Intertidal coarse sediment	Intertidal seagrass	Screening
Above water noise						OUT - There is no direct impact of this pressure on this feature
Abrasion/disturbance of the seabed	S	S	S	NS	S	IN - Pressure would be exerted on intertidal habitats, through harvesting of target species by hand or with apparatus such as rakes/ forks. Magnitude would depend on the spatial scale and intensity of activity. Three known boats access the east side of Thorney Island and Inner Thorney channel to harvest clams and sometimes oysters.
Collision above water with static or moving objects not naturally found in the marine environment(e.g boats, machinery and structures)						OUT- There is no direct impact of this pressure on these sub-feature
Collison below water with static or moving objects not naturally found in the marine environment						OUT- There is no direct impact of this pressure on these sub-feature
Deoxygenation	NS	NS	NS	NS	NS	OUT- There is no direct impact of this pressure on these sub-feature
Habitat structure changes - removal of substratum (extraction)	S	S	S	S	S	OUT - Activities such as bait digging could cause this pressure through the displacement/removal of intertidal substrate [1441]. However, the magnitude of the pressure will depend on the nature, scale, intensity and duration of the activity.

Pressure	Intertidal mud	Intertidal sand and muddy sand	Intertidal mixed sediment	Intertidal coarse sediment	Intertidal seagrass	Screening
Hydrocarbon and PAH contamination includes those priority substances listed in Annex II of the directive 2008/105/EC	NS	NS	NS	NS	NS	OUT- These subfeatures are not sensitive to this pressure
Introduction to light						OUT - There is no direct impact of this pressure on this feature
Introduction or spread of non-indigenous species	IE	S	S	IE	S	OUT - There is no direct impact of this pressure on this feature
Litter	IE	S	IE	IE	IE	OUT- Activity may result in littler but it is unlikely at a level that would cause concern
Penetration and/or disturbance of the substrate below the surface of the seabed, including abrasion	NS	S	S	NS	S	IN - Pressure would be exerted on intertidal habitats through harvesting of target species by digging by hand or with apparatus such as forks. Magnitude of pressure will depend on spatial scale/intensity of activity
Removal of non-target species				S	S	IN - Activities such as shore based netting, angling, bait digging etc can all lead to the bycatch and removal of non target species whereby the species removed experience mortality as a result of this activity.
Removal of target species		S	S		NS	OUT - Species can be directly removed as part of a targeted fishery. Seagrass beds however are protected and it is prohibited to gather on this habitat type.
Underwater noise changes						NO There is no direct impact of this pressure on this feature

Pressure	Intertidal mud	Intertidal sand and muddy sand	Intertidal mixed sediment	Intertidal coarse sediment	Intertidal seagrass	Screening
Visual disturbance						NO There is no direct impact of this pressure on this feature

Key	
S	Sensitive: The evidence suggests the feature is sensitive to the pressure at benchmark and taken to further assessment
NS*	Not sensitive at the benchmark:The evidence base suggests the feature is not sensitive at the benchmark but shouldn't be precluded from consideration (e.g variation in pressure intensity and exposure, in combination or indirect effects) and taken to further assessment
	The evidencebase suggests that there is no direct interaction between the pressure and the feature under assessment OR, the activity and the feature could not interact and taken to further assessment
NA	A sensitvity assessment has not been made for this feature but should not be precluded from consideration. The best available evidence, relevant to that activity at time of application must be sourced and taken to further assessment
IE	Insuffient evidence to assess: The evidence base is not considered to be developed enough for assessment to be made of sensitivity at the benchmark pressure level and should not be precluded from consideration . The best available evidence, relevant to that activity at time of application must be sourced and taken to further assessment

Table 5.2: Assessment of LSE – Attributes

This table identifies the attributes of each feature/subfeature that the activity could impact via the pressures screened in table 5.1. This attributes and the justification is taking from Natural England's supplementary advice section of it's interim conservation advice package for the Solent SAC.

Attribute	Justification	Screening
Extent and distribution	Intertidal mudflats and sandflats are found throughout the Solent Maritime SAC and form the predominant intertidal region. The current extent of this feature is 4616.99 ha (Ball et al., 2000), (Natural England, 2010), (Natural England, 2010), (Hamshire & Isle of Wight Wildlife Trust, 2013), (English Nature, 2003), (English Nature, 2005), (Isle of Wight County Council, 2004), (Unknown, 2010), (Joyce et al., 2009), (Joyce et al., 2009), (Cope and Wilkinson, 2014). The intertidal mudflats and sandflats feature in the Solent Maritime SAC comprises the following sub-features: intertidal coarse sediment (A2.1), intertidal sand and muddy sand (A2.2), intertidal mud (A2.3), intertidal mixed sediment (A2.4), and intertidal seagrass beds (A2.61). Coarser sediments are found in areas of open coast, harbour and estuary mouths, with progressively finer sediments dominating the upper reaches of the three harbours, four estuaries and Southampton Water. Surveys conducted from 2005 to 2012 indicate that the extent and distribution of intertidal sediments across the Solent SAC remain the same (English Nature, 2005), (Centre for Marine and Coastal Studies Ltd. (CMACS), 2012), (Joyce et al., 2009). The Solent dynamic coast project (Cope et al., 2008) has used available data to map the intertidal habitat evolution to predict the extent of mudflats in the Solent over the next 100 years. Gains in mudflats are attributable to loss of saltmarsh however an overall long-term loss is anticipated due to coastal squeeze. The URS Estuary Characterisation Report (URS, 2014) characterises the extent of saltmarsh based on tidal elevation and sediment transport rates. To view the distribution of mudflats and sandflats not covered by seawater at low tide, please refer to the MAGIC map application.	

	(URS, 2014) There is evidence from survey or monitoring that shows the feature to be in a good condition and/or currently un-impacted by anthropogenic activities.	
Distribution: presence and spatial distribution of mudflat and sandflat communities	A variety of communities make up the habitat. Listed component communities reflect the habitat's overall character and conservation interest. Communities are described as biotopes using EUNIS or the Marine Habitat Classification. Communities include, but are not limited to, those that are notable or representative of the feature. Representative communities include, for example, those covering large areas and notable communities include those that are rare, scarce or particularly sensitive to pressure. Changes to the spatial distribution of communities across the feature, could highlight changes to the overall feature (Joint Nature Conservation Committee (JNCC), 2004). The mudflats and sandflats in the Solent range from low and variable salinity in the upper reaches of the estuaries to very sheltered almost fully marine muds in Chichester and Langstone Harbours (English Nature (EN), 2005). Mud communities are present in the most sheltered areas of the site and are dominated by worms, bivalve molluscs and the mud snail Hydrobia ulvae. Coarser sand and cobble communities are found on beaches on the more exposed open coast and embayment areas around the Solent, where wave action and/or strong tidal currents prevent the deposition of finer silt (English Nature, 2001). Please refer to sub-features for descriptions and targets of the relevant communities. To view the distribution of mudflats and sandflats not covered by seawater at low tide, please refer to the MAGIC map application. There is evidence from survey or monitoring that shows the feature to be in a good condition and/or currently un-impacted by anthropogenic activities.	
Non-native species and pathogens	Non-native species may become invasive and displace native organisms by preying on them or out-competing them for resources such as food, space or both. In some cases this has led to the loss of indigenous species from certain areas (Joint Nature Conservation Committee (JNCC), 2004). A pathogen causes disease or illness to its host. Pathogens include bacteria, viruses,	OUT – asscociated pressures have been screened out

	protozoa and fungi (Biology-Online, 2008;.Eno et al., 1997;Royal Yacht Association (RYA) and British Marine Federation, 2010;Connor et al., 2004) The large volume of shipping in the Solent means it is susceptible to the introduction of non-native species from ballast water or anchor lines. Much of the available data is from harbours and marinas (Bray and Cottle, 2003), (Bray and Cottle, 2003).	
Presence and abundance of structural and influential species	Natural England has included an attribute for the abundance of key structural and influential species for habitat features. **Structural species** are those that form part of the habitat structure or help to define a key biotope. **Influential species** are those that are likely to have a key role affecting the structure and function of the habitat (such as bioturbators (mixers of sediment), grazers, surface borers, predators or other species with a significant functional role linked to the habitat). These will be identified at a national level in accordance with the criteria defined in the key structural and influential species paper (Covey et al., 2016). *For each species listed the reason for its inclusion as structural or influential and the information supporting its presence within the community of this site will be provided.	The pressure and spatial distribution of the feature and subfeatures communities could be impacted from the following pressures; • abrasion • penetration and • removal of non –target species
Substrate composition and distribution (All other features)	The substrate types (hard and soft) and their distribution are important to the biodiversity of this complex feature. Substrate character is instrumental in determining the biological communities present within the estuary. Some estuaries also include geological or geomorphological features of interests and so substrates associated with these should also be considered (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001), (Dyer, 1997), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (Defra, 2005). The existing distribution should be used where no historical data is available to provide a baseline (ie in an assessment, a survey would have to be undertaken first to establish the existing composition and distribution). Mudflats within the Solent Maritime SAC range from low and variable salinity in the upper reaches of the estuaries to very sheltered almost fully marine muds in Chichester and Langstone Harbours. As well as occurring within the estuaries, mudflats and sandflats are found throughout	IN - The sediment composition and distribution of the feature and subfeatures could be impacted from the following pressures; • abrasion and • penetration

	the Solent and form the predominant intertidal substrates. Subtidal sands and gravels and muddy sand can be found accompanying sandbanks and form as bars and/or spits shaped by the predominant west to east tidal flow (Goodchild and Brutto, 2015). An intertidal survey in 2011 did not find any significant differences in sediment composition compared to data from 2006 (Centre for Marine and Coastal Studies Ltd. (CMACS), 2012). .	
Species composition of component communities	Species composition of communities includes a consideration of both the overall range of species present within the community, as well as their relative abundance. Species composition could be altered by human activities without changing the overall community type. Within each component community, species composition and population structure should be taken into consideration to avoid diminishing biodiversity and affecting ecosystem functioning within the habitat (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001), (Dyer, 1997), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (Davidson and Buck, 1997). Several subtidal and intertidal features and sub-features have a “restore” target based on the Infaunal Quality Index (IQI). The Solent Maritime SAC encompasses ten Environment Agency estuarine and coastal water bodies in which regular monitoring under the Water Framework Directive (WFD) is carried out (Environment Agency (EA), 2012), (Environment Agency, 2014). The objective is to have an IQI ≥ 0.64, which equates to Good Ecological Status.	IN - The species composition of component communities of the feature and subfeatures could be impacted from the following pressures; • abrasion and • penetration
Topography	Topography is considered an essential structural component of estuaries. Changes in topography, eg altering the slope of the shore, will change the exposure / extent of habitats (lower intertidal may become shallow subtidal). Some estuaries have been chosen for designation because they are representative of particular types of estuaries within Europe. Altering an estuary’s topography will alter its behaviour and morphology (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (Defra, 2005), (Manning, 2012), (Davidson and Buck, 1997), (Townend, 2005), (Townend and Wright, 2005); Environment Agency (EA), 2009; Channel Coastal Observatory (CCO), 2013 The estuaries within the Solent Maritime SAC fall within the coastal plain estuary and bar built estuary sub-groups (URS, 2014). Typically estuaries within the coastal plain sub-group were formed when pre-existing river valleys were flooded during the last ice age. They usually widen and deepen towards the mouth, giving a large width-to depth ratio. Many systems have extensive	IN - The topography of the feature and subfeatures could be impacted from the following pressures; • abrasion and • penetration

	sediment flats and saltmarsh throughout (Davies et al., 2001). The Yar, Medina, King's Quay Shore and Hamble are all examples of coastal plain estuaries (URS, 2014). Bar-built estuaries characteristically have a sediment bar across their mouths, or an extensive spit formation to the side (DEFRA, 2008). These estuaries are partially drowned river valleys that have been infilled with sediment (Davies et al., 2001). These estuaries are typically found in areas with active coastal deposition and tend to be shallow with extensive lagoons and shallow waterways near the mouth. Newtown Harbour, Beaulieu, Langstone Harbour and Chichester Harbour are all examples of bar built estuaries (URS, 2014). Chichester and Langstone Harbours, Beaulieu Estuary and Yar Estuary have experienced a small amount of net erosion, with estuary volumes, plan areas and average depths all typically increasing for given tide levels between 2005 and 2013. Hamble Estuary has experienced little change in its key gross geometric parameters between 2001 and 2013. Newtown Harbour has experienced a small amount of net accretion with decreases to the estuary volume, plan areas and average depths between 2008 and 2012 (URS, 2014).	
Morphology	Morphology describes the behaviour of an estuarine system, and the interaction of the topography, sediments and physical processes, eg wave and tides (Dyer, 1997), (Environment Agency (EA), 2011), (Davidson and Buck, 1997). Morphology is an essential structural component of an estuary and dictates the distribution and composition of its substrate, and therefore its habitats and species (Dyer, 1997), (Townend, 2005), (Townend and Wright, 2005), (Environment Agency (EA), 2011). The Solent Estuaries Characterisation project (URS, 2014) used existing LiDAR, GIS and survey data to assess geomorphological changes of the eight estuaries that form part of the Solent maritime SAC. Chichester and Langstone Harbours, Beaulieu Estuary and Yar Estuary have experienced a small amount of net erosion, with estuary volumes, plan areas and average depths all typically increasing for given tide levels between 2005 and 2013. The Hamble Estuary has experienced little change in its key gross geometric parameters between 2001 and 2013. Newtown Harbour has experienced a small amount of net accretion with decreases to the estuary volume, plan areas and average depths between 2008 and 2012.	OUT- the associated pressures have been screened out

	Due to poor data quality, it was not possible to assess recent changes in estuary geometric parameters of the Medina Estuary. Data analysis suggests that the extent of the Medina Estuary is constrained by the presence of seawalls or other engineering structures. It was not possible to asseschanges for King's Quay Estuary either due to the lack of bathymetry data. The tidal prism at both spring and neap tides has typically increased through time across all of the estuaries, apart from Newtown Harbour.	
Sediment movement , sources and sinks	Sediment movement, sources and sinks within, and interacting with, an estuary are important to maintaining a healthy estuarine system and sediment budget. This includes sediment inputs to an estuary from rivers, coastal and marine sources, and the movement of sediment to and from the subtidal to the intertidal. If the sediment budget or sediment movement is restricted this can cause the decline and erosion, or change, of habitats. A shift in the sediment budget from morphological equilibrium would indicate a decline or an adverse negative impact (Joint Nature Conservation Committee (JNCC), 2004), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (Defra, 2005), (Environment Agency (EA), 2009). The major coarse sediment sinks within the Solent result from accumulations which began some 6500-8400 years ago, when the Solent was inundated by rising sea-levels and the present coastal regime was initiated. Stores around the East Solent and the Harbours are more recent. Overall, over 100 million m^3 of potentially mobile shingle and sand has become stored within the Solent making it a major sink area on the South coast of England. Major accumulations such as Brambles Bank, Ryde Sand and the East Winner Bank remain unquantified. Over 25 million m^3 of material has been dredged from these inshore deposits to maintain navigable channels and provide materials for reclamation and the aggregates industry (Bray and Cottle, 2003), (Bray and Cottle, 2003), (ABPmer, 2008), (Bray et al., 2004). Storage of fine sediments is primarily within mudflat and saltmarsh deposits that flank the channels, estuaries and harbours of the Solent. The volumes of material are unquantified, but it is understood that erosion of stores significantly exceeds fresh deposition so that there is an overall loss of fine sediments from storage. The fate of materials released in this manner is poorly understood (Bray and Cottle, 2003), (Bray and Cottle, 2003), (Bray et al., 2004).ABPmer, 2008).	OUT- the associated pressures have been screened out

	A growing number of coastal defence schemes have involved imports of replenishment materials to stabilise eroding beaches within the Solent area. Marine gravels are preferred due to their durability. This introduces new material to the shoreline sediment transport system and contributes positively to the budget (Bray and Cottle, 2003), (Bray and Cottle, 2003). Due to a limited sediment supply at Newtown Harbour the shingle spit at the entrance to the estuary is likely to continue to break down in the future, increasing the exposure of saltmarsh to erosion (Bray and Cottle, 2003), (Mercer, 2013), (URS, 2014). Beaulieu estuary is largely undeveloped and no records of channel dredging exist (Bray and Cottle, 2003), (Bray and Cottle, 2003).	
Habitat zonation	The distribution of habitats within an estuary is influenced by both changes in salinity gradients and tidal currents in the transition from the terrestrial to the marine environment. Retaining natural transitions from river to sea and upper to lower shore are important to a healthy estuary structure (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001). Habitat zonation will be representative of the limits and range of estuarine communities with tidal movements and salinity (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001), (Dyer, 1997), (Hiscock et al., 2006), (Davidson and Buck, 1997). In general, a natural intertidal system shows a vertical zonation of habitats and species. Mudflats are typically located at the lower elevations between Lowest Astronomical Tide (LAT) and Mean High Water Neaps (MHWN) whereas saltmarsh is found higher up, between MHWN and the Highest Astronomical Tide (HAT) (URS, 2014).	OUT- the associated pressures have been screened out
Energy/exposure	This feature is characterised by either low, medium or high energy. The amount of energy received across the site significantly affects the communities present. Physical energy can be received through wave energy and tidal flow, and can be altered through human activity. Any such alterations to energy should be avoided (Hiscock et al., 2006). The exposure of an estuary to wave and tidal energy dictates its physical structure, substrate character and habitat distribution. Increasing energy can result in increased erosion, the steepening of the shoreline or increases in the particle size of the sediment. Reductions in energy	OUT – the associated pressure have been screened out

	can increase sedimentation (Hiscock et al., 2006), (Channel Coastal Observatory (CCO), 2013), (Environment Agency (EA), 2011), (Davidson and Buck, 1997). The Solent Maritime SAC is quite unique for the complexity and particularly dynamic nature of the marine and estuarine habitats present within the area. The variety of marine habitats is influenced by wave shelter and intensity of tidal streams, resulting in a uniquely complex site. The physical structure of the intertidal flats can range from the mobile, coarse sand beaches of wave-exposed coasts to the stable, fine sediment mudflats of estuaries and embayments (English Nature, 2001). Within the Solent Maritime SAC saltmarshes play an important role helping to attenuate the action of waves within the estuary. The intimate relationship between saltmarsh vegetation and other coastal habitats such as shingle structures, sand dunes and intertidal flats means that they need to be considered as a functional unit (Bray and Cottle, 2003), (Bray and Cottle, 2003). Data gathered by the Channel Coastal Observatory (CCO) is relevant to this attribute. The CCO's WaveRider buoy network records wave height, wave period, wave direction and sea temperature at specific locations around the coast. These data are available from the CCO Map Viewer and Data Catalogue (Channel Coastal Observatory, 2015).	
Water density	Water density is influenced by temperature and salinity and is an essential structural component of an estuary and its water column. Density gradients are important in determining the stratification and character of an estuary (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001), (Dyer, 1997), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (Knauss, 1997).	OUT- the associated pressures have been screened out

Tidal regime	Tidal regime is considered an essential structural component of estuaries. Changes in tidal energy can result in changes to habitat composition / distribution. Tidal range is the vertical height difference between high and low water (Joint Nature Conservation Committee (JNCC), 2004), (Davies et al., 2001), (Hiscock et al., 2006), (Environment Agency (EA), 2011). Tidal currents in the Solent are some of the most complex in the British Isles, with notable differences between the western and eastern Solent. The tidal regime is further complicated by double high waters, which are best known at Southampton. During spring tides, the tide rises following Low Water (LW) but the tidal stream slackens some 2 hours before Hight Water (HW) leading to a stand for up to 2 hours prior to a rapid rise to HW. In total, the flood and double HW can last up to 9 hours, leaving only 3 hours for the tidal ebb. The ebb tide is therefore associated with very strong ebb currents. This ebb tide dominance is reflected throughout the whole of the Solent (New Forest District Council (NFDC), 2010), (Picksley, 2008), (Stratton, 2008). In the western Solent, tidal range (spring tides) varies from 2.0 m at Hurst Point to around 3.9 m at Calshot, producing a significant hydraulic gradient. In the eastern Solent, tidal ranges are around 4 m for most of the coastline between Southampton and Chichester Harbour entrance and, therefore, the hydraulic gradient observed in the eastern Solent is less pronounced. As a result, tidal currents in the eastern Solent, whilst still considerable, are less strong than in the western Solent (Picksley, 2008), (Stratton, 2008),(New Forest District Council (NFDC), 2010). The tidal range for the component estuaries of the Solent Maritime SAC is provided below: Chichester and Langstone Harbours and Medina Estuary = 4.2 m, Beaulieu Estuary = 3.2 m, Yar Estuary = 2.5 m, Newtown Harbour = 2.9 m (URS, 2014), (DEFRA, 2008). The tidal range for the Hamble Estuary varies from 4.7 m at Warsash Jetty to 2.8 at Mercury Yacht Haven. The peak spring current speeds are between 0.4-0.9 ms-1 on the flood tide and 0.7-1.1 ms-1 on the ebb; neap current speeds are 0.2-0.4 ms-1 on the flood and 0.4-0.6 ms-1 on the ebb (ABP Marine Environment Research Ltd, 2011).	OUT- the associated pressures have been screened out
Sediment contaminants	Various different contaminants are known to affect the species that live in or on the surface of subtidal sediments. These include heavy metals (mercury, arsenics, zinc, nickel, cadmium, etc), poly-aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs), organotins (TBT) and	OUT – the associated pressure have been screened out

	pesticides such as hexachlorobenzene. These can impact species sensitive to particular contaminants, degrading the community structure (eg heavy metals) and bioaccumulating within organisms, entering the marine food chain (eg PCBs) (OSPAR Commission, 2012). The Solent is an important waterway for oil tankers and other shipping and tankers from the major ports of Southampton, Portsmouth and the oil refinery in Southampton Water (Wild on Wight, 2004). Atlantic salt meadows, cordgrass swards and *Salicornia* occurring within the Solent Maritime SAC are considered to have a high sensitivity and a high vulnerability to toxic contamination by synthetic compounds and a moderate sensitivity and moderate vulnerability to non-synthetic compounds (English Nature, 2001). Although saltmarsh plants may be reasonably tolerant of certain synthetic substances, they can bioaccumulate toxic compounds and act as sinks for them (Holt, 1995), (Wild on Wight, 2004).	
Water quality-contaminants	Various different contaminants are known to affect the species that live in or on the surface of subtidal sediments. These include heavy metals (mercury, arsenics, zinc, nickel, cadmium, etc), poly-aromatic hydrocarbons (PAHs), poly-chlorinated biphenyls (PCBs), organotins (TBT) and pesticides such as hexachlorobenzene. These can impact species sensitive to particular contaminants, degrading the community structure (eg heavy metals) and bioaccumulating within organisms, entering the marine food chain (eg PCBs) (OSPAR Commission, 2012). The Solent is an important waterway for oil tankers and other shipping and tankers from the major ports of Southampton, Portsmouth and the oil refinery in Southampton Water (Wild on Wight, 2004). Atlantic salt meadows, cordgrass swards and *Salicornia* occurring within the Solent Maritime SAC are considered to have a high sensitivity and a high vulnerability to toxic contamination by synthetic compounds and a moderate sensitivity and moderate vulnerability to non-synthetic compounds (English Nature, 2001). Although saltmarsh plants may be reasonably tolerant of certain synthetic substances, they can bioaccumulate toxic compounds and act as sinks for them (Holt, 1995), (Wild on Wight, 2004).	OUT – the associated pressures have been screened out
Water quality-dissolved oxygen	Dissolved Oxygen (DO) levels affect the condition and health of features. Excessive nutrients and / or high turbidity can lead to a drop in DO, especially in warmer months. Low DO can have sub-lethal and lethal impacts on fish and infauna and epifauna communities (Best et al., 2007). However, there's a significant amount of natural variation that needs to be considered (Royal Society for the Protection of Birds (RSPB), 2014), (Joint Nature Conservation Committee (JNCC),	OUT – the associated pressures have been screened out

	2004), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (OSPAR Commission, 2010), (Defra, 2010), (Environment Agency Marine Monitoring Service, 2014). The Solent Maritime SAC encompasses ten Environment Agency estuarine and coastal water bodies in which regular monitoring under Water Framework Directive (WFD) is carried out. For Dissolved Oxygen this site has been classified as having High Ecological Status under the WFD for at least 5 of the years since 2009 (Environment Agency Marine Monitoring Service, 2014). There is evidence from survey or monitoring that shows the feature to be in a good condition and/or currently un-impacted by anthropogenic activities.	
Water quality-nutrients	High concentrations of nutrients in the water column can cause phytoplankton and opportunistic macroalgae blooms, leading to reduced dissolved oxygen availability. This can impact sensitive fish, epifauna and infauna communities. The aim is to seek no further deterioration or improve water quality (Devlin et al., 2007), (Best, 2014). Nutrients affect primary production in the water column and benthos. Estuaries tend to be nutrient-rich and sources include freshwater input, direct discharges and coastal water exchange. Other factors affecting nutrient levels include tidal flushing, seasonality and climate. Excessive nutrients can lead to eutrophication due to extensive phytoplankton blooms and algal mats (WFD UKTAG, 2012), (Joint Nature Conservation Committee (JNCC), 2004), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (OSPAR Commission, 2010), (Defra, 2010). The Solent Maritime SAC encompasses ten Environment Agency estuarine and coastal water bodies in which regular monitoring under the Water Framework Directive (WFD) is carried out. The site has been assessed as at risk of eutrophication, using the Environment Agency's Weight of Evidence approach. This takes into account assessments of the WFD opportunistic macroalgae and phytoplankton quality elements using the respective assessment tools. Adverse effects to integrity should be avoided. Therefore opportunistic macroalgae levels should be restored so there is no adverse effect to the feature through limited algal cover (< 15 %) and low biomass (< 500 g m2) of macroalgal blooms in the available intertidal habitat, with the area of available intertidal habitat affected by opportunistic macroalgae less than 15 %. There should also be limited (< 5 %) entrainment of algae in the underlying sediment (all accounting for seasonal variations and fluctuations in growth). Phytoplankton levels should be restored to above a WFD assessment tool score of 0.6, where there is only a minor (a) decline in species richness,	OUT – the associated pressures have been screened out

	and (b) disturbance to the diatom-dinoflagellate succession in the spring bloom compared to reference conditions.	
Water quality-turbidity	Water turbidity is a result of material suspended in the water, including sediment, plankton, pollution or other matter washed into the sea from land sources. In coastal environments turbidity levels can rise and fall rapidly as a result of biological (eg plankton blooms), physical (eg storm events) or human (eg coastal development) factors. Prolonged changes in turbidity may influence the amount of light reaching the seabed, affecting the primary production and nutrient levels of the habitat's associated communities. Changes in turbidity may also have a range of biological effects on different species within the habitat, eg affecting their abilities to feed or breathe (Joint Nature Conservation Committee (JNCC), 2004), (Hiscock et al., 2006), (Environment Agency (EA), 2011), (Department for Environment Food and Rural Affairs (Defra), 2010). Suspended sediment concentrations (SSC) in the Solent have a high variability dependent on location, tidal state, storminess and freshwater flows into the estuaries (Associated British Ports (ABP), 2011), (DEFRA, 2008). SSC concentrations are generally higher in the open Solent with lower levels found upstream in the estuaries (Associated British Ports (ABP), 2011), (ABP Research and Consultancy Ltd., 2000), (DEFRA, 2008). SSC models for the Solent and Southampton Water predict depth-averaged concentrations of around 40 mg/l at the mouth of Southampton Water and between 60 and 80 mg/l in the Solent (Associated British Ports (ABP), 2011), (ABP Research and Consultancy Ltd., 2000), (DEFRA, 2008). Surface level SSC sampling undertaken by the Environment Agency (between 2003 and 2007) showed average SSCs varied between 5 and 17 mg/l with maximum to minimum concentrations ranging from 3 to 49 mg/l. Both modelled and sampled data demonstrate a high level of variability of SSCs.	OUT – the associated pressures have been screened out

Annex 6 – Condition Assessment

Table 6.1 Condition assessments of intertidal units within Chichester Harbour, part of the Solent Maritime SAC and Chichester and Langstone Harbours SPA

Mudflats and sandflats not covered by seawater at low tide

Feature description:
Intertidal mudflats and sandflats are found throughout the Solent Maritime SAC and form much of the intertidal region. They support nationally rare seagrass beds (*Zostera* species and *Ruppia marina*) (English Nature (EN), 2005), (Marsden and Chesworth, 2015).

The mudflats and sandflats in the Solent range from low and variable salinity in the upper reaches of the estuaries to very sheltered almost fully marine muds in Chichester and Langstone Harbours (English Nature (EN), 2005). Mud communities are present in the most sheltered areas of the site and are dominated by worms, bivalve molluscs and the mud snail *Hydrobia ulvae*. Coarser sand and cobble communities are found on beaches on the more exposed open coast and embayment areas around the Solent, where wave action and / or strong tidal currents prevent the deposition of finer silt (English Nature, 2001).

The intertidal mudflat and sandflat communities provide a vital food source for internationally important populations of birds (English Nature, 2001). The seagrass beds provide a major food source for dark-bellied brent geese (*Branta bernicla bernicla*) and valuable spawning and nursery areas for fish (English Nature, 2001).

Sub feature condition(s)

Sub feature name	Assessment date	Feature condition	Confidence
A2.1-Intertidal coarse sediment	05/2/2019	UnfavourableNoChange	Medium
A2.2-Intertidal sand and muddy sand	05/2/2019	UnfavourableNoChange	Medium
A2.3-Intertidal mud	05/2/2019	UnfavourableNoChange	Medium
A2.4-Intertidal mixed sediments	05/2/2019	UnfavourableNoChange	Medium
A2.61-Intertidal seagrass beds	06/2/2019	UnfavourableUnknown	Medium